



Figure 4[®] MED-AMB 10

Biocompatible* Rigid

A rigid, amber material for applications requiring biocompatibility, translucency and/or thermal resistance

Figure 4

TRANSLUCENT PARTS THAT CAN BE STERILIZED AND TESTED AT HIGH TEMPERATURE

Figure 4[®] MED-AMB 10 is a rigid, translucent material for a range of medical and industrial applications, including when biocompatibility, sterilization and/or thermal resistance is required with fluid flow visualization. It delivers parts with excellent feature resolution and high definition.

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

- General medical applications requiring biocompatibility, sterilization and/or thermal resistance
- Surgical drill guides, splints
- Parts requiring rigidity with high temperature resistance
 - Fluid handling manifolds
 - Elevated temperature testing
- Parts with high definition details
 - Threaded assemblies
- Visualization and fluid flow models

BENEFITS

- Capable of meeting ISO 10993-5 & -10 standards for biocompatibility (cytotoxicity, sensitization and irritation)
- Excellent visualization for parts requiring evaluation of internal features and their performance
- High temperature testing
- True-to-CAD accuracy and crisp feature detail

FEATURES

- Biocompatible capable per ISO10993-5 and ISO10993-10
- Sterilizable by autoclave
- Thermal resistance over 100 °C
- Excellent humidity/moisture resistance
- Rigid and translucent

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.

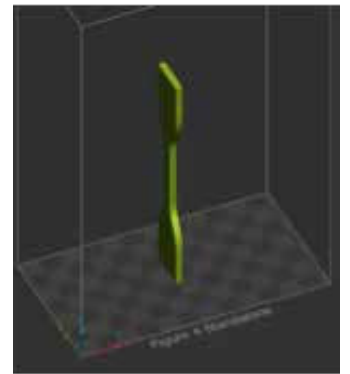
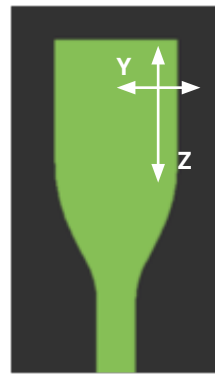
Solid material properties reported were printed along the vertical axis (ZY-orientation). Figure 4 material properties are relatively uniform across print orientations, as detailed in the following section on Isotropic Properties. Because of this, parts do not need to be oriented in a particular direction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

