DuraForm® ProX® PA

Nylon/Polypropylene-like

Production-grade nylon 12 plastic provides high performance combination of toughness, heat resistance, chemical, and biocompatibility for end-use applications.

Select Laser Sintering

A DURABLE, TOUGH THERMOPLASTIC WITH BALANCED MECHANICAL PROPERTIES AND FINE-FEATURE SURFACE RESOLUTION

Designed for real world functional testing and low-to mid-volume production runs, DuraForm ProX PA offers a balanced mix of properties including durability, toughness, impact strength, accuracy, and fine-feature surface resolution. DuraForm ProX PA is capable of meeting USP Class VI requirements, and with its white finish is ideal for a range of functional medical device components as well as surgical aids and guides.

DuraForm ProX PA is engineered for long-term environmental stability of mechanical properties, and is tested for up to 8 years indoor and 1.5 years outdoor use, per ASTM methods. Vapor-honed DuraForm ProX PA parts display an enhanced, smooth surface finish, more comparable to injection molded plastic parts. In addition, vapor honing helps to seal the porous surface of SLS parts, making them suitable for air and water tight applications.

APPLICATIONS

- Prototypes that require good durability and strength
- Low to mid volume direct manufacturing of end-use parts
- Medical parts that require USP Class VI compliance or sterilization
- Complex, thin-walled ducts
- Aircraft and motorsports parts
- Enclosures and housings
- Parts with snap-fits and living hinges
- Automotive dashboards, grilles and bumpers

BENEFITS

- Long-term stability of mechanical properties
- Balanced mechanical properties and processability
- Build prototypes that withstand functional testing
- Produce durable end-use parts without tooling
- Create accurate and repeatable parts as demanded by manufacturers
- Machinable and paintable for demonstration parts

FEATURES

- Excellent surface resolution and feature detail
- Easy-to-process
- Good isotropic properties
- Compliant with USP Class VI testing
- Compatible with autoclave sterilization
- Compatible with automotive fluids and chemicals

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

3D SYSTEMS®

MATERIAL PROPERTIES

The full suite of mechanical properties is 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 X-axis.

SOLID MATERIAL						
METRIC	**ASTM METHOD**	**METRIC**	**ENGLISH**	**ISO METHOD**	**METRIC**	**ENGLISH**
PHYSICAL				**PHYSICAL**		
Color		Natural				
Sintered Part Density	ASTM D792	0.95 g/cm^3	0.034 lbs/in^3	ISO 1183	0.95 g/cm^3	0.034 lb/in^3
24 Hour Water Absorption	ASTM D570	0.65 %	0.65 %	ISO 62	0.65%	0.65%
Blend Ratio - % Fresh		40%				
MECHANICAL				**MECHANICAL**		
Tensile Strength Ultimate	ASTM D638 Type I	48 MPa	7000 psi	ISO 37	49 MPa	7100 psi
Tensile Strength at Yield	ASTM D638 Type I	48 MPa	7000 psi	ISO 37	49 MPa	7100 psi
Tensile Modulus	ASTM D638 Type I	2100 MPa	300 ksi	ISO 37	1900 MPa	273 ksi
Elongation at Break	ASTM D638 Type I	19 %	19 %	ISO 37	17 %	17 %
Elongation at Yield	ASTM D638 Type I	13 %	13 %	ISO 37	12.3 %	12.3 %
Flex Strength	ASTM D790	63 MPa	9100 psi	ISO 178	60 MPa	8100 psi
Flex Modulus	ASTM D790	1700 MPa	240 ksi	ISO 178	1700 MPa	244 ksi
Izod Notched Impact	ASTM D256	47 J/m	0.9 ft-lb/in	ISO 180-A	3.7 kJ/m^2	1.8 ft-lb/in^2
Izod Unnotched Impact	ASTM D4812	460 J/m	9 ft-lb/in	ISO 180-U	22 kJ/m^2	1.7 ft-lb/in^2
Shore Hardness	ASTM D2240	74D	74D	ISO 7619	74D	74D
THERMAL				**THERMAL**		
Tg (DMA, E")	ASTM E1640 (E"Peak at 1C/min)	46 °C	115 °F	ISO 6721-1/11 (E" Peak)	46 °C	115 °F
HDT @ 0.455 MPa/66 PSI	ASTM D648	176 °C	349°F	ISO 75- 1/2 B	153°C	308 °F
HDT @ 1.82 MPa/264 PSI	ASTM D648	82 °C	180 °F	ISO 75-1/2 A	58 °C	136°F
CTE -20 to 70°C	ASTM E831	91 ppm/°C	51 ppm/°F	ISO 11359-2	91 ppm/K	51 ppm/°F
CTE 95 to 180°C	ASTM E831	201 ppm/°C	112 ppm/°F	ISO 11359-2	201 ppm/K	112 ppm/°F
Specific Heat Capacity	ASTM E1269	1.55 J/g-°C	0.37 BTU/lb-°F			
Thermal Conductivity	ASTM E1530	0.21 W/m-K	1.46 BTU-in/hr-ft-^{2}°F			
UL Flammability Rating	UL94	HB	HB			
ELECTRICAL				**ELECTRICAL**		
Dielectric Strength (kV/mil) @ 3mm thickness	ASTM D149	15				
Dielectric Constant @ 1kHz	ASTM D150	2.85				
Dissipation Factor @ 1kHz	ASTM D150	0.022				
Volume Resistivity (ohm-cm)	ASTM D257	1.5x10^{15}				
Surface Resistivity (ohm/sq)	ASTM D257	4.7x10^{15}				

