



# Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes<sup>1</sup>

This standard is issued under the fixed designation A1023/A1023M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers the general requirements for the more common types of stranded steel wire ropes. Included in this specification are wire ropes in various grades and constructions from ¼ in. [6 mm] to 2⅝ in. [60 mm] manufactured from uncoated or metallic coated wire. Also included are cord products from ⅓<sub>32</sub> in. [0.8 mm] to ⅜ in. [10 mm] manufactured from metallic coated wire. For specific applications, additional or alternative requirements may apply.

1.2 The values stated in either inch-pounds or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

A931 Test Method for Tension Testing of Wire Ropes and Strand

A1007 Specification for Carbon Steel Wire for Wire Rope

2.2 *ISO Standards*:<sup>3</sup>

ISO 2232 Round Drawn Wire for General-Purpose Non-alloy Steel Wire Ropes

ISO 3108 Steel Wire Ropes for General Purposes—Determination of Actual Breaking

## 3. Terminology

### Description of Terms Specific to this Specification

3.1 *inserts*, *n*—fiber or solid polymer so positioned as to separate adjacent strands or wires in the same or overlying layers or to fill interstices of the rope.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.03 on Steel Rod and Wire.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from International Organization for Standardization (ISO), 1 rue de Varembe, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

### 3.2 Lubrication:

3.2.1 *impregnating compound*, *n*—material used in the manufacture of natural fiber cores, covers, or inserts for the purpose of providing protection against rotting and decay of the fiber material.

3.2.2 *preservation compound*, *n*—material, usually containing some form of blocking agent, applied during, after, or both during and after manufacture of the rope to fiber inserts, fillers, and coverings for the purpose of providing protection against corrosion.

3.2.3 *rope lubricant*, *n*—general term used to signify material applied during the manufacture of a strand, core, or rope for the purpose of reducing internal friction, providing protection against corrosion, or both.

3.3 *rope cores*, *n*—central element, usually of fiber or steel (but may be a combination of both), of a round rope around which are laid helically the strands of a stranded rope or the unit ropes of a cable-laid rope (Fig. 1).

3.3.1 *fiber core (FC)*, *n*—an element made from either natural or synthetic fibers.

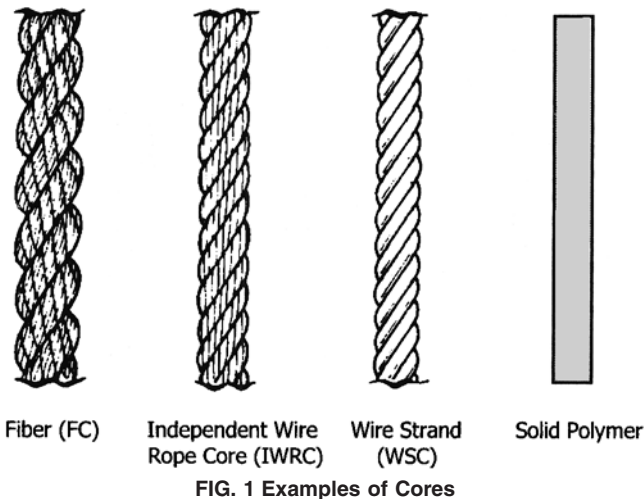
3.3.2 *solid polymer core*, *n*—a single element of solid polymer material that is either cylindrical or shaped (grooved). It may also include an element or elements of wire or fiber.

3.3.3 *steel core*, *n*—a stranded rope (IWRC), or a round strand (WSC) construction. The round strand or the stranded rope core or its outer strands, or both, may also be covered or filled with either fiber or solid polymer. Steel cores are normally made as a separate independent element, the exception being rope with a stranded rope core closed parallel with the outer strands.

3.4 *strand*, *n*—an element of rope normally consisting of an assembly of wires of appropriate shape and dimensions laid helically in one or more layers around a center. The center may consist of one round or shaped wire, of several round wires forming a built-up center, or of fiber or some other material. If multiple wires are used in a strand center, they may be counted as one wire.

### 3.4.1 Cross-Section Shape:

3.4.1.1 *compacted strand*, *n*—a strand that has been subjected to a compacting process such as drawing, rolling, or swaging (Fig. 2).



(d) *Warrington (W)*, *adj*—describes a construction having outer (Warrington) layer containing alternately large and small wires and twice the number of wires as the inner layer. Warrington layers are designated by listing the number of large and small wires with a + sign in between and bracketing ( ) the layer, for example, (6+6) (Fig. 6d).

NOTE 1—Strand construction is designated by listing the number of wires, beginning with the outer wires, with each layer separated by a hyphen.

3.4.3.3 *single lay, n*—strand that contains only one layer of wires.

3.5 *stranded wire rope, n*—an assembly of strands laid helically in one or more layers around a core. Exceptions are stranded wire ropes consisting of three or four outer strands that may or may not be laid around a core. Elements of stranded wire rope are shown in Fig. 7.

### 3.6 Wires:

3.6.1 *finish and quality of coating, n*—the condition of the surface finish of the wire, that is, uncoated or metallic coated (zinc or zinc alloy).

3.6.1.1 *metallic coated wire, n*—carbon steel wire that has a metallic coating.

(a) *drawn-galvanized wire, n*—coated carbon steel wire with a zinc coating applied prior to the final wire drawing operation, that is, galvanized in process.

(b) *drawn-Zn5/Al-MM wire, n*—coated carbon steel wire with a zinc-aluminum alloy (mischmetal) coating applied prior to the final wire drawing operation.

(c) *final-coated Zn5/Al-MM wire, n*—coated carbon steel wire with a zinc-aluminum alloy (mischmetal) coating applied after the final wire drawing operation.

(d) *final-galvanized wire, n*—coated carbon steel wire with a zinc coating applied after the final wire drawing operation, that is, galvanized at finished size.

3.6.1.2 *uncoated wire, n*—carbon steel wire that does not have a metallic coating. Commonly referred to as bright wire.

### 3.6.2 Function:

3.6.2.1 *filler wires, n*—comparatively small wires used in certain constructions of parallel lay ropes to create the necessary number of interstices for supporting the next layer of covering wires.

3.6.2.2 *load-bearing wires (main wires), n*—those wires in a rope that are considered as contributing toward the breaking force of the rope.

3.6.2.3 *non-load-bearing wires, n*—those wires in a rope that are considered as not contributing toward the breaking force of the rope.

3.6.2.4 *seizing (serving) wires or strands, n*—single wires or strands used for making a close-wound helical serving to retain the elements of a rope in their assembled position.

3.6.3 *layer of wires, n*—an assembly of wires having one pitch diameter. The exception is a Warrington layer comprising large and small wires where the smaller wires are positioned on a larger pitch circle than the larger wires. The first layer of wires is that which is laid over the strand center. Filler wires do not constitute a separate layer.

### 3.6.4 Position:

3.4.1.2 *round strand, n*—strand having a perpendicular cross-section that is approximately the shape of a circle (Fig. 3).

3.4.1.3 *triangular strand, n*—strand having a perpendicular cross-section that is approximately the shape of a triangle (formerly referred to as flattened strand) (Fig. 4).

(a) Style B—Solid center wire.

(b) Style G—3×2 or 3×2+3F center.

(c) Style H—3 or 3+3F center.

(d) Style V—1×7 center.

3.4.2 *strand lay direction, n*—the direction right (z) or left (s) corresponding to the direction of lay of the outer wires in relation to the longitudinal axis of the strand (Fig. 5).

### 3.4.3 Type and Constructions:

3.4.3.1 *multiple operation lay, n*—construction containing at least two layers of wires in which successive layers are laid in more than one operation, with different lay lengths. There are two basic types of multiple operation strand:

(a) *compound lay, n*—strand that contains a minimum of three layers of wires where a minimum of one layer is laid in a separate operation, but in the same direction, over a parallel lay center.

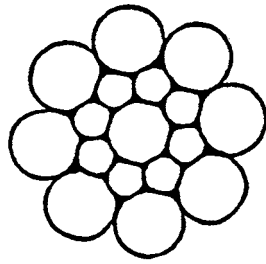
(b) *cross-lay, n*—strand in which the wires are laid in the same direction. The wires of superimposed wire layers cross one another and make point contact.

3.4.3.2 *parallel lay, n*—strand that contains at least two layers of wires, all of which are laid in one operation (in the same direction). The lay length of all the wire layers is equal, and the wires of any two superimposed layers are parallel to each other, resulting in linear contact. There are four types of parallel lay constructions:

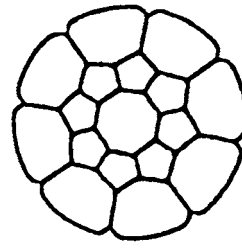
(a) *combined, adj*—describes a parallel lay construction having three or more layers laid in one operation and formed from a combination of the above, for example, Warrington-Seale construction (Fig. 6a).

(b) *filler (F)*, *adj*—describes a construction having outer layer containing twice the number of wires than the inner layer, with filler wires laid in the interstices between the layers. Filler wires are designated with the letter “F” (Fig. 6b).

(c) *Seale (S)*, *adj*—describes a construction having same number of wires in each layer, for example, 9-9-1 (Fig. 6c).



Strand Before Compacting



Strand After Compacting

FIG. 2 Compacted Round Strand—Before and After

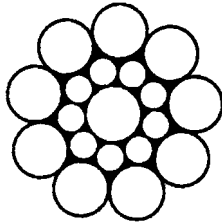


FIG. 3 Round Strand

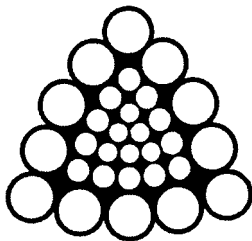


FIG. 4 Triangular Strand

## Dimensional Characteristics

### 3.7 Diameter of Rope:

3.7.1 *diameter of plastic-coated rope, n*—the diameter that circumscribes the overall rope cross-section including the cover followed by the diameter, which circumscribes the underlying rope (for example,  $\frac{3}{4} \times \frac{5}{8}$  in.).

3.7.2 *diameter of round rope, n*—the diameter ( $d$ ) that circumscribes the rope cross-section. Diameter is expressed in inches or millimeters (Fig. 8).

### 3.8 Lay Length:

3.8.1 *rope lay length, n*—that distance measured parallel to the longitudinal rope axis in which the outer strands of a stranded rope or the component ropes of a cable-laid rope make one complete turn (or helix) about the axis of the rope (Fig. 9).

3.8.2 *strand lay length, n*—that distance measured parallel to the longitudinal strand axis, in which the wire in the strand makes one complete turn (or helix) about the axis of the strand. The lay length of a strand is that corresponding to the outer layers of wires (Fig. 9).

## Manufacture (Rope)

### 3.9 Preformation:

3.9.1 *non-preformed rope, n*—rope in which the wires and strands in the rope will, after removal of any seizing (serving), spring out of the rope formation.

3.9.2 *preformed rope, n*—rope in which the wires and strands in the rope will not, after removal of any seizing (serving), spring out of the rope formation.

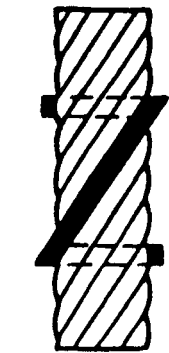
3.10 *prestretching, n*—the name given to a process that results in the removal of a limited amount of constructional stretch.

## Mechanical Properties

### 3.11 Rope:

3.11.1 *actual (measured) breaking force, n*—breaking force obtained using the prescribed test method in Test Method A931 or ISO 3108.

3.11.2 *calculated breaking force, n*—value of breaking force obtained from the sum of the measured breaking forces of the wires in the rope, before rope making, multiplied by the measured spinning loss factor as determined by the rope manufacturer's design.



Right Lay (z)



Left Lay (s)

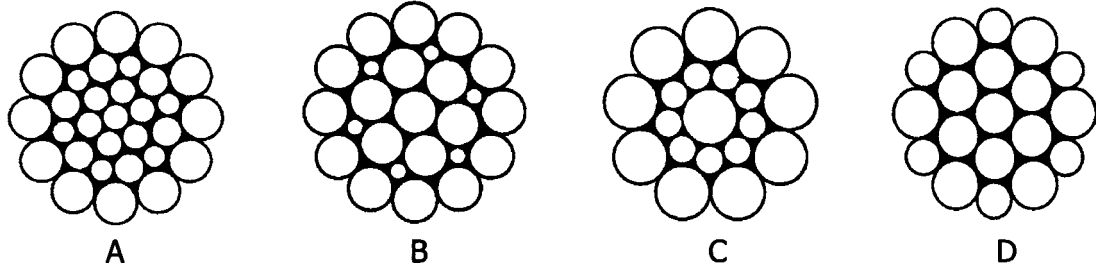
FIG. 5 Lay Direction of Strands for Stranded Ropes

3.6.4.1 *center wires, n*—wires positioned at the center of a strand of a stranded rope.

3.6.4.2 *core wires, n*—all wires comprising the core of a stranded rope.

3.6.4.3 *inner wires, n*—all wires except center, filler, core, and outer wires in a stranded rope.

3.6.4.4 *outer wires, n*—all wires in the outer layer of the outer strands of a stranded rope.