| LIQUID MATERIAL | | | | | | |
|--|---|--|--------------------------|------------------------------|------------------------|------------------------------|
| MEASUREMENT | CONDITION/METHOD | METRIC | | ENGLISH | | |
| Viscosity | Brookfield Viscometer @ 25 °C (77 °F) | 1138 cps | | 2750 lb/ft-hr | | |
| Color | | Amber | | | | |
| Liquid Density | Kruss K11 Force Tensiometer @ 25 °C (77 °F) | 1.12 g/cm ³ | | 0.040 lb/in ³ | | |
| Default Print Layer Thickness (Standard Mode) | | 0.05 mm | | 0.002 in | | |
| Speed - Standard Mode | | 43 mm/hr | | 1.7 in/hr | | |
| Speed - Draft Mode | | 63 mm/hr | | 2.5 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 | 1.20 g/cm ³ | 0.043 lb/in ³ | ISO 1183 | 1.20 g/cm ³ | 0.043 lb/in ³ |
| 24 Hour Water Absorption | ASTM D570 | 0.26% | 0.26% | ISO 62 | 0.26% | 0.26% |
| MECHANICAL | | | | MECHANICAL | | |
| Tensile Strength Ultimate | ASTM D638 | 69 MPa | 10010 psi | ISO 527 -1/2 | 68 MPa | 9845 psi |
| Tensile Modulus | ASTM D638 | 2760 MPa | 400 ksi | ISO 527 -1/2 | 2760 MPa | 400 ksi |
| Elongation at Break | ASTM D638 | 4% | 4% | ISO 527 -1/2 | 4 % | 4 % |
| Flex Strength | ASTM D790 | 111 MPa | 16100 lbf/in | ISO 34 | 110 MPa | 15923 psi |
| Flex Modulus | ASTM D790 | 2810 MPa | 410 MPa | | 3178 MPa | 461 ksi |
| Izod Notched Impact | ASTM D256 | 18 J/m | 0.3 ft-lb/in | ISO 180-A | 1.7 J/m ² | 0.0008 ft-lb/in ² |
| Izod Unnotched Impact | ASTM D4812 | 220 J/m | 4.1 ft-lb/in | ISO 180-U | | |
| Shore Hardness | ASTM D2240 | 84D | 84D | ISO 7619 | 84D | 84D |
| THERMAL | | | | THERMAL | | |
| Tg (DMA, E'') | ASTM E1640 (E''at 1C/min) | 110 °C | 230 °F | ISO 6721-1/11 (E''at 1C/min) | 110 °C | 230 °F |
| HDT @ 0.455 MPa/66 PSI | ASTM D648 | 119 °C | 246 °F | ISO 75- 1/2 B | 115 °C | 238 °F |
| HDT @ 1.82 MPa/264 PSI | ASTM D648 | 94 °C | 201 °F | ISO 75-1/2 A | 96 °C | 205 °F |
| CTE below Tg | ASTM E831 | 84 ppm/°C | 47 ppm/°F | ISO 11359-2 | 84 ppm/°C | 47 ppm/°F |
| CTE above Tg | ASTM E831 | 177 ppm/°C | 98 ppm/°F | ISO 11359-2 | 177 ppm/°C | 98 ppm/°F |
| UL Flammability | UL94 | HB | HB | | | |
| ELECTRICAL | | | | ELECTRICAL | | |
| Dielectric Strength (V/mil) @ 3.0 mm thickness | ASTM D149 | | | | | |
| Dielectric Constant @ 1 MHz | ASTM D150 | | | | | |
| Dissipation Factor @ 1 MHz | ASTM D150 | | | | | |
| Volume Resistivity (ohm-cm) | ASTM D257 | | | | | |

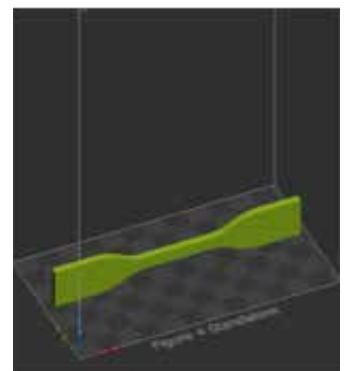
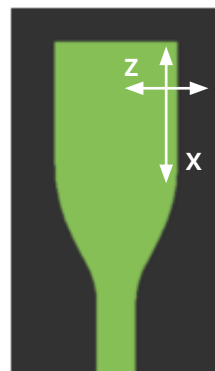
ISOTROPIC PROPERTIES

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

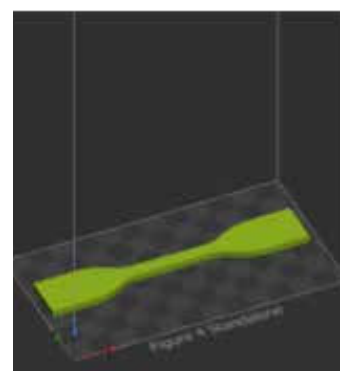
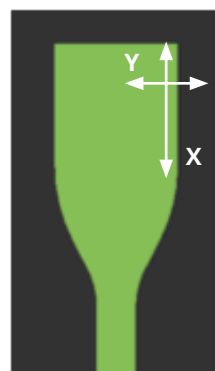
Parts do not need to be oriented to get the highest mechanical properties, further improving the degree of freedom for part orientation for mechanical properties.



