

LOKSET® X2

HARD ROCK MINING – WEST COAST OPTIMISED DOUBLE RESIN CAPSULES

DESCRIPTION

Lokset® X2 resin capsules have been developed to enable full encapsulated mechanised resin bolting, utilising the Quick-Chem™ resin capsule insertion system. The Lokset X2 system incorporates two resin capsules that are joined and folded in half for packaging.

The Lokset resin capsule consists of a reinforced, thixotropic polyester resin mastic in one compartment and an organic peroxide catalyst separated by a physical barrier in the other. The rotation of the bolt during installation ruptures the capsule, shreds the skin and mixes the two components causing a chemical reaction and transforming the resin mastic into a solid anchor.

Available in either single speed or two speed (Toospeedie®) configurations.

APPLICATION AND USES

The Lokset X2 resin capsule is used primarily as an anchoring medium for rockbolts. The Lokset X2 resin capsules are typically installed using development Jumbos in underground headings with an excavation height of 4–6 m, where hand insertion is not safe or practical.

ADVANTAGES

- ▶ Rapid insertion, easy and quick to use
- ▶ Higher compressive strength, strong, rapid and consistent anchorage
- ▶ Higher modulus
- ▶ Protects bolt from corrosion, can be used in wet or underwater conditions
- ▶ Unaffected by vibration
- ▶ No expansion stresses and can be used in weak strata
- ▶ Full encapsulation without pre-tensioning using slow set single speed capsules
- ▶ Point anchor installation with fast set single speed capsule
- ▶ Full encapsulation with pre-tensioning when using combination Toospeedie capsules
- ▶ Unique design of capsule configuration enabling extremely effective mixing of resin mastic and catalyst compartments



Figure 1 - Lokset X2 Resin Capsules

- ▶ Enables efficient use of the Quick-Chem installation system.
- ▶ Eliminates the requirement to use 2 separate capsules
- ▶ No capsule connectors or joiners required.
- ▶ Quick and easy to handle
- ▶ Supplied folded at join in capsule carton
- ▶ Impossible for join to separate
- ▶ Reduces box lengths for ease of handling
- ▶ Manufactured in Australia

TECHNICAL DATA

X2 Resin Capsule Range

Description	Total length
¹ Classic 800/30 Medium X2 with Quick-Chem Cap	1600mm
¹ Classic 900/30 Medium X2 with Quick-Chem Cap	1800mm
¹ Classic 1100/30 Medium X2 with Quick-Chem Cap	2200mm
¹ Classic 1200/30 Medium X2 with Quick-Chem Cap	2400mm
² TOOSPEEDIE 1050/26 Medium/Slow X2 with Quick-Chem Cap	2100mm
² TOOSPEEDIE 1200/26 Medium/Slow X2 with Quick-Chem Cap	2400mm
² TOOSPEEDIE 1500/26 Medium/Slow X2 with Quick-Chem Cap	3000mm

¹ Classic, single speed resin capsule

² Toospeedie, two speed resin capsule

Classic, Single Speed Resin Capsules

Typical insertion properties at 25°C are as follows:

Speed	Spin Time ¹	Hold Time ²	Capsule Colour	Label Colour
Super Fast	8 sec	>4 sec	Yellow	White
Extra Fast	8 sec	>4 sec	Yellow	Orange
Fast	10 sec	>4 sec	Yellow	Yellow
Medium	15 sec	>4 sec	Red	Red
Slow	20 sec	>70 sec	Blue	Blue

¹ Approximate spin time in seconds

² Minimum hold time in seconds

Toospeedie, Two Speed Resin Capsules

Typical insertion properties at 25°C:

Speed Ratio	Speed	Spin Time ¹	Hold Time ²
50:50	XFast/Medium	11	12-19
50:50	Super Fast/Slow	11	10-60
50:50	XFast/Slow	12	12-60
50:50	Fast/Slow	14	12-60
50:50	Medium/Slow	16	19-60
40:60	XFast/Slow	12	12-60
40:60	Fast/Slow	14	15-60
40:60	Medium/Slow	16	19-60

¹ Approximate spin time in seconds

² Minimum hold time in seconds

The hold time is the minimum time allowed after completion of the spin time before bolt tensioning is attempted. In many cases the hold time will be greater than that listed.

