

3M Advanced Materials Division

3M™ Fused Silica Castables and Shapes

3M™ Fused Silica Castables

Introduction

3M fused silica castables are individually formulated for customer-specific applications. All 3M castable products consist of the highest quality fused silica and cements, and are designed for ease of use, with 30 to 40 minutes working times. 3M fused silica castables are noted for their superior performance in areas requiring precision, durability and resistance to thermal shock. These products are packaged in 50 lb. (22.7 kg) plastic-lined paper bags, 40 per pallet.

Products

3M™ Fused Silica Castable 120 is a low cost material, designed for use as a durable insulating material in induction heating units. This product is a thermal shock-resistant nonreceptor that directs all the energy to the product being heated. Fused silica castable 120 exhibits very low shrinkage, and can serve as a high temperature tooling material.

3M™ Fused Silica Castable ICL is a modified version of fused silica castable 120 containing a small amount of abrasion resistant ceramic. Fused silica castable ICL is used in areas where abrasion in an induction heating system may be the primary mode of failure.

3M™ Fused Silica Castable 220 is primarily employed as a precision high temperature tooling material. Specific applications include the high temperature forming of glass and titanium products. This product is comprised of precisely-sized, high purity fused silica, silicon carbide and a calcium aluminate binder. Fused silica castable 220 is designed to produce highly accurate tools ranging in size from less than 0.014 m³ to more than 2.0 m³.

3M™ Fused Silica Castable AR and AR Fine is a high purity fused silica castable formulated for use in applications involving direct contact with molten aluminum. There are three grades: Castable AR for general

Typical Physical Properties

(Not for specification purposes)

| | 120 | 220 | ICL | AR | AR Fine |
|--|------------------|-------------------|------------------|--------------------|--------------------|
| Material Required (avg. lbs. to place 1 cubic ft.) | 120 | 130 | 120 | 120 | 120 |
| Water Required (rec. water range by %wt.)* | 11.0 to 12.0 | 8.0 to 9.0 | 11.0 to 12.0 | 9.0 to 10.0 | 13.0 to 14.0 |
| Density (nominal fired) | 114 to 118 PCF | 130 to 140 PCF | 115 to 125 PCF | 115 to 125 PCF | 115 to 125 PCF |
| MOR (ASTM C133) | | | | | |
| @ 230°F | 1000 to 1500 psi | 1400 to 1900 psi | 900 to 1200 psi | 500 to 900 psi | 450 to 800 psi |
| @ 1500°F | 600 to 1000 psi | 1200 to 1600 psi | 500 to 900 psi | 1100 to 1500 psi | 900 to 1200 psi |
| Cold Crush Strength (ASTM C133) | | | | | |
| @ 230°F | 6000 to 8000 psi | 6000 to 10000 psi | 6000 to 8000 psi | 8000 to 10000 psi | 10000 to 13000 psi |
| @ 1500°F | 4000 to 6000 psi | 8000 to 10000 psi | 4000 to 6000 psi | 10000 to 14000 psi | 10000 to 13000 psi |
| Linear Change (ASTM C113) @ 1500°F | -0.30 to -0.40% | -0.20% | -0.20% | -0.50% | -0.80% |
| Chemical Analysis | | | | | |
| Silicon Carbide, SiC | — | 40 to 50% | — | — | — |
| Silica, SiO ₂ | 75 to 85% | 30 to 45% | 70 to 80% | 55 to 85% | 55 to 85% |
| Alumina, Al ₂ O ₃ | 0 to 16% | 0 to 15% | 5 to 25% | 0 to 18% | 0 to 18% |
| Calcium Oxide, CaO + Other | 0 to 4% | 0 to 4% | 0 to 4% | 0 to 4% | 0 to 4% |
| Thermal Conductivity (ASTM E1461) BTU-in/hr-ft²-°F | | | | | |
| @ 1000°F | 9.1 | 23.4 | 8.9 | 9.2 | 9.4 |
| @ 1500°F | 9.8 | 24.3 | 9.6 | 10.6 | 10.7 |

70 See Casting and Curing Guidelines

castings and larger shapes; Castable AR Fine for casting smaller or more intricate shapes; and Castable AR Fine No Lithium, also for casting smaller or more intricate shapes but with increased working time.

3M™ Fused Silica Shapes

Introduction

3M fused silica shapes are formulated using the highest quality fused silica under precise manufacturing methods to provide finished shapes that offer superior reliability and performance. Features include high purity, excellent thermal shock resistance, minimal porosity, and excellent strength. Two formulations are available and can be used to produce virtually any desired shape.

Products

3M™ Fused Silica Shapes HS is a relatively fine-grained slip and aggregate kiln-fired product. This body yields high bending and cold crushing strengths, while exhibiting superior resistance to thermal shock. Typical applications range from large shapes such as tweels for glass production to tubes for metal transfer applications to pins and spouts and special crucibles.

3M™ Fused Silica Shapes IM products are primarily used in applications that require shapes of large mass or superior resistance to compressive loads at high temperatures. The engineered fused silica body consists of relatively large grains bound with special slips. The kiln-fired shapes demonstrate extraordinary consistency of density with minimal porosity, even in the largest mass castings. Products typical of this body include high temperature precision press platens, load-bearing refractory bolsters and high longevity coke oven door plugs.

Product Storage, Handling and Safety

Storage: Store away from acids. Store away from oxidizing agents. See product Safety Data Sheet (SDS) for additional information.

Handling: Do not handle until all safety precautions have been read and understood. Do not breathe dust/fume/gas/mist/vapors/spray. Do not get in eyes, on skin, or on clothing. Do not eat, drink or smoke when using this product. Wash thoroughly after handling. Avoid contact with oxidizing agents (e.g. chlorine, chromic acid etc.). Use personal protective equipment (gloves, respirators, etc.) as required. See product SDS for additional information.

Safety: Handling of this product may be hazardous. Obtain special instructions before use. Do not handle until all safety precautions have been read and understood. Wear eye/face protection. Wear protective gloves. Wash thoroughly after handling. See product SDS for additional information.

Typical Physical Properties

(Not for specification purposes)

| Property | HS | IM |
|--|--------------------|-------------------|
| Density | 120 to 125 PCF | 122 to 127 PCF |
| Apparent Porosity (ASTM C2) | 8 to 10% | 6 to 9% |
| Modulus of Rupture (ASTM C133) | 2100 to 2600 psi | 800 to 1100 psi |
| Cold Crush Strength (ASTM C133) | 14000 to 18000 psi | 6000 to 10000 psi |
| Coefficient of Thermal Expansion (in /in • °F • 10 ⁻⁶) | 0.4 | 0.4 |
| Crystalline Content (x-ray diffraction) | < 1% | < 1% |

Chemical Analysis

| | | |
|---|----------|----------|
| Silica, SiO ₂ | 99.65% | 99.65% |
| Alumina, Al ₂ O ₃ | 2700 ppm | 2700 ppm |
| Titanium Dioxide, TiO ₂ | 170 ppm | 170 ppm |
| Calcium Oxide, CaO | 80 ppm | 80 ppm |
| Potassium, K | 80 ppm | 80 ppm |
| Sodium, Na | 70 ppm | 70 ppm |

Thermal Conductivity (ASTM E1461) BTU-in/hr-ft²-°F

| | | |
|--------|------|------|
| 1000°F | 12.6 | 9.5 |
| 1500°F | 13.2 | 11.8 |

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