

Lokset[®] Resin Capsules Product Data



Solutions from Materials Technology





Lokset® Resin Capsules

For over 30 years Minova Australia has lead the world in the development, manufacture and supply of resin capsules for rock bolting. Lokset® resin capsules are used primarily as an anchoring medium for rock bolts and cable bolts to provide roof (backs) and sidewall support to underground excavations. Minova's Lokset® resin capsules are industry renowned for consistent quality and performance. With state of the art technical and manufacturing facilities, Minova Australia provides an extensive and flexible range of resin capsules to suit all types of bolting parameters including variations in equipment, environment and strata conditions.

Lokset® resin capsules consist of a reinforced thixotropic polyester resin mastic in one compartment and organic peroxide catalyst separated by a physical barrier in the other compartment. The rotation of a rock 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.

Over the past 30 years Minova has successfully introduced a range of revolutionary developments in resin capsules including the Lokset TOOSPEEDIE® (1993), Lokset® Long Tendon (1996), Lokset® X2 (2000) and more recently the Lokset *Supamix*® (2008) series. These developments have ensured that Australian mining and tunnelling industries continue to lead the world in safe, efficient and consistent resin bolting. Minova Australia resin capsule series are available in multiple configurations of length, double length combinations (X2), diameter, set time, set time combinations (TOOSPEEDIE) and viscosity.

Australian development and manufacture ensures 100% security of supply to every customer regardless of the location. Experienced technical and mining personnel are involved in the development, daily service and support of Minova's range of Lokset® resin capsules.





Minova Australia's range of resin capsule systems includes the following:

Lokset® Resin Capsule	<ul style="list-style-type: none"> the original single speed polyester resin capsule
Lokset TOOSPEEDIE®	<ul style="list-style-type: none"> two separate speeds in a single capsule eliminates the need to use multiple single speed resin capsules in a single bolt hole
Lokset® Long Tendon	<ul style="list-style-type: none"> specifically developed range of capsules for use with point anchored or fully encapsulated cable bolts double length (joined) capsules enable full encapsulation mechanised bolting, for use in conjunction with Minova's Quick-Chem resin capsule insertion system
Lokset® X2	<ul style="list-style-type: none"> low mastic to catalyst ratio for improved mixing consistency and installed bolt quality, extended shelf life
Lokset Supamix®	<ul style="list-style-type: none"> Resin capsule insertion system
Quick-Chem	



Selection of the appropriate Lokset® capsule enables a wide variety of applications:

Advantages:	<ul style="list-style-type: none"> Full encapsulation with pre-tensioning utilising combination TOOSPEEDIE capsules Point anchor installation with fast set single speed Lokset® resin capsules Full encapsulation without pre-tensioning using slow set single speed Lokset® capsules Unique capsule configuration design enabling extremely effective mixing of resin mastic and catalyst compartments Rapid insertion, easy and quick to use High compressive strength, strong, rapid & consistent anchorage High modulus Protects bolt from corrosion, can be used in wet or underwater conditions Unaffected by vibration No expansion stresses, can be used in weak strata
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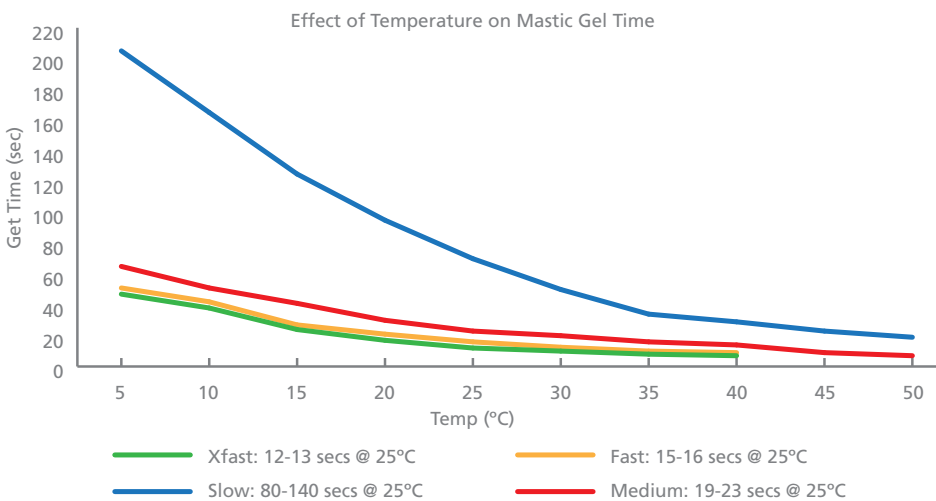
Lokset[®] Resin Capsules

