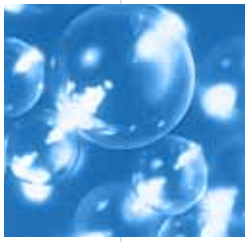
3M™ Glass Bubbles
For Resin Systems

Injection molding image courtesy of AP Plasman.

High Strength Low Density

High-strength additives
for reduced part weight,
improved dimensional stability,
improved processing

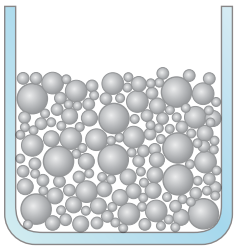
Engineered to Add Value



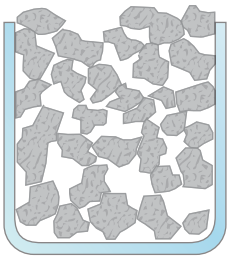
3M™ Glass Bubbles are high-strength, low-density additives made from a water resistant and chemically-stable soda-lime-borosilicate glass. They are used in a variety of applications including thermoplastics, sheet/bulk-molded composites, structural foams and elastomers to reduce weight, improve dimensional stability, improve processing, enhance surface appearance, reduce overall material costs – and more.

These hollow glass microspheres offer a variety of advantages over irregularly-shaped mineral fillers and glass fiber. They create a "ball-bearing" effect that can result in higher filler loading without the degree of flow issues encountered by other fillers. For example, glass bubbles' spherical shape does not increase resin viscosity as much as other fillers when compared on an equal volume percent basis. 3M glass bubbles can also reduce warpage and differential shrinkage and improve dimensional stability, while reducing overall system costs. And their low density can be a significant factor in helping meet weight reduction targets.

3M glass bubbles are available in a broad range of sizes, densities and crush strengths, to help you achieve the ideal balance of properties for your application. And they can be optimized for use in existing formulations. This brochure highlights our range of 3M high-strength glass bubbles, capable of surviving high-shear and pressure processes to enable a new generation of lighter, stronger plastic and elastomer products.



The spherical shape and low density of 3M glass bubbles increases volume loading capacity, compared to irregularly shaped fillers. This can mean reduced shrinkage, isotropic physical properties and significant weight reduction in certain applications.



The chart below shows properties of 3M glass bubbles commonly used in resin system applications.

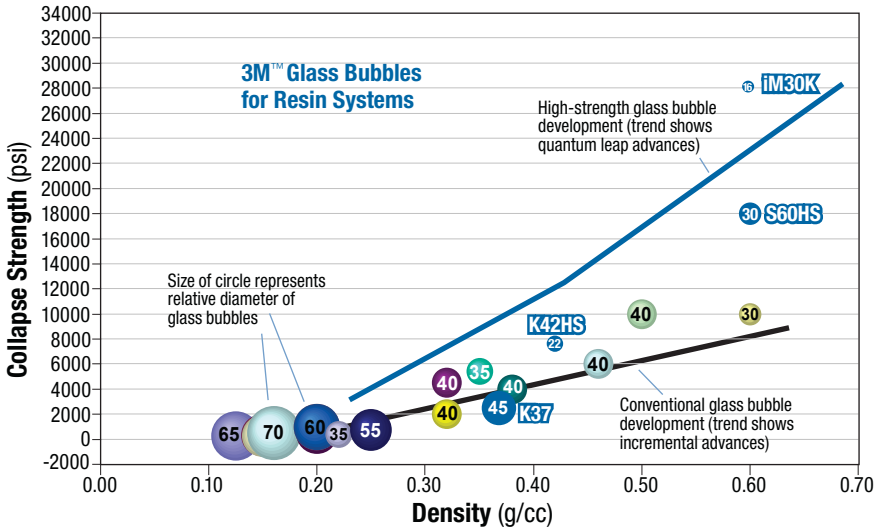
Product	Target Crush Strength (90% survival, psi)	True Density (g/cc)	Particle Size (microns, by volume) Distribution 10th%	50th%	90th%	Effective top size (>=95%)
K37	3,000	0.37	20	45	80	85
S38	4,000	0.38	15	40	75	85
S38HS	5,500	0.38	15	40	75	85
K42HS	7,500	0.42	11	22	37	42
S60	10,000	0.60	15	30	55	65
S60HS	18,000	0.60	11	30	50	60
iM30K	28,000	0.60	9	16	25	29

The following chart represents the 3M™ Glass Bubble product portfolio, arranged by their relative strengths and densities.

Following their initial development in the 1970s, improvements in glass bubble crush strength tended to be incremental (as shown by the black trend line), and were accompanied by corresponding increases in density.

