

Mining machinery

Presented By:

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Lecture Details:

Wire Rope

Surface Mining/Mining, IV Semester .

Regulation GRBT-19	Godavari Institute of Engineering & Technology (Autonomous)	IV B. Tech. I Sem. (7 th Semester)			
Course Code 19160702	Mining Machinery				
Teaching	Total contact hours - 50	L	T	P	C
Prerequisite(s): Surface Mining, Mine Transportation, Underground Coal Mining		2	1	0	3

Course Objectives

1. To introduce the principles, operations and application of wire ropes.
2. To discuss the principles, operations and application of mine pumps.
3. To elaborate the electrical and telecommunication systems used in mines.
4. To impart the knowledge on surface mining machinery systems and their applications.
5. To educate on the underground mining machinery systems and their applications.

Course Outcomes

On Completion of the course, the students will be able to-	
C01:	Comprehend the operations and application of conveyors.
C02:	Plan and design the pumping system of a mine.
C03:	Comprehend and plan the electrical and telecommunication systems in mines.
C04:	Identify the operations and application of surface mining equipment.
C05:	Assess the operations and application of machinery in underground mines.

UNIT-I Wire Ropes

- Construction of wire ropes;
- Various types of rope used in mining;
- Factor of safety (FOS) of rope;
- Care and maintenance of rope in use and also in storage;
- Splicing of haulage rope;
- Calculation of size of winding rope;
- Examination of rope;
- Life of rope and norms for discarding a rope;
- Rope capel and recapping.

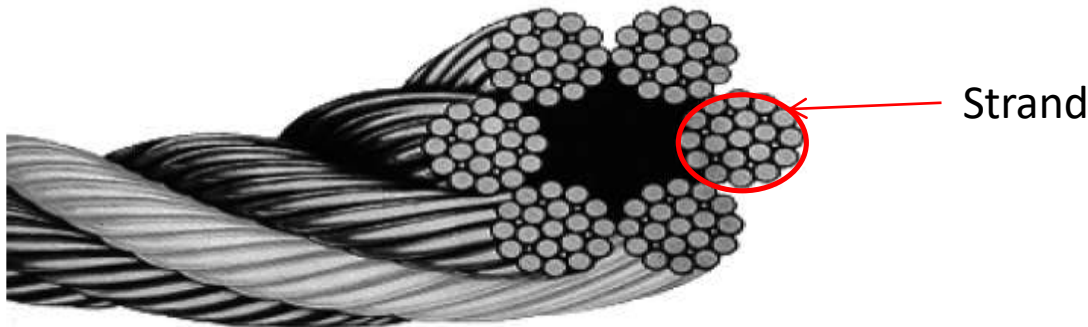
Flexible Load Handling Attachment: Steel Wire rope

Advantages over chains:

- Lighter weight, easy to handle
- Less susceptibility to damage from jerks
- Silent operation even at high working speeds
- More reliable and durable
- Longer life
- Less liable to kink
- High efficiency
- Withstand shock and load
- Low cost

Wire Ropes

- Wire rope is several strands of metal wire twisted into a helix forming a composite rope, in a pattern known as laid rope. Larger diameter wire rope consists of multiple strands of such laid rope in a pattern known as cable laid.
- If the wire is to be used in wet shaft the wire are galvanised (i.e. coated with molten zinc).



What are the applications of wire rope?



- Construction.
- Mining.
- Manufacturing.
- Transportation.
- Lifting. The lifting industry comprises cranes and hoists, both mobile and fixed.

*Ropes used for different
puposes in mining :*

- 1.Winding ropes
- 2.Guide ropes
- 3.Haulage ropes
- 4.Coal cutting machines
- 5.Dipper shovel ropes
- 6.Dragline hoist rope
- 7.Aerial rope way
- 8.Mobile cranes
- 9.Bridges

Characteristics of a wire ropes:

(1) Strength (2) Flexibility (3) Robustness (4) Fatigue strength and corrosion resistance (5)

Strength can be increased by:

- Increasing the diameter of the wire rope
- Increasing the tensile strength of the individual wires
- Decreasing the air voids between the wires
- Using a steel core construction.

Flexibility can be increased by:

- Using more wires of a smaller diameter
- Decreasing the tensile strength of the individual wires
- Using a fiber core.

Robustness, or resistance to physical damage:

- Increased by using fewer wires of a larger diameter
- Using a steel core
- Coatings can be applied to protect against corrosion.

Type of rope

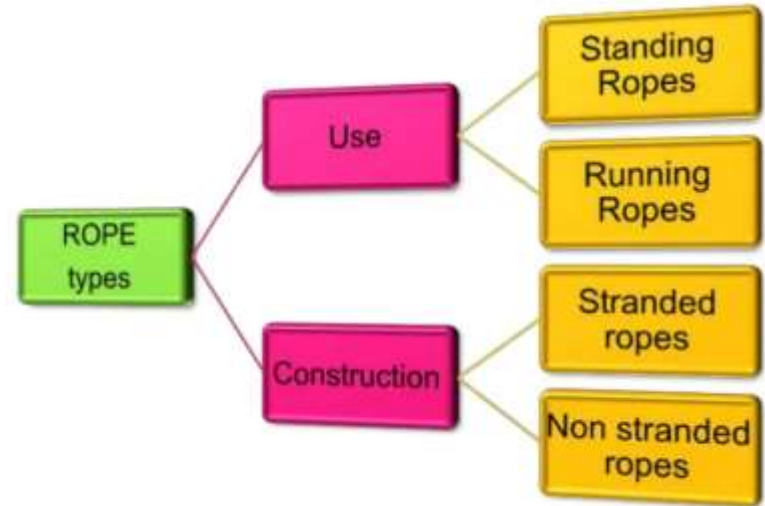
Based on used

- Standing rope
- Running rope

Based on construction

- Stranded rope
- Non-stranded rope

Types of wire rope :-



Based on use of rope :-

1.Standing ropes :

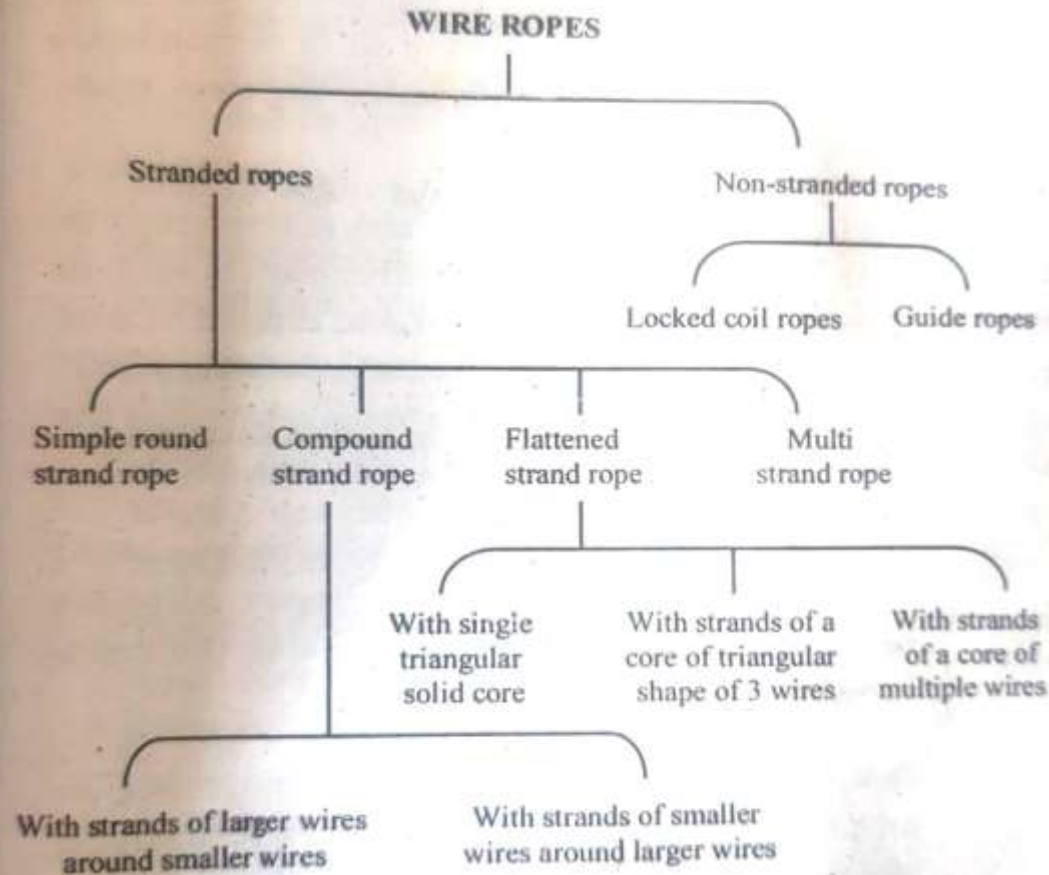
- Carry the burden or load but are more or less stationary.

Exp. :- guide rope, bucket supporting ropes etc.

2 .Running ropes :

- Have to undergo frequent movement or running often with varying loads.

Exp. :- in winding , haulage , CCM, excavators cranes etc.



2. Non -Stranded ropes :



• *Full locked coil rope*

- A rope in which the wires are not laid up in strands but in concentric sheaths, and in opposite directions in the different sheaths, which gives the rope non spinning properties.
- The outer sheaths are composed of specially shaped interlocking wires, and there is no hemp core in the rope.

The disadvantages of locked coil ropes (non-strand rope)

1. Its construction is somewhat difficult.
2. Its interior cannot be lubricated from outside.
3. It cannot be spliced.
4. It is not so flexible.
5. It is somewhat difficult to cap as compared with the stranded ropes.