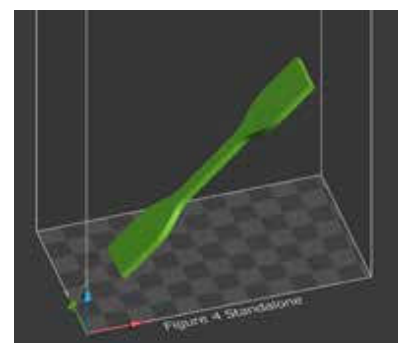
YZ - orientation



XZ - orientation



XY - orientation



Z45-Degree - orientation

| SOLID MATERIAL | | | | | |
|---------------------------|------------|----------|----------|----------|----------|
| METRIC | METHOD | METRIC | | | |
| MECHANICAL | | | | | |
| | | ZY | XZ | XY | Z45 |
| Tensile Strength Ultimate | ASTM D638 | 69 MPa | 61 MPa | 67 MPa | 71 MPa |
| Tensile Strength at Yield | ASTM D638 | N/A | N/A | N/A | N/A |
| Tensile Modulus | ASTM D638 | 2800 MPa | 2700 MPa | 2500 MPa | 2300 MPa |
| Elongation at Break | ASTM D638 | 4% | 3 % | 5 % | 5 % |
| Elongation at Yield | ASTM D638 | N/A | N/A | N/A | N/A |
| Flex Strength | ASTM D790 | 111 MPa | 82 MPa | 99 MPa | 96 MPa |
| Flex Modulus | ASTM D790 | 2810 MPa | 2554 MPa | 2484 MPa | 2949 MPa |
| Izod Notched Impact | ASTM D256 | 18 J/m | 16 J/m | 16 J/m | 15 J/m |
| Izod Unnotched Impact | ASTM D2240 | 220 kN/m | 204 kN/m | 124 kN/m | 202 kN/m |
| Shore Hardness | ASTM D624 | 84D | 84D | 82D | 85D |

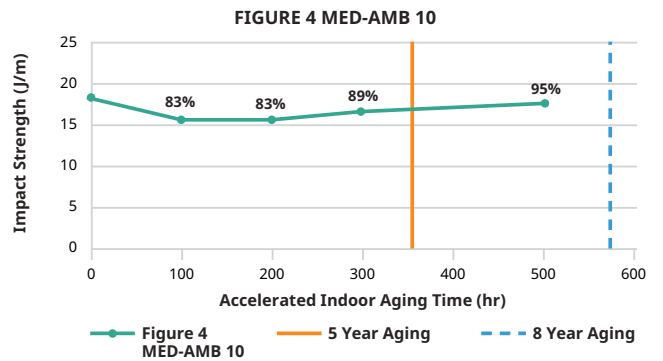
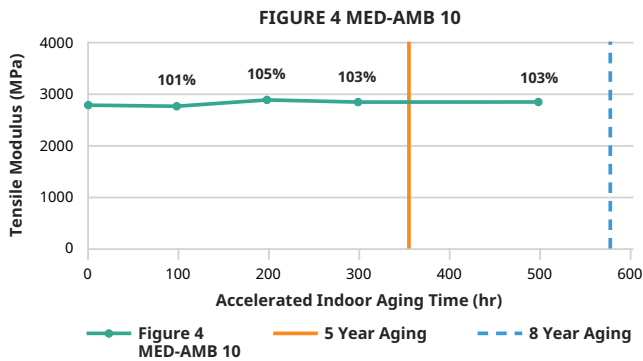
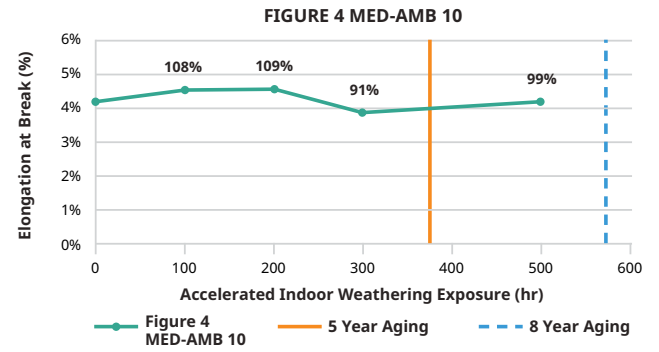
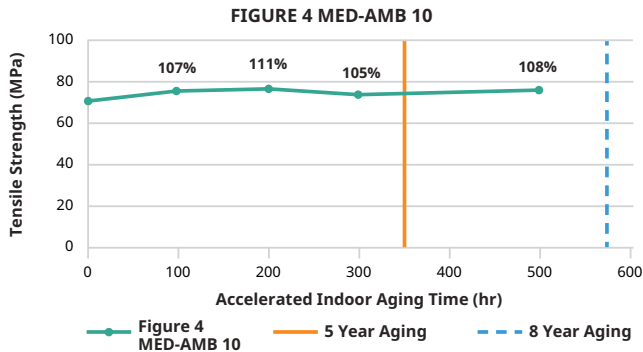
Figure 4 MED-AMB 10

