

# Materials Buyer's Guide

## True Production-Grade Materials for Figure 4

How to Evaluate Additive Manufacturing  
Materials for Production



# Contents

- 3** Introduction
- 8** Production
  - 9** Rigid
  - 11** Durable
  - 13** Rubber
  - 17** High Thermal Resistance
  - 19** Biocompatible
- 24** Indirect Production
  - 25** Molding
  - 26** Casting
- 28** Prototyping
  - 29** Functional Prototyping
  - 30** Prototyping Elastomer
  - 31** Design Verification
- 33** Contact Us
- 34** Appendix



Figure 4® is an ultra-fast projection-based additive manufacturing (AM) technology designed to help users seamlessly transition from prototyping to production.

Available in different configurations that vary in footprint, capacity, and versatility, Figure 4 uses a non-contact membrane to combine accuracy and amazing detail fidelity with fast print speeds. Together with its quick post-processing, Figure 4 is a workhorse solution for a variety of applications across industries, at any stage.

Yet going from prototype to production is a multi-step process. Finding the right approach to move from design verification, to functional prototyping, to end-use parts requires the convergence of multiple variables. Beyond part accuracy, repeatability, and operational costs, suitable materials are paramount.



# What's Different About Figure 4 Production-Grade Materials

A major stigma around AM materials is the belief that they are brittle and only have reliable mechanical properties for short periods of time. These perceptions have posed a hurdle to adoption, and are something the 3D printing industry has struggled with for years.

Now that advancements in part quality, speed, and cost are moving AM technology beyond prototyping and into production, it is necessary for AM materials to level-up as well. To do this, the right material properties, performance, and testing standards are necessary. 3D Systems recognizes this, and we have adapted our approach to material property and performance testing as well as our datasheets for Figure 4 production materials. We are proud to provide our users with comprehensive information in a consistent format to enable you to

effectively evaluate our production additive materials for your specific application(s). To ensure data integrity, all of our Figure 4 production materials data is tested and conditioned per ASTM and ISO requirements.



# Consistent and Comprehensive Testing

Within the Production Materials section of this document, you will find material performance highlights of our Figure 4 production-grade materials. If viewing this document digitally, you will also be able to navigate to the complete material datasheets of any material you are interested in exploring further.

Each Figure 4 production material datasheet provides clear and separate reports on the following measures, as relevant:

- Mechanical, thermal, and electrical properties (including flammability, dielectric properties, and 24-hour water absorption);
- Isotropic properties;
- Long-term indoor and outdoor environmental stability;
- Chemical and automotive fluid compatibility;
- Biocompatibility.



# A Word from Our Materials Development Team

*"It's up to the design engineer to decide how well a given material will work for a given application, that's why our datasheets include all the data we tested, and not just the most impressive results. We want our users to be able to quickly and confidently identify the right choice for their project.*

*When I look at these datasheets, some of the places I look right away are the elongation of yield and the tensile modulus in the long-term environmental stability section. If my elongation is flat, I have not gone brittle. If my tensile modulus is flat, I have not gotten stiff. Heat Deflection Temperature (HDT) is also an important data point to pay attention to and indicates how well a part will withstand heat exposure for things as routine as transportation conditions to more intense aspects of production such as sterilization in an autoclave.*

*We also tested each of our production-grade materials in a range of common build orientations to provide early visibility into the relationship of part orientation to part performance. Our goal in how we tested and documented these materials was to equip design engineers with as much upfront data as possible to help them get the most out of these capabilities. These datasheets are packed with information, because we want to help our users make informed decisions."*

**Martin Johnson**

**Technical Fellow, Materials & Print Process, 3D Systems**

# Mechanical Properties

The full suite of mechanical properties included in our Figure 4 production materials datasheets are given per industry standards such as ASTM and ISO test standards. Additional properties provided include flammability, dielectric properties, and 24-hour water absorption. This allows for better understanding of the material capability to aid in design decisions for each material. All parts are conditioned per ASTM recommended standards for a minimum of 40 hours at 23 °C, 50% RH.

Solid material properties reported reflect printing along the vertical axis (ZY-orientation). Figure 4 material properties are relatively uniform across print orientations, as detailed within each specific section on isotropic properties. Because of this, parts for most materials do not need to be oriented in a particular direction to exhibit these properties.

## **LONG-TERM ENVIRONMENTAL STABILITY**

Material stability has been a big hurdle for AM. To combat conventional expectations, 3D Systems has conducted extensive testing on its Figure 4 production materials to demonstrate stability as far out as eight years from production. Our testing shows we can now produce parts that last.

Indoor stability was tested per the ASTM D4329 standard method; outdoor stability was tested per the ASTM G154 standard method.

## **CHEMICAL AND AUTOMOTIVE FLUID COMPATIBILITY**

Exposure to hydrocarbons and cleaning chemicals is a routine part of many applications. Our Figure 4 production-grade materials were therefore tested for sealed and surface contact compatibility per ASTM D543 test conditions and per USCAR2 test conditions. In addition to the tensile strength (MPa) results included within this document, the full datasheets include data tables for tensile modulus, elongation at break, and notched impact strength.

## **MATERIALS FROM PROTOTYPING TO PRODUCTION**

3D Systems' Figure 4 platform spans the prototyping to production workflow, and our materials portfolio is likewise divided by application. As a comprehensive guide to all of our Figure 4 materials, this document includes all classes of Figure 4 materials, including:

- Production materials for direct production parts (pages 8-16);
- Indirect production materials for multi-stage production processes (pages 23-25);
- Prototyping materials for general purpose prototypes and functional testing (pages 26-29).



# Production



# Figure 4<sup>®</sup> PRO-BLK 10

Long-term indoor & outdoor environmental stability

## PROPERTIES:

-  Exhibits thermoplastic behavior in necking at tensile break point
-  Fast print speed up to 62 mm/hr at 50 micron layer thickness
-  >70 °C heat deflection temperature
-  12% elongation at break
-  Durability and strength
-  UL 94 HB flammability
-  Biocompatible capable per ISO 10993-5 and 10993-10

No secondary thermal cure required; simple, solvent cleaning.

