J-LOK® Resin

J-LOK equipment is the most modern and technologically advanced in the resin business, equipped with the most accurate system for ratio control of the resin/limestone mixture ensuring that resin/catalyst proportions are consistent. The entire plant is interconnected to provide coordinated control of the entire process. Operators utilize PLC touch screens to enter product recipes and to make operational adjustments. Quality control testing encompasses everything from raw material testing, in-process testing and final product quality and performance testing.

The labs at J-LOK have custom designed equipment such as the automated gel time tester that takes all the technician variation out of the test providing consistent results every time. Both J-LOK plants as well as the R&D lab in Pittsburgh have modified roof bolting machines to measure parameters such as pull strength and insertion force allowing products to be customized as necessary.

J-LOK personnel work with key suppliers to optimize raw material specifications. J-LOK has created many innovations such as TWIN-LOK® 2-speed resin cartridges for torque-tension applications, J-LOK LIF, Low Insertion Force resin where bolter thrust is an issue and J-LOK P™, pumpable resin for grouting from a distance. Several of these products have been patented.

J-LOK produces resin products to complement JENNMAR products and provide an optimum system of bolt and resin. J-LOK's R&D capability utilizing product formulation expertise from the resin plants in conjunction with the mining expertise of JENNMAR's engineering affiliate, ***JENNMAR Engineering*** *is unmatched.*

J-LOK® Resin Cartridges

Polyester Resin Anchoring System

The Cartridge

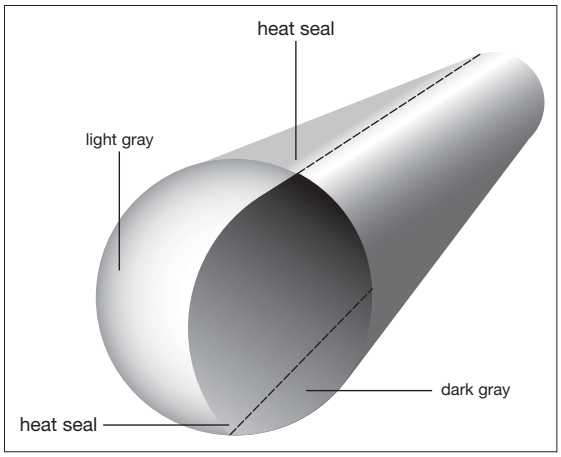
The J-LOK® resin in the cartridge is used to anchor bolts to the surrounding strata. This unification of the resin, bolt and strata layers provides the necessary strength and rigidity to prevent sag by acting as a reinforcement which anchors the individual stratified layers of rock into a single high strength beam.

The two-compartment cartridge shown in illustration A above consists of a heat-sealed tube of polyester film clipped at both ends. One compartment contains a dark gray resin; the other, a light gray catalyst. A cross section of the cartridge is shown in illustration B.

A film barrier of heat sealed polyester film prevents migration between the resin and the catalyst to provide optimum shelf life. The excellent chemical resistance of the film minimizes migration from the inside and the absorption of contaminants from the outside.

The lightweight, dimensionally stable casing of film is strong enough to withstand rough handling, but shreds quickly and thoroughly during the installation procedure.

J-LOK is thixotropic and fast setting. This reduces viscosity during insertion of the bolt and permits relatively low installation force and torque. The results are fast installation, rapid achievement of full strength, and a minimum tendency for ungelled resin to drip from the holes during installation.



Cross Section

Advantages

The proprietary J-LOK® package has a distinct advantage over other resin systems due to:

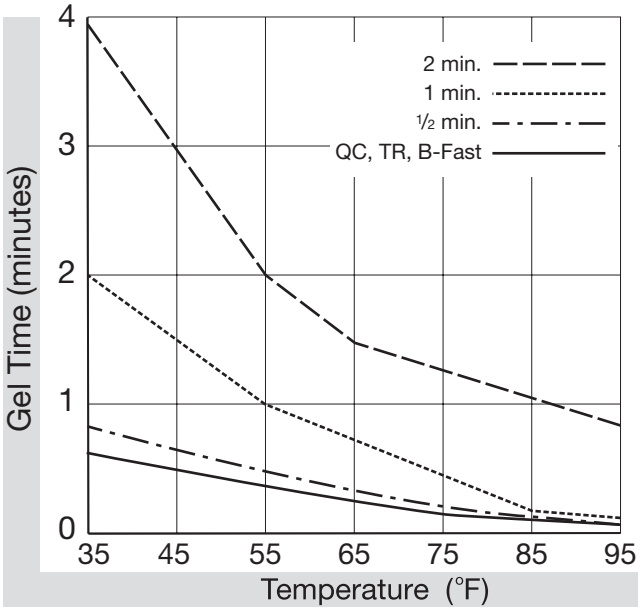
- High catalyst/resin ratio
- Uniform installation time
- Mixing efficiency

