Figure 4® HI TEMP 300-AMB

High Temperature

Industry-leading, ultra-high temperature resistant rigid plastic suitable for the harshest thermal environments

Figure 4

HIGH THERMAL-RESISTANCE, TRANSLUCENT AMBER PLASTIC FOR FLOW VISUALIZATION (HDT >300 °C)

Figure 4 HI TEMP 300-AMB is an ultra-high temperature plastic for use in applications requiring high heat resistance. It is the industry's highest heat resistant material with heat deflection temperature of over 300 °C at both low and high stress (at 0.455 and 1.82 MPa). This material is well suited for the testing of high temperature components in applications including HVAC, consumer appliances, motor enclosures, stators, molds, and the like. It does not require a secondary thermal post-cure.

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

- High temperature components testing and general use parts including: HVAC, consumer appliances, motor enclosures, stators, etc.
- Low pressure molding/tooling: expanding foams, rubbers, etc.
- Overmolding

BENEFITS

- Production-grade material
- High heat resistance for testing and use in high heat environments
- No secondary thermal post-cure required
- Excellent visualization for parts requiring evaluation of internal features and fluid flow performance

FEATURES

- HDT over 300 °C at both low and high stress (HDT at 0.455 and 1.82 MPa)
- Rigid and translucent
- High tensile modulus for use in molds (4000 MPa)

Figure 4 HI TEMP 300-AMB

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)	1725 cPs	4100 lb/ft·h
Color		Amber	
Liquid Density	Kruss K11 Force Tensiometer @ 25 °C (77 °F)	1.19 g/cm³	0.04 lb/in³
Default Print Layer Thickness (Standard Mode)		50um	0.002 in
Speed - Standard Mode		36 mm/hr	1.42 in/hr
Speed - Draft Mode		40 mm/hr	1.57 in/hr
Package Volume		1 kg bottle - Figure 4 Standalone 2.5 kg cartridge - Figure 4 Modular 10kg bottle Figure 4 Production	

SOLID MATERIAL						
METRIC	**ASTM METHOD**	**METRIC**	**ENGLISH**	**ISO METHOD**	**METRIC**	**ENGLISH**
PHYSICAL				**PHYSICAL**		
Solid Density	ASTM D792	1.3 g/cm³	0.047 lb/in³	ISO 1183	1.3 g/cm³	0.047 lb/in³
24 Hour Water Absorption	ASTM D570	0.36 %	0.36 %	ISO 62	0.36 %	0.36 %
MECHANICAL				**MECHANICAL**		
Tensile Strength Ultimate	ASTM D638 Type IV	77 MPa	11200 psi	ISO 527 -1/2	75 MPa	10900 psi
Tensile Strength at Yield	ASTM D638 Type IV	N/A	N/A	ISO 527 -1/2	N/A	N/A
Tensile Modulus	ASTM D638 Type IV	4100 MPa	5.9 ksi	ISO 527 -1/2	4200 MPa	6.1 ksi
Elongation at Break	ASTM D638 Type IV	2.3 %	2.3 %	ISO 527 -1/2	2.3 %	2.3 %
Elongation at Yield	ASTM D638 Type IV	N/A	N/A	ISO 527 -1/2	N/A	N/A
Flex Strength	ASTM D790	85 MPa	12300 psi	ISO 178	130 MPa	1900 psi
Flex Modulus	ASTM D790	4300 MPa	6.2 ksi	ISO 178	4500 MPa	6.5 ksi
Izod Notched Impact	ASTM D256	10 J/m	0.2 ft-lb/in	ISO 180-A	1.6 J/m²	N/A
Izod Unnotched impact	ASTM D4812	102 J/m	1.9 ft-lb/in	ISO 180-U		
Shore Hardness	ASTM D2240	89 D	89 D	ISO 7619	89 D	89 D
THERMAL				**THERMAL**		
Glass Transition (Tg)	ASTM E1640 (E"Peak)	N/A	N/A	ISO 6721-1/11 (E" Peak)	N/A	N/A
HDT 1.82MPa/264 PSI	ASTM D648	>300 °C	>572 °F	ISO 75-1/2 A	>300 °C	>570 °F
HDT 0.455MPa/66PSI	ASTM D648	>300 °C	>572 °F	ISO 75- 1/2 B	280 °C	540 °F
HDT 8.0MPa/ 1160PSI	N/A			ISO 75-1/2 C	100 °C	210 °F
CTE 0-110C	ASTM E831	69 ppm/°C	38 ppm/°F	ISO 11359-2	69 ppm/K	38 ppm/°F
CTE 165-250C	ASTM E831	58 ppm/°C	32 ppm/°F	ISO 11359-2	58 ppm/K	32 ppm/°F
UL Flammability	UL94	HB				
ELECTRICAL				**ELECTRICAL**		
Dielectric Strength (kV/mm) @ 3.0 mm thickness	ASTM D149	18.1				
Dielectric Constant @ 1 MHz	ASTM D150	3.29				
Dissipation Factor @ 1 MHz	ASTM D150	0.013				

