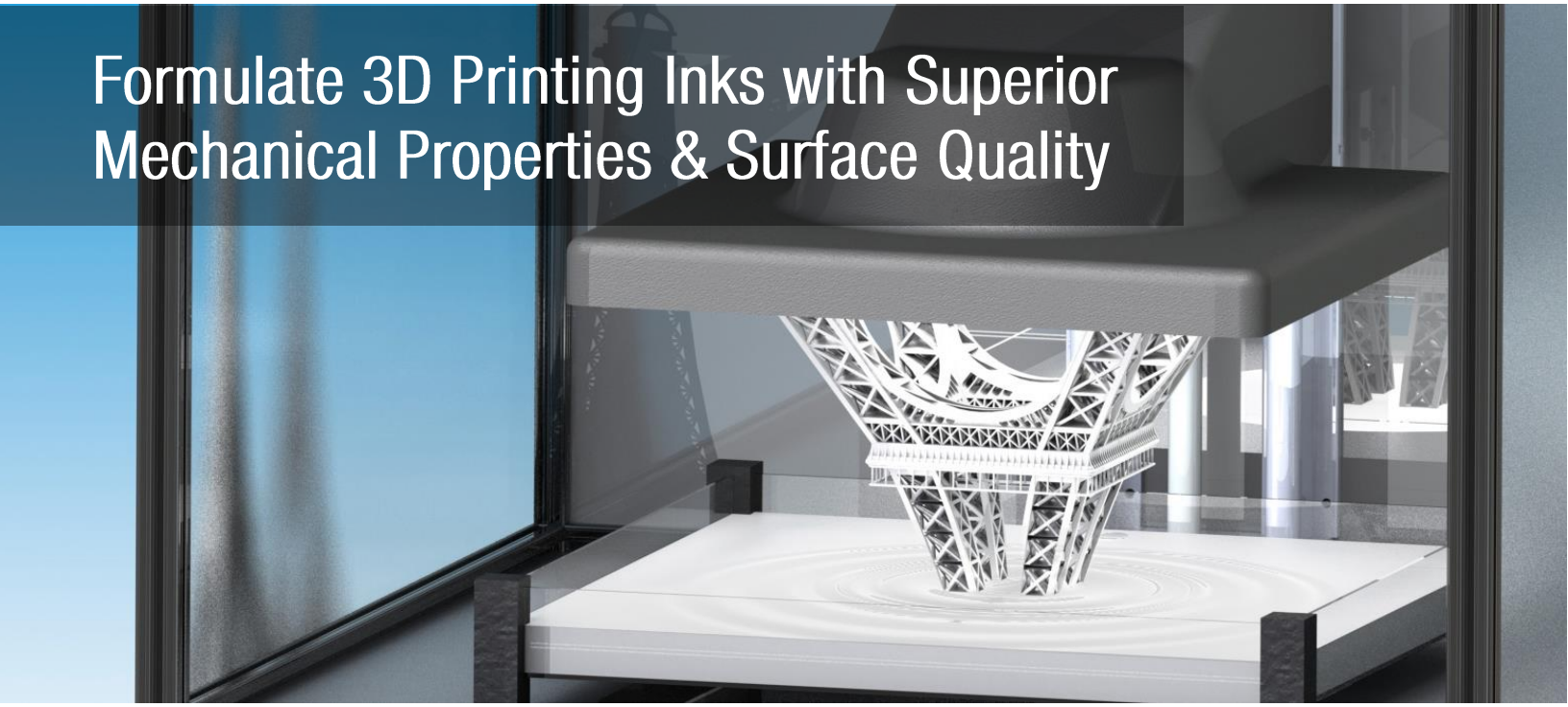
Formulate 3D Printing Inks with Superior Mechanical Properties & Surface Quality



Bomar® Oligomers for 3D Printing Inks & Resins in Stereolithography (SLA), Digital Light Processing (DLP), and 3D Inkjet Applications

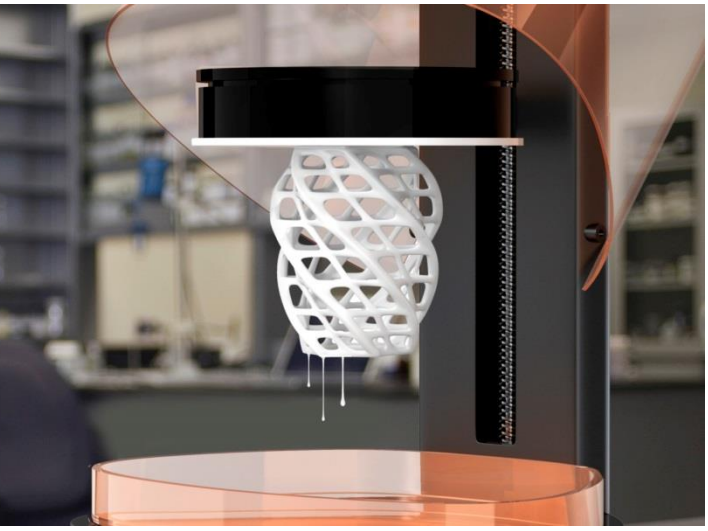
As the 3D printing industry continues to grow at a faster rate than ever, manufacturers are striving to create new, higher quality printing materials that overcome problems with deformation, have superior surface quality, and provide better mechanical properties. Addressing these problems will allow 3D printing to be used not only for rapid prototyping but also for rapid manufacturing of final products.