Product Information

Capsule	Description	Capsule Colour	Label Colour	Approx Spin Time (seconds)	Approx Hold Time (seconds)	Gel Time 25°C (seconds)
SF	Super Fast	Yellow	White	8	> 4	10 – 11
XF	Extra Fast	Yellow	Orange	8	> 4	12 – 13
F	Fast	Yellow	Yellow	10	> 4	15 – 16
M	Medium	Red	Red	15	> 4	19 – 23
M	Medium – J Series	Red	Red	12	Tension > 5 minutes	15 – 23
S	Slow	Blue	Blue	20	> 70	80 – 140
S	Slow – J Series	Blue	Blue	20	Tension > 10 minutes	60 – 110
FRS	F Series Slow	L Green	Green	20	> 120	100 – 160
FRXXS	F Series XX Slow	L Pink	Pink	20	> 1200	1200 – 1500
XFM	Extra Fast/Medium 50:50 TOOSPEEDIE	Yellow/Red	Orange/Red	11	12 – 19	–
SFS	Super Fast/Slow 50:50 TOOSPEEDIE	Yellow/Blue	White/Blue	11	10 – 60	–
FS	Fast/Slow 50:50 TOOSPEEDIE	Yellow/Blue	Yellow/Blue	14	12 – 60	–
MS	Medium/Slow 50:50 TOOSPEEDIE	Red/Blue	Red/Blue	16	19 – 60	–
XFS	Extra Fast/Slow 40:60 TOOSPEEDIE	Yellow/Blue	Orange/Blue	12	12 – 60	–
FS	Fast/Slow 40:60 TOOSPEEDIE	Yellow/Blue	Yellow/Blue	14	12 – 60	–
MS	Medium/Slow 40:60 TOOSPEEDIE	Red/Blue	Red/Blue	16	19 – 16	–
XFS	Extra Fast/Slow 50:50 TOOSPEEDIE	Yellow/Blue	Orange/Blue	12	12 – 60	–



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. The following graph shows the effect of temperature on gel times.



Quality

The superior quality of Lokset® resin capsules 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.



Lokset[®] Resin Capsules

Product Testing Specifications

A combination of testing is completed to ensure the ongoing quality control of Minova's Lokset[®] resin capsule range. Each of the following tests forms an important part of this process.

Push out test

Measured to determine bond strength using a 22 mm bolt, 50 mm encapsulation in 28 mm I.D. threaded cylinder, with slow set Lokset[®] resin.

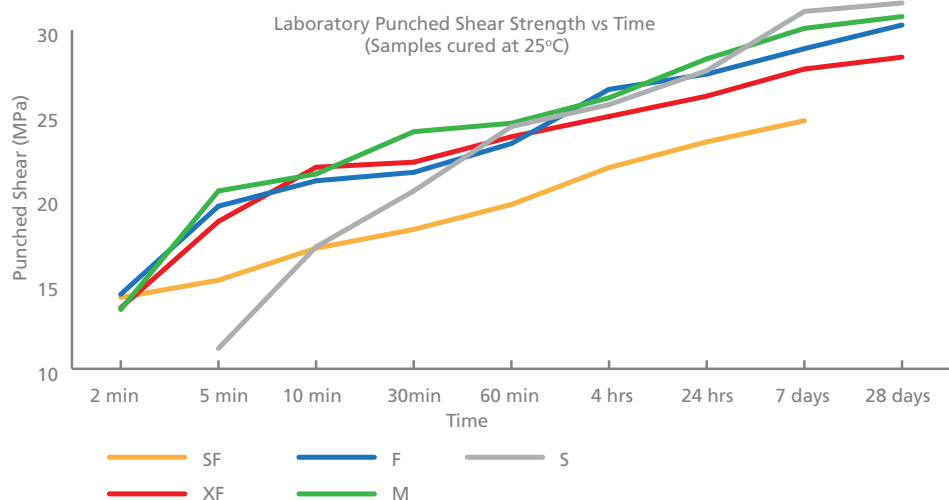
Pull out test

This is a routine test commonly performed on in-situ bolts to confirm effective anchorage. It is important to note that only short encapsulation in-situ tests can provide meaningful results. Minova's QC tests are measured with fast set resin. 300 mm encapsulation in 80 MPa grout using 21.7 mm core diameter high tensile grade bolts in 28 mm diameter hole.

