

manufactured by  
**Wire Rope  
Works,  
Inc.**





**Wire Rope Works, Inc. (WW) manufactures Bethlehem Wire Rope® to meet the exacting demands of modern lifting practices. The key to the success of Bethlehem Wire Rope is the total commitment WW makes to the mining industry.**

**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 wire rope 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 wire rope industry with a large warehouse network, while developing additional outlets for our products. In addition, we continue to train and educate consumers in the use and application of wire ropes.



**Owned by Americans.  
Made by Americans.**

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Wire rope and strand products will break if abused, misused or overused. Regular inspection and maintenance are necessary. Consult Industry recommendations and OSHA Standards before using.

Wire Rope 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. W/W-01/11

## Bethlehem Mining Rope

### Wire Grades Used In Bethlehem Mining Ropes

Wirerope Works, Inc. (WW), manufacturer of Bethlehem Wire Rope, offers four grades of Bethlehem Mining Rope for different applications.

*Purple* grade wire, known as Improved Plow Steel (IPS), is a strong, tough, durable steel which combines great strength with high resistance to fatigue. Its minimum tensile strength varies from 223 to 258 ksi, depending upon wire size.

WW's *Purple Plus* grade wire, or Extra Improved Plow Steel (EIP or XIP), is a high strength grade designed for use where a higher breaking strength is required. Minimum tensile strength varies from 245 to 284 ksi, depending on wire size.

The *Excavator* grade applies to an improved outer strand and core construction. WW tailors the wire properties within the rope and manufactures each Excavator grade Bethlehem Mining Rope using a variety of wire grades. WW manufactures the independent wire rope core (IWRC) wires and center wires of the main strands with very ductile steel. This ductility prevents wire failure by better absorption of the extreme internal pressures which occur during the rope's operating life. Custom selection of steel grade and our wire drawing practices for the wires in the outer layer of each strand provide excellent resistance to failure from abrasion and bending fatigue.

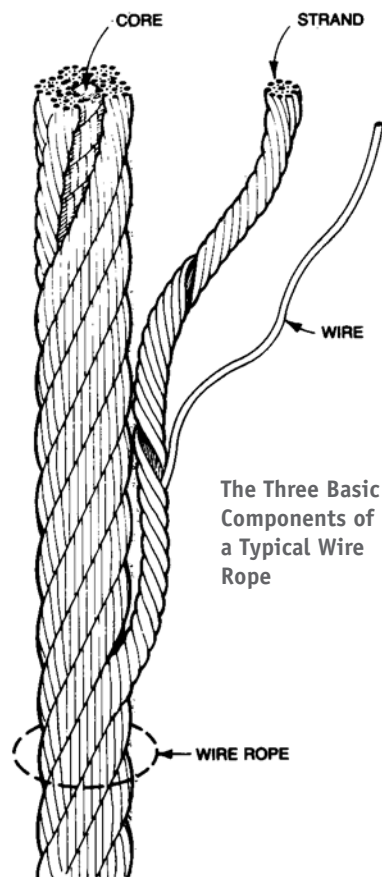
*Excavator-AR* (abrasion resistant), an extension of WW's proven Excavator grade, is intended for those applications where more severe, abrasive operating conditions exist. Abrasion resistance is improved by changing the chemical and physical properties of the outside wires while maximizing wire ductility by closely controlling the wire drawing practices.

### Cores

For surface and underground mines, WW supplies Bethlehem Mining Ropes with fiber or steel cores. The core is the foundation of a wire rope. Its primary function is to support the wire strands of the rope, maintaining them in their correct positions during the operating life of the rope.

Fiber cores are ropes made from fibers formed into yarns, then into strands and finally into the finished core form. There are two general types of fiber: natural vegetable material, such as sisal, and synthetic filaments, such as polypropylene.

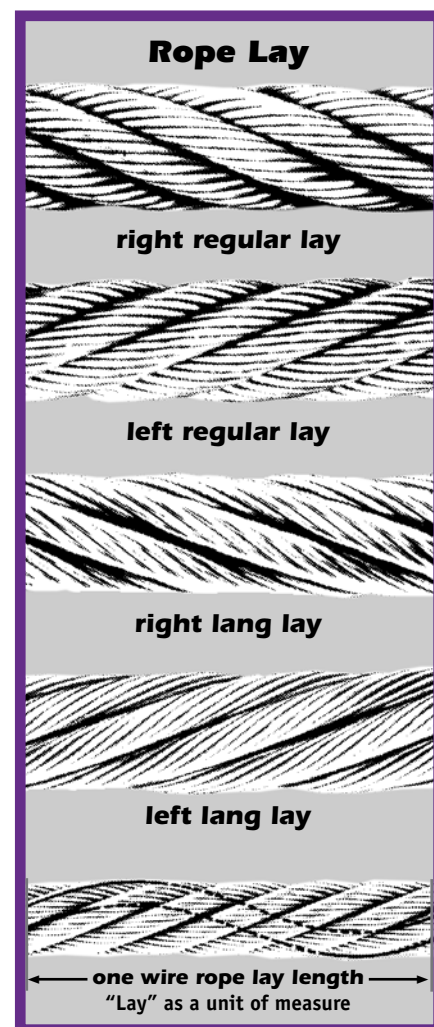
Steel wires comprise the Independent Wire Rope Core (IWRC). Ropes with IWRCs resist crushing, are resistant to heat, reduce stretch and increase the strength of the rope.



The Three Basic Components of a Typical Wire Rope

### Wire Rope Lay

The direction of the helix or spiral of the wires and strands in a rope is called the *lay*. *Regular lay* means the wires and strands spiral in opposite directions; 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 seem to run at a diagonal to the center line of the 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, the rope is *left lay*.





When a *lay-length* is used as a unit of measure, it refers to the length it takes a single strand to make one complete turn around the rope. Lay-length is measured in a straight line parallel to the center line of the rope, not following the path of the strand. The appropriate time to replace a wire rope in service is frequently determined by counting the number of broken wires in the length of one rope lay and comparing the number of breaks with industry standards.

### Preformed Wire Rope

*Form-set* is WW's trade name for preformed wire rope. Form-set means that the wires and strands have been preset during manufacture into the permanent helical form they take in the completed rope. Unless otherwise specified, Bethlehem Mining Rope is furnished Form-set.

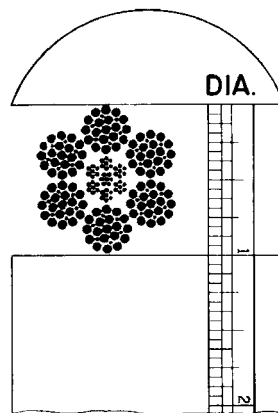
Preformed wire rope has definite characteristics which are advantageous in most wire rope applications. Preforming greatly reduces internal stresses, eases rope handling and gives more equal distribution of load on the wires and strands. Preformed rope runs smoother and spools more uniformly on a drum than non-preformed, has greater flexibility and gives longer service in bending.

**Inspection of preformed rope.** Preformed wires tend to remain in position after breaking. This reduces the tendency for them to protrude and damage the wires next to them. However, because the wires do not protrude, we strongly suggest greater care and more thorough inspection to detect broken wires in a preformed rope.

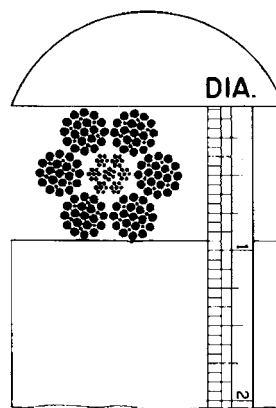
### How to Caliper a Wire Rope

Rope diameter is specified by the user and is generally given in the equipment manufacturer's instruction manual accompanying the machine on which the rope is used.

Rope diameter is determined by measuring the rope as shown below:



Right Way



Wrong Way

### Specifications

ASTM A 1023 and the recommended specifications of the U.S. Bureau of Mines serve as a basis for the manufacture of Bethlehem Mining Ropes.

Specifications serve a useful purpose in establishing manufacturing limitations. However, they do not specify how good a wire rope may be. They only indicate the nominal requirements. Bethlehem Mining Ropes include many quality features not defined in specifications.

### Wire Rope Diameter Tolerances

Wire rope diameter tolerances are normally  $-0 +5\%$ . Bethlehem Mining Ropes, however, are manufactured to a tolerance of  $-0 +2\frac{1}{2}\%$ .

### Bethlehem Mining Rope Length Tolerance

Standard tolerance on "as-ordered" lengths is  $\pm .5\%$ . Lengths specified as *exact*, *taped* or *matched* are manufactured with a tolerance of  $.025\%$ . Tighter tolerances are available upon request.

### End Preparation and Packaging

Bethlehem Mining Ropes are available with the following end preparations:

- Plain cut (saw cut) end and seized
- Becket
- Taper and weld
- Zinc- or resin-attached sockets
- Ferrule beackets (beer cans)
- Swaged sockets and fittings



## Technical Data

### 6x19 Class Wire Rope

6 strands, nominally 19 wires per strand

This class is the most widely used and is found in its many variations throughout many industries. With its good combination of flexibility and wear resistance, rope in this class is suited to the specific needs of many kinds of machinery and equipment.

The designation 6x19 is only nominal; the number of wires ranges from 15 to 26. The following constructions are included in this class:

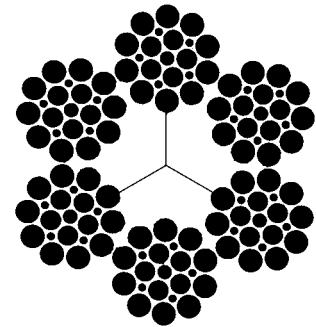
**6x25 Filler Wire.** In this construction, there are 19 main wires in each strand, plus six small filler wires. The filler wires are located between the outer layer of 12 wires and the inner layer of six. They provide support and stability to the strand. This construction is the best combination of flexibility and abrasion resistance found in the 6x19 Class.

**6x19 Warrington.** Each strand is made up of 19 wires. The outer layer of 12 wires has two different sizes of wire; the inner layer of six is one size of wire. The Warrington construction is somewhat less flexible than 6x25 Filler Wire, but more flexible than 6x21 Filler Wire.

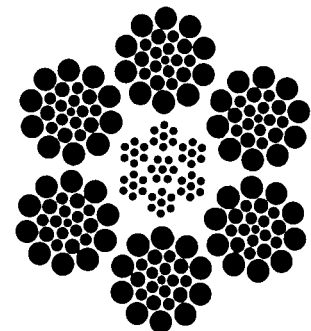
**6x21 Filler Wire.** Each strand is made up of 21 wires. The rope has an outer layer of 10 large wires, an inner layer of five smaller wires and a still smaller center wire. There are five filler wires, located between the outer layer of ten wires and the inner layer of five. The 6x21 Filler Wire ropes are more wear-resistant but less flexible than Warrington, and less abrasion-resistant but more flexible than 6x19 Seale constructions.

**6x26 Warrington Seale.** This construction is composed of 26-wire strands. It has the same size outer wires as the 6x21 Filler Wire, with an inner wire configuration similar to the 6x36 Class ropes. Thus, it combines the wear resistance of a 6x19 rope with a flexibility between 6x19 and 6x36 Class ropes.

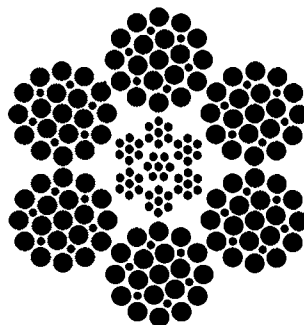
**6x19 Seale.** This construction has an outer layer of nine large wires, an inner layer of nine smaller wires and a single center wire. The Seale ropes are the least flexible of the 6x19 Class ropes. However, the large outer wires, solidly supported, provide resistance to abrasion and crushing.



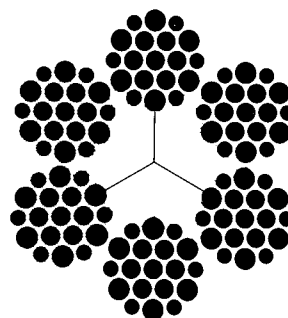
6x21 Filler Wire  
with Fiber Core



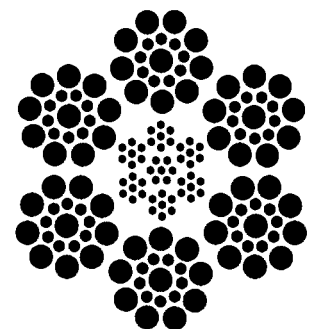
6x26 Warrington Seale  
with IWRC



6x25 Filler Wire  
with IWRC



6x19 Warrington  
with Fiber Core



6x19 Seale  
with IWRC

## 6x19 Class Wire Rope



Regular or Lang Lay ■ IWRC or Fiber Core ■ Royal Purple (IPS)  
Purple Plus (EIP) ■ Excavator and Excavator-AR

Technical data for the following constructions in the 6x19 Class are listed below.

**6x19 Seale ■ 6x19 Warrington ■ 6x21 Filler Wire  
6x25 Filler Wire ■ 6x26 Warrington Seale**

Rope Diameter		Approx. Weight (lb./ft.)		Nominal Strength, tons (bright or drawn galvanized**)		
				Royal Purple	Purple Plus	
inches	mm	Fiber Core	IWRC	IWRC	Fiber Core	IWRC
1/4	6.5	0.11	0.12	3.74	3.01	3.40
5/16	8.0	0.16	0.18	5.80	4.69	5.27
3/8	9.5	0.24	0.26	8.30	6.71	7.55
7/16	11.0	0.32	0.35	11.2	9.10	10.2
1/2	13.0	0.42	0.46	14.6	11.8	13.3
9/16	14.5	0.53	0.58	18.5	14.9	16.8
5/8	16.0	0.66	0.72	22.7	18.4	20.6
3/4	19.0	0.95	1.04	32.4	26.2	29.4
7/8	22.0	1.29	1.41	43.8	35.4	39.8
1	26.0	1.68	1.85	56.9	46.0	51.7
1-1/8	29.0	2.13	2.34	71.5	57.9	65.0
1-1/4	32.0	2.63	2.89	87.9	71.1	79.9
1-3/8	35.0	3.18	3.49	106	85.5	96
1-1/2	38.0	3.78	4.16	125	101	114
1-5/8	42.0	4.44	4.88	146	118	132
1-3/4	45.0	5.15	5.66	169	136	153
1-7/8	48.0	5.91	6.49	192	155	174
2	52.0	6.73	7.39	217	176	198
2-1/8	54.0	7.60	8.34	243	197	221
2-1/4	58.0	8.52	9.35	272	220	247
2-3/8	60.0	9.49	10.4	301	244	274
2-1/2	64.0	10.5	11.6	332	269	302
2-3/4	70.0	12.7	14.0	397	321	361

\*\*Galvanizing: For Class A galvanized wire rope (EIP grade only), deduct 10% from the nominal strength shown.



