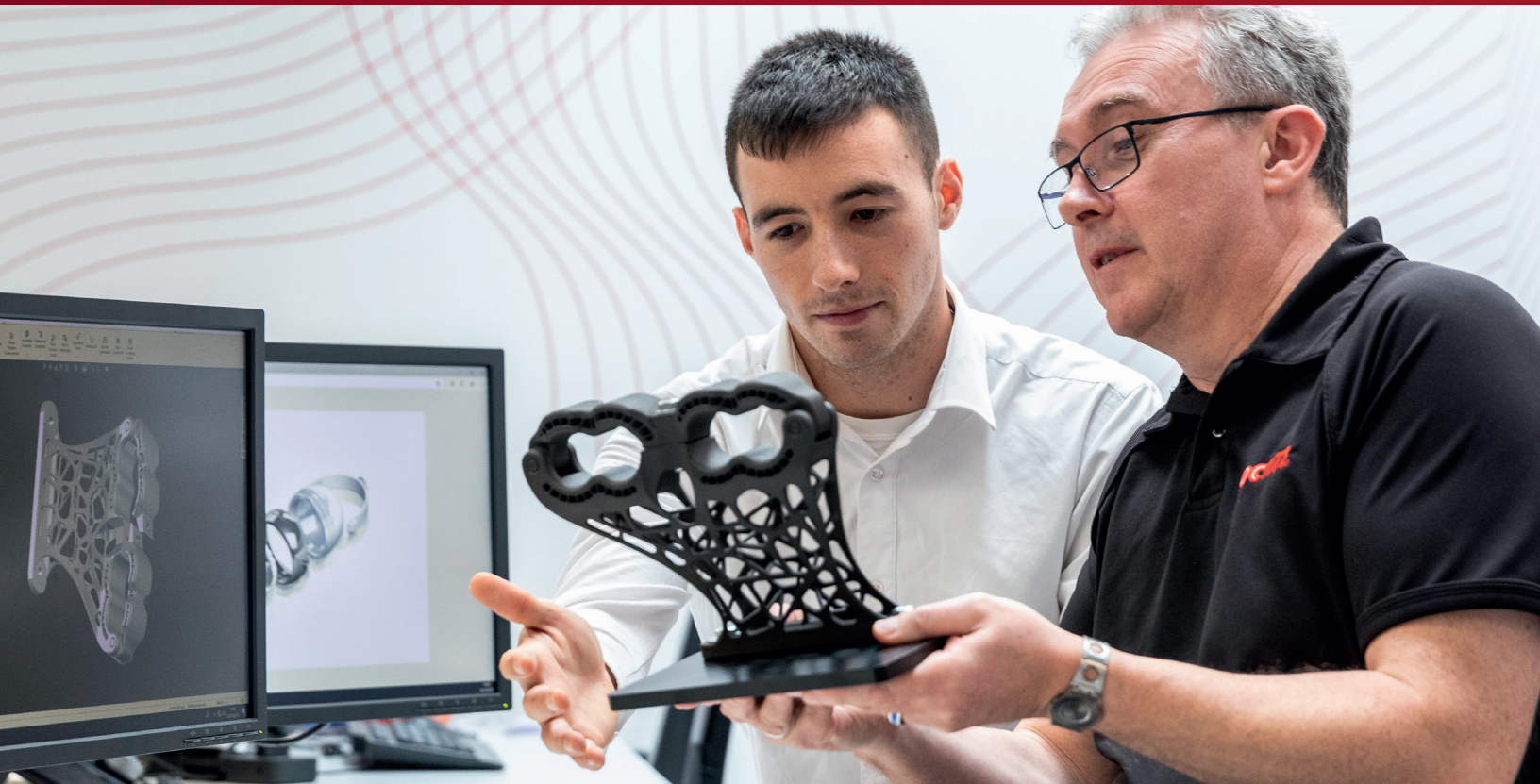


LOCTITE®

ih R.S. HUGHES

MATERIAL SOLUTION GUIDE FOR ADDITIVE MANUFACTURING

Henkel

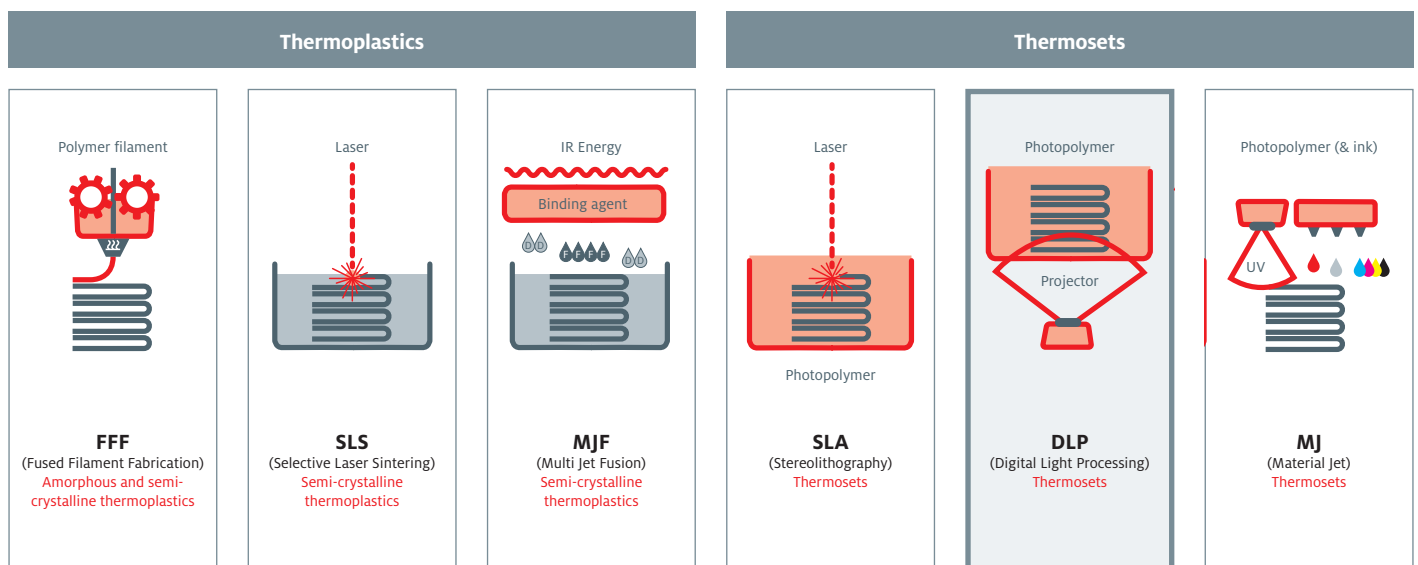


Current 3D printers and materials have limitations on parts performance. The small range of material options in the market prevents manufacturers from leveraging 3D printing for final parts production.

