



# Accura<sup>®</sup> AMX<sup>™</sup> Durable Natural

Production Tough

Production-grade stereolithography resin featuring long-term environmental stability, high toughness, and superior surface finish for large-scale plastic parts and mandrel tooling

Stereolithography

## PRODUCTION-GRADE RESIN FOR DURABLE, TOUGH PLASTIC PARTS AND MANDREL TOOLING

Accura AMX Durable Natural is a tough, production-grade resin with a unique combination of impact and fatigue resistance and high elongation at break. Engineered to withstand repeated flexing, bending, and loading, Accura AMX Durable Natural is ideal for cost-efficiently delivering durable parts with the high surface quality, accuracy, and repeatability advantages of stereolithography.

With comparable aesthetics to injection molded plastics, parts printed in Accura AMX Durable Natural offer long-term stability of mechanical properties, making it an excellent choice for repeatable mechanical loads and structural prototypes and parts for motorsports, aerospace, consumer durables, and manufacturing services. It is also ideal for mandrel tooling of composites, when the tool needs to be removed in a single piece from convoluted tubing.

## HANDLING AND POST-PROCESSING GUIDELINES

Proper cleaning, drying, and curing are required for this material. More details can be found at <https://infocenter.3dsystems.com/bestpractices/sla-best-practices/accura-amx-durable-natural>

Note: All properties are based on using the documented post-processing method. Any deviation from this method could yield a different result.

## APPLICATIONS

- Mandrel tooling for composites in automotive and aerospace applications
- Functional assemblies and prototypes
- Manufacturing aids, jigs, and fixtures
- Containers and enclosures
- Structural components such as brackets and couplings

## BENEFITS

- High impact, high elongation
- Superior toughness and fatigue resistance
- Enables mandrels to be easily removed whole, even from convoluted tubing
- Withstands repeated flexing, bending, and loading
- Long-term environmental and mechanical stability (indoor to 8 years)
- High accuracy and fine detail resolution
- Aesthetics comparable to injection molded plastics



*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 is given per ASTM and ISO standards where applicable. Properties like flammability, dielectric properties, and 24-hour water absorption are also provided for better understanding of material capabilities to help design decisions using the material. All parts are conditioned per ASTM recommended standards for a minimum of 40 hrs at 23°C, 50% RH.

Solid material properties reported were printed along the horizontal axis (ZX-orientation). Stereolithography material properties are relatively uniform across print orientations. Parts do not need to be oriented in a particular direction to exhibit these properties.

LIQUID MATERIAL						
MEASUREMENT	CONDITION/METHOD	METRIC		ENGLISH		
Viscosity (@25C)	Brookfield Viscometer @ 25°C (77 °F)	990 cps		2400 lbs/ft-h		
Color				Natural		
Liquid Density (@25C)	Kruss K11 Force Tensiometer @ 25 °C (77 °F)	1.11 g/cm³		0.04 lb/in³		
Default Print Layer Thickness	Internal	102um		.004 in		