The times listed are an indication only, they may vary with temperature, mining conditions, equipment, hole:bolt annulus, age and storage conditions of resin capsules.

Each mine site should be evaluated to determine optimum installation parameters.

Temperature/Mastic Gel Time

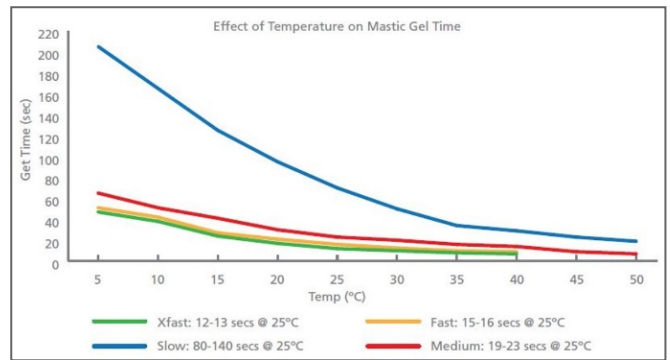


Figure 2 - Temperature/Mastic Gel Time

Compressive Strength

Tested in accordance with ¹BS 7861: Part 1:1996. Tested on 40 mm cubes with slow set resin.

¹Strata reinforcement support system components used in coal mines: Part 1, specification for rock bolting).

Typical results:

Age (hours)	Uniaxial Compressive Strength (MPa)
24	>60

Young Modulus

Tested on 2:1 aspect ratio cylinder with slow set resin.

Typical results:

Age (hours)	Young Modulus (GPa)
24	>6.5

Push Out Test

Measured on 22 mm bolt, 50 mm encapsulation in 28 mm I.D. threaded cylinder, with slow set resin.

Typical results:

Age (hours)	Push Out Force (kN)
24	>72

Punched Shear Strength

This test (according to BS 2782 Part 3) provides excellent correlation with mine pull out tests (without the variances) and is directly related to the strength of the resin. With fast setting resins the test can be performed in a very short time after the resin mixture has gelled (15 seconds).

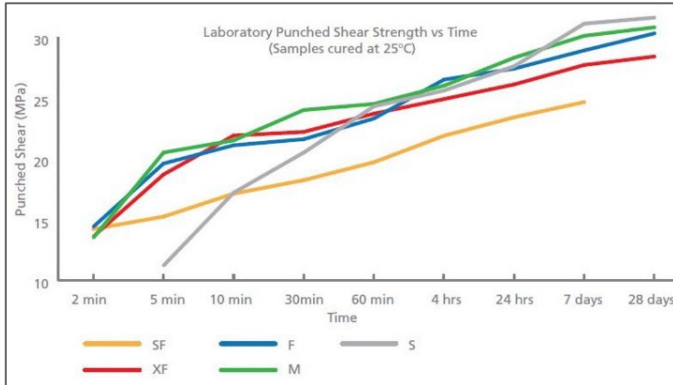


Figure 3 - Punched Shear Strength v's Time

QUICK-CHEM™ INSERTION SYSTEM

The Quick-Chem system is used in conjunction with Lokset X2 resin capsules to ensure quick, safe, efficient and remote installation of resin capsules into boreholes for rock bolting.

The Quick-Chem system consists of a specially designed cap suitable for attaching to 25 mm nominal diameter, 26 mm diameter, 30 mm diameter and 36 mm diameter Lokset resin capsules.



Figure 4 - Quick-Chem Insertion Tubes

In addition, the insertion tube consists of a threaded R32 adaptor sleeve (that locates in the drill coupling of the Jumbo drifter in seconds) and is secured to a 3-meter length of clear, high strength, flexible plastic tubing.

APPLICATION METHOD

X2 resin capsules application method

It is essential that good bolting procedures are followed and the instructions on the box are observed.