LOCTITE introduces a broad range of engineering materials for DLP printing to cover multiple industrial applications, for customers who want to produce final parts for Transportation, Aerospace, Consumer, Medical and / or General Manufacturing.

Overview of different additive manufacturing methods for polymer 3D printing

LOCTITE offers a broad material portfolio for DLP printing



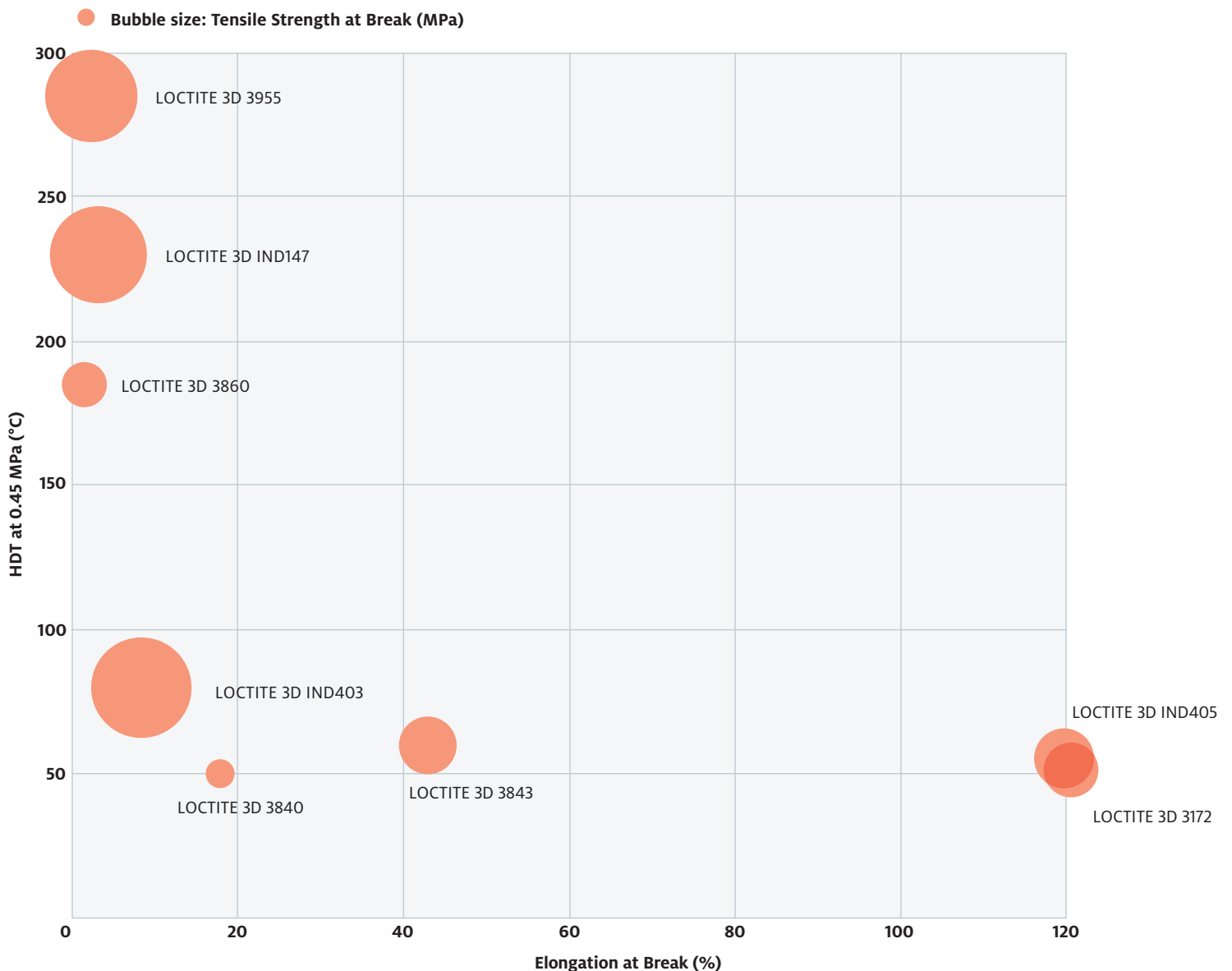
Why Digital Light Processing (DLP) is the right technology for you?