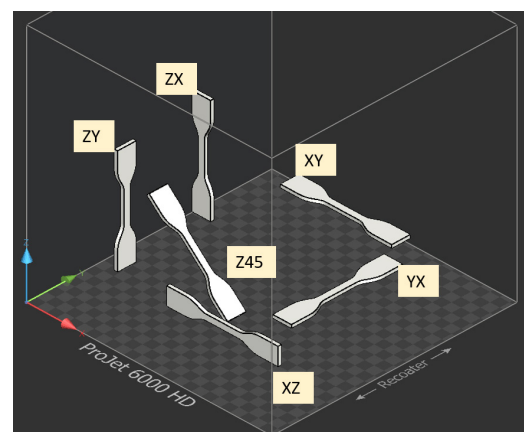
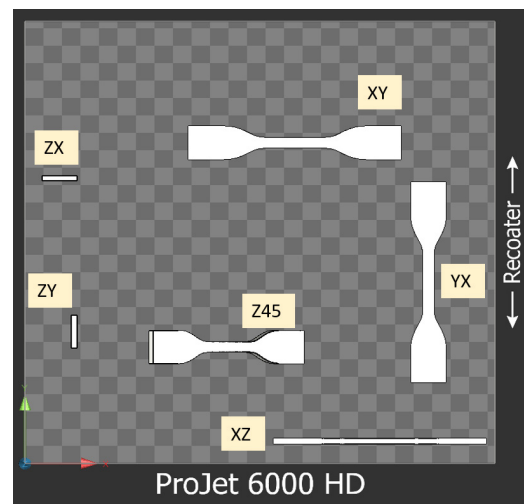
SOLID MATERIAL						
METRIC	ASTM METHOD	METRIC	ENGLISH	ISO METHOD	METRIC	ENGLISH
PHYSICAL				PHYSICAL		
Solid Density	ASTM D792	1.2 g/cm³	0.043 lb/in³	ISO 1183	1.2 g/cm³	0.043 lb/in³
24 Hour Water Absorption	ASTM D570	0.49 %	0.49 %	ISO 62	0.49 %	0.49 %
MECHANICAL				MECHANICAL		
Tensile Strength Ultimate	ASTM D638 Type IV	32 MPa	4600 psi	ISO 527 -1/2	28 MPa	4000 psi
Tensile Strength at Yield	ASTM D638 Type IV	25 MPa	3700 psi	ISO 527 -1/2	23 MPa	3300 psi
Tensile Modulus	ASTM D638 Type IV	1000 MPa	150 ksi	ISO 527 -1/2	1000 MPa	148 ksi
Elongation at Break	ASTM D638 Type IV	80 %	80 %	ISO 527 -1/2	70 %	70 %
Elongation at Yield	ASTM D638 Type IV	7.3 %	7.3 %	ISO 527 -1/2	7.4 %	7.4 %
Flex Strength	ASTM D790	20 MPa	2900 psi	ISO 178	20 MPa	3100 psi
Flex Modulus	ASTM D790	590 MPa	90 ksi	ISO 178	730 MPa	105 ksi
Izod Notched Impact	ASTM D256	64 J/m	1.2 ft-lb/in	ISO 180-A	7 kJ/m²	3.5 ft-lb/in²
Izod Unnotched Impact	ASTM D4812	1230 J/m	23 ft-lb/in	ISO 180-U	24 kJ/m²	11.5 ft-lb/in²
Shore Hardness	ASTM D2240	64 D	64 D	ISO 7619	64 D	64 D
THERMAL				THERMAL		
Tg (DMA E")	ASTM E1640 (E" at 1C/min)	23 °C	74 °F	ISO 6721-1/11 (E" at 1C/min)	23 °C	74 °F
HDT 0.455MPa/66PSI	ASTM D648	42 °C	108 °F	ISO 75- 1/2 B	43 °C	109 °F
HDT 1.82MPa/264 PSI	ASTM D648	25 °C	77 °F	ISO 75-1/2 A	25 °C	77 °F
CTE -40 to 15C	ASTM E831	106 ppm/°C	59 ppm/°F	ISO 11359-2	106 ppm/K	59 ppm/°F
CTE 55 to 125C	ASTM E831	173 ppm/°C	96 ppm/°F	ISO 11359-2	173 ppm/K	96 ppm/°F
UL Flammability	UL94	HB				
ELECTRICAL				ELECTRICAL		
Dielectric Strength (kV/mm) @ 3mm thickness	ASTM D149	41				
Dielectric Constant @ 1 MHz	ASTM D150	3.7				
Dissipation Factor @ 1 MHz	ASTM D150	0.048				
Volume Resistivity (ohm-cm)	ASTM D257	1.46x10 <sup>14</sup>				