[Get the full datasheet for Figure 4 PRO-BLK 10 here](#)

## GOOD FOR:

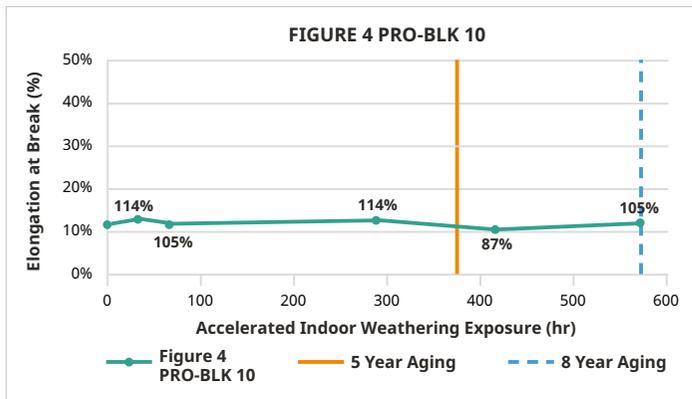
- Alternative to injection molding or cast urethane processes
- Motor housings, connectors, snap-fits
- Other general-use production parts



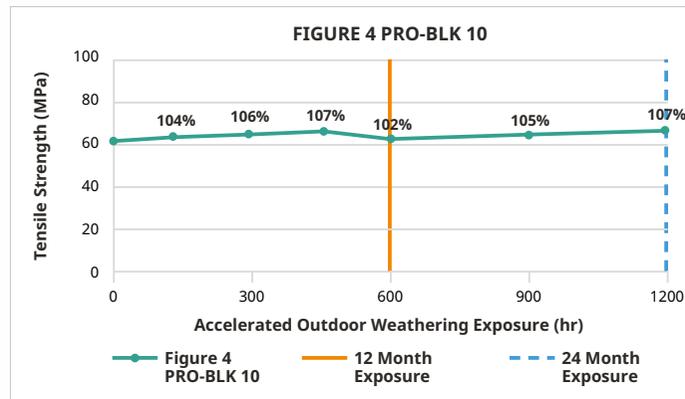
# Figure 4<sup>®</sup> PRO-BLK 10

## Long-term indoor & outdoor environmental stability

Indoor Elongation

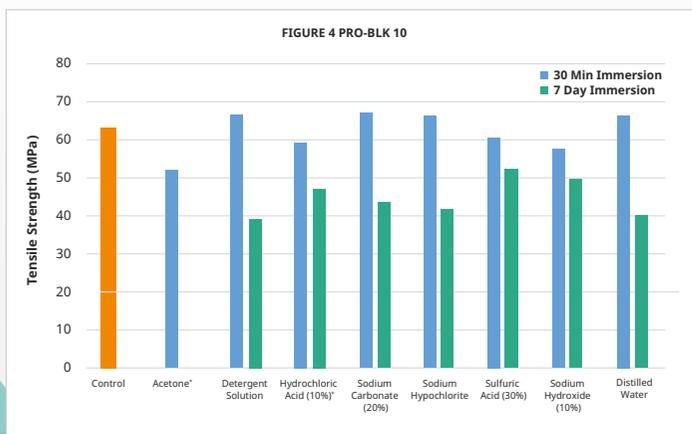


Outdoor Tensile Strength

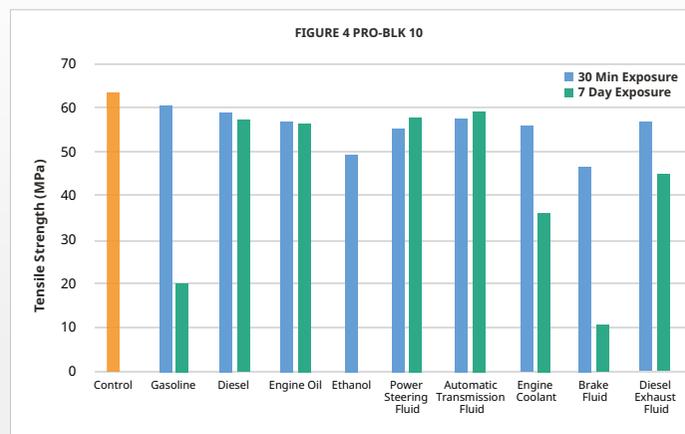


## Chemical and Automotive Fluid Compatibility

Chemical Tensile Strength



Automotive Fluid Tensile Strength



# Figure 4<sup>®</sup> Rigid White

Long-term environmental stability and long-lasting clean opaque white color

## PROPERTIES:

-  Exhibits thermoplastic behavior in necking at tensile break point
-  Fast print speed up to 47 mm/hr at 50 micron layer thickness
-  65 °C heat deflection temperature
-  20% elongation at break
-  Durability and strength
-  UL 94 HB flammability
-  Biocompatible capable per ISO 10993-5 and 10993-10

No secondary thermal cure required; simple, solvent cleaning.

[Get the full datasheet for Figure 4 Rigid White here](#)

## GOOD FOR:

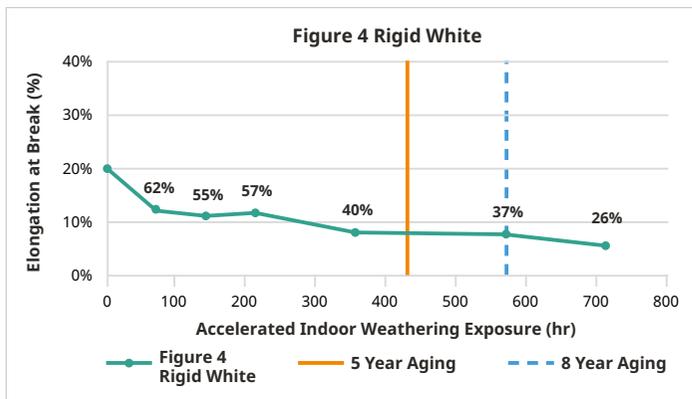
- Handles and fixtures for medical applications that require biocompatibility
- Electronics enclosures and small components or parts for devices
- Motor housings, covers, guards, snap-fit parts, jigs, fixtures and other functional prototypes and low volume production plastic parts