DLP printing has numerous advantages compared to other additive manufacturing technologies:

- High resolution and great surface finish
- Broad range of high-performance materials available from LOCTITE
- Easy, fast and less expensive installation process (1 – 2 days) vs. other powder bed fusion systems
- Faster print speed than SLA
- Excellent isotropic properties
- Less infrastructure costs, less maintenance and lower energy consumption
- Easy and convenient change over for managing multiple materials, with the same equipment

A broad range of materials to meet your industrial requirements across multiple applications

Learn more about LOCTITE Engineering resins, customised for DLP production processes



Selecting the right material

1 Process consideration?

- Which technology are you using?
- Required part size
- Needed surface finish
- Level of accuracy
- Which SLA or DLP printer did you choose?

2 End use of the part?

- Current solution and issues
- What is the application type? (industrial / medical etc.)
- To which environment will the part be exposed?
- What is the reference material? (PP / ABS / rubber)
- Needs temperature resistance
- Needs impact resistance
- Stiffness / elongation requirements
- Physical properties (appearance / hardness / scratch resistance etc.)

3 Special considerations?

- Flame and Smoke Toxicity (FST)
- Medical approval (skin contact, biocompatibility)
- Environmental durability (long term aging resistance)
 - Media resistance
 - UV aging
 - Thermal aging
- End to end cycle time
- Cost considerations

Application case example – the right material choice

Adhesive Fixture for Bonding Assembly: Weight, lead time and cost reduction needed
Solution: Design optimization and LOCTITE 3D 3172 HDT50 High Impact

1 Process consideration?

- Existing DLP printer
- Medium part size
- High surface finish and precision required
- Material needs to be validated on existing printer

2 End use of the part?

- Current issue: heavy aluminium part with long lead times
- Fixture required for adhesive bonding in assembly line
- Parts used at room temperature and managed directly by operators
- High stiffness and impact resistance needed

3 Special considerations?

- No FST or medical approval needed
- Parts need to be durable and delivered fast
- Costs need to be competitive vs. aluminium milling



1. Requirements
High Impact Resistance



2. Design optimization
Light and ergonomic



3. Fully optimised
Printed with LOCTITE 3D 3172 HDT50 High Impact

- > 50% cost reduction
- > 83% material reduction
- > Same functionality, more ergonomic
- > From 2 weeks to 5 hours production