LONG TERM ENVIRONMENTAL STABILITY

Figure 4 MED-AMB 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.**

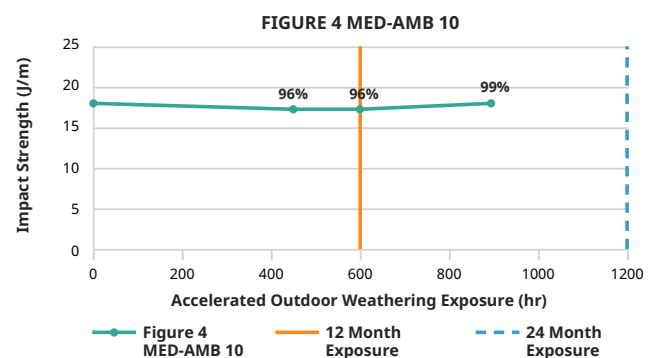
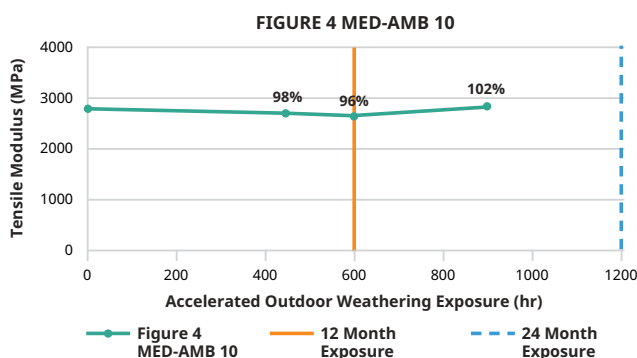
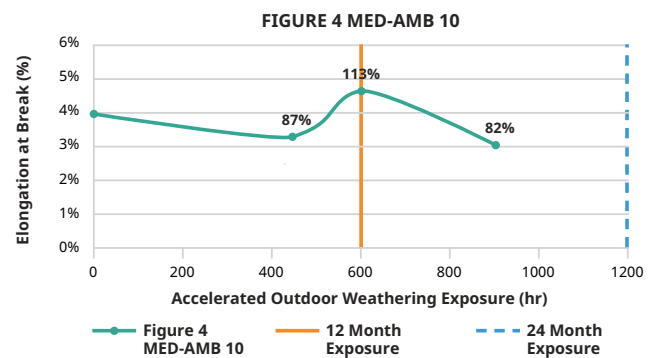
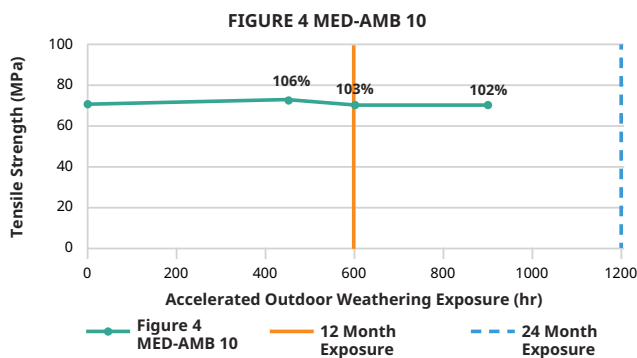
INDOOR STABILITY: Tested per ASTM D4329 standard method.