## ISOTROPIC PROPERTIES

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

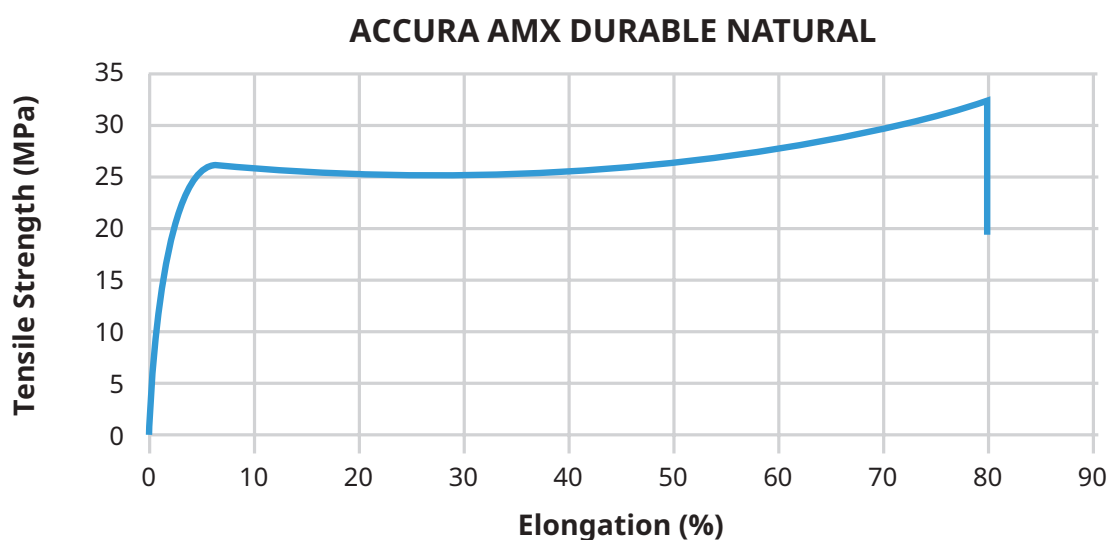
Parts do not need to be oriented to get the highest mechanical properties, further improving the degree of freedom for part orientation for mechanical properties.

SOLID MATERIAL							
MEASUREMENT	METHOD	METRIC					
MECHANICAL							
		ZY	ZX	XZ	XY	YX	Z45
Tensile Strength Ultimate	ASTM D638 Type IV	32 MPa	28 MPa	27 MPa	26 MPa	28 MPa	25 MPa
Tensile Strength at Yield	ASTM D638 Type IV	25 MPa	24 MPa	24 MPa	23 MPa	26 MPa	21 MPa
Tensile Modulus	ASTM D638 Type IV	1000 MPa	1000 MPa	900 MPa	1000 MPa	1100 MPa	800 MPa
Elongation at Break	ASTM D638 Type IV	80 %	71 %	67 %	59 %	62 %	62 %
Elongation at Yield	ASTM D638 Type IV	7.3 %	7.3 %	8.4 %	7.2 %	7.3 %	9.8 %
Flex Strength	ASTM D790	20 MPa	21 MPa	21 MPa	22 MPa	24 MPa	17 MPa
Flex Modulus	ASTM D790	590 MPa	680 MPa	630 MPa	630 MPa	750 MPa	480 MPa
Izod Notched Impact	ASTM D256	64 J/m	85 J/m	99 J/m	91 J/m	82 J/m	77 J/m
Shore Hardness	ASTM D2240	64 D	64 D	64 D	65 D	65 D	65 D



## STRESS-STRAIN CURVE

Accura AMX Durable Natural exhibits thermoplastic behavior with a long plastic deformation ductile necking before fracturing which gives better snap and clip performance.

