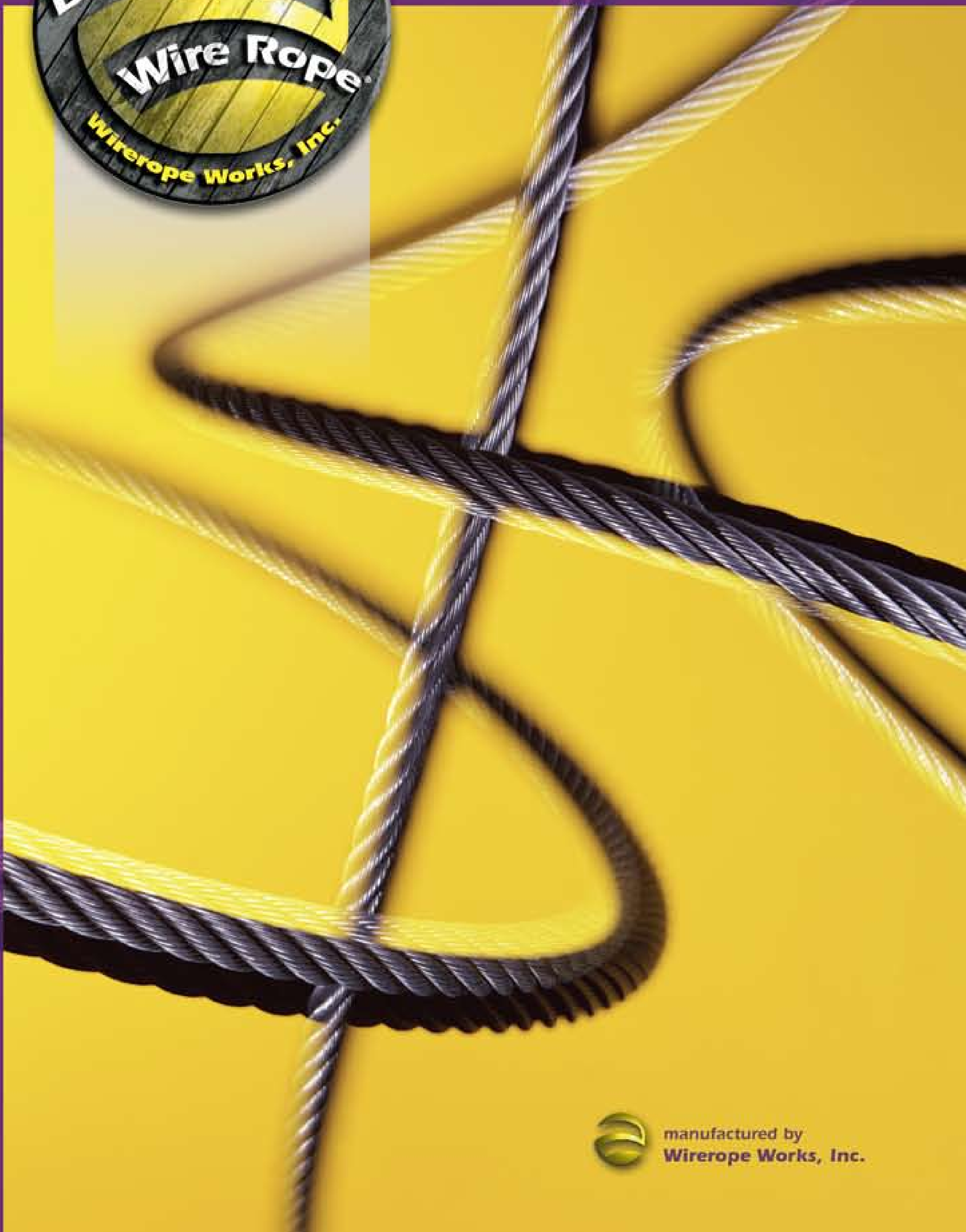
ELEVATOR PRODUCTS CATALOG

Bethlehem Wire Rope®

Wirerope Works, Inc.



manufactured by
Wirerope Works, Inc.

understand
treat the best
make easy
recognize
respond
provide
assist solutions
follow-up
satisfy
relationship
hear needs

Our Service Pledge

- To understand that our customers always come first.
- To treat each customer as our best customer.
- To make our customers' jobs as easy as possible, saving their time and their money.
- To remember, if a customer perceives a problem, a problem really exists.
- To provide fast, friendly responses to our customers, offering service with a smile.
- To provide efficient, error-free order entry and billings.
- To help our customers solve their problems, assist them in product selection and track their orders.
- To follow up with our customers, satisfying their requirements and developing personal relationships.
- To hear what our customers are saying and to understand their needs.

Wirerope Works, Inc.

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Wirerope Works, Inc. (WW) manufactures Bethlehem Wire Rope® to meet the exacting demands of modern elevator service. The key to the success of Bethlehem Wire Rope is the total commitment WW makes to the elevator industry.

QUALITY REGISTRAR
ISO 9001:2008
Wirerope Works, Inc. Williamsport Facility
REGISTRATION NO. 0049
WILLIAMSPORT, PA 17701

Owned by Americans.
Made by Americans.

If your specific elevator rope needs or requirements are not shown in this catalog, please consult our Sales or Engineering Departments at 800-541-7673.

Committed to the Consumer

We continue to support our customers by offering supply contracts and field evaluations of rope performance. We work with our customers to ensure maximum return of the investments made in elevator systems.

Committed to Quality

WW is certified to ISO 9001:2008 and API 9A by the American Petroleum Institute (API). We are also certified by the American Bureau of Shipping (ABS) and Lloyd's of London.

Committed to Service

We service the elevator industry with a large warehouse network, while developing additional outlets for our products, e.g., elevator distributors. In addition, we continue to train and educate consumers in the use and application of elevator ropes.

Wire rope products will break if abused, misused or overused. Consult industry recommendations and ASME Standards before using. Wirerope Works, Inc. warrants all Bethlehem Wire Rope® and Strand products. However, any warranty, expressed or implied as to quality, performance or fitness for use of wire rope products is always premised on the condition that the published breaking strengths apply only to new, unused rope, that the mechanical equipment on which such products are used is properly designed and maintained, that such products are properly stored, handled, used and maintained, and properly inspected on a regular basis during the period of use. Wirerope Works, Inc. expressly prohibits the resale of worn, previously owned and used Bethlehem Wire Rope and Strand products. Immediately following removal from service, all wire rope products are to be properly disposed of in accordance with applicable municipal, state, and federal guidelines. Manufacturer shall not be liable for consequential or incidental damages or secondary charges including but not limited to personal injury, labor costs, and a loss of profits resulting from the use of worn, previously owned and used products. Manufacturer shall not be liable for consequential or incidental damages or secondary charges including but not limited to personal injury, labor costs, a loss of profits resulting from the use of said products or from said products being incorporated in or becoming a component of any product

Wire Rope Specification

Terminology

Wire rope is a machine composed of a number of precise, moving parts, designed and manufactured to bear a very definite relation to one another. In fact, some wire ropes contain more moving parts than many complicated mechanisms. An 8-strand rope with 25 wires per strand laid around a fiber core contains a total of 200 individual wires which all must work together and move with respect to one another if the rope is to have the flexibility, abrasion resistance and fatigue resistance necessary for successful operation.

The successful operation of an elevator rope, however, is not limited to the manufacturer's designs and practices. Other elements are critical to the operation of any wire rope in any industry.

Users of elevator rope must have the ability to properly specify a wire rope for a specific application. Not only is a familiarity with the application required, but also an understanding of the terminology used for wire rope.

The following is a quick explanation of rope terminology. Throughout the explanation we will use a typical elevator hoist rope as an example:

1/2" 8x19S BRT TRC RR FS FC

If further information on rope terminology is needed, please refer to Bethlehem Elevator Rope Technical Bulletin No. One on *Rope Nomenclature.*

Wire Rope Diameter

1/2" 8x19S BRT TRC RR FS FC

It is important to recognize that wire rope is always manufactured larger, never smaller, than the nominal diameter. In standard practice, the nominal diameter, or 1/2" in our example, is the minimum diameter to which the wire rope will be manufactured. WW's diameter tolerances are shown in the table below.

Wire Rope Construction

1/2" **8x19S** BRT TRC RR FS FC

Wire rope is identified by its construction, or the number of strands per rope and number of wires in each strand. For example, the construction 8x19 Seale denotes an 8-strand rope, with each strand having 19 wires. Seale (S) denotes the design. Other designs include Warrington and Filler Wire. Constructions having similar weights and breaking strengths are grouped into wire rope classifications, such as the 8x19 and 6x19 Classes. Factors that influence the type of construction specified include the type of groove contour, diameter of the sheave, and rope flexibility requirements.

Wire Rope Finish

1/2" 8x19S **BRT** TRC RR FS FC
(BRT = bright)

The term bright refers to a wire rope manufactured with no protective coating or finish other than lubricant. WW manufactures and stocks all elevator rope as bright unless otherwise specified. Some applications require more corrosion protection than lubricant can provide, such as with elevator ropes used in underground mines. In these instances, a galvanized finish is specified. Galvanized elevator rope is not stocked, and is manufactured and sold by special order in master lengths only. Contact our sales or engineering departments for further information.

Wire Grade

1/2" 8x19S BRT **TRC** RR FS FC
(TRC = traction)

In the early days, most elevator hoist ropes were made to an iron specification that has a very soft grade of steel. After the traction elevator was developed, iron became obsolete in hoist applications due to its inadequate strength and minimal ability to withstand abrasion. Instead, a special grade of steel, suitably named traction steel, was developed to meet the service conditions of traction machines.

The tensile strength of traction steel (TRC) is between 170,000 and 230,000 lbs. per square inch. It is characterized by an excellent combination of strength, toughness, ductility and fatigue resistance. Traction steel ropes

WW diameter tolerances—fiber core only

Diameter		Loaded Rope		Unloaded Rope		Out of Round Tolerance
inches	decimal equivalent	minimum	maximum	minimum	maximum	
3/8	0.375"	0.375"	0.390"	0.382"	0.397"	0.008"
1/2	0.500"	0.500"	0.515"	0.510"	0.525"	0.008"
9/16	0.563"	0.563"	0.579"	0.574"	0.591"	0.009"
5/8	0.625"	0.625"	0.643"	0.637"	0.654"	0.009"
11/16	0.687"	0.687"	0.708"	0.701"	0.722"	0.011"
3/4	0.750"	0.750"	0.772"	0.765"	0.787"	0.011"
13/16	0.812"	0.812"	0.836"	0.828"	0.852"	0.012"
7/8	0.875"	0.875"	0.901"	0.892"	0.918"	0.013"
1	1.000"	1.000"	1.030"	1.020"	1.050"	0.015"

Right Regular Lay

Right Lang Lay

are designed primarily for use as hoist ropes on modern passenger and freight elevators of the traction drive type. Traction steel elevator ropes provide the qualities needed for satisfactory elevator service. In hoist rope, as well as many compensating and governor rope applications, traction steel is more durable and reliable than iron.

