



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

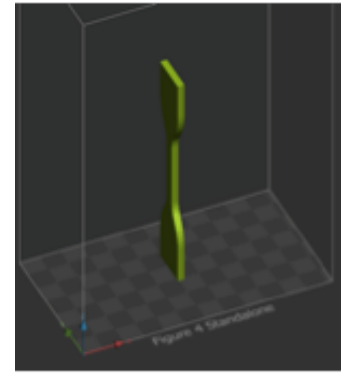
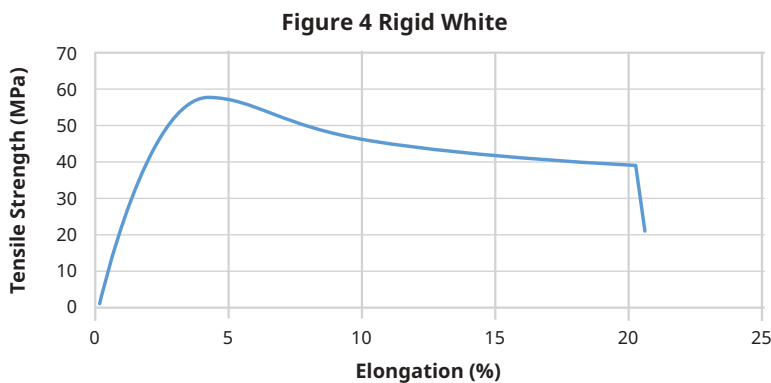
Figure 4 technology prints parts that are isotropic in mechanical properties meaning the parts printed along either the XYZ axis will give similar results.

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.

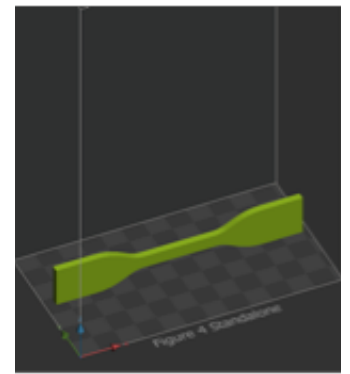
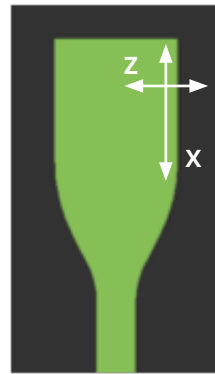
| SOLID MATERIAL | | | | | |
|---------------------------|-------------------|----------|----------|----------|----------|
| METRIC | METHOD | METRIC | | | |
| MECHANICAL | | | | | |
| | | ZY | XZ | XY | Z45 |
| Tensile Strength Ultimate | ASTM D638 Type IV | 57 MPa | 62 MPa | 61 MPa | 59 MPa |
| Tensile 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

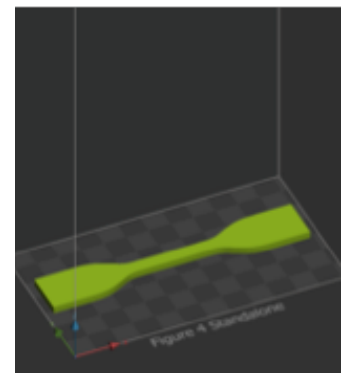
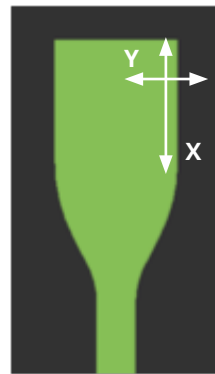
Figure 4 Rigid White exhibits thermoplastic behavior with a long plastic deformation ductile necking before fracturing which gives better snap and clip performance.