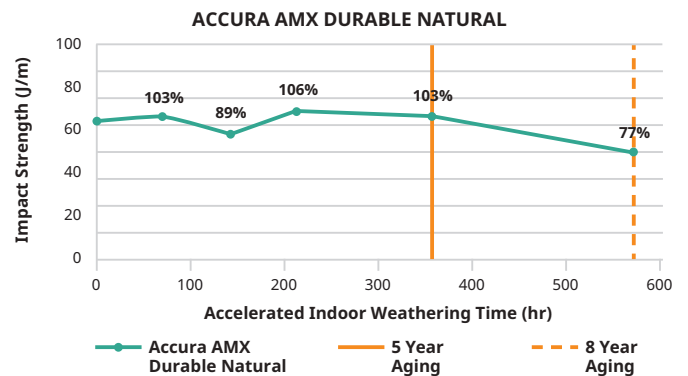
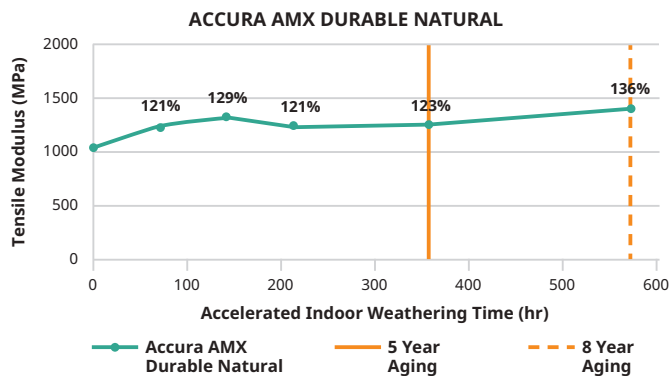
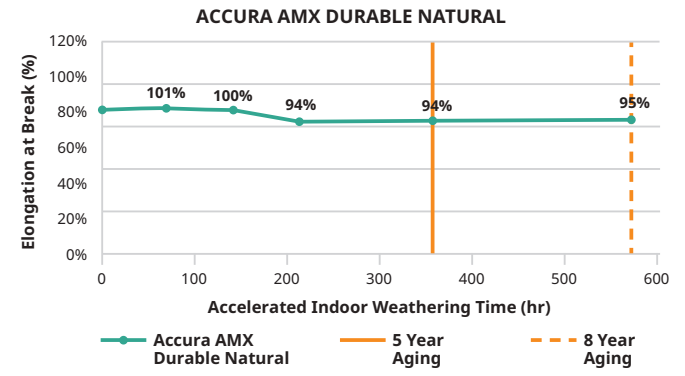
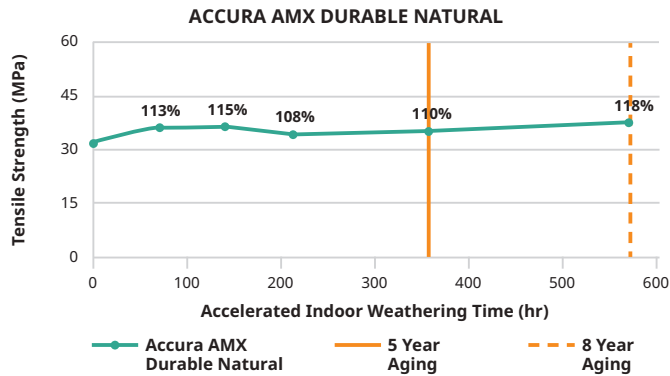


## LONG TERM ENVIRONMENTAL STABILITY

Accura AMX Durable Natural 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.**

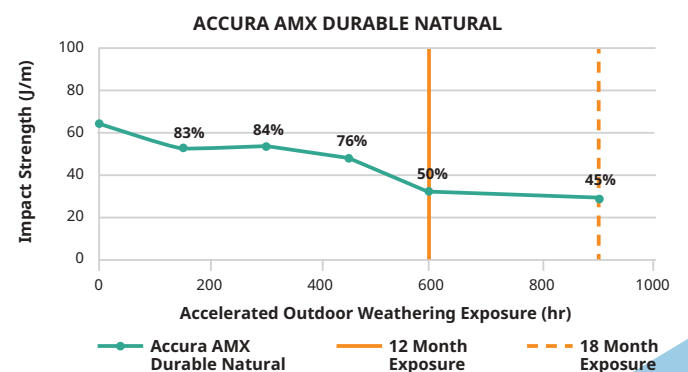
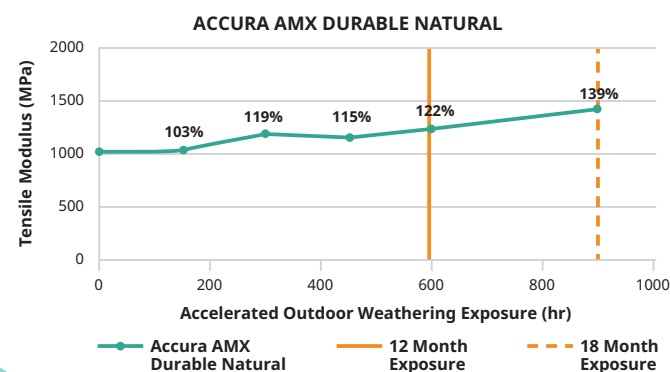
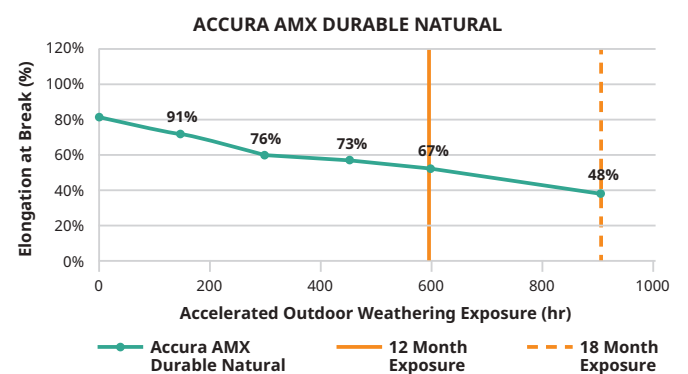
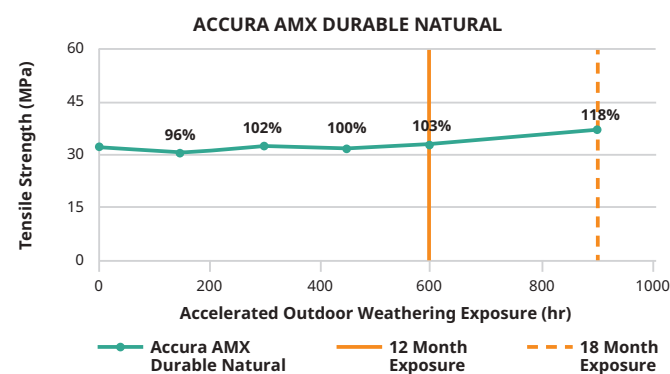
**INDOOR STABILITY:** Tested per ASTM D4329 standard method.