Iron ropes are relatively low in tensile strength (approximately 110,000 to 172,000 lbs. per square inch), and are soft and extremely ductile. Because of this combination, their use for elevator service is mainly limited to governor and compensating ropes.

High rise and high speed elevators often require high strength hoist ropes to meet the required safety factor. WW's extra high strength traction steel often provides the extra margin needed.

Wire Rope Lay

1/2" 8x19S BRT TRC **RR** FS FC
(RR = right regular lay)

The helix or spiral of the wires and strands in a rope is called the lay.

Regular lay denotes rope in which the wires are laid in one direction, and the strands in the opposite direction to form the rope. The wires appear to run roughly parallel to the center line of the rope.

Lang lay is the opposite; the wires and strands spiral in the same direction and appear to run at a diagonal to the center line of the rope. Due to the longer length of exposed outer wires, Lang lay ropes have greater flexibility and abrasion resistance than do regular lay ropes. Greater care, however, must be exercised in handling and spooling Lang lay ropes. These ropes are more likely to twist, kink and crush than regular lay ropes. Also, both ends of lang lay ropes must be secured to prevent the rope from unlaying when hanging these ropes in the hoistway.

Right or left lay refers to the direction in which the strands rotate around the wire rope. If the strands rotate around the rope in a clockwise direction (as the threads do in a right hand bolt), the rope is said to be right lay. When the strands rotate in a counterclockwise direction (as the threads do in a left hand bolt), the rope is left lay.

Right regular lay ropes are furnished unless otherwise specified.

Preformed Wire Rope

1/2" 8x19S BRT TRC RR **FS** FC
(FS = Form-set)

Form-set is WW's trade name for preformed wire rope. Preforming occurs during the closing operation where the component wires and strands are preset into the permanent helical form they take in the completed rope.

Preforming greatly reduces internal torsional stresses and increases the fatigue resistance of the wire, resulting in a stable, better balanced rope with longer service life. Form-set elevator ropes run smoothly over sheaves and drums. Broken wires are less inclined to protrude from the rope surface. As a result, damage to adjacent wires in the strands is minimized.

Form-set ropes are easy to handle. Therefore, socketing is easier and the cost of installation reduced. However, cut ends do need to be seized to prevent unwinding.

Wire Rope Core

1/2" 8x19S BRT TRC RR FS **FC**
(FC = fiber core)

Sisal Core

The core's most important job is providing support for the strands. If the core fails in this support, the ultimate result will be short life for the elevator rope. Lack of proper lubrication is the most common cause of core failure.

The core also contributes elasticity to the elevator rope. It allows for the constructional adjustments needed to equalize stresses when the elevator rope is bent or loaded.

Syncor

This core can be used where adverse operating conditions exist such as high groove pressure. In some applications, it may increase service life by 200%. Provides increased fatigue resistance, reducing the number of internal breaks. Syncor also resists diameter reduction and it maintains strength with severe bending applications longer than standard elevator rope. Standard field lube practices are appplicable. ASME and CAN/CSA inspection and removal criteria apply. Available in 1/2" and 5/8" diameters, Syncor is manufactured in a right regular or lang lay 8x19 Seale construction. It will use less field lubricant, and have less stretch and moisture absorption.

Steel Core (IWRC)

Certain rope applications may be better suited by using a rope with a Steel Core. Variations to the core alter strength, weight, fatigue and stretch characteristics.

Prestretching

To minimize the effects of constructional stretch (discussed in further detail on page 17), prestretched ropes are available upon request. **Note:** Repeated handling can temporarily reverse the prestretching effect but this effect is realized when the rope is installed and initially loaded.

Suggestions

Where WW suggests several rope constructions, the preferred construction is shown first. The following section discusses certain conditions under which a different construction or grade is suggested.

Hoist Ropes

With the advent of high rise elevators and increased car speeds, elevator designers and manufacturers frequently select a higher strength hoist rope. The grade of steel (traction, extra high strength traction) is dependent upon many factors, the most critical being load requirement and car speed. It is not always advantageous to use an EHS traction rope where traction will suffice. The low carbon wire used on traction grade wire ropes may provide better fatigue life than a higher carbon EHS wire.

Drum and Counterweight Ropes

Use 8x19 Seale traction steel ropes for most drum and counterweight ropes. If the drum and sheave material of the existing elevator is softer than that required for traction steel, the use of iron ropes may be considered.

Compensating Ropes

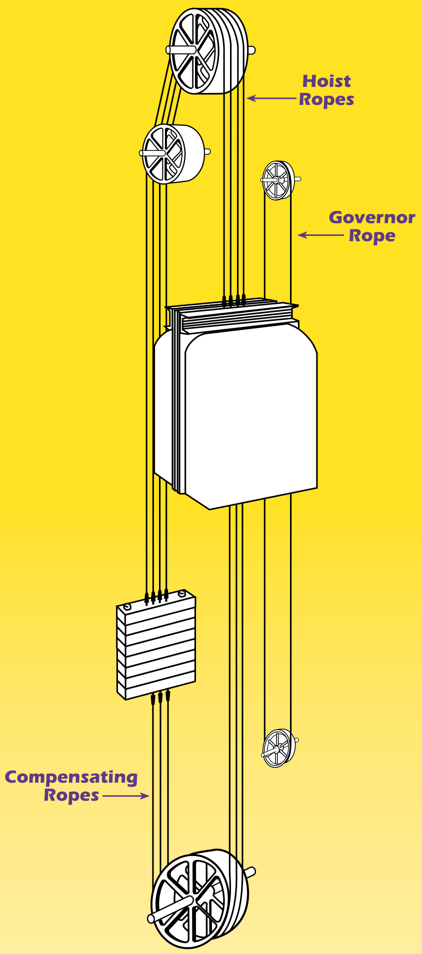
8x25 Filler Wire traction steel ropes provide longer and more economical service. For existing installations that require iron, WW suggests 8x25 Filler Wire.

Governor Ropes

Use an 8-strand traction steel governor rope for longer service life, unless iron is specified. Make sure replacement governor ropes are in accordance with the elevator manufacturer's specifications.

Note: For Steel Core (IWRC) ropes please refer to page 12.

1:1 Single Wrap Traction Overhead Type Elevator

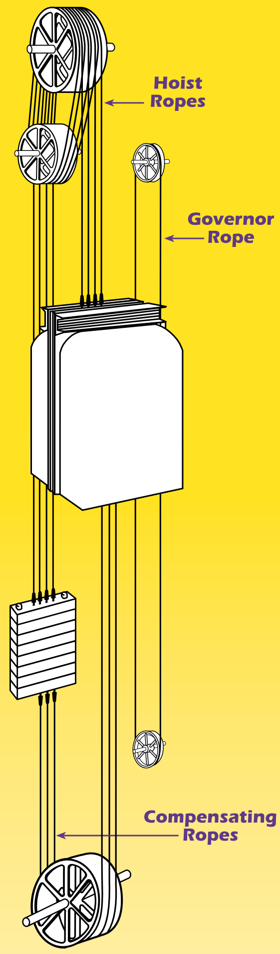


Hoist Ropes:
8x19 Seale, Traction*
6x25 Filler Wire, Traction*

Compensating Ropes:
8x25 Filler Wire, Traction
8x25 Filler Wire, Iron

Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron
6x25 Filler Wire, Iron

1:1 Double Wrap Traction Overhead Type Elevator



Hoist Ropes:
8x19 Seale, Traction*
6x25 Filler Wire, Traction*

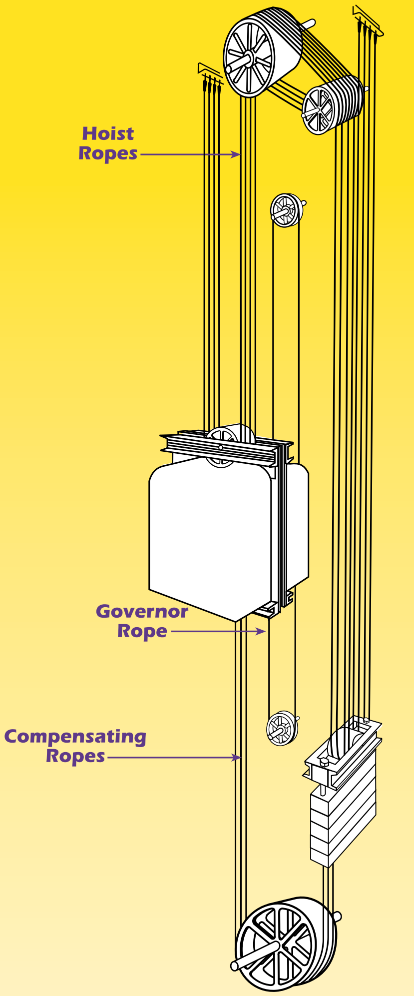
Compensating Ropes:
8x25 Filler Wire, Traction
8x25 Filler Wire, Iron

Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron
6x25 Filler Wire, Iron

*EHS traction may be needed due to load requirements.
**Use 8x19 Warrington for 7/16" and 3/8" diameter rope.