Stranded rope

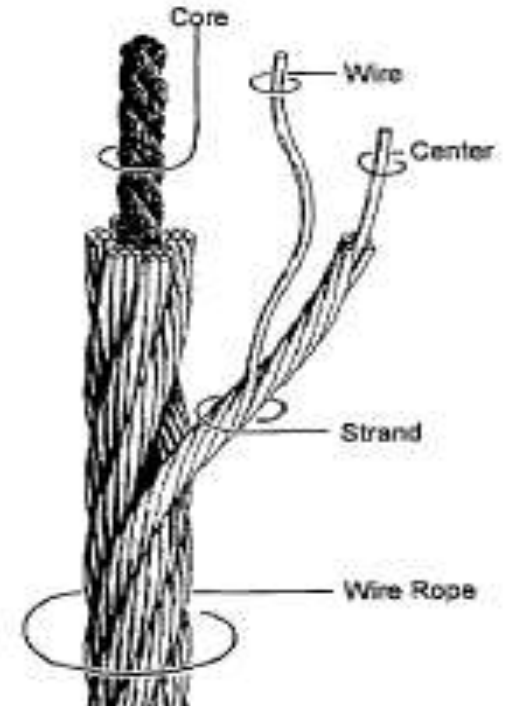
- Stranded rope is build up of strands and each strands consists of a numbers of concentrically twisted wires lead in the form of helix round a central steel wire.
- Strand consists of a single centre wire, called king wire, covered by multiple (i.e., 6) concentrically laid wire and its commonly used for haulages.
- The king wire in strand is of triangular cross-section.

What makes up a wire rope?

The three components of a wire rope include

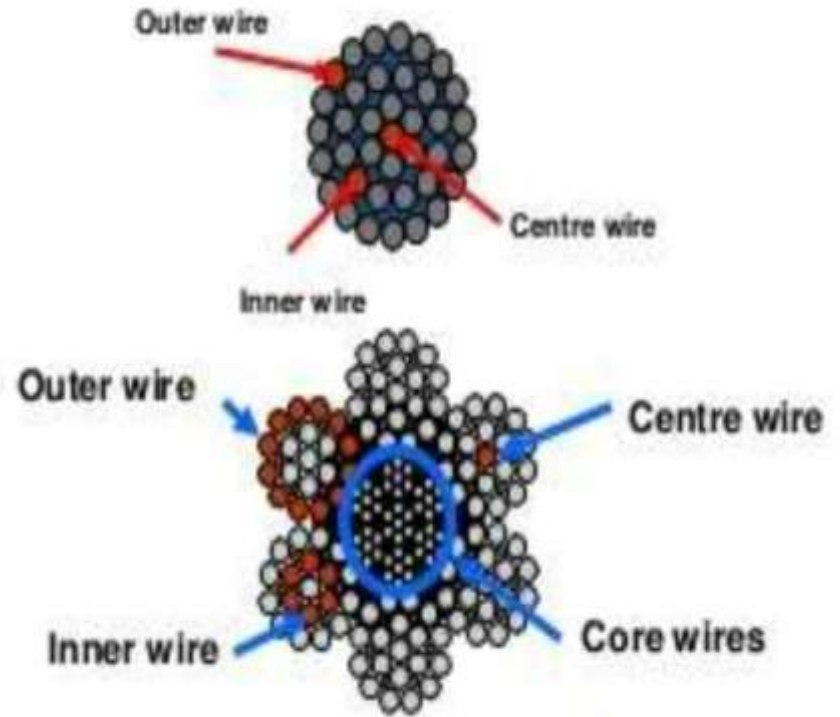
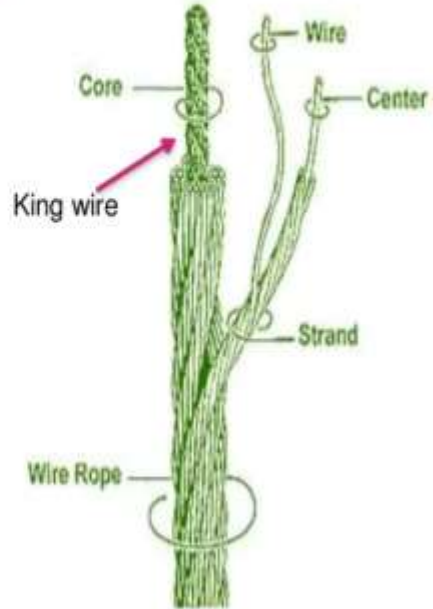
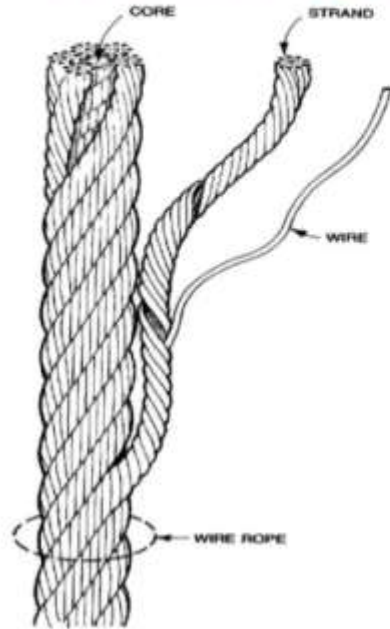
- **Wires**
- **Strands**
- **core.**

Depending on the use and customer specifications, these ropes are made from stainless steel, iron, steel, bronze, Monel metal, and high-carbon steel, with the latter being the most widely used.



Based on construction of rope :-

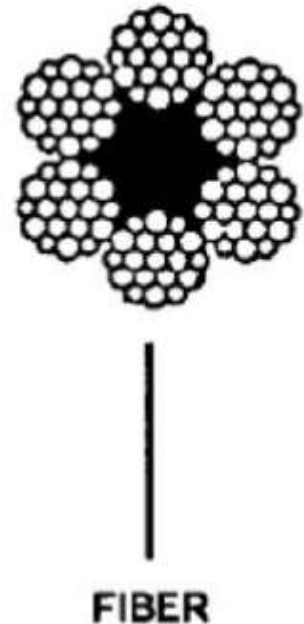
1.Stranded ropes :



Wire rope core: Fiber Core

Fiber Core:

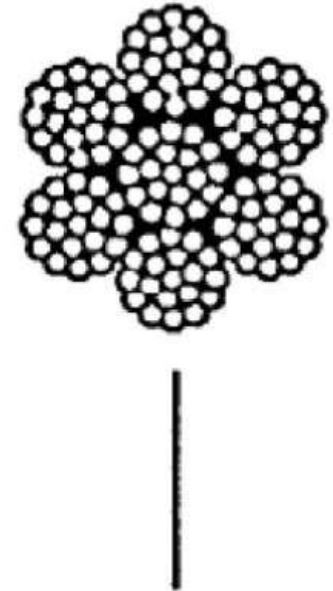
- May be made of a hard fiber such as manila, hemp, plastic, paper, or sisal.
- Serves as a cushion to reduce effects of sudden strain.
- Acts as an oil reservoir to lubricate the wire strands (to reduce friction).
- Used when flexibility of the rope is important.
- These rope used for haulage and winding purpose.



Wire rope core: Wire Strand Core

Wire Strand Core:

- Resists more heat than a fiber core.
- Adds about 15% to the strength of the rope
- Wire strand core makes the wire less flexible than fiber core



WIRE STRAND

Wire rope core: Independent Wire Rope Core:

Independent Wire Rope Core:

- Is a separate wire rope over which the main strands of the rope are laid
- This strengthens the rope and provides support against crushing.
- Supplies maximum resistance to heat.
- Used for subjected to shock loads e.g. coal cutting machinery.



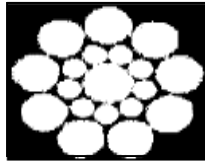
Wire rope Strands: STRAND CONSTRUCTIONS:

Strands are designed with various combinations of wires and wire sizes to produce the desired resistance to fatigue and abrasion. Generally, a small number of large wires will have more abrasion resistant and less fatigue resistant than a large number of small wires.



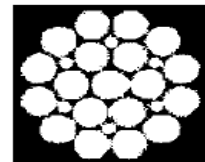
**Single
Size**

The basic strand has wires of the same size wound around a centre.



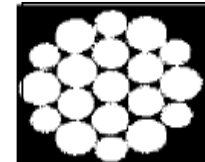
Seale

Provides excellent abrasion resistance but less fatigue resistance. When used with an IWRC, it also offers excellent crush resistance over drums.



**Filler
Wire**

Small wires fill spaces between large wires to produce crush resistance and a good balance of strength, flexibility and resistance to abrasion



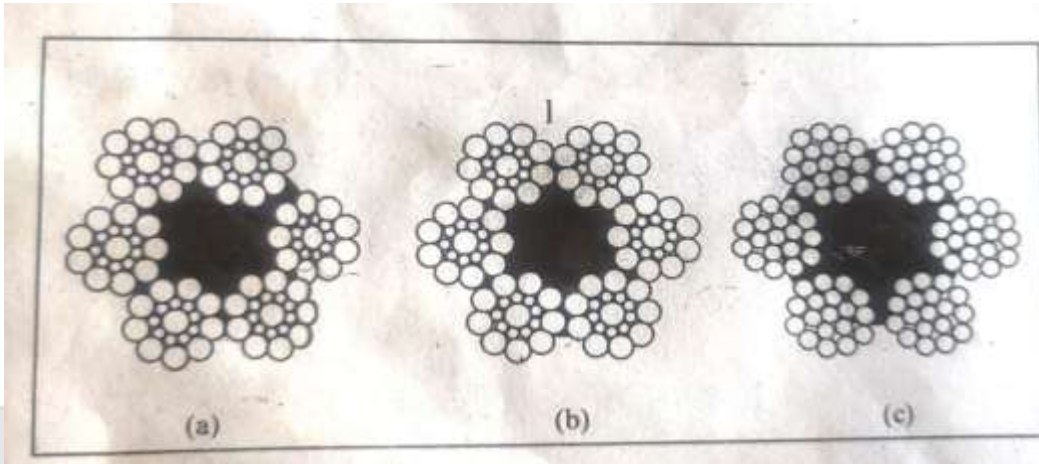
Warrington

Outer layer of alternately large and small wires provides good flexibility and strength but low abrasion and crush resistance.