### 6x19 Class

6x19 Seale  
6x19 Warrington  
6x21 Filler Wire  
Type U  
6x21 Seale  
6x25 Filler Wire  
Type W  
6x25 Seale  
6x26 Warrington  
Seale

Technical data for the above listed constructions are the same and are detailed in the table. For further information on additional constructions and diameters, contact WW's customer service department.

## 6x36 Class Wire Rope

### 6 strands, nominally 36 wires per strand

The 6x36 Class of wire rope is characterized by the relatively large number of wires in each strand. Ropes of this class are more flexible than the 6x19 Class, but their resistance to abrasion is less than the 6x19 Class ropes.

The designation 6x36 is only nominal, as is the case with 6x19 Class. Ropes in the 6x36 Class may contain 27 to 49 wires per strand. Improvements in wire rope design, as well as changing machine designs, resulted in the use of strands with widely varying numbers of wires and geometry.

Regular or Lang Lay ■ IWRC or Fiber Core ■ Royal Purple (IPS)

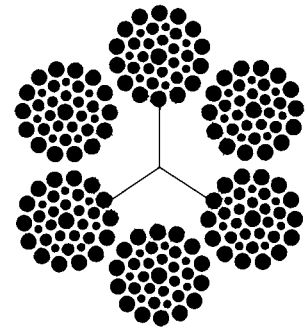
Purple Plus (EIP) ■ Excavator and Excavator-AR

Technical data for the following constructions in the 6x36 Class are listed below.

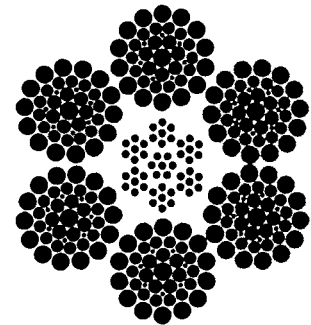
**6x36 Warrington Seale ■ 6x43 Filler Wire-Seale ■ 6x49 Filler Wire-Seale**

Rope Diameter		Approx. Weight (lb./ft.)		Nominal Strength, tons (bright or drawn galvanized**)		
				Royal Purple	Purple Plus	
inches	mm	Fiber Core	IWRC	IWRC	Fiber Core	IWRC
1/4	6.5	0.11	0.12	3.74	3.01	3.40
5/16	8.0	0.16	0.18	5.80	4.69	5.27
3/8	9.5	0.24	0.26	8.30	6.71	7.55
7/16	11.0	0.32	0.35	11.2	9.10	10.2
1/2	13.0	0.42	0.46	14.6	11.8	13.3
9/16	14.5	0.53	0.58	18.5	14.9	16.8
5/8	16.0	0.66	0.72	22.7	18.4	20.6
3/4	19.0	0.95	1.04	32.4	26.2	29.4
7/8	22.0	1.29	1.41	43.8	35.4	39.8
1	26.0	1.68	1.85	56.9	46.0	51.7
1-1/8	29.0	2.13	2.34	71.5	57.9	65.0
1-1/4	32.0	2.63	2.89	87.9	71.1	79.9
1-3/8	35.0	3.18	3.49	106	85.5	96
1-1/2	38.0	3.78	4.16	125	101	114
1-5/8	42.0	4.44	4.88	146	118	132
1-3/4	45.0	5.15	5.66	169	136	153
1-7/8	48.0	5.91	6.49	192	155	174
2	52.0	6.73	7.39	217	176	198
2-1/8	54.0	7.60	8.34	243	197	221
2-1/4	58.0	8.52	9.35	272	220	247
2-3/8	60.0	9.49	10.4	301	244	274
2-1/2	64.0	10.5	11.6	332	269	302
2-3/4	70.0	12.7	14.0	397	321	361

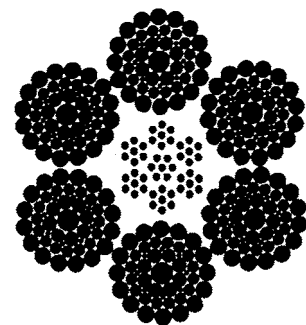
\*\*Galvanizing: For Class A galvanized wire rope (EIP grade only), deduct 10% from the nominal strength shown.



6x36 Warrington-Seale  
with Fiber Core



6x43 Filler Wire Seale  
with IWRC



6x49 Filler Wire Seale  
with IWRC



## 6x61 Class Wire Rope



Lang Lay  
IWRC

Excavator and Excavator-AR

Technical data for the following constructions in the 6x61 Class are listed below.

**6x50 Seale-Filler Wire-Seale ■ 6x57 Seale-Filler Wire-Seale**  
**6x64 Seale-Filler Wire-Seale ■ 6x70 Seale-Filler Wire-Seale**  
**6x77 Seale-Filler Wire-Seale**

Nominal Diameter*		Approximate Weight (lb. per ft.)
Inches	mm	
2 <sup>5</sup> / <sub>8</sub>	67	12.4
2 <sup>3</sup> / <sub>4</sub>	70	13.7
2 <sup>7</sup> / <sub>8</sub>	73	14.8
3	76	16.2
3 <sup>1</sup> / <sub>8</sub>	79	17.6
3 <sup>1</sup> / <sub>4</sub>	83	19.1
3 <sup>3</sup> / <sub>8</sub>	86	20.5
3 <sup>1</sup> / <sub>2</sub>	89	22.0
3 <sup>5</sup> / <sub>8</sub>	92	23.7
3 <sup>3</sup> / <sub>4</sub>	95	25.3
3 <sup>7</sup> / <sub>8</sub>	98	26.8
4	102	28.5
4 <sup>1</sup> / <sub>4</sub>	108	32.2
4 <sup>3</sup> / <sub>8</sub>	111	33.8
4 <sup>1</sup> / <sub>2</sub>	114	35.7
4 <sup>3</sup> / <sub>4</sub>	121	40.6
5	127	43.9

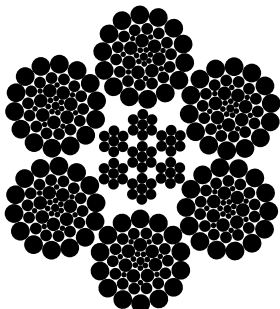
\*Bethlehem Mining Ropes are available in diameters through 7".

### 6 strands, nominally 61 wires per strand

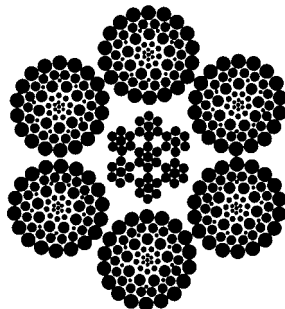
Larger wire ropes frequently incorporate a larger number of wires, resulting in a more complex geometry than found in the 6x19 or 6x36 Class wire ropes. WW's 6x61 Class Bethlehem Mining Ropes generally are designed to comply with ASTM A 1023 geometry, although we added some innovations.

WW strands the 6x61 Class Bethlehem Mining Ropes in a single operation, relying on dense, well-fitted geometry to provide exceptional rope performance and the flexibility normally associated with 6x61 Class ropes.

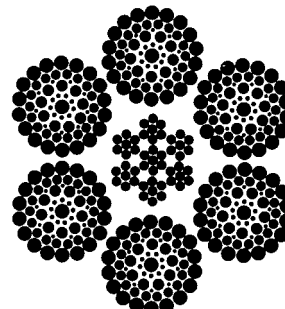
The 6x61 Class ropes have a Seale-Filler Wire-Seale design, as shown in the cross sections below, containing from 50 to 77 wires per strand. WW further enhances Bethlehem Mining Rope performance by wire metallurgy and wire properties which are selectively modified to augment the specific rope geometries.



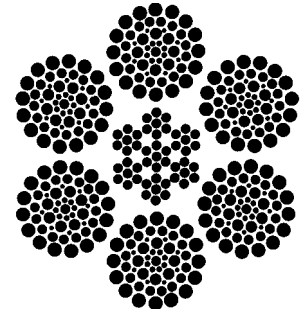
6x50 Seale Filler Wire Seale



6x57 Seale Filler Wire Seale



6x64 Seale Filler Wire Seale



6x70 Seale Filler Wire Seale

## The Excavator Family of Wire Rope

Lang Lay • IWRC • Excavator and Excavator-AR (XAR)

excavator family mining rope								
Nominal Diameter		6x19 Class (const.)	Grade	6x36 Class (const.)	Grade	6x61 Class (const.)	Grade	Lb./Ft.
In.	mm							
1 <sup>3</sup> / <sub>4</sub>	45	6x26 6x25	XAR	6x49	Excavator or XAR			5.6
1 <sup>7</sup> / <sub>8</sub>	48	6x26 6x25	XAR	6x49	Excavator or XAR			6.6
2	52	6x26 6x25	XAR	6x49	Excavator or XAR			7.5
2 <sup>1</sup> / <sub>8</sub>	54	6x26 6x25	XAR	6x49	Excavator or XAR			8.3
2 <sup>1</sup> / <sub>4</sub>	58	6x26 6x25	XAR	6x49	Excavator or XAR			9.4
2 <sup>3</sup> / <sub>8</sub>	60	6x26 6x25	XAR	6x49	Excavator or XAR			10.3
2 <sup>1</sup> / <sub>2</sub>	64	6x25	XAR	6x49	Excavator or XAR			11.7
2 <sup>5</sup> / <sub>8</sub>	67	6x25	XAR	6x43	XAR	6x57	Excavator or XAR	12.5
2 <sup>3</sup> / <sub>4</sub>	70	6x25	XAR	6x43	XAR	6x57	Excavator or XAR	13.8
2 <sup>7</sup> / <sub>8</sub>	73			6x43	XAR	6x57	Excavator or XAR	14.9
3	76					6x50 6x57	XAR Excavator	16.4
3 <sup>1</sup> / <sub>8</sub>	79					6x50 6x57	XAR Excavator	17.8
3 <sup>1</sup> / <sub>4</sub>	83					6x50 6x57	XAR Excavator	19.3
3 <sup>3</sup> / <sub>8</sub>	86					6x50 6x57	XAR Excavator	20.7
3 <sup>1</sup> / <sub>2</sub>	89					6x50 6x57	XAR Excavator	22.2
3 <sup>5</sup> / <sub>8</sub>	92					6x50 6x57	XAR Excavator	23.9
3 <sup>3</sup> / <sub>4</sub>	95					6x50 6x57	XAR Excavator	25.6
3 <sup>7</sup> / <sub>8</sub>	98					6x50 6x57	XAR Excavator	27.0
4	102					6x50 6x57	XAR Excavator	29.0
4 <sup>3</sup> / <sub>8</sub>	111					6x57 6x64	Excavator or XAR	34.0
4 <sup>1</sup> / <sub>2</sub>	114					6x57 6x64	Excavator or XAR	35.9
4 <sup>3</sup> / <sub>4</sub>	121					6x57 6x70	Excavator or XAR	40.2
5	127					6x70 6x77	Excavator or XAR	46.4

Note: XAR = Excavator-AR

WW, while a division of Bethlehem Steel, pioneered the practice of combining wires of different grades in the manufacture of surface mining ropes. In Bethlehem Mining Ropes, for example, the IWRC is made from a different grade of wire, and in total, as many as four wire grades are used in each rope. Physical properties of the selected wires have a significant influence on the performance and service life of the entire mining rope because the wire properties more perfectly meet the requirements needed for specific wire location.

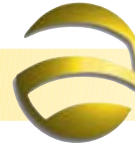
This concept of tailor-made surface mining ropes for specific applications led to the creation of the Excavator Family of Bethlehem Mining Ropes. The Excavator Family incorporates: (1) metallurgical properties, (2) geometric variations, (3) IWRC options, and (4) compacted strands. Virtually any mining rope application can benefit from one or more of these options.

### Rope Grades Based on Metallurgical Properties

Excavator grade, introduced in the 1970s in Bethlehem Mining Ropes, revolutionized surface mining ropes. The idea was to provide performance-based ropes and depart from the usual practice of meeting a minimum rope strength rating. In order to provide these rope characteristics, the metallurgical properties of the wires were changed, and multiple wire grades were used in the same rope structure.

The original concept was successful in two ways. First, the rope service life was usually much better than conventional rope grades. Second, other wire rope manufacturers followed suit and stopped listing rope strengths. Though they have tried to copy the original, the Excavator Family of Bethlehem Mining Ropes still outperforms other mining ropes.

Excavator-AR, a more resilient grade of the original Excavator grade, was introduced to provide greater abrasion resistance and increased rope strength for dragline use. This adaption of performance-based rope design has improved rope life for many applications where increases in loading and duty cycle over the years have created conditions of great rope abuse.



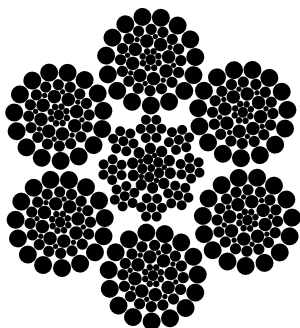
## Rope Geometry

The concept of using the rope property of "flexibility" for improvement in rope life is not new to industry. However, in surface mining, most wire rope companies have offered only one choice of rope geometry for any given rope size.

The Excavator Family of Bethlehem Mining Ropes are offered in two geometries, which result in rope properties that are either (A) more flexible, or (B) more abrasion-resistant.