Wire Rope Specification

2:1 Double Wrap Traction Overhead Type Elevator

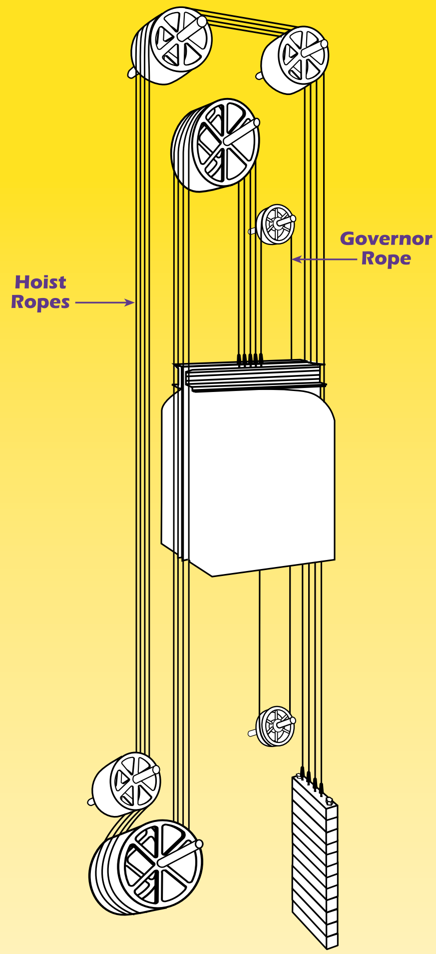


Hoist Ropes:
8x19 Seale, Traction*
6x25 Filler Wire, Traction*

Compensating Ropes:
8x25 Filler Wire, Traction
8x25 Filler Wire, Iron
6x25 Filler Wire, Iron

Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron

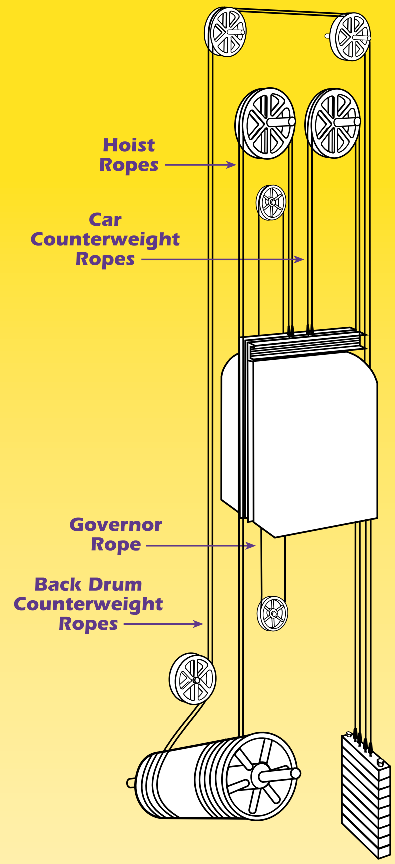
Single Wrap Traction Basement Type Elevator



Hoist Ropes:
8x19 Seale, Traction*
8x21 Filler Wire, Traction*

Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron
6x25 Filler Wire, Iron

Basement Drum Type Elevator



Hoist Ropes:
8x19 Seale, Traction***

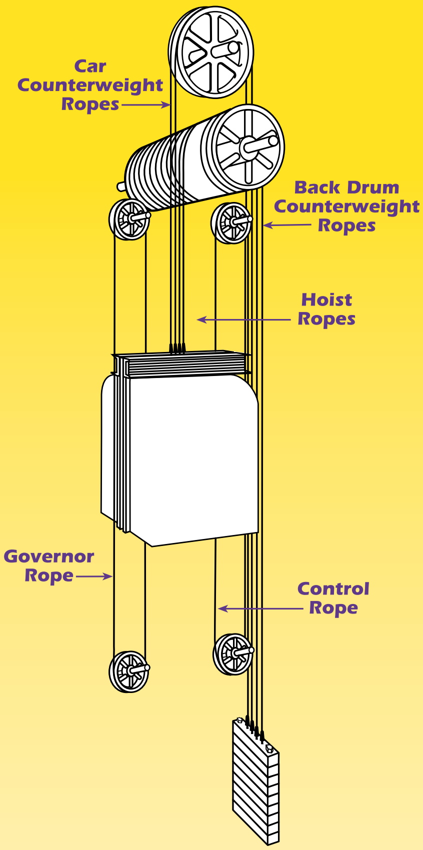
Drum and Car Counterweight Ropes:
8x19 Seale, Traction***

Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron
6x25 Filler Wire, Iron

Control Ropes:
8x19 Warrington, Iron

*EHS traction may be needed due to load requirements
**Use 8x19 Warrington for 7/16" and 3/8" diameter rope.
***For certain drum and sheave materials, a 6x25 Filler Wire Iron grade may be preferable.

Overhead Drum Type Elevator



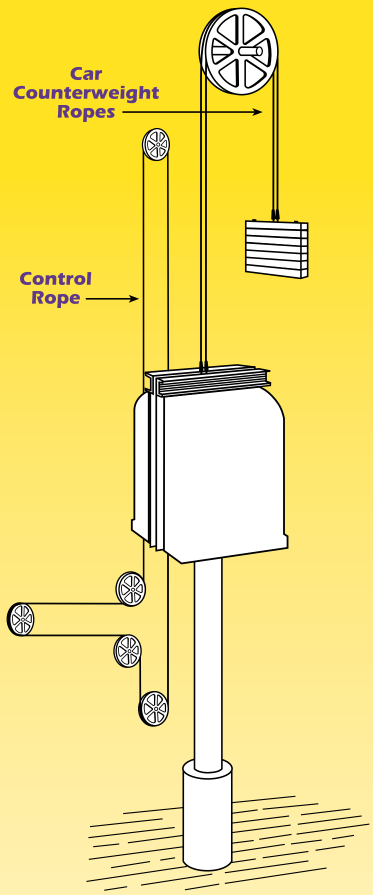
Hoist Ropes:
8x19 Seale, Traction***

Drum and Car Counterweight Ropes:
8x19 Seale, Traction***

Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron
6x25 Filler Wire, Iron

Control Ropes:
8x19 Warrington, Iron

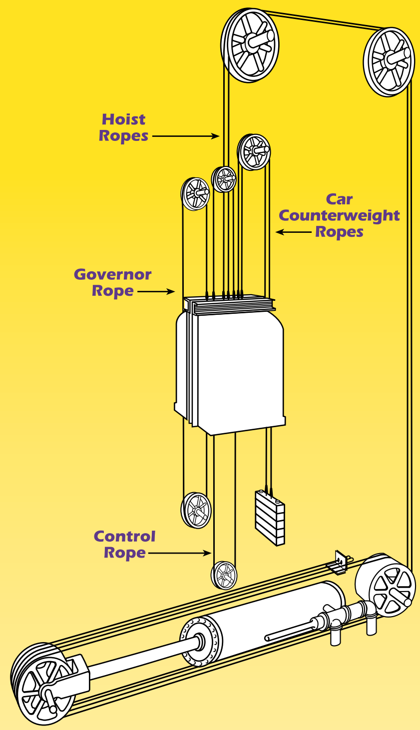
Hydraulic Elevator Direct Plunger Type



Car Counterweight Ropes:
8x19 Seale, Traction***

Control Ropes:
8x19 Warrington, Iron

Hydraulic Elevator Horizontal Plunger Type



Hoist Ropes:
8x19 Seale, Traction***

Car Counterweight Ropes:
8x19 Seale, Traction***

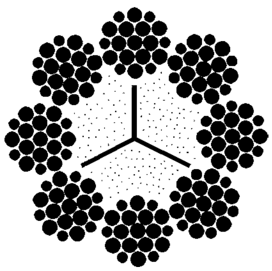
Governor Ropes:
8x25 Filler Wire**, Traction
8x25 Filler Wire**, Iron
6x25 Filler Wire, Iron

Control Ropes:
8x19 Warrington, Iron

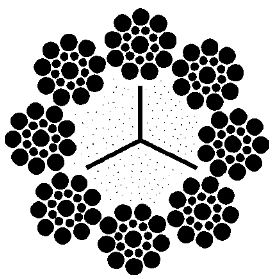
*EHS traction may be needed due to load requirements
**Use 8x19 Warrington for 7/16" and 3/8" diameter rope.
***For certain drum and sheave materials, a 6x25 Filler Wire Iron grade may be preferable.

Standard Elevator Rope Technical Data

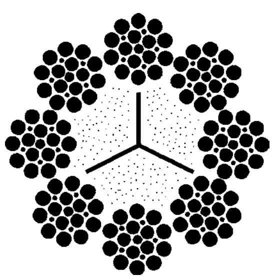
WW manufactures its standard elevator rope in a variety of diameters, constructions, lays and grades.



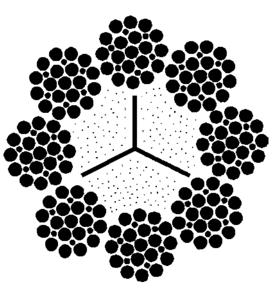
8x19 Warrington
through 7/16" diameter



8x19 Seale
3/8" diameter and larger



8x21 Filler Wire
1/2" diameter and larger



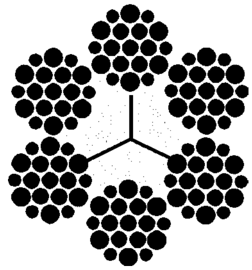
8x25 Filler Wire
1/2" diameter and larger

Diameter		8x19 class (8x19 Warrington, 8x19 Seale, 8x21 Filler Wire, 8x25 Filler Wire)			
		Approx. Wt. (lb./ft.)	Nominal Strength (lbs.)		
inches	mm		Iron	Traction	EHS Traction
1/4	6.4	0.09	1,800	3,600	4,500
5/16	7.9	0.14	2,900	5,600	6,900
3/8	9.5	0.20	4,200	8,200	9,900
7/16	11.1	0.28	5,600	11,000	13,500
1/2	12.7	0.36	7,200	14,500	17,500
9/16	14.3	0.46	9,200	18,500	22,100
5/8	16.0	0.57	11,200	23,000	27,200
11/16	17.5	0.69	13,400	27,000	32,800
3/4	19.1	0.82	16,000	32,000	38,900
13/16	20.6	0.96	18,600	37,000	46,000
7/8	22.2	1.11	21,400	42,000	52,600
15/16	23.8	1.27	24,600	48,000	60,000
1	25.4	1.45	28,000	54,000	68,400
1 1/16	27.0	1.64	-	61,000	77,000

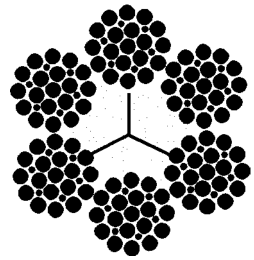
For information on diameters above 1 1/16", please contact WW Sales or Engineering Department.

Diameter		6x19 class (6x19 Warrington, 6x25 Filler Wire)			
		Approx. Wt. (lb./ft.)	Nominal Strength (lbs.)		
inches	mm		Iron	Traction	EHS Traction
1/4	6.4	0.10	2,200	3,600	5,200
5/16	7.9	0.16	3,200	5,600	8,100
3/8	9.5	0.23	5,000	8,200	11,600
7/16	11.1	0.31	6,400	11,000	15,700
1/2	12.7	0.40	8,400	14,500	20,400
9/16	14.3	0.51	10,600	18,500	25,700
5/8	16.0	0.63	12,800	23,000	31,600
11/16	17.5	0.76	15,500	27,000	38,200
3/4	19.1	0.90	18,200	32,000	45,200
13/16	20.6	1.06	21,500	37,000	52,900
7/8	22.2	1.23	24,800	42,000	61,200
15/16	23.8	1.41	28,500	48,000	70,000
1	25.4	1.60	32,000	54,000	79,500
1 1/16	27.0	1.81	-	61,000	89,400

For information on diameters above 1 1/16", please contact WW Sales or Engineering Department.