Storage Recommendations

For maximum shelf life, J-LOK cartridges should be stored away from direct sunlight in a reasonably cool, well-ventilated, dry area. Storage life is up to 1 year, depending on ambient temperature conditions. Under adverse conditions shelf-life is reduced. To ensure proper storage, the product should not be subjected to temperatures in excess of 90°F for prolonged periods. Storage is recommended under cover, on original pallets with adequate ventilation. If stored in trailers in hot weather, door should be left ajar or a sun screen erected over the trailer. Conversely, while cold storage does not adversely affect the shelf-life of J-LOK, it should be warmed to a range of 50°–60°F before using to assure gel times within the specified range (see Figure 2).

The time required for cases of J-LOK to warm or cool to ambient temperature is dependent on both the initial temperature and how the cases are stacked. Where the initial temperature is anywhere between 25° and 85°F, cases will come within 5° of ambient temperature in 48 hours when stacked in single columns with 4 sides of each case exposed to the air. Multiple columns should be separated by at least 2" to assist air circulation between columns.

Fig. 2. Gel time



J-LOK® Resin

GEL, Spin and Hold Times

Gel Time

Generally, the sum of the Spin Time and Hold Time is the Gel Time. The time from the start of mixing until the resin starts to harden is the Gel Time. Gel Time is influenced by temperature of resin, strata and bolt. Additionally, the amount of heat generated in mixing during the spin time also affects Gel Time. Field trials are recommended.

Spin Time

Cartridge contents should be completely mixed to achieve maximum anchorage. The generally accepted mix standard is a minimum of 30 revolutions of the bolt. Spin Time is the time required, at typical bolter rotation of 400–600 rpm, to achieve the complete mix.

Hold Time

After the cartridge contents are mixed, the resin must harden to achieve strength. The time required after mixing is completed and the bolt has achieved a firm anchorage is referred to as Hold Time.

Gel, Spin and Hold Times

Gel Time, Seconds	Spin Time, Seconds	Hold Time, Seconds	Color Code
10	3 to 5	3 to 8	Pink
20	3 to 6	4 to 8	Orange
30	3 to 7	8 to 15	Blue
45	4 to 9	8 to 20	White
60	5 to 10	18 to 28	Green
75 & 90	5 to 10	20 to 40	Green/White
120	5 to 10	25 to 75	Yellow
120–240 & Higher	5 to 15	45 to 240	Yellow/White
TWIN-LOK, 10	3 to 5	3 to 5	Pink/White
TWIN-LOK, 20	3 to 6	3 to 6	Orange/White

Resin Cartridge Size

The diameter and length of the J-LOK cartridge depends on the dimensions of the specific bolt and borehole. Cartridges are available in lengths from 12" to 60". The diameter and length of cartridges employed in USA coal mines are specified by ASTM F-432-10. The systems developed by J-LOK engineers following ASTM F-432-10 are summarized in the following table:

Technical Data — J-LOK Resin Cartridges

Cartridge Diameter, in. (mm)	Hole Diameter, in. (mm)	Bolt Type	Bolt Diameter, in. (mm)	J-Lok System*	Product Use Class	Strength Index
0.9 (23)	1 (25)	#6 Rebar	3/4 (19)	A	I, II, III	10
0.9 (23)	1 (25)	Point Anchor #6 Tension	3/4 (19)	A-TA	I, II, III	10
0.9 (23)	1 (25)	#5 Rebar	5/8 (16)	B	I, II, III	10
0.9 (23)	1 (25)	Cable	0.5, 0.6, 0.7 (13, 15, 18)	CA, A, B	I, II, III	10
0.9 (23)	1 (25)	INSTaL Resin	5/8 (16)	BI	I, II, III	10
1.25 (32)	1-3/8 (35)	#7 Rebar	7/8 (22)	J, CJ, JI	I, II, III	10
1.25 (32)	1-3/8 (35)	Cable	0.5, 0.6, 0.7 (13, 15, 18)	CJ	I, II, III	10
1.25 (32)	1-3/8 (35)	INSTaL Resin	3/4–7/8 (19–22)	JI	I, II, III	10
1.25 (32)	1-3/8 (35)	Combination	7/8 (22)	CBJ, J	I, II, III	10
0.9 (23)	1 (25)	#6 Rebar	3/4 (19)	TA	I, II, III	10
0.9 (23)	1 (25)	#5 Rebar	5/8 (16)	TB	I, II, III	10

* Designated J-LOK Systems are shown for typical applications and can be used for other bolt types and sizes.