LOCTITE Product Selector Overview^{1,2}

		PRODUCT	COLOUR	PACKAGING	HDT ⁴ @ 0.455 MPa	TENSILE STRENGTH AT BREAK	ELONGATION AT BREAK	TENSILE MODULUS	FLEXURAL MODULUS	IZOD IMPACT	HARDNESS, SHORE A / SHORE D	IDEAL FOR	INDUSTRIES	PAGE			
ASTM				1 kg bottle, 5 kg jerry can, *metal can	ASTM D648	ASTM D638 (D412 ⁵)	ASTM D638 (D412 ⁵)	ASTM D638	ASTM D790	ASTM D256	ASTM D2240						
Photoplastic		General Purpose Resins			3818	Black	1 kg	N/A	60 MPa	5.1%	2,300 MPa	2,384 MPa	N/A	N/A	Functional Prototyping	Industry	6
		General Purpose Resins			3840	Black, White, Grey	1 kg	50°C	25 MPa	18%	1,100 MPa	900 MPa	30 J/m	70 D	Fixtures, Functional Prototyping, Anatomical Models	Industry	6
		General Purpose Resins			3820	Clear	1 kg	N/A	23 MPa	36%	680 MPa	N/A	34 J/m	60 D	Lighting, Functional Prototyping, Secondary Lightning Lenses	Industry, Automotive	7
		High Impact Resins			3172	Grey	1 kg	51°C	47.5 MPa	121%	1,280 MPa	1,150 MPa	73 J/m	63 D	Tooling, Manufacturing Aids, Housings, Insoles (similar to PP)	Industry, Automotive, Consumer Goods	8
		High Impact Resins			3843	Black, Grey	1 kg, 5 kg	60°C	50 MPa	43%	1,806 MPa	1,780 MPa	54 J/m	67 D	Tooling, Low Temp Molding, Anatomical Models, Insoles (similar to ABS)	Industry, Automotive, Medical, Consumer Goods	8
		High Impact Resins			IND405 ³	Black, Clear	1 kg, 5 kg	53°C	52 MPa	120%	1,378 MPa	1,500 MPa	70 J/m	63 D	Tooling, Manufacturing Aids, Housings, Consumer Products	Industry, Consumer Goods	9
		High Temperature Resistant Resins			3860	Black	1 kg	185°C	39 MPa	1.5%	3,500 MPa	N/A	N/A	80 D	Functional Prototyping, High Temp Application	Industry	10
		High Temperature Resistant Resins			3955	Black	1 kg*, 5 kg*	>250°C	80 MPa	2.5%	3,670 MPa	5,200 MPa	N/A	N/A	Flame and Smoke Toxicity (FST) applications, Connectors, Interiors	Automotive, Transportation, Aerospace, Industry	10
		High Temperature Resistant Resins			IND147 ³	Black	1 kg, 5 kg	230°C	84 MPa	3.2%	3,285 MPa	3,900 MPa	N/A	94 D	Tooling, Molds	Industry	11
		High Temperature Resistant Resins			IND403 ³	Black	1 kg, 5 kg	80°C	87 MPa	8.5%	2,750 MPa	2,900 MPa	27 J/m	80 D	Interior Applications, Molds	Industry, Automotive, Machinery	11
Photoelastic		Elastomeric Resins			8195	Red, Grey	1 kg, 5 kg	N/A	2.3 MPa	70%	4 MPa	N/A	N/A	60 A	Gaskets, Seal, Anatomical Models	Industry, Medical	12
		Elastomeric Resins			5010	Clear, White, Black	1 kg	N/A	4 MPa ⁵	185% ⁵	N/A	N/A	N/A	60 A	Gaskets, Seal, Tubes, Functional Prototyping	Industry, Medical	12
		Elastomeric Resins			5015	Clear, White, Black	1 kg	N/A	8 MPa ⁵	160% ⁵	N/A	N/A	N/A	80 A	Gaskets, Seal, Tubes, Functional Prototyping	Industry, Medical	13
		Elastomeric Resins			IND402 ³	Black	1 kg, 5 kg	N/A	5.6 MPa	230%	42 MPa	N/A	N/A	73 A	Lattices e.g. Mid Soles, Soft Inserts	Consumer Goods	13

¹ For further information please see TDS, contact Technical Service Centre or Customer Service Representative. The physical properties provided in this document are typical results of printed parts and are provided for reference purposes only. ² All data after post-cure. ³ Preliminary test data. ⁴ HDT: Heat Deflection Temperature. ⁵ Test method: D412.

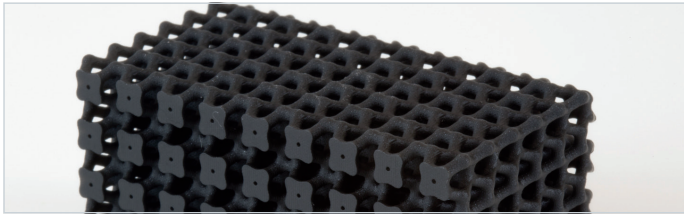
General Purpose Resins

For Functional Prototyping

Accelerate your product development process with rapid prototyping resins that deliver **high accuracy and fine surface details**.

IDEAL FOR

- Functional prototyping
- Jigs & fixtures



LOCTITE 3D 3818 High Accuracy

High resolution & fast printing

Rigid resin ideal for rapid **functional prototyping** that can be printed with high accuracy and fine surface details.

Benefits:

- Exceptional surface finish
- Fast printing capabilities
- Great dimensional stability during post curing



LOCTITE 3D 3840 High Accuracy

Versatile high-resolution printing

Semi-rigid resin that allows to print at high resolution, with great accuracy. Ideal to manufacture functional parts required in customised **fixtures, functional prototyping applications or anatomical models**.

Benefits:

- Easy to print across platforms with high resolution
- Not brittle (semi-flex)
- Low shrinkage
- Short exposure times during printing

PROPERTY ¹	METHOD	3818
Colour	–	Black
Tensile Strength at Break	ASTM D638	60 MPa
Elongation at Break	ASTM D638	5.1%
Tensile Modulus	ASTM D638	2,300 MPa
Flexural Modulus	ASTM D790	2,384 MPa

PROPERTY ¹	METHOD	3840
Colour	–	Black, White & Grey
HDT @ 0.455 MPa	ASTM D648	50°C
Tensile Strength at Break	ASTM D638	25 MPa
Elongation at Break	ASTM D638	18%
Tensile Modulus	ASTM D638	1,100 MPa
Flexural Modulus	ASTM D790	900 MPa
IZOD Impact	ASTM D256	30 J/m
Hardness, Shore D	ASTM D2240	70 D

For further information please see TDS, contact Technical Service Centre or Customer Service Representative.
The physical properties provided in this document are typical results of printed parts and are provided for reference purposes only.