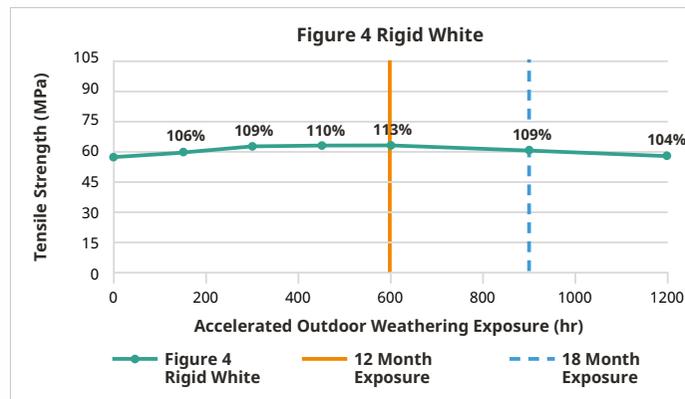
# Figure 4<sup>®</sup> Rigid White

Long-term indoor & outdoor stability and long-lasting clean opaque white color

Indoor Elongation

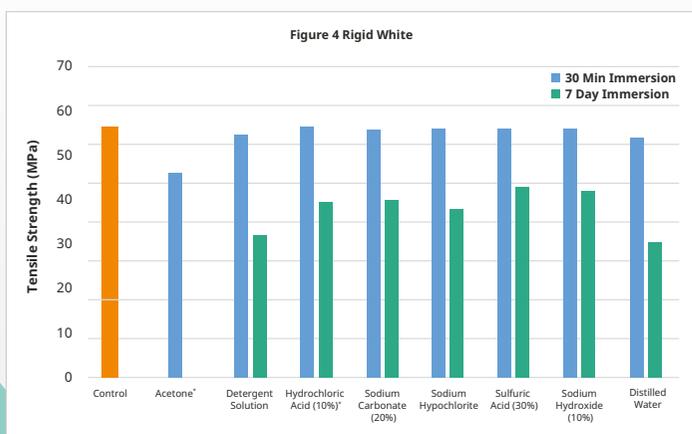


Outdoor Tensile Strength

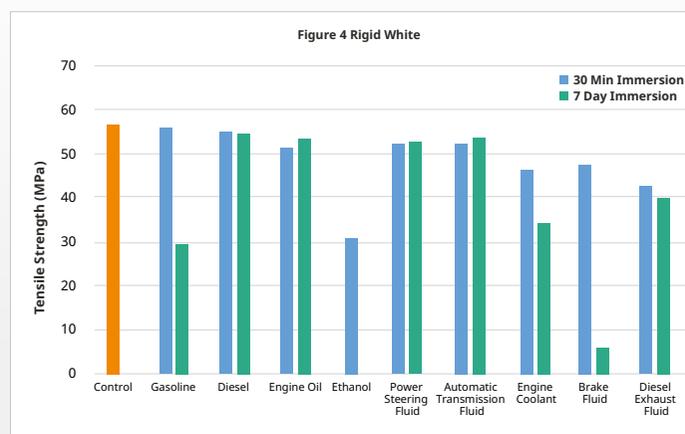


## Chemical and Automotive Fluid Compatibility

Chemical Tensile Strength



Automotive Fluid Tensile Strength



# Figure 4<sup>®</sup> FLEX-BLK 20

Long-term indoor & outdoor environmental stability

## PROPERTIES:

-  76% elongation at break
-  91 J/m notched impact strength
-  UL 94 HB flammability
-  Long-term environmental stability

Fatigue-resistant black plastic with look and feel of production polypropylene.

[Get the full datasheet for Figure 4 FLEX-BLK 20 here](#)

## GOOD FOR:

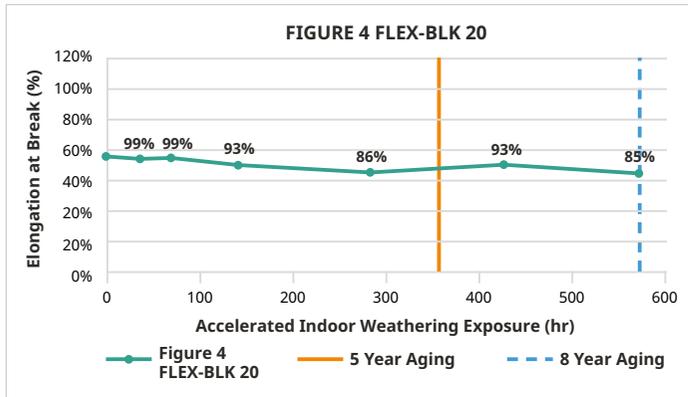
- Housings, brackets, covers, and fixtures
- Functional assemblies and prototypes
- Automotive styling parts
- Consumer goods and electronic components
- Containers and enclosures
- Concept and marketing models



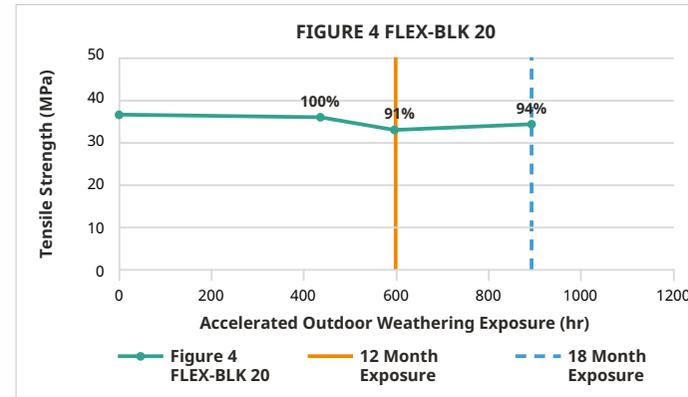
# Figure 4<sup>®</sup> FLEX-BLK 20

Long-term indoor & outdoor environmental stability

Indoor Elongation

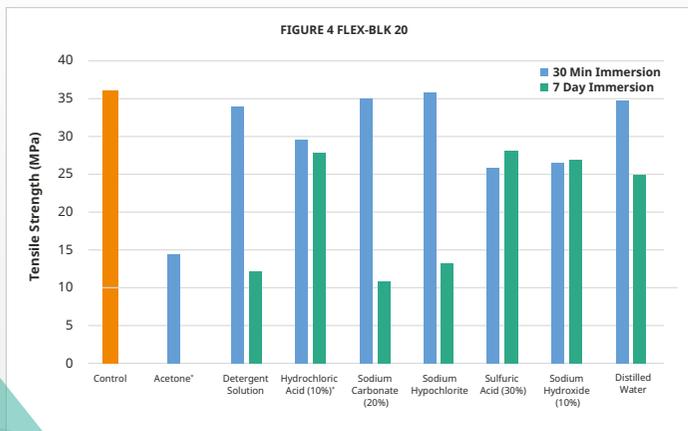


Outdoor Tensile Strength

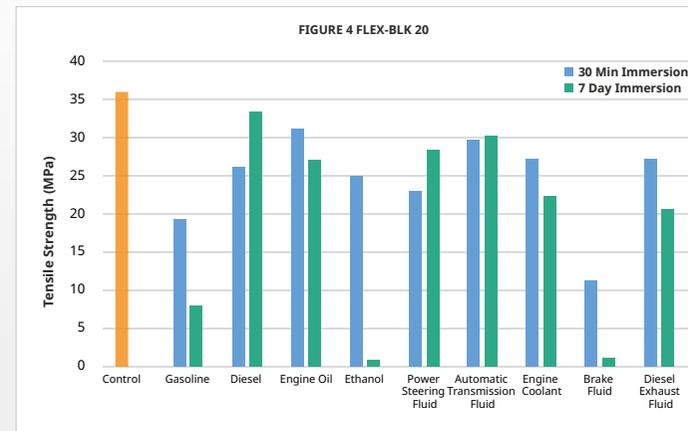


## Chemical and Automotive Fluid Compatibility

Chemical Tensile Strength



Automotive Fluid Tensile Strength



# Figure 4<sup>®</sup> RUBBER-65A BLK

Long-term environmental stability + high elongation at break

## PROPERTIES:

-  Shore-A of 65 (medium hard rubber)
-  8.5 kN/m tear strength printed Type-C printed vertically on Z-axis
-  High elongation at break (125% XZ)
-  UL 94 HB flammability
-  Long-term environmental stability
-  Biocompatible capable per ISO 10993-5 and 10993-10