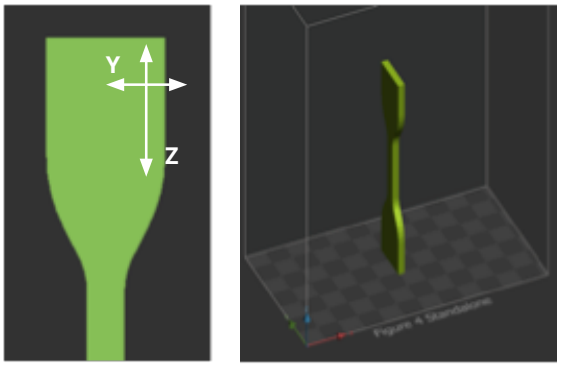
Figure 4 HI TEMP 300-AMB

ISOTROPIC PROPERTIES

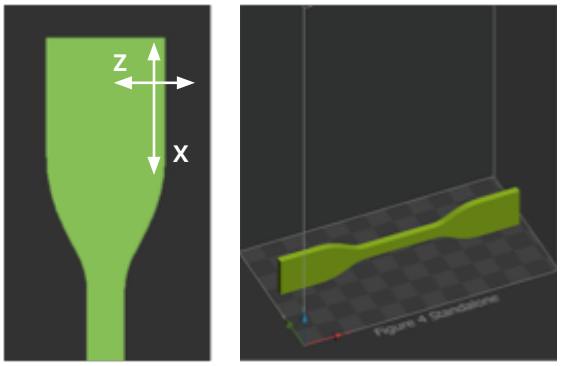
Figure 4 technology prints parts that are isotropic in mechanical properties meaning the parts printed along either the XYZ axis will give similar results.

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.

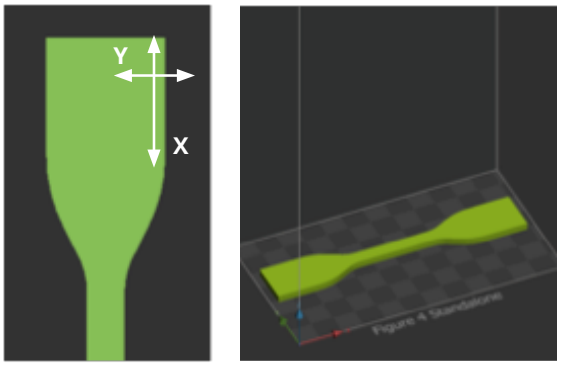
SOLID MATERIAL					
METRIC	METHOD	METRIC			
MECHANICAL					
		ZY	XZ	XY	Z45
Tensile Strength Ultimate	ASTM D638 Type IV	77 MPa	74 MPa	68 MPa	79 MPa
Tensile Strength at Yield	ASTM D638 Type IV	N/A	N/A	N/A	N/A
Tensile Modulus	ASTM D638 Type IV	4100 MPa	3800 MPa	3900 MPa	3900 MPa
Elongation at Break	ASTM D638 Type IV	2.3 %	2.3 %	1.9 %	2.4 %
Elongation at Yield	ASTM D638 Type IV	N/A	N/A	N/A	N/A
Flex Strength	ASTM D790	85 MPa	98 MPa	105 MPa	96 MPa
Flex Modulus	ASTM D790	4300 MPa	4200 MPa	4000 MPa	4100 MPa
Izod Notched Impact	ASTM D256	10 J/m	9 J/m	11 J/m	10 J/m
Shore Hardness	ASTM D2240	89 D	90 D	89 D	90 D