OUR PRODUCTS

- **LOCTITE 3D 3818 High Accuracy**
Rigid resin with 5% elongation
- **LOCTITE 3D 3840 High Accuracy**
Semi-rigid resin with 18% elongation
- **LOCTITE 3D 3820 Ultra Clear**
Semi-rigid resin with up to 90% transparency

PROPERTIES

- Easy & fast to print
- Exceptional surface finish
- Great dimensional stability
- Low shrinkage
- Short exposure times during printing



LOCTITE 3D 3820 Ultra Clear

Semi-rigid resin for transparent components

Non brittle material that achieves obviously clear properties on finished parts without the thorough post processing required by similar resins. It does not yellow and is stable over time. The resin has a unique properties that make it ideal not only for **functional prototyping**, but also for **secondary lighting lens applications**.

Benefits:

- Fantastic clear finish
- Limited post processing required (vs. competition)
- Non brittle, stable

PROPERTY ¹	METHOD	3820
Colour	–	Clear
Tensile Strength at Break	ASTM D638	23 MPa
Elongation at Break	ASTM D638	36%
Tensile Modulus	ASTM D638	680 MPa
IZOD Impact	ASTM D256	34 J/m
Hardness, Shore D	ASTM D2240	60 D
Print Appearance Transparency ²	–	80 – 90%

¹ All data after post-cure in accordance with TDS.

² % value of visible light through a 3D printed object (standard 7.0 mm block).

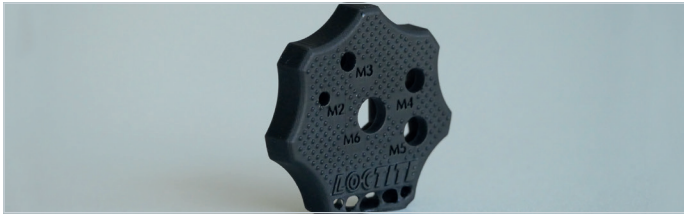
High Impact Resins

Tough Materials for Final Parts Production

Unique high impact resistant 3D printing materials for durable, functional, production parts.

IDEAL FOR

- High impact strength applications
- Tooling and fixtures
- Manufacturing aids
- Low temperature molding
- Insoles
- Final parts



LOCTITE 3D 3172 HDT50 High Impact

Tough high impact for fixtures and tooling

Resin that allows to produce functional parts that require high stiffness with a good surface finish and high impact resistance. Attributes are similar to Polypropylene (PP). This material is resistant to impact stress and is **ideal for tooling applications, manufacturing aids, housings** and consumer applications such as **insoles**.

Benefits:

- Tough
- Superior impact strength
- Durable
- Nice surface finish, good machinery



LOCTITE 3D 3843 HDT60 High Toughness

High impact, semi-flexible resin for tooling

A high-strength engineering plastic with good impact resistance and excellent surface finish. Ideal for a wide variety of tools in the production floor. Attributes are similar to ABS. Applicable for **tooling, low temperature molding, anatomical models** as well as consumer applications such as **insoles**.

Benefits:

- Tough with outstanding surface finish
- Superior strength and impact resistant

PROPERTY¹	METHOD	3172
Colour	–	Grey
HDT @ 0.455 MPa	ASTM D648	51°C
Tensile Strength at Break	ASTM D638	47.5 MPa
Elongation at Break	ASTM D638	121%
Tensile Modulus	ASTM D638	1,280 MPa
Flexural Modulus	ASTM D790	1,150 MPa
IZOD Impact	ASTM D256	73 J/m
Hardness, Shore D	ASTM D2240	63 D

PROPERTY¹	METHOD	3843
Colour	–	Black & Grey
HDT @ 0.455 MPa	ASTM D648	60°C
Tensile Strength at Break	ASTM D638	50 MPa
Elongation at Break	ASTM D638	43%
Tensile Modulus	ASTM D638	1,806 MPa
Flexural Modulus	ASTM D790	1,780 MPa
IZOD Impact	ASTM D256	54 J/m
Hardness, Shore D	ASTM D2240	67 D

For further information please see TDS, contact Technical Service Centre or Customer Service Representative.
The physical properties provided in this document are typical results of printed parts and are provided for reference purposes only.