6x19 Warrington
through 5/16" diameter



6x25 Filler Wire
3/8" diameter and larger

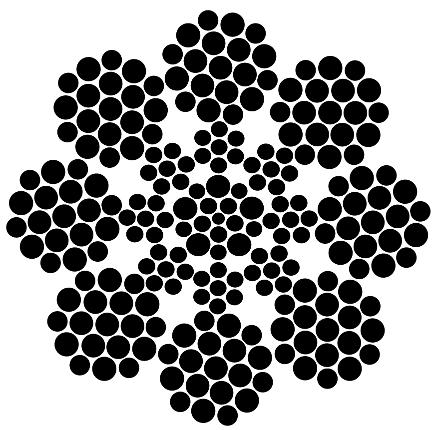
Elevator Hoist Rope with Steel Core (IWRC) Technical Data

Diameter Inches	mm	Construction	Approx. Wt. (lb./ft.)	Nominal Strength (lbs)	Load on Rope	Diameter Tolerance Min	Max	Out-of Round Tolerance
5/16	8	8x19 Warr BRT EHS RR FS IWRC	0.184	9,740	0 10%	0% -1%	3% 2%	2.5% 1.5%
--	10	8x19 Warr BRT EHS RR FS IWRC	0.285	15,220	0 10%	0% -1%	3% 2%	2.5% 1.5%
1/2	12.7	9x21F BRT EHS RR FS IWRC	0.473	23,820	0 10%	0% -1%	3% 2%	2.5% 1.5%
--	13	9x21F BRT EHS RR FS IWRC	0.486	25,200	0 10%	0% -1%	3% 2%	2.5% 1.5%
5/8	16	9x25F BRT EHS RR FS IWRC	0.729	39,120	0 10%	0% -1%	3% 2%	2.5% 1.5%
3/4	19	9x25F BRT EHS RR FS IWRC	1.021	55,200	0 10%	0% -1%	3% 2%	2.5% 1.5%

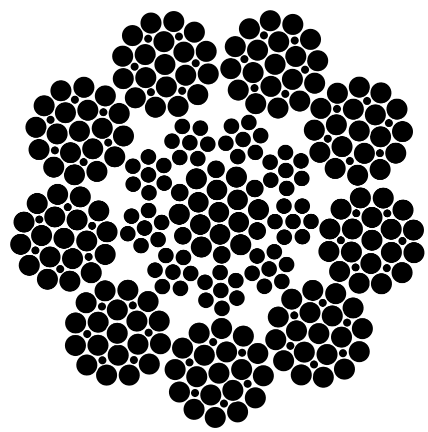
*All ropes are available as traction.

Steel Core elevator hoist ropes are used where additional strength is required without increasing the diameter of the wire rope. An additional benefit of the steel core is that these ropes will exhibit somewhat reduced stretch when compared with that of fiber core ropes.

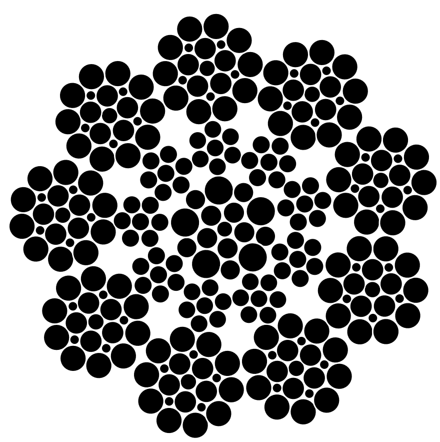
Equipment utilizing Steel Core hoist ropes are specifically designed with steel core ropes in mind and are not to have fiber core ropes substituted.



10 mm 8x19Warr BRT EHS RR FS IWRC



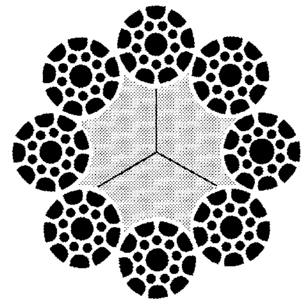
16 mm 9x25f BRT EHS RR FS IWRC



1/2" 9x21f BRT EHS RR FS IWRC

Lift-Pac Technical Data

Diameter		Lift-Pac		
		Approx. Wt. (lb./ft.)	Nominal Strength (lbs)	
inches	mm		Traction	EHS Traction
3/8	9.5	0.23	9,000	11,000
1/2	12.7	0.39	16,000	19,400
5/8	15.9	0.62	25,400	30,800
For information on other diameters, please contact WW Sales or Engineering Department.				



Lift-Pac is designed for use wherever elevator hoist ropes exhibit short service life due to adverse operating conditions. Primary applications include: (1) systems with reverse bends; (2) applications where wire fatigue breakage with minimal surface wear is the cause for retirement; (3) where high groove pressures cause uneven and accelerated wear. Lift-Pac is not recommended for high rise/high speed applications. Also, Lift-Pac should not be used as a remedy for poor rope performance due to worn sheaves and/or differential groove depths.

Features

Fatigue Resistance. The compacted strand surface minimizes the interstrand and interlayer nicking that takes place in elevator ropes, dramatically decreasing the amount of internal breaks. This reduction in internal wire breakage can also be expressed as an increase in reserve strength. By decreasing internal breakage at the interstrand contact points, Lift-Pac maintains its strength longer than standard elevator rope in severe bending applications.

Abrasion Resistance. Lift-Pac's compacted strand design provides improved abrasion resistance when compared with standard 8-strand ropes because of the increased wire and strand surfaces contacting the sheaves and drums.

Resistance To Diameter Reduction. Lift-Pac's compacted design resists diameter reduction due to the higher metallic content and less core deterioration at the strand contact area.

Noise Reduction. Lift-Pac's compacted surface passes smoothly over drums and sheaves, allowing for an extremely quiet running rope.

Specifications

Lift-Pac is a compacted strand rope manufactured as a right Lang lay 8x19 Seale wire rope. For technical data refer to the table above. Lift-Pac fully complies with the A17 elevator code.

Inspection

Due to Lift-Pac's compacted strands, its slightly flattened crown appearance should not be misconstrued as wear. Two methods may be used during inspection to make a distinction between Lift-Pac and a standard worn rope. (1) Check the outer wires in the strand valleys. The crown of the wires of a worn standard rope will obviously be abraded or worn. As these wires travel into the valleys, however, they resume their normal rounded shape. The wires in a Lift-Pac rope retain their die drawn state throughout the crown and valleys. (2) Check the ropes at the shackles. If Lift-Pac is being used, the rope wires at the shackles will have the same flattened crown appearance. If the standard rope is worn, the rope wires at the shackle will be rounded. ASME and CAN/CSA inspection and removal criteria apply.

Inquire about Steel Core (IWRC) Lift-Pac Ropes

Handling

Measuring Rope Diameter

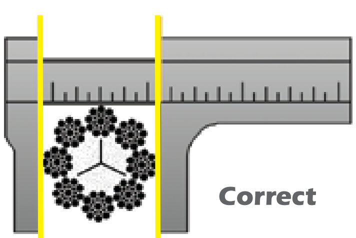
Wire rope diameter is determined by measuring the circle that just touches the extreme outer limits of the strands — that is, the greatest dimension that can be measured with a pair of parallel-jawed calipers or machinist's caliper square. A mistake could be made by measuring the smaller dimension, as shown below.

Always measure the diameter of the rope prior to installation to ensure that you have received the diameter specified for the equipment.

Reels & Coils

Unreeling

The Right Way To Unreel. To unreel wire rope from a heavy reel, place a shaft through the center and jack up the reel far enough to clear the floor and revolve easily. One person holds the end of the rope and walks a straight line away from the reel, taking the wire rope off the top of the reel. A second person regulates the speed of the turning reel by holding a wood block against the flange as a brake, taking care to prevent slack from developing on the reel, as this can easily cause a kink in the rope. Lightweight reels can be properly unreeled using a vertical shaft; the same care should be taken to keep the rope taut.



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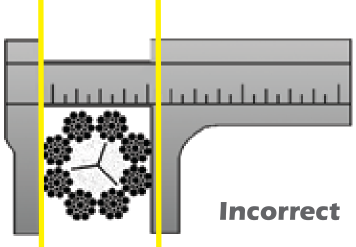
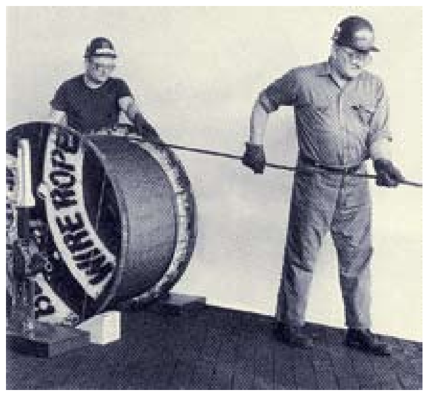


Incorrect

Correct



The Wrong Way To Unreel. If a reel of wire rope is laid on its flange with its axis vertical to the floor and the rope unreeled by throwing off the turns, spirals will occur and kinks are likely to form in the rope. Wire rope should always be handled in a way that neither twists nor unlays it. If handled in a careless manner, reverse bends and kinks can easily occur.

Incorrect

Uncoiling

The Right Way To Uncoil. There is only one correct way to uncoil wire rope. One person must hold the end of the rope while a second person rolls the coil along the floor, backing away. The rope is allowed to uncoil naturally with the lay, without spiraling or twisting. Always uncoil wire rope as shown.

Correct

The Wrong Way To Uncoil. If a coil of wire rope is laid flat on the floor and uncoiled by pulling it straight off, spirals will occur and kinking is likely. Torsions are put into the rope by every loop that is pulled off, and the rope becomes twisted and unmanageable. Also, wire rope cannot be uncoiled like fiber rope. Pulling one end through the middle of the coil will only result in kinking.

Incorrect

Kinks

Great stress has been placed on the care that should be taken to avoid kinks in wire rope. Kinks are places where the rope has been unintentionally bent to a permanent set.

This happens where loops are pulled through by tension on the rope until the diameter of the loop is only a few inches. They are also caused by bending a rope around a sheave having too small a radius. Wires in the strands at the kink are **permanently damaged** and will not give normal service, even after apparent "restraightening."