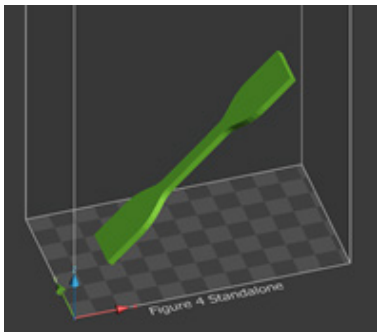
ZY - orientation



XZ - orientation



XY - orientation



Z45-Degree - orientation

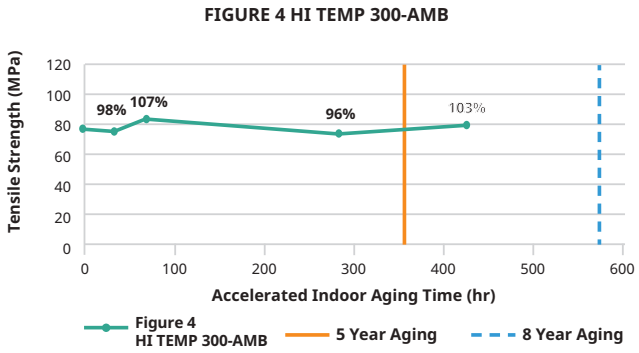
Figure 4 HI TEMP 300-AMB

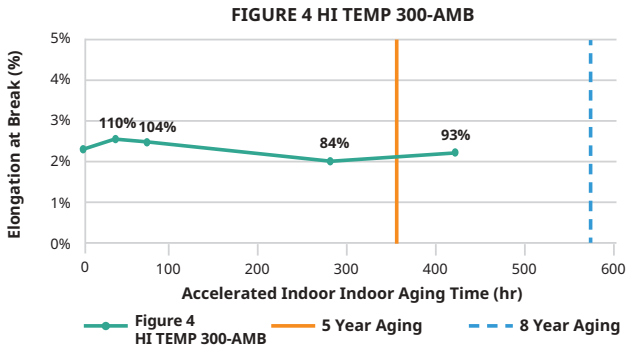
LONG TERM ENVIRONMENTAL STABILITY

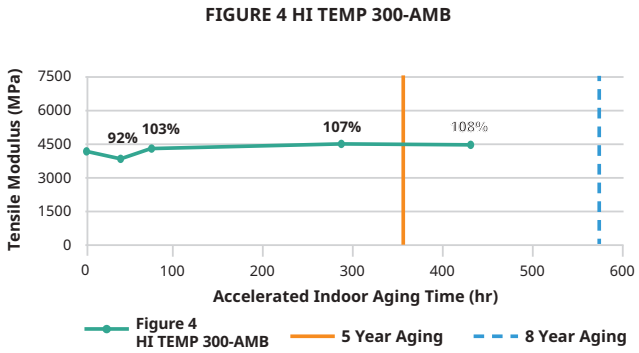
Figure 4 HI TEMP 300-AMB is engineered to give long term environmental UV and humidity stability. This means the material is tested for the ability to retain a high percent of the initial mechanical properties over a given period of time. This provides real design conditions to consider for the application or part. **Actual data value is on Y-axis, and data points are % of initial value.**