A—Example of Combined Parallel Lay ex. 31WS, 12-(6+6)-6-1  
B—Filler Construction ex. 25F, 12-6F-6-1  
C—Seale Construction ex. 19S, 9-9-1  
D—Warrington Construction ex. 19W, (6+6)-6-1

FIG. 6 Parallel Lay Constructions

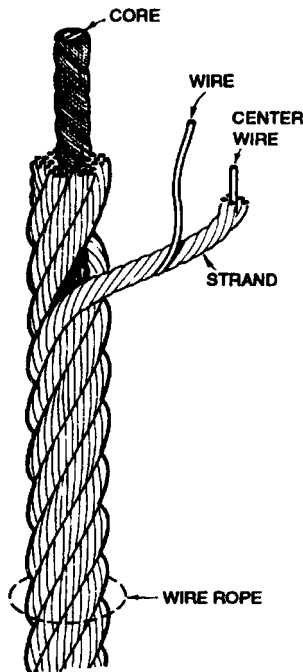


FIG. 7 Elements of Stranded Wire Rope

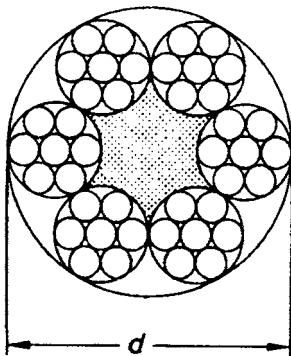


FIG. 8 Diameter of Round Rope

### 3.12 Rope Stretch (Extension):

3.12.1 *constructional stretch (extension)*,  $n$ —amount of extension that is attributed to the initial bedding down of wires within the strands and the strands within the rope due to loading. Initial extension cannot be determined by calculation.

3.12.2 *elastic stretch (extension)*,  $n$ —amount of recoverable extension that follows Hooke's law within certain limits due to application of a load.

3.12.3 *permanent stretch (extension)*,  $n$ —non-elastic extension.

### 3.13 Wire:

3.13.1 *torsions*,  $n$ —a measure of wire ductility normally expressed as the number of 360° revolutions that a wire can withstand before breakage occurs, using a prescribed test method. Torsion requirements are based on the wire diameter and either the wire level, as specified in Specification A1007, or the tensile strength grade, as specified in ISO 2232.

3.13.2 *wire tensile strength*,  $n$ —ratio between the maximum force obtained in a tensile test and the nominal cross-sectional area of the test piece. Requirements for wire tensile strength are determined by either the wire level, as specified in Specification A1007, or by the tensile strength grade, as specified in ISO 2232.

3.13.2.1 *tensile strength grade*,  $n$ —a level of requirement for tensile strength based on the SI system of units. It is designated by a value according to the lower limit of tensile strength and is used when specifying wire. Values are expressed in N/mm<sup>2</sup> (for example, 1960).

3.13.2.2 *wire level*,  $n$ —a level of requirement for tensile strength based on the inch-pound system of units (for example, Level 3).

## Terminology Relating to Ropes

### 3.14 Rope Classification and Construction:

3.14.1 *rope classification*,  $n$ —a grouping of ropes of similar characteristics on the basis of, for stranded ropes, the number of strands and their shape, the number of strand layers, the number of wires in one strand, the number of outer wires in one strand, and the number of wire layers in one strand. For classification details, refer to Table 2.

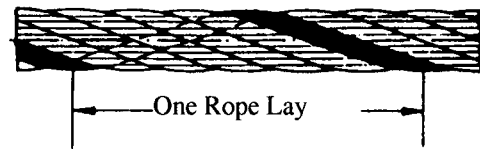
3.14.2 *rope construction*,  $n$ —detail and arrangement of the various elements of the rope, taking into account the number of strands, and the number of wires in the strand. For construction details, refer to Tables 7-32.

3.11.3 *measured spinning loss factor*,  $n$ —ratio between the measured breaking force of the rope and the sum of the measured breaking forces of the wires, before rope making.

3.11.4 *minimum breaking force*,  $n$ —specified value that the actual (measured) breaking force must meet or exceed in a prescribed test.



Strand Lay Length



Rope Lay Length

FIG. 9 Lay Lengths

TABLE 1 Wire Tensile Strength Grades or Levels for Given Rope Grades

Rope Grade	Wire Tensile Strength Grade or Level	
	Minimum	Maximum
IPS	Level 2 / 1570	Level 4 / 1960
EIP	Level 3 / 1770	Level 5 / 2160
EEIP	Level 4 / 1960	Level 5 / 2160
1770	1570 / Level 2	1960 / Level 4
1960	1770 / Level 3	2160 / Level 5
2160	1960 / Level 4	2160 / Level 5

TABLE 2 Classification

Classification	Table		Diameter (in.)	Diameter [mm]
	SC	FC		
3x7 CORD	7		1/32	0.8
7x7 CORD	7		3/64 – 3/8	1.2–9.5
7x19 CORD	7		3/64 – 3/8	1.2–9.5
6x7	8	9	1/4 – 1 1/2	6–36
6x19	10	11	1/4 – 3 1/2	6–88.9
6x36	12	13	1/4 – 3 1/2	6–88.9
7x19	14		1/4 – 2 3/8	6–60
7x36	15		1/4 – 2 3/8	6–60
8x19	16		1/4 – 2 3/8	6–60
8x36	17		1/4 – 2 3/8	8–60
8x19 SR	18		1/4 – 1 1/2	6.3–38.1
19x7	19		1/4 – 1 3/4	6–44.5
34x7	20		1/4 – 1 5/8	6.3–41.3
35x7	21		3/8 – 1 5/8	9–40
6x12		22	5/16 – 1	7.9–25.4
6x24		23	3/8 – 2 1/16	9.5–51
6x25 TS	25	24	3/8 – 2 3/4	9.5–69.8
6x19 CS	26		3/8 – 2 1/4	10–56
6x36 CS	27		3/8 – 2 1/4	10–56
6x19 SW	28		1/2 – 1 1/2	12.7–38.1
6x36 SW	29		1/2 – 1 1/2	12.7–38.1
19x7 CS	30		1/4 – 1	6–24
19x19	31		3/8 – 1 5/8	10–40
35x7 CS	32		7/16 – 1 5/8	10–40

Designation key:

SR = spin resistant

TS = triangular strand

CS = compacted strand

SW = swaged rope

CORD = small diameter specialty wire rope

SC = steel core

FC = fiber core

TABLE 3 Tolerances on Rope Diameter (Stranded Rope) (Inch-Pound Units)

Nominal Rope Diameter (d), in.	Diameter Tolerances as a Percentage of Nominal Diameter
thru 1/8	-0, +8 %
over 1/8 thru 3/16	-0, +7 %
over 3/16 thru 5/16	-0, +6 %
over 5/16 and larger <sup>A</sup>	-0, +5 %

<sup>A</sup> 6x12 and 6x24 classifications -0, +7 % (Tables 22 and 23)

TABLE 4 Tolerances on Rope Diameter (Stranded Rope) [SI Units]

Nominal Rope Diameter (d), [mm]	Diameter Tolerances as a Percentage of Nominal Diameter
from 2 to <4	-0, +8 %
from 4 to <6	-0, +7 %
from 6 to <8	-0, +6 %
8 and greater	-0, +5 %

TABLE 5 Permissible Differences in Rope Diameter (Inch-Pound Units)

Nominal Rope Diameter (d), in.	Percentage Allowable Difference (%)
1/8 and smaller	7
over 1/8 thru 3/16	6
over 3/16 thru 5/16	5
over 5/16 and larger	4

TABLE 6 Permissible Differences in Rope Diameter [SI Units]

Nominal Rope Diameter (d), [mm]	Percentage Allowable Difference (%)
from 2 to <4	7
from 4 to <6	6
from 6 to <8	5
8 and greater	4

Rope grade does not imply that the actual tensile strength of the wires in the rope is necessarily of this grade.

### 3.16 Rope Lay:

3.16.1 *lay direction of rope, n*—the direction right (Z) or left (S) corresponding to the direction of lay of the outer strands in a stranded rope or the unit ropes in a cable laid rope in relation to the longitudinal axis of the rope.

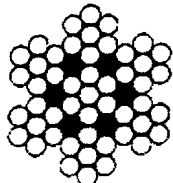
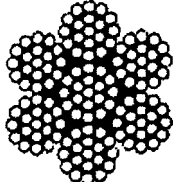
### 3.16.2 Lay Types:

3.16.2.1 *alternate lay, adj*—describes stranded rope in which the type of lay of the outer strands is alternately regular (ordinary) lay followed by lang lay such that half of the outer strands are regular (ordinary) lay and the other half are lang





TABLE 7 Classification 7×7 and 7×19 Small Diameter (Galvanized) Specialty Cord

Cross Section Examples		Construction of Rope		Construction of Strand							
		Item	Quantity	Item	Quantity						
	Strands <sup>A</sup>		7	Wires	7 or 19						
	Outer Strands		6	Outer Wires	6 or 12						
	Layer of Strands		2	Layer of Wires	1 or 2						
	Wires in Rope <sup>A</sup> (excluding core strand)		42 or 114								
7×7											
	Typical Examples		Number of Outer Wires								
	Rope	Strand	Total	Per Strand							
	3×7	1–6	18	6							
	7×7	1–6	36	6							
7×19	1–6/12	72	12								
7×19											
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>		Diameter Range					
in.	[mm]	7×7		7×19		7×7		7×19		Min. in.	Max. in.
		lb/100 ft	[kg/30.5 m]	lb/100 ft	[kg/30.5 m]	lbs	[kN]	lbs	[kN]		
1/32 <sup>A</sup>	0.79	0.16	0.07			110	0.49			0.031	0.037
3/64	1.19	0.42	0.19			270	1.2			0.047	0.055
1/16	1.59	0.75	0.34	0.75	0.34	480	2.1	480	2.1	0.063	0.073
5/64	1.98	1.1	0.50			650	2.9			0.078	0.089
3/32	2.38	1.6	0.73	1.7	0.77	920	4.1	1000	4.4	0.094	0.106
7/64	2.78	2.2	1.0			1260	5.6			0.109	0.122
1/8	3.18	2.8	1.3	2.9	1.3	1700	7.6	2000	8.9	0.125	0.139
5/32	3.97	4.3	2.0	4.5	2.0	2600	11.6	2800	12.5	0.156	0.172
3/16	4.76	6.2	2.8	6.5	3.0	3700	16.5	4200	18.7	0.188	0.206
7/32	5.56	8.3	3.8	8.6	3.9	4800	21.4	5600	24.9	0.219	0.237
1/4	6.35	10.6	4.8	11.0	5.0	6100	27.1	7000	31.1	0.250	0.268
9/32	7.14	13.4	6.1	13.9	6.3	7600	33.8	8000	35.6	0.281	0.301
5/16	7.94	16.7	7.6	17.3	7.9	9200	40.9	9800	43.6	0.313	0.335
11/32	8.73	20.1	9.1	20.7	9.4	11 100	49.4	12 500	55.6	0.344	0.368
3/8	9.53	23.6	10.7	24.3	11.0	13 100	58.3	14 400	64.1	0.375	0.401

<sup>A</sup> 1/32 construction is 3×7.

lay. The lay direction of the rope will be either right (AZ) or left (AS). Alternate lay can also be supplied with two lang lay strands followed by one regular (ordinary) lay strand in a repeating pattern.

3.16.2.2 *contra-lay, adj*—describes rope in which at least one layer of strands is laid in the opposite direction to the other layers.

3.16.2.3 *lang lay, adj*—describes stranded rope in which the direction of lay of the wires in the outer strands is the same direction as that of the outer wires in the rope (Fig. 10).

3.16.2.4 *regular (ordinary), adj*—describes stranded rope in which the direction of lay of the wires in the outer strands is in the opposite direction to the lay of the outer strands in the rope.

3.16.2.5 *Discussion*—The lower case letter denotes strand direction; the upper case letter denotes rope direction.

### 3.17 Rope Types:

3.17.1 *cable-laid rope, n*—an assembly of several (usually six) round stranded ropes laid helically over a core (usually a seventh rope). Requirements for cable-laid rope are not covered in this standard.

3.17.2 Ropes incorporating filling and covering materials:

3.17.2.1 *cushioned rope, n*—rope in which the inner layers, inner strands or core strands are covered with solid polymers or fibers to form a cushion between adjacent strands or overlying layers.

3.17.2.2 *plastic-coated core rope, n*—rope in which the core is covered, or filled and covered, with a solid polymer.

3.17.2.3 *plastic-coated rope, n*—rope in which the exterior surface is coated (covered) with a solid polymer.

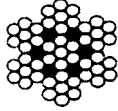
3.17.2.4 *plastic-filled rope, n*—rope in which the free spaces up to the diameter of the rope are filled with a solid polymer.

