Elevator Rope Nomenclature

This bulletin is the first in a series of technical information intended to help our customers understand elevator wire rope. Along with the Bethlehem Elevator Rope Catalog, these bulletins will discuss, in further detail, those items and questions in which our customers are most interested. The first bulletin is intended to help in the basic terminology of the product. This information will also be useful in discussing future bulletins.

Diameter

The easiest rope parameter to understand is diameter. However, do not assume rope diameters. Measure the diameter of the set of ropes before installation to insure the material meets the design requirements for the equipment on which it is to be used.

If the rope is undersize, the rope breaking strength will be lower; therefore, stresses are higher. The outer wires are smaller, adding to shorter abrasion life. The rope also tends to cut into the sheave since the area of rope support is less on a smaller diameter rope.

An oversize rope will be pinched in the grooves, causing a concentrated pattern of stress and eventual wire breakage along the planes of groove support. Some customers actually choose to go to a larger diameter rope in an effort to increase traction. However, the trade-off is shortened rope life.

The actual rope diameter is measured as the diameter of the circumscribed circle (largest cross-sectional dimension). **Figure 1** illustrates this method for measuring 6- or 8-strand rope.

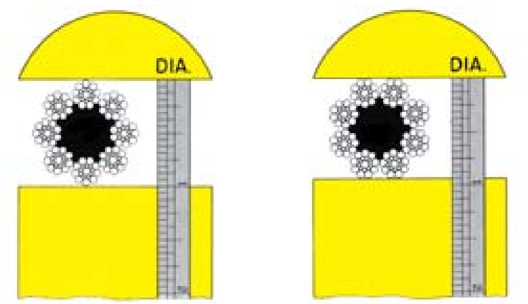

Figure A: Right way **Figure B: Wrong way**

Figure 1: Calipering Elevator Rope

As shown in **Figure 1**, to properly measure the diameter of elevator rope, caliper from the top of one strand to the top of the opposite strand, as shown in **Figure A**. Do not caliper across two strands as shown in **Figure B**.

Table 1 illustrates the diameter tolerances for Bethlehem Elevator Ropes. Statistical Process Control methods ensure diameter consistencies within each production run.

Rope Diameter (Inches)	Loaded Rope* (Inches)	Unloaded Rope (Inches)	Out of Round Tolerance (Inches)
3/8	.375/.390	.382/.397	.008
1/2	.500/.515	.510/.525	.008
5/8	.625/.643	.637/.654	.009
11/16	.687/.708	.701/.722	.011
3/4	.750/.772	.765/.787	.011
13/16	.812/.836	.828/.852	.012
7/8	.875/.901	.892/.918	.013
1	1.000/1.030	1.020/1.050	.015
1 1/16	1.062/1.094	1.083/1.115	.016

Table 1: Diameter Tolerance

*Loaded rope equals 10% of breaking strength.

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Construction

Ropes are classified by the number of strands as well as by the number of wires in each strand. For example, an 8 x 19 Seale rope has 8 outer strands, with each strand containing 19 wires. The term Seale refers to the wire arrangement in the outer strands. Figure 2 illustrates various constructions commonly used on elevator applications, along with highlighting the components of the rope.

Ropes are also identified by nominal classification that may not reflect their actual construction. For example, an 8 x 19 Seale, 8 x 21 Type U and 8 x 25 Type W are all classified as 8 x 19 Class ropes. This is very important to know when a job requires a particular rope construction but only specifies the class reference. To avoid potential misunderstanding, order specific constructions.

Generally speaking, an 8 x 19 Warrington is more flexible than an 8 x 19 Seale. However, the Seale rope has larger outside wires making it more abrasion resistant. Similarly, the 8 x 25 Type W is more flexible, yet less abrasion resistant than a 8 x 21 Type U. Contact Wirerope Works' (WW) Sales or Engineering Departments for help in determining your specific needs.