ISOTROPIC PROPERTIES

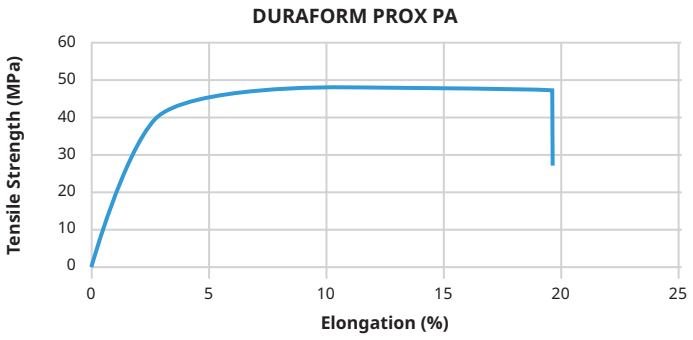
Parts are tested in the XYZ and angled orientations to determine the degree of isotropy within the mechanical properties.

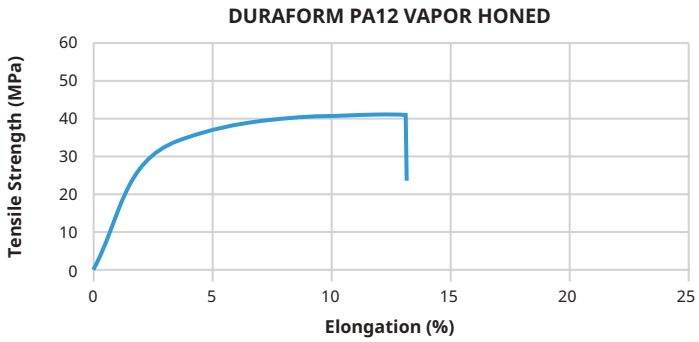
Vapor-honed parts do not need to be oriented to get the highest mechanical properties, further improving the degree of freedom for part orientation for mechanical properties.

DURAFORM PROX PA						DURAFORM PROX PA VAPOR HONED				
	METHOD	METRIC				METHOD	METRIC			
MECHANICAL						MECHANICAL				
		X	Y	Z	Z45		X	Y	Z	Z45
Tensile Strength Ultimate	ASTM D638 Type I	48 MPa	48 MPa	42 MPa	46 MPa	ASTM D638 Type I	41 MPa	35 MPa	46 MPa	47 MPa
Tensile Strength at Yield	ASTM D638 Type I	48 MPa	48 MPa	N/A	N/A	ASTM D638 Type I	41 MPa	34 MPa	46 MPa	47 MPa
Tensile Modulus	ASTM D638 Type I	1900 MPa	2000 MPa	2100 MPa	2000 MPa	ASTM D638 Type I	1500 MPa	1200 MPa	1600 MPa	1800 MPa
Elongation at Break	ASTM D638 Type I	19 %	21 %	5 %	8 %	ASTM D638 Type I	13 %	13 %	14 %	20 %
Elongation at Yield	ASTM D638 Type I	13 %	13 %	N/A	N/A	ASTM D638 Type I	13 %	13 %	14 %	15 %
Flex Strength	ASTM D790	63 MPa	58 MPa	62 MPa	60 MPa	ASTM D790	52 MPa	55 MPa	60 MPa	56 MPa
Flex Modulus	ASTM D790	1700 MPa	1500 MPa	1700 MPa	1600 MPa	ASTM D790	1400 MPa	1500 MPa	1700 MPa	1500 MPa
Izod Notched Impact	ASTM D256	47 J/m	42 J/m	42 J/m	48 J/m	ASTM D256	38 J/m	36 J/m	42 J/m	42 J/m
Shore Hardness	ASTM D2240	74D	74D	75D	N/A	ASTM D2240	73D	73D	73D	74D
24hr Hour Water Absorption	ASTM D570	0.65%	0.65%	0.65%	0.65%	ASTM D570	0.23%	0.23%	0.23%	0.23%

STRESS-STRAIN CURVE

The graph represents the stress-strain curve for DuraForm ProX PA plastic per ASTM D638 testing.