3.17.3 *rotation-resistant rope, n*—stranded ropes designed to generate reduced levels of torque and rotation when loaded and comprising an assembly of two or more layers of strands laid helically around a center, the direction of lay of the outer strands being opposite to that of the underlying layer. There are three categories of rotation-resistant rope:

3.17.3.1 *category 1, adj*—describes stranded rope constructed in such a manner that it displays little or no tendency to rotate, or, if guided, transmits little or no torque, has at least fifteen outer strands and comprises an assembly of at least three layers of strands laid helically over a center in two operations,



TABLE 8 Classification 6x7 Steel Core

Cross Section Examples				Construction of Rope			Construction of Strand				
				Item		Quantity	Item		Quantity		
 6x7 SC				Strands		6	Wires		5 to 9		
				Outer Strands		6	Outer Wires		4 to 8		
				Layer of Strands		1	Layer of Wires		1		
				Wires in Rope		30 to 54					
				Typical Examples			Number of Outer Wires				
Diameter		Approx. Mass		Rope 6x7	Strand 1–6		Total 36	Per Strand 6			
				Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	Min. in.	Max. in.		
1/4	6	0.10	0.144	2.84	22.9	3.12	25.3	0.236	0.250		
		0.11	0.161					0.250	0.265		
5/16	7	0.13	0.196	4.41	31.1	4.85	34.5	0.276	0.292		
		0.17	0.252					0.313	0.331		
3/8	8	0.17	0.256	6.30	40.7	6.93	45.0	0.315	0.331		
	9	0.22	0.324		51.5		57.0	0.354	0.372		
	10	0.24	0.363		63.5		6.93	0.375	0.394		
		0.27	0.400					70.4	0.394	0.413	
7/16	11	0.33	0.484	8.52	76.9	9.37	85.1	0.433	0.455		
	12	0.33	0.494		91.5		9.37	0.438	0.459		
		0.39	0.576					101	0.472	0.496	
1/2	13	0.43	0.645	11.1	107	12.2	119	0.500	0.525		
		0.45	0.676					125	138	0.512	0.537
9/16	14	0.53	0.784	14.0	125	15.4	138	0.551	0.579		
	0.55	0.817	15.4					0.563	0.591		
5/8	16	0.68	1.008	17.1	163	18.8	180	0.625	0.656		
		0.69	1.024					0.630	0.661		
3/4	18	0.87	1.296	24.4	206	26.8	228	0.709	0.744		
	19	0.97	1.444		229		254	0.748	0.785		
	20	0.98	1.452		254		26.8	0.750	0.788		
		1.08	1.600					281	0.787	0.827	
7/8	22	1.30	1.936	33.0	308	36.3	341	0.866	0.909		
	1.33	1.976	366		405		0.875	0.919			
1	24	1.55	2.304	42.7	366	47.0	405	0.945	0.992		
	1.73	2.581	476					552	1.000	1.050	
1 1/8	26	1.82	2.704	53.5	430	58.9	476	1.024	1.075		
	28	2.11	3.136					498	552	1.102	1.157
1 1/4	32	2.19	3.266	65.6	651	72.2	721	1.125	1.181		
		2.71	4.032					1.250	1.313		
1 3/8	36	2.75	4.096	78.6	824	86.5	912	1.260	1.323		
		3.28	4.879					1.375	1.444		
1 1/2	36	3.48	5.184	92.7	824	102	912	1.417	1.488		
		3.90	5.806					1.500	1.575		

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

the direction of lay of the outer strands being opposite to that of the underlying layer.

3.17.3.2 *category 2, adj*—stranded rope constructed in such a manner that it has significant resistance to rotation, has at least ten outer strands, and comprises an assembly of two or more layers of strands laid helically over a center in two or three operations, the direction of lay of the outer strands being opposite to that of the underlying layer.

3.17.3.3 *category 3, adj*—stranded rope constructed in such a manner that it has limited resistance to rotation, has no more than nine outer strands, and comprises an assembly of two layers of strands laid helically over a center in two operations, the direction of lay of the outer strands being opposite to that of the underlying layer.

3.17.3.4 *Discussion*—Rotation resistant ropes have previously been referred to as multi-strand and non-rotating ropes.

3.17.3.5 *Discussion*—Ropes having three or four strands can also be designed to exhibit rotational resistant properties.

### 3.17.4 Stranded Rope Types:

3.17.4.1 *compacted strand rope, n*—rope in which the strands, prior to closing of the rope, are subjected to a compacting process such as drawing, rolling, or swaging.

3.17.4.2 *multi-layer, adj*—describes an assembly of two or more layers of strands laid helically around a core, the direction of the lay of the outer strands being opposite (that is, contra-lay) to that of the underlying layer.

3.17.4.3 *single layer, adj*—describes rope consisting of one layer of strands laid helically around a core.

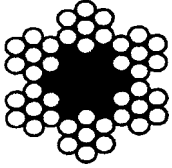
3.17.4.4 *swaged (compacted) rope, n*—rope that is subjected to a compacting process after closing the rope, thus reducing its diameter.

### Values

3.18 *actual (measured) value, n*—value derived from direct measurement in a prescribed manner.



TABLE 9 Classification 6×7 Fiber Core

Cross Section Examples				Construction of Rope			Construction of Strand		
				Item		Quantity	Item		Quantity
				Strands		6	Wires		5 to 9
				Outer Strands		6	Outer Wires		4 to 8
				Layer of Strands		1	Layer of Wires		1
				Wires in Rope		30 to 54			
				Typical Examples			Number of Outer Wires		
				Rope	Strand	Total	Per Strand		
				6×7	1–6	36	6		
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>				Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS	1770	EIP	1960	Min.	Max.
				Tons	[kN]	Tons	[kN]	in.	in.
1/4	6	0.08	0.124	2.64	21.2	2.90	23.4	0.236	0.248
		0.09	0.139				0.250	0.263	
5/16	7	0.11	0.169	4.10	28.8	4.51	31.9	0.276	0.289
		0.15	0.217				0.313	0.328	
	8	0.15	0.221		37.6		41.6	0.315	0.331
		0.19	0.279				47.6	0.354	0.372
3/8	9	0.21	0.313	5.86		6.45		0.375	0.394
		0.23	0.345		58.8		65.1	0.394	0.413
	11	0.28	0.417		71.1		78.7	0.433	0.455
		0.29	0.426	7.93		8.72		0.438	0.459
7/16	12	0.33	0.497		84.6		93.7	0.472	0.496
		0.37	0.556	10.3		11.3		0.500	0.525
	13	0.39	0.583		99.3		110	0.512	0.537
		0.45	0.676		115		128	0.551	0.579
9/16	14	0.47	0.704	13.0		14.3		0.563	0.591
		0.58	0.869	15.9				0.625	0.656
5/8	16	0.59	0.883		150		167	0.630	0.661
		0.75	1.118		190		211	0.709	0.744
	18	0.84	1.245		212		235	0.748	0.785
		0.84	1.252	22.7		25.0		0.750	0.788
3/4	20	0.93	1.380		235		260	0.787	0.827
		1.12	1.670		284		315	0.866	0.909
7/8	22	1.15	1.704	30.7		33.8		0.875	0.919
		1.34	1.987		338		375	0.945	0.992
1	24	1.50	2.226	39.7		43.7		1.000	1.050
		1.57	2.332		397		440	1.024	1.075
	26	1.82	2.705		461		510	1.102	1.157
		1.89	2.817	49.8		54.8		1.125	1.181
1 1/8		2.34	3.478	61.0		67.1		1.250	1.313
1 1/4	32	2.37	3.533		602		666	1.260	1.323
		2.83	4.208	73.1		80.4		1.375	1.444
1 3/8	36	3.00	4.471		762		843	1.417	1.488
		3.37	5.008	86.2		94.8		1.500	1.575

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.  
 Note—To convert to kilonewtons (kN), multiply tons by 8.896.

3.19 *maximum value, n*—specified value that an actual value must not exceed.

3.20 *minimum value, n*—specified value that an actual value must meet or exceed.

3.21 *nominal value, n*—the conventional value by which a physical characteristic is designated.

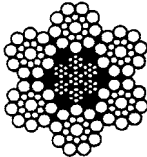
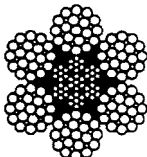
#### 4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:





TABLE 10 Classification 6x19 Steel Core

Cross Section Examples				Construction of Rope				Construction of Strand				
				Item		Quantity		Item		Quantity		
	Strands			6			Wires			15 to 26		
	Outer Strands			6			Outer Wires			7 to 12		
	Layer of Strands			1			Layer of Wires			2 to 3		
	Wires in Rope			90 to 156								
6x19 Seale IWRC					Typical Examples				Number of Outer Wires			
				Rope		Strand		Total		Per Strand		
	6x19S			1-9-9				54		9		
	6x21F			1-5-5F-10				60		10		
	6x26WS			1-5-(5+5)-10				60		10		
	6x19W			1-6-(6+6)				72		12		
	6x25F			1-6-6F-12				72		12		

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.10	0.153		22.7		25.1		27.7	0.236	0.250
		0.12	0.172	2.94		3.40				0.250	0.265
5/16	7	0.14	0.209		30.9		34.2		37.7	0.276	0.292
		0.18	0.268	4.58		5.27				0.313	0.331
3/8	8	0.18	0.273		40.3		44.7		49.2	0.315	0.331
		0.23	0.345		51.0		56.5		62.3	0.354	0.372
3/8	9	0.26	0.386	6.56		7.55		8.30		0.375	0.394
		0.29	0.426		63.0		69.8		76.9	0.394	0.413
7/16	10	0.35	0.515		76.2		84.4		93.0	0.433	0.455
		0.35	0.526	8.89		10.2		11.2		0.438	0.459
1/2	12	0.41	0.613		90.7		100		111	0.472	0.496
		0.46	0.687	11.5		13.3		14.6		0.500	0.525
1/2	13	0.48	0.720		106		118		130	0.512	0.537
		0.56	0.835		124		137		151	0.551	0.579
9/16	14	0.58	0.870	14.5		16.8		18.5		0.563	0.591
		0.72	1.074	17.7		20.6		22.7		0.625	0.656
5/8	16	0.73	1.091		161		179		197	0.630	0.661
		0.93	1.380		204		226		249	0.709	0.744
5/8	18	1.03	1.538		227		252		278	0.748	0.785
		1.04	1.546	25.6		29.4		32.4		0.750	0.788
3/4	20	1.15	1.704		252		279		308	0.787	0.827
		1.39	2.062		305		338		372	0.866	0.909
7/8	22	1.41	2.104	34.6		39.8		43.8		0.875	0.919
		1.65	2.454		363		402		443	0.945	0.992
1	24	1.85	2.748	44.9		51.7		56.9		1.000	1.050
		1.94	2.880		426		472		520	1.024	1.075
1	26	2.24	3.340		494		547		603	1.102	1.157
		2.34	3.478	56.5		65.0		71.5		1.125	1.181
1 1/8	32	2.89	4.294	69.4		79.9		87.9		1.250	1.313
		2.93	4.362		645		715		787	1.260	1.323
1 3/8	34	3.49	5.196	83.5		96.0		106		1.375	1.444
		3.71	5.521		817		904		997	1.417	1.488
1 1/2	36	4.16	6.184	98.9		114		125		1.500	1.575
		4.58	6.816		1008		1116		1230	1.575	1.654
1 5/8	40	4.88	7.257	115		132		146		1.625	1.706
		5.54	8.247		1220		1351		1489	1.732	1.819
1 3/4	44	5.66	8.417	133		153		169		1.750	1.838
		6.49	9.662	152		174		192		1.875	1.969
1 7/8	48	6.60	9.815		1452		1608		1772	1.890	1.984
		7.39	10.994	172		198		217		2.000	2.100
2	52	7.74	11.519		1704		1887		2079	2.047	2.150
		8.34	12.411	192		221		243		2.125	2.231
2 1/8	56	8.98	13.359		1976		2188		2411	2.205	2.315
		9.35	13.914	215		247		272		2.250	2.363
2 1/4	60	10.31	15.336		2268		2512		2768	2.362	2.480
		10.42	15.503	239		274		301		2.375	2.494
2 3/8	64	11.6	17.261	262		302		332		2.500	2.625
		12.8	19.046	288		331		364		2.625	2.756
2 3/4	72	14.0	20.832	314		361		397		2.750	2.888
		15.3	22.766	341		392		432		2.875	3.019

TABLE 10 *Continued*

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
3		16.6	24.701	370		425		438		3.000	3.150
3 <sup>1</sup> / <sub>8</sub>		18.1	26.933	399		458		504		3.125	3.281
3 <sup>1</sup> / <sub>4</sub>		19.5	29.016	429		492		543		3.250	3.413
3 <sup>3</sup> / <sub>8</sub>		21.0	31.248	459		529		582		3.375	3.544
3 <sup>1</sup> / <sub>2</sub>		22.7	33.778	491		564		621		3.500	3.675

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

Item	Examples	
	inch-pound	[SI]
Length	500 ft	175 m
Size (diameter)	<sup>3</sup> / <sub>4</sub> in.	16 mm
Rope classification or construction (if known)	6×36	6×36
Preformed or non-preformed	Preformed	Preformed
Lay direction and type	Right regular	sZ
Wire finish (uncoated or metallic coated and type)	uncoated	drawn-galvanized
Rope Grade	EIP	1960
Core Type	FC (fiber)	SC
Applicable specification	ASTM A1023	ASTM A1023
Special requirements		
Termination of rope ends		
Special length tolerance		
Type of certificate		
Special packaging and identification		
Lubrication, other than as noted in 5.3		
Prestretching		

## 4.2 Certification of Conformance and Test:

4.2.1 A certificate of conformance and test shall confirm compliance with this standard. It shall contain the following information items:

- 4.2.1.1 Certificate number,
- 4.2.1.2 Purchaser's name and address,
- 4.2.1.3 Purchaser's order number,
- 4.2.1.4 Rope supplier's name and address,
- 4.2.1.5 Supplier's order number,
- 4.2.1.6 Number traceable to manufacturer's production length,
- 4.2.1.7 Nominal length(s) of rope,
- 4.2.1.8 Rope designation (nominal diameter, construction and core, lay and grade), and
- 4.2.1.9 Minimum breaking force in tons (short tons) or kilonewtons.

4.2.2 *Tests on Wires and Rope*—If wire tests are required, indicate if the wire samples are taken before the rope fabrication or if they are taken from a completed rope. The following additional information can be supplied under agreement between purchaser and supplier. These items shall be completed as agreed between the supplier and the purchaser.

- 4.2.2.1 Quality system registration number of the rope manufacturer, if applicable;
- 4.2.2.2 Approximate mass in lb/ft [kg/m];
- 4.2.2.3 Wire standard used;
- 4.2.2.4 Number of wires tested;
- 4.2.2.5 Nominal dimensions of wire;
- 4.2.2.6 Measured dimensions of wire;

4.2.2.7 Breaking force of wire;

4.2.2.8 Tensile strength of wire;

4.2.2.9 Number of torsions completed (and test length);

4.2.2.10 Mass of zinc (or zinc alloy);

4.2.2.11 Actual (measured) diameter of rope; and

4.2.2.12 Actual (measured) breaking force of rope.

## 4.2.3 Additional Information and Certification:

4.2.3.1 Space for additional information, and

4.2.3.2 Space for certification with provision for certifying the foregoing, name and position held, signature, and date.

