

3M™ Glass Bubbles K Series, S Series and iM Series

Introduction

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 unique spherical shape of 3M glass bubbles offers a number of important benefits, including: higher filler loading, lower viscosity/improved flow and reduced shrinkage and warpage. It also helps the 3M glass bubbles blend readily into compounds and makes them adaptable to a variety of production processes including spraying, casting and molding.

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 non-porous, so they do not absorb resin. And, their low alkalinity gives 3M glass bubbles compatibility with most resins, stable viscosity and long shelf life.

3M Glass Bubbles K Series, S Series and iM Series are specially formulated for a high strength-to-weight ratio. This allows greater survivability under many demanding processing conditions, such as injection molding. They also produce stable voids, which results in low thermal conductivity and a low dielectric constant. 3M glass bubbles are available in a variety of sizes and grades to help you meet your product and processing requirements.

Typical Properties

Not for specification purposes

Isostatic Crush Strength

| | Product | Test Pressure (psi) | Target Fractional Survival | Minimum Fractional Survival |
|-----------|---------|---------------------|----------------------------|-----------------------------|
| K Series | K1 | 250 | 90% | 80% |
| | K15 | 300 | 90% | 80% |
| | K20 | 500 | 90% | 80% |
| | K25 | 750 | 90% | 80% |
| | K37 | 3,000 | 90% | 80% |
| | K46 | 6,000 | 90% | 80% |
| S Series | S15 | 300 | 90% | 80% |
| | S22 | 400 | 90% | 80% |
| | S32 | 2,000 | 90% | 80% |
| | S35 | 3,000 | 90% | 80% |
| | S38 | 4,000 | 90% | 80% |
| | S38HS | 5,500 | 90% | 80% |
| | S60 | 10,000 | 90% | 80% |
| | S60HS | 18,000 | 90% | 90% |
| iM Series | iM16K | 16,000 | 90% | 90% |
| | iM30K | 28,000 | 90% | 90% |

True Density

| | Product | True Density (g/cc) | | |
|-----------|---------|---------------------|---------|---------|
| | | Typical | Minimum | Maximum |
| K Series | K1 | 0.125 | 0.10 | 0.14 |
| | K15 | 0.15 | 0.13 | 0.17 |
| | K20 | 0.20 | 0.18 | 0.22 |
| | K25 | 0.25 | 0.23 | 0.27 |
| | K37 | 0.37 | 0.34 | 0.40 |
| | K46 | 0.46 | 0.43 | 0.49 |
| S Series | S15 | 0.15 | 0.13 | 0.17 |
| | S22 | 0.22 | 0.19 | 0.25 |
| | S32 | 0.32 | 0.29 | 0.35 |
| | S35 | 0.35 | 0.32 | 0.38 |
| | S38 | 0.38 | 0.35 | 0.41 |
| | S38HS | 0.38 | 0.35 | 0.41 |
| | S60 | 0.60 | 0.57 | 0.63 |
| | S60HS | 0.60 | 0.57 | 0.63 |
| iM Series | iM16K | 0.46 | 0.43 | 0.49 |
| | iM30K | 0.60 | 0.57 | 0.63 |



Typical Properties

Chemical Resistance

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

Thermal Conductivity

| Product | Calculated Thermal Conductivity (W-m-1-K-1) at 70°F (21°C) | |
|-----------|------------------------------------------------------------|-------|
| K Series | K1 | 0.047 |
| | K15 | 0.055 |
| | K20 | 0.070 |
| | K25 | 0.085 |
| | K37 | 0.124 |
| | K46 | 0.153 |
| S Series | S15 | 0.055 |
| | S22 | 0.076 |
| | S32 | 0.108 |
| | S35 | 0.117 |
| | S38 | 0.127 |
| | S38HS | 0.127 |
| | S60 | 0.200 |
| | S60HS | 0.200 |
| iM Series | iM16K | 0.153 |
| | iM30K | 0.200 |

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.

Flotation

| Product | Floaters (% by bulk volume) | | |
|-----------|-----------------------------|---------|-----|
| | Typical | Minimum | |
| K Series | K1 | 96% | 90% |
| | K15 | 96% | 90% |
| | K20 | 96% | 90% |
| | K25 | 96% | 90% |
| | K37 | 94% | 90% |
| | K46 | 92% | 90% |
| S Series | S15 | 96% | 90% |
| | S22 | 96% | 90% |
| | S32 | 94% | 90% |
| | S35 | 96% | 90% |
| | S38 | 94% | 90% |
| | S38HS | 96% | 90% |
| | S60 | 92% | 90% |
| | S60HS | 92% | 90% |
| iM Series | iM16K | 96% | 90% |
| | iM30K | 92% | 90% |

Packing Factor (Ratio of bulk density to true particle density)

Averages about 60%.

