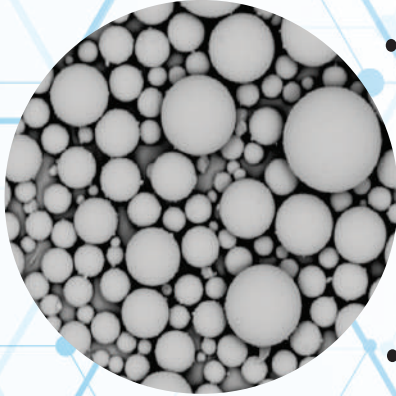




NANOVISION

Special Fillers

3M Glass Bubbles



- Resistance to Water - Chemicals - UV radiation - Thermal Stability
- Excellent Thermal Insulation - Low Thermal Conductivity
- Low Dielectric Constant - Low Oil Absorption
- Reduced Shrinkage and Warpage
- Weight Reduction - Cost Effectiveness
- Improved Flow - Machinability and Sandability
- Low Resin Demand - Low Viscosity - Increased Filler Loading

3M Glass Bubbles are engineered hollow glass microspheres that are alternatives to conventional fillers and additives such as silicas, calcium carbonate, talc, clay, etc., for many demanding applications. These low-density particles are used in a wide range of industries to reduce part weight, lower costs and enhance product properties.

The chemically stable soda-lime-borosilicate glass composition of 3M Glass Bubbles provides excellent water resistance to create more stable emulsions. They are also non-combustible and nonporous, so they do not absorb resin. And, their low alkalinity gives 3M Glass Bubbles compatibility with most resins, stable viscosity and long shelf life.

Typical Properties

(not for specification purposes)

Chemical Resistance

In general, the chemical properties of 3M Glass Bubbles resemble those of a soda-lime-borosilicate glass.

Thermal Conductivity

Conductivity increases with temperature and product density. The thermal conductivity of a composite will depend on the matrix material and volume loading of 3M Glass Bubbles.

Thermal Stability

Appreciable changes in bubble properties may occur above 1112°F (600°C) depending on temperature and duration of exposure.

Oil Absorption

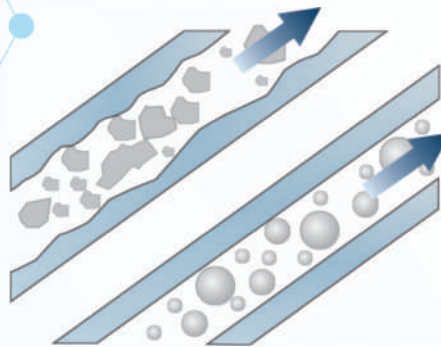
0.2-0.6 g oil/cc of 3M Glass Bubbles, per ASTM D281-84.

Thermal Insulation

Because 3M Glass Bubbles are hollow, they provide low thermal conductivity.
@ 32°F (0°C): 0.06-0.2 W/mK

Low Dielectric Constant

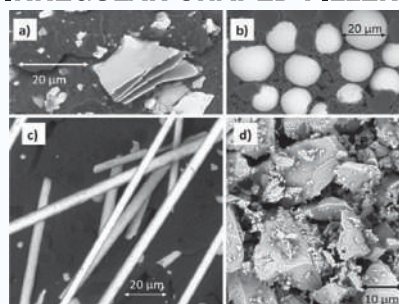
3M Glass Bubbles are hollow, providing low dielectric constant @ 100mHz 1.2-2.0 Varies w/grade



Improved Flow

Unlike many irregularly shaped fillers, 3M Glass Bubbles roll easily over one another, similar to ball bearings. This can help improve the flow of many materials to which microspheres are added, like paint, helps increase volume loading capacity, reduce shrinkage, and lower resin demand. It can also help reduce warpage in many molded plastic parts.

IRREGULAR SHAPED FILLERS



Scanning electron microscopy images:
a) talc; b) glass bubbles;
c) glass fibers; and d) calcium carbonate.

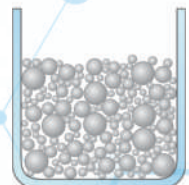
Low Viscosity / High Filler Loading

One effect of low resin demand and the ball-bearing action of spheres is lower viscosity at equivalent filler loading, or higher filler loading at equivalent viscosities.