Drum Winding

When wire rope is wound onto a sheave or drum, it should bend in the manner in which it was originally wound. This will avoid causing a reverse bend in the rope. Always wind wire rope from the **top of the one reel onto the top of the other.** Also acceptable, but less so, is re-reeling from the bottom of one reel to the bottom of another. Re-reeling may also be done with reels having their shafts vertical, but extreme care must be taken to ensure that the rope always remains taut. It should never be allowed to drop below the lower flange of the reel. A reel resting on the floor with its axis horizontal may also be rolled along the floor to unreel the rope.

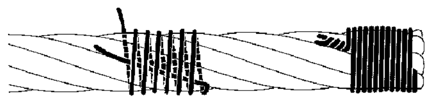
Seizing Wire Rope

Seizing Wire

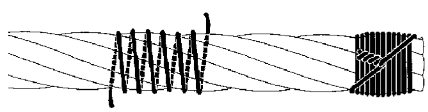
Proper seizing and cutting operations are not difficult to perform, and they ensure that the wire rope will meet the user's performance expectations. Proper seizings must be applied on both sides of the place where the cut is to be made. In a wire rope, carelessly or inadequately seized ends may become distorted and flattened, and the strands may loosen. Subsequently, when the rope is operated, there may be an uneven distribution of loads to the strands; a condition that will significantly shorten the life of the rope.

Either of the following seizing methods is acceptable. Method No. 1 is usually used on wire ropes over one inch in diameter. Method No. 2 applies to ropes one inch and under.

Method No. 1: Place one end of the seizing wire in the valley between two strands. Then turn its long end at right angles to the rope and closely and tightly wind the wire back over itself and the rope until the proper length of seizing has been applied. Twist the two ends of the wire together, and by alternately pulling and twisting, draw the seizing tight.



Method No. 2: Twist the two ends of the seizing wire together, alternately twisting and pulling until the proper tightness is achieved.



The seizing wire should be soft or annealed wire or strand. Seizing wire diameter and the length of the seize will depend on the diameter of the wire rope. The length of the seizing should never be less than the diameter of rope being seized.

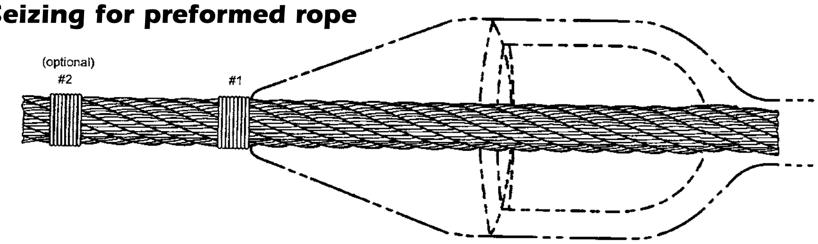
When seizing wire rope in preparation for socketing, please refer to ASME A17.1-2004 2.20.9.7. If preformed rope is being used, ASME requires only single seizing, or one seizing on either side of where the cut is to be made. The seizing should be placed at a distance from the end of the rope equal to the length of the tapered portion of the socket plus the length of the portion of the rope to be turned in.

The guidelines for non-preformed rope are more stringent. Non-preformed rope requires triple seizing, or three separate seizings, on each side where the cut is to be made. The first seizing is to be close to the cut. The second seizing should be placed back from the first a length of the end of the rope to be turned in, and the third at a distance from the second seizing equal to the length of the tapered portion of the socket.

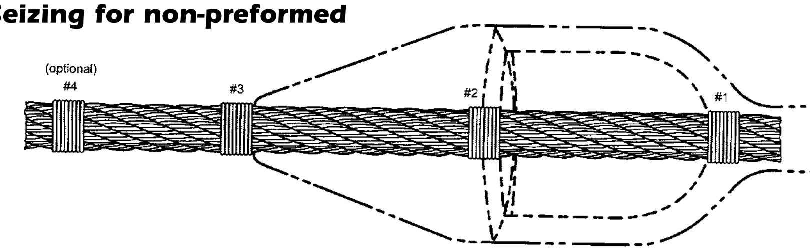
Cable Bands

Many companies are turning to cable bands in lieu of seizing wire to secure the ends of wire rope. Easy to use, cable bands are nothing more than "wrappers" that can be wound around the rope and crimped into place with a pair of pliers. When following the same ASME guidelines and in the absence of seizing wire or tools, the use of cable bands is acceptable.

Seizing for preformed rope



Seizing for non-preformed



Socketing

Tapered Rope Sockets

While wire rope manufacturers universally advocate the use of zinc (spelter) for socketing wire rope, the difficulties of making this type of secure fastening in the field are so great that elevator companies have used babbitt to attach sockets. With the babbitting method, even a poorly made socket will develop a considerable portion of the rope strength, whereas with spelter socketing, if the bond between metal and the wire is not good, there is little or no holding power. Further, the melting point of zinc is considerably higher than babbitt, and the danger of overheating and damaging the wire is greater. Taking this into account, babbitting is recommended.

1. **Prepare the rope for socketing.** After cutting and seizing, insert the rope through the hole in the small end of the socket, allowing sufficient distance for manipulation. Remove the first two seizings if non-preformed rope is used. Spread the rope strands and trim the fiber core to meet the next seizing.

Figure 1: Strands separated and straightened in preparation for socketing

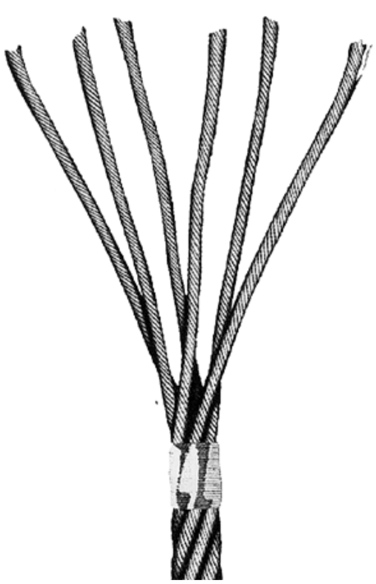


Figure 2: Strand ends turned in

2. **Remove grease and oil from the rope.** Remove grease and oil by cleaning the outer surface of the exposed rope strands with a nonflammable, low toxic solvent. **Note:** Certain elevator companies now omit this washing with solvent, depending on the hot babbitt to burn off the lubricant. Tests of two sockets, one with the rope carefully cleaned and the other uncleaned, were made and both sockets gave more than the required 80% of the strength of the rope.

3. **Turn in the rope strands.** Bend, turn in and closely bunch the strands, making sure each strand is turned in the same distance (see Figure 2). When done correctly, the length of the turned in section is not less than 2-1/2 times the diameter of the rope. When the rope is pulled as far as possible into the socket, the bend of the turned in strands slightly protrudes over the large end of the socket and is visible when the socket is babbitted, as shown in Figure 3. When rope with an IWRC is used, cut the core center even with the top of the looped strands.

4. **Insert the turned in rope strands into the socket.** Pull the rope as far as possible into the socket so the remaining seizing is outside of the small end of the socket, permitting inspection of the wires just below the small end.

5. **Prepare the socket.** Hold the socket in a vertical position, making sure the rope is straight. Wind tape or other material around the rope at the base of the socket to prevent the babbitt from seeping through, and remove after the metal is cool.

6. **Heat the babbitt metal before pouring.** While heating and pouring the babbitt, wear either a bab-

Figure 3: Turned ends pulled into basket ready for pouring

Figure 4: Properly poured basket

bitting mask or suitable goggles to protect the eyes in case the babbitt splatters. Only use babbitt metal or the equivalent to secure wire ropes in tapered babbitted sockets, making sure it is clean and free of dross. Heat the babbitt to fluidity at a temperature sufficient to char a soft piece of wood (preferably white or Ponderosa pine) without igniting it. Do not overheat the babbitt.

7. **Heat the socket basket and pour the babbitt.** Heat the socket basket with a blowtorch to prevent the babbitt from hardening before it completely fills the basket and the spaces between the rope strands. Pour the molten babbitt slowly and evenly into the basket until it is level with the top of the basket.

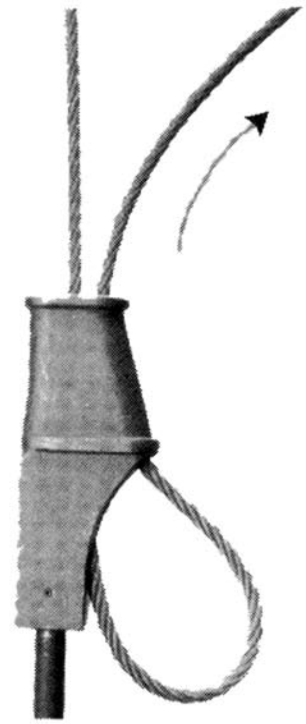
8. **Inspect the socket after pouring.** After the babbitt cools, visually inspect the socket, which should show:
   a. the babbitt visible at the small end of the socket.
   b. the tops of the looped strands just visible above the surface of the babbitt, as shown in Figure 4. (If the rope has an IWRC, core will also be visible above the surface of the babbitt.) If an entire loop shows, reject the socket.
   c. no loss of rope lay where the rope enters the basket (as shown in Figure 5).
   d. the loops meeting the minimum and maximum projection criteria, as outlined by ASME.

   Reject babbitt sockets which do not conform to the above requirements and resocket the rope.

An optional method of attaching poured sockets utilizes a thermosetting resin composition instead of molten metal. The socket preparation used in this type of socketing is identical to that used for babbitt. Since resin socketing does not require special fittings, those sockets used in the babbitting method may be applied to resin socketing. When properly measured and mixed, the two and three component systems solidify in a few minutes at ambient temperatures.

Figure 5: Incorrectly socketed wire rope showing loss of rope lay

Figure 6: Insert the wire rope through the body and thread it back through the front



Wedge Sockets

Another end termination is the wedge socket. This method uses a special socket in which the rope is looped inside the socket and secured by a compatible wedge. Since the inside configuration of the socket and wedge are designed together, the connection is particularly secure when a load is applied to the finished connection. Care is required to ensure the wedge is not reversed in the socket, which could cause early breakage or reduced attachment efficiency. When performed properly, the initial installation and reapplication for shortening are quick and easy. However, wedge sockets generally achieve about 90% breaking strength as compared to 100% on a properly babbitted or resin socket.

1. **Insert the rope in the socket.** Insert the end of the wire rope through the socket body, taking up all the slack in the rope. Thread the end of the rope up through the front side of the socket body, leaving just enough loop to install the wedge. Ensure

the rope is placed into the body of the socket as shown in Figure 6 or it will not align properly.