The flexible Type A rope is specifically designed for hoist ropes and drag ropes with reverse bends in the rope path. These ropes generally are produced in diameters 1<sup>3</sup>/<sub>4</sub>" through 4<sup>3</sup>/<sub>4</sub>" and contain 49 to 77 wires per strand. This geometry is used in conjunction with the more ductile metallurgy of Excavator grade.

The abrasion-resistant Type B is specifically designed for drag ropes with straight fairleads. The relatively large outer wires can accommodate much more surface wear. Rope diameters 1<sup>3</sup>/<sub>4</sub>" through 4<sup>3</sup>/<sub>8</sub>" are produced. These ropes contain 26 through 57 wires per strand. The Type B geometry achieves optimum performance when used in conjunction with the more abrasion-resistant metallurgy of Excavator-AR grade.



6x57 Maxi-Core

6-strand maxi-core			
Nominal Diameter		Construction	Approximate Weight (lb. per ft.)
Inches	mm		
1 <sup>3</sup> / <sub>4</sub>	45	6x25, 6x26, 6x49	5.8
1 <sup>7</sup> / <sub>8</sub>	48	6x25, 6x26, 6x49	6.6
2	52	6x25, 6x26, 6x49	7.5
2 <sup>1</sup> / <sub>8</sub>	54	6x25, 6x26, 6x49	8.4
2 <sup>1</sup> / <sub>4</sub>	58	6x25, 6x26, 6x49	9.5
2 <sup>3</sup> / <sub>8</sub>	60	6x25, 6x26, 6x49	10.5
2 <sup>1</sup> / <sub>2</sub>	64	6x25, 6x49	11.7
2 <sup>5</sup> / <sub>8</sub>	67	6x25, 6x57	12.9
2 <sup>3</sup> / <sub>4</sub>	70	6x25, 6x57	14.1
2 <sup>7</sup> / <sub>8</sub>	73	6x43, 6x57	15.5
3	76	6x50, 6x57	16.8
3 <sup>1</sup> / <sub>8</sub>	79	6x50, 6x57	18.2
3 <sup>1</sup> / <sub>4</sub>	83	6x50, 6x57	19.7
3 <sup>3</sup> / <sub>8</sub>	86	6x50, 6x57	21.2
3 <sup>1</sup> / <sub>2</sub>	89	6x50, 6x57	22.9
3 <sup>5</sup> / <sub>8</sub>	92	6x50, 6x57	24.5
3 <sup>3</sup> / <sub>4</sub>	95	6x50, 6x57	26.3
3 <sup>7</sup> / <sub>8</sub>	98	6x50, 6x57	28.1
4	102	6x50, 6x57	30.0
4 <sup>3</sup> / <sub>8</sub>	111	6x57, 6x64	35.7

## IWRC Options: Maxi-core

Many wire rope users have observed that heavily loaded ropes fail internally due to the failure of the IWRC. Such conditions illustrate that heavy IWRC stresses exist, which promote fewer fatigue cycles and create short rope life. WW designed Maxi-core to improve rope life under these conditions.

Maxi-core utilizes an IWRC design which features eight strands around a strand center. Maxi-core's IWRC provides longer life, and, therefore, increases the overall service life of the rope. Because of its specialized IWRC, Maxi-core is resilient and able to accommodate shock loads better than conventional IWRC designs. Maxi-core also adds 33% more core support to the outer strands, thereby reducing internal stresses and promoting longer rope life.

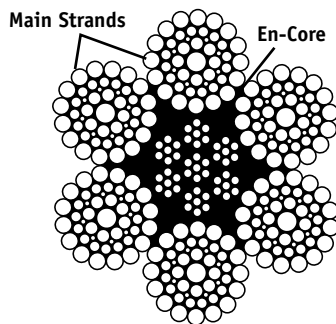
As with all Bethlehem Excavator Family Ropes, WW does not publish Maxi-core rope strengths. WW relies on specific rope improvements and specialized features to provide rope designs which give proven, superior field service.



## En-core

En-core refers to a tough, extruded jacket encapsulating the IWRC and pressure-filling the interstrand spaces. The plastic material used for En-core was selected for:

- **mechanical toughness**
- **low temperature flexibility**
- **resistance to oil and water absorption**



**6x49 Filler Wire Seale with En-Core**

This plastic jacket acts as a cushion or shock absorber between adjacent main strands and at main strand-to-IWRC contact points. The improved internal support is especially significant for ropes subjected to continual bending stresses and fluctuating loads (shock loading). Reduction of wear and damage at internal contact points results in longer and more predictable service life.

En-core is available in both Excavator and Excavator-AR grades in diameters 1<sup>3</sup>/<sub>4</sub>" through 4<sup>3</sup>/<sub>4</sub>", as shown.

6-strand en-core			
Nominal Diameter		Construction	Approximate Weight (lb. per ft.)
Inches	mm		
1 <sup>3</sup> / <sub>4</sub>	45	6x25, 6x26, 6x49	5.8
1 <sup>7</sup> / <sub>8</sub>	48	6x25, 6x26, 6x49	6.6
2	52	6x25, 6x26, 6x49	7.5
2 <sup>1</sup> / <sub>8</sub>	54	6x25, 6x26, 6x49	8.4
2 <sup>1</sup> / <sub>4</sub>	58	6x25, 6x26, 6x49	9.5
2 <sup>3</sup> / <sub>8</sub>	60	6x25, 6x26, 6x49	10.5
2 <sup>1</sup> / <sub>2</sub>	64	6x25, 6x49	11.7
2 <sup>5</sup> / <sub>8</sub>	67	6x25, 6x57	12.9
2 <sup>3</sup> / <sub>4</sub>	70	6x25, 6x57	14.1
2 <sup>7</sup> / <sub>8</sub>	73	6x43, 6x57	15.5
3	76	6x50, 6x57	16.8
3 <sup>1</sup> / <sub>8</sub>	79	6x50, 6x57	18.2
3 <sup>1</sup> / <sub>4</sub>	83	6x50, 6x57	19.7
3 <sup>3</sup> / <sub>8</sub>	86	6x50, 6x57	21.2
3 <sup>1</sup> / <sub>2</sub>	89	6x50, 6x57	22.9
3 <sup>5</sup> / <sub>8</sub>	92	6x50, 6x57	24.5
3 <sup>3</sup> / <sub>4</sub>	95	6x50, 6x57	26.3
3 <sup>7</sup> / <sub>8</sub>	98	6x50, 6x57	28.0
4	102	6x50, 6x57	29.9
4 <sup>3</sup> / <sub>8</sub>	111	6x57, 6x64	35.8
4 <sup>1</sup> / <sub>2</sub>	114	6x57, 6x64	37.8
4 <sup>3</sup> / <sub>4</sub>	121	6x70	42.1

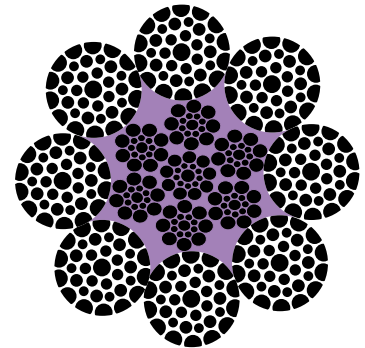
## 8-Strand Shovel Hoist Ropes



### Compacted Strands: Beth Pac

Beth Pac refers to rope manufactured by compacting each individual strand before closing the rope. In comparison to conventional wire rope, Beth Pac has a higher metallic area, improved crushing resistance and a smoother surface contacting sheaves and drums. Beth Pac is offered in Excavator and Excavator-AR in diameters 2 1/4" through 2 3/4" in 8x36 construction for hoist ropes. Beth Pac can be combined with other Bethlehem Mining Rope features, such as En-core. For more information and help in determining your need for Beth Pac and other available sizes, please contact WW's Sales and Engineering Departments.

8-Strand Shovel Hoist Ropes			
Nominal Diameter		Hoists	
inches	mm	Construction	Approximate Weight (lb. per ft.)
2 1/4	54	8x36	10.09
2 3/8	60	8x36	11.28
2 1/2	64	8x36	12.36
2 5/8	67	8x36	13.66
2 3/4	70	8x36	14.95

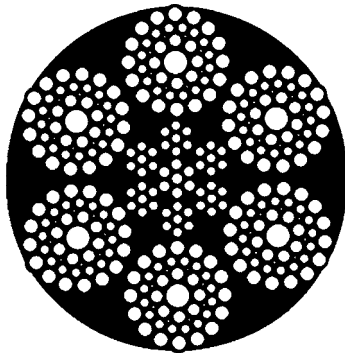


8-Compacted Strands En-Core



## Plastic-infused Wire Rope

Diameter		BXL	BXL w/Maxi-core	
Inches	mm	Approximate Weight (lb. per ft.)	Approximate Weight (lb. per ft.)	Construction Supplied
1 <sup>5</sup> / <sub>8</sub>	42	5.12	5.17	6x26, 8x31/36
1 <sup>3</sup> / <sub>4</sub>	45	5.88	5.94	6x26, 6x49, 8x31/36
1 <sup>7</sup> / <sub>8</sub>	48	6.93	7.00	6x26, 6x49, 8x31/36
2	52	7.88	7.96	6x25, 6x26, 6x49, 8x31/36
2 <sup>1</sup> / <sub>8</sub>	54	8.72	8.81	6x25, 6x26, 6x49, 8x31/36
2 <sup>1</sup> / <sub>4</sub>	58	9.87	9.97	6x25, 6x26, 6x49, 8x36
2 <sup>3</sup> / <sub>8</sub>	60	10.82	10.93	6x25, 6x26, 6x49
2 <sup>1</sup> / <sub>2</sub>	64	12.28	12.40	6x25, 6x49
2 <sup>5</sup> / <sub>8</sub>	67	13.12	13.25	6x25, 6x57
2 <sup>3</sup> / <sub>4</sub>	70	14.49	14.63	6x25, 6x57



Plastic-infused Round Wire Rope

- Increased Fatigue Resistance
- Increased Abrasion Resistance
- Increased Resistance to Multilayer Drum Crushing
- Extended Sheave & Drum Service Life
- Increased Corrosion Protection
- Clean Handling & Operation

### Construction

BXL is furnished as right regular or lang lay, Form-set, IWRC wire rope manufactured in the 6x19, 6x36 and 8x36 Classes. Available grades are Excavator and Excavator-AR. For specific information, please refer to the table. For information on smaller diameters for mining applications, please contact our Customer Service Department.

BXL provides the characteristics common to Bethlehem Mining Rope, enhanced by the plastic-infusion. BXL starts with WW's special wire grades used in the manufacture of mining rope. *Excavator* grade is designed to provide excellent resistance to bending fatigue, such as those conditions found with hoist ropes. *Excavator-AR* is intended for those applications where more abrasive operating conditions exist, such as in drag line applications. Enhanced by plastic infusion, BXL offers several improved features.

Improved fatigue resistance is one key feature of BXL. BXL's polymer cushions each wire and strand, minimizing interstrand and interlayer nicking.

BXL also offers improved abrasion resistance. The polymer acts as a barrier between the individual strands, preventing penetration of any adverse material, such as dust, dirt and metal particles. The polymer also distributes and reduces contact stresses between the rope and sheave, reducing the wire rope wear normally associated with uncoated wire rope.

Perhaps the most important feature of BXL, however, is the polymer's ability to maintain the balance of the rope. When a rope is in operation, or simply wound upon a drum, the rope's components move and adjust accordingly. Due to the nature of wire rope, this movement may cause accelerated wear, and in uncoated rope, may also produce a flattening or ovaling of the rope. The polymer in BXL minimizes this movement by locking the individual wires and strands in place. With the rope's holding its intended shape during operation, operating stresses such as vibration are evenly distributed to all wires and strands, thereby reducing fatigue breaks and increasing service life.



## Flattened Strand Shaft Hoist Rope



flattened strand shaft rope with fiber core—6x27 type H			
Nominal Diameter		Breaking Strength	Approximate Weight (lb. per ft.)
Inches	mm		
1 1/8	29	70.1	2.28
1 1/4	32	85.9	2.81
1 3/8	35	103	3.40
1 1/2	38	122	4.05
1 5/8	42	143	4.75
1 3/4	45	167	5.51
1 7/8	48	188	6.33
2	52	213	7.20
2 1/8	54	237	8.13
2 1/4	58	264	9.10

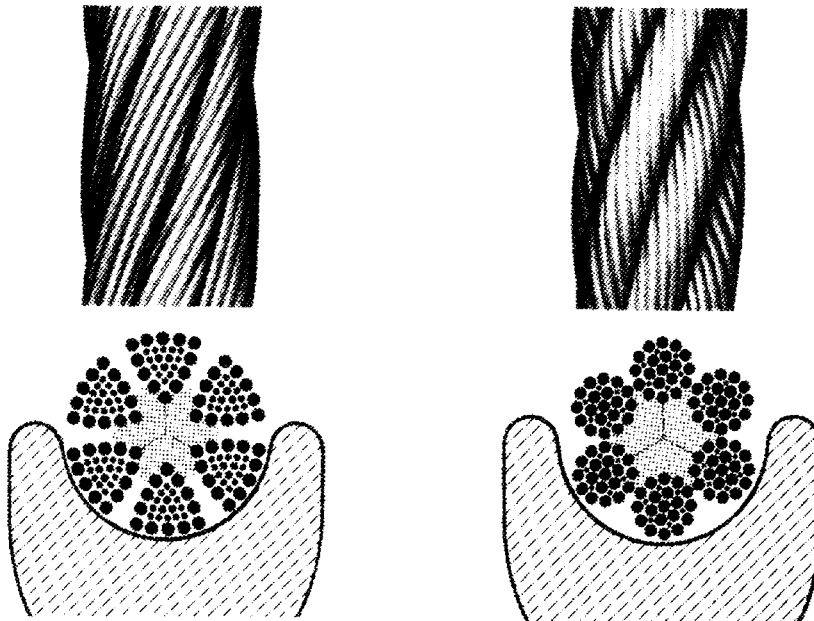
### Flattened Strand Shaft Hoist Rope

This rope is particularly suitable where severe crushing and abrasion on a drum occur, or where a higher strength design is required than can be obtained with a similar round strand rope. The triangular strand shape not only provides better resistance to crushing, but also offers a greater exposed surface area for contact with sheaves, drums or underlying areas of spooled rope.