Dymax Oligomers & Coatings offers a selection of six Bomar® oligomers that are ideal for formulating printing inks and resins for SLA, DLP, and 3D inkjet printers. The selection consists of oligomers with varying T_gs that allow for flexibility in mechanical properties. Formulators looking to eliminate object deformation can select an oligomer with a high T_g and low linear shrinkage. The oligomers also cover a large range of viscosities so formulators can achieve the flow characteristics they desire.

In addition to the mechanical properties these oligomers provide, they also are non-yellowing for higher clarity and offer color stability for better looking objects. Formulations using Bomar® oligomers also gain high impact resistance, making them more durable against dropping and every day wear. If one of our existing oligomers do not provide the desired properties for your application, Dymax O&C can work with you to develop a custom oligomer. We also offer a range of scale up and manufacturing services.

- **Excellent mechanical properties** for products that can be used in applications beyond prototyping
- **Superior surface quality and deformation resistance** for better aesthetics
- **High impact resistance** for more durable products
- **Variety of viscosities** for desired flow characteristics

For complete technical data on all of our Bomar® oligomers for 3D printing inks, visit dymax-oc.com/index.php/oligomers/oligomers-for-3D-printing



Oligomer Properties

Six Bomar® oligomers with varying degrees of flexibility were tested for potential 3D printing applications using a simple model formula. Most formulations were cured on a Dymax UVCS conveyor using two 5000-EC flood lamps outfitted with metal-halide bulbs. Curing was completed with an intensity of 300 mW/cm^2 and 4,000 mJ/cm^2 energy at a speed of 3 ft. per minute. The curing intensity was recorded using an ACCU-CAL™ 150 radiometer. A summary of the test results can be found below.

Formula
45% oligomer
51% monomer
4% photoinitiators

Property	BR-144B*	BR-345	BR-741	BR-930D**	BR-970BT	BR-970H
Viscosity (cP) ASTM D4287	950	860	1,010	600	170	200
Durometer Hardness (D) **ASTM D2240**	87	29	89	87	82	86
Tensile Strength (psi)* ** **ASTM D638**	5,020	2,040	4,150	6,000	7,210	5,930
Elongation at Break (%) **ASTM D638**	3	550	2	3.2	6	5.5
Modulus (ksi) **ASTM D638**	105	20	130	110	100	207
Glass Transition Temp. (°C)	118	87	131	119	85	117
Heat Distortion Temp. (°C) at 66 psi **ASTM D648**	70	36	110	110	74	107
Linear Shrinkage (%) **ASTM D2556**	0.7	0.8	0.6	0.64	0.4	0.7
% Water Absorption **ASTM D570**	0.22	0.48	0.16	0.18	0.18	0.15

* Because of the higher functionality of this oligomer, the curing procedure was adjusted to accommodate its faster cure. Testing on BR-144B was completed using a Dymax UVCS conveyor with one 5000-EC flood lamp outfitted with a metal-halide bulb at a speed of 5 ft. per minute.

** Model formula was adjusted to reflect the monomer in BR-930D.

*** Tensile strength testing was completed using a 2000-EC flood lamp outfitted with a metal-halide bulb.

Recommended Equipment for Post Cure and Rework

After a 3D model is built, it may be necessary to supply additional curing energy to the part to ensure that optimized material properties are achieved. Dymax has several curing system configurations that are ideally suited for the post-cure process or rework.

UV Light-Curing Flood Systems

Ideal for post cure

Dymax flood-lamp systems are designed for area curing or for curing multiple assemblies at once. These flood lamp models use a powerful UV light-curing lamp (up to 225 mW/cm^2) for fast curing over a 5" x 5" (12.7 cm x 12.7 cm) area. Typical flood-lamp curing systems are composed of three main components: a UV flood lamp, manual or automatic shutter, and a light shield. CE-marked systems are available.

BlueWave® 200 3.0 Spot Lamp System

Ideal for rework or repair such as curing drain hole fills, assembling larger assemblies, or repairing cracked or broken models

The BlueWave® 200 3.0 is a high-intensity, light-curing spot-lamp system. This spot-curing lamp emits energy in the UVA and visible portion of the spectrum (300-450 nm) and is ideally suited for either manual or automated processes. The unit contains an integral shutter which can be actuated by a foot pedal or PLC and a universal power input that provides consistent performance at any voltage. A wide range of lightguides in various materials and configurations are available for use with this unit, providing application flexibility. This unit is also CE-marked for distribution in Europe.

Dymax Oligomers & Coatings:
Innovating Unique Oligomers for Over Twenty Years

Dymax Oligomers & Coatings, formerly Bomar Specialties, Inc., is a leading innovator of advanced-performance materials for energy (UV/EB), light, and other free-radical cure applications. We couple our technical strength in acrylate and urethane chemistry with a strong emphasis on new product development. Our scientists synthesize a broad range of select specialty oligomers, custom-designed to satisfy the unique performance requirements of emerging application technologies, while providing customers an edge in formulating products with outstanding performance, reproducibility, and cost effectiveness. In addition to our line of Bomar® oligomers, we provide assistance in coatings formulation, custom blending, toll manufacturing, and contract manufactured coatings solutions.

In addition to our high-performance oligomers, Dymax also offers a variety of light-curable adhesives and coatings as well as dispensing and light-curing equipment. Our products are perfectly matched to work seamlessly with each other, providing design engineers with tools to dramatically improve manufacturing efficiency and reduce costs. Dymax is committed to providing the best chemistry, curing equipment, and dispensing systems that offer customers complete manufacturing solutions for their challenging applications.

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