Oil Absorption

0.2–0.6 g oil/cc of 3M glass bubbles, per ASTM D281-84.

Volatile Content

Maximum of 0.5 percent by weight.

Alkalinity

Maximum of 0.5 milliequivalents per gram

pH

Because 3M glass bubbles are a dry powder, pH is not defined. The pH effect will be determined by the alkalinity as indicated above.

When 3M glass bubbles are mixed with deionized water at 5% volume loading, the resulting pH of the slurry is typically 9.1 to 9.9, as measured by a pH meter.

Dielectric Constant

K Series: 1.2 to 1.7 @ 100 MHz, based on theoretical calculations.

S Series: 1.2 to 2.0 @ 100 MHz, based on theoretical calculations.

iM Series: 1.2 to 1.7 @ 100 MHz, based on theoretical calculations

The dielectric constant of a composite will depend on the matrix material and volume loading of 3M glass bubbles.

Particle Size

| Product | Particle Size (microns, by volume) 3M QCM 193.0 | | | | |
|-----------|-------------------------------------------------|-------|-------|--------------------|------|
| | Distribution | | | Effective Top Size | |
| | 10th% | 50th% | 90th% | | |
| K Series | K1 | 30 | 65 | 115 | 120 |
| | K15 | 30 | 60 | 105 | 115 |
| | K20 | 30 | 60 | 90 | 105 |
| | K25 | 25 | 55 | 90 | 105 |
| | K37 | 20 | 45 | 80 | 85 |
| | K46 | 15 | 40 | 70 | 80 |
| S Series | S15 | 25 | 55 | 90 | 95 |
| | S22 | 20 | 35 | 65 | 75 |
| | S32 | 20 | 40 | 70 | 80 |
| | S35 | 20 | 40 | 65 | 80 |
| | S38 | 15 | 40 | 75 | 85 |
| | S38HS | 19 | 44 | 70 | 85 |
| | S60 | 15 | 30 | 55 | 65 |
| | S60HS | 12 | 29 | 48 | 60 |
| iM Series | iM16K | 12 | 20 | 30 | 40 |
| | iM30K | 8.6 | 15.3 | 23.6 | 26.7 |

Particle Size (continued)

Hard Particles (3M QCM 93.4.3)

No hard particles (e.g. glass slag, flow agent, etc.) greater than U.S. number 40 (420 microns) standard sieve will exist.

Oversize Particles (3M QCM 93.4.4)

For *K1*, *K15*, *K20* and *K25* glass bubbles:

Using a 10 gram sample on a U.S. number 80 standard sieve (177 microns), a maximum of five (5) percent by weight glass bubbles will be retained on the sieve.

For *K37* and *K46* glass bubbles:

Using a 10 gram sample on U.S. number 100 standard sieve (149 microns), a maximum of one (1) percent by weight glass bubbles will be retained on the sieve.

For *S15*, *S32*, *S35*, *S38*, *S38HS*, *S60*, *S60HS*, *iM16K* and *iM30K* glass bubbles:

Using a 10 gram sample on a U.S. number 140 standard sieve (105 microns), a maximum of three (3) percent by weight glass bubbles will be retained on the sieve.

For *S22* glass bubbles:

Using a 10 gram sample on a U.S. number 200 standard sieve (74 microns), a maximum of five (5) percent by weight glass bubbles will be retained on the sieve.

Appearance (3M QCM 22.85)

White to the unaided eye.

Flow (3M QCM 22.83)

3M™ Glass Bubbles remain free flowing for at least one year from the date of shipment if stored in the original, unopened container in the minimum storage conditions of an unheated warehouse.

Labeling

3M glass bubbles will be packaged in suitable containers to help prevent damage during normal handling and shipping. Each container will be labeled with:

1. Name of manufacturer
2. Type of 3M glass bubbles
3. Lot number
4. Quantity in pounds

Storage and Handling

To help ensure ease of storage and handling while maintaining free flowing properties, 3M™ Glass Bubbles have been made from a chemically stable glass and are packaged in a heavy-duty polyethylene bag within a cardboard container.