Punched Shear

Measured according to BS 2782 (part 3). The appropriate quantities of resin mastic and catalyst are mixed together for six (6) seconds. The resultant mixture squashed between two uniform flat steel plates and allowed to gel. The plates are taken apart and the cured slice of resin is placed between two steel templates. The device is placed in a tensiometer and a plunger is forced into a hole in the plates at a predetermined rate thus pushing a flat circular disc out of the resin slice (ie shearing the resin). The force applied to shear the resin is recorded electronically by the tensiometer and converted to shear stress in MPa using the thickness of the disc in mm.

This test 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).



Application instructions

It is essential 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. Do not exceed the manufacturers recommended diameter.
2. Drill hole to correct length for bolt. The ideal hole length should be 100 mm –140 mm shorter than the bolt, depending on attachments such as dome ball washer, nut, plate etc. Do not deviate from the manufacturer's recommended length of hole in relation to the bolt.
3. Select the correct resin capsule that has been specified for the job.
4. Check that the use by date on the box label has not expired.
5. Where FAST (or MEDIUM) and SLOW set capsules are used together, when pre-tensioning, it is essential that the FAST (or MEDIUM) set (yellow or red) capsule be inserted first followed by SLOW set (green) capsule. 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

Should insertion problems occur then the problem must be investigated.

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, 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 also be checked where hand held (air operated) equipment is utilised:
 - Compressed air supply should be clean and dry
 - 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.



Lokset[®] Resin Capsules

Limitations

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

Bolt core diameter: 22 mm

Hole diameter: 27 mm

Annular gap: 5 mm

Where annular gaps larger than this are encountered (e.g. in metal mines) then the bolt must possess larger deforms or a mixing device such as Secura bolts etc and the installation guidelines followed. Larger hole diameters/annular gaps can result in extended cure times, less efficient mixing, finger gloving of the bolt into the resin capsule, a reduction in load transfer (strength) and encapsulation length.

In all cases it is strongly recommended that short encapsulation pull tests be performed to verify that required load strengths are being 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
- Over mixing of the resin well above the appropriate spin time
- Attempting to tension the bolt too soon and damaging the resin as it cures

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

- High temperatures
- Smaller hole diameters
- 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 a number of factors such as:

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

Packaging

Lokset® Resin Capsules are 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 300 mm to 1700 mm, with X2 providing additional length. They are packaged in water resistant cardboard cartons labelled with colour codes and supplied on wooden pallets.

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. Refer to encapsulation chart available at www.minova.com.au

Storage

Shelf Life

The Lokset® resin capsule suggested shelf life is 4 months when stored between 20 – 25°C. Storage at lower temperatures such as in cool rooms is highly recommended and will extend the shelf life when stored at 0 – 5°C. Stock rotation is strongly recommended. Storage at higher temperatures will reduce shelf life.

Storage conditions

Lokset® resin capsules should be stored in a cool dry place away from direct sunlight. 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

- Wear suitable protective clothing, gloves and eye/face protection.
- In case of contact with skin remove contaminated clothing and immediately wash with soap and water, seek medical attention if skin irritation persists.
- In case of contact with eyes, flush with copious amounts of water and seek medical assistance.
- If inhaled remove from exposure and seek medical advice if effects persist.
- If ingested wash out mouth with water and obtain medical attention.

For further information see the relevant material safety data sheet.



Lokset[®] Resin Capsules

Lokset[®] resin capsules are a single speed polyester resin mastic and organic peroxide catalyst system used for standard point anchor or fully encapsulation bolting requirements. Available in multiple lengths, diameters and set times, Lokset[®] resin capsules have been the benchmark for quality and performance in resin bolting for over 30 years.

Resin capsule product code breakdown:

Typical code:	• RA65025F(C)
RA	• Lokset [®] resin anchoring capsule
650	• Capsule length (650 mm)
25	• Nominal capsule diameter (25 mm)
F	• Set time (Fast)
C	• A range of inclusions or attachments are also available such as cardboard cylinders (C), and are indicated by an additional letter at the end of the typical code.