Compounded Strand core wire

The rope containing wire of different size and many be arranged in various ways.

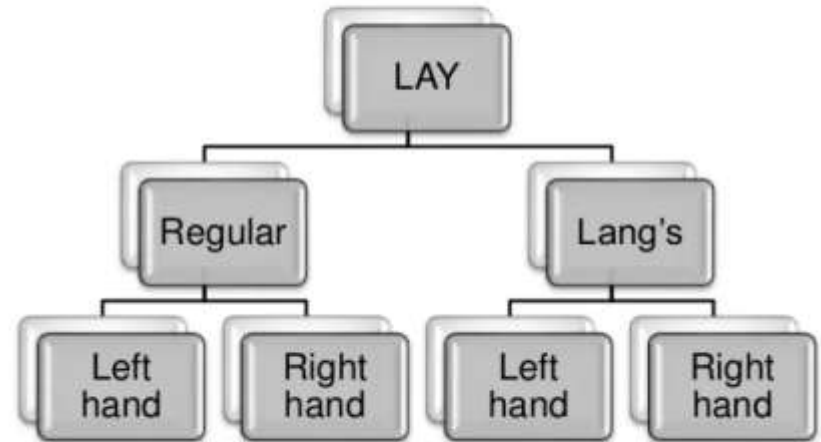
- Compound strand rope (Type – A): $6 \times 8-6-1$
- Compound strand rope (Type – B): $6 \times 9-9-1$ (6 strand, each strand formed 9 outer wire around 9 thinner wire around a large central core wire)
- Compound strand rope (Type – C): $6 \times 12-6 + 6-1$ (the rope is more flexible)

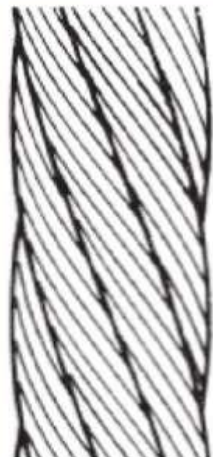


Wire rope lays

The directions of the strand and rope twist affect some of the characteristics of rope, such as flexibility, wear, and tendency to rotate.

LAYS of rope:





**Left Lay
LANG LAY**



**Left
Regular
Lay**



**Right Lay
LANG LAY**



**Right
Regular
Lay**



Lang's lay and ordinary lay

- A rope is of ordinary lay construction if the wire in the strand and the strands in the rope are laid in opposite direction. Hence tend to balance each other's rotating tendency. Ordinary lay also known as regular lay. They used for place where they are freely suspended such as cranes.
- A rope is of Lang's lay construction if the wire in the strands are laid in the same direction as the strands are laid in the rope. Such construction cause the rope to spin. For this reason Lang's rope must never be used if there is a free end to rotates.

Continue...

- The advantage of Lang's rope lay is that the rope offers a better wearing surface than one of the ordinary lay and it is also more resistance to bending fatigue.
- Lang's rope are favoured for winding and haulage purpose not only because they present much greater wearing surface than the ordinary lay but also because they are not liable to break on the crown of the strand unlike in ordinary lay.

Wire rope lays

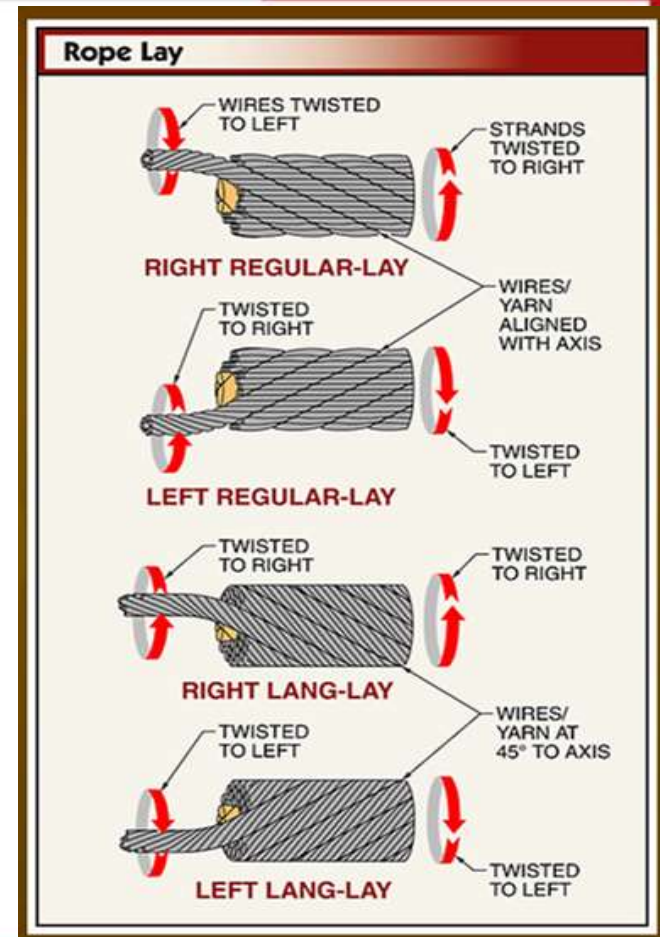
Lang lay is recommended for excavating, construction, and mining applications including draglines, hoist lines. This is because of the Lang lay ropes are more flexible than regular lay ropes. They also have greater wearing surface per wire than regular lay ropes.

There are two types of lays:

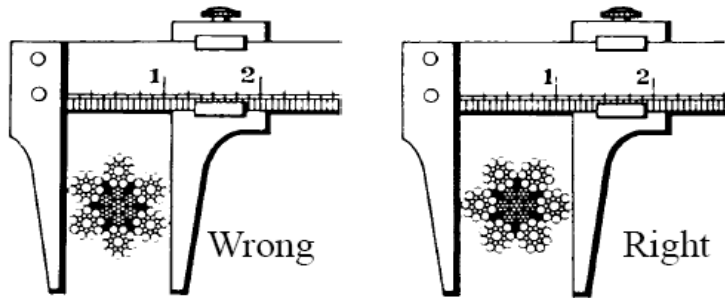
- Right hand lay: the rope resembles a multi-start right hand screw thread.
- Left hand lay: not commonly used for haulage rope or winding ropes used on drum winder but it sometime adopted for ropes on multi-rope Koepe winders, where adjacent ropes are of opposite lays i.e. one rope in right hand lay and adjacent rope of left hand lay. This prevent untwisting of strand.

From figure we observe that

- The *lay* is a designation for the direction in which the strands are twisted, specified as they spiral away from the observer.
- *Right-lay rope* is rope with strands that spiral to the right (clockwise).
- *Left-lay rope* is rope with strands that spiral to the left (counterclockwise).
- The lay of the strands, in combination with the twist direction of the yarn or wires, results in regular-lay or Lang-lay rope.



Wire Rope Size Measurement



The rope is measured from a high spot on one side of the rope to the high spot on the opposite side using calipers. Normally, new ropes are slightly larger in diameter than the specifications indicate.

Results: Designation of a wire rope: 12mm (12/6/1) wire

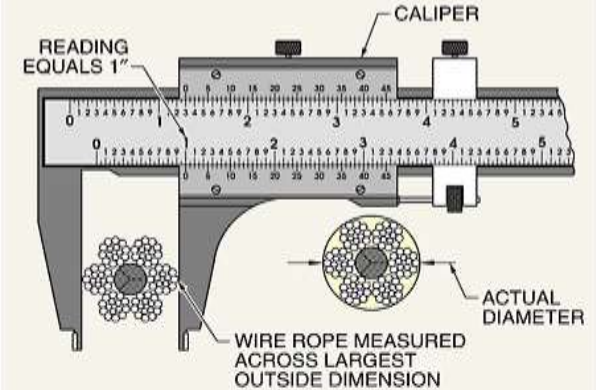
Nominal diameter of wire rope : 12mm

No. of strands: 6

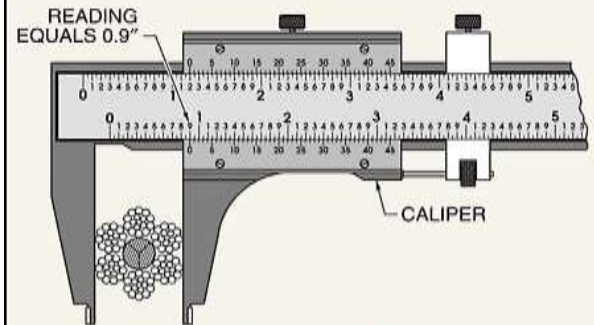
No. of wire in each strands = 12

Core: 1 core

Measuring Wire Rope Diameter



CORRECT

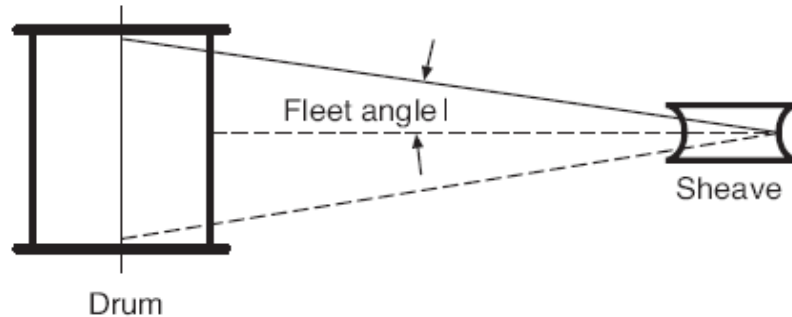


INCORRECT

Factors influencing the lifetime of wire ropes:

- Type of wire ropes;
- Diameter of the drums and sheaves;
- Reverse bending
- Speeds with which the wire ropes run through the sheaves
- Ratio between normal working load and the maximum load in the wire ropes;
- Safety factor; being the ratio between the breaking load and the normal working load
- Choice of the hardness in the groove of the sheaves;
- Fleet-angle between the wire rope and the sheave, respectively between the drum groove and wire rope;
- Greasing or lubrication of the wire ropes and the frequency of greasing or lubrication;
- Mechanical damage

Fleet angle in wire rope:



Range of Fleet angle for maximum efficiency and service:

< 1.5° for smooth drum

< 2° for grooved drum

Large fleet angle: results in excessive rubbing of the rope against the flanges of the drum and the sheave groove, or crushing and abrasion of the rope on the drum.