INDOOR STABILITY



**OUTDOOR STABILITY:** Tested per ASTM G154 standard method.

OUTDOOR STABILITY



## AUTOMOTIVE FLUID COMPATIBILITY

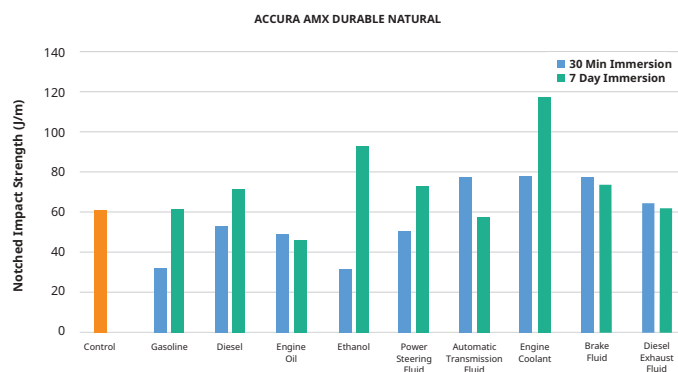
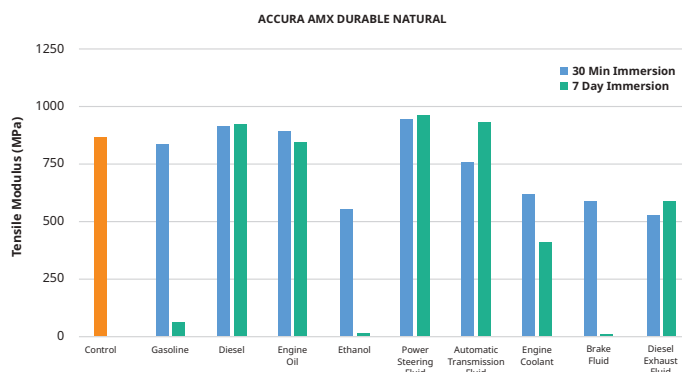
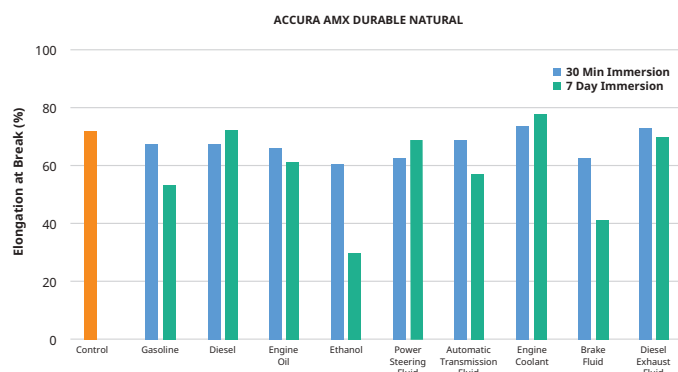
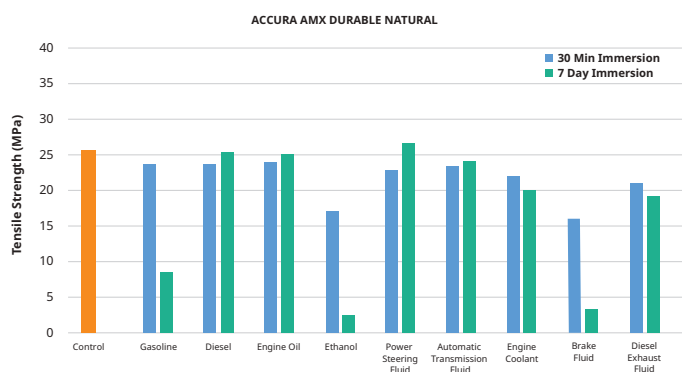
The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part application. Accura AMX Durable Natural parts were tested for sealed and surface contact compatibility per USCAR2 test conditions. The fluids below were tested in two different ways per the specs.