In recent years, however, growing customer interest in glass bubbles as fillers for engineered thermoplastics has led to rapid advances in the technology (shown by the blue trend line). Today, we are able to increase glass bubble strength many times, without corresponding increases in density or bubble size.

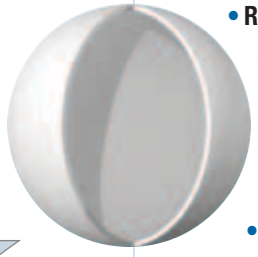
3M™ Glass Bubbles Strength/Density/Size Map



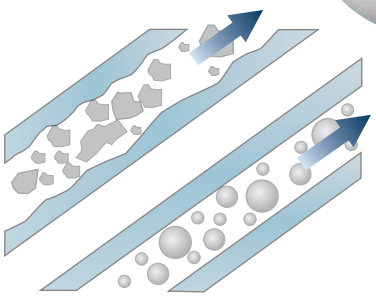
3M glass bubbles can be used in thermoplastics to replace metal parts in many demanding applications – helping to reduce weight and avoid corrosion concerns.

Customer-proven Performance

Users of 3M™ Glass Bubbles are reporting significant process and product improvements, including:



- **Reduced part density** – significant reduction in some compounds
- **Improved dimensional stability** – helps you meet tight tolerances
- **Improved throughput** – for lower injection pressures and faster cooling
- **Increased filler loading** – for reduced resin demand, lower costs
- **Excellent thermal and electrical insulation properties**
- **Resistant to water, chemicals, UV radiation**



Unlike irregularly-shaped fillers, 3M glass bubbles roll easily over one another. This helps increase volume loading capacity, reduce shrinkage, and lower resin demand. It can also help reduce warpage in many molded plastic parts.

Dimensional Stability

A leading resin compounder has found that the addition of 3M glass bubbles not only reduces the density of thermoplastic olefin parts, but also helps improve part stiffness and dimensional stability, while reducing shrinkage.

Cost Reduction

By using 3M glass bubble-filled polypropylene in place of talc-filled PC/ABS, a Korean automotive OEM reports a 50% cost reduction in producing finished core parts for instrument panels, as well as 16.8% less weight, use of original tooling and improved material flow.

Class A Surface Finish

Because of their small size (16 micron average), 3M glass bubbles iM30K added to sheet molding compounds (SMC) are enabling a Midwest auto parts supplier to meet OEM Class A surface quality standards, while achieving significant density reduction targets. Unlike larger bubbles, which tend to leave surface voids when sanded, the iM30K bubbles produce a surface finish that can be sanded smooth, without visual defects.

Weight Reduction

A U.S.-based plastics molder has achieved weight reductions of up to 32% in sheet molded compounds for automotive and non-automotive panels without compromising product quality. By using 3M glass bubbles in the resin matrix, this molder also reported excellent performance compared to alternative fillers such as carbon fiber, organic fillers, nano-particles, and nanometer particles.

Reduced Production Time

A U.S.-based developer of injection molding compounds indicates that the use of 3M glass bubbles can cut cycle times as much as 20%, primarily because the reduced mass results in faster cooling.

Injection molding image courtesy of AP Plasman.

Customer-pleasing Possibilities

Recreation

Furniture

Because of their unique ability to reduce density, increase filler loading, improve dimensional stability and other useful properties, 3M™ Glass Bubbles are finding utility in a growing number of plastics and rubber applications. To learn how 3M glass bubbles could help improve your product's performance, contact your 3M representative.

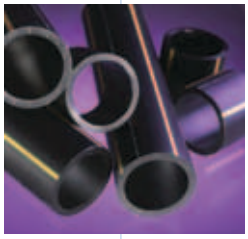
Transportation

Construction

Electronics

Applications for Thermoplastics

3M offers a family of high-strength/low density glass bubbles that can withstand the rigors of compounding and injection molding. They offer excellent survivability at the high pressures encountered in typical plastics processing operations – up to 28,000 psi for 3M™ Glass Bubbles iM30k – with a true density of only 0.60 g/cc at a particle size of 16 microns.



This high strength-to-weight ratio allows their use in many of the most demanding injection molding and extrusion processes, and provides for consistent and effective density modification. Compared to conventional fillers, 3M glass bubbles give you the design flexibility to create lighter, more uniform parts from ABS, acetal, nylon and other engineered thermoplastics.

In addition, thermoplastics filled with 3M glass bubbles demonstrate less thermal expansion warpage and differential shrinkage, while improving dimensional stability.