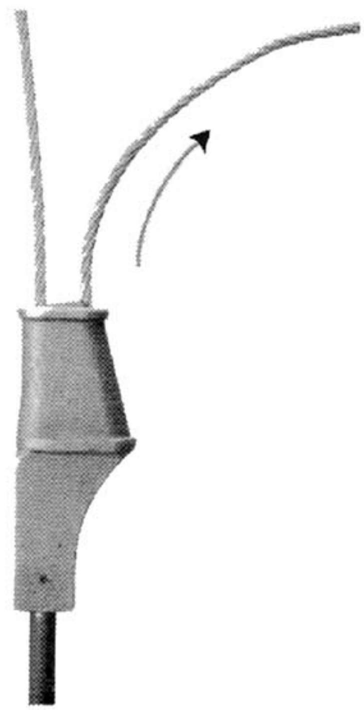
2. **Install the wedge.** Place the wedge into the loop. Wedge inserts are marked and color coded for the rope diameter for which they are to be used.

3. **Seat the wedge.** While pulling down on the hoist rope with one hand to keep it taut, pull up on the loose end with a quick pull until the rope loop and the wedge are seated in the socket body.

4. **Seat the rope and attach retaining clips.** After the ropes are installed, let the weight of the car and counterweight rest on the ropes. When the rope is seated in the wedge socket by the load on the rope, the wedge must be visible. Cut off any excess rope, making sure to leave a minimum of six inches of rope pulled through the socket. Attach a minimum of two retaining clips on the rope to bind the dead end to the live, or load bearing, end of the rope. Place the first clip a maximum of four times the rope's diameter above the socket, and the second clip within eight times the rope's diameter above the first clip. The purpose of the clips is to retain the wedge and prevent the rope from slipping should the load be removed for any reason.

Figure 7: Place wedge in the loop, choosing the correct wedge for the socket

Figure 8: Seat the rope and wedge into the socket by quickly pulling the dead end



5. **Equalize the ropes.** Any rope or ropes that are slack can be easily adjusted by tapping the wedge. Using a hammer and drift pin, insert the drift pin into the top of the socket body between the rope's live and dead ends. Tap the wedge until the rope slides, then tighten the wedge. Repeat the procedure until all ropes have equal tension. Tie down rope sockets to prevent rotation.

Review local codes to determine approval of any end attachments.

Rope Equalization

All elevator ropes in a set must be under equal tension. If a set is unbalanced, the rope to rope lengths are not the same, loading is not equal and wear can vary considerably. Consequently, unequal tension results in unsatisfactory operation, variable rope life, unequally worn grooves, and compromised safety factors.

In recently installed ropes, unequal tension is usually due to improper adjustment at the sockets. However, make sure all ropes in a set are seated in the sheave grooves to the same depth so the length of travel is identical. If the grooves do not have uniform characteristics, differential loading between the ropes will be created.

Adjust tension using the shackle rod nuts. After each adjustment, run the car to the other end of hoistway and make any necessary changes. If the car is returned to the original position in the hoistway and the ropes still require adjusting, a variation in groove depth is indicated, requiring repairs to the drive sheave.

Do not twist elevator ropes in any direction, for any reason. Doing so completely unbalances the elevator rope structure and disturbs the rope lay. If any or all of the ropes are handled in this manner, a balanced set of ropes is impossible to maintain, and a much shorter rope life results.

Check and balance the rope tension of active passenger elevators as often as needed.

For further information on tensioning, please refer to Bethlehem Elevator Rope Technical Bulletin No. Eight on *Tensioning*.

Wire rope is an elastic member; it stretches and elongates under load. The two primary types of stretch are elastic and constructional. Elastic stretch is load dependent—it lengthens and shortens as the load changes. Constructional stretch is a lenthening process only; it is permanent and removed by normal operation over time or by factory prestretching.

$$\text{Change in Length (ft.)} = \frac{\text{Change in Load (lbs.)} \times \text{Length of One Rope (ft.)}}{\text{Metallic Area of One Rope (in}^2\text{)} \times \text{Modulus of Elasticity (psi)}}$$

Elastic Stretch

Elastic stretch results from recoverable deformation of the metal itself. A good analogy for elastic stretch is a rubber band. When a load is placed upon the band, it stretches and elongates; when the load is removed, the band returns to its original size and shape. Wire rope acts in the same manner.

In elevator applications, elastic stretch is determined by the formula shown above.

On any elevator application, once a rope is installed, the length of the rope, metallic area and modulus of elasticity remain constant. Therefore, the only factor affecting elastic stretch is changes in the load. Stretch occurs in two stages. The first is immediately after installation when the combined weight of the car and counterweight causes the ropes to stretch. The second stage occurs as the car becomes loaded and unloaded during normal service. A normal 1/2" 8x19 traction preformed fiber core rope, with each rope in the set loaded to 10%, will stretch approximately 2.5" per 100 feet. The same rope in an EHS traction grade will stretch approximately 3" per 100 feet. Since the metallic area and modulus of elasticity of a 6x25 elevator rope are greater than the comparable 8x19 rope, the approximate elastic stretch for 6-strand rope is reduced to 1.6" per 100 feet for traction and 2.2" per 100 feet for EHS traction. Elevator ropes with steel cores (IWRC) have even lower elastic stretch.

stretch factors
Bethlehem Wire Rope Non-Prestretched

		Stretch in Inches Per 100 Feet: Elastic		Constructional		Total
6-strand traction	FC	1.5 to 2	+	4 to 6	=	5.5 to 8
6-strand EHS traction	FC	2 to 2.5	+	4 to 6	=	6 to 8.5
6-strand EHS traction	**IWRC**	1.3 to 1.7	+	2.6 to 4	=	3.9 to 5.7
8-strand traction	FC	2.5 to 3	+	6 to 9	=	8.5 to 12
8-strand EHS traction	FC	3 to 3.5	+	6 to 9	=	9 to 12.5
8-strand EHS traction	**IWRC**	2 to 2.4	+	4 to 6	=	6 to 8.4
9-strand EHS traction	**IWRC**	1.5 to 2	+	3 to 5	=	4.5 to 7
Bethlehem Wire Rope Prestretched						
6-strand traction	FC	1.5 to 2	+	1.5 to 3	=	3 to 5
6-strand EHS traction	FC	2 to 2.5	+	1.5 to 3	=	3.5 to 5.5
6-strand EHS traction	**IWRC**	1.3 to 1.7	+	1 to 2	=	2.3 to 3.7
8-strand traction	FC	2.5 to 3	+	2 to 4	=	4.5 to 7
8-strand EHS traction	FC	3 to 3.5	+	2 to 4	=	5 to 7.5
8-strand EHS traction	**IWRC**	2 to 2.4	+	1.3 to 2.7	=	3.3 to 5.1
9-strand EHS traction	**IWRC**	1.5 to 2	+	1 to 2	=	2.5 to 4

Note: Prestretching significantly reduces constructional stretch, but does not remove it totally (see chart). Elastic stretch is not affected by prestretching. Per chart, both constructional and elastic stretch must be considered when installing the ropes whether or not the ropes were prestretched.

Constructional Stretch

Constructional stretch occurs during the operation of the rope, and is caused by the wires and strands pulling down, compressing the core and bringing all of the elements into closer contact. The result is a slight reduction in diameter and an accompanying lengthening of the rope. Factors affecting constructional stretch include type of core, quality of core, rope construction, lay lengths, preforming and load.

The highest percentage of constructional stretch occurs shortly after the elevator ropes are installed. Because the fiber core will stretch more than the steel strands, the core will pull down until the outer strands begin to load against themselves. In lightly-loaded ropes, the constructional stretch will generally take longer to occur than in a rope under higher loads. However, in both cases, the constructional stretch will reduce dramatically once the outer strands begin to load against themselves.

ASME Rules & Guidelines

The following excerpts on the inspection of elevator ropes are as published by the American Society of Mechanical Engineers.

ASME A17.1 — 2004 Safety Code for Elevators and Escalators

SECTION 8.11.2
Periodic Inspection and Tests of Electric Elevators

8.11.2.1.3 Top-of-Car

(z) Governor Rope (Item 3.20). Governor ropes should be inspected and replaced as specified in 8.11.2.1.3(cc)(1) and (cc)(3) for traction elevator suspension and compensating ropes.

(cc) Wire Suspension and Compensating Ropes (Item 3.23).

(1) Wire suspension and compensating ropes shall be replaced:

(a) if the broken wires are equally distributed among the strands, when the number of broken wires per rope lay in the worst section of the rope exceeds the values shown in column A of Table 8.11.2.1.3(cc)(1); or

(b) if the distribution of broken wires is unequal, and broken wires predominate in one or two strands, when the number of broken wires per rope lay in the worst section of the rope exceeds the values shown in column B of Table 8.11.2.1.3(cc)(1);

(c) if four or five wires, side by side, are broken across the crown of any strand, when the number of broken wires per rope lay in the worst section of rope exceeds values shown in column C of Table 8.11.2.1.3(cc)(1) ; or

(d) if in the judgement of the inspector, any unfavorable condition, such as fretting, corrosion (red dust or rouge), excessive wear of individual wires in the strands, unequal tension, poor sheave grooves, etc., exist, the criteria for broken wires will be reduced by 50% of the values indicated in Table 8.11.2.1.3(cc)(1) for any of the three conditions described above; or

(e) if there is more than one valley break per rope lay.

(2) On winding drum machines, the ropes should be replaced:

(a) if the broken wires are equally distributed among the strands, when the number of broken wires per rope lay in the worst section of rope exceeds 12 to 18; or

(b) if wire breaks predominate in one or two strands, when the number of broken wires per rope lay in the worst section of rope exceeds 6 to 12; or

(c) if there is more than one valley break per rope lay.

(3) On any type of elevator, the suspension compensation and governor ropes should be replaced when their actual diameter is reduced below the value shown in Table 8.11.2.1.3(cc)(3).

Section 8.6.2 Repairs

8.6.2.5 Repair of Ropes. Suspension, governor, and compensating ropes shall not be lengthened or repaired by splicing (see 8.7.2.21).

Section 8.6.3 Replacements

8.6.3.1 Replacement Parts. Replacements shall be made with parts of at least equivalent materials, strength, and design.

8.6.3.2 Replacement of a Single Suspension Rope. If one rope of a set is worn or damaged and requires replacement, the entire set of ropes shall be replaced, except, where one rope has been damaged during installation or acceptance testing prior to being subjected to elevator service, it shall be permissible to replace a single damaged rope with a new rope, provided that the requirements of 8.6.3.2.1 through 8.6.3.2.6 are met.

8.6.3.2.1 The wire rope data for the replacement rope must correspond to the wire rope data specified in 2.20.2.2(a), (b), (c), (f), and (g) for the other ropes.