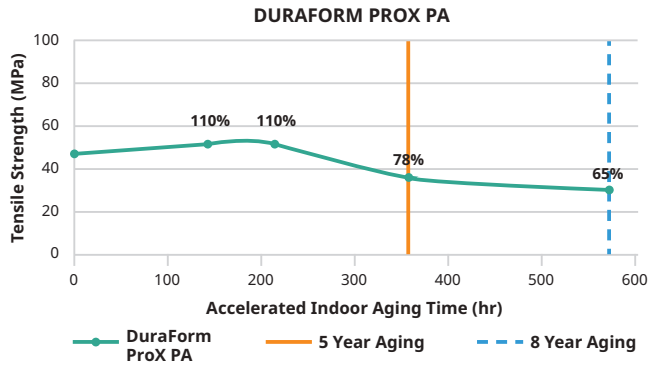


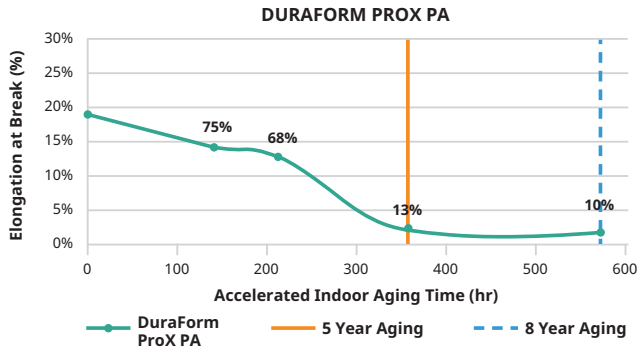
LONG-TERM ENVIRONMENTAL STABILITY

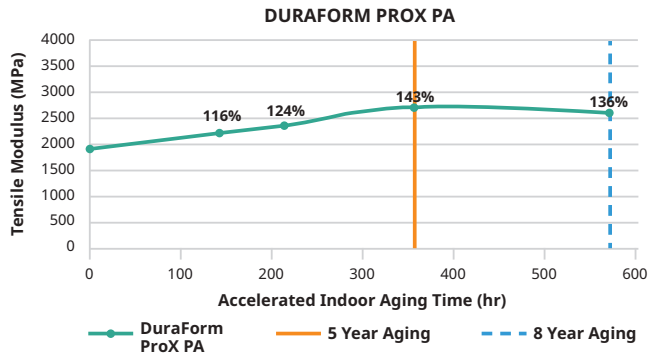
DuraForm ProX PA is engineered to give long-term environmental UV and humidity stability. This means the material is tested for the ability to retain a high percentage of the initial mechanical properties over a given period of time. This provides real design conditions to consider for the application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

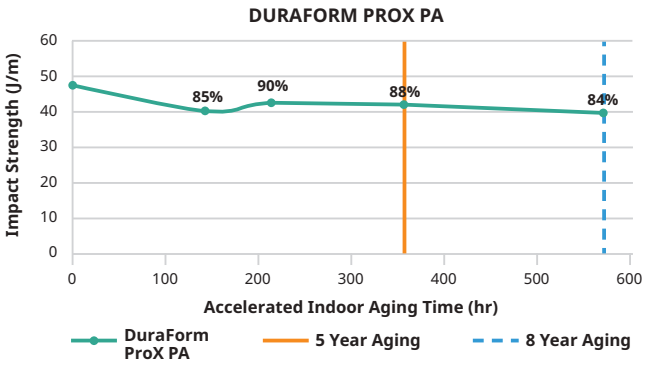
INDOOR STABILITY: Tested per ASTM D4329 standard method.