Selection of drum and sheave diameter

For faster operation of ropes in cranes:

$$D/d=30$$

For fast un-loaders:

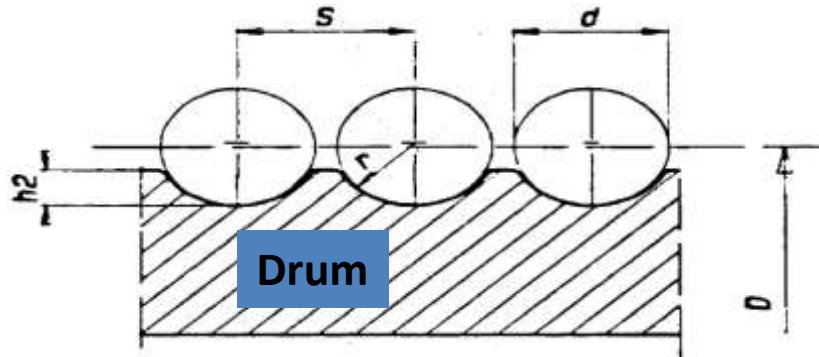
$$D/d= 36$$

Where,

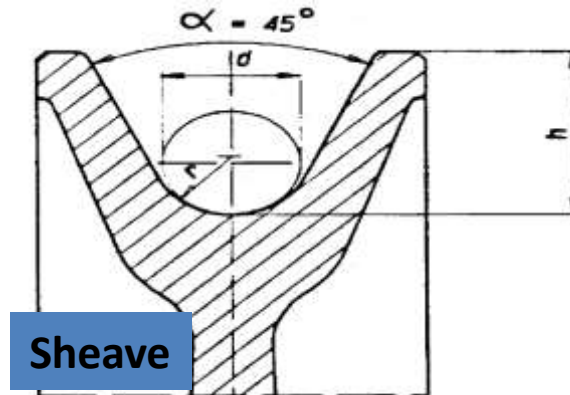
D= sheave diameter or drum diameter, centre to centre of wire rope,

d= wire rope diameter.

Dimension of grooves on drums and in sheaves:



$$h_2 \approx 0,3d$$
$$r \approx 1,05 \cdot (d:2)$$
$$S_{\min} \approx 1,1d$$



$$h = 1,5d \text{ to } 2d$$
$$r \approx 1,05(d:2)$$

Ropes are often wrapped over pulleys or around loads. This bending puts a rope under additional mechanical stress, which reduces its ability to withstand tension forces. Bending a rope over a small diameter can reduce its effective strength by more than 50%. The *bending efficiency* is the ratio of the strength of a bent rope to its nominal strength rating. The *bend ratio* is the ratio of the diameter of a bend to the nominal diameter of the rope. The bend ratio is also known as the D/d ratio and is calculated with the following formula:

$$R_{bend} = \frac{D}{d}$$

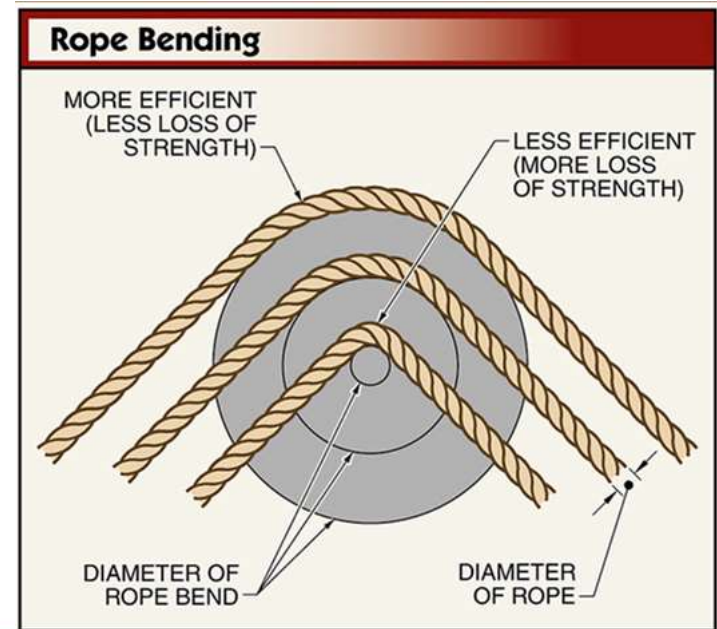
where

R_{bend} = bend ratio

D = diameter of rope bend (in in.)

d = diameter of rope (in in.)

Bend ratio



The calculated bend ratio is used to determine the rope bending efficiency according to a chart or plot. This efficiency data is compiled by laboratories that conduct load tests on ropes. The efficiency percentage is then used with the rope's working load limit to calculate the resulting effective strength using the following formula:

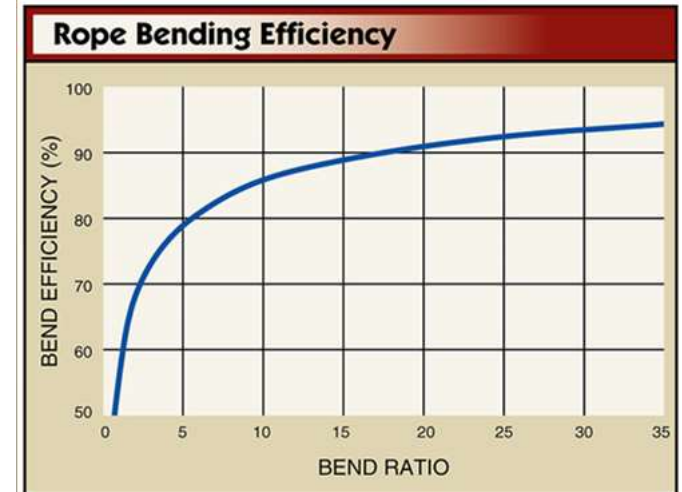
$$S_{bend} = WLL \times \eta_{bend}$$

where

S_{bend} = rope bending strength (in lb)

WLL = rope working load limit (in lb)

η_{bend} = bending efficiency



Breaking strength

- The strength rating of rope is its breaking strength. The breaking strength of rope is obtained from tests where samples of rope are tensioned under increasing loads until they break.
- Many samples are tested and the results provide an average breaking strength for a particular type and size of rope.

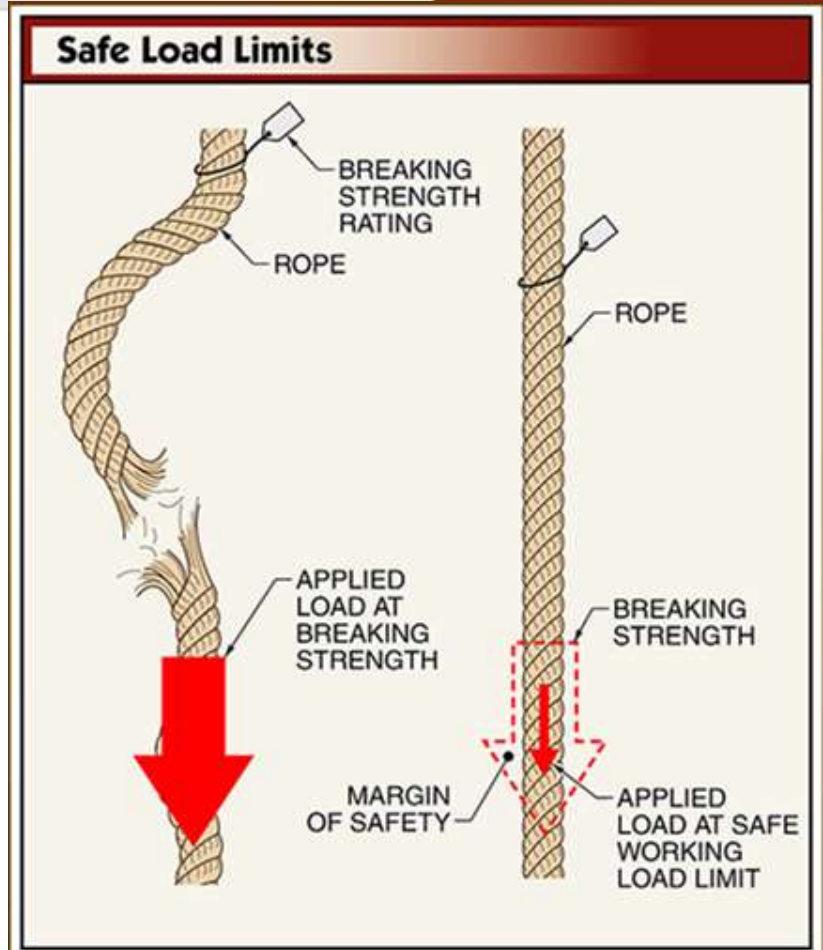
Breaking Strengths of Selected Wire Ropes*			
Diameter†	Improved Plow Steel		Extra-Improved Plow Steel
	Fiber Core	IWRC‡	IWRC‡
1/4	5340	5740	6640
5/16	8300	8940	10,280
3/8	11,900	12,800	14,720
7/16	16,120	17,340	19,900
1/2	20,800	22,400	26,000
9/16	26,400	28,200	32,800
5/8	32,600	35,000	40,200
3/4	46,400	50,000	57,400
7/8	62,800	67,400	77,600
1	81,600	87,600	100,800