## GOOD FOR:

- Seals and housings
- Vibration dampeners and pipe spacers
- Air/dust gaskets
- Bumpers
- Grips and handles



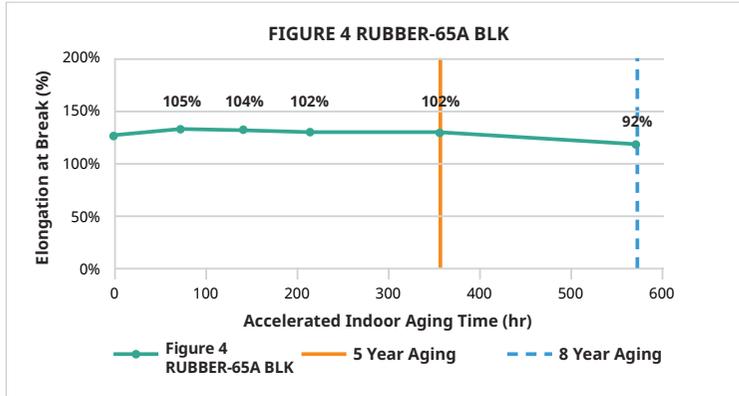
Engineered for long-term environmental stability.

[Get the full datasheet for Figure 4 RUBBER-65A BLK here](#)

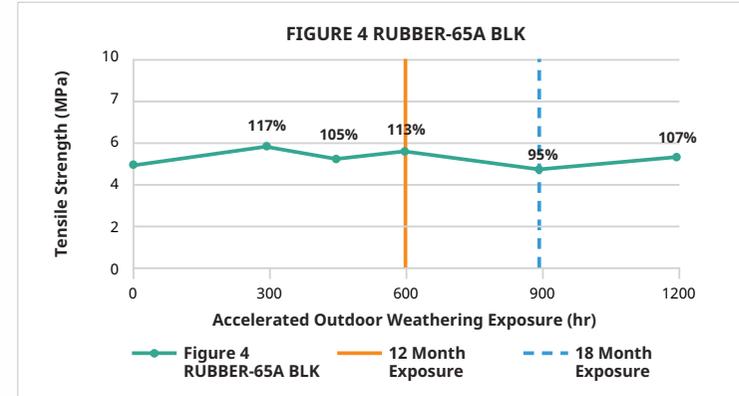
# Figure 4<sup>®</sup> RUBBER-65A BLK

Long-term environmental stability + high elongation at break

Indoor Stability

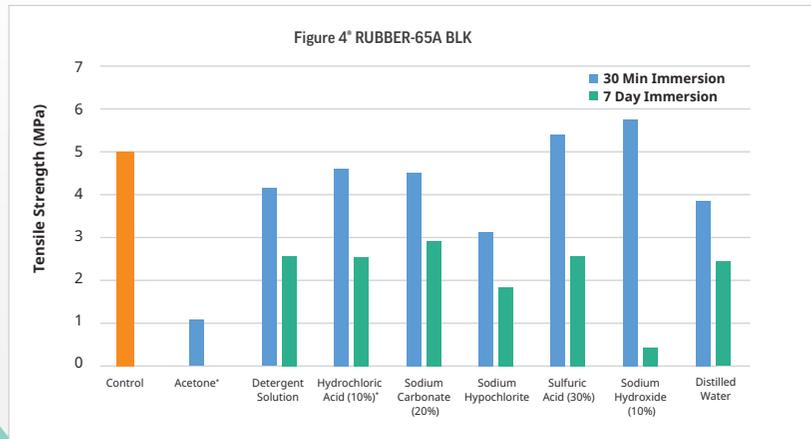


Outdoor Stability

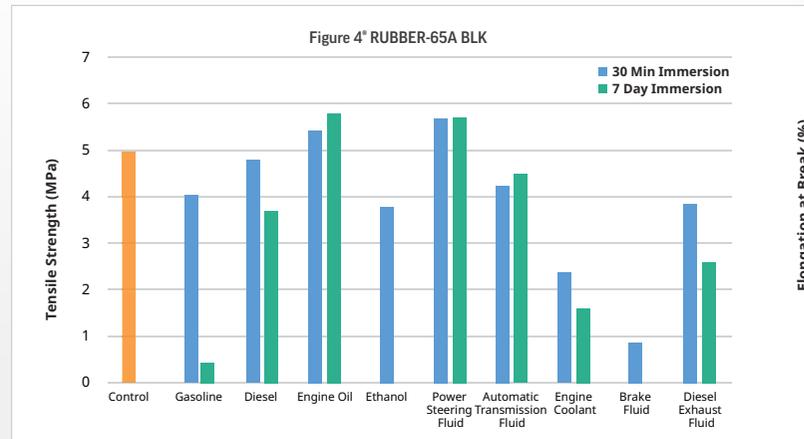


## Chemical and Automotive Fluid Compatibility

Chemical compatibility - tensile strength



Automotive fluid compatibility - tensile strength



# Figure 4<sup>®</sup> RUBBER-BLK 10

Long-term environmental stability + high tear strength

## PROPERTIES:

-  Shore hardness of 59D and 97A
-  125 J/m notch impact
-  76 kN/n tear strength printed Type-C
-  Long-term environmental stability
-  Biocompatible capable per ISO 10993-5 and 10993-10

Engineered for long-term environmental stability.

[Get the full datasheet for Figure 4 RUBBER-BLK 10 here](#)

## GOOD FOR:

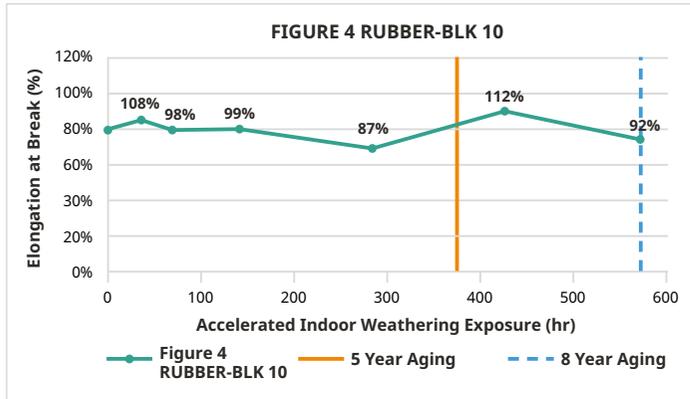
- Strain relief applications
- Couplings and overmoldings
- Slow-rebound, hard-rubber touch applications, such as grips, handles, bumpers, etc.