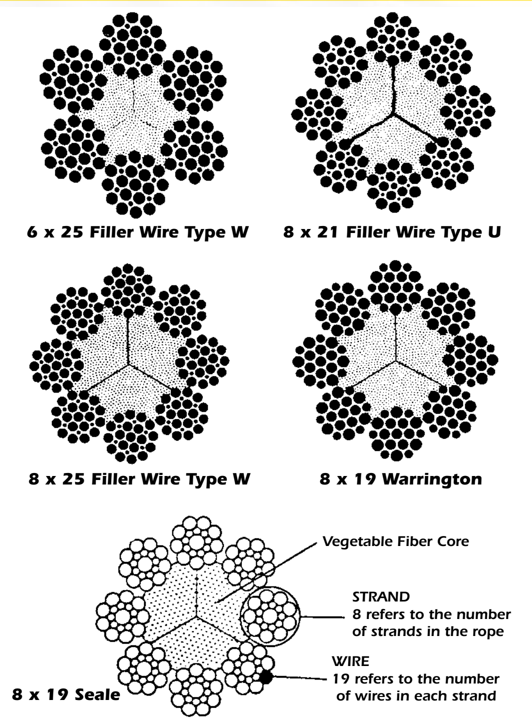

Figure 2: Commonly Used Constructions of Elevator Rope

Lay Direction and Type of Lay

Lay is sometimes a confusing wire rope term but its meaning is important to know. Essentially, the term derives from the way in which the rope is put together. Contrary to its appearance, wire rope is not strands of wire twisted together. Rather, the strands are laid into position. Great care is taken in the manufacture of wire rope to ensure that no unwanted twist is imparted to the wires or strands.

The term lay is used in two ways: (1) describing the appearance or construction of the wire rope in regard to the direction of its spiral, and (2) measuring the length of the helix (spiral) of the rope.

When used in the first context, the terms right and left refer to the direction in which the strands rotate around the rope. The terms regular lay and Lang lay refer to the way the wires rotate around the strands in relation to the direction of the strands in the rope.

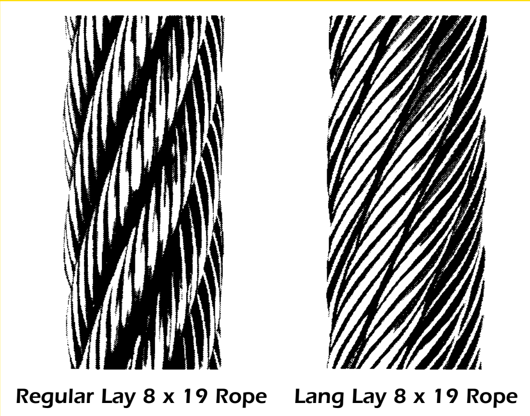

Figure 3

In right lay, strands rotate around the rope in a clockwise direction, as the threads do in a right-handed bolt. Regular lay means the wires in a strand rotate in a direction opposite to the direction in which the strand rotates around the rope. The net result of regular lay is that the visible wires run roughly parallel to the core of the rope. Lang lay is the reverse of regular. Wires in a Lang lay rope rotate in the same direction as the strands and appear to spiral diagonally around the rope. Figure 3 illustrates right regular lay and right Lang lay. If direction and type of lay are omitted from the rope description, it is presumed to be right regular lay.

Lang lay ropes offer greater fatigue resistance and abrasion resistance than regular lay ropes. In-house fatigue testing by Wirerope Works confirms 1/2″ 8 x 19 Lang lay ropes show increased fatigue life over similar regular lay ropes when subjected to reverse bend sheave testing.