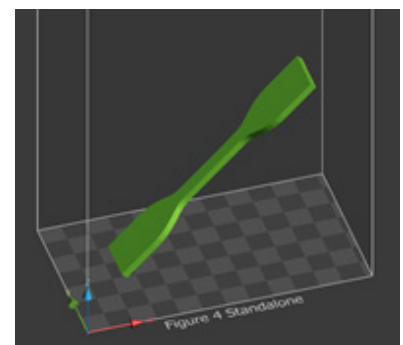
ZY - orientation



XZ - orientation



XY - orientation



Z45-Degree - orientation

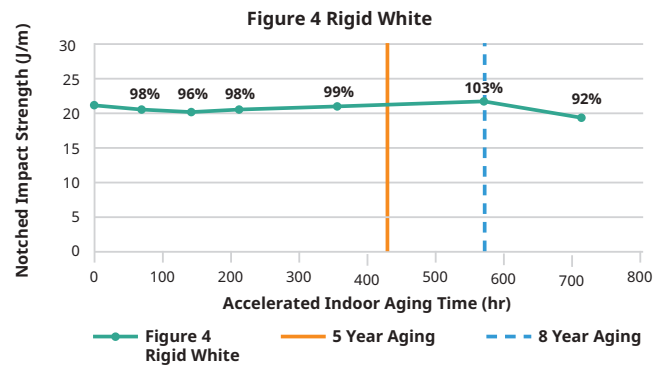
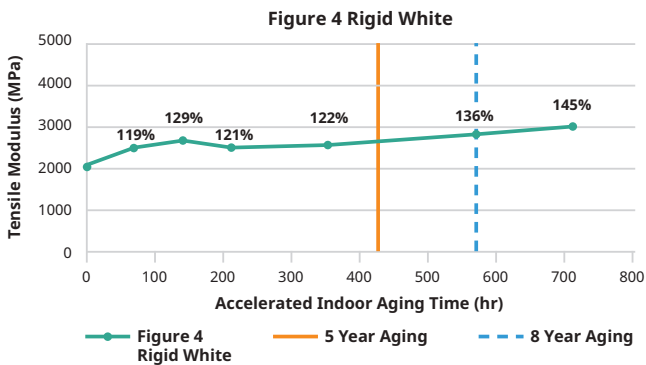
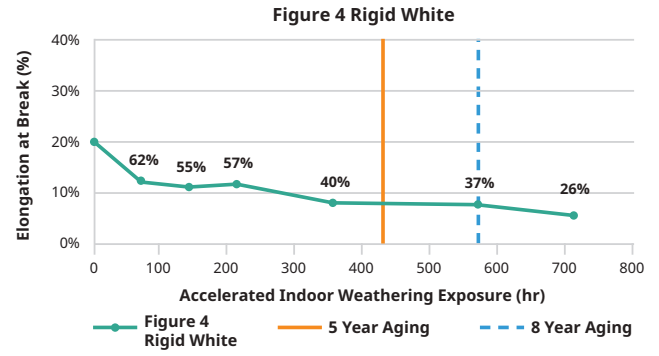
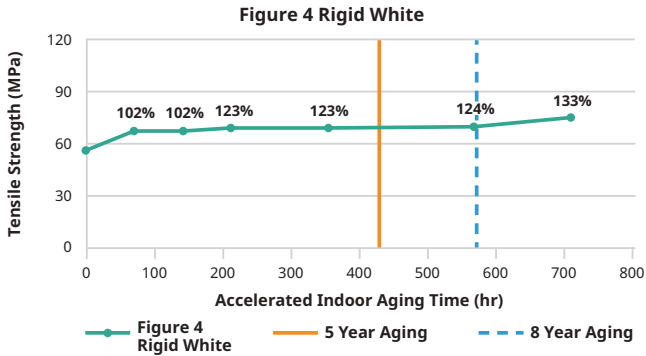
Figure 4 Rigid White

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.**

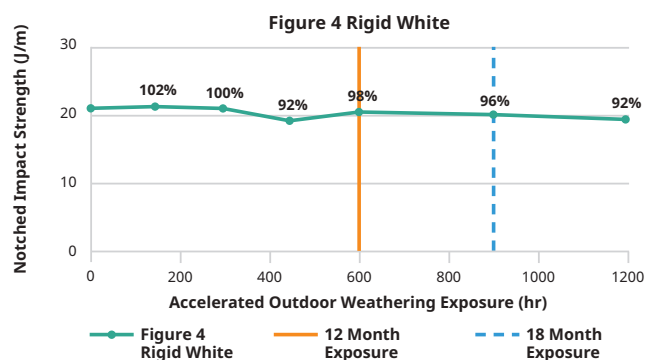
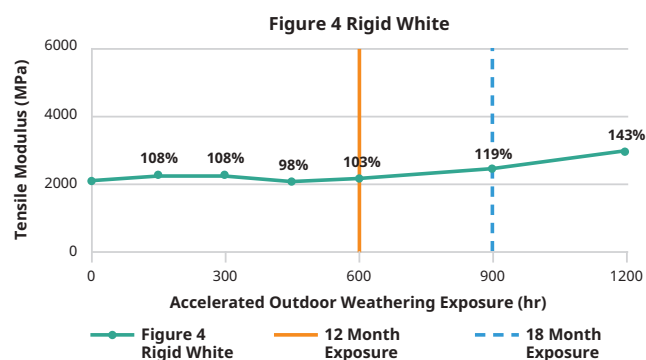
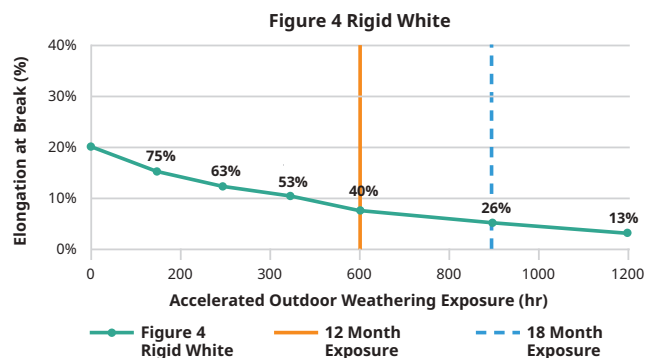
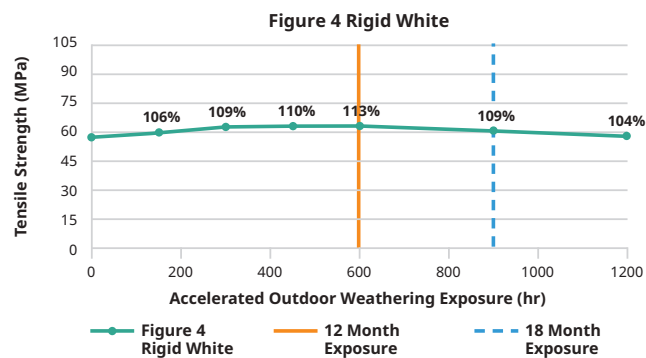
INDOOR STABILITY: Tested per ASTM D4329 standard method.