OUR PRODUCTS

- **LOCTITE 3D 3172 HDT50 High Impact**
Flexible resin with high impact resistance
- **LOCTITE 3D 3843 HDT60 High Toughness**
Semi-flexible resin with high impact resistance and HDT 60°C
- **LOCTITE 3D IND405 HDT50 High Elongation Black – Coming soon**
Flexible resin with high impact resistance, high elongation and HDT 50°C

PROPERTIES

- Printable at room temperature
- Excellent performance and durability vs. other resins in the market
- Printable at high resolution
- Outstanding surface finishing



LOCTITE 3D IND405 HDT50 High Elongation Black

High elongation and tough resin

A high-strength engineering plastic with good impact resistance and excellent surface finish. Ideal for a wide variety of tools in the production floor including **tooling, manufacturing aids, and housings** as well as for **consumer goods**.

Benefits:

- Tough
- Outstanding surface finish
- Superior strength and impact resistant

PROPERTY ¹	METHOD	IND405
Colour	–	Black & Clear
HDT @ 0.455 MPa	ASTM D648	53°C
Tensile Strength at Break	ASTM D638	52 MPa
Elongation at Break	ASTM D638	120%
Tensile Modulus	ASTM D638	1,378 MPa
Flexural Modulus	ASTM D790	1,500 MPa
IZOD Impact	ASTM D256	70 J/m
Hardness, Shore D	ASTM D2240	63 D

¹ All data after post-cure in accordance with TDS.

High Temperature Resistant Resins

Temperature Resistant Materials for Final Parts Production

Unique 3D printing materials for functional production parts that withstands high temperature requirements.

IDEAL FOR

- High temperature applications
- Tooling
- Manufacturing aids
- Molds
- Connectors
- Interiors
- Housings
- Consumer products
- FST* applications



LOCTITE 3D 3860 HDT180 High Heat
Rigid resin with high temperature resistance

Rigid resin that withstands **high temperature stress @ 220°C** (@ 455 MPa). Ideal for **functional prototyping** and **high temperature applications** where high resolution and high HDT is required.

Benefits:

- No deformation, more durable & survives longer vs. other tooling resins in the market
- Easy to print with high print resolution

PROPERTY ¹	METHOD	3860
Colour	–	Black
HDT @ 0.455 MPa	ASTM D648	185°C
Tensile Strength at Break	ASTM D638	39 MPa
Elongation at Break	ASTM D638	1.5%
Tensile Modulus	ASTM D638	3,500 MPa
Hardness, Shore D	ASTM D2240	80 D

For further information please see TDS, contact Technical Service Centre or Customer Service Representative. The physical properties provided in this document are typical results of printed parts and are provided for reference purposes only.



LOCTITE 3D 3955 HDT280 FST*
Flame-retardant photopolymer for production

Rigid resin with **flame retardant properties** that passes flammability 2x10 second Vertical Burn and FST* (AirBus AITM2-0002, AITM2-0007, AITM3-0005) ideal for **FST* applications, connectors** and **interiors** in the industry or automotive, transportation and aerospace.

Benefits:

- Halogen free
- High performance, high modulus with excellent flexural and tensile physical properties
- Extremely high HDT delivers negligible deformation in harsh environments

PROPERTY ¹	METHOD	3955
Colour	–	Black
HDT @ 0.455 MPa	ASTM D648	>250°C
HDT @ 1.82 MPa	ASTM D648	200°C
Tensile Strength at Break	ASTM D638	80 MPa
Elongation at Break	ASTM D638	2.5%
Tensile Modulus	ASTM D638	3,670 MPa
Flexural Modulus	ASTM D790	5,200 MPa
Rating (Flammability)	Internal (2x10 second Vertical Burn)	Pass
Rating (FST*)	AITM2-0002, AITM2-0007, AITM3-0005	Pass

* Flame and Smoke Toxicity (FST)

OUR PRODUCTS

- **LOCTITE 3D 3860 HDT180 High Heat**
Rigid resin with HDT 185°C
- **LOCTITE 3D 3955 HDT280 FST***
Flame-retardant photopolymer for production
- **LOCTITE 3D IND147 HDT230 Tough Natural – Coming soon**
Rigid resin with HDT 230°C
- **LOCTITE 3D IND403 HDT80 High Modulus Black – Coming soon**
Rigid resin with HDT 80°C

PROPERTIES

- Printable at room temperature
- Ideal for tooling and flexible gears where high temperature resistance is required
- Outstanding performance and durability vs. other resins in the market
- Easy to print at high resolution



LOCTITE 3D IND147 HDT230 Tough Natural
High temperature resistant resin with HDT 230 for tooling & molding

Tough resin designed for **tooling** and **molding** applications, due to its high temperature resistance withstanding up to 230°C and high stiffness.

Benefits:

- High heat deflection temperature, HDT 230°C
- Tough with good dimensional stability
- Good surface finish

PROPERTY ¹	METHOD	IND147
Colour	–	Black
HDT @ 0.455 MPa	ASTM D648	230°C
Tensile Strength at Break	ASTM D638	84 MPa
Elongation at Break	ASTM D638	3.2%
Tensile Modulus	ASTM D638	3,285 MPa
Flexural Modulus	ASTM D790	3,900 MPa
Hardness, Shore D	ASTM D2240	94 D



LOCTITE 3D IND403 HDT80 High Modulus Black
High modulus tough resin for high T resistance

Due to its high surface quality, dimensional accuracy and temperature resistance this tough resin is ideal for **interior applications** in automotive and **mold production**.