## 5. Material

5.1 *Wire*—The wires used in rope making shall comply with the appropriate requirements of Specification A1007 or ISO 2232. The manufacturer, subject to the limits in Table 1, shall determine the tensile strength grade so that the minimum breaking force of the rope is achieved.

5.1.1 Wire tensile limitations in Table 1 do not apply to center, filler, and core wires.

5.1.2 Wire tensile limitations do not apply to compacted ropes, or compacted strand ropes.

5.1.3 The manufacturer shall have the option to adopt a single wire level or tensile strength grade throughout the rope, or decide on a combination of wire levels or tensile strength grades.

5.1.4 Wire diameters shall be selected by the manufacturer in accordance with applicable wire rope design requirements.

5.2 *Core*—Cores of stranded ropes shall normally be either steel or fiber composition.

5.2.1 *Fiber Core*—All fiber cores shall be natural fiber (for example, sisal), polypropylene, or other suitable synthetic fiber. The cores shall be of uniform hardness, effectively supporting the strands. Natural fiber cores shall be treated with an impregnating compound free from acid. Fiber cores larger than <sup>5</sup>/<sub>32</sub>-in. (4 mm) diameter shall be doubly closed.

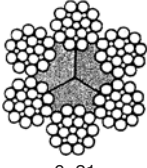
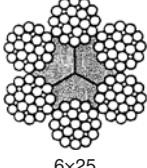
5.2.2 *Steel Core*—Steel main cores shall be either an independent wire rope (IWRC) or a wire strand (WSC). Steel cores of single layer ropes larger than <sup>7</sup>/<sub>16</sub>-in. (12 mm) diameter shall be independent wire ropes (IWRC), unless specified otherwise. Steel cores shall be lubricated. Cores closed in one operation (parallel lay) with the outer strands of the rope may be specified by agreement between the supplier and the purchaser.

5.3 *Lubricant*—All wire rope, unless otherwise specified, shall be lubricated and impregnated in the manufacturing process with a suitable lubricant selected by the manufacturer.



# A1023/A1023M – 15

**TABLE 11 Classification 6×19 Fiber Core**

Cross Section Examples	Construction of Rope		Construction of Strand	
	Item	Quantity	Item	Quantity
 6×21 fiber wire FC	Strands	6	Wires	15 to 26
	Outer Strands	6	Outer Wires	7 to 12
	Layer of Strands	1	Layer of Wires	2 to 3
	Wires in Rope	90 to 156		
 6×25 fiber wire FC	Typical Examples		Number of Outer Wires	
	Rope	Strand	Total	Per Strand
	6×19S	1–9–9	54	9
	6×21F	1–5–5F–10	60	10
	6×26WS	1–5–(5+5)–10	60	10
	6×19W	1–6–(6+6)	72	12
	6×25F	1–6–6F–12	72	12

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.09	0.140		21.0		23.3		25.7	0.236	0.250
		0.11	0.156	2.74		3.01				0.250	0.265
5/16	7	0.13	0.190		28.6		31.7		34.9	0.276	0.292
		0.16	0.244	4.26		4.69				0.313	0.331
3/8	8	0.17	0.248		37.4		41.4		45.6	0.315	0.331
		0.21	0.314		47.3		52.4		57.7	0.354	0.372
7/16	10	0.24	0.352	6.10		6.71		7.38		0.375	0.394
		0.26	0.388		58.4		64.7		71.3	0.394	0.413
1/2	11	0.32	0.469		70.7		78.3		86.2	0.433	0.455
		0.32	0.479	8.27		9.10		10.0		0.438	0.459
5/8	12	0.38	0.559		84.1		93.1		103	0.472	0.496
		0.42	0.626	10.7		11.8		12.9		0.500	0.525
3/4	13	0.44	0.656		98.7		109		120	0.512	0.537
		0.51	0.760		114		127		140	0.551	0.579
7/8	14	0.53	0.792	13.5		14.9		16.3		0.563	0.591
		0.66	0.978	16.7		18.4		20.2		0.625	0.656
1	16	0.67	0.993		150		166		182	0.630	0.661
		0.84	1.257		189		210		231	0.709	0.744
1 1/8	18	0.94	1.401		211		233		257	0.748	0.785
		0.95	1.408	23.8		26.2		28.8		0.750	0.788
1 1/4	20	1.04	1.552		234		259		285	0.787	0.827
		1.26	1.878		283		313		345	0.866	0.909
1 1/2	22	1.29	1.917	32.2		35.4		39.0		0.875	0.919
		1.50	2.235		336		373		411	0.945	0.992
1 3/4	24	1.68	2.503	41.8		46.0		50.6		1.000	1.050
		1.76	2.623		395		437		482	1.024	1.075
1 7/8	26	2.04	3.042		458		507		559	1.102	1.157
		2.13	3.168	52.6		57.9		63.6		1.125	1.181
2	28	2.63	3.911	64.6		71.1		78.2		1.250	1.313
		2.67	3.973		598		662		730	1.260	1.323
2 1/8	32	3.18	4.733	77.7		85.5		94.0		1.375	1.444
		3.38	5.028		757		838		924	1.417	1.488
2 1/4	36	3.78	5.632	92.0		101		111		1.500	1.575
		4.17	6.208		935		1035		1140	1.575	1.654
2 3/8	40	4.44	6.610	107		118		129		1.625	1.706
		5.05	7.512		1131		1252		1380	1.732	1.819
2 1/2	44	5.15	7.666	124		136		150		1.750	1.838
		5.91	8.800	141		155		171		1.875	1.969
2 5/8	48	6.01	8.940		1346		1490		1642	1.890	1.984
		6.73	10.013	160		176		194		2.000	2.100
2 3/4	52	7.05	10.492		1579		1749		1927	2.047	2.150
		7.60	11.304	179		197		217		2.125	2.231
2 7/8	56	8.18	12.168		1832		2028		2235	2.205	2.315
		8.52	12.673	200		220		242		2.250	2.363
3	60	9.39	13.968		2103		2328		2566	2.362	2.480
		9.49	14.120	222		244		269		2.375	2.494
3 1/8		10.5	15.624	244		269		295		2.500	2.625

TABLE 11 *Continued*

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
2 <sup>5</sup> / <sub>16</sub>		11.6	17.261	268		294		324		2.625	2.756
2 <sup>3</sup> / <sub>4</sub>		12.7	18.898	292		321		353		2.750	2.888
2 <sup>7</sup> / <sub>8</sub>		13.9	20.683	317		349		384		2.875	3.019
3		15.1	22.469	344		378		416		3.000	3.150
3 <sup>1</sup> / <sub>8</sub>		16.4	24.403	371		408		448		3.125	3.281
3 <sup>1</sup> / <sub>4</sub>		17.7	26.338	399		438		483		3.250	3.413
3 <sup>3</sup> / <sub>8</sub>		19.1	28.421	427		470		518		3.375	3.544
3 <sup>1</sup> / <sub>2</sub>		20.6	30.653	457		503		552		3.500	3.675

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

Stranding lubricants used for fiber core ropes shall be compatible with the impregnating compound of the fiber core.

## 6. Rope Properties and Tolerances

6.1 *Classification*—The rope classification shall be specified by the purchaser and shall normally be one of those covered in **Table 2** although other classifications and constructions are available by agreement between the supplier and purchaser.

NOTE 2—Where only the rope classification is specified by the purchaser, the manufacturer shall determine the construction.

6.2 *Rope Core*—Steel core (SC) shall be supplied unless otherwise specified. The manufacturer shall determine core construction. Cores with inserts or solid polymer cores are subject to agreement between the supplier and purchaser.

6.3 *Rope Grade*—The rope grade shall be one of the following although other grades are available by agreement between the supplier and purchaser.

6.3.1 The listed rope grades for the following inch-pound units are shown in the indicated tables:

6.3.1.1 *IPS*—**Tables 8-19, Tables 22-25**

6.3.1.2 *EIP*—**Tables 8-19, Tables 24-31**

6.3.1.3 *EEIP*—**Tables 10-18, Tables 24-27, Tables 30 and 31**

6.3.2 Rope Grades for the following SI units are shown in the indicated tables:

6.3.2.1 *1770*—**Tables 8-17, Tables 19-21**

6.3.2.2 *1960*—**Tables 8-17, Tables 19-21, Tables 26 and 27, Tables 30-32**

6.3.2.3 *2160*—**Tables 10-17, Table 21, Tables 26 and 27, Tables 30-32**

6.4 *Wire Finish*—Unless otherwise specified, wire ropes will be furnished with uncoated wires. For wire ropes requested with metallic coated wires, unless specified other than zinc or zinc alloys in the purchase order, wires shall be galvanized in accordance with Specification **A1007** for A1023 wire rope; for A1023M wire rope, wires shall be galvanized in accordance with ISO 2332.

6.4.1 Final-galvanized rope shall be supplied with minimum breaking forces 10 % lower than those listed in **Tables 7-32**, except for **Tables 19 and 20**.

6.5 *Direction and Type of Rope Lay*—The direction and type of rope lay shall be as specified by the purchaser and shall be one of the following:

Right regular (ordinary) lay (sZ)

Left regular (ordinary) lay (zS)

Right lang lay (ZZ)

Left lang lay (sS)

Right alternate lay (AZ)

Left alternate lay (AS)

Right regular (ordinary) lay will be supplied for six, seven, and eight-strand constructions unless otherwise specified by the purchaser.

### 6.6 Dimensions:

6.6.1 *Rope Diameter*—The nominal diameter shall be as specified by the purchaser and shall be the dimension by which the rope is designated.

6.6.1.1 *Tolerance on Rope Diameter*—When measured in accordance with **8.6.1**, the actual diameter shall not vary from the nominal diameter by more than the tolerances specified in **Table 3** or **Table 4**. For small diameter specialty cord with diameters from <sup>1</sup>/<sub>32</sub> in. [0.8 mm] to <sup>3</sup>/<sub>8</sub> in. [10 mm] inclusive, diameter tolerances shall be as specified in **Table 7**.

6.6.1.2 *Permissible Differences in Diameter*—The difference between any two of the four measurements taken in accordance with **8.6.1**, and expressed as a percentage of the nominal diameter, shall not exceed the values given in **Table 5** or **Table 6**.

### 6.6.2 Lay Length:

6.6.2.1 For single layer ropes of 6×7 class, the lay length of the finish rope shall not exceed eight times the nominal rope diameter.

6.6.2.2 For other single layer ropes with round strands, except for 3 or 4 strand ropes, and multi-layer ropes with round or shaped strands, the length of lay of the finished rope shall not exceed 7.25 times the nominal rope diameter.

6.6.2.3 For single layer ropes with shaped strands, for example, flattened (triangular) strand, the length of lay of the finished rope shall not exceed ten times the nominal rope diameter.

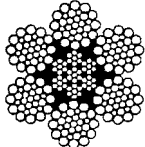
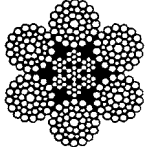
### 6.7 Mechanical Properties:

6.7.1 *Breaking Force*—Values for minimum breaking force for the more common classes of rope are specified in **Tables 7-32** of this standard.

6.7.1.1 The minimum breaking force for other classes and constructions not covered by the tables, shall be agreed upon by the manufacturer and the purchaser.



TABLE 12 Classification 6x36 Steel Core

Cross Section Examples	Construction of Rope		Construction of Strand	
	Item	Quantity	Item	Quantity
	Strands	6	Wires	27 to 49
	Outer Strands	6	Outer Wires	12 to 18
	Layer of Strands	1	Layer of Wires	3 to 4
	Wires in Rope (excluding steel core)	156 to 276		
	Typical Examples		Number of Outer Wires	
	Rope	Strand	Total	Per Strand
	6x31WS	1-6-(6+6)-12	72	12
	6x36WS	1-7-(7+7)-14	84	14
6x41 Warrington Seale IWRC	6x41WS	1-8-(8+8)-16	96	16
	6x41SF	1-8-8-8F-16	96	16
	6x49SWS	1-8-8-(8+8)-16	96	16
	6x46WS	1-9-(9+9)-18	108	18

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.10	0.153		22.7		25.1		27.7	0.236	0.250
		0.12	0.172	2.94		3.40				0.250	0.265
5/16	7	0.14	0.209		30.9		34.2		37.7	0.276	0.292
		0.18	0.268	4.58		5.27				0.313	0.331
3/8	8	0.18	0.273		40.3		44.7		49.2	0.315	0.331
		0.23	0.345		51.0		56.5		62.3	0.354	0.372
7/16	9	0.26	0.386	6.56		7.55		8.30		0.375	0.394
		0.29	0.426		63.0		69.8		76.9	0.394	0.413
1/2	10	0.35	0.515		76.2		84.4		93.0	0.433	0.455
		0.35	0.526	8.89		10.2		11.2		0.438	0.459
5/8	11	0.41	0.613		90.7		100		111	0.472	0.496
		0.46	0.687	11.5		13.3		14.6		0.500	0.525
3/4	12	0.48	0.720		106		118		130	0.512	0.537
		0.56	0.835		124		137		151	0.551	0.579
7/8	13	0.58	0.870	14.5		16.8		18.5		0.563	0.591
		0.72	1.074	17.7		20.6		22.7		0.625	0.656
1	16	0.73	1.091		161		179		197	0.630	0.661
		0.93	1.380		204		226		249	0.709	0.744
1 1/8	18	1.03	1.538		227		252		278	0.748	0.785
		1.04	1.546	25.6		29.4		32.4		0.750	0.788
1 1/4	20	1.15	1.704		252		279		308	0.787	0.827
		1.39	2.062		305		338		372	0.866	0.909
1 1/2	22	1.41	2.104	34.6		39.8		43.8		0.875	0.919
		1.65	2.454		363		402		443	0.945	0.992
1 3/4	24	1.85	2.748	44.9		51.7		56.9		1.000	1.050
		1.94	2.880		426		472		520	1.024	1.075
1 7/8	26	2.24	3.340		494		547		603	1.102	1.157
		2.34	3.478	56.5		65.0		71.5		1.125	1.181
2	28	2.89	4.294	69.4		79.9		87.9		1.250	1.313
		2.93	4.362		645		715		787	1.260	1.323
2 1/8	32	3.49	5.196	83.5		96.0		106		1.375	1.444
		3.71	5.521		817		904		997	1.417	1.488
2 1/4	36	4.16	6.184	98.9		114		125		1.500	1.575
		4.58	6.816		1008		1116		1230	1.575	1.654
2 3/8	40	4.88	7.257	115		132		146		1.625	1.706
		5.54	8.247		1220		1351		1489	1.732	1.819
2 1/2	44	5.66	8.417	133		153		169		1.750	1.838
		6.49	9.662	152		174		192		1.875	1.969
2 5/8	48	6.60	9.815		1452		1608		1772	1.890	1.984
		7.39	10.994	172		198		217		2.000	2.100
2 7/8	52	7.74	11.519		1704		1887		2079	2.047	2.150
		8.34	12.411	192		221		243		2.125	2.231
3	56	8.98	13.359		1976		2188		2411	2.205	2.315
		9.35	13.914	215		247		272		2.250	2.363
3 1/8	60	10.31	15.336		2268		2512		2768	2.362	2.480
		10.42	15.503	239		274		301		2.375	2.494
3 1/4		11.6	17.261	262		302		332		2.500	2.625