INDOOR STABILITY



OUTDOOR STABILITY: Tested per ASTM G154 standard method.

OUTDOOR STABILITY



AUTOMOTIVE FLUID COMPATIBILITY

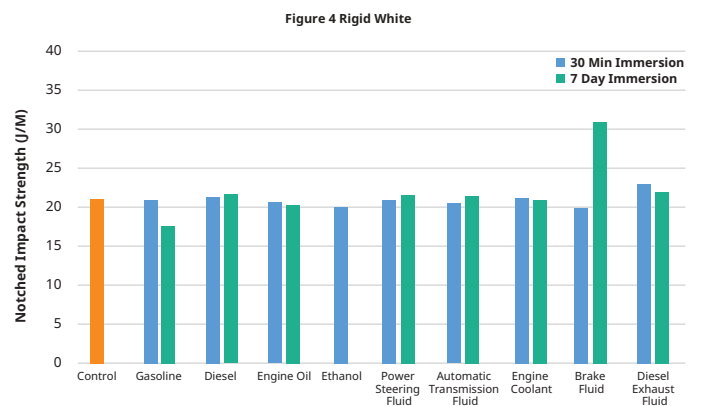
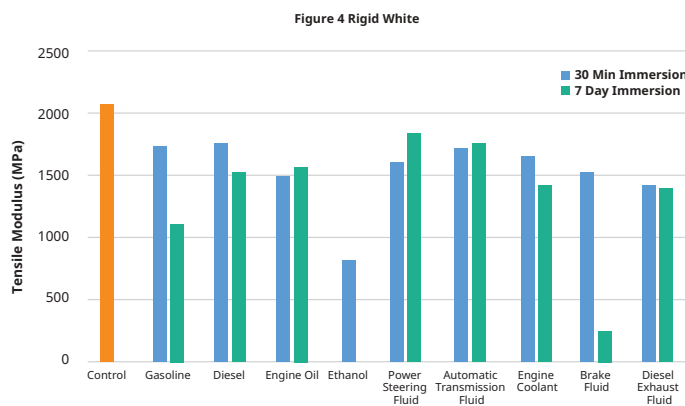
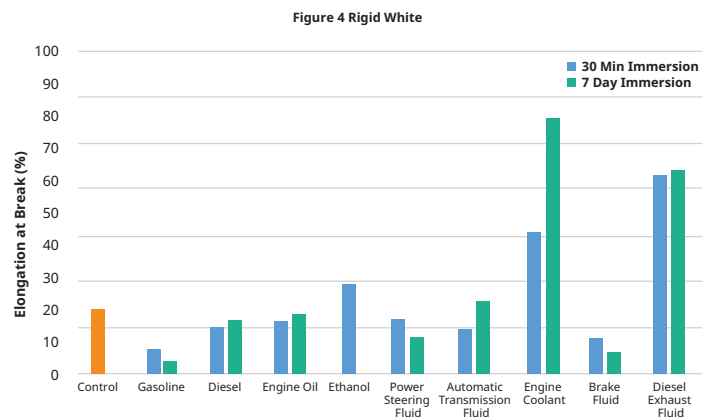
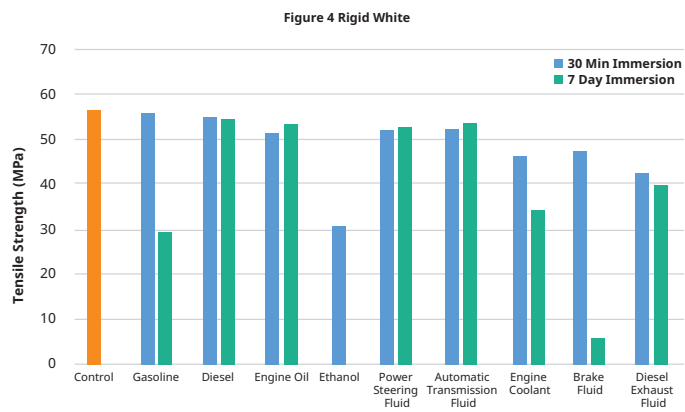
The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. Figure 4 Rigid White parts were tested for sealed and surface contact compatibility per USCAR2 test conditions. The fluids below were tested in two different ways per the specs.

