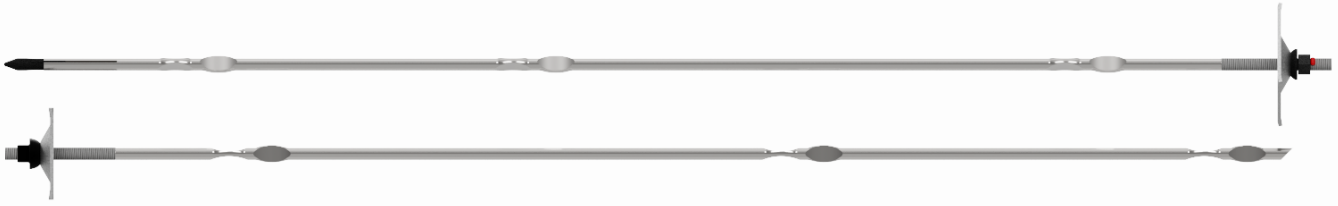


Dynamic Rock Bolt



DESCRIPTION

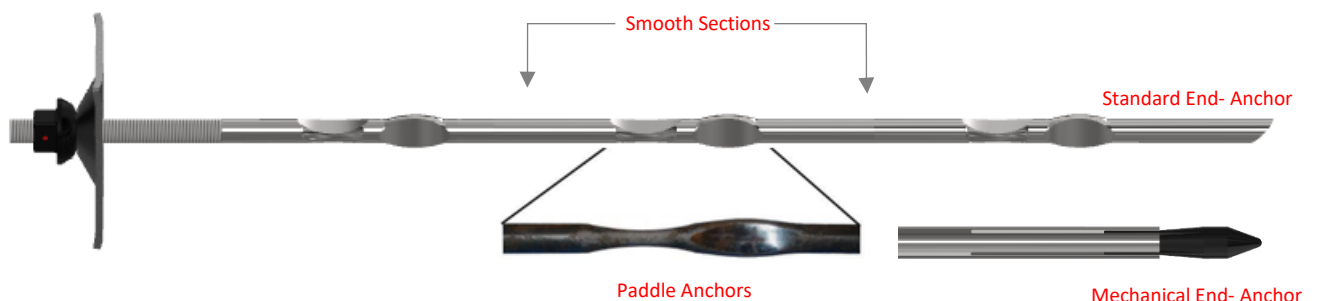
D-Bolt® is a proprietary class of dynamic rock bolt developed to control squeezing or seismically active ground. D-Bolt® is produced from a specialized steel that offers high levels of initial support stiffness yet allows for significant ductility once the yield limit of the steel has been exceeded. This unique steel property allows the bolt to serve as stiff rock support but with the capacity to absorb large rock mass deformation without losing tensile confinement. To prevent over-stressing of the rock and surface support, D-Bolt's® post-yield tensile resistance is designed to be approximately linear, offering uniform confinement force as the bolt elongates.

D-Bolt® comprises of a smooth steel bar featuring intermittent deformations along its length. These paddle deformations serve as specifically located anchor points into the encapsulating resin or grout. If installed into capsule resin, these paddles also serve to mix the resin during installation. This design allows the smooth sections of the bolt, the stems between the anchor points, to elongate without constraint and without damaging the encapsulating resin or grout.

D-Bolt® specifically features more than two anchoring paddle-sets along its length to ensure some degree of confinement is maintained should one of the stems fail or anchorage of a paddle-set become compromised by an event. Multiple paddle-sets also improve the initial stiffness of the bolt to preserve rock mass integrity. The number of paddles and their location are configurable to suit the specific geotechnical requirements of the mine.

TYPICAL APPLICATIONS

D-Bolt® is used as permanent rock reinforcement in underground excavations and is suited to applications where rock mass deformation or seismicity are expected during the life of the mine. D-Bolt® can be installed with standard mechanized bolting equipment, or manual hand-held equipment, in conjunction with either cementitious grout or polyester capsule resin. D-Bolt® is available with a mechanical end-anchor for use in cementitious grout, allowing pre-tensioning of the bolt before the encapsulating grout has cured.