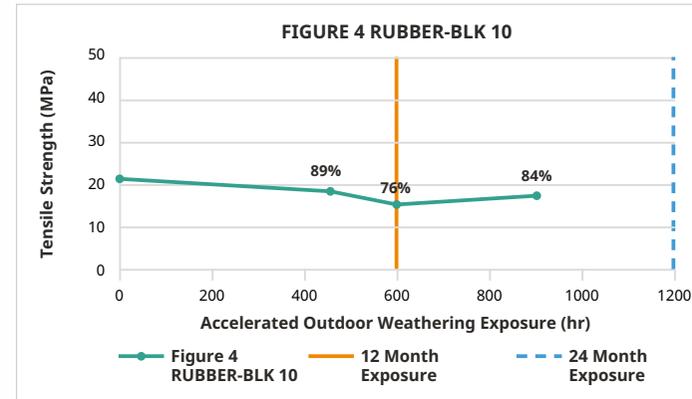
# Figure 4<sup>®</sup> RUBBER-BLK 10

Long-term environmental stability + high tear strength

Indoor Elongation

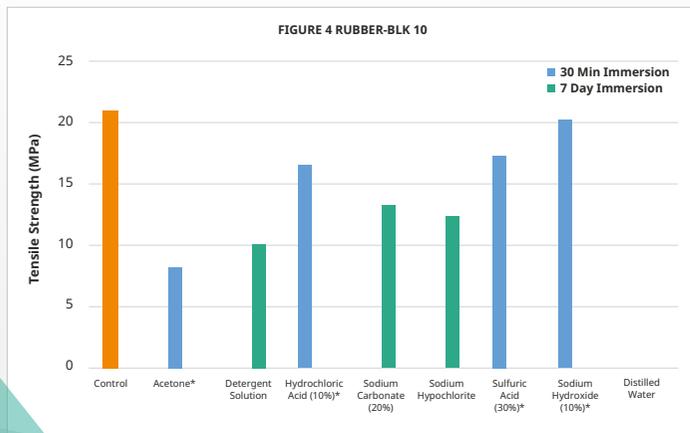


Outdoor Tensile Strength

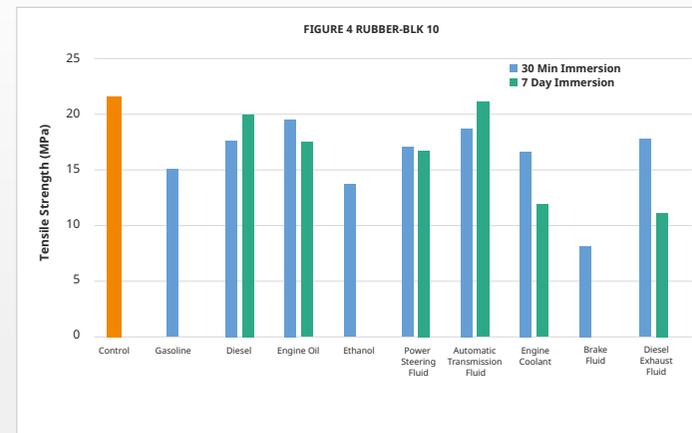


## Chemical and Automotive Fluid Compatibility

Chemical Tensile Strength



Automotive Fluid Tensile Strength



# Figure 4<sup>®</sup> HI TEMP 300-AMB

Rigid plastic for ultra-high heat environments

## PROPERTIES:

-  >300 °C heat deflection temperature at 0.455 and 1.82 MPa
-  High tensile modulus (4000MPa)
-  10J/m notched impact strength
-  Rigid and translucent

## GOOD FOR:

- HVAC, consumer appliances, motor enclosures, and other test or end-use components requiring high heat resistance
- Low pressure molding/tooling
- Overmolding

No secondary thermal cure required; excellent visualization for internal features and fluid flow performance.

[Get the full datasheet for Figure 4 HI TEMP 300-AMB here](#)

Additional materials with high thermal resistance:

[Figure 4 MED-AMB 10](#) >

[Figure 4 MED-WHT 10](#) >



# Figure 4<sup>®</sup> HI TEMP 300-AMB

Rigid plastic for ultra-high heat environments

## Liquid Material

LIQUID PROPERTIES			
MEASUREMENT	CONDITION	METRIC	
Viscosity	@ 25 °C (77 °F)	1725 cps	4170 lb/ft-hr
Color		Amber	
Liquid Density	@ 25 °C (77 °F)	1.19 g/cm <sup>3</sup>	
Package Volume		1 kg bottle - Figure 4 Standalone 2.5 kg cartridge - Figure 4 Modular 10 kg container - Figure 4 Production	
Layer Thickness (Standard Mode)		0.05 mm	
Vertical Build Speed (Standard Mode Draft Mode)		36 mm/hr 40 mm/hr	

## Post-Cured Material

MECHANICAL PROPERTIES			
MEASUREMENT	CONDITION	METRIC	U.S.
Solid Density (g/cm <sup>3</sup>   lb/in <sup>3</sup> )	ASTM D792	1.3	0.047
Tensile Strength, Ultimate (MPa   PSI)	ASTM D638	81	11750
Tensile Modulus (MPa   KSI)	ASTM D638	4000	580
Elongation at Break	ASTM D638	2.6%	
Flexural Strength (MPa   PSI)	ASTM D790	140	20305
Flexural Modulus (MPa   KSI)	ASTM D790	4260	618
Notched Izod Impact Strength (J/m   Ft-lbs/in)	ASTM D256	10	0.2
Unnotched Izod Impact Strength (J/m   Ft-lbs/in)	ASTM D4812	138	2.6
Heat Deflection Temperature @ 0.455 MPa (66 PSI) @ 1.82 MPa (264 PSI)	ASTM D648	>300 °C > 300 °C	>570 °F > 570 °F
Coefficient of Thermal Expansion (CTE) (ppm/°C   ppm/°F) 0-100 °C 150-250 °C	ASTM E831	62 54	34 30
Hardness, Shore	ASTM D2240	89D	
Water Absorption (24 hour)	ASTM D570	0.36%	

# Figure 4<sup>®</sup> MED-AMB 10

Long term indoor and outdoor environmental stability

## PROPERTIES:

-  Biocompatible capable per ISO 10993-5 and 10993-10
-  > 100 °C heat deflection temperature
-  110 °C HDT at 0.455MPa for MED-AMB 10
-  High tensile modulus
-  2800 MPa for MED-AMB 10
-  Long-term stability
-  Autoclavable

## GOOD FOR:

- Surgical handles and surgical tooling
- General medical applications requiring biocompatibility, sterilization, and/or thermal resistance
- Parts requiring rigidity with high temperature resistance
- Parts with high definition details

Figure 4 MED-AMB 10 is a rigid, translucent amber material that can be used for visualization and fluid flow models. It offers excellent feature resolution and high definition parts for medical and industrial applications. It can be sterilized and tested at high temperatures.