INDOOR STABILITY

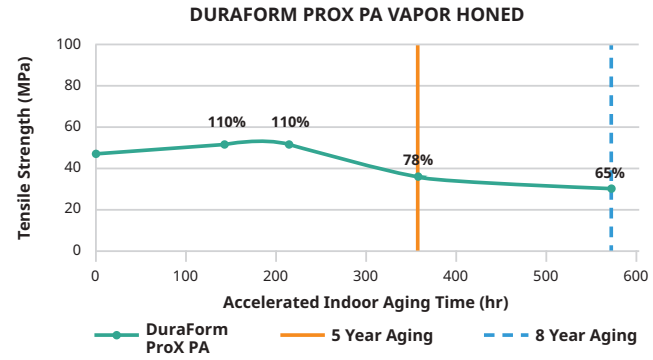


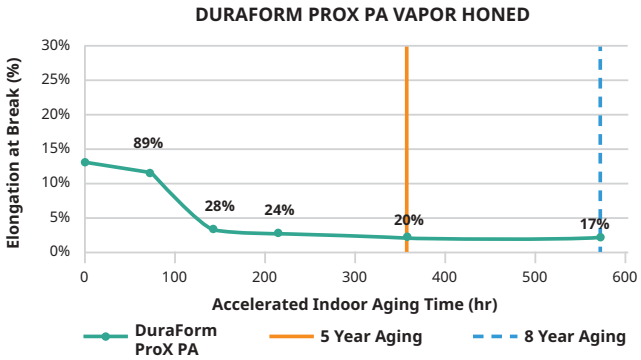


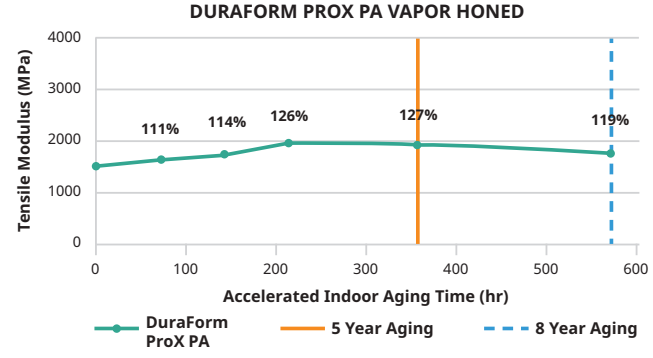


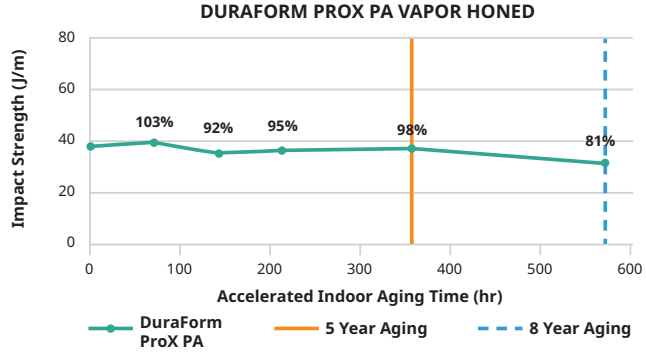


INDOOR STABILITY - VAPOR HONED







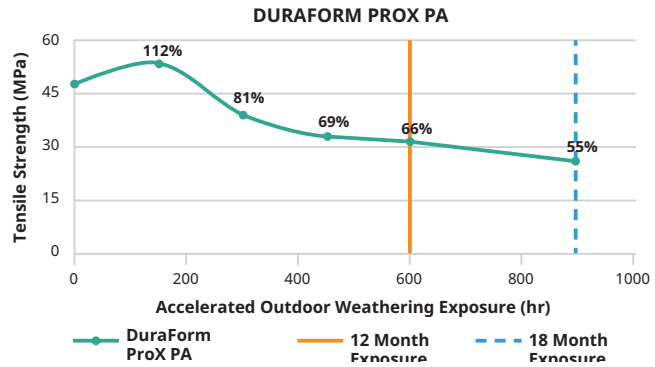


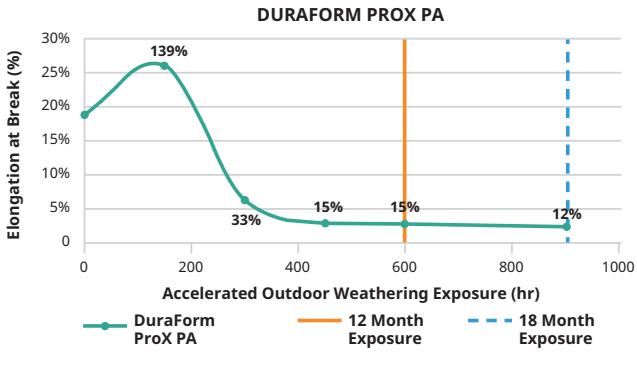
LONG-TERM ENVIRONMENTAL STABILITY

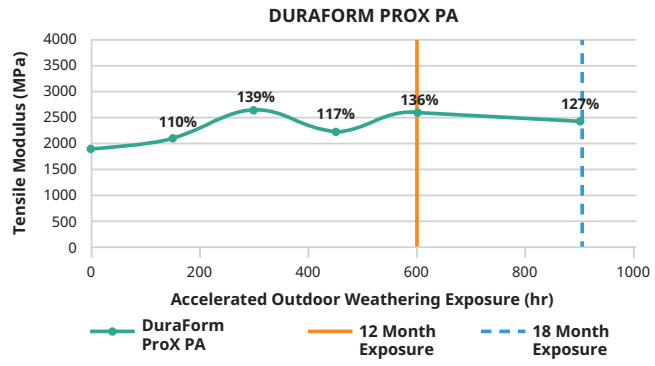
DuraForm ProX PA is engineered to give long-term environmental UV and humidity stability. This means the material is tested for the ability to retain a high