This feature, combined with Lang lay, distributes the abrasive wear over a greater number and longer length of wires. The broad, smooth surface of the rope also helps to minimize wear on drums and sheaves.

### 35x7 Tail Ropes

We make a full line of tail ropes customized to meet your requirements of strength and weight to balance your friction hoist system. Please contact your salesman or customer service with your specifications and we will supply a quotation to meet your needs.



6x27 Type H Flattened Strand Rope with Fiber Core

Round Strand Rope

## Specialty Crane Ropes

The rated strengths of the 8x19 Class and 19x7 wire ropes are less than wire ropes in the 6x19 and 6x36 Classes. Larger sheaves are required in order to achieve comparable fatigue life. *Refer to Technical Information: Effect of Sheave Size* for further information on proper sheave sizes.

### 8x19 Classification Rotation-Resistant

**The 8x19 Classification rotation-resistant ropes are recommended for hoisting unguided loads with a single-part or multi-part line.**

The eight outer strands are manufactured in right lay, with the inner strands being left lay.

These ropes are slightly stronger and significantly more rugged than the 19x7 construction. However, the rotation-resistant properties of the 8x19 rotation-resistant ropes are much less than those of the 19x7 construction.

These ropes are manufactured in right regular lay in the 8x19 Seale and 8x25 Filler Wire constructions.

Rope Diameter		Approx. Weight (lb./ft.)	Nominal Strength (tons)
inches	mm		Purple Plus
7/16	11.0	0.36	9.0
1/2	13.0	0.47	11.6
9/16	14.5	0.60	14.7
5/8	16.0	0.73	18.1
3/4	19.0	1.06	25.9
7/8	22.0	1.44	35.0
1	26.0	1.88	45.5
1-1/8	29.0	2.39	57.3
1-1/4	32.0	2.94	70.5
1-3/8	35.0	3.56	84.9
1-1/2	38.0	4.24	100.0

**Strands:** 8

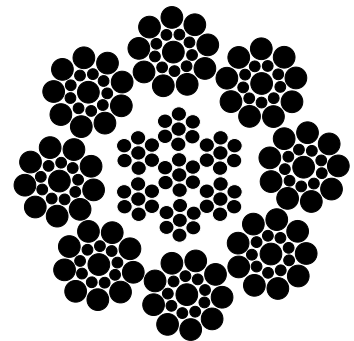
**Wires per strand:** 19 to 25

**Core:** IWRC

**Standard grade(s):** Purple Plus

**Lay:** Right Regular

**Finish:** Bright



### 19x7 Rotation-Resistant

**19x7 is recommended for hoisting unguided loads with a single-part line.**

The rotation-resistant properties of this rope are secured by two layers of strands. The inner strands are left lay, while the 12 outer strands are right lay, which enables one layer to counteract the other layer's rotation.

The rotation-resistant characteristics of the 19x7 wire ropes are superior to those of the 8x19 Class wire ropes.

Rope Diameter		Approx. Weight (lb./ft.)	Nominal Strength (tons)
inches	mm		Purple Plus
7/16	11.0	0.350	8.33
1/2	13.0	0.450	10.80
9/16	14.5	0.580	13.60
5/8	16.0	0.710	16.80
3/4	19.0	1.020	24.00
7/8	22.0	1.390	32.50
1	26.0	1.820	42.20
1-1/8	29.0	2.300	53.10
1-1/4	32.0	2.840	65.10
1-3/8	35.0	3.430	78.40
1-1/2	38.0	4.080	92.80

**Strands:** 19

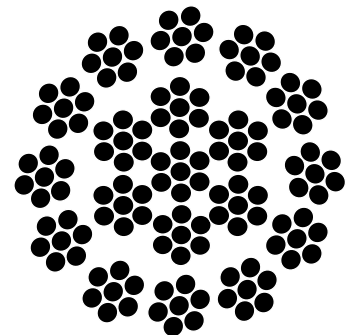
**Wires per strand:** 7

**Core:** WSC

**Standard grade(s):** Purple Plus

**Lay:** Regular

**Finish:** Bright



## Super Flex Pac 19

SFP 19 is recommended for both multi-part load and single-part fast line applications where rotational stability of the lifted load is needed, such as for use as a long fall on off-shore pedestal cranes, rough and all terrain cranes, and crawler cranes.

SFP 19 provides: **Fatigue Resistance.** Improved fatigue properties are derived through the combination of the flexible 19x19 construction and die drawn strands. The drawn strand surfaces minimize the interstrand and interlayer nicking that take place in round rotation-resistant ropes.

**Abrasion Resistance.** Die drawn ropes provide improved abrasion resistance as compared with round wire ropes because of the greater wire and strand bearing surfaces contacting sheaves and drums.

Rope Diameter		Approx. Weight (lb./ft.)	Nominal Strength (tons)
inches	mm		Royal Purple
1/2	13.0	0.54	14.6
9/16	14.5	0.69	18.5
5/8	16.0	0.83	22.7
3/4	19.0	1.19	32.4
7/8	22.0	1.62	43.8
1	26.0	2.12	56.9
1-1/8	29.0	2.68	71.5
1-1/4	32.0	3.31	87.9
1-3/8	35.0	4.01	106.0
1-1/2	38.0	4.77	125.0

**Note:** 5/8 and below 19x7 construction; 3/4 and larger 19x19 construction

**Resistance to Drum Crushing.** SFP 19 wire ropes are resistant to the effects of drum crushing due to the compacted strands and smoothness of the rope surface.

**Strands:** 19

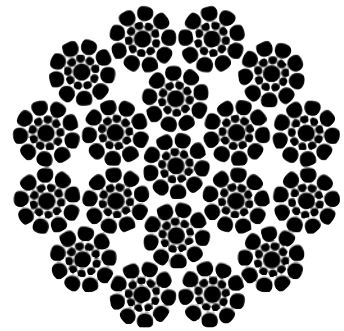
**Wires per strand:** 7/19

**Core:** WSC

**Standard grade(s):** Royal Purple

**Lay:** Right Regular

**Finish:** Bright



## Super Flex Pac 35

SFP 35 is a rotation-resistant rope of high strength that can resist block twist in long falls.

SFP 35 provides: **Superior Rotation Resistance**—the SFP 35 rope is the most rotation resistant rope manufactured by WW. Due to its rotation-resistant properties, SFP 35 may be used with a swivel in both single part and multipart reeving.

**High Strength.** WW's compaction process provides a high strength rope which exceeds EEIP nominal breaking strength.

**Application.** SFP 35 excels in crawler and truck-type crane load lines, and tower crane hoist ropes.

**Flexibility.** SFP 35's multiple strand construction provides increased flexibility which improves service life and high speed spooling. The compacted multiple strand construction also reduces sheave and drum abrasion and provides excellent resistance to drum crushing.

**Strands:** 35

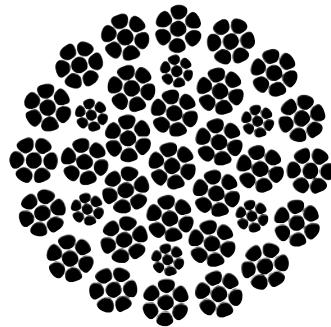
**Wires per strand:** 7

**Core:** WSC

**Standard grade(s):** 2160 N/mm<sup>2</sup>

**Lay:** Right Lang

**Finish:** Bright



Rope Diameter		Approx. Weight		Nominal Strength	
inches	mm	(kg/m)	(lb/ft)	(kN)	(tons)
5/8			.84		28.2
	16	1.27		251	
	19	1.79		344	
	20	1.99		382	
3/4			1.21		38.70
	22	2.40		466	
7/8			1.65		53.00
1			2.15		70.00
	26	3.36		660	
	28	3.90		758	
1 1/8			2.73		86.90
1 1/4			3.37		110
	32	5.09		980	

\*Acceptance strength is not less than 2-1/2% below the nominal strengths listed. Tons of 2,000 lbs.



## Suggested Ropes for Surface Mining Equipment

Application	Diameter	Construction	Lay	Grade	Core
<b>Shovels</b>					
Shovel	$\frac{3}{4}$ to $1\frac{1}{4}$ incl.	6x25 FW	Lang	Purple Plus or Purple	IWRC
	$1\frac{3}{8}$ to $1\frac{5}{8}$	6x49 FW Seale 8-strand BXL	Lang	Purple Plus or	IWRC Purple
	$1\frac{3}{4}$ to $2\frac{1}{2}$	6x49 FW Seale 8-strand BXL	Lang	Excavator	IWRC or XAR
	$2\frac{5}{8}$ to 4	6x57 S-FW-S 8-strand BXL to $2\frac{3}{4}$	Lang	Excavator	IWRC or XAR
where small sheaves and drums are used	$\frac{3}{4}$ to $1\frac{1}{4}$ incl.	6x36 Class	Lang	Purple Plus or Purple	IWRC
Crowd and Retract Lines	$\frac{3}{4}$ to $1\frac{1}{4}$	6x25 FW 6x36 Warrington Seale	Lang	Purple Plus or Purple	IWRC
	$1\frac{3}{8}$ to $1\frac{5}{8}$	6x36 Warrington Seale 8-strand BXL	Lang	Purple Plus or Purple	IWRC
	$1\frac{3}{4}$ to $2\frac{1}{2}$	6x49 FW Seale 8-strand BXL	Lang	Excavator	IWRC or XAR
	$2\frac{5}{8}$ to 3	6x57 S-FW-S 8-strand BXL to $2\frac{3}{4}$	Lang	Excavator	IWRC or XAR
Boom Lines	$\frac{3}{4}$ to $1\frac{1}{4}$ incl.	6x25 FW 6x26 Warrington Seale	Lang Alternate	Purple Plus or Purple	IWRC
	$1\frac{3}{8}$ and larger	6x36 Class	Lang	Purple Plus or Purple	IWRC
Trip Lines	$\frac{1}{4}$	6x19 Warrington	Regular	Purple Plus or Purple	Fiber
	$\frac{5}{16}$ to $\frac{7}{16}$ incl.	8x19 Warrington	Regular	Purple Plus or Purple	Fiber

*continued . . .*

## Suggested Ropes



Application	Diameter	Construction	Lay	Grade	Core
<b>Drag Lines</b>					
<b>Drag Ropes</b>  *please see Table 13 for special conditions	3/4 to 15/8	6x21 FW	Lang	Purple Plus	IWRC
	13/4 to 2 1/2	6x25 FW, 6x26 Warrington Seale 8x36 BXL	Lang	Excavator or XAR	IWRC
	25/8 to 2 3/4	6x25 FW 6x57 S-FW-S 8x36 BXL	Lang	Excavator or XAR	IWRC
	2 7/8	6x43 FW Seale 6x57 S-FW-S 8x36	Lang	Excavator or XAR	IWRC
	3 to 4	6x50 S-FW-S 6x57 S-FW-S 8x36	Lang	Excavator or XAR	IWRC
	4 1/4 to 4 1/2	6x64 S-FW-S 6x70 S-FW-S	Lang	Excavator or XAR	IWRC
	4 3/4	6x57 S-FW-S 6x70 S-FW-S	Lang	Excavator or XAR	IWRC
	5	6x70 S-FW-S	Lang	Excavator or XAR	IWRC
<b>Hoist Ropes</b>	3/4 to 1 3/8 incl.	6x25 FW	Lang	Purple Plus or Purple	IWRC
	1 1/2 to 1 5/8	6x49 FW Seale	Lang	Purple Plus or Purple	IWRC
	1 3/4 to 2 1/2	6x49 FW Seale 8x36 BXL	Lang	Excavator	IWRC
	2 5/8 to 4	6x57 S-FW-S 8x36 BXL	Lang	Excavator	IWRC
	4 1/4 to 4 1/2 4 3/4 to 5	6x64 FW Seale 6x70 S-FW-S 6x77 S-FW-S	Lang Lang	Excavator Excavator	IWRC IWRC
<b>Boom Lines</b>	1/2 to 3/4 incl.	6x25 FW 6x26 Warrington Seale	Regular Alternate	Purple Plus or Purple	IWRC
	7/8 to 1 1/4 incl.	6x25 FW 6x26 Warrington Seale	Lang Alternate	Purple Plus or Purple	IWRC
	1 3/8 and larger	6x36 Class	Lang	Purple Plus or Purple	IWRC
<b>Dump Line</b>	5/8 to 1 incl.	6x25 FW	Regular or Lang	Purple Plus or Purple	IWRC
	1 1/8 to 3 1/2	6x36 Class	Lang	Purple Plus or Purple	IWRC

- FW = Filler Wire    S-FW-S = Seale-Filler Wire-Seale    Regular = right regular lay    XAR = Excavator-AR
- Options such as En-core and Beth Pac are also available. Contact your Bethlehem Wire Rope sales representative for further information and recommendations.
- Form-set is furnished unless specifically noted otherwise.