Dynamic Rock Bolt

FUNCTIONALITY

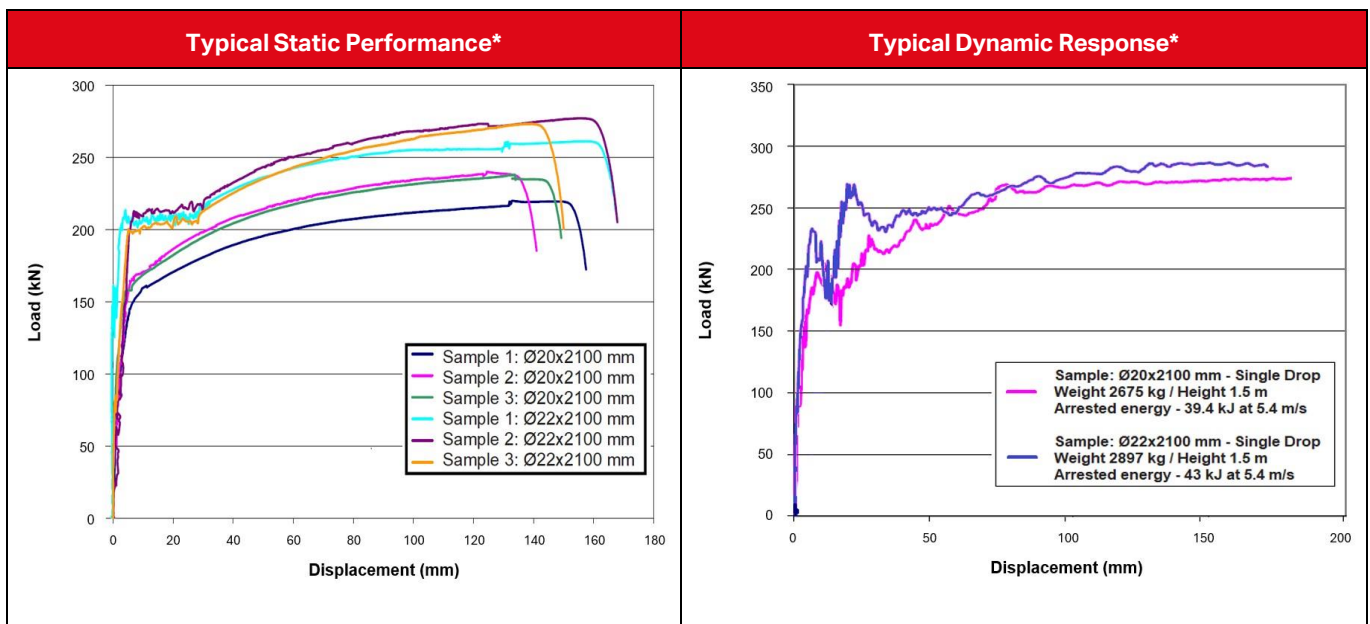
The collar end of D-Bolt® is threaded and is designed to be used in a system with a face plate, spherical washer and a nut that pre-tensions the bolt against the rock face. D-Bolt® is available in lengths from 1.8 m to 3.0 m. For longer lengths, a coupling version of the D-Bolt® is available allowing multiple D-Bolt® segments to be joined together.

D-Bolt® reinforces the rock mass by confining dilation between the paddle-sets. For confinement forces less than the yield limit of the steel, the bolt offers elastic, stiff support properties. However, as confinement forces exceed the yield limit, the smooth stem sections de-bond from the resin or grout and undergo permanent plastic elongation, allowing the bolt to deform with the rock mass and absorb dynamic energy, while still maintaining a near constant confinement force between the paddle sets. The multiple paddle-set design ensures that if a stem section of the bolt fails or a paddle-set loses anchorage to the rock mass, the reinforcement function of the remaining stem sections and paddle-sets along the bolt will remain unaffected. This design offers greater support redundancy compared to conventional dual paddle-set design.

TECHNICAL PERFORMANCE DATA

Description of Parameter	Ø 20 mm D-Bolt®	Ø 22 mm D-Bolt®
Yield Strength	510 MPa (Typ.)	
Ultimate Tensile Strength	691 MPa (Typ.)	
Material Elongation A5	18% to 22% - Selectable	
Charpy Test Impact Resistance	126 - 148 J / cm ²	
Bar Nominal Diameter	20.3 mm ± 0.2 mm	22 mm ± 0.2 mm
Cross Sectional Area	~324 mm ²	~387 mm ²
Yield Load	165 kN (Typ.)	197 kN (Typ.)
Ultimate Tensile Load	224 kN (Typ.)	267 kN (Typ.)
Displacement Capacity Static*	138 mm ± 11 mm	153 mm ± 11 mm
Dynamic Energy Capacity*	40 kJ (Typ.)	50 kJ (Typ.)
Installation hole sizes	Ø29 – Ø33 mm	Ø32 – Ø36 mm