Benefits:

- High heat deflection temperature, HDT 80°C
- Tough with good dimensional stability
- Good surface finish
- MSDS, and TPB available

PROPERTY ¹	METHOD	IND403
Colour	–	Black
HDT @ 0.455 MPa	ASTM D648	80°C
Tensile Strength at Break	ASTM D638	87 MPa
Elongation at Break	ASTM D638	8.5%
Tensile Modulus	ASTM D638	2,750 MPa
Flexural Modulus	ASTM D790	2,900 MPa
IZOD Impact	ASTM D256	27 J/m
Hardness, Shore D	ASTM D2240	80 D

¹ All data after post-cure in accordance with TDS.

Elastomeric Resins

Elastomeric Materials for Functional Prototyping and Final Parts Production

Unique 3D printing materials for durable, functional, production parts with **elastomeric behaviour**.

IDEAL FOR

- Lattices e.g. mid soles, soft inserts
- Gaskets and seal
- Tubes and fluid management
- Functional prototyping



LOCTITE 3D 8195 A60 High Rebound

Flexible & easy to print

Elastomeric material formulated to have firm compression properties with extremely quick rebound performance to emulate soft rubber material. The material is easy to print and it is recommended for **gaskets, seals** and **anatomical models**.

Benefits:

- Excellent surface finish across various SLA & DLP printer platforms with fast printing
- 1 part elastomeric material
- High resilience / high energy return



LOCTITE 3D 5010 A60 Elastomeric

True elastomeric behaviour

Single component silicone tough elastomer material with little post processing needed to achieve great results. Ideal when true elastomeric properties are needed e.g. for **gaskets, seals, tubes and functional prototyping applications**.

Benefits:

- True elastomeric behaviour
- Stable at temperatures up to +100°C and down to -20°C (better vs. other market option that deteriorate @ T >50°C)
- Good interlayer adhesion
- Low shrinkage

PROPERTY ¹	METHOD	8195
Colour	–	Red & Grey
Tensile Strength at Break	ASTM D638	2.3 MPa
Elongation at Break	ASTM D638	70%
Tensile Modulus	ASTM D638	4 MPa
Hardness, Shore A	ASTM D2240	60 A

PROPERTY ¹	METHOD	5010
Colour	–	Clear, White & Black
Tensile Strength	ASTM D412	4 MPa
Elongation at Break	ASTM D412	185%
Hardness, Shore A	ASTM D2240	60 A

For further information please see TDS, contact Technical Service Centre or Customer Service Representative.
The physical properties provided in this document are typical results of printed parts and are provided for reference purposes only.

OUR PRODUCTS

- **LOCTITE 3D 8195 A60 High Rebound**
Elastomeric resin for functional prototyping
- **LOCTITE 3D 5010 A60 Elastomeric**
Elastomeric resin with Shore A 55
- **LOCTITE 3D 5015 A80 Elastomeric**
Elastomeric resin with Shore A 77
- **LOCTITE 3D IND402 A70 High Rebound Black**
Elastomeric resin with Shore A 70

PROPERTIES

- Printable at room temperature
- True elastomeric behaviour
- Stable -20 to +100°C
- Good interlayer adhesion with low shrinkage
- Outstanding performance and durability



LOCTITE 3D 5015 A80 Elastomeric

True elastomeric behaviour

Single component silicone tough elastomer material with little post processing needed to achieve great results. Ideal when true elastomeric properties are needed e.g. for **gaskets, seals, tubes and functional prototyping applications**.

Benefits:

- True elastomeric behaviour
- Stable at temperatures up to +100°C and down to -20°C (better vs. other market option that deteriorate @ T >50°C)
- Good interlayer adhesion
- Low shrinkage

PROPERTY ¹	METHOD	5015
Colour	–	Clear, White & Black
Tensile Strength	ASTM D412	8 MPa
Elongation at Break	ASTM D412	160%
Hardness, Shore A	ASTM D2240	80 A



LOCTITE 3D IND402 A70 High Rebound Black

High rebound elastomers

Single component elastomer materials with high resilience, that maintaining excellent tensile strength and do not require thermal post processing. Ideal for lattice structures e.g. **mid soles** and **soft inserts**.