percentage of the initial mechanical properties over a given period of time. This provides real design conditions to consider for the application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

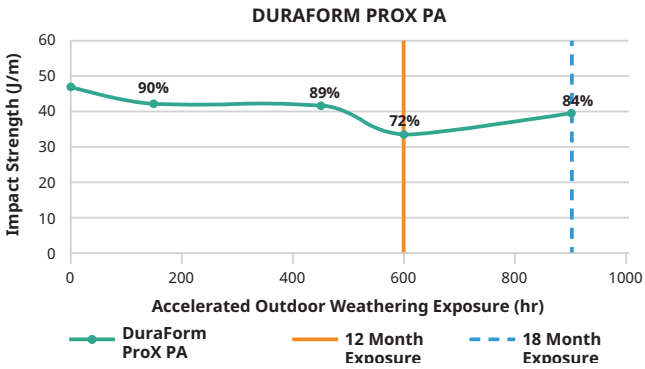
OUTDOOR STABILITY: Tested per ASTM G154 standard method.

OUTDOOR STABILITY









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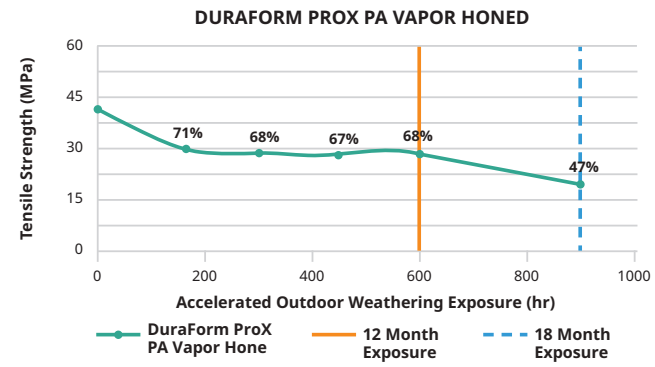
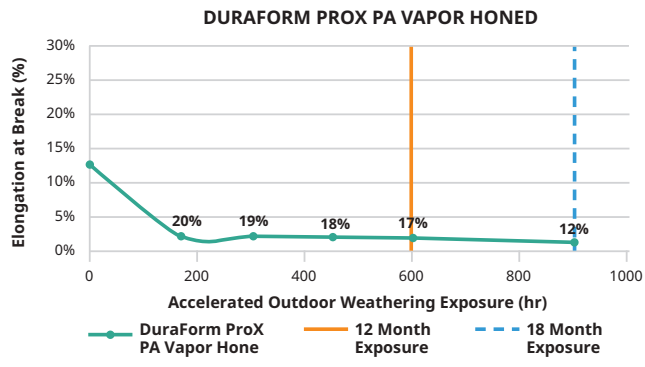
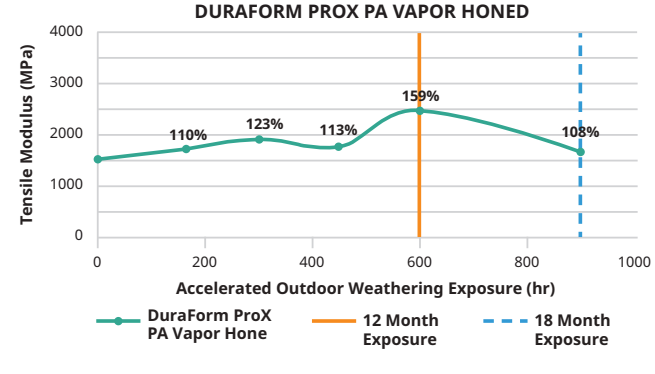
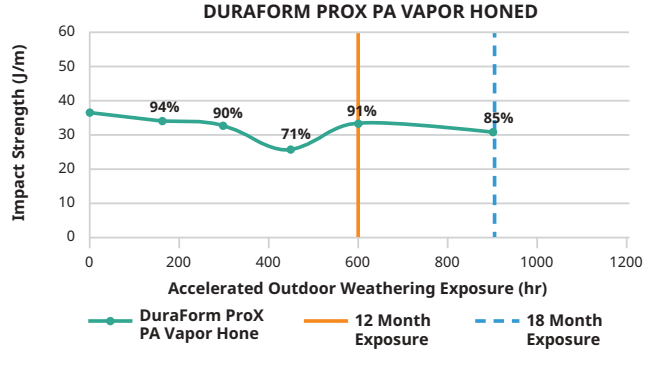