Low Resin Demand

With the lowest surface area to volume ratio of any shape, 3M Glass Bubbles can help reduce resin demand in a variety of applications.



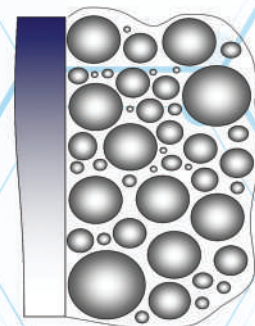
The spherical shape and low density of 3M Glass Bubbles increases volume loading capacity, compared to irregularly shaped fillers. This can mean reduced shrinkage, isotropic physical properties and significant weight reduction in certain applications.

Standard Paint



600µm wet - 300µm dry

High Built Coating



600µm wet - 450µm dry



+ Acrylic UV cured binding system

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Water Resistance

3M Glass Bubbles are soda-lime borosilicate (true glass) with inherently greater water resistance than borosilicate glass bubbles (water glass), maintaining integrity even when boiled in water for more than 40 minutes. In the photo at right, 3M Glass Bubbles are at left; borosilicate glass bubbles at right. Both are floating on the surface. After boiling (bottom photo), borosilicate glass bubbles dissolved while 3M Glass Bubbles were still floating on the surface, virtually unchanged.



Cost effectiveness

3M Glass Bubbles on the left have the same weight as the Calcium Carbonate on the right. Since 3M Glass Bubbles obviously occupy more space, a comparison of filler cost effectiveness must consider cost per unit volume instead of cost per kg.

Weight Reduction

The low density of 3M Glass Bubbles can help reduce the weight of a wide variety of finished products.

Reduced Shrinkage and Warp

The high filler loading possible with 3M Glass Bubbles can often result in reduced shrinkage. 3M Glass Bubbles help reduce cracking and shrinkage in spackling compound.

Machinability and Sandability

Parts or tooling compounds containing 3M Glass Bubbles can often be easier to cut, sand, machine and shape. Note the threads in the cone at below. With 3M Glass Bubbles in autobody filler, filing and sanding is easier and there is very little gouging. And there's less clogging of tools, which can help extend the service life of sandpaper and files.

Spackling compound without 3M Glass Bubbles



Potential Applications

- Acrylic and industrial latex paints
- Architectural paints
- Brush/Roller coatings
- Cultured marble
- Airless spray coatings
- Exterior solar reflective coatings
- Lightweight putty
- Low-shrink spackling, putties, caulks and sealants
- Potting compounds
- Machinable, sandable compounds
- Preformed concrete
- Extruded profiles for window and door trim
- Architectural base covers
- Molded décor
- Engineered wood
- Lightweight hand-held tools

Case Studies

- 3M Glass Bubbles in Architectural Paint: Screening Product Grades
- Anti-Condensation Coatings
- Solar Reflective Coatings
- TiO₂ Replacement
- 3M Glass Bubbles S28HS
- High Built Façade Paint

Composition	Crush Strength, psi	True Density, g/cc	Particle Size (50%) µm/Vol	Minimum Fractional Survival, %
3M Glass Bubbles General Purpose Series				
K1	250	0,125	65	80%
K11	200	0,11	65	80%
K15	300	0,15	60	80%
S15	300	0,15	55	90%
S22	400	0,22	35	80%
K20	500	0,20	55	80%
K25	750	0,25	55	80%
S32	2000	0,32	40	80%
S28HS	3000	0,28	30	90%
S35	3000	0,35	40	80%
K37	3000	0,37	45	80%
XLD3000	3000	0,23	30	90%
S38	4000	0,38	40	80%
S38HS	5500	0,38	40	80%
S38XHS	5500	0,38	40	90%
XLD6000	6000	0,30	18	90%
K46	6000	0,46	40	80%
K42HS	7500	0,42	22	90%
S60	6000	0,60	30	90%
S60HS	18000	0,60	30	90%
IM16K	16000	0,46	20	90%
IM30K	30000	0,60	16	90%