Punch Shear Test

Measured according to BS 2782 (Part 3), with slow set Lokset[®] resin. Typical results:

Age (hours)	Shear strength (MPa)
24	> 32

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

Pull Out Test

Measured with fast set Lokset[®] resin. 300 mm encapsulation in 60 MPa grout using 21.7 mm core diameter high tensile grade bolts in 28 mm diameter hole. Typical results:

Age (hours)	Load (T)
1	> 16

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MS2181/300609

Lokset TOOSPEEDIE® Resin Capsules

In 1993 Minova Australia completed the development and introduction of Lokset TOOSPEEDIE® resin capsules, the world's first two speed resin capsule. A development that remains to be the most ground breaking evolution in resin bolting, the Lokset TOOSPEEDIE® eliminates the need to use multiple resin capsules to achieve pre-tensioning of fully encapsulated resin grouted rock bolts.

Lokset TOOSPEEDIE® capsules are available in multiple set time ratios, as designated by the product codes typically displayed below. Combinations of set times are possible using any of Minova's resin mastic formulations.

TOOSPEEDIE capsule product code breakdown:

TS	• TOOSPEEDIE 50% fast set, 50% slow set
46	• TOOSPEEDIE 40% fast set, 60% slow set
Other ratios available on request	
Typical code:	• TS120025FS
TS	• TOOSPEEDIE 50% fast set (F), 50% slow set (S)
1200	• Capsule length (1200 mm)
25	• Capsule diameter (25 mm)

Punch Shear Test

Measured according to BS 2782 (Part 3), with slow set Lokset® resin. Typical results:

Age (days)	Shear strength (MPa)
28	> 32

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

Pull Out Test

Measured with fast set Lokset® resin. 300 mm encapsulation in 60 MPa grout using 21.7 mm core diameter high tensile grade bolts in 28 mm diameter hole: Typical results:

Age (hours)	Load (T)
1	> 16



Lokset® Long Tendon Resin Capsules

To assist in the advancement of cable bolt technology, Minova developed and introduced the Lokset® Long Tendon resin capsule range in 1996. The Lokset® Long Tendon range contains specially formulated resin mastics to aid insertion and push through where long tendon support is required.

The Lokset® Long Tendon range (F Series and J Series) have been developed for use with all resin anchored cable bolts, options include:

- Point anchoring installation with Slow set (F) or (J) capsules
- Full encapsulation with pre-tensioning
- Full encapsulation without pre-tensioning

Long Tendon capsule product code breakdown:

Typical code:	• F130025FRXXS
F	• Lokset® Long Tendon F Series (alternatively J Series)
1300	• Capsule length (1,300 mm)
25	• Capsule diameter (25 mm)
FRXXS	• F Series Extra Extra Slow

Punch Shear Test

Measured according to BS 2782 (Part 3), with F Series slow set and J Series slow set Lokset® resin. Typical results:

Age (days)	Shear strength (MPa)
28	F Series > 32 J Series > 27

Push Out Test

Measured on 22 mm bolt, 50 mm encapsulation in 28 mm I.D. threaded cylinder, with F Series XX Slow set, and J Series slow set resin. Typical results:

Age (hours)	Push out force (kN)
24	F Series > 70 J Series > 56

Pull Out Test

Measured with F Series slow set and J Series slow set resin. 300 mm encapsulation in 60 MPa grout using 21.7 mm core diameter hi tensile grade bolts in 28 mm diameter hole: Typical results:

Age (hours)	Load (T)
1	F Series > 12.5 J Series > 15

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Lokset® X2 Resin Capsules

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 joined and folded in half for packaging, and is available in either single speed or TOOSPEEDIE configurations.

Lokset® X2 resin capsules are typically installed using development Jumbos in underground headings with an excavation height of 4 – 6 mm, where hand insertion is not safe or practical. Individual Quick-Chem caps are supplied in the boxes with the resin capsules, and 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. Quick-Chem caps and insertion tubes are available to suit 25 mm, 26 mm, 30 mm and 36 mm diameter resin capsules. 25 mm, 26 mm and 30 mm Quick-Chem caps are designed for use in 33 mm – 35 mm diameter boreholes. 36 mm Quick-Chem caps are designed for use in 45 mm diameter boreholes.

The Lokset® X2 range is available with any single (RA) or combination (TS) of Minova resin capsule mastics. Any capsule combination can be ordered by simply adding an X2 or X2Q (including Quick-Chem cap) to the end of an existing Lokset® Resin Capsule or Lokset TOOSPEEDIE® resin capsule code.