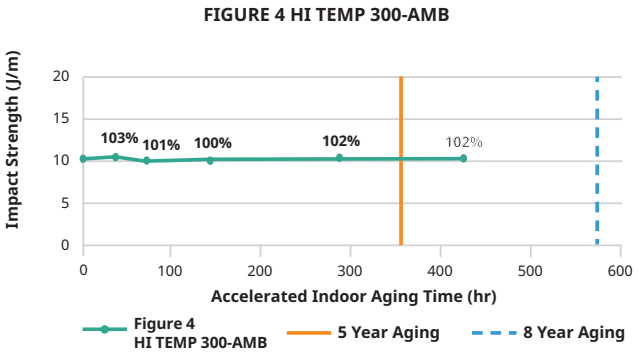
INDOOR STABILITY: Tested per ASTM D4329 standard method.

INDOOR STABILITY



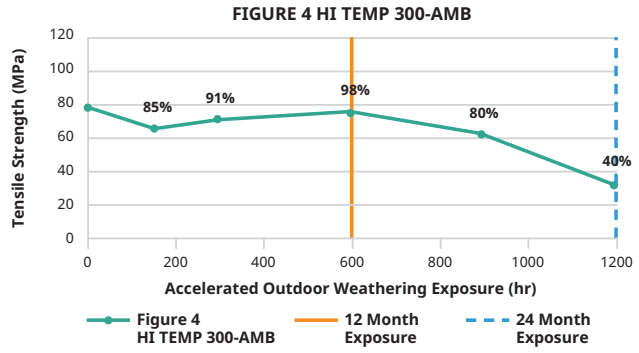


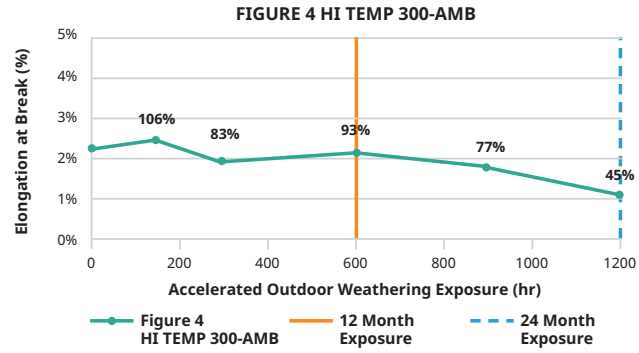


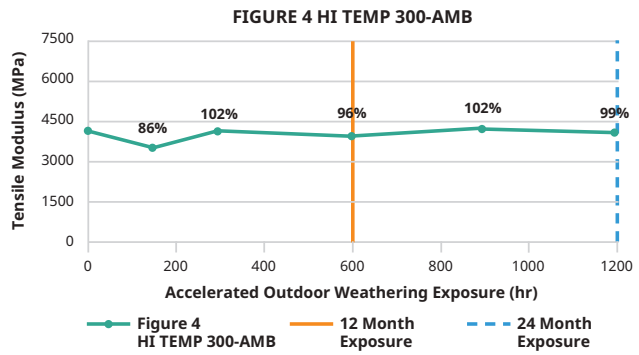


OUTDOOR STABILITY: Tested per ASTM G154 standard method.