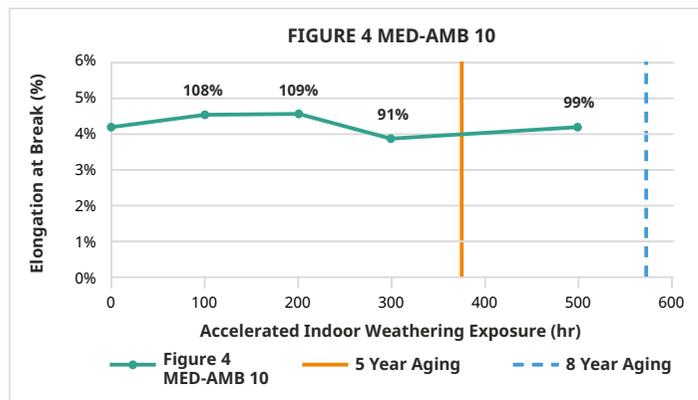
[Get the full datasheet for Figure 4 MED-AMB 10 here](#)



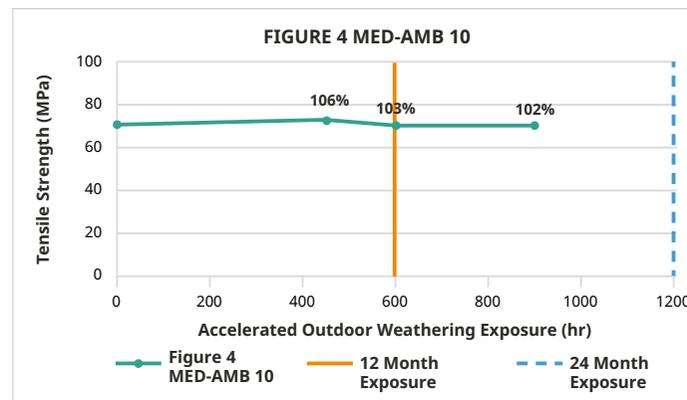
# Figure 4<sup>®</sup> MED-AMB 10

Long term indoor and outdoor environmental stability

Indoor Elongation

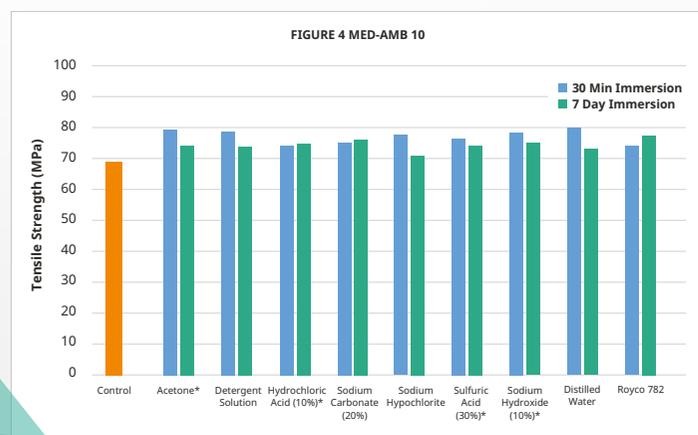


Outdoor Tensile Strength

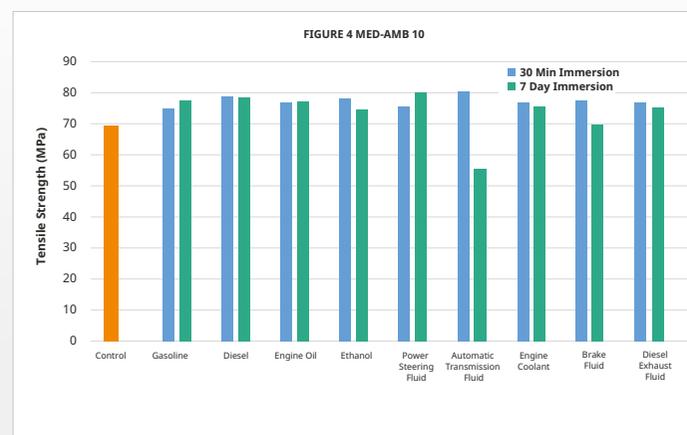


## Chemical and Automotive Fluid Compatibility

Chemical Tensile Strength



Automotive Fluid Tensile Strength



# Figure 4<sup>®</sup> MED-WHT 10

## Long term indoor environmental stability

### PROPERTIES:

-  Biocompatible capable per ISO 10993-5 and 10993-10
-  > 100 °C heat deflection temperature
-  102 °C HDT at 0.455MPa for MED-WHT 10
-  High tensile modulus
-  3000 MPa for MED-WHT 10
-  Long-term stability
-  Autoclavable

### GOOD FOR:

- Surgical handles and surgical tooling
- General medical applications requiring biocompatibility, sterilization, and/or thermal resistance
- Parts requiring rigidity with high temperature resistance
- Parts with high definition details

**Figure 4 MED-WHT 10 is a rigid white material. It offers excellent feature resolution and high definition parts for medical and industrial applications. It can be sterilized and tested at high temperatures.**

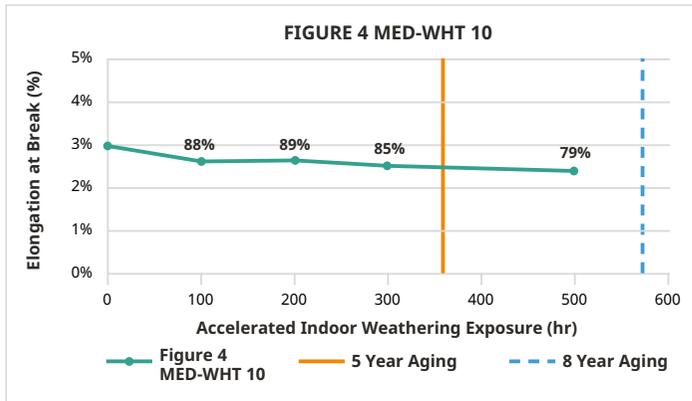
[Get the full datasheet for Figure 4 MED-WHT 10 here](#)



# Figure 4<sup>®</sup> MED-WHT 10

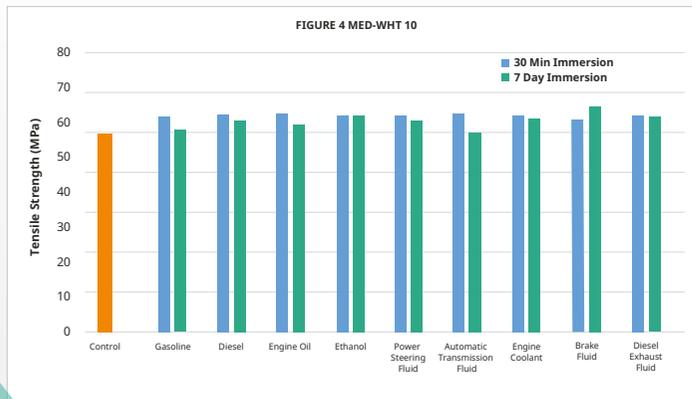
Long term indoor environmental stability

