BELL SYSTEM PRACTICES
Motor Vehicles and
Construction Apparatus

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WIRE ROPE
GENERAL

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1. GENERAL

1.01 This section provides information on the types and sizes of wire rope most generally used and on the care, inspection and lubrication of the rope.

1.02 Wire rope is used primarily as winch line for power winches and may, therefore, be subjected to relatively high loads in normal construction operations. Safe operations require constant care to maintain the strength and serviceability of wire rope.

1.03 When used with the winch, the derrick and other pieces of construction apparatus, wire rope is frequently called winch line, fall line, boom line, sling and many other designations peculiar to the equipment with which it is being used. These instructions apply to all wire rope regardless of usage or designation.

2. SAFETY PRECAUTIONS

2.01 When using wire rope observe all safety precautions pertaining to the wire rope and to the apparatus with which it is used.

2.02 At the start of each day's operations thoroughly inspect the wire rope and all eyes in accordance with the instructions in Part 6. Defective eyes and rope sections shall be cut out and discarded before performing any work operations.

2.03 Prior to heavy pulls or difficult operations with the winch, check the wire rope for any major damage which might have occurred since the last inspection and inspect the rigging involved for stability, strength, and conditions likely to cause damage to the rope as the operation progresses.

2.04 Avoid bending wire rope around sharp corners.

2.05 Never pull a loaded winch line over a stationary support.

2.06 All personnel shall be careful to place themselves in a position so as to avoid being struck by the rope or any part of the rigging employed should the rope break or any part of the apparatus fail. It is particularly important to avoid the inside of the angle formed by the winch line when pulling at an angle or making a double line pull.

2.07 Do not place hands on winch lines being moved by the winch and within arm's reach to any sheave, guide, guard, etc. These precautions should be carefully observed.

2.08 Wire rope clamps should never be used to form an eye in wire rope since the clamps have a tendency to weaken the line.

2.09 Leather gloves shall be worn when handling wire rope to prevent cuts and puncture wounds resulting from broken wires.

2.10 It is advisable that safety glasses be worn when cutting wire rope and while forming and serving eyes.

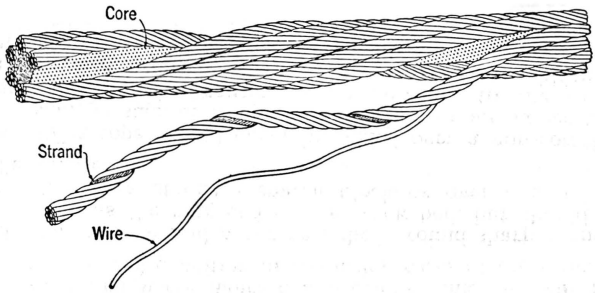
2.11 Winch lines should be kept evenly laid on the winch drums to avoid the damage caused by the incoming rope pulling down through the layers of rope already on the drum.

2.12 Wire rope shall be spliced only when forming an eye.

2.13 Blocks having sharp edges or nicked sheaves shall not be used.

3. TYPES AND GRADES OF WIRE ROPE

3.01 The wire ropes generally supplied have six strands of 19 wires with the strands preformed into the shape they will assume in the finished rope and each laid around a center core. Two types and one grade are recommended, namely, the fiber core type and the independent wire rope core type, and the improved plow steel grade.



Wire Rope Components

3.02 The independent wire rope core type is stronger than the fiber core type but is slightly less flexible. Its principal advantage is that it has better resistance to crushing and to distortion.

3.03 The improved plow steel grade is the strongest, toughest and most wear resistant commercially available grade.

3.04 Individual strands in a rope are preformed during manufacture into the shape they will assume when assembled into the finished rope. This facilitates ease of handling and forming eyes, improves smoothness of drum winding, prevents unraveling and minimizes the porcupine effect when wires become broken.

4. SIZES, STRENGTHS AND PURPOSE

4.01 The available sizes and types of wire ropes are listed in the following table together with the recommended maximum working loads. The recommended maximum working load represents one-half of the breaking strength of the rope when new and applies to ropes of the improved plow steel grade only.