- 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

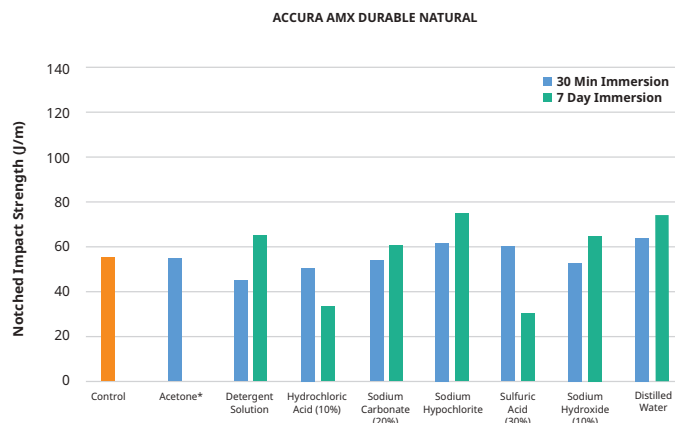
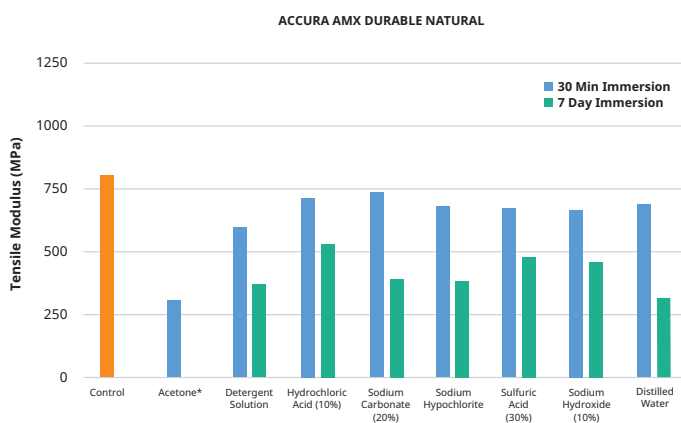
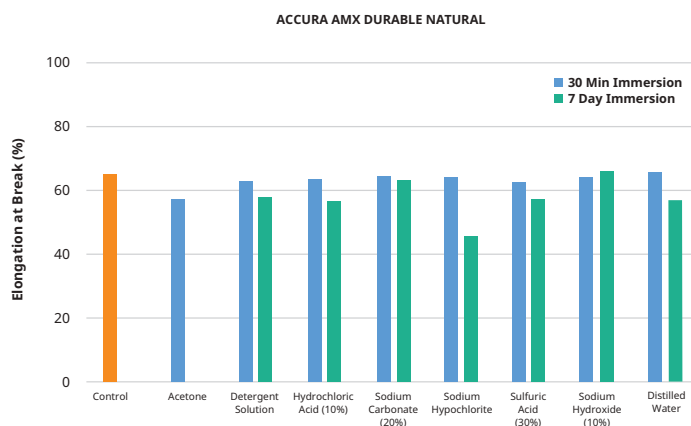
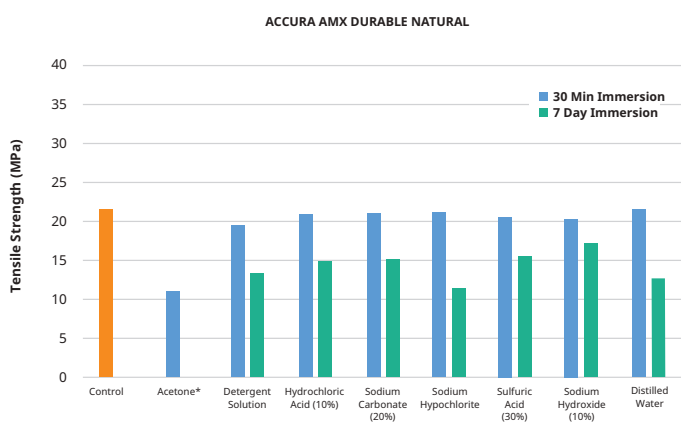
The compatibility of a material with cleaning chemicals is critical to part application. Accura AMX Durable Natural parts were tested for sealed and surface contact compatibility per ASTM D543 test conditions. The fluids below were tested in two different ways per the specs.