Indoor Elongation

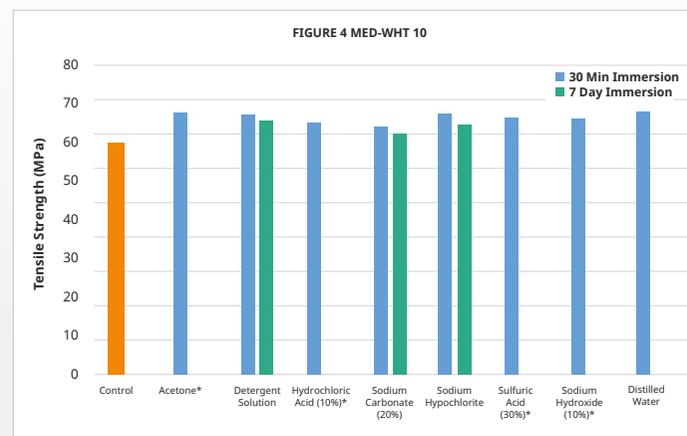


## Chemical and Automotive Fluid Compatibility

Chemical Tensile Strength



Automotive Fluid Tensile Strength



# Biocompatibility Statement

Test coupons of 3D Systems Figure 4 production-grade materials identified as biocompatible capable were printed and processed according to the post-processing instructions found within each relevant datasheet and 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). Materials deemed biocompatible capable reflect materials with test results that passed the requirements for biocompatibility according to the tests listed.

It is the responsibility of each customer to determine that its use of Figure 4 production-grade materials is safe, lawful, and technically suitable to the intended application(s). 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.

Additional Figure 4 production materials that meet biocompatibility standards include:

**Figure 4 PRO-BLK 10** >

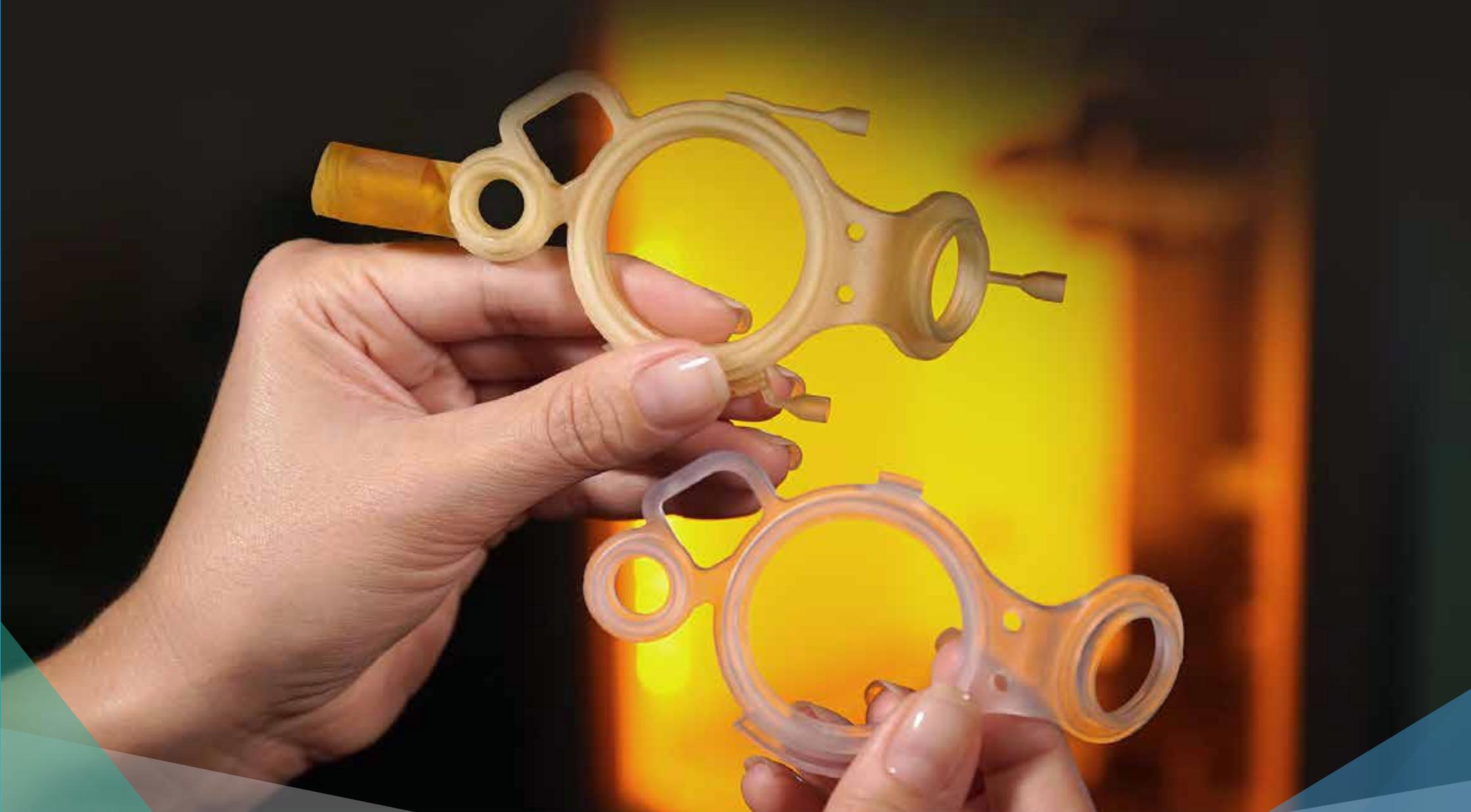
**Figure 4 Rigid White** >

**Figure 4 RUBBER-65A BLK** >

**Figure 4 RUBBER-BLK 10** >



# Indirect Production



# Figure 4<sup>®</sup> EGGSHELL-AMB 10

Process-optimized for silicone casting

## PROPERTIES:

-  High tensile modulus (2800 MPa)
-  90 °C heat deflection temperature at 0.455 MPa
-  5% elongation at break

Specifically engineered to withstand liquid silicone injection at high temperature and pressure, with intentional brittleness to easily break away from silicone once the mold has been filled and cooled. Its amber color allows for visualization of the injected silicone.