Benefits:

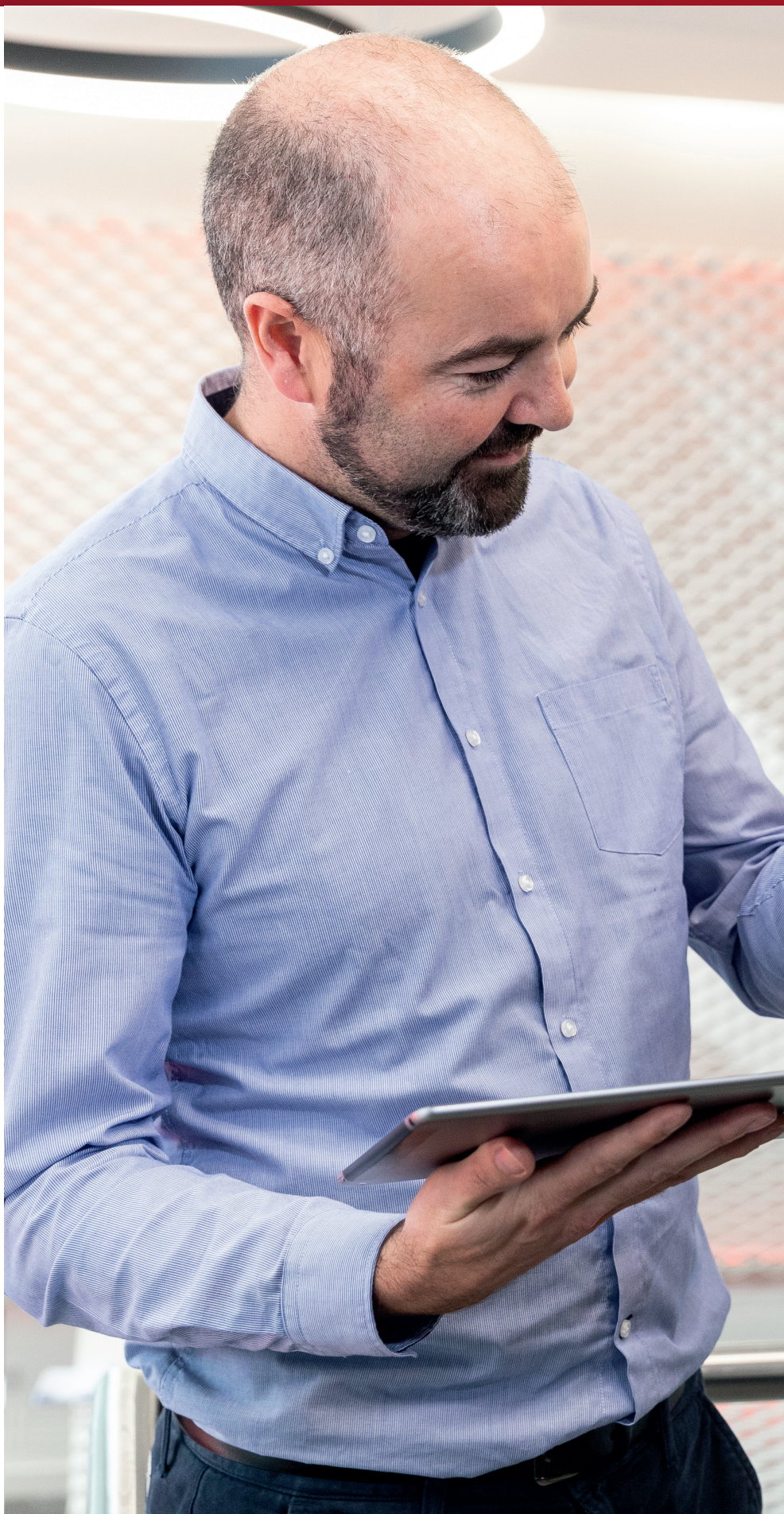
- True elastomeric behaviour
- Excellent interlayer adhesion
- Good rebound performance
- Exceptional durability to compression forces
- Colour matching capabilities

PROPERTY ¹	METHOD	IND402
Colour	–	Black
Tensile Strength	ASTM D638	5.6 MPa
Elongation at Break	ASTM D638	230%
Tensile Modulus	ASTM D638	42 MPa
Energy Return	Internal method	37 J/m
Hardness, Shore A	ASTM D2240	73 A

¹ All data after post-cure in accordance with TDS.

Summary

- Every application has its own needs, and we are here to support your journey towards additive manufacturing at industrial scale
- LOCTITE offers you a broad material portfolio of general purpose, high impact, high temperature resistant and elastomeric resins for a broad range of leading DLP systems
- We work with industry leaders and equipment manufacturers to ensure our materials are validated within a qualified industrial workflow
- LOCTITE materials allow you to produce functional, repeatable and reliable parts





Value for You

Customer Partnership

From design to the final manufacturing process, we provide you with application support and recommendations to meet your needs.

Technology Leadership

Complete product portfolio of high performing resins and industrial manufacturing systems. Ability to tailor solutions to your application.

Industry Know-How

With industry experience, we can help address design and production challenges specific to your industry and provide relevant case studies that deliver benefits.



R.S. Hughes Co., Inc.
<https://www.rshughes.com>
Tel: 877.RSHUGHES
Tel: 877.774.8443