

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 This section has been reissued to include information on H-type wire rope, to add illustrations and information on the required inspections, and to revise the maximum safe working loads. Since this is a general revision, arrows ordinarily used to indicate changes are omitted.

1.03 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.

1.04 When used with the winch and other pieces of construction apparatus, wire rope is

frequently called winch line, fall 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 Do not exceed the rated load capacity of the wire rope and associated apparatus.

2.03 At the start of each day's operations, thoroughly inspect the wire rope and all eyes in accordance with the instructions in Part 9. Defective eyes and rope sections shall be cut out and discarded before performing any work operations.

2.04 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.

2.05 Avoid bending wire rope around sharp corners.

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

2.07 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.

2.08 Do not place hands on winch lines being moved by the winch and within arm's reach

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

to any sheave, guide, guard, etc. These precautions should be carefully observed.

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

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

2.11 Eye protection shall be worn when cutting wire rope and while forming and serving eyes.

2.12 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.

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

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

3. DESCRIPTION

3.01 Wire rope recommended for all applications will be of preformed, improved plow steel (IPS) grade or extra improved plow steel (EIPS) grade with either a fibre core, independent wire rope core (IWRC), or coreless.

3.02 Preformed wire rope is made with the strands and wires preformed into the shape they will assume in the finished rope. Preforming of wire rope facilitates ease of handling, forming of eyes, smoothness of drum winding, prevents unraveling, and minimizes the porcupine effect when wires become broken.

3.03 The number of strands and wires in the rope will vary according to the diameter, tensile strength, and flexibility of the rope. (See Fig. 1.)

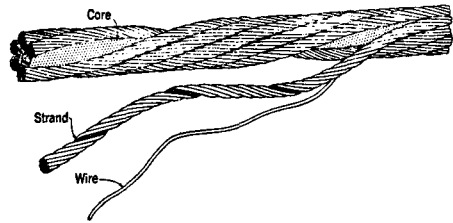


Fig. 1—Wire Rope Components

3.04 Improved plow steel (IPS) grade and extra improved plow steel (EIPS) grade designations for wire rope indicate the degree of hardness given the wires of the rope during the manufacturing process.

3.05 Fibre core rope is made with a fibre core. It is flexible, easy to handle but is subject to crushing, rotation, displacement, and distortion of the strand.

3.06 Independent wire rope core (IWRC) type has greater strength than the fibre core rope but it is less flexible and subject to rotation. Its principle advantage is its resistance to crushing and distortion.

3.07 Coreless wire rope has no center core. During manufacture the strands are swaged or compressed resulting in a smoother outer surface. The smoother surface minimizes wear on sheaves and blocks. It is highly resistant to wear, kinking, distortion, and has better nonrotating properties than conventional fibre or independent wire core rope.

4. AVAILABLE TYPES AND MAXIMUM LOADS

4.01 The available types and sizes of wire rope are listed in Table A along with the maximum safe working load in pounds. The safe working load represents the breaking strength of the wire rope when new with a safety factor of 3.5 and applies to wire rope of the IPS and EIPS grades only.

TABLE A
MAXIMUM SAFE WORKING LOAD OF WIRE ROPE

TYPE	CORE	GRADE	DIAMETER AND MAXIMUM SAFE WORKING LOAD IN POUNDS					
			3/16	1/4	5/16	3/8	7/16	1/2"
B	Fibre	IPS	900	1600		3500	4700	
C	Fibre	IPS			2400			
D*	Fibre	IPS	1200					
E	(IWRC)	IPS		1700		3800	5100	
E	(IWRC)	EIPS		1900		4300	5800	
F	Fibre	IPS		1500	2300	3300		
G	(IWRC)	IPS						6600
G	(IWRC)	EIPS						7600
H	Coreless	EIPS					6500	

* Galvanized Aircraft Cord

5. GENERAL USES AND ORDERING INFORMATION

5.01 The purpose for which the various types of wire rope are generally used is outlined below:

- (1) **Type B**—For use on truck winches not equipped with a winch rope winder and where a fibre rope core is satisfactory. Available with approved 6-inch eye in 3/8 and 7/16 diameters.
- (2) **Type C**—Primarily for use with the prelasher.
- (3) **Type D**—For use on the CR collapsible power reel and spools of the RS power reel.
- (4) **Type E**—Intended for use on truck winches equipped with a winch rope winder, or where the use of IWRC rope is desirable because of higher crush resistance and available with approved 8-inch by 4-inch eye at one end.
- (5) **Type F**—For use on power craft cable puller.