As a guide the following steps must be taken:

- 1) Drill hole to correct diameter ensuring water/air flush is used. The hole should be clean and free from dust and other loose particles. In Coal mining 27-28 mm hole diameters are normally preferred with 22 mm core diameter roof bolts or cables. Do not exceed the manufacturers recommended diameter.
- 2) Drill hole to correct length for bolt. The ideal hole length should be at least 100 mm shorter than the bolt, dependent on the bolt/cable being used. Do not deviate from the manufacturers recommended length of hole in relation to the bolt.
- 3) Select the correct resin capsule(s) that has been specified for the job.
- 4) Check that the use by date on the box label has not expired.
- 5) Follow the below insertion steps depending on which resin capsules are being used:

Classic, Single Speed Resin Capsules:

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- Step 1** Insert the capsule into the bolt hole
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- Step 2** Push the capsule(s) until the first capsule touches the top of the hole using the bolt (or other insertion device if available). Ensure the capsule reaches the top of the hole.
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Toospeedie, Two Speed Resin Capsules:

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- Step 1** Insert one Toospeedie capsule in the correct way:
- Yellow end first : Fast
: SuperFast / Slow
: XFast / Medium
: Fast / Slow
: XFast / Slow
- Red end first : Medium
: Medium / Slow
-
- Step 2** Push the capsule until the first capsule touches the top of the hole using the bolt (or other insertion device if available). Ensure the capsule reaches the top of the hole. Do not insert the Toospeedie capsule upside down. Should insertion problems occur then the problem must be investigated.
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- 6) Connect the bolt to the spinning dolly/spanner.
- 7) The bolt is pushed **and** spun at maximum rpm at a constant feed rate through the entire length of the capsule(s). When the top of the hole is reached a further 2 - 4 seconds spinning will suffice to ensure complete mixing.

Total spin time through the capsule and at the top of the hole should not exceed the "approximate spin time" on the box label. It is essential the bolt is pushed and spun to the top of the hole before mixing is completed.

- 8) Do not over mix the resin. If mixing continues beyond the recommended spin time and into the gel time, the solidifying chemical may be ground up and destroyed.
- 9) The bolt is then held stationary and after the hold time has elapsed the bolt may be tensioned as required.

The hold time is the minimum time allowed after completion of the spin time before bolt tensioning can be attempted. In many cases the hold time will be greater than that listed.

- 10) The following items must be checked where hand-held (air operated) equipment is utilised:
 - ▶ Clean and dry supply of compressed air
 - ▶ Air supply from roof bolter to miner should not be more than 100 metres of 2" hose
 - ▶ Air pressure must be between 85 - 100 psi (586 - 690 KPa) when bolter(s) are operating
 - ▶ Water pressure should be between 80-90 psi (550 - 620 KPa) and hoses flushed out prior to connection

Quick-chem application method

Individual Quick-Chem caps are supplied in the boxes with the resin capsules. One cap is fitted to the fast set end of each X2 capsule unit before being inserted into a Quick-Chem tube for installation into the borehole.

A Quick-Chem insertion tube is attached to the Jumbo drifter and used to safely insert resin capsules undamaged to the back of each borehole.

SAFETY INSTRUCTIONS AND LIMITATIONS

The annular gap between bolt and hole diameter should be at a minimum. It is recommended the annular gap be between 4 - 6mm e.g.

Bolt Diameter	22mm
Hole Diameter	27mm
Annular Gap	5mm

Where larger annular gaps are encountered (e.g. in Hardrock mines) the bolt must possess larger deforms or a mixing device such as mixing wire or Paddles. Follow the installation guidelines. Larger hole diameters/annular gaps may result in extended cure times, less efficient mixing, finger gloving of the bolt into the resin capsule, a reduction in load transfer (strength), a reduction in encapsulation length.

In all cases it is strongly recommended that short encapsulation pull tests be performed to verify that required load strengths are achieved.

Extended tensioning times may be due to:

- ▶ Low temperatures
- ▶ Broken ground
- ▶ Large hole diameters
- ▶ Insufficient spinning
- ▶ High nut break out loads
- ▶ High machine torque load levels
- ▶ Excessive thrust/feed on the installation rig
- ▶ Intermixing of slower setting resin into faster setting resin capsules.