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

**Data reflects the measured value of properties over that period of time.**

\*Denotes materials did not go through 7-day soak conditioning.

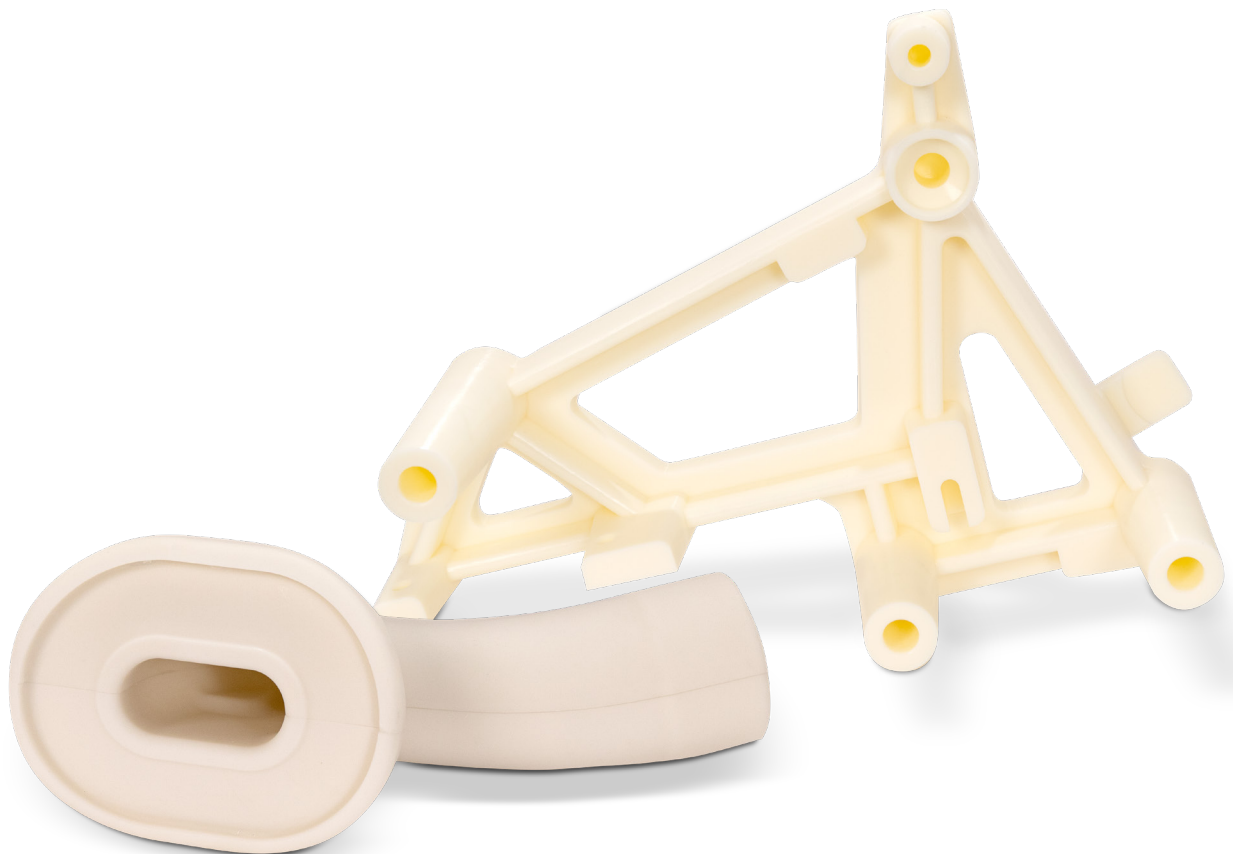
CHEMICAL COMPATIBILITY
6.3.3 Acetone
6.3.12 Detergent Solution, Heavy Duty
6.3.23 Hydrochloric Acid (10%)
6.3.38 Sodium Carbonate Solution (20%)
6.3.44 Sodium Hypochlorite Solution
6.3.46 Sulfuric Acid (30%)
6.3.42 Sodium Hydroxide (10%)
6.3.15 Distilled Water