OUTDOOR STABILITY







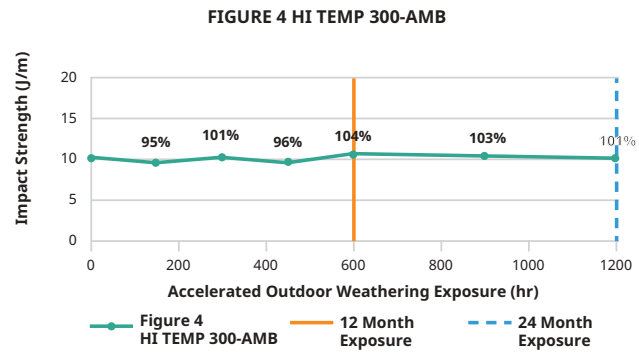


Figure 4 HI TEMP 300-AMB

AUTOMOTIVE FLUID COMPATIBILITY

The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. Figure 4 HI TEMP 300-AMB 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 HI TEMP 300-AMB

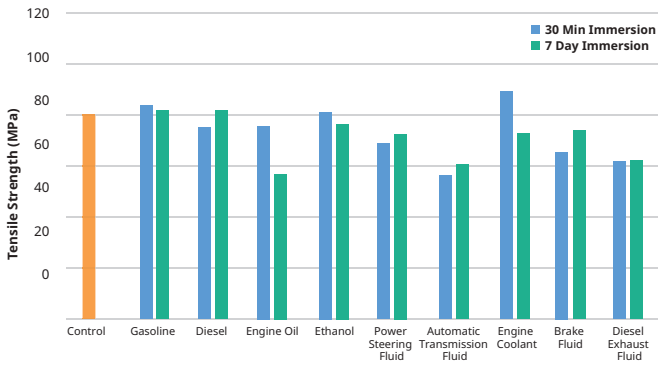


FIGURE 4 HI TEMP 300-AMB

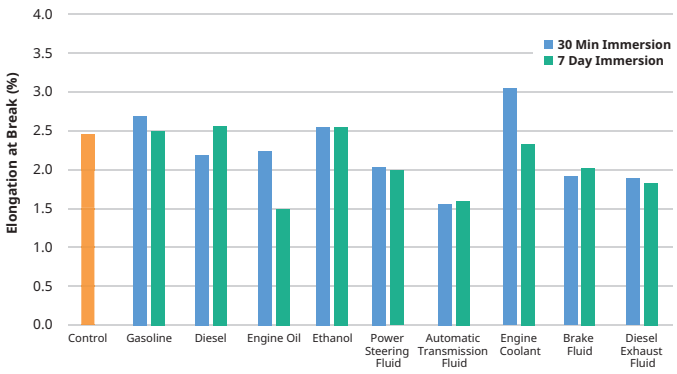
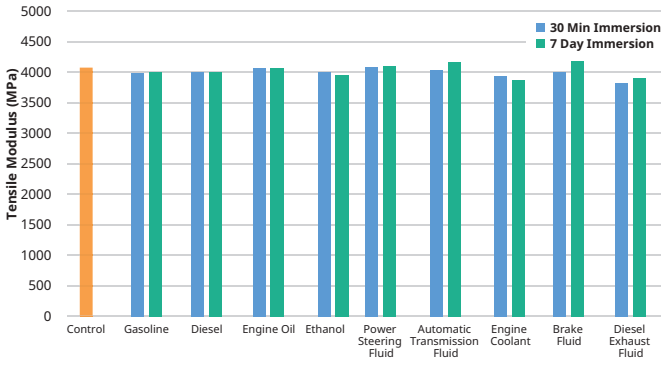


FIGURE 4 HI TEMP 300-AMB



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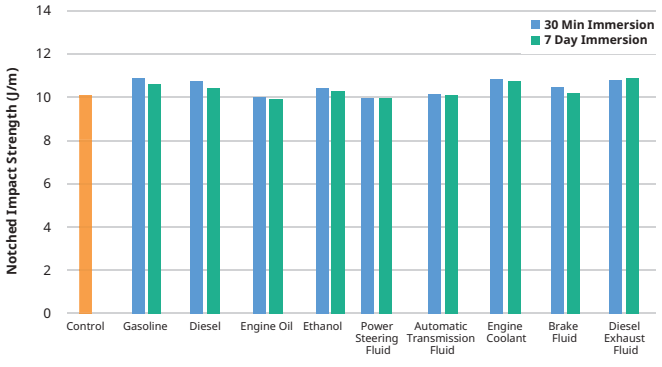


Figure 4 HI TEMP 300-AMB

CHEMICAL COMPATIBILITY

The compatibility of a material with cleaning chemicals is critical to part application. Figure 4 HI TEMP 300-AMB 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.