(6) **Type G**—Furnished in 400 foot lengths with or without approved 8-inch by 4-inch eye. For use on cable delivery trucks.

(7) **Type H**—Intended for use on truck winches equipped with winch rope winder which is used for making long high tension pulls of underground cable or where a wire rope with resistance to rotation, kinking, and wear is desirable. Can be ordered with or without an approved 8-inch by 4-inch eye.

Ordering Information

5.02 Orders should be worded as follows:

- (Quantity) Ft, rope, wire (B,C,D, or F) (Diameter as 3/8 in.) (with or without eye)
- (Quantity) Ft, rope, wire, E (Diameter as 3/8 in.) (IPS or EIPS) (with or without eye)
- (Quantity) Ft, rope, wire G (400) ft (IPS or EIPS) (with or without eyes)

- (Quantity) Ft, rope, wire H (with or without eye)

6. CARE IN HANDLING

- 6.01** Extreme care is required to prevent damage to the rope or individual wires which would affect the overall strength and serviceability of the rope.
- 6.02** Never exceed the working limitations of the rope.
- 6.03** The formation of kinks should always be prevented as this displaces the strands and wires from their original position in 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.
- 6.04** 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.
- 6.05** Wire rope should never be pulled over a nonrotating 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.
- 6.06** 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.
- 6.07** 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.
- 6.08** An even distribution of wire rope coils over the winch drum is essential to smooth operation and prevents 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.

- 6.09** Wire rope shall not be spliced, except to form eyes.

7. CUTTING OF 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 4 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.
- 7.04** Safety glasses must be worn when cutting wire rope.

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 of 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, etc.
- 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.

9. INSPECTION

9.01 Wire rope should be subjected to frequent observation by all personnel using it. Any craftsperson noticing a questionable portion in the rope shall report it in accordance with local procedures for a thorough inspection and removal from service if necessary.

9.02 The primary cause for removal from service of a wire rope, or any section thereof, is wear due to abrasion, corrosion and rust, broken wires, kinks, crushed spots, or exposure to heat serious enough to anneal and weaken the rope.

9.03 Wear is usually the 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. (See Fig. 2.)



Worn rope, usually indicated by flat spots on the outer wires as shown. This does not apply to type H rope which is designed with flats on the outer wires.

Fig. 2—Wire Rope Wear

9.04 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 damage it. It is difficult to estimate the remaining strength of the rope thus affected.

9.05 Any portion of wire rope where the thickness of the outer wires has been reduced to two-thirds or less of the original thickness, regardless of cause, shall be **removed** from service.

Caution: *Type H coreless rope is designed with flat outer wires to increase fatigue strength. This must be taken into account when measuring outer wire diameter.*

9.06 The diameter of a wire rope is the diameter of a circle that will just enclose all of the strands. The correct diameter is the greatest diameter of the wire rope as illustrated in Fig. 3.