TABLE 12 *Continued*

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
2 <sup>5</sup> / <sub>8</sub>		12.8	19.046	288		331		364		2.625	2.756
2 <sup>3</sup> / <sub>4</sub>		14.0	20.832	314		361		397		2.750	2.888
2 <sup>7</sup> / <sub>8</sub>		15.3	22.766	341		392		432		2.875	3.019
3		16.6	24.701	370		425		438		3.000	3.150
3 <sup>1</sup> / <sub>8</sub>		18.1	26.933	399		458		504		3.125	3.281
3 <sup>1</sup> / <sub>4</sub>		19.5	29.016	429		492		543		3.250	3.413
3 <sup>3</sup> / <sub>8</sub>		21.0	31.248	459		529		582		3.375	3.544
3 <sup>1</sup> / <sub>2</sub>		22.7	33.778	491		564		621		3.500	3.675

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

6.7.1.2 Wire ropes with minimum breaking forces less than those allowed in this specification may be accepted by prior agreement between the supplier and purchaser and shall be regarded as beyond the scope of this specification.

6.7.2 *Mass*—The (approximate) nominal rope mass shall be as given in **Tables 7-32** or as specified by the manufacturer.

6.7.3 *Length*—The actual length of rope supplied, expressed in feet or meters, shall be the specified length subject to the following limits of tolerance:

(a) Up to and including 1300 ft [400 m]: +5.0 % of specified length,

(b) Over 1300 ft up to 3280 ft [400 m to 1000 m]: +66 ft [20 m], and

(c) Over 3280 ft [1000 m]: +2.0 % of specified length.

NOTE 3—The rope shall be measured under no load. Ropes required with more restrictive length tolerance shall be agreed upon by the supplier and purchaser.

## 7. Rope Workmanship and Finish

### 7.1 *Strand*:

7.1.1 Strand wires shall be tight and uniform. All the wire layers in a strand shall have the same direction of lay. The lay lengths of corresponding wire layers in strands of the same size shall be uniform.

7.1.2 Center wires and fiber centers of strands shall be of a size to provide sufficient support to enable the covering wires to be evenly laid.

7.2 *Rope*—The rope shall be uniformly made and the strands shall lie tightly on the core or the underlying strands.

7.2.1 The core of a stranded rope, except for swaged (compacted) ropes, shall be designed so that in a new rope under no load there is clearance between the outer strands.

7.2.2 Rope ends that have no end fittings shall be so secured as to maintain the integrity of the rope and prevent its unraveling.

### 7.3 *Wire Joints*:

7.3.1 Wires over 0.015 in. [0.4 mm] in diameter shall have their ends joined by soldering, brazing, or welding.

7.3.2 Wires up to and including 0.015 in. [0.4 mm] diameter may be joined by soldering, brazing, welding, twisting, or by ends being simply inserted into the strand's formation.

7.3.3 The minimum distance between joints in a strand shall be 18 times the nominal rope diameter.

7.4 *Preformation*—Stranded ropes shall be preformed unless otherwise specified, except that multi-layer ropes, including rotation-resistant and low-rotation ropes, may be non-preformed.

7.5 *Prestretching*—Stranded ropes are not prestretched unless otherwise specified. When specified, ropes may be prestretched using either a process of static or dynamic loading. Prestretch loads shall not exceed 55 % of the minimum breaking force for the rope.

NOTE 4—Example of static prestretching practice: Rope is subjected to three cycles of tensile loading to 40 % of the ropes minimum breaking force for 5 min, returning to 5 % of the minimum breaking force between cycles. After the last cycle, the tensile load is completely released.

## 8. Testing and Compliance

### General

8.1 Wire ropes manufactured in accordance with this specification shall be capable of meeting all the appropriate requirements as specified in 8.2. The manufacturer shall be able to demonstrate compliance with this specification by either:

8.1.1 Testing each production length in accordance with **8.2**, or

8.1.2 Operating a quality assurance system that includes a sampling program that meets the following requirements as a minimum:

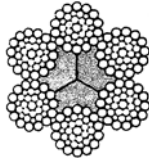
8.1.2.1 For each size and grade of a given rope construction, the manufacturer shall present evidence from testing, if requested by the purchaser, of a minimum of three production lengths representing the current design. The purpose of these tests is to assure the manufacturer's ability to produce a rope that conforms to the minimum requirements as defined in this specification. Periodic acceptance tests are successfully completed on a sample taken from a minimum of every twentieth production length.

8.1.2.2 Manufacturers complying with all requirements of **8.1.2** may use calculated breaking force to verify compliance with requirements for an individual production length not included in sample testing.

8.2 Any change in design requires that the tests specified in **8.1.2** be repeated on the modified rope. However, if the same design, apart from the wire tensile grades, is used for ropes of a lower grade than the one which has successfully passed the



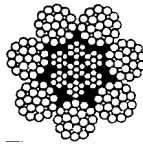
TABLE 13 Classification 6×36 Fiber Core

Cross Section Examples		Construction of Rope			Construction of Strand						
		Item		Quantity	Item		Quantity				
 6x36 Warrington Seale FC	Strands		6		Wires		27 to 49				
	Outer Strands		6		Outer Wires		12 to 18				
	Layer of Strands		1		Layer of Wires		3 to 4				
	Wires in Rope		156 to 276								
	Typical Examples			Number of Outer Wires							
	Rope		Strand		Total	Per Strand					
	6x31WS		1-6-(6+6)-12		72	12					
	6x36WS		1-7-(7+7)-14		84	14					
	6x41WS		1-8-(8+8)-16		96	16					
	6x41SF		1-8-8-8F-16		96	16					
6x49SWS		1-8-8-(8+8)-16		96	16						
6x46WS		1-9-(9+9)-18		108	18						
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>					Diameter Range		
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.09	0.140		21.0		23.3		25.7	0.236	0.250
		0.11	0.156	2.74		3.01				0.250	0.265
5/16	7	0.13	0.190		28.6		31.7		34.9	0.276	0.292
		0.16	0.244	4.26		4.69				0.313	0.331
3/8	8	0.17	0.248		37.4		41.4		45.6	0.315	0.331
	9	0.21	0.314		47.3		52.4		57.7	0.354	0.372
7/16		0.24	0.352	6.10		6.71		7.38		0.375	0.394
	10	0.26	0.388		58.4		64.7		71.3	0.394	0.413
1/2	11	0.32	0.469		70.7		78.3		86.2	0.433	0.455
		0.32	0.479	8.27		9.10		10.0		0.438	0.459
3/4	12	0.38	0.559		84.1		93.1		103	0.472	0.496
		0.42	0.626	10.7		11.8		12.9		0.500	0.525
5/8	13	0.44	0.656		98.7		109		120	0.512	0.537
	14	0.51	0.760		114		127		140	0.551	0.579
3/4		0.53	0.792	13.5		14.9		16.3		0.563	0.591
		0.66	0.978	16.7		18.4		20.2		0.625	0.656
7/8	16	0.67	0.993		150		166		182	0.630	0.661
	18	0.84	1.257		189		210		231	0.709	0.744
1	19	0.94	1.401		211		233		257	0.748	0.785
		0.95	1.408	23.8		26.2		28.8		0.750	0.788
1 1/8	20	1.04	1.552		234		259		285	0.787	0.827
	22	1.26	1.878		283		313		345	0.866	0.909
1 1/4		1.29	1.917	32.2		35.4		39.0		0.875	0.919
	24	1.50	2.235		336		373		411	0.945	0.992
1 1/2		1.68	2.503	41.8		46.0		50.6		1.000	1.050
	26	1.76	2.623		395		437		482	1.024	1.075
1 3/4	28	2.04	3.042		458		507		559	1.102	1.157
		2.13	3.168	52.6		57.9		63.6		1.125	1.181
1 7/8		2.63	3.911	64.6		71.1		78.2		1.250	1.313
	32	2.67	3.973		598		662		730	1.260	1.323
2		3.18	4.733	77.7		85.5		94.0		1.375	1.444
	36	3.38	5.028		757		838		924	1.417	1.488
2 1/2		3.78	5.632	92.0		101		111		1.500	1.575
	40	4.17	6.208		935		1035		1140	1.575	1.654
2 3/4		4.44	6.610	107		118		129		1.625	1.706
	44	5.05	7.512		1131		1252		1380	1.732	1.819
3		5.15	7.666	124		136		150		1.750	1.838
	48	5.91	8.800	141		155		171		1.875	1.969
3 1/4		6.01	8.940		1346		1490		1642	1.890	1.984
		6.73	10.013	160		176		194		2.000	2.100
3 1/2	52	7.05	10.492		1579		1749		1927	2.047	2.150
		7.60	11.304	179		197		217		2.125	2.231
3 3/4	56	8.18	12.168		1832		2028		2235	2.205	2.315
		8.52	12.673	200		220		242		2.250	2.363
4	60	9.39	13.968		2103		2328		2566	2.362	2.480
		9.49	14.120	222		244		269		2.375	2.494
4 1/4		10.5	15.624	244		269		295		2.500	2.625
		11.6	17.261	268		294		324		2.625	2.756
4 1/2	29/4	12.7	18.898	292		321		353		2.750	2.888
	27/8	13.9	20.683	317		349		384		2.875	3.019
4 3/4	3	15.1	22.469	344		378		416		3.000	3.150
	31/8	16.4	24.403	371		408		448		3.125	3.281
5	33/8	17.7	26.338	399		438		483		3.250	3.413
		19.1	28.421	427		470		518		3.375	3.544
5 1/2		20.6	30.653	457		503		552		3.500	3.675

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.



TABLE 14 Classification 7×19 Steel Core

Cross Section Examples		Construction of Rope				Construction of Strand					
		Item		Quantity		Item		Quantity			
 7x25 filler wire IWRC	Strands		7		Wires		15 to 26				
	Outer Strands		7		Outer Wires		7 to 12				
	Layer of Strands		1		Layer of Wires		2 to 3				
	Wires in Rope		105 to 182								
	Typical Examples				Number of Outer Wires						
	Rope		Strand		Total	Per Strand					
	7x19S		1-9-9		63	9					
	7x21F		1-5-5F-10		70	10					
	7x26WS		1-5-(5+5)-10		70	10					
	7x19W		1-6-(6+6)		84	12					
7x25F		1-6-6F-12		84	12						
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>						Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.11	0.157	2.94	22.7	3.40	25.1		27.7	0.236	0.250
		0.12	0.176							0.250	0.265
5/16	7	0.14	0.214	4.58	30.9	5.27	34.2		37.7	0.276	0.292
		0.19	0.275							0.313	0.331
3/8	8	0.19	0.280	6.56	40.3	7.55	44.7	8.30	49.2	0.315	0.331
		0.24	0.354		51.0		56.5		62.3	0.354	0.372
7/16	9	0.27	0.396	8.89	63.0	10.2	69.8	11.2	76.9	0.375	0.394
		0.36	0.529		76.2		84.4		93.0	0.394	0.413
1/2	10	0.36	0.540	11.5	90.7	13.3	100	14.6	111	0.438	0.459
		0.42	0.629							0.472	0.496
9/16	11	0.47	0.705	17.7	106	16.8	118	18.5	130	0.500	0.525
		0.50	0.739		124		137		151	0.512	0.537
5/8	13	0.58	0.857	25.6	14.5	20.6	16.8	22.7	18.5	0.551	0.579
		0.60	0.892							0.563	0.591
3/4	16	0.74	1.101	34.6	17.7	39.8	20.6	43.8	22.7	0.625	0.656
		0.75	1.119		161		179		197	0.630	0.661
7/8	18	0.95	1.416	44.9	204	51.7	226	56.9	249	0.709	0.744
		1.06	1.578		227		252		278	0.748	0.785
1	19	1.07	1.586	56.5	25.6	65.0	279	71.5	287	0.750	0.788
		1.17	1.748		252		338		372	0.787	0.827
1 1/8	20	1.42	2.115	69.4	305	79.9	338	87.9	372	0.866	0.909
		1.45	2.159		363		402		443	0.875	0.919
1 1/4	24	1.69	2.517	83.5	39.8	96.0	402	106	443	0.945	0.992
		1.89	2.819		44.9		472		520	1.000	1.050
1 1/2	26	1.99	2.954	98.9	426	114	472	125	520	1.024	1.075
		2.30	3.426		494		547		603	1.102	1.157
1 5/8	28	2.40	3.568	1008	56.5	132	65.0	146	71.5	1.125	1.181
		2.96	4.405		69.4		79.9		87.9	1.250	1.313
1 3/4	32	3.01	4.475	115	645	132	715	146	787	1.260	1.323
		3.58	5.330		83.5		904		997	1.375	1.444
1 7/8	36	3.81	5.664	1220	817	153	904	169	997	1.417	1.488
		4.26	6.344		98.9		1116		1230	1.500	1.575
2	40	4.70	6.992	1452	1008	174	1116	192	1230	1.575	1.654
		5.00	7.445		115		1351		1489	1.625	1.706
2 1/8	44	5.69	8.460	172	1220	198	1351	217	1489	1.732	1.819
		5.80	8.634		133		153		169	1.750	1.838
2 1/4	48	6.66	9.912	192	152	221	1608	243	1772	1.875	1.969
		6.77	10.068		1452		1608		1772	1.890	1.984
2 3/8	52	7.58	11.277	215	1704	247	1887	272	2079	2.000	2.100
		7.94	11.816		1704		1887		2079	2.047	2.150
2 1/2	56	8.56	12.731	2268	1976	274	2188	301	2411	2.125	2.231
		9.21	13.704		1976		2188		2411	2.205	2.315
2 5/8	60	9.59	14.273	239	2268		2512		2768	2.250	2.363
		10.57	15.732		2268		2512		2768	2.362	2.480
2 3/4		10.69	15.903							2.375	2.494

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

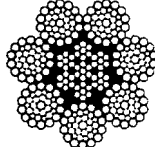
tests specified in 8.1.2, it shall not be necessary to repeat the tests on the lower grade rope(s).

