MS-D3 UG ST

KING
A SIKA COMPANY

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

FEATURES & BENEFITS

- Significantly increased load-carrying capacity
- Significantly increased energy absorbing capacity (toughness)
- Significantly increased impact resistance
- Reduction of cracking due to drying shrinkage
- 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
- All KING products are manufactured using ISO 9001:2015 Certified Processes

OPTIONAL FEATURES & BENEFITS

STEEL FIBER CONTENT

MS-D3 UG STA contains a high dosage of steel fiber.
MS-D3 UG STB contains a medium dosage of steel fiber.
MS-D3 UG STC contains a low dosage of steel fiber.
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

MS-D3 UG ST contains a level 1 dosage of accelerator.
MS-D3 UG2 ST contains a level 2 dosage of accelerator
MS-D3 UG3 ST contains a level 3 dosage of accelerator.

See the Technical Data section for more detailed information.

GRADATION

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

EXAMPLE:
For 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 MS-D3 UG2 STA.

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 KING Technical Representative for more information.

PROCEDURES

Surface Preparation: All surfaces to be in contact with MS-D3 UG ST 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 MS-D3 UG ST in accordance with the ACI 506 “Guide to Shotcrete” publication.

CURING

Good curing conditions are beneficial to optimizing physical properties of MS-D3 UG ST. 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”.

TECHNICAL DATA

The following data is representative of typical values achievable using proper application techniques as outlined in the ACI 506 “Guide to Shotcrete” publication. The data was obtained during project field tests and in-house shotcrete studies.

ACCELERATOR LEVEL

	MS-D3 UG ST	MS-D3 UG2 ST	MS-D3 UG3 ST
SET TIME* ASTM C 1117			
Initial	10 minutes	5 minutes	3 minutes
Final	45 minutes	20 minutes	10 minutes
COMPRESSIVE STRENGTH* ASTM C 116 (MODIFIED)			
4 Hour	-	2 MPa (290 psi)	7 MPa (1015 psi)
8 Hour	7 MPa (1015 psi)	8 MPa (1150 psi)	10 MPa (1500 psi)
12 Hour	10 MPa (1500 psi)	12 MPa (1750 psi)	14 MPa (2030 psi)
COMPRESSIVE STRENGTH* ASTM C 1604			
1 Day	21 MPa (3000 psi)	25 MPa (3625 psi)	25 MPa (3625 psi)
3 Day	30 MPa (4350 psi)	30 MPa (4350 psi)	30 MPa (4350 psi)
7 Day	35 MPa (5075 psi)	35 MPa (5075 psi)	35 MPa (5075 psi)
28 Day	42 MPa (6000 psi)	42 MPa (6000 psi)	42 MPa (6000 psi)

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

FLEXURAL STRENGTH
ASTM C 78
28 Day 8.0 MPa (1160 psi)

FLEXURAL PERFORMANCE
ASTM C 1609

Dosage	First Peak Strength	F^{100}_{600}	F^{100}_{400}	F^{100}_{150}
MS-D3 UG STA	6.25 MPa (906 psi)	5.50 MPa (797 psi)	5.50 MPa (797 psi)	4.50 MPa (652 psi)
MS-D3 UG STB	5.50 MPa (797 psi)	3.00 MPa (435 psi)	3.00 MPa (435 psi)	2.75 MPa (398 psi)
MS-D3 UG STC	4.50 MPa (652 psi)	3.00 MPa (435 psi)	3.00 MPa (435 psi)	2.75 MPa (398 psi)
MS-D3 UG STD	4.00 MPa (580 psi)	2.50 MPa (362 psi)	2.00 MPa (290 psi)	1.00 MPa (145 psi)

FLEXURAL TOUGHNESS
ASTM C 1550

Dosage	Peak Applied Load	Toughness as a Function of Flexure				
		5 mm	10 mm	20 mm	30 mm	40 mm
MS-D3 UG STA	40 kN (8992 lbf)	>100J	>215J	>350J	>450J	>500J
MS-D3 UG STB	25 kN (5620 lbf)	>100J	>190J	>300J	>375J	>425J
MS-D3 UG STC	20 kN (4496 lbf)	>100J	>175J	>270J	>325J	>370J
MS-D3 UG STD	20 kN (4496 lbf)	>40J	>80J	>125J	>150J	>175J

OPTIMUM PERFORMANCE

- MS-D3 UG ST should not be applied when ambient, substrate and material temperatures are below 5 °C (40 °F).
- 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.

YIELD
1,000 KG (2,205 lb) bag contains approximately 0.45 m^3 (16.5 ft^3).

PACKAGING
MS-D3 UG ST is normally packaged in 1,000 KG (2,205 lb) bulk bags and polywrapped on wooden pallets. Material can also be supplied in 30 KG (66 lb) triple-lined bags. All KING products can be custom packaged to suit specific job requirements.

STORAGE AND SHELF LIFE
Material should be stored in a dry, covered area, protected from the elements. Unopened bags have a shelf life of 12 months. Physical properties of MS-D3 UG ST may be adversely affected if material is stored in temperatures below 0 °C (32 °F). Material stored below these temperatures should be allowed to warm to ambient underground temperatures before shooting.

SAFETY PROCEDURES
MS-D3 UG ST contains Portland cement. Normal safety-wear such as rubber gloves, dust mask and safety glasses used to handle conventional cement based products should be worn. Safety Data Sheets are available upon request.

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Other Sites:
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Edmonton (Alberta)
Surrey (British Columbia)