## Suggested Ropes

different fairleads				
Diameter	Construction	Lay	Grade	Core
drag ropes with reverse bends				
1 <sup>3</sup> / <sub>4</sub> to 2 <sup>1</sup> / <sub>2</sub>	6x49 FW Seale 8x36 BXL	Lang	Excavator or XAR	IWRC
2 <sup>5</sup> / <sub>8</sub> to 4	6x57 S-FW-S 8x36	Lang	Excavator	IWRC
4 <sup>3</sup> / <sub>8</sub> to 4 <sup>1</sup> / <sub>2</sub>	6x64 S-FW-S	Lang	Excavator	IWRC
4 <sup>3</sup> / <sub>4</sub> to 5	6x70 S-FW-S	Lang	Excavator	IWRC
drag ropes with straight fairleads				
1 <sup>3</sup> / <sub>4</sub> to 2 <sup>3</sup> / <sub>4</sub>	6x25 Warrington Seale 8x36 BXL	Lang	XAR	IWRC
2 <sup>7</sup> / <sub>8</sub> to 4	6x43 FW Seale 8x36	Lang	XAR	IWRC
3 to 4	6x50 S-FW-S 8x36	Lang	XAR	IWRC
4 <sup>1</sup> / <sub>4</sub> to 4 <sup>3</sup> / <sub>4</sub>	6x57 S-FW-S	Lang	XAR	IWRC
5	6x70 S-FW-S	Lang	XAR	IWRC

- FW = Filler Wire    ▪ S-FW-S = Seale-Filler Wire-Seale    ▪ XAR = Excavator-AR
- Form-set is furnished unless specifically noted otherwise.

underground mining equipment				
Application	Construction	Lay	Grade	Core
shaft hoisting ropes				
Shallow Vertical Shafts	6x25 FW	Regular	Purple Plus or Purple	Fiber
	6x21 FW	Regular	Purple Plus or Purple	Fiber
Deep Vertical Shafts	6x21 FW	Lang	Purple Plus or Purple	Fiber
	6x25 FW	Lang	Purple Plus or Purple	Fiber
	6x27 FS Type H	Lang	Purple Plus or Purple	Fiber
Inclined Shaft Ropes	6x21 FW	Lang	Purple Plus or Purple	Fiber
	6x19 Seale	Lang	Purple Plus or Purple	Fiber
	6x27 FS Type H	Lang	Purple Plus or Purple	IWRC

- Regular = Right Regular Lay    ▪ FW = Filler Wire    ▪ FS = Flattened Strand
- Form-set is furnished unless specifically noted otherwise.

continued . . .



underground mining equipment				
Application	Construction	Lay	Grade	Core
mining machine ropes				
Head or Pull and Tail Ropes	6x36 Warrington Seale	Regular	Purple Plus or Purple	IWRC
	6x21 FW	Regular	Purple Plus or Purple	IWRC
Head or Pull Ropes	6x36 Warrington Seale	Lang	Purple Plus or Purple	IWRC
koepe or friction hoist ropes				
Hoist Ropes	6x27 FS Type H	Lang	Purple Plus or Purple	Fiber
Tail or Balance Ropes	Rotation-Resistant 35x7 or SFP 19	–	–	–
other ropes				
Miscellaneous Slope and Inclined Plane Ropes	6x19 Seale	Regular	Purple Plus or Purple	Fiber
	6x21 FW	Lang	Purple Plus or Purple	Fiber
	6x7	Lang	Purple Plus or Purple	Fiber
	6x27 FS Type H	Lang	Purple Plus or Purple	Fiber
Shaft Sinking Ropes	19x7 Rotation Resistant	Regular	Purple Plus or Purple	WSC
General Haulage Ropes	6x19 Seale	Lang	Purple Plus or Purple	Fiber
Slusher and Scraper Ropes	6x19 Seale	Regular	Purple Plus or Purple	IWRC
	3x19 Seale	Regular	Purple Plus or Purple	–
Tugger Hoist Ropes	6x19 Seale	Regular	Purple Plus or Purple	IWRC
	6x21 FW	Regular	Purple Plus or Purple	IWRC
Car Puller and Retarder Ropes	6x25 FW	Regular	Purple Plus or Purple	IWRC
	6x21 FW	Regular	Purple Plus or Purple	Fiber
	6x19 Seale	Regular	Purple Plus or Purple	Fiber



## Bethlehem Structural Strand

### Definition

Bethlehem Galvanized (zinc-coated) Structural Strand is an arrangement of wires helically laid around a center wire, producing a symmetrical cross section. Strand has two basic uses: (1) generic strands, not structural, are used as components in the manufacture of wire rope, and (2) strand is used as an individual tension member where strength is needed and flexibility is not a major requirement. WW manufactures Bethlehem Structural Strand to meet ASTM A-586, which features a maximum strength-to-weight ratio for a given diameter.

### Corrosion Protection Features

Galvanized (zinc-coated) strand is used to combat the corrosive environments of salt water, atmospheric contaminants, and humid and moist conditions.

Zinc, by its nature, protects the steel base wire by means of a sacrificial ion exchange. This sounds complicated, but basically it means that even if a minor flaw were to develop in the zinc coating, the base wire (steel) would still be protected from corrosion as long as the zinc remains

on the nearby wire surfaces. For mining applications, Bethlehem Structural Strand and Strand Pendants are always furnished with a zinc Class "A" coating.

## Bethlehem Wire Rope and Strand Pendants

### Description

Bethlehem Wire Rope and Strand Pendants are used for boom suspension systems on excavating equipment. Pendants consist of wire rope or galvanized strand with appropriate end fittings. Important considerations when ordering pendants are:

- Prestretching
- Striping
- Measuring @ required load
- Packaging (reel size, number of pieces per reel)
- End fittings (dimensions, pin sizes)
- Pin orientation
- Dampers
- Product (rope or strand)
- Size, strength and weight
- Modulus of elasticity
- Length and reference points
- Length tolerances

### Rope Pendants

Rope pendants may be supplied in 6x19, 6x36 or 6x61 Class wire rope. Refer to wire rope data at right.

\*Metric and U. S. tolerances are the same at 0,+5

6-strand rope pendants		
Nominal Diameter		Approximate Rope Weight
Inches	mm	(lb. per ft.)
1 <sup>1</sup> / <sub>8</sub>	29	2.34
1 <sup>1</sup> / <sub>4</sub>	32	2.89
1 <sup>3</sup> / <sub>8</sub>	35	3.50
1 <sup>1</sup> / <sub>2</sub>	38	4.16
1 <sup>5</sup> / <sub>8</sub>	42	4.86
1 <sup>3</sup> / <sub>4</sub>	45	5.67
1 <sup>7</sup> / <sub>8</sub>	48	6.50
2	52	7.39
2 <sup>1</sup> / <sub>8</sub>	54	8.36
2 <sup>1</sup> / <sub>4</sub>	58	9.36
2 <sup>3</sup> / <sub>8</sub>	60	10.40
2 <sup>1</sup> / <sub>2</sub>	64	11.60
2 <sup>3</sup> / <sub>4</sub>	70	14.00
3	76	16.60
3 <sup>1</sup> / <sub>4</sub>	83	19.50
3 <sup>1</sup> / <sub>2</sub>	89	22.70
3 <sup>3</sup> / <sub>4</sub>	95	26.00
4	102	29.60
4 <sup>3</sup> / <sub>8</sub>	111	34.30

## Strand Pendants



Structural strand provides high modulus of elasticity, high strength-to-weight ratio and a relatively small diameter per unit of strength.

Galvanized steel structural strand is manufactured to meet ASTM A-586 in sizes through 5½" diameter. Our in-house galvanizing and stranding facilities allow us the flexibility to manufacture zinc-coated structural strand to various specifications. Refer to strand data at right.

For other sizes not shown, contact Wire Rope Works, Inc. Customer Service Department or your Regional Sales Manager.

### properties of zinc-coated steel structural strand

Nominal Diameter		Const. Type	Approximate Weight		Approximate Metallic Area		Nominal Strength	
							Class A Coating	
Inches	mm		Lbs./Ft.	Kg./M	Inches <sup>2</sup>	mm <sup>2</sup>	Tons	Tonnes
¾	19	CLS	1.18	1.8	0.338	218.1	34.0	30.8
7/8	22	CLS	1.61	2.4	0.459	296.1	46.0	41.7
1	26	CLS	2.10	3.1	0.600	387.1	61.0	55.3
1 1/8	29	CLS	2.66	4.0	0.759	489.7	78.0	70.8
1 1/4	32	CLS	3.28	4.9	0.938	605.6	96.0	87.1
1 3/8	35	CLS	3.97	5.9	1.130	729.0	116.0	105.2
1 1/2	38	CLS	4.77	7.1	1.334	861.0	138.0	125.2
1 5/8	42	CLS	5.58	8.3	1.563	1008	162.0	147.0
1 3/4	45	CLS	6.46	9.6	1.808	1166	188.0	170.6
1 7/8	48	CLS	7.46	11.1	2.084	1345	216.0	196.9
2	52	CLS	8.47	12.6	2.365	1526	245.0	222.3
2 1/8	54	CLS	9.49	14.1	2.643	1705	277.0	251.3
2 1/4	58	CLS	10.54	15.7	2.937	1895	310.0	281.2
2 3/8	60	CLS	11.91	17.7	3.311	2136	344.0	312.1
2 1/2	64	CLS	13.09	19.5	3.642	2350	376.0	341.1
2 5/8	67	CLS	14.47	21.5	4.017	2592	417.0	378.3
2 3/4	70	PCC	15.70	23.4	4.360	2813	452.0	410.1
2 7/8	73	PCC	17.43	25.9	4.833	3118	494.0	448.2
3	76	PCC	19.51	29.0	5.405	3487	538.0	488.1
3 1/8	79	PCC	21.28	31.7	5.897	3805	584.0	529.8
3 1/4	83	PCC	22.88	34.0	6.328	4083	625.0	567.0
3 3/8	86	PCC	24.56	36.5	6.793	4383	673.0	610.5
3 1/2	89	PCC	26.43	39.3	7.312	4717	724.0	656.8
3 5/8	92	PCC	28.33	42.2	7.827	5050	768.0	696.7
3 3/4	95	PCC	30.11	44.8	8.320	5368	822.0	745.7
3 7/8	98	PCC	32.19	47.9	8.895	5739	878.0	796.5
4	102	PCC	34.29	51.0	9.465	6106	925.0	839.2
4 1/8	105	PCC	36.29	54.0	10.035	6474	985.0	893.6
4 1/4	108	PCC	38.34	57.1	10.590	6832	1002.0	909.1
4 3/8	111	PCC	40.62	60.4	11.220	7239	1108.0	1005.2
4 1/2	114	PCC	43.05	64.1	11.892	7672	1173.0	1064.2
4 5/8	117	PCC	45.40	67.6	12.538	8089	1239.0	1124.1
4 3/4	121	PCC	47.40	70.5	13.500	8710	1306.0	1184.9

CLS = Cross Laid Strand

PCC = Parallel Contact Core

Minimum moduli of elasticity of the above right strands, when prestretched, are as follows:

- ½" to 2 9/16" diameter 24,000,000 psi
- 2 5/8" to 4" diameter 23,000,000 psi
- Over 4" diameter 22,000,000 psi

## Strand Pendant Special Features

Bethlehem Strand Pendants in sizes less than 2<sup>3</sup>/<sub>4</sub>" in diameter are manufactured with a cross-laid construction as they have been for many years. Strands that are 3" and larger have a parallel contact core construction because of the significant higher internal stresses that are developed with many multiple wire layers.

### CLS (Cross-Laid Strand)

CLS is WW's proven standard construction where each covering layer is laid opposite to the previous layer. This process provides for a very stable torque free strand.

### PCC (Parallel Contact Core)

WW designed the Parallel Contact Core (PCC) to dissipate the very high internal strand pressures along the entire lengths of all wires for large diameter strands. This eliminates the point contact pressure on wires at the core of the strand. PCC also significantly reduces the "fretting corrosion" (fatigue) which results in the formation of metallic particles and eventual broken wires. PCC is intended to reduce the notching and bending stresses which may occur.

### SPL (Strand Pendant Lubricant)

WW lubricates its strand at manufacturing with a asphaltic based lubricant to reduce wire to wire friction and reduce fretting.

### End Fittings

The most commonly used end fittings for rope and strand main pendants are open- and closed-type sockets. For intermediate and safety pendants, bridge sockets are often specified. These sockets, when properly attached, will develop the full strength of the rope or strand for which they are designed.

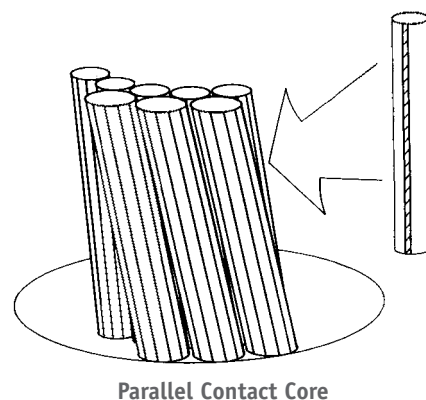
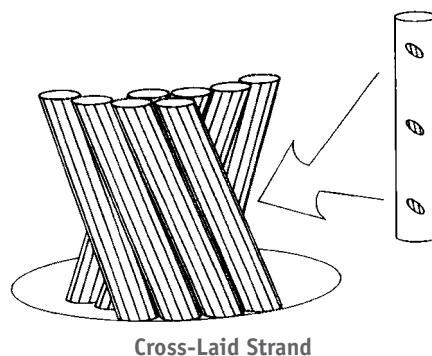
Sockets are manufactured from forging-quality steel or cast steel. Dimensional tolerances are consistent

with commercial tolerances established by the forging and steel casting industries. More rigid tolerances can be met if specified.

The following nondestructive test methods are available for pendant sockets:

- Magnetic particle
- Dye penetrant
- Ultrasonic
- X-ray

Special customer and OEM requirements can be fulfilled upon request.



WW does not assume responsibility for the integrity of customer-provided sockets. The decision to reuse sockets is entirely the responsibility of the customer. When directed to do so, WW will attach customer sockets but will only assume the responsibility for the integrity of the attachment to the wire rope or strand. The customer accepts the complete responsibility for the condition and the performance of the used sockets.

### Zinc- and Resin-Attached Sockets

Wire rope and strand sockets with tapered baskets (cone-shaped) have been in use for over 125 years. Since they develop the full strength of the attached rope or strand, these attachments are used in breaking strength tests. In fact, the attachments are secure enough that some using lead embedment were in continuous use on old suspension bridges for over 100 years.

Over the years, low-melting temperature metals such as lead, babbitt and white metal were used to "pot" wire rope and strand ends. Today, only babbitt (with at least 9% antimony) continues in use for elevators, and requires special techniques of end preparation. For modern day use, zinc and thermoset resin are regarded as acceptable embedment media for wire rope and strand tapered basket sockets. These two products differ significantly from each other, but both develop the full breaking strength of the attached wire rope or strand. Attaching is done by inserting a cleaned, broomed wire rope or strand end into the tapered basket and embedding this end with zinc (spelter) or thermoset resin. We recommend that attaching of zinc and resin sockets be left to experts who possess the knowledge, training, special tools and fixtures to perform the job. This insures the safety of the termination and provides long service life.