- 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

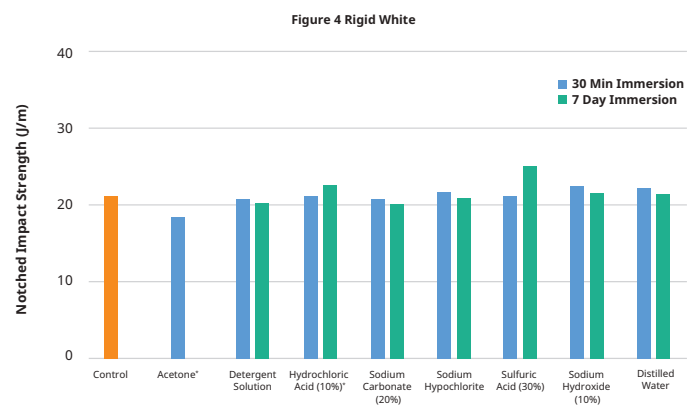
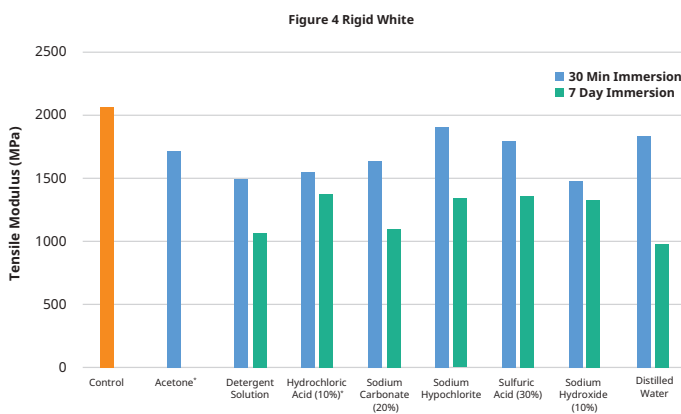
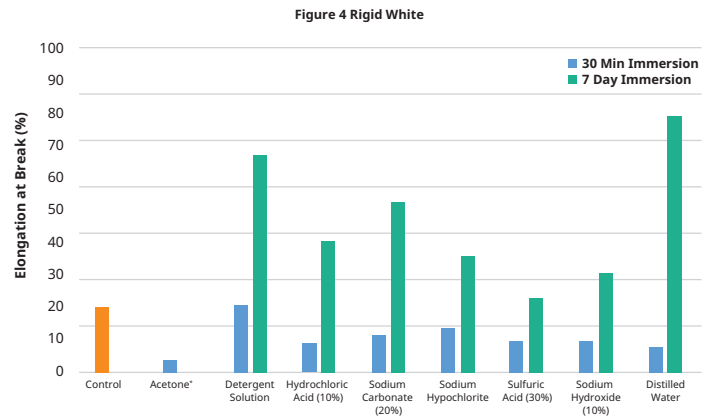
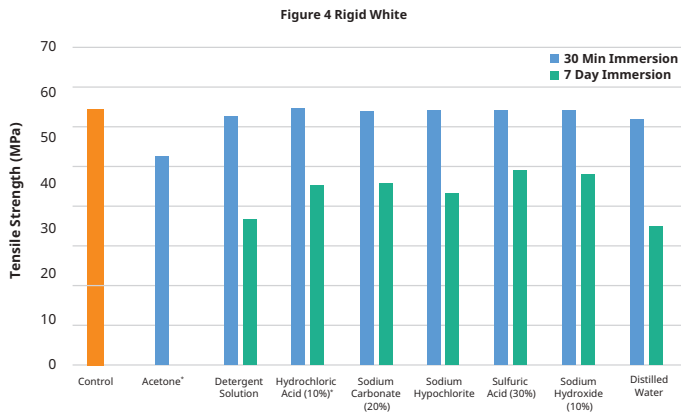
The compatibility of a material with cleaning chemicals is critical to part application. Figure 4 Rigid White parts were tested for sealed and surface contact compatibility per ASTM D543 test conditions. The fluids below were tested in two different ways per the specs.

- 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>

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

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