Nominal Size	Maximum Diameter Inches	Maximum Working Load, Lbs.	
		Fiber Core	Independent Wire Rope Core
3/16	7/32		2100
1/4	9/32	2740	2940
5/16	11/32	4260	4580
3/8	13/32	6100	6550
7/16	15/32	8270	8890
1/2	17/32	10700	11500

4.02 The purposes for which the various sizes are most generally used are outlined below:

Size	Use
3/16 & 1/4	Used on the CR Collapsible Power Reel for pulling small aerial cable.
5/16	Placing aerial cable where longer lengths of rope are required than can normally be wound on the winch drum with larger sizes of rope.
3/8 & 7/16	General telephone construction work such as placing aerial and underground cable, pole work and for wire rope slings.
1/2	Used in short lengths, primarily, as the boom line on T-45 Pole Derrick and as winch line on supply delivery trucks handling cable reels. Longer lengths are used occasionally for heavy underground work.

5. CARE IN HANDLING

5.01 Wire rope consists of a number of wires laid into strands and the strands in turn laid around a core to form the rope. Each wire is responsible in part for the performance of the rope. Care is required to prevent damage to the rope or the individual wires which will affect the over-all strength and performance of the rope.

5.02 The formation of kinks should always be prevented as this displaces the strands and wires from their original position and relation to each other, causing severe bending and unequal tensions in the strands. This distortion and wire displacement can not be corrected, even under high tension, and a permanent weak point remains in the rope. Displaced or raised wires indicate a previous kink but will not show the damaged condition of the inside wires of the rope.

5.03 The rope should never be pulled around sharp corners such as the rear end of the truck bed, but should be passed through a standard snatch block or over a standard spindle sheave.

5.04 Wire rope should never be pulled over a non-rotating support such as a spindle bar, a pin or an inoperative sheave. This practice causes severe abrasion to the outer strand wires. A properly operating sheave or snatch block is essential to safety and to long service life of the rope.

5.05 The use of worn sheaves or sheaves with flat grooves should be avoided since they do not provide sufficient support to prevent the distortion and flattening of the rope as it passes over the sheave. Sheaves having nicked or broken flanges are likely to cut or otherwise injure the rope and shall not be used.

5.06 Obtain the best possible alignment of sheaves for any work operation. This will reduce abrasion and prolong the life of the rope and the sheaves.

5.07 An even distribution of wire rope coils over the winch drum is essential to smooth operation and to prevent the rope from either cutting down through or crushing other coils on the drum with resultant damage to the rope and difficulty in pulling the line off.

6. INSPECTION

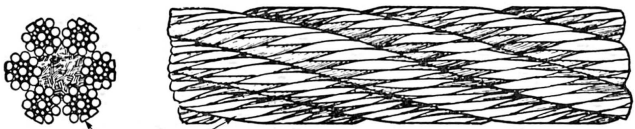
6.01 Wire rope should be subjected to frequent observation by all personnel using it. Any workman noticing a questionable portion in the rope shall call it to the attention of the man in charge for inspection and consideration as to its further serviceability.

6.02 The primary causes for the removal from service of a wire rope, or any section thereof, are wear due to abrasion, corrosion and rust, broken wires and any damage such as kinks, crushed spots, etc., serious enough to weaken the rope.

6.03 Wear is usually a result of normal operating procedures although either excessive or localized wear may result from the use of unsatisfactory sheaves or improper use of the rope.

6.04 Corrosion and rust from normal atmosphere, salt fog, acid or alkali, as evidenced on the rope surface in the form of rust and pitting of the wires, may eat into the center of the rope and ruin it. It is difficult to estimate the remaining strength of a rope thus affected.

6.05 Consequently, any part of the rope in which only one-half the thickness of the outer wires remains, regardless of the cause, is unsafe for further use.

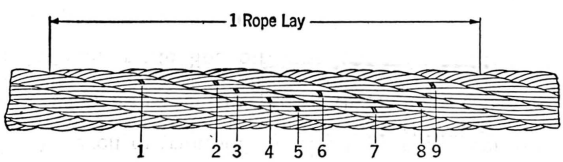


Worn rope, usually indicated by flat spots on the outer wires as shown, is unsafe for further use when less than half the thickness of the outer wire remains.