### Socket Design

Sockets may be specifically designed for resin or zinc. For example, a smooth (as-cast or as-forged) interior cone surface works best with resin, but causes zinc to seat an excessive amount. Review socket design when considering resin attachment. Other differences may exist which make it advisable to trust these connections to those who regularly attach such sockets.



## Attachment Methods

Though the method of attachment for zinc differs greatly from that of resin, both methods require exceptionally clean, broomed wire rope or strand ends. Zinc must be poured into the socket basket in a vertical position. Socket preheating is beneficial to disperse moisture and insure zinc penetration into the small end of the tapered basket, especially on heavy sockets with thick socket walls and small sockets which are generally constricted. Resin may be poured either vertically or horizontally. For pouring resin, sockets should not be heated above 10°F.

## Embedment Criteria

Most specifications for zinc socketing require High Grade or Special High Grade zinc. However, Best Western Grade is sometimes specified. All of these grades have performed throughout the years and provided socket attachments which develop the full strength of the wire rope or strand.

If good practice is followed, higher zinc purities found with High Grade and Special High Grade zinc will result in smaller amounts of socket cone seating following socket proof-loading or pendant loading.

Resin used for socketing must be a thermo-setting resin designed and tested for socketing wire rope and

strand. Several products are readily available from commercial socket sources. Using acceptable resins provides excellent results, providing the resin is fresh and has been stored in accordance with the resin manufacturer's directions. Improper resin curing may occur due to:

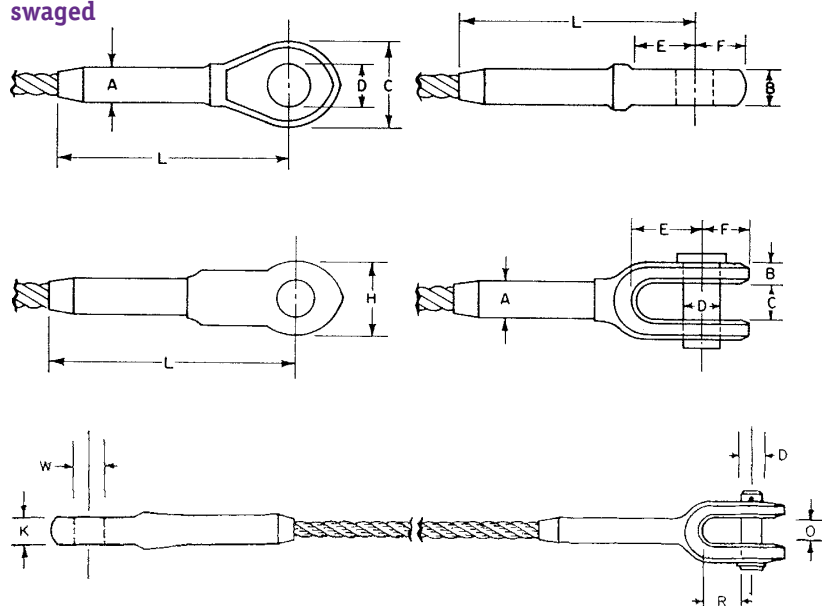
- (1) improper volume or ratio, or
- (2) inadequate temperature or time (from excessive age or heat). In each and every case, the manufacturer's directions must be carefully followed.

## Fittings and Assemblies

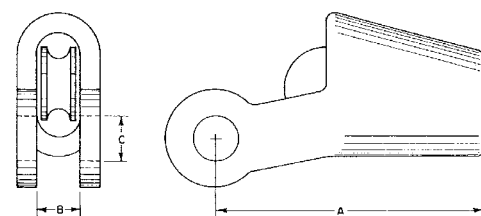
### Typical Fittings Used by Draglines and Shovels

Typical fittings used for pendants. Specific dimensions vary according to manufacture and pendant diameters. Critical dimensions need to be identified when ordering any fittings.

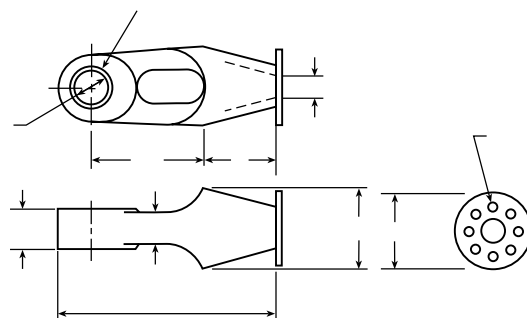
#### swaged



#### wedge



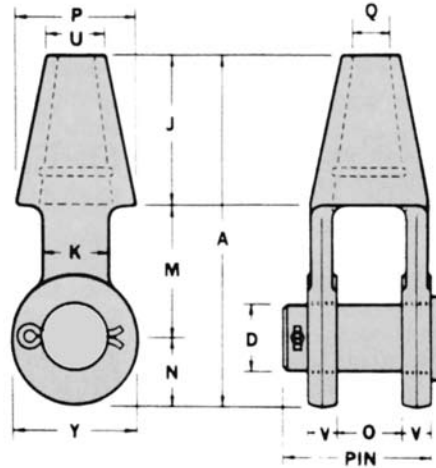
#### closed w/flange





## Typical Open Wire Rope Socket

For use on wire rope and multiple-strand structural rope. Not recommended for use on structural strand.



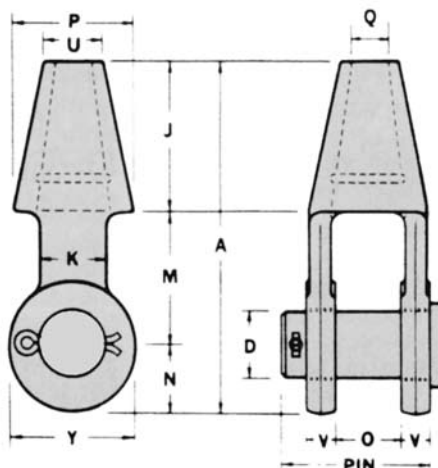
NOTE: Dimensions vary depending on socket vendor.

Rope Diam. In.	A In.	J In.	K In.	M In.	N In.	O In.	P In.	Q In.	U In.	V In.	Y In.	Pin		Cotter Pin Diam. In.	Weight lb.
												Length In.	Diam. D In.		
drop-forged steel or steel castings															
3/16, 1/4	45/16	2	3/4	19/16	3/4	11/16	15/16	5/16	5/8	5/16	15/16	13/4	11/16	3/16	0.9
5/16, 3/8	45/8	2	13/16	13/4	7/8	13/16	19/16	7/16	3/4	13/32	11/2	21/16	13/16	3/16	1.1
7/8, 1/2	59/16	2 1/2	1	2	11/16	1	17/8	9/16	1	1/2	17/8	27/16	1	3/16	2.3
9/16, 5/8	63/4	3	11/4	2 1/2	11/4	11/4	2 1/4	11/16	13/16	9/16	2 1/4	27/8	13/16	1/4	3.8
3/4	79/16	3 1/2	11/2	3	17/16	11/2	25/8	13/16	15/16	5/8	25/8	3 1/4	13/8	1/4	6.0
7/8	9 1/4	4	13/4	3 1/2	13/4	13/4	33/4	31/32	11/2	3/4	31/8	37/8	15/8	5/16	10.0
1	109/16	4 1/2	2	4	21/16	2	35/8	11/8	13/4	7/8	33/4	4 1/2	2	3/8	15.5
1 1/8	1113/16	5	23/8	4 1/2	25/16	2 1/4	4	1 1/4	2	1	4 1/8	5	2 1/4	3/8	22.0
1 1/8, 13/8	133/16	5 1/2	23/4	5	211/16	2 1/2	45/8	1 1/2	2 1/4	1 1/8	43/4	55/8	2 1/2	7/16	32.0
1 1/2	151/8	6	3	6	31/8	3	5 1/4	15/8	23/4	13/16	53/8	63/8	23/4	1/2	46.0
steel castings															
15/8	161/4	6 1/2	3 1/4	6 1/2	3 1/4	3	5 1/2	13/4	3	15/16	53/4	65/8	3	1/2	55.0
13/4, 17/8	181/4	7 1/2	37/8	7	33/4	3 1/2	63/8	2	31/8	19/16	6 1/2	75/8	3 1/2	1/2	85.0
2, 2 1/8	21 1/2	8 1/2	4 1/4	9	4	4	7 1/4	23/4	33/4	113/16	7	83/4	33/4	1/2	125.0
2 1/4, 23/8	23 1/2	9	43/8	10	4 1/2	4 1/2	8 1/4	2 1/2	4	2 1/8	73/4	97/8	4 1/4	1/2	165.0
2 1/2, 25/8	263/4	10 1/2	5	11	5 1/4	5	9	213/16	6 1/8	2 1/4	9	103/4	43/4	5/8	240
23/4, 27/8	283/4	11 1/2	5 1/4	11 1/2	53/4	53/8	10	3	7	23/8	10	113/8	5	5/8	305
3	309/16	12 1/2	5 1/2	12	61/16	53/4	103/4	33/16	75/8	2 1/2	10 1/2	12 1/4	5 1/4	3/4	370
3 1/4	343/4	14	7	14	63/4	6 1/4	11 1/2	37/16	8 1/2	23/4	11 1/2	13 1/4	5 1/4	3/4	510
3 1/2	36 1/2	15	8	14 1/2	7	7 1/2	13 1/4	311/16	9 1/4	3 1/4	12 1/2	15 1/2	63/4	3/4	760
33/4	383/4	16	8 1/4	15	73/4	73/4	14	315/16	10	33/8	14	16	7	3/4	890
4	40 1/2	17	8 1/2	15	8 1/4	8	14 1/2	4 1/4	10 1/2	3 1/2	14 1/2	16 1/2	7 1/4	3/4	1020
4 1/2	34 1/2	11 1/4	7	14 1/4	9	8	14 1/4	4 1/2	83/4	3 1/2	123/4	163/8	7 1/4	3/4	759
4 1/2, 43/4	35	113/4	7	143/4	8 1/2	8 1/4	133/4	5 1/4	9 1/2	23/4	123/4	15 1/8	7 1/4	3/4	659
5, 5 1/4	37	12 1/2	8	15 1/2	9	8 1/2	14 1/2	53/4	10 1/2	3	13 1/2	157/8	7 1/2	3/4	778
5 1/2, 53/4	40 1/4	133/4	9	16 1/2	10	83/4	143/4	6 1/4	12	3	143/4	16 1/8	8	3/4	947
6	43 1/2	15	10	17 1/4	11 1/4	9	15	6 1/2	13	3	16 1/2	163/8	8 1/2	3/4	1130

## Typical Open Strand Sockets



For use on structural strand.

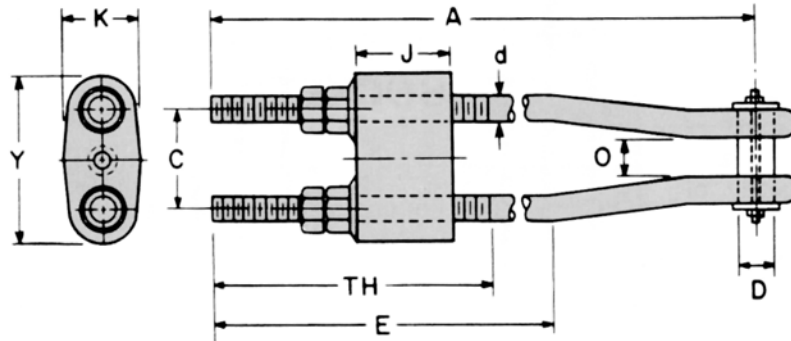


NOTE: Dimensions vary depending on socket vendor.