8.3 For the purposes of this specification, a production length is regarded as that length of rope manufactured in one

continuous operation from one loading of the closing machine comprising strands, each of which has been produced in one continuous operation on the stranding machine. A production length may comprise one or more reels of rope.



TABLE 15 Classification 7×36 Steel Core

Cross Section Examples		Construction of Rope				Construction of Strand					
		Item		Quantity		Item		Quantity			
 7x36 Warrington Seale IWRC	Strands		7		Wires		27 to 49				
	Outer Strands		7		Outer Wires		12 to 18				
	Layer of Strands		1		Layer of Wires		3 to 4				
	Wires in Rope		189 to 343								
	Typical Examples				Number of Outer Wires						
	Rope		Strand		Total		Per Strand				
	7x31WS		1-6-(6+6)-12		84		12				
	7x36WS		1-7-(7+7)-14		98		14				
	7x41WS		1-8-(8+8)-16		112		16				
	7x41SF		1-8-8F-16		112		16				
7x49SWS		1-8-8-(8+8)-16		112		16					
7x46WS		1-9-(9+9)-18		126		18					
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>					Diameter Range		
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.11	0.157		22.7		25.1		27.7	0.236	0.250
		0.12	0.176	2.94		3.40				0.250	0.265
5/16	7	0.14	0.214		30.9		34.2		37.7	0.276	0.292
		0.19	0.275	4.58		5.27				0.313	0.331
3/8	8	0.19	0.280		40.3		44.7		49.2	0.315	0.331
	9	0.24	0.354		51.0		56.5		62.3	0.354	0.372
7/16		0.27	0.396	6.56		7.55		8.30		0.375	0.394
	10	0.29	0.437		63.0		69.8		76.9	0.394	0.413
1/2	11	0.36	0.529		76.2		84.4		93.0	0.433	0.455
		0.36	0.540	8.89		10.2		11.2		0.438	0.459
3/4	12	0.42	0.629		90.7		100		111	0.472	0.496
		0.47	0.705	11.5		13.3		14.6		0.500	0.525
5/8	13	0.50	0.739		106		118		130	0.512	0.537
	14	0.58	0.857		124		137		151	0.551	0.579
7/8		0.60	0.892	14.5		16.8		18.5		0.563	0.591
	16	0.74	1.101	17.7		20.6		22.7		0.625	0.656
1		0.75	1.119		161		179		197	0.630	0.661
	18	0.95	1.416		204		226		249	0.709	0.744
1 1/8	19	1.06	1.578		227		252		278	0.748	0.785
		1.07	1.586	25.6		29.4		32.4		0.750	0.788
1 1/4	20	1.17	1.748		252		279		308	0.787	0.827
	22	1.42	2.115		305		338		372	0.866	0.909
1 1/2		1.45	2.159	34.6		39.8		43.8		0.875	0.919
	24	1.69	2.517		363		402		443	0.945	0.992
1 3/8		1.89	2.819	44.9		51.7		56.9		1.000	1.050
	26	1.99	2.954		426		472		520	1.024	1.075
1 3/4	28	2.30	3.426		494		547		603	1.102	1.157
		2.40	3.568	56.5		65.0		71.5		1.125	1.181
1 7/8		2.96	4.405	69.4		79.9		87.9		1.250	1.313
	32	3.01	4.475		645		715		787	1.260	1.323
2		3.58	5.330	83.5		96.0		106		1.375	1.444
	36	3.81	5.664		817		904		997	1.417	1.488
2 1/8		4.26	6.344	98.9		114		125		1.500	1.575
	40	4.70	6.992		1008		1116		1230	1.575	1.654
2 1/4		5.00	7.445	115		132		146		1.625	1.706
	44	5.69	8.460		1220		1351		1489	1.732	1.819
2 3/8		5.80	8.634	133		153		169		1.750	1.838
	48	6.66	9.912	152		174		192		1.875	1.969
2 1/2		6.77	10.068		1452		1608		1772	1.890	1.984
	52	7.58	11.277	172		198		217		2.000	2.100
2 3/4		7.94	11.816		1704		1887		2079	2.047	2.150
	56	8.56	12.731	192		221		243		2.125	2.231
2 7/8		9.21	13.704		1976		2188		2411	2.205	2.315
	60	9.59	14.273	215		247		272		2.250	2.363
3		10.57	15.732		2268		2512		2768	2.362	2.480
		10.69	15.903	239		274		301		2.375	2.494

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

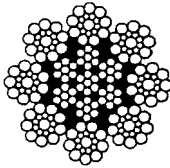
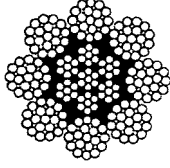
Note—To convert to kilonewtons (kN), multiply tons by 8.896.

NOTE 5—Examples of quality assurance systems are API Q1, ANSI/ ASQC Q9002 and ISO 9002.



# A1023/A1023M – 15

**TABLE 16 Classification 8×19 Steel Core**

Cross Section Examples		Construction of Rope				Construction of Strand					
		Item		Quantity	Item		Quantity				
	Strands		8		Wires		15 to 26				
	Outer Strands		8		Outer Wires		7 to 12				
	Layer of Strands		1		Layer of Wires		2 to 3				
	Wires in Rope (excluding steel core)		120 to 232								
	Typical Examples				Number of Outer Wires						
	Rope		Strand		Total	Per Strand					
	8x19S	1-9-9			72	9					
	8x21F	1-5-5F-10			80	10					
	8x26WS	1-5-(5+5)-10			80	10					
	8x19W	1-6-(6+6)			96	12					
	8x25F	1-6-6F-12			96	12					
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>					Diameter Range		
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.11	0.161	2.94	22.7	3.40	25.1		27.7	0.236	0.250
		0.12	0.180				0.250		0.265		
5/16	7	0.15	0.219	4.58	30.9	5.27	34.2		37.7	0.276	0.292
		0.19	0.281				0.313		0.331		
	8	0.19	0.285		40.3		44.7		49.2	0.315	0.331
		0.24	0.361		51.0		56.5		62.3	0.354	0.372
3/8	9	0.27	0.405	6.56		7.55		8.30		0.375	0.394
		0.30	0.446		63.0		69.8		76.9	0.394	0.413
7/16	11	0.36	0.540		76.2		84.4		93.0	0.433	0.455
		0.37	0.551				10.2			11.2	
	12	0.43	0.642	8.89	90.7	100		111	0.472		0.496
		0.48	0.719			13.3		14.6		0.500	0.525
1/2	13	0.51	0.754	11.5	106		118		130	0.512	0.537
		0.59	0.874		124		137		151	0.551	0.579
9/16	14	0.61	0.910	14.5		16.8		18.5		0.563	0.591
		0.76	1.124							0.625	0.656
5/8	16	0.77	1.142		161	20.6	179	22.7	197	0.630	0.661
		0.97	1.445		204		226		249	0.709	0.744
	18	1.08	1.610		227		252		278	0.748	0.785
		1.09	1.619				29.4			32.4	
3/4	20	1.20	1.784	25.6	252	279		308	0.787		0.827
		1.45	2.159		305		338		372	0.866	0.909
7/8	22	1.48	2.203	34.6		39.8		43.8		0.875	0.919
		1.73	2.569		363		402		443	0.945	0.992
1	24	1.93	2.877	44.9		51.7		56.9		1.000	1.050
		2.03	3.015		426		472		520	1.024	1.075
	28	2.35	3.497		494		547		603	1.102	1.157
		2.45	3.642				65.0			71.5	
1 1/8	30	3.02	4.496	69.4					87.9		
	32	3.07	4.567		645	79.9	715	87.9		787	1.260
1 3/8	36	3.66	5.440	83.5		96.0		106		1.375	1.444
		3.88	5.780		817		904		997	1.417	1.488
1 1/2	40	4.35	6.474	98.9		114		125		1.500	1.575
		4.80	7.136		1008		1116		1230	1.575	1.654
1 5/8	44	5.11	7.598	115		132		146		1.625	1.706
		5.80	8.635		1220		1351		1489	1.732	1.819
1 3/4	48	5.92	8.812	133		153		169		1.750	1.838
		6.80	10.116				174			192	
1 7/8	52	6.91	10.276	152	1452	1608		1772	1.890		1.984
		7.73	11.510	172		198		217		2.000	2.100
2	56	8.10	12.060		1704		1887		2079	2.047	2.150
2 1/8	60	8.73	12.993	192		221		243		2.125	2.231
		9.40	13.987		1976		2188		2411	2.205	2.315
2 1/4	64	9.79	14.567	215		247		272		2.250	2.363
		10.79	16.056		2268		2512		2768	2.362	2.480
2 3/8		10.91	16.230	239		274		301		2.375	2.494

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

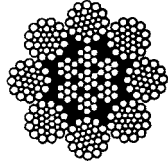
Note—To convert to kilonewtons (kN), multiply tons by 8.896.





# A1023/A1023M – 15

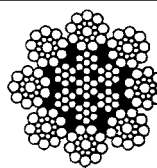
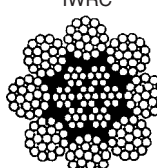
**TABLE 17 Classification 8x36 Steel Core**

Cross Section Examples		Construction of Rope				Construction of Strand					
		Item		Quantity		Item		Quantity			
 8x31 Warrington Seale IWRC	Strands		8		Wires		29 to 57				
	Outer Strands		8		Outer Wires		12 to 18				
	Layer of Strands		1		Layer of Wires		3 to 4				
	Wires in Rope (excluding steel core)		232 to 456								
	Typical Examples				Number of Outer Wires						
	Rope		Strand		Total		Per Strand				
	8x31WS		1-6-(6+6)-12		96		12				
	8x36WS		1-7-(7+7)-14		112		14				
	8x41WS		1-8-(8+8)-16		128		16				
	8x41SF		1-8-8-8F-16		128		16				
8x49SWS		1-8-8-(8+8)-16		128		16					
8x46WS		1-9-(9+9)-18		144		18					
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>					Diameter Range		
in.	[mm]	lb/ft	[kg/m]	IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.11	0.161		22.7		25.1		27.7	0.236	0.250
		0.12	0.180	2.94		3.40				0.250	0.265
5/16	7	0.15	0.219		30.9		34.2		37.7	0.276	0.292
		0.19	0.281	4.58		5.27				0.313	0.331
	8	0.19	0.285		40.3		44.7		49.2	0.315	0.331
		0.24	0.361		51.0		56.5		62.3	0.354	0.372
3/8	9	0.27	0.405	6.56		7.55		8.30		0.375	0.394
		0.30	0.446		63.0		69.8		76.9	0.394	0.413
	10	0.36	0.540		76.2		84.4		93.0	0.433	0.455
		0.37	0.551	8.89		10.2		11.2		0.438	0.459
7/16	12	0.43	0.642		90.7		100		111	0.472	0.496
		0.48	0.719	11.5		13.3		14.6		0.500	0.525
	13	0.51	0.754		106		118		130	0.512	0.537
		0.59	0.874		124		137		151	0.551	0.579
9/16	14	0.61	0.910	14.5		16.8		18.5		0.563	0.591
		0.76	1.124	17.7		20.6		22.7		0.625	0.656
5/8	16	0.77	1.142		161		179		197	0.630	0.661
		0.97	1.445		204		226		249	0.709	0.744
	18	1.08	1.610		227		252		278	0.748	0.785
		1.09	1.619	25.6		29.4		32.4		0.750	0.788
3/4	20	1.20	1.784		252		279		308	0.787	0.827
		1.45	2.159		305		338		372	0.866	0.909
7/8	22	1.48	2.203	34.6		39.8		43.8		0.875	0.919
		1.73	2.569		363		402		443	0.945	0.992
1	24	1.93	2.877	44.9		51.7		56.9		1.000	1.050
		2.03	3.015		426		472		520	1.024	1.075
	26	2.35	3.497		494		547		603	1.102	1.157
		2.45	3.642	56.5		65.0		71.5		1.125	1.181
1 1/8	32	3.02	4.496	69.4		79.9		87.9		1.250	1.313
		3.07	4.567		645		715		787	1.260	1.323
1 1/4	36	3.66	5.440	83.5		96.0		106		1.375	1.444
		3.88	5.780		817		904		997	1.417	1.488
1 1/2	40	4.35	6.474	98.9		114		125		1.500	1.575
		4.80	7.136		1008		1116		1230	1.575	1.654
1 5/8	44	5.11	7.598	115		132		146		1.625	1.706
		5.80	8.635		1220		1351		1489	1.732	1.819
1 3/4	48	5.92	8.812	133		153		169		1.750	1.838
		6.80	10.116	152		174		192		1.875	1.969
2	52	6.91	10.276		1452		1608		1772	1.890	1.984
		7.73	11.510	172		198		217		2.000	2.100
2 1/8	56	8.10	12.060		1704		1887		2079	2.047	2.150
		8.73	12.993	192		221		243		2.125	2.231
2 1/4	60	9.40	13.987		1976		2188		2411	2.205	2.315
		9.79	14.567	215		247		272		2.250	2.363
2 3/8		10.79	16.056		2268		2512		2768	2.362	2.480
		10.91	16.230	239		274		301		2.375	2.494