AUTOMOTIVE FLUID COMPATIBILITY

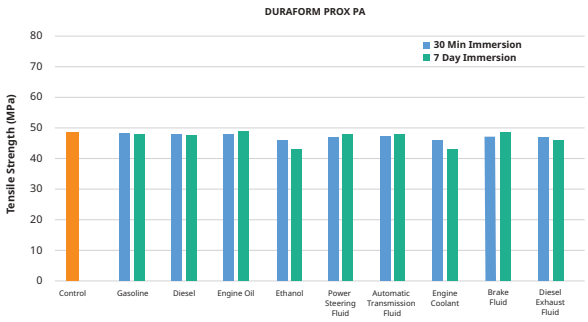
The compatibility of a material with hydrocarbons and cleaning chemicals is critical to part applications. DuraForm ProX PA plastic parts have been tested for sealed and surface contact compatibility per USCAR2 test conditions. The fluids below were tested in two different ways per the specs.

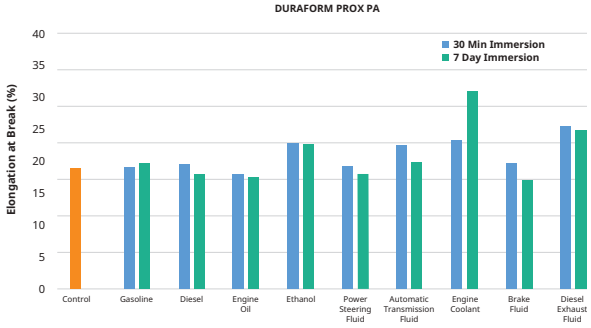
- Immerse for 7-days, then take mechanical property data for comparison.
- Immerse for 30-minutes, remove, and take mechanical property data for comparison in 7-days.

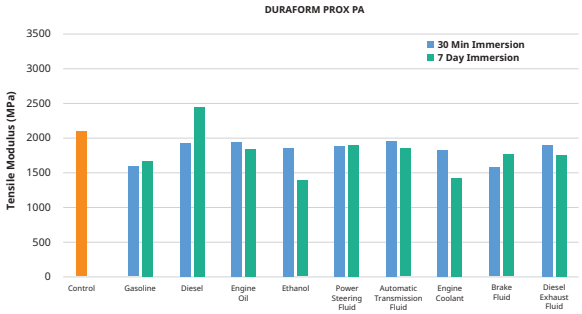
Data reflects the measured value of properties over that period of time.

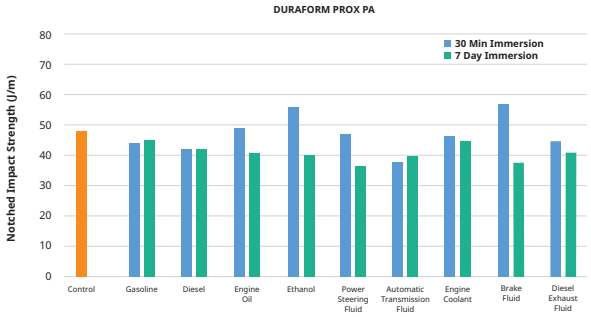
AUTOMOTIVE FLUIDS		
FLUID	**SPECIFICATION**	**TEST TEMP °C**
Gasoline	ISO 1817, liquid C	23 ± 5
Diesel Fuel	905 ISO 1817, Oil No. 3 + 10% p-xylene*	23 ± 5
Engine Oil	ISO 1817, Oil No. 2	50 ± 3
Ethanol	85% Ethanol + 15% ISO 1817 liquid C*	23 ± 5
Power Steering Fluid	ISO 1917, Oil No. 3	50 ± 3
Automative 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

