

## PRODUCT DATA SHEET

# King® MS-D3 UG

Shotcrete material for dry-process applications



### PRODUCT DESCRIPTION

King® MS-D3 UG is an accelerated, silica fume enhanced, pre-packaged, shotcrete material for dry-process applications. This product is a preblended, prepackaged, dry-process, shotcrete material containing high early Portland cement, silica fume, set-time accelerator, blended aggregates and other carefully selected components. It has greatly enhanced shooting characteristics providing reduced setting times and rapid strength development.

### USES

- Ground support applications for mining, tunneling and other underground openings.
- Construction of underground bulkheads, backfill barricades, pillars, ventilation walls and other underground concrete structures.
- Use of a predampener in conjunction with dry-process accelerated shotcrete is not recommended. Contact your local Sika Technical Representative for more information

### CHARACTERISTICS / ADVANTAGES

- Rapid early age strength development
- Improved performance in presence of running water
- Improved adhesive and cohesive plastic properties
- Significantly reduced rebound, resulting in lower material usage
- Superior ability to build greater thicknesses in a single pass in both vertical and overhead orientations
- Improved resistance to water wash-out
- Improved resistance to sulphate attack
- Low permeability

- Low shrinkage

### OPTIONAL FEATURES & BENEFITS

#### SET-TIME/STRENGTH GAIN

**King® MS-D3 UG** contains a level 1 dosage of accelerator.

**King® MS-D3 UG2** contains a level 2 dosage of accelerator

**King® MS-D3 UG3** contains a level 3 dosage of accelerator.

See the Technical Data section for more detailed information.

#### **King® MS-D3 UG LD**

Low dust, which means the dust content has been reduced as per the CIPAC 5003/m MT 171.1 standard.

#### **MACRO-SYNTHETIC FIBER CONTENT**

- Significantly increased load-carrying capacity
- Significantly increased energy absorbing capacity (toughness)
- Significantly increased impact resistance
- Significantly decreased wear on placing equipment and accessories when compared with steel fibers
- Ideal for use in man-ways or other areas where people may come in contact with the shotcrete surface
- Reduction of cracking due to drying shrinkage

**King® MS-D3 UG MFB** contains a high dosage of macro-synthetic fiber.

**King® MS-D3 UG MFC** contains a medium dosage of macro-synthetic fiber.

**King® MS-D3 UG MFD** contains a low dosage of macro-synthetic fiber.

See the Technical Data section for more detailed information.

#### SET TIME/STRENGTH GAIN WITH MACRO FIBER

**King® MS-D3 UG MF** contains a level 1 dosage of accelerator.

**King® MS-D3 UG2 MF** contains a level 2 dosage of accelerator.

**King® MS-D3 UG3 MF** contains a level 3 dosage of accelerator.

See the Technical Data section for more detailed information.

#### **STEEL FIBER CONTENT**

- Significantly increased load-carrying capacity
- Significantly increased energy absorbing capacity (toughness)
- Significantly increased impact resistance
- Reduction of cracking due to drying shrinkage

**King® MS-D3 UG STA** contains a high dosage of steel fiber.

**King® MS-D3 UG STB** contains a medium dosage of steel fiber.

**King® MS-D3 UG STC** contains a low dosage of steel fiber.

**King® MS-D3 UG STD** contains a very low dosage of steel fiber.

See the Technical Data section for more detailed information.

#### SET-TIME/STRENGTH GAIN WITH STEEL FIBER

**King® MS-D3 UG ST** contains a level 1 dosage of accelerator.

**King® MS-D3 UG2 ST** contains a level 2 dosage of accelerator

**King® MS-D3 UG3 ST** contains a level 3 dosage of accelerator.

See the Technical Data section for more detailed information.

## PRODUCT INFORMATION

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### Packaging

Normally packaged in 2,205 lb (1,000 kg) bulk bags and polywrapped on wooden pallets. All KING products can be custom packaged to suit specific job requirements.

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### Shelf Life

Unopened bags have a shelf life of 12 months

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### Storage Conditions

Material should be stored in a dry, covered area, protected from the elements. Physical properties may be adversely affected if material is stored in temperatures below 32 °F (0 °C). Material stored below these temperatures should be allowed to warm to ambient underground temperatures before shooting.