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

**TABLE 18 Classification 8×19 Rotation Resistant—Category 3**

Cross Section Examples	Construction of Rope		Construction of Strand	
	Item	Quantity	Item	Quantity
 8×19 Seale IWRC	Strands	8	Wires	15 to 26
	Outer Strands	8	Outer Wires	7 to 12
	Layer of Strands	1	Layer of Wires	2 to 3
	Wires in Rope (excluding steel core)	120 to 232		
 8×25 Filler Wire IWRC	Typical Examples		Number of Outer Wires	
	Rope	Strand	Total	Per Strand
	8×19S	1–9–9	72	9
	8×21F	1–5–5F–10	80	10
	8×26WS	1–5–(5+5)–10	80	10
	8×19W	1–6–(6+6)	96	12
	8×25F	1–6–6F–12	96	12

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>			Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	EIP Tons	EEIP Tons	Min. in.	Max. in.
1/4	6.3	0.12	0.178	2.6	3.0	3.3	0.250	0.265
5/16	7.9	0.18	0.268	4.0	4.6	5.1	0.313	0.331
3/8	9.5	0.26	0.387	5.8	6.6	7.3	0.375	0.394
7/16	11.1	0.36	0.536	7.8	9.0	9.9	0.438	0.459
1/2	12.7	0.47	0.700	10.1	11.6	12.8	0.500	0.525
9/16	14.3	0.60	0.886	12.8	14.7	16.2	0.563	0.591
5/8	15.9	0.74	1.094	15.7	18.1	19.9	0.625	0.656
3/4	19.1	1.06	1.575	22.5	25.9	28.5	0.750	0.788
7/8	22.2	1.44	2.144	30.5	35.0	38.5	0.875	0.919
1	25.4	1.88	2.800	39.6	45.5	50.1	1.000	1.050
1 1/8	28.6	2.38	3.544	49.8	57.3	63.0	1.125	1.181
1 1/4	31.8	2.94	4.375	61.3	70.5	77.6	1.250	1.313
1 3/8	34.9	3.56	5.294	73.8	84.9	93.4	1.375	1.444
1 1/2	38.1	4.23	6.300	87.3	100	110	1.500	1.575

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

## Acceptance Tests

**8.4 Test Piece**—When required by 8.1, one test piece shall be taken from each production length.

**8.5 Test Verification**—When requested, the manufacturer shall allow the purchaser or his representative the opportunity to witness acceptance tests (when these are performed), or to examine test records, to verify compliance with this specification. Test lengths required by the purchaser should be ordered as additional lengths.

### 8.6 Rope:

**8.6.1 Diameter**—Measurements for diameter shall be taken on a straight portion of the rope without tension, at two positions spaced at least three feet (or one meter) apart, and at each position two diameters at right angles shall be measured. The average of these four measurements shall be within the tolerances given in Tables 3 and 4 of this specification. The permissible differences between any two individual diameter measurements are given in Tables 5 and 6.

NOTE 6—In case of dispute concerning oversize diameter, the rope shall be measured under a tension not exceeding 20 % of the minimum

breaking force. If the measurements from this test are within the specified tolerances, the rope shall be deemed to be within the specified size.

**8.6.2 Breaking Force**—When measured in accordance with the method specified in Test Method A931 or ISO 3108, the actual (measured) breaking force obtained shall be equal to or greater than the minimum breaking force required by this specification. If the minimum breaking force is not achieved, up to three additional tests shall be permitted. At least one of the additional tests shall achieve the minimum breaking force specified. Tables 7-32 show the minimum breaking forces of the more common classes, sizes, and grades of ropes:

**8.6.2.1** Minimum breaking forces listed apply to uncoated or drawn-galvanized ropes.

**8.6.2.2** Minimum breaking forces for final-galvanized ropes are 10 % lower than values listed, except for Tables 19 and 20.

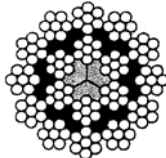
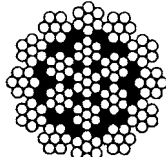
**8.6.2.3** Minimum breaking force values for IPS, EIP and EEIP are given in short tons of 2000 pounds.

### 8.7 Rope Wires:

**8.7.1 General**—Wires shall be tested for diameter, tensile strength, torsions, and, where applicable, metallic coating in



TABLE 19 Classification 19×7 Rotation Resistant—Category 2

Cross Section Examples		Construction of Rope		Construction of Strand	
		Item	Quantity	Item	Quantity
	18×7 FC	Strands	17 to 18	Wires	5 to 7
		Outer Strands	10 to 13	Outer Wires	4 to 6
		Layer of Strands	2	Layer of Wires	1
		Wires in Rope (excluding steel core)	85 to 126		
	19×7	Typical Examples		Number of Outer Wires	
		Rope	Strand	Total	Per Strand
		17×7	1–6	66	6
		18×7	1–6	72	6
		19×7	1–6	72	6

Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>				Diameter Range			
in.	[mm]	Fiber		WSC		IPS Tons	1770 [kN]	EIP Tons	1960 [kN]	Min. in.	Max. in.
		lb/ft	[kg/m]	lb/ft	[kg/m]						
1/4	6	0.10	0.144	0.10	0.151		20.9		23.1	0.236	0.248
		0.11	0.161	0.11	0.169	2.51		2.77		0.250	0.263
5/16	7	0.13	0.196	0.14	0.205		28.4		31.5	0.276	0.289
		0.17	0.251	0.18	0.264	3.90		4.30		0.313	0.328
3/8	8	0.17	0.255	0.18	0.268		37.2		41.1	0.315	0.331
	9	0.22	0.323	0.23	0.339		47.0		52.1	0.354	0.372
7/16	10	0.24	0.362	0.26	0.380	5.59		6.15		0.375	0.394
		0.27	0.399	0.28	0.419		58.1		64.3	0.394	0.413
1/2	11	0.32	0.483	0.34	0.507		70.2		77.8	0.433	0.455
		0.33	0.493	0.35	0.517	7.58		8.33		0.438	0.459
3/4	12	0.39	0.575	0.41	0.603		83.6		92.6	0.472	0.496
		0.43	0.644	0.45	0.676	9.85		10.8		0.500	0.525
5/8	13	0.45	0.674	0.48	0.708		98.1		109	0.512	0.537
		0.53	0.782	0.55	0.821		114		126	0.551	0.579
1 1/8	14	0.55	0.814	0.57	0.855	12.4		13.6		0.563	0.591
		0.68	1.006	0.71	1.056	15.3		16.8		0.625	0.656
1 1/4	16	0.69	1.021	0.72	1.073		149		165	0.630	0.661
		0.87	1.293	0.91	1.358		188		208	0.709	0.744
1 1/2	18	0.87	1.293	0.91	1.358		188		208	0.709	0.744
	19	0.97	1.440	1.02	1.513		210		232	0.748	0.785
1 3/4	20	0.97	1.448	1.02	1.521	21.8		24.0		0.750	0.788
		1.07	1.596	1.13	1.676		232		257	0.787	0.827
2	22	1.30	1.931	1.36	2.028		281		311	0.866	0.909
		1.32	1.971	1.39	2.070	29.5		32.5		0.875	0.919
2 1/4	24	1.54	2.298	1.62	2.413		334		370	0.945	0.992
		1.73	2.574	1.82	2.703	38.3		42.2		1.000	1.050
2 1/2	26	1.81	2.697	1.90	2.832		392		435	1.024	1.075
	28	2.10	3.128	2.21	3.285		455		504	1.102	1.157
2 3/4		2.19	3.258	2.30	3.421	48.2		53.1		1.125	1.181
3	30	2.70	4.022	2.84	4.224	59.2		65.1		1.250	1.313
		2.75	4.086	2.88	4.291		594		658	1.260	1.323
3 1/4	32	3.27	4.867	3.43	5.111	71.3		78.4		1.375	1.444
		3.47	5.171	3.65	5.430		752		833	1.417	1.488
3 1/2	34	3.89	5.792	4.09	6.082	84.4		92.8		1.500	1.575
		4.57	6.800	4.80	7.142	98.4		108.0		1.625	1.706
3 3/4		5.30	7.886	5.57	8.288	114.0		125.0		1.750	1.838

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

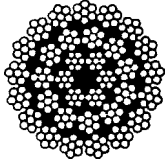
accordance with the methods in Specification A1007 or ISO 2232. The manufacturer shall have the option to test wires either before or after fabrication of the rope.

NOTE 7—After fabrication wire testing is not applicable to compacted strand ropes or swaged (compacted) ropes.

8.7.2 *Sampling*—All main wires from the equivalent of one complete strand of each layer, strand diameter and strand construction, including steel rope core, shall be tested. If there are more than eight strands of one diameter in one layer, then two strands of that diameter shall be tested.



TABLE 20 Classification 34×7 Rotation Resistant—Category 2

Cross Section Examples		Construction of Rope				Construction of Strand					
		Item		Quantity		Item		Quantity			
	34×7	Strands		34 to 36		Wires		5 to 9			
		Outer Strands		12 to 18		Outer Wires		4 to 8			
		Layer of Strands		3		Layer of Wires		1			
		Wires in Rope (excluding steel core)		170 to 324							
		Typical Examples		Number of Outer Wires							
		Rope		Strand		Total		Per Strand			
		34×7		1–6		102		6			
		17:11/6–C		1–6		108		6			
		36×7									
		18:12/6–C									
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>				Diameter Range			
in.	[mm]	Fiber		WSC		1770		1960		Min. in.	Max. in.
		lb/ft	[kg/m]	lb/ft	[kg/m]	Tons	[kN]	Tons	[kN]		
1/4	6	0.09	0.140	0.10	0.144		20.3		22.4	0.236	0.250
		0.11	0.157	0.11	0.162	2.55		2.83		0.250	0.265
5/16	7	0.13	0.191	0.13	0.196		27.6		30.5	0.276	0.292
		0.17	0.246	0.17	0.253	3.99		4.41		0.313	0.331
	8	0.17	0.250	0.17	0.257		36.0		39.9	0.315	0.331
		0.21	0.316	0.22	0.325		45.6		50.5	0.354	0.372
3/8	9	0.24	0.354	0.24	0.364	5.74		6.36		0.375	0.394
		0.26	0.390	0.27	0.401		56.3		62.3	0.394	0.413
	11	0.32	0.472	0.33	0.485		68.1		75.4	0.433	0.455
		0.32	0.482	0.33	0.495	7.81		8.65		0.438	0.459
7/16	12	0.38	0.562	0.39	0.577		81.1		89.8	0.472	0.496
		0.42	0.629	0.43	0.647	10.2		11.3		0.500	0.525
1/2	13	0.44	0.659	0.46	0.678		95.1		105.3	0.512	0.537
		0.51	0.764	0.53	0.786		110		122	0.551	0.579
9/16	14	0.53	0.796	0.55	0.819	12.9		14.3		0.563	0.591
		0.66	0.983	0.68	1.011	15.9		17.7		0.625	0.656
5/8		0.67	0.998	0.69	1.027		144		160	0.630	0.661
		0.85	1.264	0.87	1.299		182		202	0.709	0.744
	19	0.95	1.408	0.97	1.448		203		225	0.748	0.785
		0.95	1.415	0.98	1.455	23.0		25.4		0.750	0.788
3/4	20	1.05	1.560	1.08	1.604		225		249	0.787	0.827
		1.27	1.888	1.30	1.941		272		302	0.866	0.909
7/8		1.29	1.926	1.33	1.981	31.3		34.6		0.875	0.919
		1.51	2.246	1.55	2.310		324		359	0.945	0.992
1	24	1.69	2.516	1.74	2.587	40.8		45.2		1.000	1.050
		1.77	2.636	1.82	2.711		380		421	1.024	1.075
	26	2.05	3.058	2.11	3.144		441		489	1.102	1.157
		2.14	3.184	2.20	3.274	51.7		57.2		1.125	1.181
1 1/8	32	2.64	3.931	2.72	4.042	63.8		70.6		1.250	1.313
2.68		3.994	2.76	4.106		576		638	1.260	1.323	
1 3/8		3.20	4.757	3.29	4.891	77.2		85.5		1.375	1.444
		3.40	5.054	3.49	5.197		729		808	1.417	1.488
1 1/2	36	3.80	5.661	3.91	5.821	91.8		102		1.500	1.575
		4.19	6.240	4.31	6.416		901		997	1.575	1.654
1 5/8	40	4.46	6.644	4.59	6.832	108		119		1.625	1.706

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

8.7.3 For the purpose of evaluating the test results, the rope manufacturer shall record the nominal diameters and tensile grades of the wires.