* in lb, for uncoated, general purpose, rotation-resistant 6 x 19 (class 2) or 6 x 37 (class 3) wire rope

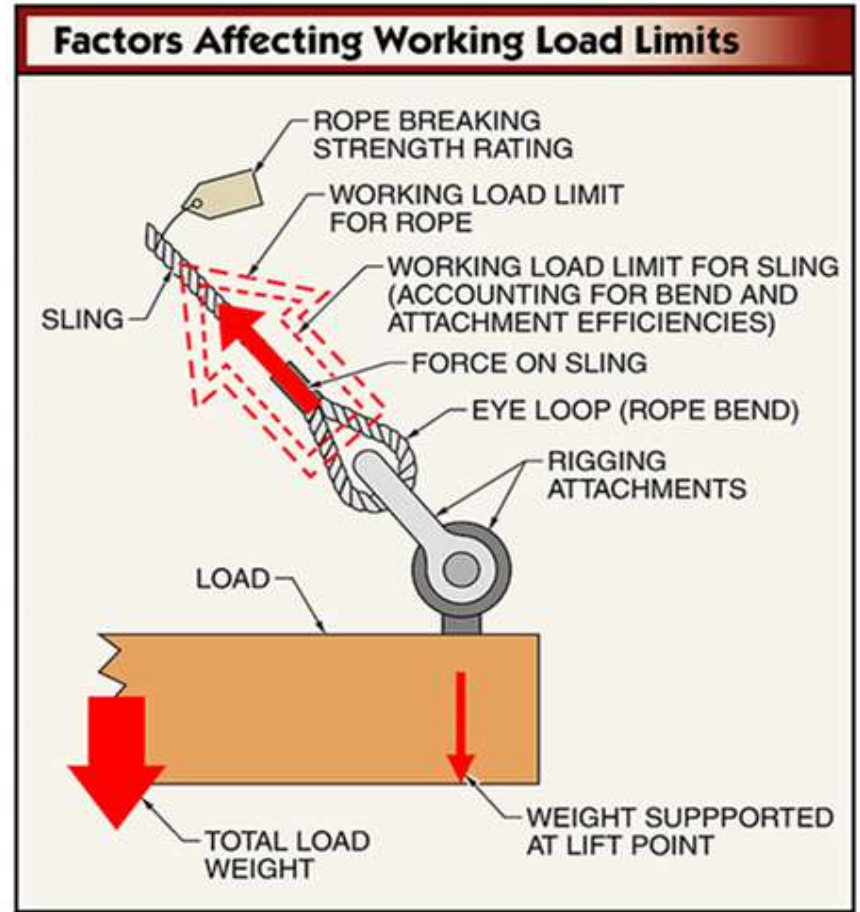
† in in.

‡ independent wire rope core

- A breaking strength value cannot be used directly as a working load limit for lifting. The *working load limit* is the maximum weight that a rigging component may be subjected to.
- Loading a rope up to its breaking strength offers no margin of safety for underestimated load weight, rope age, or other weakening conditions. Plus, slight manufacturing differences between the loaded rope and the actual tested samples mean that the working rope may break under slightly less load.
- Therefore, safe working load limits are established by dividing the breaking strength by a safety factor. A *safety factor* is the ratio of a component's ultimate strength to its maximum allowable safe working load limit.



Many factors must be considered when determining the necessary strength of rigging ropes. For example, the use of multiple slings divides the total load weight between the slings, which reduces the strength requirements. However, the use of other sling hitch arrangements, such as basket, bridle, or choker sling hitches, increases the forces on the sling due to sling angle. Also, bends and attachment hardware reduce a rope's efficiency, lowering its effective strength. After taking into account all these factors with additional calculations, the total force on the sling must not exceed the effective working load limit.



Various type of fault in wire rope

Wire Rope Damage

“Bird-caging” due to torsional unbalance



Wire Rope Damage

Kinked



Various type of fault in wire rope

Wire Rope Damage

Protrusion of core due to shock loading



Wire Rope Damage

Dog-legged



Various type of fault in wire rope

Wire Rope Damage

Fatigue fractures caused by repeated sharp bending



Wire Rope Damage

Crushed



Various type of fault in wire rope

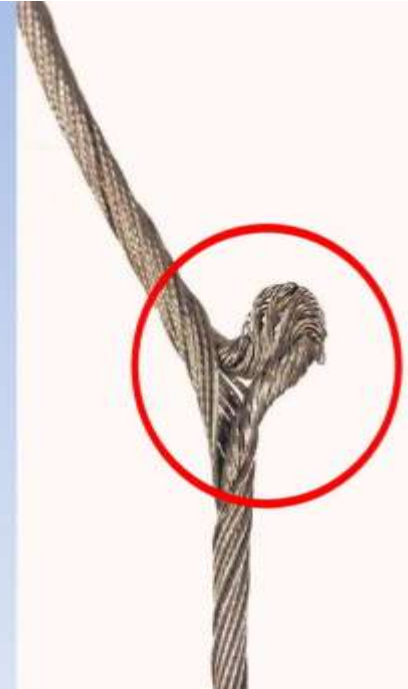
Wire Rope Damage

Two parallel paths of broken wires indicative of bending through an undersized groove in a sheave



Wire Rope Damage

Popped Core



Various type of fault in wire rope

Wire Rope Damage

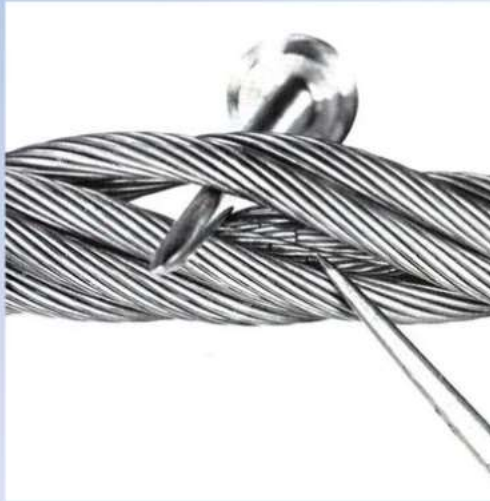
Corrosion



Inspection of wire rope

- Wire Rope Inspection:

- Use marlin spike or similar tool to lift strands so inside of rope can be inspected



Describe care & maintenance of rope



Following points should be kept in mind during the storage and use of wire rope:-

1. Avoid use of rope with fiber core, when the rope is subject to heat, fumes and extreme pressure.
2. Buy right construction of rope suitable for the job.
3. Corrosion can be delayed by using galvanized rope.
4. Don't load the rope beyond its safe working load.
5. Ensure that the rope is strongly seized before it is cut.
6. Flexibility of rope should be suitable to the size of drums and pulleys, and diameter of rope to grooves.

Continued..



7. Grease the rope and cover properly before storing in a dry ventilated shed.
8. Handle the rope carefully while transporting and uncoiling to avoid kinks.
9. Inspect the rope periodically and lubricate with acid-free lubricant.
10. Judge the safe life of the rope for the conditions under which it has to work and replace it in proper time.

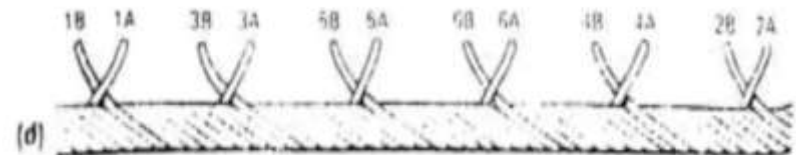
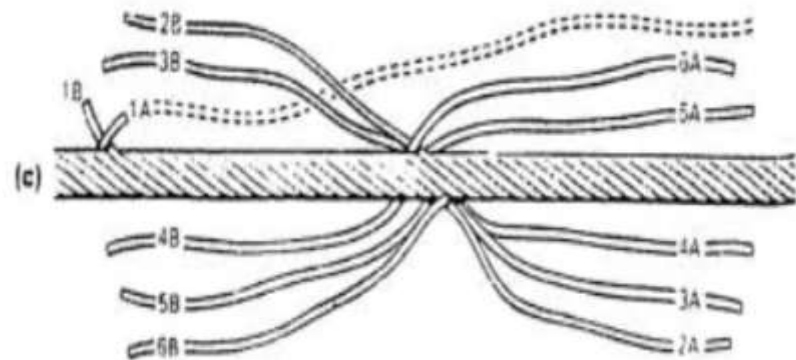
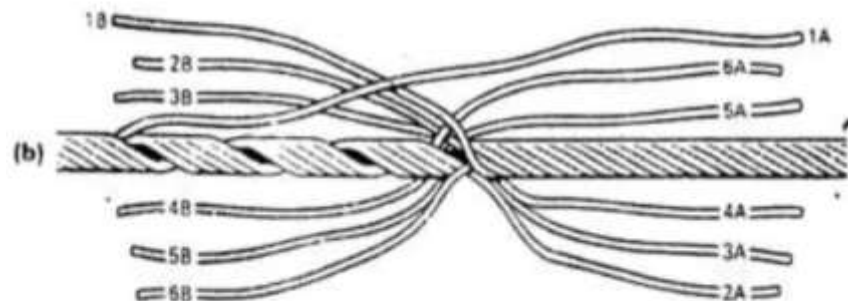
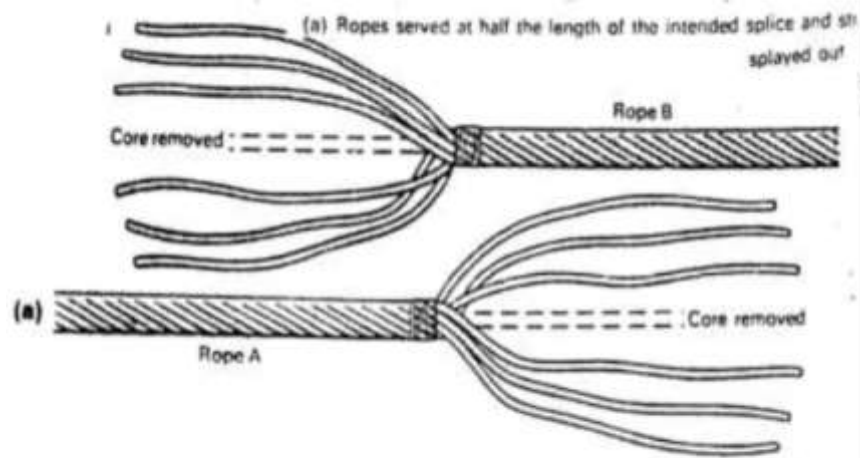
State factors influencing the F. O. S.