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#### **GRADATION**

- By default MS-D3 UG is blended to meet ACI 506 “Guide to Shotcrete”, Table 1.1, Gradation No. 2 MS-D3 UG G1 is blended to meet ACI 506 “Guide to Shotcrete”, Table 1.1, Gradation No. 1
- By default King® MS-D3 UG ST is blended to meet ACI 506 “Guide to Shotcrete”, Table 1.1, Gradation No. 2
- King® MS-D3 UG ST G1 is blended to meet ACI 506 “Guide to Shotcrete”, Table 1.1, Gradation No. 1
- By default King® MS-D3 UG MF is blended to meet ACI 506 “Guide to Shotcrete”, Table 1.1, Gradation No. 2
- King® MS-D3 UG MF G1 is blended to meet ACI 506 “Guide to Shotcrete”, Table 1.1, Gradation No. 1

#### **EXAMPLES:**

- For King® MS-D3 UG with Gradation No. 1, the name of the product would be King® MS-D3 UG G1.
- For King® MS-D3 UG ST with a high dosage of steel fiber, a level 2 dosage of accelerator and Gradation No. 2, the name of the product would be King® MS-D3 UG2 STA.
- For King® MS-D3 UG MF with high dosage of macro-synthetic fiber, a level 2 dosage of accelerator and a Gradation No. 2, the name of the product would be King® MS-D3 UG2 MFB.

**Compressive Strength**

	King® MS-D3 UG	King® MS-D3 UG2	King® MS-D3 UG3	ASTM C 116(MODIFIED)
4 Hours		290 psi (2 MPa)	1015 psi (7 MPa)	
8 Hours	1015 psi (7 MPa)	1150 psi (8 MPa)	1500 psi (10 MPa)	
12 Hours	1500 psi (10 MPa)	1750 psi (12 MPa)	2030 psi (14 MPa)	
	King® MS-D3 UG	King® MS-D3 UG2	King® MS-D3 UG3	ASTM C 1604
1 Day	3000 psi (21 MPa)	3625 psi (25 MPa)	3625 psi (25 MPa)	
3 Days	4350 psi (30 MPa)	4350 psi (30 MPa)	4350 psi (30 MPa)	
7 Days	5075 psi (35 MPa)	5075 psi (35 MPa)	5075 psi (35 MPa)	
28 Days	6000 psi (42 MPa)	6000 psi (42 MPa)	6000 psi (42 MPa)	

**Flexural Strength**

<b>FLEXURAL STRENGTH</b>			
King® MS-D3 UG			
28 Days		985 psi (6.8 MPa)	ASTM C 78
King® MS-D3 UG MF and King® MS-D3 UG ST			
28 Days		1160 psi (8.0 MPa)	ASTM C 78

**Flexural toughness**

<b>ASTM C 1550 STEEL FIBERS</b>						
King® MS-D3 UG STA						
<b>Peak applied load</b>	<b>Toughness as a function of flexure</b>					
	<b>0.2 in 5 mm</b>	<b>0.4 in 10 mm</b>	<b>0.8 in 20 mm</b>	<b>1.2 in 30 mm</b>	<b>1.6 in 40 mm</b>	
8992 lbf (40 Kn)	> 100J	> 215J	> 350J	> 450J	> 500J	
King® MS-D3 UG STB						
<b>Peak applied load</b>	<b>Toughness as a function of flexure</b>					
	<b>0.2 in 5 mm</b>	<b>0.4 in 10 mm</b>	<b>0.8 in 20 mm</b>	<b>1.2 in 30 mm</b>	<b>1.6 in 40 mm</b>	
5620 lbf (25 Kn)	> 100J	> 190J	> 300J	> 375J	> 425J	
King® MS-D3 UG STC						
<b>Peak applied load</b>	<b>Toughness as a function of flexure</b>					
	<b>0.2 in 5 mm</b>	<b>0.4 in 10 mm</b>	<b>0.8 in 20 mm</b>	<b>1.2 in 30 mm</b>	<b>1.6 in 40 mm</b>	
4496 lbf (20 Kn)	> 100J	> 175J	> 270J	> 325J	> 370J	



King® MS-D3 UG STD

**Peak applied load** Toughness as a function of flexure

	0.2 in 5 mm	0.4 in 10 mm	0.8 in 20 mm	1.2 in 30 mm	1.6 in 40 mm
4496 lbf (20 Kn)	> 40J	> 80J	> 125J	> 150J	> 175J

**MACRO SYNTHETIC FIBERS**

King® MS-D3 UG MFB

**Peak applied load** Toughness as a function of flexure

	0.4 in 10 mm	0.8 in 20 mm	1.2 in 30 mm	1.6 in 40 mm
5620 lbf (25 kN)	> 150J	> 250J	> 350J	> 450J