J-LOK® Resin Cartridge Drill Hole and Fill Charts

Mining Applications

The required diameter and length of J-LOK cartridges for civil and tunneling applications, not governed by ASTM F-432-10, is calculated by estimating the volume of the annulus between the bolt and the borehole. J-LOK cartridges are manufactured in diameters of 23, 28, 32, 35, and 40 mm. Cartridges may be manufactured in lengths to suit specific bolt and borehole combinations. However, it is generally more efficient to employ multiple standard one foot (305 mm) long cartridges to anchor each bolt.

The following English and metric tables, with 15% excess for borehole irregularities, assist in the selection and ordering J-LOK cartridges. The English unit table estimates the inches grouted by a standard one foot long cartridge. The metric unit table estimates the millimeters grouted by a standard 305 mm long cartridge.

Metric

Nominal Rebar Diameter, mm	Drill Hole Diameter, mm					
	25	28	33	35	42	51
	Resin Cartridge Diameter, mm					
	23	23	28	32	35	40
16	380					
18	466	305				
20	624	365	302			
22		468	344	367		
25			448	453		
28				616	332	
32					439	
35					603	308

English

Nominal Rebar		Drill Hole Diameter, in.						
		1	1-1/4	1-3/8	1-1/2	1-3/4	2	2-1/4
		Resin Cartridge Diameter, in.						
Rebar	Diameter, in.	0.9	1-1/8	1-1/4	1-1/4	1-3/8	1-9/16	1-9/16
#6	3/4	19.6	12.7					
#7	7/8		15.9	14.7				
#8	1		22.5	18.6	13.2			
#9	1-1/8			26.5	16.8			
#10	1-1/4				24.1	13.2		
#11	1-3/8					16.9	12.3	
#12	1-1/2					24.4	14.8	9.2
#13	1-5/8						19	10.7
#14	1-3/4							12.9

For Example: a project requires a 3 meter long 22 millimeter diameter rebar, anchored with a one meter long resin anchor. The metric table indicates that this rebar may be installed in a 28, 33, or 35 mm borehole. Assume available equipment is best suited to drill a 33 mm borehole. A 28 mm diameter cartridge is best suited for this rebar and borehole combination. A 305 mm long 28 mm cartridge grouts 344 mm. Therefore, three 305 mm cartridges would be required per bolt. Typically a fast cartridge would be followed by two slow set cartridges, to provide for efficient insertion and rapid tensioning.

Civil & Tunneling Applications

Metric & English

Grade 75 All-Thread Rebar Grade 60 Solid Rebar	Drill Hole Diameter, in. (mm)										
	1 (25)	1-1/4 (32)	1-1/2 (38)	1-9/16 (40)	1-1/2 (38)	1-9/16 (40)	1-3/4 (44)	1-7/8 (48)	2 (51)	2-1/4 (57)	2-1/2 (64)
	Resin Cartridge Diameter, in. (mm)										
	15/16 (24)	1-1/8 (29)	1-1/4 (32)	1-1/4 (32)	1-3/8 (35)	1-3/8 (35)	1-9/16 (40)	1-9/16 (40)	1-9/16 (40)	1-3/4 (44)	1-3/4 (44)
#6, 3/4 in. (19 mm)	20 (508)	13 (330)									
#7, 7/8 in. (22 mm)		16 (406)									
#8, 1 in. (25 mm)		23 (584)	13 (330)		16 (406)	15 (381)					
#9, 1-1/8 in. (29 mm)			16 (406)	14 (356)	20 (508)	16 (406)					
1-3/16 in. (30 mm)			19 (483)	15 (381)	23 (584)	18 (457)	15 (381)				
#10, 1-1/4 in. (32 mm)				18 (457)		22 (559)	17 (432)				
#11, 1-3/8 in. (35 mm)							21 (533)	15 (381)	12 (305)		
#14, 1-3/4 in. (44 mm)										14 (356)	
150 KSI All-Thread Bar											
1 in. (25 mm)			15 (381)	12 (305)	18 (457)	15 (381)					
1-1/4 in. (32 mm)							23 (584)	16 (406)	12 (305)		
1-3/8 in. (35 mm)								19 (483)	14 (356)		
1-3/4 in. (44 mm)										18 (457)	12 (305)

The Resin Cartridge Drill Hole Fill Chart shows the length of drill hole that will be encapsulated by a 12 in. (305 mm) resin cartridge. This chart can be used as a guide for the most common combinations of hole, bolt, and resin diameters. Other combinations are possible as long as the annular space does not exceed 1/4 to 3/8 in. (6 to 10 mm). Due to difficulty in overcoming drag of the bar through the resin cartridges during insertion, encapsulated resin drill holes are most practical with shorter anchorages.