Minimum storage conditions should be unopened cartons in an unheated warehouse.

Under high humidity conditions with an ambient temperature cycling over a wide range, moisture can be drawn into the bag as the temperature drops and the air contracts. The result may be moisture condensation within the bag. Extended exposure to these conditions may result in “caking” of the 3M glass bubbles to various degrees. To minimize the potential for “caking” and prolong the storage life, the following suggestions are made:

1. Carefully re-tie open bags after use.
2. If the polyethylene bag is punctured during shipping or handling, use this bag as soon as possible, patch the hole, or insert the contents into an undamaged bag.
3. During humid summer months, store in the driest, coolest space available.
4. If good storage conditions are unavailable, carry a minimum inventory, and process on a first in/first out basis.

Dusting problems that may occur while handling and processing can be minimized by the following procedures:

1. For eye protection wear chemical safety goggles. For respiratory system protection wear an appropriate NIOSH/MSHA approved respirator. (For additional information about personal protective equipment, refer to Material Safety Data Sheet.)
2. Use appropriate ventilation in the work area.
3. Pneumatic conveyor systems have been used successfully to transport 3M glass bubbles without dusting from shipping containers to batch mixing equipment. Static eliminators should be used to help prevent static charges.

Diaphragm pumps have been used to successfully convey 3M glass bubbles. Vendors should be consulted for specific recommendations.

3M glass bubble breakage may occur if the product is improperly processed. To minimize breakage, avoid high shear processes such as high speed Cowles Dissolvers, point contact shear such as gear pumps or 3-roll mills, and processing pressures above the strength test pressure for each product.

Health and Safety Information

For product Health and Safety Information, refer to product label and Material Safety Data Sheet (MSDS) before using product.

Packaging Information

Small Box (10 Cubic ft.)

A single corrugated box with a plastic liner. All boxes are banded together and to the wooden pallet. 4 boxes per pallet.

Each box inside diameter is 22 in. × 19 in. × 39 in.

Pallet size is 42 in. × 48 in.

Large Box (50 Cubic ft.)*

A single corrugated box with a plastic liner. Top enclosed with interlocking double cover banded. Bottom is normal box closure, entire box banded to wooden pallet.

Each box inside diameter is 48 in. × 42 in. × 44 in. Overall load size is 48³/₄ in. × 42³/₄ in. × 50 in. including pallet.

Pallet size is 42 in. × 48 in.

*S60 and S60HS large boxes are 38 cubic ft.

Resources

3M™ Glass Bubbles are supported by global sales, technical and customer service resources, with fully-staffed technical service laboratories in the U.S., Europe, Japan, Latin America and Southeast Asia. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

For additional technical information on 3M glass bubbles in the United States, call 3M Advanced Materials Division, **800-367-8905**. For other 3M global offices, and information on additional 3M products, visit our website at: www.3M.com/engineeredadditives.

Box Weights

| | Product | Small Box | Large Box* | Truckload Large Box* 44 Pallets |
|-----------|---------|-----------|------------|------------------------------------|
| K Series | K1 | 40 lb. | 210 lb. | 9,240 lb. |
| | K15 | 50 lb. | 265 lb. | 11,660 lb. |
| | K20 | 60 lb. | 350 lb. | 15,400 lb. |
| | K25 | 80 lb. | 430 lb. | 18,920 lb. |
| | K37 | 100 lb. | 660 lb. | 29,040 lb. |
| | K46 | 125 lb. | 815 lb. | 35,860 lb. |
| S Series | S15 | 50 lb. | 265 lb. | 11,660 lb. |
| | S22 | 60 lb. | 385 lb. | 16,940 lb. |
| | S32 | 100 lb. | 525 lb. | 23,100 lb. |
| | S35 | 100 lb. | 630 lb. | 27,720 lb. |
| | S38 | 100 lb. | 680 lb. | 29,920 lb. |
| | S38HS | 100 lb. | 680 lb. | 29,920 lb. |
| | S60 | 125 lb. | 850 lb. | 37,400 lb. |
| | S60HS | 125 lb. | 850 lb. | 37,400 lb. |
| iM Series | iM16K | 99 lb. | 800 lb. | — |
| | iM30K | 125 lb. | 850 lb. | 37,400 lb. |

*Box weights may vary due to manufacturing tolerances on each product.

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