[Get the full datasheet for Figure 4 EGGSHELL-AMB 10 here](#)

## GOOD FOR:

- Casting silicone parts in multiple durometers
- Customized end-use and low volume production parts in silicone



# Figure 4<sup>®</sup> JCAST-GRN 10

Clean burnout for direct jewelry casting

## PROPERTIES:

-  High contrast green color
-  High detail and feature resolution
-  Suitable for a range of precious metals

## GOOD FOR:

- Master patterns for gypsum investment casting
- Highly detailed models for design verification, customer samples, etc.

[Get the full datasheet for Figure 4 JCAST-GRN 10 here](#)



# Figure 4<sup>®</sup> JEWEL MASTER GRY

Versatile high contrast gray resin

## PROPERTIES:

-  High heat deflection temperature (up to 300 °C) compatible with a range of silicones
-  Stunning surface finish and excellent print quality available in 30 µm and 50 µm build styles
-  High contrast gray color shows fine details
-  Meets biocompatibility standard ISO 10933-5 for cytotoxicity

## GOOD FOR:

- High definition master patterns for silicone and RTV molds
- Extended try-ons and fit tests
- Snap-fit and stone-in-place testing
- Design and functional prototyping

[Get the full datasheet for Figure 4 JEWEL-MASTER GRY here](#)





# Prototyping



## Figure 4<sup>®</sup> TOUGH-BLK 20, Figure 4<sup>®</sup> FLEX-BLK 10, Figure 4<sup>®</sup> TOUGH-GRY 15

### PROPERTIES:

 Tough and durable

### GOOD FOR:

High performance design and functional prototyping

Specific properties vary by material



**FIGURE 4 TOUGH-BLK 20**

Figure 4 TOUGH-BLK 20 is a rigid black plastic with industry-leading long-term environmental stability and excellent humidity and moisture resistance.

[Get the full datasheet for Figure 4 TOUGH-BLK 20 here](#)



**FIGURE 4 FLEX-BLK 10**

Figure 4 FLEX-BLK 10 is a black plastic with rigid and flexible snap-back characteristics for polypropylene-like performance.

[Get the full datasheet for Figure 4 FLEX-BLK 10 here](#)



**FIGURE 4 TOUGH-GRY 15**

Figure 4 TOUGH-GRY 15 is an economical material for the production of rigid gray parts.

[Get the full datasheet for Figure 4 TOUGH-GRY 15 here](#)

# Figure 4<sup>®</sup> ELAST-BLK 10

Excellent compressive characteristics

## PROPERTIES:

-  Medium softness/stiffness
-  High elongation at break
-  Excellent shape recovery

## GOOD FOR:

Design verification, validation and testing of:

- Hoses
- Tubes
- Weatherstripping
- Seals
- Grommets
- Gaskets
- Spacers, and other vibration dampening components

Accelerate the design and iteration of new concepts with rubber-like functional prototypes for industrial and consumer goods applications.

[Get the full datasheet for Figure 4 ELAST-BLK 10 here](#)



# Figure 4<sup>®</sup> TOUGH-GRY 10

High speed printing

## PROPERTIES:

 Print speeds up to 100 mm/hr

 25% elongation at break

## GOOD FOR:

- Rapid design iteration
- Strong functional parts, including snap fits
- Master patterns for RTV molding or other uses

Ready for painting or plating, this dark gray plastic material is extremely stable, including under high humidity conditions, and offers exceptionally fast print speeds to advance product development.

[Get the full datasheet for Figure 4 TOUGH-GRY 10 here](#)



# Get Figure 4 Parts On Demand

Trial Figure 4 for your application with 3D Systems' On Demand services. 3D Systems' technologies, processes, tools, and expertise are available across global facilities to help you quickly translate your designs into manufactured parts.

3D Systems On Demand offers a range of rigid, durable, rubber, high temperature resistant and biocompatible Figure 4 materials.

[Get in touch with our On Demand team to get started](#)



# What's Next?

Interested in finding the right Figure 4 solution for your application?

**FIGURE 4 EGGSHELL-AMB 10**

**FIGURE 4 ELAST-BLK 10**

**FIGURE 4 FLEX-BLK 20**

**FIGURE 4 FLEX-BLK 10**

**FIGURE 4 HI TEMP 300-AMB**

**FIGURE 4 JCAST-GRN 10**

**FIGURE 4 JEWEL MASTER GRY**

**FIGURE 4 MED-AMB 10**

**FIGURE 4 MED-WHT 10**

**FIGURE 4 PRO-BLK 10**

**FIGURE 4 Rigid White**

**FIGURE 4 RUBBER-BLK 10**

**FIGURE 4 RUBBER-65A BLK**

**FIGURE 4 TOUGH-BLK 20**

**FIGURE 4 TOUGH-GRY 10**

**FIGURE 4 TOUGH-GRY 15**

Talk to an expert about which materials and printers would work for you

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# Appendix A

## Material and Printer Compatibility

Material	Certified Printers
Figure 4 EGGSHELL-AMB 10	S   M   P
Figure 4 ELAST-BLK 10	S   M   P
Figure 4 FLEX-BLK 10	S   M   P
Figure 4 FLEX-BLK 20	S   M   P
Figure 4 HI TEMP 300-AMB	S   M   P
Figure 4 JCAST-GRN 10	S     P   J
Figure 4 JEWEL MASTER GRY	S       J
Figure 4 MED-AMB 10	S   M   P
Figure 4 MED-WHT 10	S
Figure 4 PRO-BLK 10	S   M   P
Figure 4 Rigid White	S   M   P
Figure 4 RUBBER-BLK 10	S   M   P
Figure 4 RUBBER-65A BLK	S   M   P
Figure 4 TOUGH-BLK 20	S   M   P
Figure 4 TOUGH-GRY 10	S   M   P
Figure 4 TOUGH-GRY 15	S   M   P

**S = Figure 4® Standalone**  
**M = Figure 4® Modular**  
**P = Figure 4® Production**  
**J = Figure 4® Jewelry**

# Appendix B

## Materials by Application

Concept and Draft	Design/ Functionality	Medical/ HI TEMP	Direct Production	Indirect Production
<p><b>TOUGH-GRY 10</b></p> 	<p><b>TOUGH-BLK 20</b></p> 	<p><b>HI TEMP 300 AMB</b></p> 	<p><b>PRO-BLK 10</b></p> 	<p><b>EGGSHELL-AMB 10</b></p> 
<p><b>TOUGH-GRY 15</b></p> 	<p><b>ELAST-BLK 10</b></p> 	<p><b>MED-AMB 10</b></p> 	<p><b>Rigid White</b></p> 	<p><b>JCAST-GRN 10</b></p> 
	<p><b>FLEX-BLK 10</b></p> 	<p><b>MED-WHT 10</b></p> 	<p><b>RUBBER-65A BLK</b></p> 	<p><b>JEWEL MASTER GRY</b></p> 
			<p><b>RUBBER-BLK 10</b></p> 	
			<p><b>FLEX-BLK 20</b></p> 	