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. Figure 4 MED-AMB 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

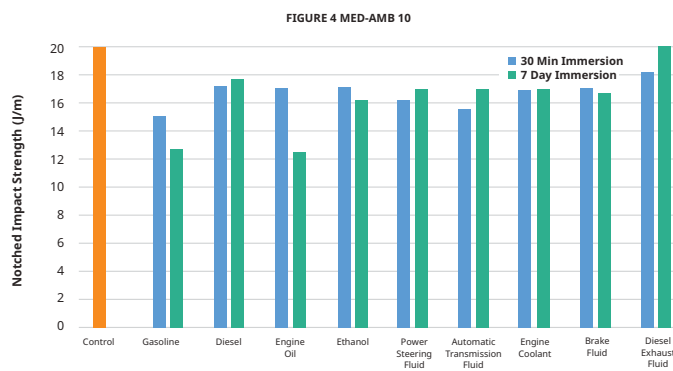
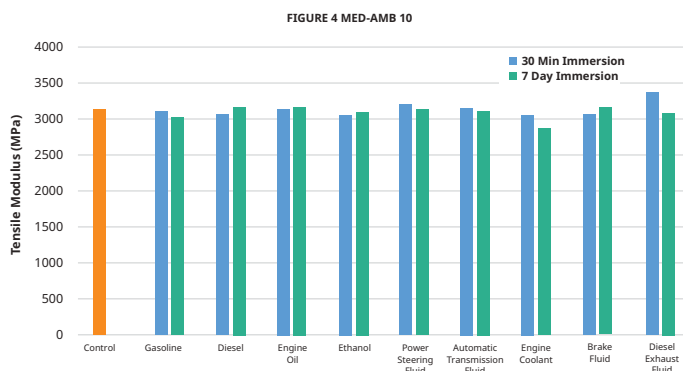
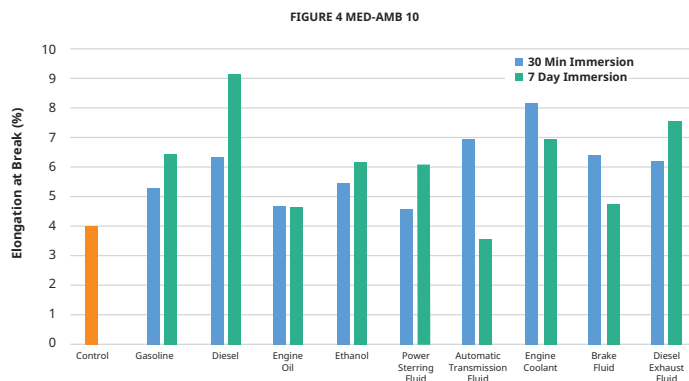
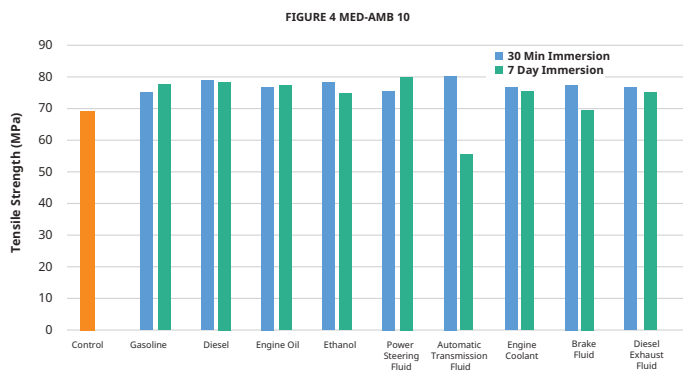