King® MS-D3 UG MFC

**Peak applied load** Toughness as a function of flexure

	0.4 in 10 mm	0.8 in 20 mm	1.2 in 30 mm	1.6 in 40 mm
4495 lbf (20 kN)	> 80J	> 125J	> 250J	> 350J

King® MS-D3 UG MFD

**Peak applied load** Toughness as a function of flexure

	0.4 in 10 mm	0.8 in 20 mm	1.2 in 30 mm	1.6 in 40 mm
3370 lbf (15 kN)	> 50J	> 80J	> 150J	> 275J

**FLEXURAL PERFORMANCE**

**ASTM C 1609**

Dosage	First peak strength	F <sup>100</sup> <sub>600</sub>	F <sup>100</sup> <sub>150</sub>
King® MS-D3 UG STA	906 psi (6.25 MPa)	797 psi (5.50 MPa)	652 psi (4.50 MPa)
King® MS-D3 UG STB	797 psi (5.50 MPa)	435 psi (3.00 MPa)	398 psi (2.75 MPa)
King® MS-D3 UG STC	580 psi (4.00 MPa)	362 psi (2.50 MPa)	145 psi (1.0 MPa)

**Porosity**

**BOILED ABSORPTION**

6.0%

ASTM C 642

**MAXIMUM VOLUME OF PERMEABILITY VOIDS**

14.0%

ASTM C 642

**Coverage**

2,205 lb (1,000 KG) bag contains approximately 16.5 ft<sup>3</sup> (0.45 m<sup>3</sup>).



## Cure Time

Good curing conditions are beneficial to optimizing physical properties of King® MS-D3 UG. Although the high relative humidity commonly found in underground environments provides for good curing conditions, additional curing is often appropriate and should be performed in accordance with ACI 308 “Guide to Curing Concrete”.

Thinner	Set Time	King® MS-D3 UG	King® MS-D3 UG2	King® MS-D3 UG3	ASTM C 1117
	Initial	10 minutes	5 minutes	3 minutes	
	Final	45 minutes	20minutes	10 minutes	

## BASIS OF PRODUCT DATA

Results may differ based upon statistical variations depending upon mixing methods and equipment, temperature, application methods, test methods, actual site conditions and curing conditions.

\*The following data was obtained under controlled conditions with material and ambient temperatures of 70 °F (21 °C). Higher or lower temperatures can respectively accelerate or delay setting time and early-age compressive strength gain.

## AVAILABILITY/WARRANTY

Each of the following descriptors / features have the possibility of being included in a specific mix design; Either on their own, or combined with any other descriptor / feature:

- Level 2 dosage of accelerator (UG2)
- Level 3 dosage of accelerator (UG3)
- Corrosion inhibitor (CI)
- Gradation 1 (G1)
- Crystalline Waterproofing (CW)
- Air Entrained (E)
- NX

Fibers (at different dosage)

- Micro synthetic fibers (SY)
- Macro synthetic fibers (MF,MFB,MFC,MFD)
- Steel Fiber (ST)

## ENVIRONMENTAL, HEALTH AND SAFETY

For further information and advice regarding transportation, handling, storage and disposal of chemical products, user should refer to the actual Safety Data Sheets containing physical, environmental, toxicological and other safety related data. User must read the current actual Safety Data Sheets before using any products. In case of an emergency, call CHEMTREC at 1-800-424-9300, International 703-527-3887.

## SURFACE PREPARATION

All surfaces to be in contact with King® MS-D3 UG and its variations must be free from dust, oil, grease or any other foreign substances that may interfere with the bond of the material. Remove all loose or delaminated rock. Clean the area with potable water, leaving the substrate saturated but free of standing water (SSD).

## APPLICATION

Apply in accordance with the ACI 506 “Guide to Shotcrete” publication.

### OPTIMUM PERFORMANCE

- Should not be applied when ambient, substrate and material temperatures are below 40 °F (5 °C).
- Performance of in-place shotcrete relies heavily upon application techniques. To ensure optimum quality of in-place shotcrete, the material, equipment and key personnel should be pre-qualified prior to project start-up.

## CLEANING OF TOOLS

Clean all tools and equipment after use with water. Once hardened, the product can only be removed mechanically.

## OTHER RESTRICTIONS

See Legal Disclaimer.

## LEGAL DISCLAIMER

- KEEP CONTAINER TIGHTLY CLOSED
- KEEP OUT OF REACH OF CHILDREN
- NOT FOR INTERNAL CONSUMPTION
- FOR INDUSTRIAL USE ONLY
- FOR PROFESSIONAL USE ONLY

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### Product Data Sheet

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