Table 8.11.2.1.3(cc)(1)
Wire Suspension and Compensation Ropes

types of wire rope	A [Note (1)]	B [Note (1)]	C [Note (1)]
6 x 19 class	24-30	8-12	12-20
8 x 19 class	32-40	10-16	16-34

GENERAL NOTE: 6 x 19 class rope has 6 strands with 16-26 wires per strand. 8 x 19 class rope has 8 strands with 16 to 26 wires per strand.
Note: (1) The upper limits may be used when inspections are made monthly by a competent person.

Table 8.11.2.1.3(cc)(3)

Nominal Size, in.	Maximum Reduced Diameter, in.
3/8	11/32 (.344)
7/16	13/32 (.406)
1/2	15/32 (.469)
9/16	15/32 (.531)
5/8	37/64 (.578)
11/16	41/64 (.641)
3/4	45/64 (.703)
1	15/16 (.938)

8.6.3.2.3 The suspension ropes, including the damaged rope, shall not have been shortened since their original installation.

8.6.3.2.4 The diameter of any of the remaining ropes shall not be less than the nominal diameter minus 0.4 mm (0.015 in.).

8.6.3.2.5 The tension of the new replacement rope shall be checked and adjusted as necessary at semi-monthly intervals over a period of not less than two months after installation. If proper equalization of rope tension cannot be maintained after 6 months, the entire set of hoist ropes shall be replaced.

8.6.3.2.6 The replacement rope shall be provided with the same type of suspension rope fastening used with the other ropes.

8.6.3.3 Replacement of Ropes Other Than Governor Ropes

8.6.3.3.1 Replacement of all ropes, except governor ropes (see 8.6.3.4), shall conform to the following:

(a) Replacement ropes shall be as specified by the original elevator manufacturer or be at least equivalent in strength, weight, and design.

(b) Ropes that have been previously used in another installation shall not be reused.

(c) When replacing suspension, compensating, and car or drum counterweight ropes, all ropes in a set shall be replaced, except as permitted by 8.6.3.2

(d) The ropes in the set shall be new, all from the same manufacturer, and of the same material, grade, construction, and diameter.

ASME A17.2. — 2004 Guide for Inspection of Elevators, Escalators, and Moving Walks

ITEM 3.20 GOVERNOR ROPE

3.20.1 Periodic Inspections

Inspect the governor rope for evidence of lubricant being added after installation as the additional lubricant may interfere with the ability of the governor to retard the governor rope and apply the safety. Check the governor rope data tag and verify that the rope complies with the specification on the governor marking plate. Inspect the governor rope as outlined in Item 3.23 for suspension ropes.

3.20.2 Periodic Test

3.20.3 Acceptance

Verify the governor rope that has been installed is the correct type, size, and construction as indicated on the speed governor data plate. See Item 2.12. Check for installation of the required governor rope data tag.

ITEM 3.23 SUSPENSION ROPE

3.23.1 Periodic Inspections

3.23.1.1 Electric Elevators

(a) **Wire Rope Inspection.** Examine suspension ropes and note if they conform to the Code requirements.

(1) Internal breakage of wire ropes is difficult to detect and, consequently, may be a greater hazard than surface wear. The surface of the rope may show little or no wear, but if the rope is bent over a short radius, individual wires will snap and in extreme cases the rope may be broken by hand. Such failures are more likely to occur in governor and compensating ropes where the ropes are lightly loaded and the ratio of sheave diameter to rope diameter is smaller.

(2) When replacing suspension ropes, all ropes in a set must be replaced. The ropes in the set must all be from the same manufacturer and of the same material, grade, construction, and diameter.

(3) The lengths of all wire ropes in a set of suspension ropes, and consequently the rope tensions, should be substantially equal if maximum rope life and efficiency are to be obtained. If the tensions do not appear to be substantially the same, equalization of the rope lengths is recommended.

(4) If ropes are dirty or overlubricated, a proper inspection may not be possible unless the dirt or excess lubricant is removed.

(b) **Wire Rope Inspection Procedure.** Note that it is not possible to describe the inspection procedure for every single type of wire rope installation nor to outline every detail of the inspection procedure. Select the location from which a proper examination of the rope can best be made. For example, the suspension ropes of an overhead drum machine cannot be examined from the top of the car. See Item 2.27.1.

(1) For suspension ropes on traction machines with 1:1 roping, examination of the ropes should preferably start with the car located at the top of the hoistway and made from the top of the car, examining the ropes on the counterweight side.

(2) For traction machine ropes with 2:1 roping, examination of the ropes should preferably start with the car located at the top of the hoistway and made from the top of the car. Examine both the dead-end side and the traveling-end side of the counterweight ropes, and dead-end side of the car ropes. The remainder of the ropes can be examined at the traction sheave by moving the car up the hoistway.

(3) For overhead winding drum machines with 1:1 roping, the hoisting ropes must be examined from the overhead machinery space. Where the driving machine is located below, those portions of the ropes leading from the driving machine drum or sheave and from the counterweight to the overhead sheaves can be examined from the car top as the car descends, except for a small portion which must be examined from the pit.

(4) On all elevators, mark the ropes with chalk to indicate the location of the unexamined section of ropes and examine them later from the machine room or overhead machinery space, or from the pit.

(c) Wire Rope Inspection Criteria

(1) The following method based on field experience is recommended as a guide for the inspection and evaluation of wire ropes. Give particular attention to where the wire rope passes over sheaves, such as in relation of the position of the wire rope over sheaves with the car at terminal landings.

(a) Move the car downward 2 ft. (610 mm) or 3 ft. (914 mm) at a time and examine each rope at each of these stops. Note when broken wires begin to appear. Thereafter check at frequent intervals to determine the rate of increase in the number of broken wires. Any rapid increase in the number of broken wires is significant.

(b) Count the number of broken crown wires in a rope lay (see Fig. 3.23.1) measured along the length of a rope within which the spiral strands complete one turn about the axis. A lay may be considered as a section of rope approximately 6-1/2 times the diameter of the rope, that is, 3-1/4 in. (83 mm) for ½ in. (13 mm) rope and 4-1/16 in. (103 mm) for 5/8 in. (16 mm) rope.

Refer to the A17.1 Code for rope replacement criteria.

(2) Breaks in the valleys of the ropes, while infrequent, may be an indication of internal breaks. This is not to be confused with a broken outside wire when the original break occurred at a worn crown and a secondary fracture has occurred near the point where two adjacent strands make contact. In this case, a piece of wire has broken out and is missing, and generally both ends of the broken wire remaining are visible.

(3) Note that where preformed rope is used, greater care is required to detect broken wires which do not protrude from the surface of the rope.

(d) **Governor Ropes.** Governor ropes should be inspected and replaced as outlined for suspension and compensating ropes of traction machines. Check governor rope and data tag. The Code also requires the governor rope data to be shown on a metal plate attached to the speed governor.

(1) If a governor rope has been replaced since the last inspection, determine that the new rope is of the same material, diameter, and construction as that specified on the governor marking plate. If not, a test of the car safety and governor is required.

(2) Ensure wire ropes which have been previously installed have not been used.

ITEM 3.33 COMPENSATING ROPES AND CHAINS

3.33.1 Routine

3.33.1.2 Electric Elevators

Examine compensating chains and fastenings for excessive wear, damage, or detoriation. Sash cord wear is no indication of chain damage. See Item 3.23 for inspection of compensating ropes.

1 Lay Length of a 6-strand Rope

Wire Rope Replacement Criteria per ASME A17.6—2010

TABLE 1.10.1—WIRE BREAKS

Crown Wire Breaks Per Lay Length

Notes (Table 1.10.1):

1) Where ropes are subjected to reverse bends or where ropes are installed on non-metallic coated, plastic, fiber-reinforced plastic sheaves or sheaves with on-metallic liners or inserts, extra attention must be given to any steel wire rope (6, 8 or 9 stand) due to possible acceleration of valley breaks.

2) Table 1.10.1 does not apply to Winding Drum Machines. See requirement 1.10.2 for replacement criteria.

3) No more than 1 valley break per lay length and no valley breaks allowed if visible rouge.

4) For ropes less than 8 mm, also see requirement 1.10.1.9 for additional replacement requirements.

6-Strand Rope Applications

	Normal Wear Conditions	Unfavorable Wear Conditions	Ropes Showing Rouge
Distributed Breaks (max)	24	12	12
Unequal Breaks (max)	8	4	4
4 Side-by-Side Breaks	12	6	6

8- and 9-Strand Rope Applications

	Normal Wear Conditions	Unfavorable Wear Conditions	Ropes Showing Rouge
Distributed Breaks (max)	32	16	16
Unequal Breaks (max)	10	5	5
4 Side-by-Side Breaks	16	8	8

Table 1.10.3—DIAMETER (minimum)

Notes (Table 1.10.3)

1) For ropes less than 8 mm, the rope must be replaced if rouge is evident. See requirement 1.10.1.9

2) Maximum allowable diameter reduction below nominal for rope diameters less than 8 mm is 3.125%

3) Maximum allowable diameter reduction below nominal for rope diameters equal to or greater than 8 mm are as follows:

a. Normal wear or unfavorable wear conditions is 6.25%

b. Ropes showing rouge is 3.125%

8- and 9-Strand Rope Applications

Nominal Rope Size	Normal Wear Conditions		Unfavorable Wear Conditions		Ropes Showing Rouge	
	in.	mm	in.	mm	in.	mm
4 mm	0.153	3.875	0.153	3.875	Note 1	Note 1
5 mm	0.191	4.844	0.191	4.844	Note 1	Note 1
6 mm	0.229	5.813	0.229	5.813	Note 1	Note 1
1/4 in.	0.242	6.152	0.242	6.152	Note 1	Note 1
6.5 mm	0.248	6.297	0.248	6.297	Note 1	Note 1
6.7 mm	0.256	6.491	0.256	6.491	Note 1	Note 1
5/16 in.	0.303	7.689	0.303	7.689	Note 1	Note 1
8 mm	0.295	7.500	0.295	7.500	0.305	7.750
9 mm	0.332	8.438	0.332	8.438	0.343	8.719
3/8 in.	0.352	8.930	0.352	8.930	0.363	9.227
10 mm	0.369	9.375	0.369	9.375	0.381	9.688
11 mm	0.406	10.31	0.406	10.31	0.420	10.66
7/16 in.	0.410	10.42	0.410	10.42	0.424	10.77
12 mm	0.433	11.25	0.433	11.25	0.458	11.63
1/2 in.	0.469	11.91	0.469	11.91	0.484	12.30
13 mm	0.480	12.19	0.480	12.19	0.496	12.59
14 mm	0.517	13.13	0.517	13.13	0.534	13.56
9/16 in.	0.527	13.39	0.527	13.39	0.545	13.84
15 mm	0.554	14.06	0.554	14.06	0.572	14.53
5/8 in.	0.586	14.88	0.586	14.88	0.605	15.38
16 mm	0.591	15.00	0.591	15.00	0.610	15.50
11/16 in.	0.645	16.37	0.645	16.37	0.666	16.92
18 mm	0.664	16.88	0.664	16.88	0.687	17.44
19 mm	0.701	17.81	0.701	17.81	0.725	18.41
3/4 in.	0.703	17.86	0.703	17.86	0.727	18.45
20 mm	0.738	18.75	0.738	18.75	0.763	19.38
13/16 in.	0.762	19.35	0.762	19.35	0.787	19.99
22 mm	0.812	20.63	0.812	20.63	0.839	21.31
7/8 in.	0.820	20.84	0.820	20.84	0.848	21.53
15/16 in.	0.879	22.32	0.879	22.32	0.908	23.07
1 in.	0.938	23.81	0.938	23.81	0.969	24.61
1 1/8 in.	1.055	26.79	1.055	26.79	1.090	27.68
1 1/4 in.	1.172	29.77	1.172	29.77	1.211	30.76
1 3/8 in.	1.289	32.74	1.289	32.74	1.332	33.83
1 1/2 in.	1.406	35.72	1.406	35.72	1.453	36.91