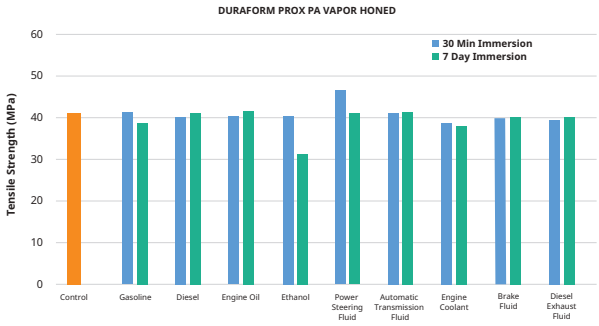


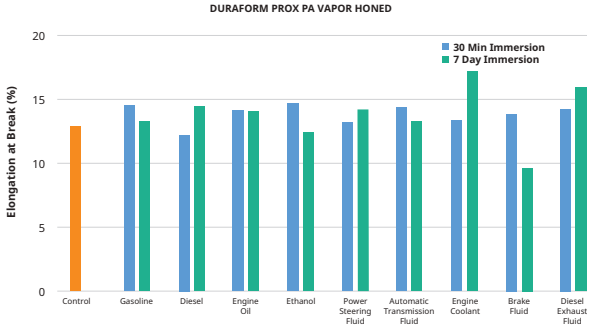


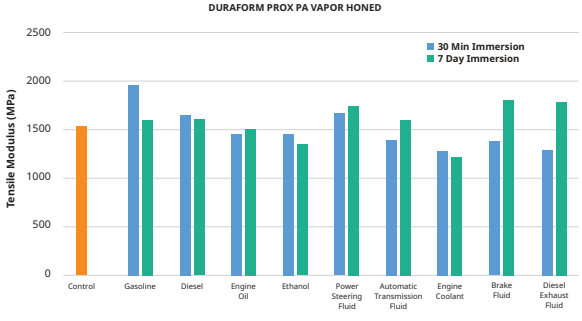


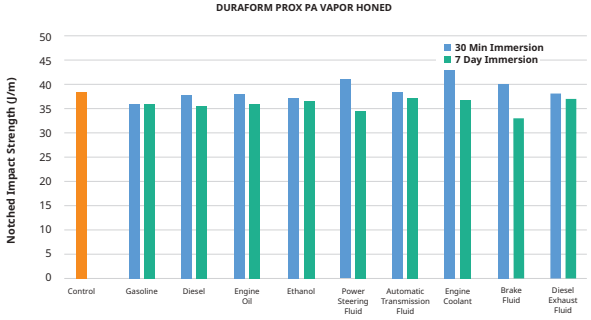


VAPOR HONED









CHEMICAL COMPATIBILITY

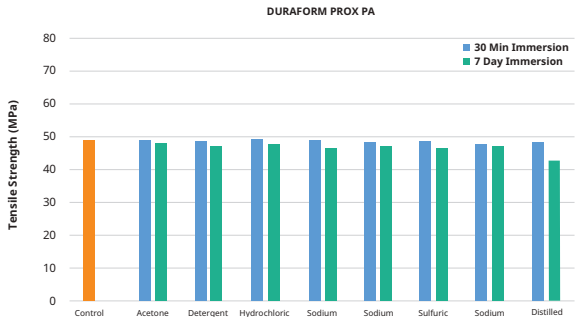
The compatibility of a material with cleaning chemicals is critical to part applications. DuraForm ProX PA parts have been tested for sealed and surface contact compatibility per ASTM D543 test conditions. The fluids below were tested using two different methods per the specs.

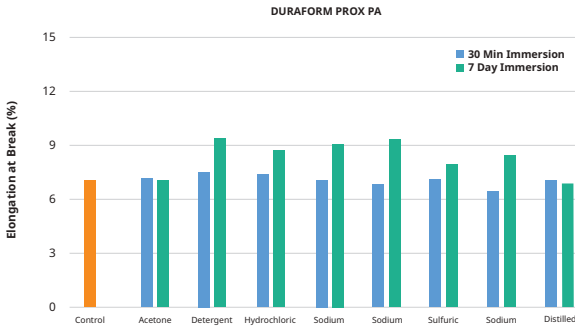
- Immerse for 7-days, then take mechanical property data for comparison.
- Immerse for 30-minutes, remove, and take mechanical property data for comparison in 7-days.