* Canmet MMSL report 12-039 (CR) and 10-043 (CR), 2100 mm samples



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TECHNICAL DETAIL

Diameter and Length	
Paddle width Ø20.3 / 13/16" bar	28 ± 0.5 mm
Paddle width Ø22.0 / 7/8" bar	30 ± 0.5 mm
Standard Lengths	1.8 to 3.0 m ± 5.0 mm (Longer lengths and connectable D-Bolts available on request)
Standard stem lengths between paddle-sets	500 – 1500 mm 3 - 4 paddle sets of 2 - 4 paddles each <i>(Section lengths can be adjusted to suit conditions and bolt length)</i>
Bar finish	Black Hot Dip Galvanized <i>(ISO 1461)</i>

Standard Bar Weights (excl. accessories)	
Diameter	Kg/m
20 mm	2.47
13/16"	2.65
22 mm	2.98
7/8"	3.08

Shear Pin Break-out Torque (BOT)	
Standard	105 – 145 Nm
Low BOT (Optional)	75 – 105 Nm
High BOT (Optional)	160 – 200 Nm

Standard Pack	
Bolts per bundle Bundled with steel bands	50/100

Threads	
Bar Diameter	Thread Type, Diameter and Dir.
Thread length	150 mm to 300 mm
20 mm	M22x2.5 (CW/CCW) DIN405 RD22 (CCW)
13/16"	7/8" UNC9 (CCW) DIN405 RD22 (CCW)
22 mm	M24 x 3.0 (CW/CCW) RD24 x 4.5 (CW/CCW) DIN405 RD24 (CW/CCW)
7/8"	M24 x 3.0 (CW/CCW) RD24 x 4.5 (CW/CCW) DIN405 RD24 (CW/CCW)

Nuts and Spherical Seats	
Hex nuts	Ø20 mm bar – 32 mm A/F, 30 mm high Ø22 mm bar – 36 mm A/F, 30 mm high Proof load: 300 kN (Typ.)
Spherical seat	Ø50 x 20 mm, R25
Dome Nut	All sizes - Ø50 x 20 mm dome, 28.5 A/F x 20 mm high square drive Proof load: 300 kN (Typ.)
Coupler	Ø33 x 150 mm

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INSTRUCTION GUIDELINES FOR THE D-BOLT® USING RESIN GROUT

Recommended Borehole Diameter Range

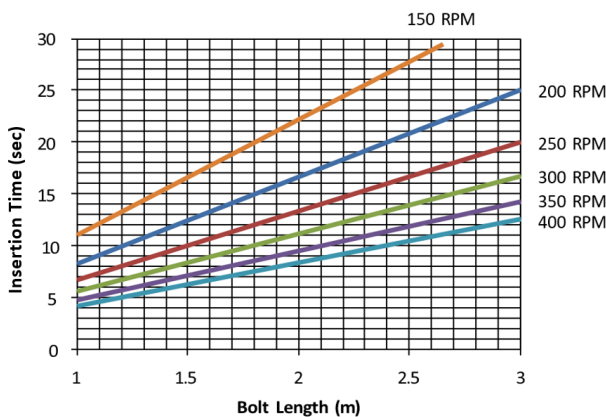
D-Bolt® Ø20 / 13/16"	Min. 29 mm Max. 33 mm
D-Bolt® Ø22 / 7/8"	Min. 32 mm Max. 36 mm

*Max. Ø39 mm with modified tip

Resin Cartridge Diameter

D-Bolt Dia.	Bore Hold Dia.	Resin Cartridge Dia.
Ø20 - 13/16"	29 - 31 mm	22 - 24 mm
	31 - 33 mm	26 - 28 mm
Ø22 - 7/8"	32 - 34 mm	26 - 28 mm
	34 - 36 mm	29 - 31 mm

Resin Mixing Time Guideline



May vary between resin suppliers, temperature and other local conditions

General Installation Procedure – Capsule Resin

- › The installation angle between the bolt and the rock face should not exceed 15 degrees.
- › Resin capsules are inserted into the pre-drilled borehole, prior to bolt installation.
- › The bolt is spun into the borehole until the nut and plate reaches the rock face. Refer to the resin mixing time guideline to select the feed rate vs. RPM.
- › The bolt is spun for an additional 3 seconds once the faceplate bottoms out.
- › Stop rotation and hold for the hold period specified by the resin supplier.
- › Once the hold time has lapsed, resume rotation to break the shear pin and pre-tension the bolt against the faceplate.
- › For optimal, long-term performance of the D-Bolt®, the resin should reach a min. UCS of 35 MPa when fully cured

See 2024 resin bolt installation guideline for detailed instructions

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