## BIOCOMPATIBILITY STATEMENT

Accura AMX Durable Natural 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*. The test results indicate that Accura AMX Durable Natural has passed the requirements for biocompatibility according to the above test.

It is the responsibility of each customer to determine that its use of Accura AMX Durable Natural 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

### CLEANING INSTRUCTIONS

- Clean with 2 solvents of 1-TPM,1-IPA (wash and rinse)
- Agitate parts in 'wash' TPM for 20 minutes manually or in automated cleaning system
- Manually rinse in 'clean' IPA using squirt bottle to remove TPM solvent
- Submerge, and manually rinse in 'clean' IPA for 10 minutes while agitating part
  - DO NOT EXCEED more than 10 minutes submerged exposure to IPA to preserve mechanical properties
- Using a soft brush can aid cleaning on downfacing surfaces. Use care when handling parts to prevent marking the surfaces
- Refresh IPA when cleaning becomes ineffective

### DRYING INSTRUCTIONS

- Oven dry at 35°C for 25 minutes

### UV CURE TIME

- 3D Systems LC-3DPrint Box UV Post-Curing Unit: 180 minutes

### POST CURE SYSTEMS

3D Systems LC-3DPrint Box UV Post-Curing Unit was used to get data sheet properties. There are other existing post cure systems for SLA that allow for larger parts such as the Procure 350 and Procure 750. The table below compares mechanical property output.

- Optimal post cure temperature is at 60°C
- The times for each post cure system is 180 minutes for the data in the table below

PROPERTY	ASTM METHOD	LC-3DPRINT BOX	PROCURE 350	PROCURE 750
Max. Part Size	L x W x H	ø 260 x 195 mm	350 x 350 x 350 mm	630 x 1050 x 1050 mm
Tensile Strength Ultimate	ASTM D638 Type IV	32 MPa	30 MPa	29 MPa
Tensile Strength at Yield	ASTM D638 Type IV	25 MPa	19 MPa	22 MPa
Tensile Modulus	ASTM D638 Type IV	1000 MPa	789 MPa	864 MPa
Elongation at Break	ASTM D638 Type IV	80 %	101 %	95 %
Elongation at Yield	ASTM D638 Type IV	7.3 %	9 %	8 %
Flexural Strength	ASTM D790	20 MPa	14 MPa	14 MPa
Flexural Modulus (MPa)	ASTM D790	590 MPa	391 MPa	435 MPa
Izod Notched Impact	ASTM D256	64 J/m	71 J/m	73 J/m
Shore Hardness	ASTM D2240	64 D	62 D	60 D
HDT@0.455 MPa/66 PSI	ASTM D648	42 °C	39 °C	39 °C
HDT@1.82 MPa/264 PSI	ASTM D648	25 °C	25 °C	25 °C