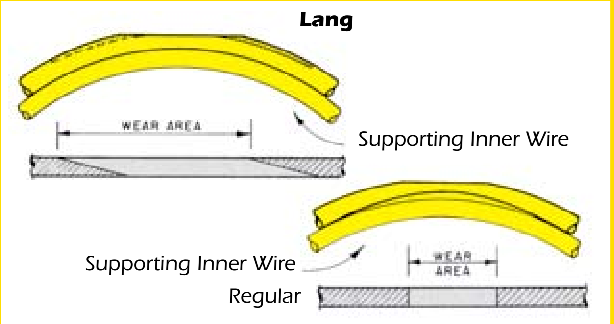

Figure 4: ***The Worn Crown of the Regular Lay has a Shorter Exposed Length.***

The superior fatigue life of Lang lay ropes is attributed to the longer, exposed length of the outer wires. Since the individual wires in a Lang lay rope run in the same direction as the strands, the valley-to-valley length is much greater than on a regular lay rope. Bending the exposed wire over a greater length results in lower axial bending stresses of the outer wires and greater torsional flexure. In addition, the wear pattern on a Lang lay rope is extended, allowing greater distribution of contact stresses. The worn crown of a regular lay rope, combined with its shorter exposed length, causes the wire to spring away from the supporting inner wires as illustrated in Figure 4. This results in higher bending stresses and shorter fatigue life.

Because the wires of a regular lay rope are wound counterlaid to the strands, the individual wires in this type of rope run almost parallel to the rope, making a regular lay rope more torque resistant than a Lang lay. A Lang lay rope also has more stretch than a similar regular lay rope.

As a unit of measure, rope lay (Figure 5) means the length-wise distance a single strand covers in making one complete turn around the rope. Lay length is measured in a straight line parallel to the center line of the rope, not by following the strand as it spirals around the rope. It is necessary to know the lay length because it provides a convenient basis for rope inspection. For example, a rope may be removed from service after a certain number of wires break in one rope lay.

Figure 5: ***Lay as a Unit Measure***

Showing how "One-Rope Lay" is the lengthwise distance in which a strand makes one complete turn around the rope.

Preforming

Form-set, WW's trade name for preformed rope, reduces internal torsional stresses and thereby increases fatigue resistance of the wires. This results in a stable, better balanced rope. Form-set elevator ropes run smoother over sheaves and drums. When wire breaks do occur, the broken wires are less likely to protrude from the rope surface. This results in less damage to adjacent wires and may increase fatigue life.

Preforming occurs in the rope closing operation in which the component wires and strands are permanently formed into the helical position occupied in the finished rope.

Form-set ropes are easy to handle and, normally, cut ends do not need to be seized to prevent unwinding. Preforming makes installation easier and more cost-efficient.

Preforming may increase rope stretch by approximately 50% over non-preformed rope.

Grade of Rope

In the early days, most elevator hoist ropes were made of Iron. After the invention of the traction elevator, iron hoist ropes became obsolete due to their inadequate strengths and abilities 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 is between 170,000 and 230,000 lbs. per square inch. Charac-

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terized by an excellent combination of strength, toughness, ductility and fatigue-resistance, traction steel ropes are designed primarily for hoist ropes for modern, traction-drive passenger and freight elevators. Traction steel elevator ropes provide the qualities of traction and hardness needed for satisfactory elevator service. In hoist rope applications, traction steel is more durable and reliable than iron grade.

Iron grade 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 provides the extra margin needed.

Coatings

The most common finish for elevator rope is "bright" or uncoated. Galvanized (zinc-coated) rope may be specified where corrosion may be a serious problem. Galvanized rope is not a stock item and a special production run is required.

Type of Core

The core of elevator rope is usually made of vegetable fiber, such as sisal or manila, and is lubricated to WW specifications.

During core manufacturing, lubricant penetrates to all fibers of the core. This lubricant eventually breaks down as the elevator rope operates and should be replenished by proper field maintenance. Field lubrication is addressed in Bethlehem Elevator Rope Technical Bulletin No. Two on Lubrication.

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

The core's most important job is providing support for the strands. Valley breakage is directly related to the support provided by the core. Lack of proper lubrication is the most common cause of core failure.

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. 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.

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