Standard Lokset® X2 Product Codes and Descriptions

Product Code	Description	Total Length
RA80030MX2Q	Lokset® Resin Anchor 800/30 Medium X2 including Quick-Chem Cap	1600 mm
RA90030MX2Q	Lokset® Resin Anchor 900/30 Medium X2 including Quick-Chem Cap	1800 mm
RA110030MX2Q	Lokset® Resin Anchor 1100/30 Medium X2 including Quick-Chem Cap	2200 mm
RA120030MX2Q	Lokset® Resin Anchor 1200/30 Medium X2 including Quick-Chem Cap	2400 mm
TS105026MSX2Q	Lokset TOOSPEEDIE® 1050/26 Medium/Slow X2 incl. Quick-Chem Cap	2100 mm
TS120026MSX2Q	Lokset TOOSPEEDIE® 1200/26 Medium/Slow X2 incl. Quick-Chem Cap	2400 mm
TS150026MSX2Q	Lokset TOOSPEEDIE® 1500/26 Medium/Slow X2 incl. Quick-Chem Cap	3000 mm



Lokset Supamix[®] Resin Capsules



In 2008 Minova completed an extensive product development program focusing on improving the quality of installed resin bolts. Key product development objectives included improved mixing quality, and encapsulation consistency, reduction of hole back pressure, extended shelf life and a lower cost formulation. All the proposed development objectives were achieved culminating in the launch of the Lokset **Supamix[®]** range of resin capsules.

The Lokset **Supamix[®]** range incorporates significant improvements:

Improvements

- Lowest available mastic:catalyst ratio of 2:1 – improving mixing quality and consistency
- Lower viscosity and modified rheology – easier push through and improved encapsulation
- Improved formulation providing extended shelf life – 6 months at 25°C to reduce wastage
- Larger catalyst compartment – improved catalyst compartment mixing, bolt should not miss
- Lower cost

Punch Shear Test

Measured according to BS 2782 (Part 3), with slow set Lokset[®] resin. Typical results:

Age (days)	Shear strength (MPa)
28	> 23

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	> 50

Pull Out Test

Measured with fast set Lokset[®] resin. 300 mm encapsulation in 60 MPa grout using 21.7 mm core diameter hi tensile grade bolts in 28 mm diameter hole: Typical results:

Age (hours)	Load (T)
1	> 16

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Quick-Chem™ Resin Capsule Insertion System

Quick-Chem is a patented system developed to remotely install resin capsules into boreholes for rock bolting. The Quick-Chem system has been developed to mechanically install resin capsules where hand installation is not safe or practical. Historical methods of hand installation from man baskets etc. into boreholes in high headings have now been eliminated by an extremely safe and simple system.

Quick-Chem consists of purpose designed retaining caps (which are attached to resin capsules) and insertion tubes. The insertion tubes consist of a specific diameter tube and R32 threaded adaptor.

The tubes are fitted into the drifter of development Jumbos. Caps are fitted to the resin capsules and inserted into the tubes. The jumbo boom is then used to insert the tube and resin capsules undamaged to the back of the hole. Minova has developed the Lokset TOOSPEEDIE® X2 range of resin capsules for exclusive use with the Quick-Chem system, and Quick-Chem caps are supplied in the boxes with the resin capsules. The joined resin capsule system eliminates the requirement for multiple capsules and hole insertions.

Advantages

- Safe and simple system, suitable for any remote installation
- Available in various lengths and diameters
- Clear tube enables visual confirmation of resin capsule position
- Up to 200 hole insertions is possible with each tube
- Insertions are completed from under supported ground
- Quick and efficient installation method
- Caps are supplied inside the resin capsule boxes

Technical Data

Quick Chem Tube Size	Tube ID	Tube OD	Total Length (including adaptor)
26 mm (and 25 mm)	26.8 mm – 27.5 mm	31.4 mm – 31.8 mm	3.15 metres
30 mm	30.35 mm – 30.85 mm	33.5 mm – 33.75 mm	3.15 metres
36 mm	36.3 mm – 36.8 mm	40.75 mm – 41.25 mm	3.75 metres

Quick-Chem™ is a trademark of Minova International Ltd, and the Quick-Chem system is subject to Patent No.s 2002248972 and 2004216586.
MS2365/300609





Product Service Support

Minova provides a full service support package to customers, including underground pull testing, operator awareness training, underground audits and stock control assistance. Each service package is developed to suit the individual customers requirements.

All aspects of Minova's product service support service is provided by experienced trained and qualified personnel.

Additional Information

For additional information relating to any aspect of this product specification data, including product performance, quality, testing, specification, range, availability etc. please contact your nearest Minova office, or email: technicalsupport@minovaint.com

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