1. Depth of wind.
2. Accelerating force.
3. Type of construction of rope.
4. Conditions under which rope is used and the period of use.
5. Bending of ropes.
6. Man winding or material winding.
7. A winding rope is subjected to shock loads

Splicing

- Splicing is a method of joining two wire ropes permanently without using special fitting or attachments.
- Splicing of winding ropes, by which men are raised or lowered is not permitted under mining regulations, but haulage, power transmission, and aerial ropes can be used after splicing and the splice can be made nearly as strong as the original rope.



SMH is the space left by strand 1A is filled by strand 1B from rope B and strand 1B is filled by strand 1A from rope A. The same process is repeated for all strands.

The splicing is now completed.

Procedure of splicing of wire rope

Procedure :

1. Decide the length of splice.
2. Bring the two ends of the rope to be spliced side by side the length of splice. On each rope, from the end, beyond length of the splice, tie twine on the rope.
3. Open out strands of the two ropes up to the twine binding and cut the fibre core.
4. Cut out alternate strands of each rope about 30cm from the twine binding.
5. Bring the two ropes face to face so that the cut-out cores meet. Temporarily lash the separated strands of left hand rope to the strands of right hand rope.
6. Gradually unwind or inlay strands of left hand rope which will be a short strand, and in its bed insert the meshing strand from right hand rope which will be a long strand.

Continued..

7. Cut off strand to keep an equal length i.e 0.3 m and tie the strands temporarily in place.
8. In a similar manner lay strand of right hand rope into the groove formed by unlaying strand of left hand rope, but stopping the pair about $\frac{1}{5}$ of the length of splice short of the preceding pair.
9. Repeat the process for the pair, strand of left hand rope and corresponding meshing strand of right hand rope.
10. Bend the splice back and forth until all strands rest firmly in their places. This also puts them under nearly equal tension.
11. Straighten each tail by removing any spiral formation.

Continued..

12. With a vice and clamps untwist and open the rope at the end crossing, cut the fibre core at the centre, pull it out and tuck in its place the tail of the strand. Cut off the fibre core at the end of the strand tail.
13. Shift the vice and clamps to the next crossing and hammer the strands with a wooden mallet to fix them securely in their place.
14. Repeat the operations at the other five crossings and the splicing job is complete

E. FACTOR OF SAFETY OF WIRE ROPES :-

- Factor of safety of wire rope is the ratio of ultimate normal breaking strength of rope to the maximum static load.

$$\text{FOS} = \frac{\text{Normal breaking strength}}{\text{Maximum static load}}$$

Factors influencing factor of safety in winding rope :-

FACTORS :-

1. STATIC LOAD :-

- With higher static load, the factor of safety decreases. The static load is the sum of the weight of the rope, cage attachment, full load tub etc.

2. DYNAMIC LOAD :-

- Consists of forces due to acceleration and the effect of the kinetic shock load. Severe shock loads may be caused due to
 - starting with slack cage or bridle chains.
 - Friction from shaft guides when they are out of alignment.
 - Incorrect setting of the valve geared engine.
 - Out of balance forces by steam winders.

3. DEPTH OF WIND :-

- In deeper shaft the length and diameter of the rope and hence the weight increases. But capacity to resist kinetic shock is roughly proportional to its length and hence lower factor of safety is permissible in deeper shaft.

4. CONSTRUCTION OF ROPE :-

- Locked coil ropes are stronger with than the stranded rope due to higher space factor. Hence, these ropes can be used in place of larger diameter stranded ropes.

5. CONDITION OF USE :-

- With new rope, safety factor is more than the rope in use. Wire rope in upcast shaft, exposed to moisture and temperature has reduced factor of safety.

6. BENDING STRESSES :-

- CMR has stipulated the size of the pulley sheave etc. to be 120 times the diameter of the rope. If the diameter is less, the bending stresses reduce the safety factor.

7. MAN OR MATERIAL WINDING :-

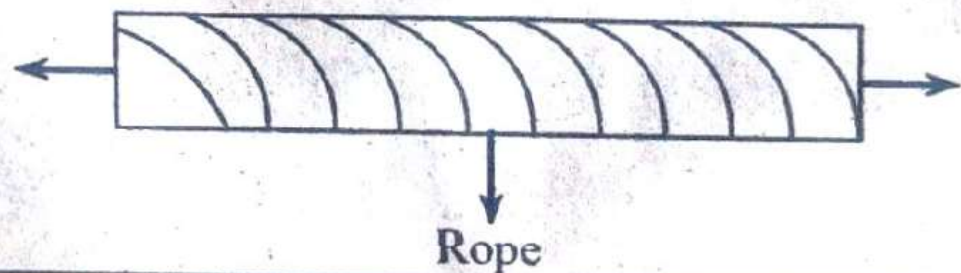
- Wire rope in use for material winding have reduced safety factor than the rope used in man-winding work.

Testing of wire rope

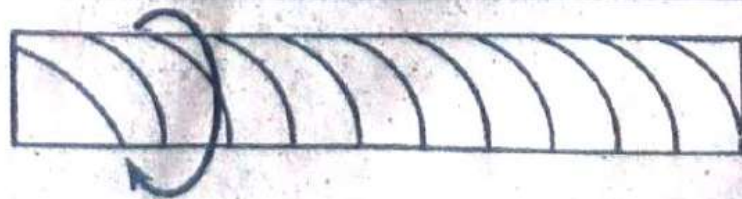
The wire is subjected to the following tests carried out according to I.S. specifications:

- Tensile test: The purpose of the tensile test is to determine the breaking force, yield strength, elongation, and modulus of elasticity.
- Torsion test: Torsion testing involves the twisting of a sample along an axis and is a useful test for acquiring information like torsional shear stress and maximum torque.
- Bending test: A bending test (bending tensile test) is a method of testing materials for their bending strength and other important properties. The three-point bending flexural test provides values for the modulus of elasticity in bending (E), flexural stress and strain, and the flexural stress–strain response of the material.
- Wrapping test: 1) A test of wire a given number of times, over a mandrel of its own diameter and then uncoiling. The usual test is to wrap eight turns and unwrap seven. The wire must not fracture and the surface must remain free of imperfections. 2) A test to evaluate the adherence of zinc coating on galvanized wire; in this case the wire is usually wound over a mandrel larger than its own diameter.
- Looping test: Test ropes were made by adding artificial anomalies to 17.4-m (57-ft) lengths of rope, and then joining the ends together with hooks to make a continuous loop.

Tension Test : In this test a specified length of wire is subjected to a stretching force in a testing machine until it breaks. This enables its ultimate tensile strength to be determined in tons /cm².



Torsion Test : A specified length of wire gripped in two vices is twisted until it brakes. A minimum number of twists is specified for each grade and gauge of wire and the sample must not show any defect before reaching this number. The test is a measure of the ductility and uniformity of the wire.



L. CAUSES OF DETERIORATION OF ROPES :-

The main causes of deterioration are as follows :-

1. Wear,
2. Corrosion, &
3. Fatigue.

1. WEAR :-

- It is due to friction of the rope with drums and pulleys and due to differential internal movements of internal wires and strands.
- The wear is partly abrasive due to removal of metal from the outer wire.

2. CORROSION :-

- The external corrosion is due to contact of acidic or alkaline water.
- A small corrosion is worst to produce failure than a considerable amount of rusting.
- The internal corrosion is worst in presence of moisture together with the acids liberated by the lubricant or by disintegration of fibre core.
- Corrosion can be minimised by proper lubrication and by the use of rope of galvanised wires.

3. FATIGUE :-

- Fatigue is the physical change in the condition of a rope after repeated applications of stress.
- The stress below which fatigue does not occur is called the **Fatigue Limit.**
- The rope should not be exposed to repeated loading greater than about 1/4 of the breaking strength.
- The fatigue of the winding rope is likely to occur near the capel.
- Because of various vibrations, kinetic stresses and shocks are arrested and reflected at this point.

Fatigue can be reduced by

- a. Correct installation and regularity in winding, &
- b. Cutting of 3 meter length of rope at each recapping.