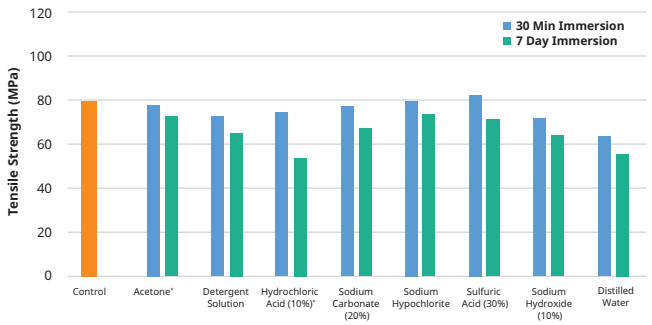
- Immerse for 7-days, then take mechanical property data for comparison.
- Immerse for 30-minutes, remove, and take mechanical property data for comparison in 7-days

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 HI TEMP 300-AMB



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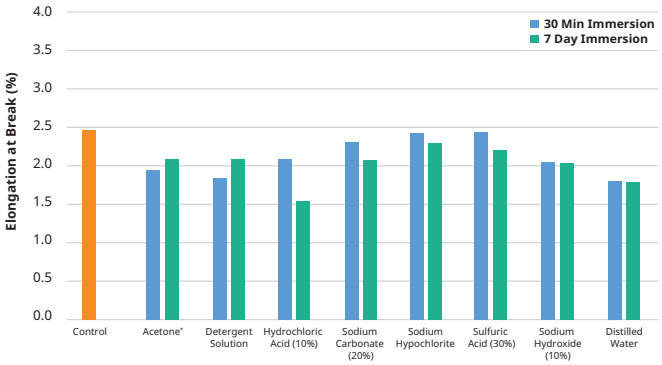

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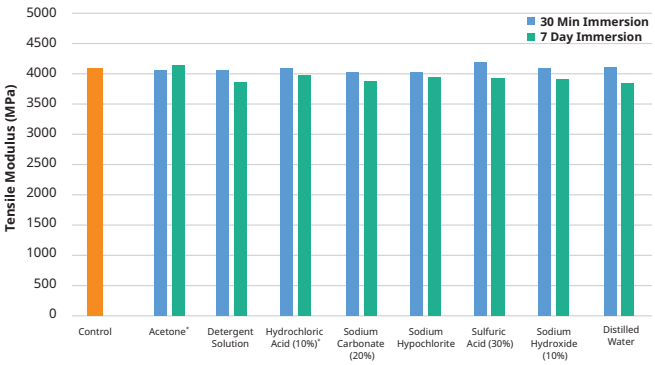

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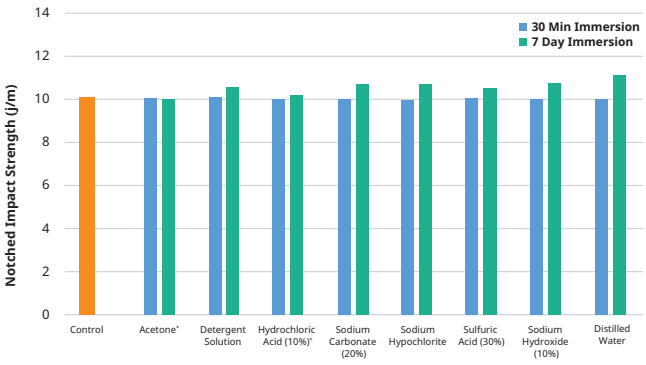

POST-PROCESSING

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

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