Because of their ability to significantly reduce resin use, combined with helping to decrease cycle times, cut down on scrap, and reduce machining, 3M high-strength glass bubbles are helping processors reduce their overall part costs – while helping increase throughput and productivity.

Our strongest glass bubble yet!

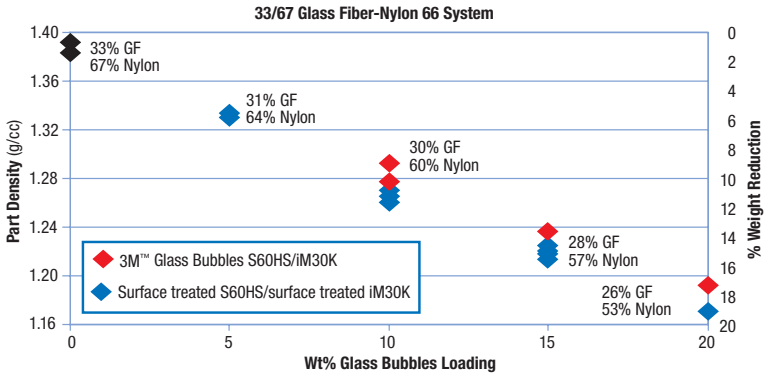
3M™ Glass Bubbles iM30K

Withstands molding and extrusion pressures up to 28,000 psi

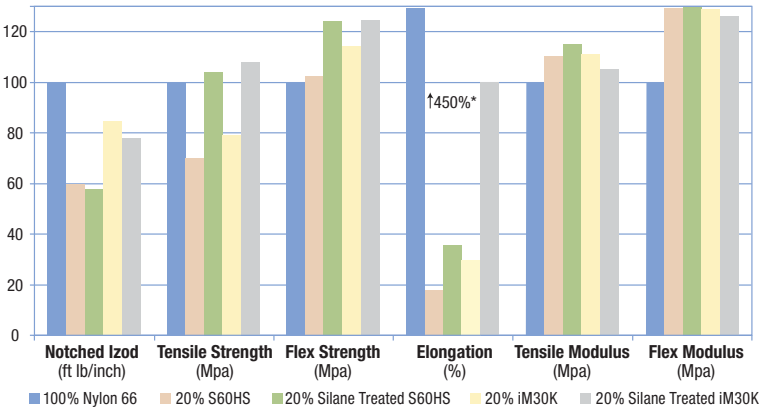
3M Glass Bubbles iM30K – designed to reduce density and improve the modulus and dimensional stability of thermoplastics – are derived from a breakthrough technology that delivers an order of magnitude increase in strength and survivability over conventional glass bubbles. They can also enable a number of important process improvements, including increased throughput and reduced wear on tooling and secondary operations.

With a true density of only 0.60 g/cc at a particle size of 16 microns, 3M glass bubbles iM30K give you the design flexibility to create lighter, more uniform parts from ABS, acetal, nylon and other engineered thermoplastics.

Effect of 3M™ Glass Bubbles on Weight Reduction



Effect of Surface Treatment on Mechanical Properties



*All data, with the exception of elongation, have been normalized for the base virgin resin to equal 100%.

Applications for Thermosets

3M™ Glass Bubbles are a high performance alternative to conventional fillers in the production of sheet molding compounds (SMC), bulk molding compounds (BMC) and other thermoset plastics.

For over 25 years, 3M glass bubbles have proven their ability to reduce the density of parts such as doors, fenders, acoustic covers and sunroof shades, while maintaining a desirable balance of physical properties.

Lightweight 3M glass bubbles (shown in the flask at right) occupy more space than an equal weight of typical mineral filler (shown at left). When you consider cost per unit volume – instead of cost per pound – 3M glass bubbles can be the cost-effective choice in many applications.

Example

Headlight assembly made with standard SMC formulation.

Headlight assembly made with 3M glass bubbles.

A new way of calculating SMC formulations

Traditionally, most SMC formulations specify the proportions of their ingredients as weight fractions, or parts per hundred of resin. This can present problems when replacing calcium carbonate with lightweight, high-performance fillers such as 3M glass microspheres.

A pound of 3M glass microspheres,* for instance, takes up almost 7 times as much space as a pound of calcium carbonate. If you were simply to substitute an equal weight of glass bubbles for the calcium carbonate in a formulation, the volume ratio of all other ingredients would be reduced substantially.

Formulating by volume fraction instead of weight allows the proper balance of resin, filler and reinforcement, so parts can be made lighter – while still maintaining an acceptable balance of physical properties.

* At a true density of 0.37 g/cc

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