6.06 Broken wires, usually caused by kinks, sharp bends and strains due to normal rope usage, are sometimes difficult to detect in preformed rope since the broken wires tend to remain in their normal positions in the rope structure. This necessitates slightly greater care during rope inspections.

6.07 In examining the rope it is advisable to first make a complete general inspection in order to determine the sections that are in questionable condition. These sections can then be examined more carefully and the actual broken wire count by strands per rope lay can be made. The length of the rope in which one strand makes one complete revolution of the rope or, in other words, one complete spiral, is termed a rope lay.

6.08 The rope shall be considered unsafe if there are more than nine broken wires in any one rope lay or more than four broken wires in one strand in any one rope lay.



Rope is unsafe for further use if there are either four broken wires in one strand (Breaks 2,3,4,5) or a total of nine broken wires in all strands in any one rope lay.

6.09 Three scheduled inspections, daily, monthly and semi-annual, should be made. These scheduled inspections vary in the degree of thoroughness as outlined below, and

should be made at the intervals recommended or sooner should the general appearance of a particular rope indicate the need for more frequent or more thorough inspection.

6.10 The daily inspection is made before the rope is used for the first time on any particular day. It should cover the eye and that portion of the rope used most extensively in daily operations. For winch lines this length is usually about 100 feet at the eye end. For slings, etc., it is advisable to check the entire length.

6.11 The eye shall be inspected thoroughly for abrasion, corrosion, broken wires and loose or broken serving and shall be replaced should it fail to meet the minimum requirements of Paragraphs 6.02 to 6.08.

6.12 In addition to inspecting the eye, examine the remainder of the rope length normally used for daily operations for points showing kinks, sharp bends, or any other evidences of damage or excessive wear. These damaged or worn points shall be inspected thoroughly and the damaged portion cut off and discarded should it fail to meet the minimum requirements of this practice.

6.13 Should a length greater than that inspected as required in Paragraphs 6.10 to 6.12 be required for an operation, the entire length to be used should be checked as outlined in Paragraph 6.12.

6.14 During the monthly inspections the entire length of wire rope should be examined. A thorough inspection shall be made of the eye and the length of rope normally used in daily operations. The remainder of the rope shall be observed for kinked, crushed or otherwise damaged points and these points shall be inspected thoroughly. Should any section of the rope fail to meet the minimum requirements, the damaged section shall be cut off or the entire rope discarded.

6.15 The semi-annual inspection requires a thorough inspection of the entire rope length. This inspection will usually indicate greater wear at the eye end of the rope. It is advisable, therefore, if the rope is in good condition and is to remain in service, to reverse it on the drum so that the wear will more nearly equalize along the entire length.

7. CUTTING WIRE ROPE

7.01 Wire rope may be cut using a cold chisel or a standard strand cutter.

7.02 When using a cold chisel, wrap the rope with a continuous layer of friction tape for about four inches centered over the place to be cut, and cut through the tape.

7.03 When using a strand cutter, place several wraps of tape on both sides of the point to be cut. The tape helps to maintain the shape of the rope but does not interfere with the action of the strand cutter.

8. LUBRICATION

8.01 Wire rope is thoroughly impregnated with lubricant at the factory. The need for additional lubricant during the life of the rope depends largely upon its length of service and the type and severity of the operations performed with it. Telephone construction work is severe service for wire rope, and in most cases the rope will be worn or damaged to a degree serious enough to require discarding it before additional lubrication is necessary.

8.02 Ropes shall, however, be lubricated when they show evidence of corrosion.

8.03 Ropes to be lubricated shall be cleaned to the extent that they are free from caked dirt, grit, sand and the like.

8.04 To lubricate a rope pull it from the drum, spread it carefully on the ground and, after it has been cleaned, rewind it slowly under tension. Apply a light coat of lubricant with a swab or brush where the rope contacts the winch drum. At this point, the rope is bending around the drum and the strands have a tendency to spread slightly thus allowing the lubricant to penetrate to the core of the rope.

8.05 Light bodied wire rope lubricants containing rust inhibitors are commercially available for this purpose. A good substitute may be readily prepared in the field by mixing one part boiled linseed oil and two parts SAE No. 20 engine oil.