Figure 4 MED-AMB 10

CHEMICAL COMPATIBILITY

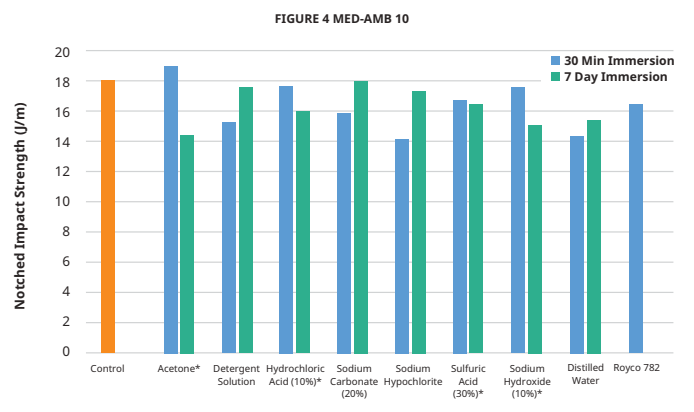
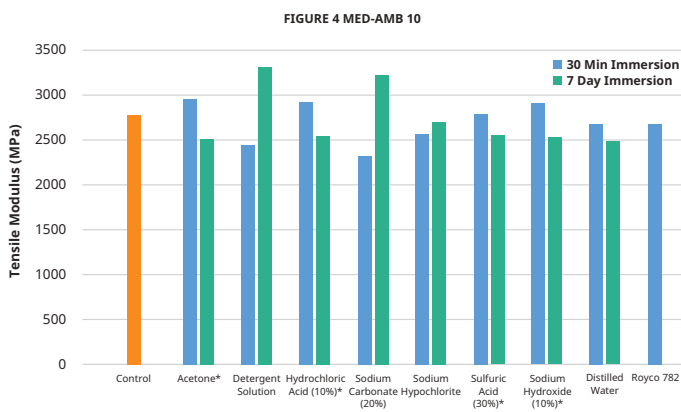
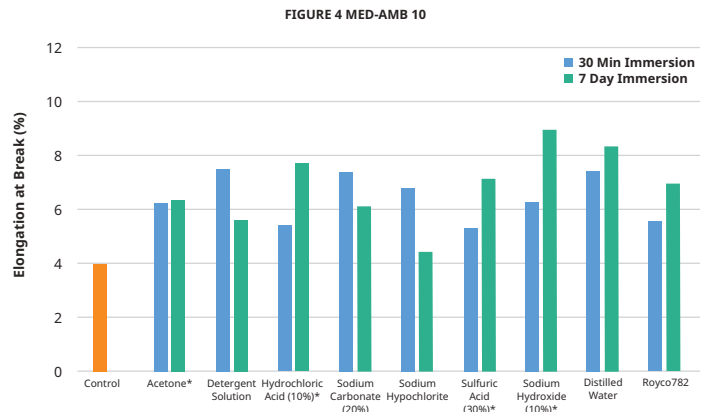
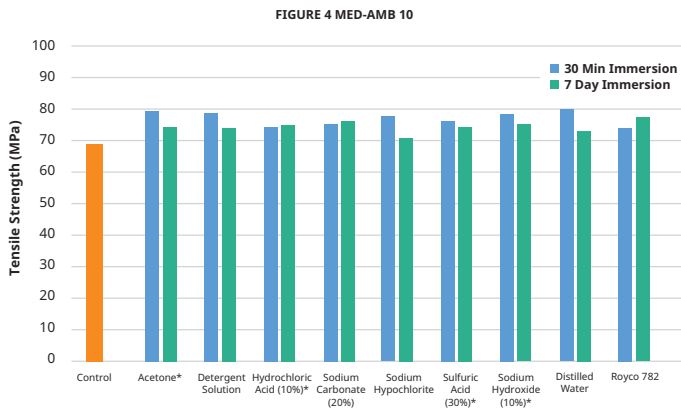
The compatibility of a material with cleaning chemicals is critical to part application. Figure 4 MED-AMB 10 parts were tested for sealed and surface contact compatibility per ASTM D543 test conditions. The fluids below were tested in two different ways per the specs.

- 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 |



BIOCOMPATIBILITY STATEMENT

Figure 4[®] MED-AMB 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[®] MED-AMB 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[®] MED-AMB 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 5 minutes on 3D Systems LC-3D Mixer for first use
- Roll for 5 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 : 60 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>