CORROSION FATIGUE :-

- When the rope is subjected simultaneously to both corrosion and repeated stressing, much more deterioration occurs.
- Moreover, there is no fatigue limit under corrosive conditions.
- The most characteristic evidence of corrosion fatigue is presence of multiple cracks, any of which may cause fracture.

M. PRECAUTIONS TO BE TAKEN FOR MAXIMISING THE LIFE OF THE ROPE :-

USE AND CARE OF ROPES :

1. STORAGE AND HANDLING :-

- The rope should be stored in dry place in a shelter in a little high place on the ground.

- The air should move freely below the rope. Fibre rope slings should be used for lifting the rope.
- For uncoiling the rope, the rope reel should be mounted on the spindle. While opening out a rope, kink should be avoided which injures the wires permanently.

2. DRUMS AND PULLEYS :-

- Recommended size of the drum and pulleys should be used.
- For winding rope drums and pulleys should be between 80 to 120 times the diameter of the rope.
- For haulage ropes this ratio is minimum 80 times.

3. LUBRICATION :-

- Lubricants are applied to each wire and strands during manufacture to prevent and minimise corrosion and reduce friction between wires and strands.
- During the use of the rope, lubricant should be applied regularly to the external parts of the ropes, weekly or monthly accordingly to the condition.
- Before lubricating, the ropes should be cleaned and dried in air and accumulated dust should be removed by a wire brush.

4. AVOIDANCE OF KINETIC SHOCKS :-

- The kinetic shock is due to the slack rope at the beginning of the upward wind. This should be avoided.
- The lifting of heavy gates at the surface or badly aligned rigid guides result in shocks leading to deterioration of the rope by fatigue.

5. RECAPING :-

- The rope must be recapped every six months and the 3 meter length of the rope is cut.
- So that the same portions are not subjected to the worst condition for too long a time.

6. EXAMINATION :-

- Regular examination of the rope is essential.
- DAILY EXAMINATION :- To detect visible faults, broken wires, excessive wear, loosening of the strands etc.
- MONTHLY EXAMINATION :- Selected cleaned portions of the rope are very minutely inspected for wear, corrosion and fatigue cracks.
- At each recapping, the internal condition of the rope is examined strand by strand and wire by wire.

I. TUCKING :-

- The spiral formations of the tail strands are straightened.
- The rope is untwisted with the help of the vice and clamp at the crossing. The core rope is cut and pulled out and the tail rope is cut & pulled out and the tail rope is inserted in the space occupied earlier by core rope.
- Other tail end is also similarly inserted.
- This tucking is repeated at the next pair of tail rope.

J. ROPE CAPEL :-

Following types of capels are in use :-

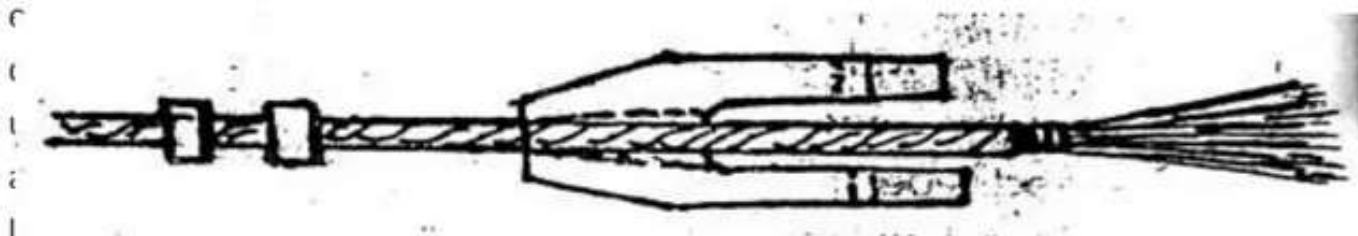
1. Bent back wire capel (used for haulage ropes.)
 - a. Split capel with rivets, &
 - b. Coned socket type of capel

Disadvantage:-

- Its strength and reliability depends on the workmanship of the person making the rope capel.
- These capels are forbidden to be used in the winding ropes.

1.b CONED-SOCKET TYPE CAPPEL :-

- Clamp the rope temporarily by a thin binding wire before cutting of the old cappel.
- Thread the socket on the rope and push it along.
- Seize (bind) the rope tightly with soft iron binding wire at the length decided, which is



- Put some thick grease into the socket to keep out water.

AIM :-

The aim in making a bent back wire cappel is to get a tight solid core of wires at the end of the rope. It is squeezing of bent back wires against the ropes which holds the rope in the socket.

2. CONICAL CAPPEL WITH WHITE METAL :-

In this type of capel, a cone of white metal is made which fits tightly into the barrel of the capel.

CAPPING METHOD :-

- Deducting twice the rope diameter from the length of the tapered portion of the CAPPEL.
- A place is marked on the rope.

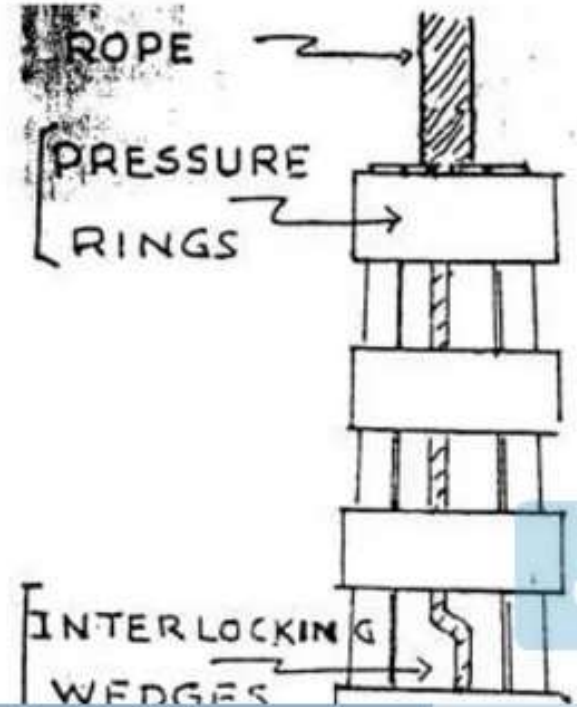
- Heat the socket evenly upto 100 degree centigrade with the help of blow lamp (not permitted in underground coal mines). When the socket is hot, powdered resin is sprinkled over the rope brush in the capel.
- White metal is heated upto 365°C and is poured in the molten form in the conical hole of the capel.
- The metal is allowed to cool gradually till the capel cools down to the atmospheric temperature.

CONICAL CAPPEL WITH ZINC CONE AND TAIL STRAND :-

- This type is also D.G M.S approved.
- The cones are ready made with the fixed length tail rope.
- At one end of the tail rope a zinc cone is made.
- This capel can only be used in the ropes with central hemp rope.

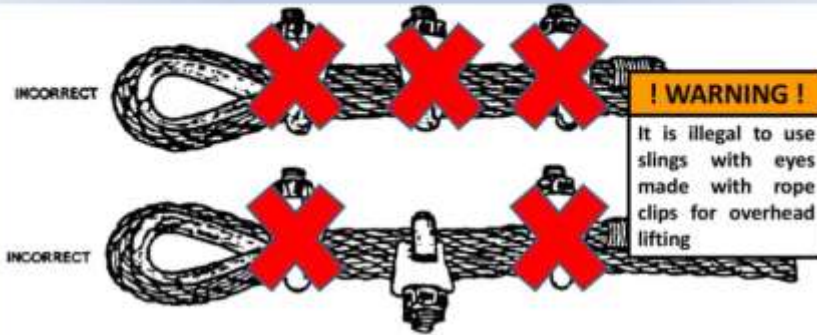
- The socket is threaded over the rope and is placed at a distance.
- Remove the serving from the rope end and unlay three neighbouring strands for a length of approximately 75 mm more than the length of the tail unit.
- Measure of the from the rope end, the length of the cone and the tail unit +10mm.
- Remove the rope core upto this position and cut it.
- Insert the tail strand in place of removed core and relay the opened strand to reform the rope.
- Place the strands one in each of the grooves provided on the cone in natural lay of rope.
- The strand should protrude over the end of the cone.
- Bind the rope tightly at the small end of the cone using a fine wire of a size which will

- As shown in the sketch, the rope is seized at two places with binding wire.
- The length of this binding is twice the length of the metal block.
- The pressure rings/clamps are threaded over the ropes in correct sequence. The conical block is threaded at the end.
- A clamp is clamped in the position.
- The binding of the rope end is opened and the wires are separated to form brush.
- The hemp rope inside the brush is cut, and the wires are cleaned of grease or lubricant. The clamp C is taken out for a while and the upper conical block is brought down on the brush.
- The clamp, the brush and the rope is held vertically in

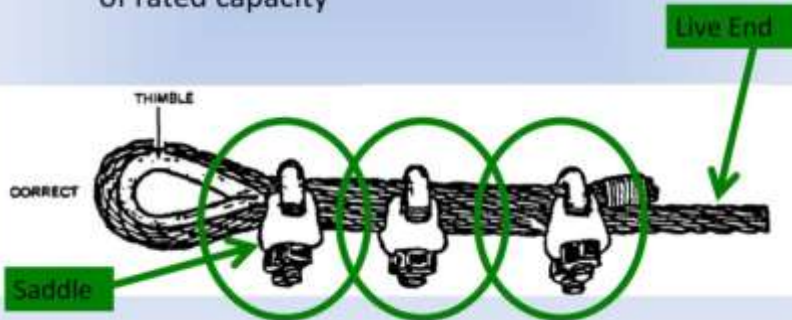


- Cable Clips

- A rule of thumb to remember when attaching a wire rope clip is to “**NEVER saddle a dead horse.**”