Strand Diam. In.	A In.	J In.	K In.	M In.	N In.	O In.	P In.	Q In.	U In.	V In.	Y In.	Pin		Cotter Pin Diam. In.	Weight lb.
												Length In.	Diam. D In.		
drop-forged steel or steel castings															
1/2 9/16, 5/8 11/16, 3/4	6 5/8 7 3/4 8 15/16	2 7/8 3 9/16 4 1/4	1 1/4 1 1/2 1 3/4	2 1/2 2 3/4 3	1 1/4 1 7/16 1 11/16	1 1/4 1 1/2 1 3/4	2 1/2 3 3 3/8	3/4 13/16 15/16	1 1/2 1 7/8 2	5/8 3/4 13/16	2 2 1/2 2 3/4	3 1/16 3 5/8 4	13/16 1 3/8 1 5/8	1/4 1/4 1/4	4.4 6.7 10.2
13/16, 7/8 15/16, 1	10 3/8 12	4 7/8 5 5/8	2 2 1/4	3 1/2 4	2 2 3/8	2 2 1/4	3 3/4 4	1 1/16 1 1/4	2 1/8 2 3/8	7/8 7/8	3 1/4 3 3/4	4 3/8 4 1/4	2 2 1/4	1/4 3/8	14.3 19.0
1 1/16, 1 1/8 1 3/16, 1 1/4	12 1/2 13 5/8	5 1/4 5 1/2	2 1/2 2 3/4	4 1/2 5	2 3/4 3 1/8	2 1/2 3	4 3/8 4 1/2	1 1/2 1 5/8	2 1/2 2 3/4	15/16 1	4 1/4 4 3/4	5 1/4 5 7/8	2 1/2 2 3/8	3/8 3/8	25.0 32.0
steel castings															
15/16, 1 3/8 1 7/16, 1 5/8 1 11/16, 1 3/4	14 7/16 16 5/8 17 1/2	5 7/16 6 1/8 6 1/2	3 1/4 3 1/2 3 5/8	5 1/2 6 1/2 7	3 1/2 4 4	3 3 1/2 4	4 7/8 6 6 3/4	1 3/4 2 2 1/4	3 4 4	1 1 1/4 1 5/8	5 1/2 6 1/4 6 1/4	6 7 8 3/8	3 3 1/2 3 3/4	1/2 1/2 1/2	40.0 71.0 92.0
1 13/16, 1 7/8 1 15/16, 2 2 1/16, 2 1/8	19 1/4 21 3/8 22 1/2	6 3/4 7 7 3/4	3 3/4 3 7/8 3 7/8	8 9 1/2 10	4 1/2 4 7/8 4 3/4	4 1/4 4 1/2 4 1/2	7 1/8 7 1/2 8	2 3/16 2 5/16 2 1/2	4 1/2 4 3/4 4 3/4	1 5/8 1 5/8 2	6 7/8 7 1/2 7 1/2	8 5/8 8 7/8 9 5/8	4 4 1/4 4 1/2	1/2 1/2 1/2	111 138 161
2 3/16, 2 1/4 2 5/16, 2 3/8	24 1/8 24 3/4	7 7/8 8 1/4	4 4 1/2	11 11	5 1/4 5 1/2	5 5 1/4	8 1/2 9	2 5/8 2 3/4	5 1/2 6	2 2 1/8	8 8 1/2	10 1/4 10 3/4	4 3/4 5	5/8 5/8	196 231
2 7/16, 2 9/16 2 5/8, 2 3/4 2 7/8, 3	26 1/4 27 3/8 29 3/4	8 1/2 8 3/4 10	5 5 5 5/8	12 12 1/4 13	5 3/4 6 3/8 6 3/4	5 1/2 6 6 1/4	9 3/8 10 1/4 11	3 3 1/8 3 3/8	6 1/2 6 1/2 7	2 1/4 2 1/2 2 1/2	9 9 3/4 10 1/2	11 1/4 12 1/4 12 1/2	5 1/4 5 3/4 6	5/8 5/8 5/8	261 320 392
3 1/8, 3 1/4 3 3/8, 3 1/2	31 1/2 32 3/4	10 1/2 10 3/4	6 1/8 6 3/8	13 1/4 13 3/4	7 3/4 8 1/4	6 3/4 7 1/4	11 3/4 12 3/4	3 3/4 4	7 1/2 8	2 3/4 3	11 1/4 11 3/4	13 1/2 14 5/8	6 1/2 6 3/4	5/8 5/8	433 582
3 5/8, 3 3/4 3 7/8, 4	33 1/2 34 1/2	11 11 1/4	6 3/4 7	14 14 1/4	8 1/2 9	7 1/2 8	13 1/2 14 1/4	4 1/4 4 1/2	8 1/2 8 3/4	3 3/8 3 1/2	12 1/4 12 3/4	15 1/2 16 3/8	7 7 1/4	5/8 3/4	677 754
4 1/8, 4 3/8 4 1/2, 4 3/4 4 7/8, 5 1/8	35 37 40 1/4	11 3/4 12 1/2 13 3/4	7 8 9	14 3/4 15 1/2 16 1/2	8 1/2 9 10	8 1/4 8 1/2 8 3/4	13 3/4 14 1/2 14 3/4	5 1/4 5 3/4 6 1/4	9 1/2 10 1/2 12	2 3/4 3 3	12 3/4 13 1/2 14 3/4	15 1/8 15 7/8 16 1/8	7 1/4 7 1/2 8	3/4 3/4 3/4	659 778 947
5 1/4, 5 1/2	43 1/2	15	10	17 1/4	11 1/4	9	15	6 1/2	13	3	16 1/2	16 3/8	8 1/2	3/4	1130

## Typical Open Bridge Sockets

For standard and 48 in. take-up.  
For use on structural strand  
and rope.



NOTE: Dimensions vary depending on socket vendor. Other take-ups available upon request.

(Read right) Rope Diam. In.	Std. Take- Up In.	A for Std. Take- Up In.	A for 48-in. Take- Up In.	C In.	d In.	D In.	E for Std. Take- Up In.	E for 48-in. Take- Up In.	J In.	K In.	O In.	Pin P In.	TH for Std. Length Up In.	TH for 48-in. Take- Up In.	Take- Y In.	Cotter Pin Diam. In.	Weight Lb.		(Read left) Strand Diam. In.
																	Std. Take- Up	48-in. Take- Up	
1/2	9	20	59	33/8	5/8	13/16	14 1/2	53 1/2	3 1/8	2 1/16	1 1/4	3 1/16	10 1/2	49 1/2	45/8	1/4	9	16	1/2
5/8	9	22	61	43/8	3/4	13/8	15	54	3 13/16	27/16	1 1/2	3 5/8	10 3/4	49 3/4	57/8	1/4	16	26	9/16, 5/8
3/4, 7/8	9	23	62	4 11/16	1	15/8	16 1/2	55 1/2	4 7/16	3 1/4	1 3/4	4 3/8	11 1/4	50 1/4	6 9/16	1/4	28	45	1 1/16, 3/4
1	9	25	64	5 3/16	1 1/8	2	17	56	5 1/16	3 11/16	2	4 7/8	11 1/2	50 1/2	7 5/16	1/4	40	62	13/16, 7/8
1 1/8	9	26	65	5 3/4	1 1/4	2 1/4	18 1/2	57 1/2	6	4 1/16	2 1/4	5 1/2	11 3/4	50 3/4	8 1/8	3/8	55	82	15/16, 1
1 1/4	12	30	66	6	1 3/8	2 1/2	21 1/2	57 1/2	5 13/16	4 1/2	2 1/2	6 1/8	15	51	8 5/8	3/8	68	98	1 1/16, 1 1/8
1 3/8	12	33	69	6 3/4	1 5/8	2 3/4	22 1/2	58 1/2	6 3/8	4 7/8	3	7 1/8	15 1/2	51 1/2	9 3/4	3/8	100	143	13/16, 1 1/4
1 1/2	12	34	70	7 3/16	1 3/4	3	23 1/2	59 1/2	6 15/16	5 5/16	3	7 1/2	15 3/4	51 3/4	10 7/16	1/2	124	173	15/16, 1 3/8
1 5/8, 1 3/4	15	39	72	8 1/8	2	3 1/2	27	60	7 5/16	6 1/2	3 1/2	8 1/2	19 1/4	52 1/4	11 3/4	1/2	180	239	17/16, 1 1/2
1 7/8, 2	15	42	75	9	2 1/4	3 3/4	28 1/2	61 1/2	8 1/8	7 5/16	4	9 5/8	19 3/4	52 3/4	13 1/8	1/2	249	323	19/16, 1 3/4
2 1/8, 2 1/4	18	50	80	10 1/4	2 1/2	4 1/4	33	63	9 5/16	8 1/8	4 1/2	10 5/8	23 1/4	53 1/4	14 3/4	1/2	356	439	1 13/16, 2
2 3/8, 2 1/2	18	52	82	11 1/2	2 3/4	4 3/4	35 1/2	65 1/2	10 7/8	8 15/16	5	11 3/4	23 3/4	53 3/4	16 1/2	5/8	485	586	2 1/16, 2 1/4
2 5/8, 2 3/4	18	54	84	12 11/16	3	5	36 1/2	66 1/2	11 13/16	9 3/4	5 3/8	12 5/8	24 1/4	54 1/4	18 1/16	5/8	610	730	2 5/16, 2 3/8
2 7/8, 3	21	59	86	13 3/8	3 1/4	5 3/4	41	68	12 13/16	10 9/16	6	13 3/4	27 3/4	54 3/4	19 1/4	5/8	776	903	2 7/16, 2 5/8
3 1/4	21	61	88	14 1/16	3 1/2	5 3/4	42 1/2	69 1/2	13	9 7/8	6 1/4	14 1/4	28 1/4	55 1/4	20 5/16	5/8	882	1030	2 11/16, 2 3/4
3 1/2	21	63	90	15 1/4	3 3/4	6 3/4	45	72	15 1/2	12 3/16	7 1/2	16 3/8	28 3/4	55 3/4	22	5/8	1180	1349	2 7/8, 3
3 3/4	24	70	94	17 1/4	4	7	50	74	16	11 5/16	7 3/4	17	32 1/4	56 1/4	24 1/2	5/8	1508	1679	3 1/8, 3 1/4
(none)	24	75	99	18 5/16	4 1/4	7 1/4	53	77	16 3/4	11 7/8	8	17 7/8	32 3/4	56 3/4	26 1/16	3/4	1621	1821	3 3/8, 3 1/2
4	24	80	104	19 3/8	4 1/2	7 1/2	55 1/2	79 1/2	18 3/16	12 3/4	8 1/4	18 5/8	33 1/4	57 1/4	27 5/8	3/4	2031	2251	3 5/8, 3 3/4
4 1/4	24	85	109	20 7/16	4 3/4	7 3/4	57 1/2	81 1/2	20	13 7/16	8 1/2	19 3/8	33 3/4	57 3/4	29 7/16	3/4	2444	2684	3 7/8, 4
4 1/2, 4 3/4	27	87	108	20	4 1/4	7 1/4	59 1/2	80 1/2	20	14	8 1/4	18 1/4	36	57	28	3/4	2311	2480	4 1/8, 4 3/8
5, 5 1/4	27	90	111	21	4 3/4	7 1/2	62	83	21 1/4	14 7/8	8 1/2	19 1/2	37	58	30 1/4	3/4	2917	3129	4 1/2, 4 3/4
5 1/2, 5 3/4	30	96	114	22	5	8	67	85	22 3/4	16	8 3/4	20 1/4	40 1/2	58 1/2	31 1/2	3/4	3427	3627	4 7/8, 5 1/8
6	30	99	117	23	5 1/2	8 1/2	69 1/2	87 1/2	24 1/2	17	9	21 1/2	41 1/2	59 1/2	33	3/4	4166	4408	5 1/4, 5 1/2



## Prestretching

Stretching under load is inherent in wire rope and strand. This tendency is due to two factors:

- (1) **The elasticity of the product.**  
*Elastic stretch is fully recoverable upon release of the load, provided the elastic limit of the steel wires has not been exceeded.*
- (2) **The non-elastic constructional stretch, which is a variable quantity depending upon diameter, construction, length of lay of the rope or strand and the manufacturing equipment.**

To obtain uniform elastic behavior and the close length tolerances required for pendant applications, the inherent constructional stretch of the rope or strand must be removed. This is accomplished by prestretching.

Prestretching is the repeated application of a predetermined load to a finished wire rope or strand, for the following reasons: (1) to make the rope or strand truly elastic by removing constructional stretch, and (2) to permit measuring and marking at prescribed loads on the rope or strand in order to achieve close tolerances.

## Striping

For installation purposes, a longitudinal paint stripe is applied to the entire length of the wire rope or strand while it is under the prescribed measuring tension. Striping allows the rope or strand pendant to be installed in the same orientation as it was measured during fabrication.

## Measuring

To provide the necessary length tolerances specified by our customers, our measuring techniques include:

- **Measuring the rope or strand under prescribed tension using a calibrated, certified and tensioned steel tape secured to the rope or strand.**
- **Use of predetermined reference marks and a fixed gauge for accurate socket positioning.**

With these measuring practices, assembly tolerances of  $\pm 1/8"$  can be maintained.

## Attaching Sockets

Spelter sockets are widely used for rope and strand end fittings. Therefore, attaching them correctly is of prime importance since the connection must be at least as strong as the rope or strand.

At WW, we follow the attachment procedures contained in the Wire Rope Technical Board Wire Rope Users Manual for zinc- and resin-poured sockets. In addition, our standard procedures include:

- **Ultrasonic degreasing of the broomed-out ends.**
- **Positive means of holding rope or strand ends to prevent loss of lay.**
- **Towers and equipment tailored to accommodate any size rope or strand to insure accurate alignment.**

Equipment and procedures are in place to meet the very latest customer and OEM specifications which require more stringent socket alignment and concentricity.

Zinc attachment is considered standard, though resin attachment using approved procedures is available when specified.

## Accurate Socket Alignment and Concentricity

WW's Accurate Socket Alignment and Concentricity (ASAC) method of attaching sockets insures that the axis of the strand as it enters the socket basket is parallel to the centerline of the socket basket within  $0^\circ - 15' (1/4")$  and concentric to within 0.010". When specified by the customer, this procedure is used for attaching sockets to main pendants on walking draglines. Sockets are inspected for dimensional limitations and machined on the base (or nose) and on the outside of the socket basket at the base. Sockets are attached to the strand using specially machined fixtures to insure the desired accuracy.

## Proofloading Sockets

Proofloading is the application of a prescribed, non-destructive tensile load to prove the integrity of the end fitting and connection, and is available upon request.

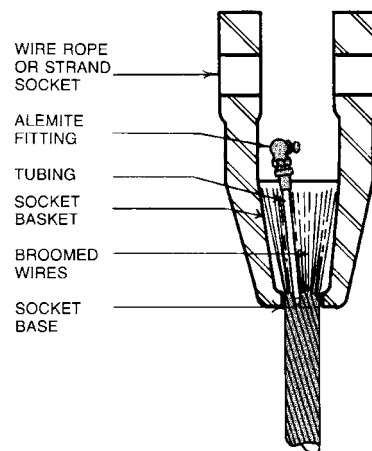
## Bethlehem Rope and Strand Pendant Specialty Items

To improve pendant service life, WW offers the following items:

### Relubrication Tube

Originally patented by Bethlehem Wire Rope, the relubrication tube (lube tube) provides a means for internally lubricating the rope or strand at the socket base to combat corrosion and fatigue. WW installs a lube tube with a grease fitting in the socket. This hollow tube is carefully inserted between the wires in the socket base prior to pouring the zinc. WW recommends that relubrication be repeated as often as necessary to keep fresh lubrication in these areas.

Relubrication tubes are standard on Bethlehem Strand Pendants  $2\frac{5}{8}"$  diameter and larger. Lube tubes are not installed in smaller diameters unless specified by the customer.