Factors Contributing to Short Service Life

This briefly summarizes the major contributors of premature retirement in elevator ropes.

1. **Improper Lubrication.** The most frequent cause of unsatisfactory service involves the improper usage of lubricant, such as permitting the core to dry out, using the wrong type of lubricant, using too much lubricant, and so on. For further information please refer to Bethlehem Elevator Rope Technical Bulletin Nos. Two and Six on *Lubrication and Lubricant Build-up*.

2. **Lack of Equalization.** This results in a creeping action of the lightly loaded ropes, increasing wire breaks and wear on sheaves and ropes. Please refer to Bethlehem Elevator Rope Technical Bulletin No. Eight on *Tensioning* for further detail.

3. **Excessive Acceleration.** Excessive acceleration increases the stretch and load on the elevator rope and reduces the diameter. This increases contact stresses and undercuts the sheaves.

4. **Improperly Adjusted Brakes.** A brake causing harsh, severe stresses to the elevator rope creates a stress equal to the most severe acceleration and results in accelerated wear and fatigue.

5. **Worn Sheave Grooves.** Worn sheave grooves encourage distortion by improperly supporting the elevator rope, and causing wire breaks by pinching the rope. If the rope seats too deeply, unequal tension in the set will result. Further explanations may be found in Bethlehem Elevator Rope Technical Bulletin Nos. Seven and Eight on *Traction Sheave Hardness and Tensioning*.

6. **Use of the Incorrect Construction.** The correct construction is one that has design features to give satisfactory service under operating conditions.

7. **Worn Sheave Bushings and Bearings.** Worn sheave bushings or bearings causes wobbling and unequal tensions. These conditions cause abrasion and vibration. Repair bushings and keep them well-lubricated.

8. **Light Loading of Compensating and Governor Ropes.** Light loading induces a higher percentage of wire failures. Additions to loading lessen this deterioration, but should be made only with the specific approval of the elevator manufacturer and the insurance company inspectors. If such weights are installed without approval, the owner may assume all liability if an accident occurs.

9. **Damage During Installation.** Damage during installation rarely occurs and therefore is unlikely to be the cause of reduced elevator rope service, but it is still worth investigating. Do not allow tools to fall on the elevator rope. Do not permit the elevator rope to become nicked, bruised or kinked. Do not pull ropes over edges. For further information on handling, please refer to page 14.

10. **Damage Prior to Installation.** As with damage during installation, damage that occurs prior to installation is rarely a cause for trouble, but does happen. Check new elevator rope for nicks and other signs of damage received prior to installation. Upon receipt of material, inspect for handling and other transportation damage.

Many of these areas are covered in further detail in WW's technical and service bulletin series. To obtain copies of the following Bethlehem Elevator Rope Technical or Service Bulletins, please contact WW's Customer Service or Sales Departments.

Technical Bulletins

One:	*Rope Nomenclature*
Two:	*Lubrication*
Three:	*Rouging*
Four:	*Slippage*
Five:	*Stretch*
Six:	*Lubricant Build-up*
Seven:	*Traction Sheave Hardness*
Eight:	*Tensioning*
Nine:	*Fatigue*
Ten:	*Sheaves and Grooves*
Eleven:	*Vibration*
Twelve:	*Moisture*

Service Bulletins

One:	*Elevator Rope Investigation, Part I The Machine Room*
Two:	*Elevator Rope Investigation, Part II The Car Top*

Standard Products List

WW manufactures Bethlehem Wire Rope up to 7" diameter and structural strand products up to 6" diameter. Contact WW's Customer Service Department for further information on these and other products.

Construction and Industrial Applications

- Standard 6x19 and 6x36 classes
- Standard rotation-resistant ropes in 8x19, 8x25, 19x7 constructions
- Specialized rotation-resistant ropes SFP-19
- 6-PAC and 6-PAC RV
- TRIPLE-PAC EEEIP crane rope
- BXL plastic-infused wire rope
- Roepac compacted wire rope
- Alternate lay wire rope

Oilfield Applications

- Rotary drill lines
- Tubing lines
- Sand lines
- Well measuring line
- Well servicing line
- 6x25 flex seale tubing line
- 6-PAC tubing line
- Flattened strand rope

Elevator Applications

- 6x19, 8x19, & 9x19 classes for hoist, governor and compensating rope applications

Logging Applications

- Standard 6x19 and 6x36 Classes
- Super-B
- SUPER-PAC
- 6-PAC
- BXL
- SKYBRITE

Mining Applications

- Standard 6x19, 6x36, 6x61, 6x70, 8x19 & 8x36 Classes
- Boom pendants
- Flattened strand rope
- En-Core plastic encapsulated core for drag ropes
- Bethpac compacted wire rope
- Maxi-Core IWRC
- BXL plastic-infused rope
- Phoenix specially-designed hoist ropes

Ocean Cable Systems

- Anchor/mooring systems
- Galvanized torque-balanced spiral strand, bare or sheathed, with or without Z-nodes
- Galvanized wire rope, with or without Z-nodes

Bethlehem Wire Rope Service Centers

California:	Compton
Illinois:	Chicago
Indiana:	Boonville
Oklahoma:	Oklahoma City
Oklahoma:	Woodward
Missouri:	St. Louis
Pennsylvania:	Williamsport
Texas:	Houston
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Washington:	Longview

Elevator Product

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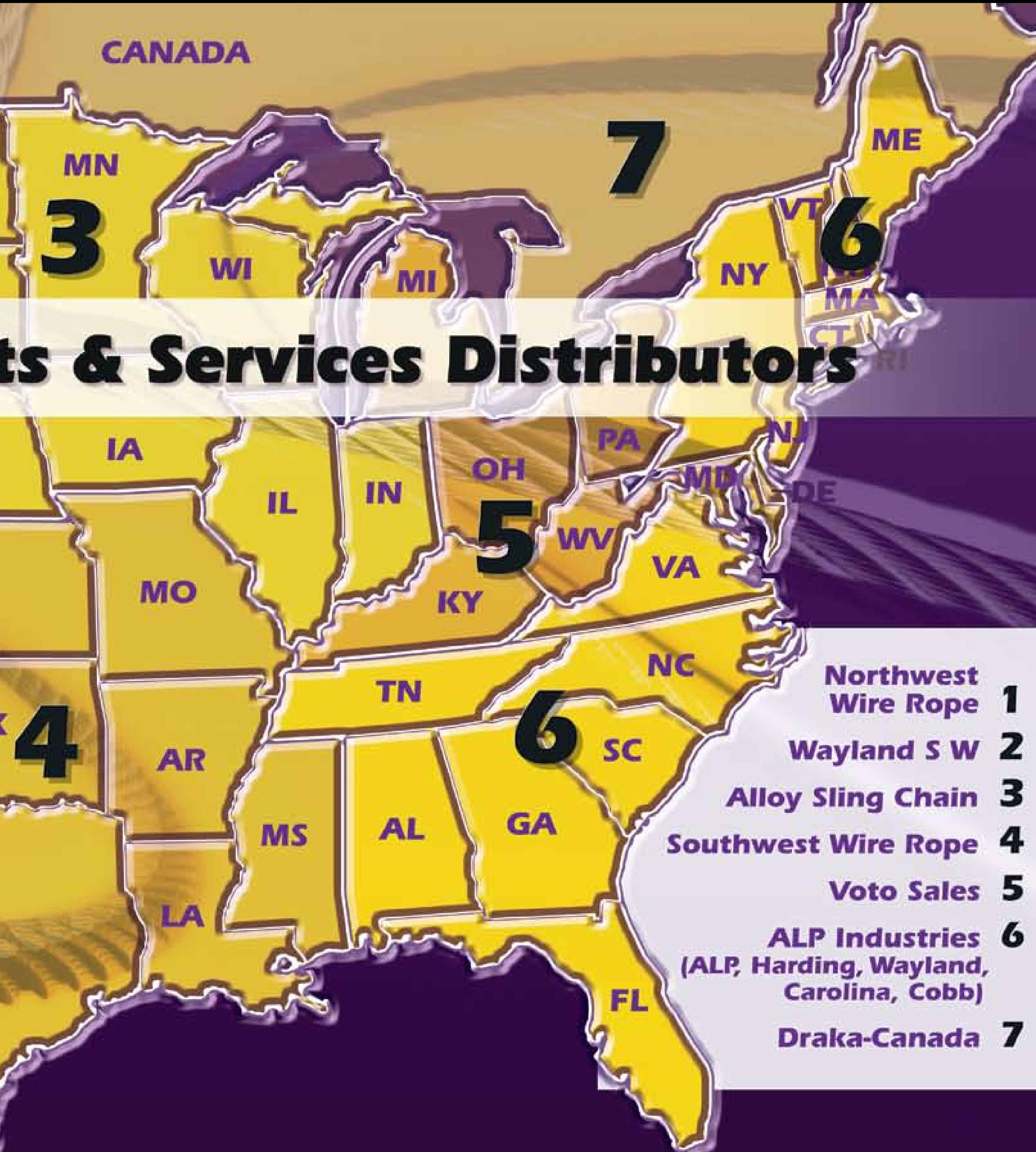

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