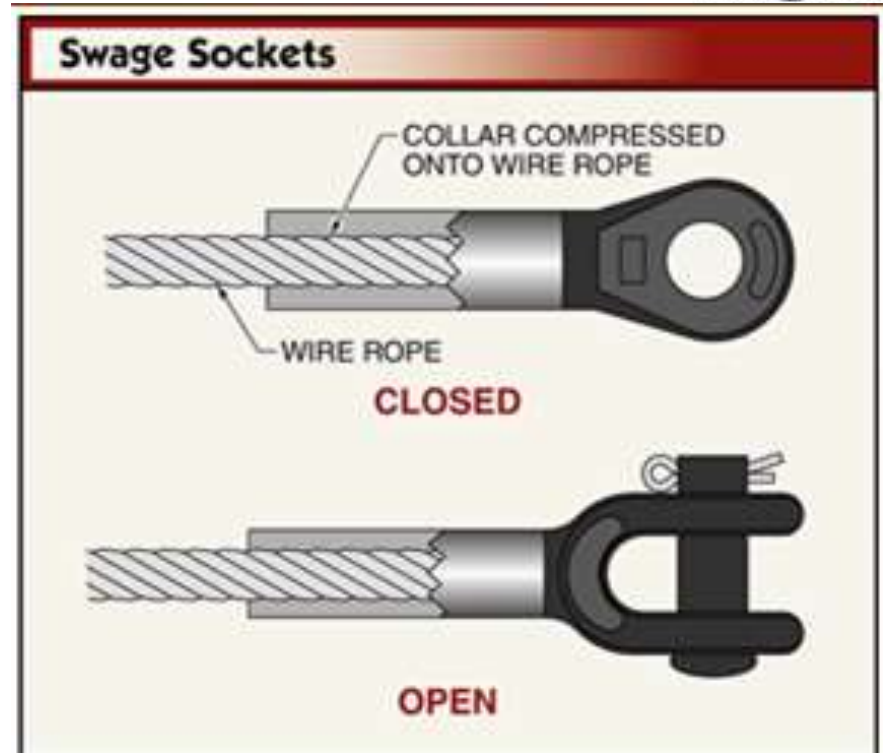


- The wrong application of even one clip can reduce the efficiency of the connection to 40% of rated capacity



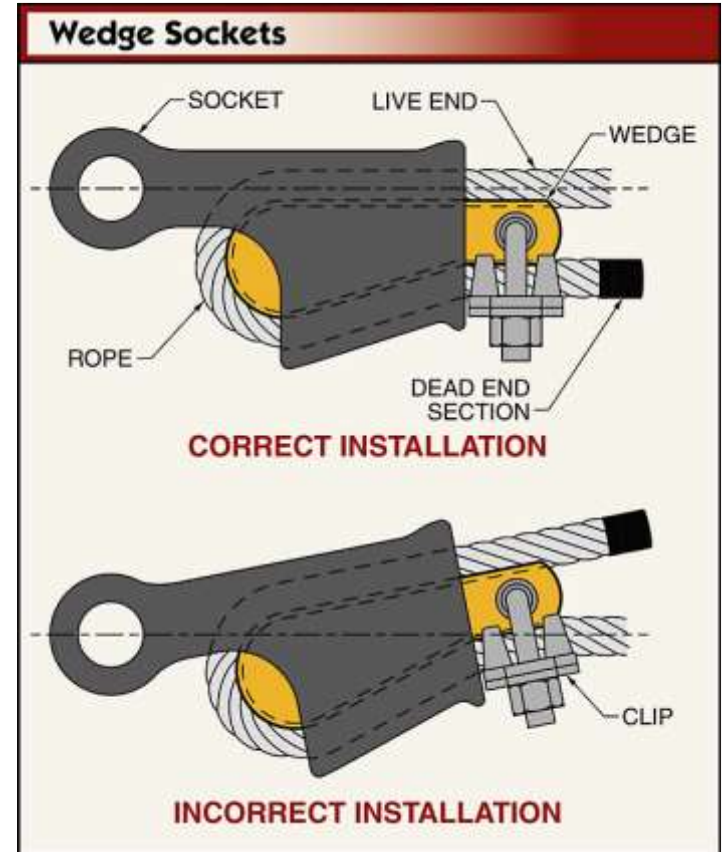
Swage Socket

- A *swage socket* is a socket that is compressed onto the end of a wire rope.
- Swage sockets must be compressed in a hydraulic press to achieve the necessary binding to the rope.
- The inside of the socket conforms to the shape of the rope strands and locks it into place.



Wedge Socket

- A *wedge socket* is a socket that holds a loop of wire rope securely with a wedge that is tightened by tension on the rope.
- Wedge sockets are popular because they can be installed and repositioned quickly and easily. It also creating a sharp bend on the live end of the rope.
- The live end must be in line with the socket. The exposed dead-end section must extend out of the wedge a minimum of eight rope diameters.



Calculate the size of wire ropes for winding & haulages.

- The size of a wire rope is usually quoted in mm, but the centimetre (cm) leads to more convenient constants. If it is considered necessary to work with the rope diameter in mm all the time, the two formulate can be written as.
- $\text{Mass} = k (d/10)^2$ in kg/m, d being in mm and
- $\text{breaking strength} = s(d/10)^2$ in kN, d being in mm.

Describe rope capel for haulage winding & recapping.

- The end of a rope where the load is to be attached should be a good portion of the rope, free from worn, rusted, bent or broken wires and free from effects of bending and corrosion.
- The simplest and easiest way to make the rope end suitable for attachment of load is to use a grooved thimble and bend back the rope end on it and part of the rope before finally tightening 4-6 rope lips at intervals on.
- The method needs little skill. Such attachment is permissible for haulage ropes and skips ropes hoisting on inclined planes but not permitted for winding ropes. Rope length under clips is nearly 30 times rope dia.

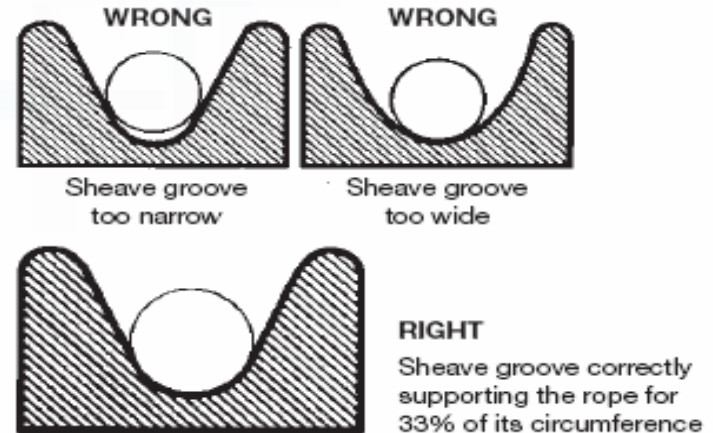
Specification of wire rope



- The wire rope factor receives from rolling mills coil of carbon steel rods (0.5 – 0.8% carbon, silicon 0.11, manganese 0.48, sulphur 0.033, phosphorus 0.014, rest iron) of 6 to 13mm dia.
- According to I.S. standard specification no. 1835 of 1961 neither sulphur nor phosphorus content in steel for wire should exceed 0.050%).
- The ultimate tensile strength or breaking strength of rod is about 65kg/mm² (638MN/m²).
- The ultimate tensile strength of wires used for haulage/winding ropes is generally between 140 to 170 kg/mm².

Factors Affecting Rope Performance:

- Multi-coiling
- Bad coiling
- Small diameter sheaves
- Oversize grooves
- Undersize grooves
- Excessive angle of fleet



SURFACE MINING

Usage	Rope Type	Rope Size (mm)	Rope Details
Drag line	Hoist Rope	38-144	Minesflex 6/Cushion Core; Minesform 8 PVF/Minesflex 8
	Drag Rope	38-127	Drag 6
	Dump Rope	38-83	6x36WS, 6x41WS, 6x37SF, Minesflex 8, Minesform 8PVF
	Boom Suspension Rope	25-116	Full locked coil wire rope/ Spiral strand
Shovels	Hoist Rope Crowd/Retract Rope	38-86	Minesform 8PVF/Minesflex 8/ Cushion Core/Minesflex 6
	Trip Rope	8-26	6x26SW; 6x36WS
	Boom Suspension Rope	25-116	Full locked coil wire rope/ Spiral strand

Note: Other sizes and constructions available on request

Sector	Rope Type	Rope Size (mm)	Rope Details
Under ground Mines	Haulage Rope	16-28	6x7, 6x17S, 6x19S
	Winding Rope	16-55	LCWR-Full Lock
			6xV8, 6xV20, 6xV25, 6xV27, 6xV28
			6x7, 6x19S, 6x26SW, 6x36SW, 8x19
	Guide Rope	29-54	LCWR; Half Lock, Right Lay, Galvanised/Ungalvanised.
	Balance Rope	16-64	34x7 (Rotation resistant)

Sector	Rope Type	Rope Size (mm)	Rope Details
Material Handling	Haulage Rope	16-51	6x7, 6x17S, 6x19S, 6xV8, 6xV22
	Lock Coil Track Rope	25-70	Full Lock/Right lay; Ungalvanised.

Rope End Terminations

The wire ropes can be supplied for different types of boom pendants tailored to the particular mining requirement.



1



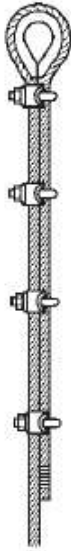
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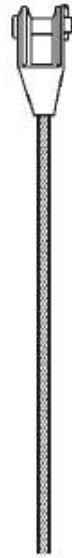
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5



6



7

1. Wedge Socket
2. Hand Splice
3. Aluminium Ferrule
4. Steel Sleeve/Flemish Eye
5. Rope Grips
6. Swaged Socket
7. Poured Socket