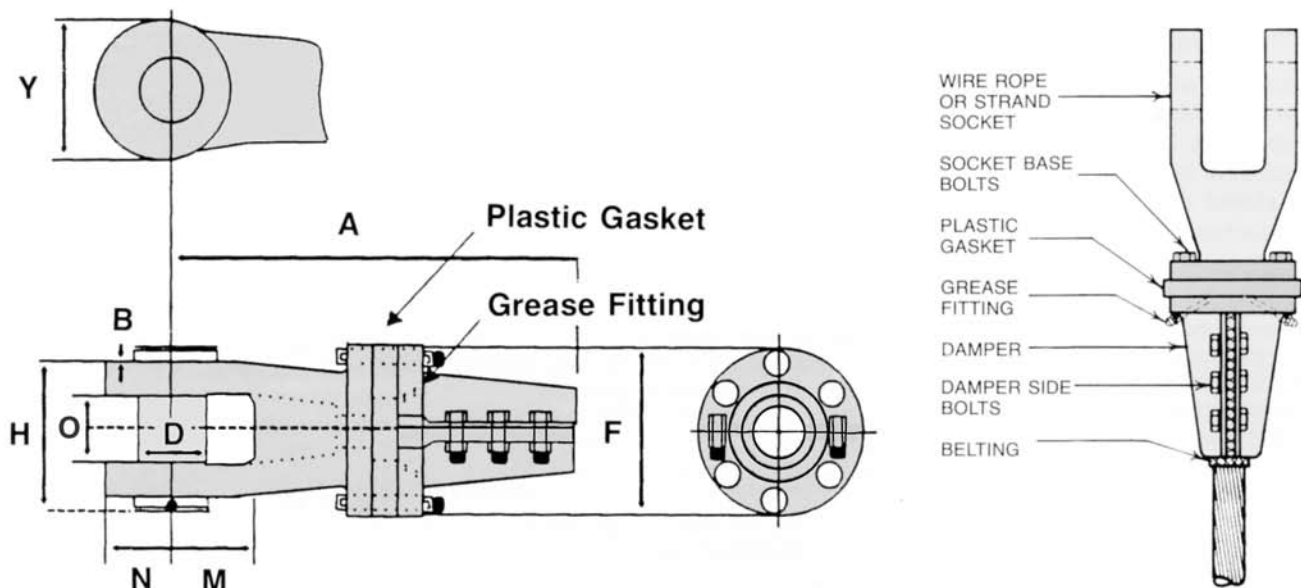


## Vibration Damping System

WW's Vibration Damping System consists of a split-flanged clamp resiliently secured to the rope or strand and bolted to a flanged socket through an elastomeric gasket. A lubricant reservoir is provided around the rope or strand within the gasket. This system is designed to reduce vibration and fatigue in the rope or strand wires adjacent to the end fitting, resulting in longer operating life.



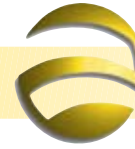
## Fittings and Damper Assemblies for Bridge Strand



\*covered under U.S. Patent 3,549,183

Strand Dia.	A In.	B In.	D In.	F In.	H In.	M In.	N In.	O In.	Y In.	Est. Wt. lbs.
2	27½	7/8	4¼	9¼	8⅞	9½	4⅞	4½	7½	200
2⅛	29	9/16	4½	9⅜	9⅝	10	4¾	4½	7½	228
2¼	30⅛	¼	4¾	9⅜	10¼	11	5¼	5	8	268
2⅜	30½	1	5	10¼	10¾	11	5½	5¼	8½	308
2½	32¼	1	5¼	10⅝	11¼	12	5¾	5½	9	352
2⅝-2¾	33¼	1	5¾	10¼	12¼	12¼	6¾	6	9¾	401
2⅞-3	37½	1	6	11½	12½	13	6¾	6¼	10½	529
3⅛-3¼	38½	1	6½	12½	13½	13¼	7¾	6¾	11¼	663
3⅜-3½	39½	1	6¾	13	14⅝	13¾	8¼	7¼	11⅜	794
3⅝-3¾	40½	1	7	13¾	15½	14	8½	7½	12¼	907
3⅞-4	41½	1	7¼	14	16⅜	14¼	9	8	12¾	1006

## Packaging and Installation



Boom pendants are normally prepared for shipment in two basic packages: coils and reels. Although each basic package requires certain specific handling procedures, there are a number of general precautions to be followed which are common to both.

Method of packaging is determined by WW, unless otherwise specified by the customer. Strand or rope pendants, 1" through 3" diameters with a maximum length of 100 feet are furnished in coils strapped to pallets. When shipped on reels, pendants are packaged two pieces per nonreturnable wooden reel.

### General

(1) During unpackaging of pendants in the field, lifting slings should be attached to the socket end attachments. If it is necessary to lift on the body of the assembly, either a nylon sling or a wire rope sling should be used. If a wire rope sling is used, cover the pendant with some protective material such as a piece of belting, a section of rubber tire, or the like. The purpose of this precaution is to prevent damage to the zinc coating or possible nicking of the outer wires of the pendant.

(2) When lifting on the body of the pendant, exercise care so the radius of curvature of the pendant at the point of lift is large enough to minimize wire displacement. A bridle sling with a three-to four-foot spreader should be used.

**Never lift with a single hitch on the pendant.**

(3) Do not pull pendants over sharp edges or short bend radii during handling. This may result in permanent damage to the arrangement and surface of the wires. Particular care must be taken to insure that nothing is done during handling to nick the outer wires. WW recommends that wooden planks or timbers be used when the pendant is being laid out prior to installation or storage to prevent the pendant from contacting the ground.

(4) During manufacturing, a longitudinal stripe is placed along the entire length of the pendant. During installation, it is of the utmost importance that this stripe be kept in a straight line and not spiralled around the rope or strand.

(5) Following installation and periodically thereafter, lubricate the pendants at the base of each socket for a minimum distance of three feet. If the socket does not have a relubrication tube, apply a suitable lubricant with a brush or pressurized spray can.

### Coils

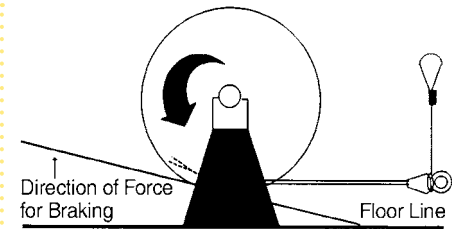
(1) If the pendant is small enough to be uncoiled by hand, one man must hold the socket on the leading end. The second man should roll the coil along a level and obstacle-free surface away from the first man. In this way, the pendant is permitted to uncoil naturally without spiralling or twisting. Do not uncoil pendants like a garden hose, where the coil is laid on the ground and one end is carried away from the coil. This method can easily damage the pendant.

(2) If a turntable is used, and this is recommended for large diameter pendants shipped in coils, a drag-type braking device should be used to prevent the swift speed from exceeding the pulling speed so kinking or looping of the pendant does not happen. Attach the pulling device to the socket on the leading end.

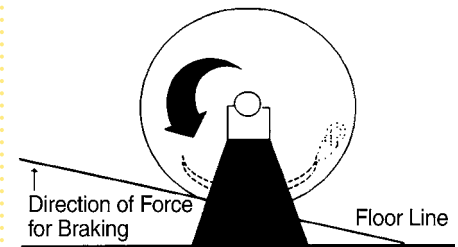
### Reels

(1) Place the shaft through the center hole in the reel and jack up the reel so it clears the ground and revolves properly.

(2) Use a simple timber brake or other mechanical friction brake against the reel flange or flanges to prevent slack from developing. Caution must be used to prevent "run-away" unreeling caused by the heavy socket placement on the reel.



(3) Position the reel so that the socket tagged "Front End" (tag stapled to reel flange) is **as close** to the bottom of the reel as practical, and remove this socket from the reel first.

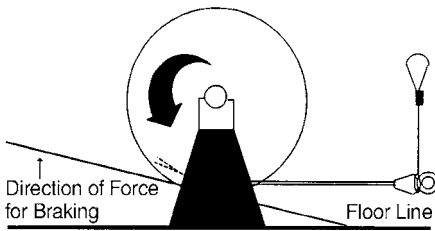


(4) Unwind the pendant from the reel, as shown **above**, by pulling the free end away from the reel. We recommend that the pulling hitch or sling be attached to the socket. However, if the sling is attached to the pendant, exercise care so a kink or dog leg does not develop at the base of the socket and the wires are not nicked or damaged. Keep the longitudinal stripe aligned.

WW "blocks-out" an area of the reel for positioning and securing the socket during shipping. Be careful when removing the end fittings from this "blocked-out" section.

(continued on next page)

## Packaging and Installation



- (5) During unwinding from the reel, pull the pendant in a straight line, avoiding sharp edges or objects on the ground.
- (6) After the pendant has been nearly unwound from the reel, remove the socket tagged "Rear End" (tag stapled to reel flange).
- (7) If more than one pendant is packaged on the reel, remove lengths in the order in which they are tagged, and proceed as above.

### The Right Way to Recoil:

After wire rope has been used, it should be recoiled in the direction of its lay. It is not difficult to determine when wire rope is being coiled in the wrong direction; it becomes lively and hard to manage. This does not happen when rope is coiled properly. **Here is a good general rule: looking down at the rope on the floor, coil right lay rope clockwise (overwind), and left lay rope counterclockwise (underwind).**

### Kinks

Great emphasis has been placed on the care that should be taken to avoid kinks in wire rope and strand. Kinks are places where the rope or strand has been bent to a permanent set. This happens where loops have been pulled through by tension on the rope or strand until the diameter of the loop is relatively small. Kinks are also caused by bending rope or strand around a sheave having too small of a radius. Wires in the kink are so bent that they are permanently damaged and will not give normal service, even after apparent restraightening. **A kink is forever.**

### Inspection and Maintenance

Inspection and maintenance consists of three components: (1) determining frequency of inspection and maintenance, (2) inspection and evaluation of rope conditions, and (3) maintenance. Conduct rope and strand pendant in-

spection on a regular basis, preferably coinciding with normal maintenance schedules. It is equally important to keep accurate records. Complete, accurate records help in analyzing existing problems and avoiding future problems.

The following components should be included in this inspection:

#### End Fittings

Check for excessive or nonuniform zinc cone seating and any visual abnormalities. During this inspection, those fittings with a relubrication tube should be greased. If the socket does not have a relubrication tube, apply a suitable lubricant with a brush or pressurized spray can for a distance of several feet from the base of the socket.

#### Vibration Damping Systems

All bolts on the socket flange and the clamp should be tightened using a torque wrench. A torque of 150 foot-pounds is recommended for the 3/4" diameter bolts and 100 foot-pounds for the 5/8" diameter bolts.

If any bolts are broken, they should be replaced with bolts of the same specification as originally furnished. The bolts on the dampers are heavy hex head galvanized grade A325 or galvanized hex head cap screws SAE Grade 5. Socket base bolts are modified to meet 100,000/125,000 psi tensile strength.

Grease should be applied through the alemite fittings on the damper flange. A grease such as Lubriplate 630 AAA or equivalent is recommended. When the damper was assembled at the mill, grease was pumped into the reservoir area where the strand enters the socket. The amount of grease to be replaced can be determined visually.

At six-month intervals, one of the dampers should be removed for examination of the strand that is under the clamp. The fabric belting was saturated with Gulf Harmony Oil No. 47, a light lubricant, prior to assembly and should be resaturated with light oil if it is dry. Soak belting in Harmony Oil No. 47, or equivalent, for a minimum of one hour. Apply belting around the strand so it protrudes beyond the nose of the damper 1/4" to 3/8". The split in the belting is to be positioned 45° to the bolted split of the damper housing. Wire belting in position with .048" galvanized wire at three positions prior to

setting the damper halves (remove wire before attaching damper halves). Snug socket base bolts first, then snug damper side bolts, torquing all bolts as outlined above. Depending on the results of this inspection, other dampers should be removed for examination and servicing.

At approximately one-half of the pendant's expected service life, remove all damper clamps and store for future use. Removal of the clamps transfers the damping fatigue point to new, unaffected areas and will help in extending service life. Removing the clamps also allows for easy and proper x-ray inspection of critical pendant areas.

#### Pendant Spacers

Check for tightness of nuts and bolts to prevent movement of spacers on the pendants. Refer to the OEM for the proper location of spacers.

**Never use wooden spacers made from oak.** Tannic acid forms when oak becomes wet, which may cause displacement of the zinc-coating on the wires, eventually leading to fretting and corrosion of the contact areas.

#### Pendants

Check rope and strand pendants for wire breakage and diameter reduction throughout their lengths. Special attention should be directed to the socket entrance and pendant spacers.

The number of visual broken wires alone is not a totally reliable criteria for evaluating the overall condition of the pendant; WW's analysis of pendants removed from service has shown the presence of internal wire breakage. Length of service, number and rate of breaks, location of breaks, rouging and the general condition of pendants is very important in evaluating overall condition.

A sudden increase of visible broken wires indicates the overall condition of the pendant is deteriorating at an accelerated rate and may be just cause for removal.

For further information regarding rope and strand pendant replacement criteria, refer to Wire Rope Users Manual and the appropriate OEM recommendations.

## Standard Product List



### 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

### Oil Field 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, and 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 and 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

WW manufactures a complete line of Bethlehem Wire Rope up to 7" diameter and structural strand products up to 6" diameter, as well as various wire products. Contact WW's customer service department for further information on these and other products.

## Bethlehem Wire Rope Service Centers

<b>California:</b>	Compton
<b>Illinois:</b>	Chicago
<b>Indiana:</b>	Boonville
<b>Oklahoma:</b>	Oklahoma City
<b>Oklahoma:</b>	Woodward
<b>Missouri:</b>	St. Louis
<b>Pennsylvania:</b>	Williamsport
<b>Texas:</b>	Houston
<b>Texas:</b>	Odessa
<b>Washington:</b>	Seattle



understand  
treat the best  
make easy

**Our**

**Service**

**Pledge**

respond

provide

assist solutions

follow-up

satisfy

relationship

hear needs

- **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.**



**Wire Rope Works, Inc.**



**Bethlehem Mining Rope®**  
manufactured by **Wirerope Works, Inc.**



# **Wirerope Works, Inc.**



Manufacturer of  
**Bethlehem Wire Rope®**

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1-800-541-7673 Inside the U.S.  
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