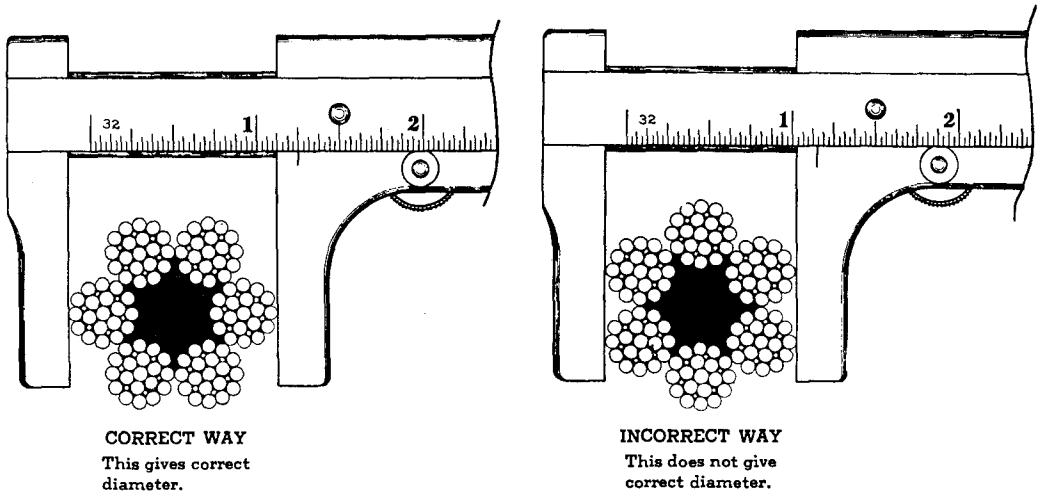


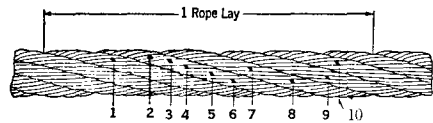
Fig. 3—Measuring the Diameter of Wire Rope

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

9.08 In examining the rope it is advisable first to 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.

9.09 Wire rope will be considered unsafe and removed from service if there are ten or

more broken wires in any one rope lay or five or more broken wires in one strand in any one rope lay. (See Fig. 4.)



Rope is unsafe for further use if there are five broken wires in one strand (2, 3, 4, 5, 6) or a total of 10 broken wires in all strands in any one rope lay. (1 through 10, inclusive.)

Fig. 4—Inspection of Wire Rope for Broken Wires

9.10 Three scheduled inspections, daily, periodic, and semiannual should be made of all wire rope. These inspections vary in the degree of thoroughness as outlined in the following paragraph 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 inspections.

9.11 A daily inspection should be made, by the craftsperson or designated person, of the portion of wire rope to be used in the daily work, prior to the start of work operations.

9.12 A periodic inspection should be made of the entire rope by the craftsperson or designated person.

9.13 The Motor Vehicle Department should measure the wire rope for wear as outlined in 9.05, on a periodic basis. Frequency should be determined by the condition and appearance of the rope or when daily and periodic inspections reveal signs of wear.

9.14 Details describing inspections are as follows:

(1) Daily inspection (craftsperson or designated person):

(a) This inspection should cover the eye and the portion of the rope used most extensively in daily work operations. Should a longer length be required for a particular operation, the length to be used will be inspected before using.

(b) The eye will be inspected for wear, corrosion, broken wires, loose serving, or swag fittings.

(c) The rope will be inspected for wear, corrosion, broken wires, crushed spots, kinking, or damage from heat.

(d) Any questionable section will be inspected thoroughly for signs of internal damage.

If there is any question of safety or serviceability of the wire rope, remove that portion from service.

(e) Any evidence of extreme wear or pitting should be reported to the Motor Vehicle Department so the diameter of the wire rope can be measured and removed from service if it does not meet the requirements of this section.

(2) Periodic inspection (craftsperson or designated person):

(a) This inspection should cover the *entire length* of wire rope and eye as outlined for the daily inspection.

(b) Inspection interval should be determined by severity of service, weather conditions, or exposure to corrosive atmosphere.

(3) Semiannual inspection (Motor Vehicle Department):

(a) This inspection of the wire rope for wear or pitting will be done on a periodic basis and when advised to do so by the Construction Forces. The wire rope will be measured as outlined in 9.05 of this section. The wire rope or effected portion of it will be removed from service if it does not meet these requirements.

(b) Under adverse conditions the frequency of this inspection should be increased depending upon the severity of service of the rope or the exposure to corrosive atmosphere.

(c) This inspection will usually indicate some wear at the eye end of the rope. If the rope is in good condition and is to remain in service, it would be advisable to reverse it on the drum so the wear is evenly distributed along the entire length.