The resin appearing to be "too quick" with the bolt not reaching the top of the hole may be due to:

- ▶ High temperatures
- ▶ Smaller diameter holes
- ▶ Hole closure
- ▶ Angled holes
- ▶ Misaligned holes/rigs
- ▶ Low feed pressure
- ▶ Premature nut break out
- ▶ Old/out of date resin

All bolting parameters will vary depending on several factors such as:

- ▶ Strata condition/type
- ▶ Temperature
- ▶ Hole:bolt annulus
- ▶ Age of resin capsule
- ▶ Equipment
- ▶ Installation method

Volume

It is essential the correct length of capsule is selected to fill the volume left in the hole after allowing for the volume of the bolt.

It is good practice to use a capsule size which exceeds this volume by around 10% to allow for variations in hole diameter and length, bolt size and strata conditions.

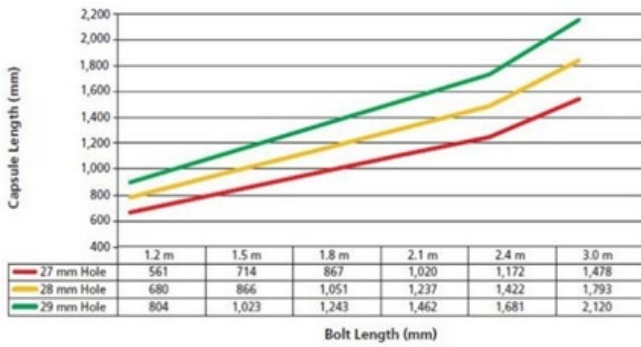


Figure 5 - 25mm nominal diameter capsule with 22mm core diameter bolt (Theoretical encapsulation + 10%)

PACKAGING AND TRANSPORTATION

Lokset X2 resin capsules

Available in standard diameters of 20 mm, nominal 25 mm (actual 23.6 mm), 26 mm, 30 mm, 36 mm and 38 mm. Lengths range from 800 mm x2 to 1500 mm x2.

Resin capsules are packaged in water resistance cardboard cartons labelled with colour codes and supplied on wooden pallets. Capsules are packed according to their length and in quantities relative to the capsule size.

Label colour is dependent on resin speed and resin combination:

Resin Speed	Colour of Label
Super Fast	White diamond
Extra Fast	Yellow diamond
Fast	Light yellow diamond
Medium	Red diamond
Slow	Blue diamond

Example of Toospeedie X2 with retainer label.



Figure 6 - Capsule Label

Quick-chem caps and insertion tubes

Available to suit 25mm, 26mm, 30mm and 36mm diameter resin capsules.

- ▶ 25mm, 26mm and 30mm Quick-Chem caps are designed for use in 33mm to 35mm diameter boreholes.
- ▶ 36mm Quick-Chem caps are designed for use in 45mm diameter boreholes.

STORAGE AND SHELF LIFE

Suggested shelf life for Lokset Toospeedie resin capsule is 4 months when stored between 20- 25°C. Extended shelf life can be expected when stored at lower temperatures of 0-5°C in cool rooms and is highly recommended. Stock rotation is strongly recommended. Storage at higher temperatures will severely reduce shelf life.

STORAGE CONDITIONS

Store in a cool, dry place away from direct sunlight. Do not double stack pallets. When using cool room storage, the resin capsules should be allowed time to attain ambient temperature before use otherwise SPIN and HOLD TIMES will be extended.

HEALTH AND SAFETY

For further information see the Lokset Safety data sheet on www.minovaglobal.com/apac

TECHNICAL SUPPORT

We provide technical advisory service by a team of specialists in the field. The service includes on site assistance and advice on evaluation trials and laboratory work.

Packed in water resistant cardboard cartons labelled with colour codes and supplied on wooden pallets.

QUALITY

The superior quality of the Lokset resin capsule is assured through a four-part quality control program:

- 1) Raw Material Testing
- 2) In-process quality control testing
- 3) Finished product acceptance testing
- 4) Quality system management to ISO 9001

Testing levels and specifications for each of the above programs have been established statistically, based on actual historical data to ensure the customer receives a uniform quality product which will perform dependably under field conditions.

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