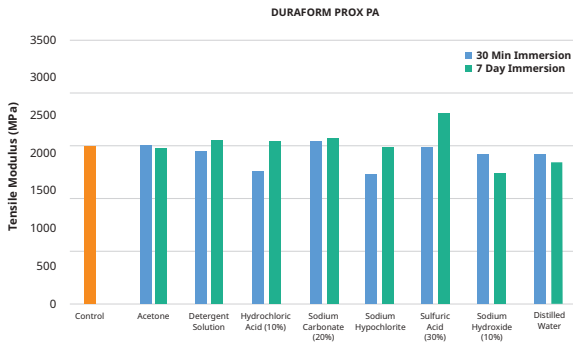
Data reflects the measured value of properties over that period of time.

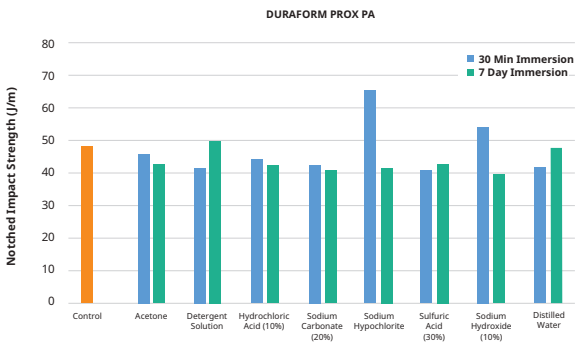
*Denotes materials did not go through 7-day soak conditioning.

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 Solution (10%)
6.3.15 Distilled Water









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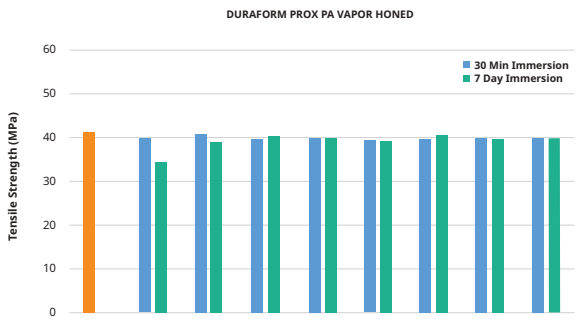

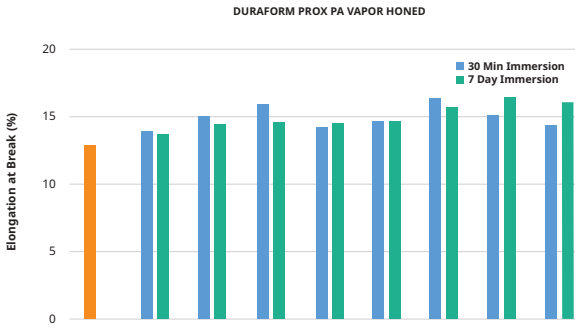

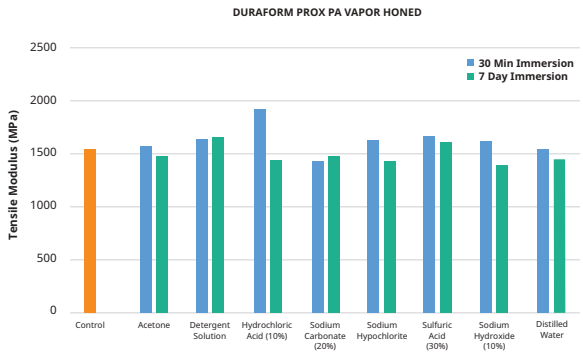

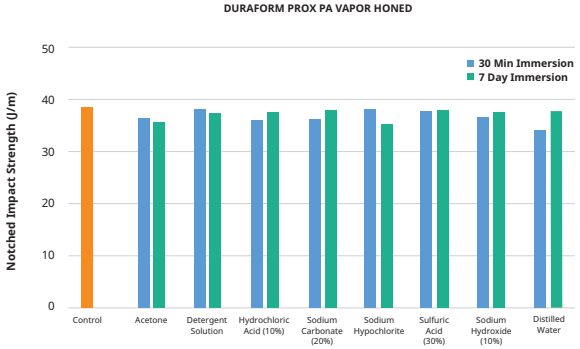

BIOCOMPATIBILITY STATEMENT

DuraForm ProX PA test coupons printed and processed according to the standard methods 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 DuraForm ProX PA has passed the requirements for biocompatibility according to the above tests.

It is the responsibility of each customer to determine that its use of DuraForm ProX PA 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.

Warranty/Disclaimer: The performance characteristics of these products may differ according to variations in printing and post processing conditions, test equipment, product application, operating conditions, or with end use. 3D Systems makes no warranties of any type, express or implied, including, but not limited to, the warranties of merchantability or fitness for a particular use.

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