8.7.3.1 The sample selected shall be of sufficient length to allow for retest.

8.7.3.2 The wires shall be selected at random.

8.7.3.3 Filler wires and center wires shall be excluded from this test.

#### 8.7.4 Levels of Acceptance:

8.7.4.1 *Wire before Fabrication*—Wire samples tested before fabrication shall meet the requirements for the size and grade (level) specified by the supplier and as found in the appropriate wire specification.

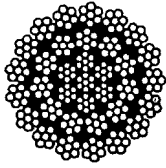
8.7.4.2 *Wire after Fabrication*—For each requirement, a maximum of 5 % of wires tested is permitted to lie outside the values specified, rounded to the nearest whole number of wires. Failure of the same wire to satisfy more than one requirement shall be considered as a single failure.

(a) *Diameter*—The diameter of 5 % of the wires may exceed, by up to 50 %, the specified tolerance for the nominal diameter.

(b) *Tensile Strength*—When tested in accordance with the requirements of Specification **A1007**, the measured values shall be within the tolerance specified with an additional tolerance of 7000 psi [50 N/mm<sup>2</sup>] below the minimum value. The measured value of wire diameters less than 0.020 in. [0.5



TABLE 21 Classification 35×7 Rotation Resistant—Category 1

Cross Section Examples		Construction of Rope		Construction of Strand							
		Item	Quantity	Item	Quantity						
	35×7	Strands	35	Wires	5 to 9						
		Outer Strands	16	Outer Wires	4 to 8						
		Layer of Strands	3	Layer of Wires	1						
		Wires in Rope (excluding steel core)	238								
		Typical Examples		Number of Outer Wires							
		Rope 35×7	Strand 1–6	Total 96	Per Strand 6						
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>				Diameter Range			
in.	[mm]	WSC		1770		1960		2160		Min.	Max.
		lb/ft	[kg/m]	Tons	[kN]	Tons	[kN]	Tons	[kN]	in.	in.
3⁄8	9	0.25	0.369		55.4		60.2		66.6	0.354	0.372
		0.28	0.413	6.98		7.46		8.22		0.375	0.394
7⁄16	10	0.31	0.455		69.2		75.4		83.5	0.394	0.413
	11	0.37	0.551		83.1		90.6		100	0.433	0.455
1⁄2		0.38	0.562	9.53		10.1		11.2		0.438	0.459
	12	0.44	0.655		99.9		106		119	0.472	0.496
5⁄8		0.49	0.734	12.6		13.6		14.6		0.500	0.525
	13	0.52	0.769		117		127		142	0.512	0.537
9⁄16	14	0.60	0.892		136		147		165	0.551	0.579
		0.62	0.929	15.9		17.3		18.5		0.563	0.591
3⁄4	16	0.77	1.147	19.7		21.7		22.8		0.625	0.656
		0.78	1.165		178		193		217	0.630	0.661
7⁄8	18	0.99	1.474		223		241		271	0.709	0.744
	19	1.10	1.643		251		275		308	0.748	0.785
1		1.11	1.651	28.4		30.9		32.9		0.750	0.788
	20	1.22	1.820		278		299		336	0.787	0.827
1 1⁄8	22	1.48	2.202		337		368		413	0.866	0.909
		1.51	2.247	38.7		41.6		44.7		0.875	0.919
1 1⁄4	24	1.76	2.621		401		439		493	0.945	0.992
		1.97	2.935	50.3		54.4		58.4		1.000	1.050
1 1⁄2	26	2.07	3.076		469		514		576	1.024	1.075
	28	2.40	3.567		549		596		646	1.102	1.157
1 3⁄8		2.50	3.715	64.3		68.9		73.9		1.125	1.181
	32	3.08	4.587	78.8		86		91.3		1.250	1.313
1 3⁄4		3.13	4.659		711		765		829	1.260	1.323
	36	3.73	5.550	95.4		106		110		1.375	1.444
1 7⁄8		3.96	5.897		906		977		1060	1.417	1.488
	40	4.44	6.605	114		120		131		1.500	1.575
1 7⁄8		4.89	7.280		1112		1200		1300	1.575	1.654
		5.21	7.752	134		140		154		1.625	1.706

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

mm] shall be greater than the minimum values specified in the appropriate wire specification.

(c) *Torsion*—When tested in accordance with the requirements of Specification **A1007**, the measured values of wires of 0.020 in. [0.5 mm] diameter and greater shall be at least 85 % of the values specified, rounded down to the next whole number. The measured value of wire diameters less than 0.020 in. [0.5 mm] shall be greater than the minimum values specified.

## 9. Packaging and Identification

9.1 *Packaging*—Unless otherwise specified by the purchaser, ropes shall be supplied in coils or on reels at the discretion of the manufacturer.

9.2 *Identification*—Each package of rope shall be legibly identified with the following information, as a minimum:

9.2.1 Rope supplier and address,

9.2.2 Rope length and description, and

9.2.3 Number traceable to manufacturer's production length.

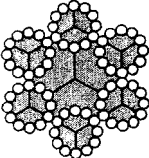
## 10. Keywords

10.1 aircraft cable; cable; steel cable; steel rope; utility cable; wire rope



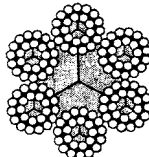


## TABLE 22 Classification 6x12 Fiber Core

Cross Section Examples			Construction of Rope		Construction of Strand	
			Item	Quantity	Item	Quantity
 6x12 Running Rope FC			Strands	6	Wires	12
			Outer Strands	6	Outer Wires	12
			Layer of Strands	1	Layer of Wires	1
			Wires in Rope (excluding steel core)	72		
			Typical Examples		Number of Outer Wires	
			Rope	Strand	Total	per Strand
			6x12	FC-12	72	12
Diameter			Approx. Mass		Minimum Breaking Force	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	Min. in.	Max. in.
5/16	7.9	0.10	0.152	2	0.313	0.328
3/8	9.5	0.15	0.219	3.36	0.375	0.394
7/16	11.1	0.20	0.298	4.55	0.438	0.459
1/2	12.7	0.26	0.389	5.91	0.500	0.525
9/16	14.3	0.33	0.492	7.45	0.563	0.591
5/8	15.9	0.41	0.607	9.16	0.625	0.656
3/4	19.1	0.59	0.875	13.1	0.750	0.788
13/16	20.6	0.69	1.026	15.3	0.813	0.853
7/8	22.2	0.80	1.190	17.7	0.875	0.919
1	25.4	1.04	1.555	23.0	1.000	1.050

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

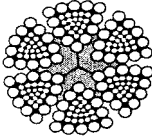
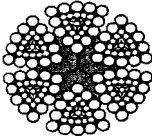
## TABLE 23 Classification 6x24 Fiber Core

Cross Section Examples			Construction of Rope		Construction of Strand	
			Item	Quantity	Item	Quantity
 6x24 (2 operation) Hawser Rope FC			Strands	6	Wires	24
			Outer Strands	6	Outer Wires	12–16
			Layer of Strands	1	Layer of Wires	2
			Wires in Rope (excluding steel core)	144		
			Typical Examples		Number of Outer Wires	
			Rope	Strand	Total	per Strand
			6x24	FC/9/15	90	15
			6x24W	FC/8-(8+8)	96	16
			6x24S	FC/12-12	72	12
Diameter			Approx. Mass		Minimum Breaking Force	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	Min. in.	Max. in.
3/8	9.5	0.19	0.289	4.77	0.375	0.394
1/2	12.7	0.34	0.513	8.40	0.500	0.525
9/16	14.3	0.44	0.649	10.6	0.563	0.591
5/8	15.9	0.54	0.801	13.0	0.625	0.656
3/4	19.1	0.78	1.154	18.6	0.750	0.788
7/8	22.2	1.06	1.571	25.2	0.875	0.919
1	25.4	1.38	2.052	32.8	1.000	1.050
1 1/8	28.6	1.74	2.597	41.2	1.125	1.181
1 1/4	31.8	2.15	3.206	50.7	1.250	1.313
1 3/8	34.9	2.61	3.879	61.0	1.375	1.444
1 1/2	38.1	3.10	4.616	72.3	1.500	1.575
1 5/8	41.3	3.64	5.418	84.5	1.625	1.706
1 3/4	44.5	4.22	6.283	97.5	1.750	1.838
1 7/8	47.6	4.85	7.213	111	1.875	1.969
2	50.8	5.51	8.206	126	2.000	2.100
2 1/16	52.4	5.87	8.734	134	2.063	2.166

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



TABLE 24 Classification 6×25 Triangular Strand Fiber Core

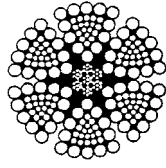
Cross Section Examples		Construction of Rope		Construction of Strand				
		Item	Quantity	Item	Quantity			
	6×30 Style G Flattened Strand (Plaited Center) FC	Strands	6	Wires	144			
		Outer Strands	6	Outer Wires	72			
		Layer of Strands	1	Layer of Wires	2			
		Wires in Rope						
	6×31 Style V (Brangle Center) FC	Typical Examples		Number of Outer Wires				
		Rope	Strand	Total	Per Strand			
		6×25B	1/12/12	72	12			
		6×30G	(3×2)/12/12	72	12			
		6×27H	3/12/12	72	12			
		6×31V	1–6/12/12	72	12			
Diameter		Approx. Mass		Minimum Breaking Force <sup>A</sup>			Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS Tons	EIP Tons	EEIP Tons	Min. in.	Max. in.
3⁄8	9.5	0.25	0.372	6.7	7.4	8.1	0.325	0.394
1⁄2	12.7	0.45	0.669	11.8	13.0	14.3	0.500	0.525
9⁄16	14.3	0.57	0.847	14.9	16.4	18.0	0.563	0.591
5⁄8	15.9	0.70	1.046	18.3	20.1	22.1	0.625	0.656
3⁄4	19.1	1.01	1.506	26.2	28.8	31.7	0.750	0.788
7⁄8	22.2	1.38	2.050	35.4	38.9	42.8	0.875	0.919
1	25.4	1.80	2.677	46.0	50.6	55.7	1.000	1.050
1 1⁄8	28.6	2.28	3.389	57.9	63.7	70.1	1.125	1.181
1 1⁄4	31.8	2.81	4.183	71.0	78.1	85.9	1.250	1.313
1 3⁄8	34.9	3.40	5.062	85.5	94.1	103	1.375	1.444
1 1⁄2	38.1	4.05	6.024	101	111	122	1.500	1.575
1 5⁄8	41.3	4.75	7.070	118	130	143	1.625	1.706
1 3⁄4	44.5	5.51	8.200	138	152	167	1.750	1.838
1 7⁄8	47.6	6.33	9.413	155	171	188	1.875	1.969
2	50.8	7.20	10.710	176	194	213	2.000	2.100
2 1⁄8	54.0	8.12	12.090	196	215	237	2.125	2.231
2 1⁄4	57.2	9.11	13.554	220	240	264	2.250	2.363
2 3⁄8	60.3	10.15	15.102	241	265	292	2.375	2.494
2 1⁄2	63.5	11.20	16.665	269	295	325	2.500	2.625
2 3⁄4	69.8	13.60	20.237	321	354	389	2.750	2.888

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



TABLE 25 Classification 6×25 Triangular Strand Steel Core

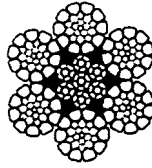
Cross Section Examples				Construction of Rope		Construction of Strand			
				Item		Quantity	Item		Quantity
 <p>6x30 Style G Flattened Strand (Plated Center) IWRC</p>				Strands		6	Wires		144
				Outer Strands		6	Outer Wires		72
				Layer of Strands		1	Layer of Wires		2
				Wires in Rope					
				Typical Examples			Number of Outer Wires		
				Rope	Strand	Total	Per Strand		
				6x25B	1/12/12	72	12		
				6x30G	(3x2)/12/12	72	12		
				6x27H	3/12/12	72	12		
				6x31V	1-6/12/12	72	12		
Diameter				Approx. Mass		Minimum Breaking Force <sup>A</sup>		Diameter Range	
in.	[mm]	lb/ft	[kg/m]	IPS	EIP	EEIP	Min.	Max.	
				Tons	Tons	Tons	in.	in.	
3/8	9.5	0.26	0.387	7.2	7.9	8.7	0.375	0.394	
1/2	12.7	0.47	0.703	12.6	14.0	15.4	0.500	0.525	
9/16	14.3	0.60	0.890	16.0	17.6	19.4	0.563	0.591	
5/8	15.9	0.74	1.099	19.6	21.7	23.9	0.625	0.656	
3/4	19.1	1.06	1.582	28.1	31.0	34.1	0.750	0.788	
7/8	22.2	1.45	2.154	38.0	41.9	46.1	0.875	0.919	
1	25.4	1.89	2.813	49.4	54.4	59.8	1.000	1.050	
1 1/8	28.6	2.39	3.560	62.2	68.5	75.4	1.125	1.181	
1 1/4	31.8	2.95	4.395	76.3	84.0	92.4	1.250	1.313	
1 3/8	34.9	3.57	5.318	91.9	101	111	1.375	1.444	
1 1/2	38.1	4.25	6.329	108	119	131	1.500	1.575	
1 5/8	41.3	4.99	7.428	127	140	154	1.625	1.706	
1 3/4	44.5	5.79	8.615	146	161	177	1.750	1.838	
1 7/8	47.6	6.65	9.889	167	184	202	1.875	1.969	
2	50.8	7.56	11.252	189	207	228	2.000	2.100	
2 1/8	54.0	8.54	12.702	211	232	255	2.125	2.231	
2 1/4	57.2	9.57	14.240	237	260	286	2.250	2.363	
2 3/8	60.3	10.66	15.867	261	287	316	2.375	2.494	
2 1/2	63.5	11.80	17.558	289	318	350	2.500	2.625	
2 3/4	69.8	14.30	21.278	345	381	418	2.750	2.888	

<sup>A</sup> Minimum breaking force for final-galvanized ropes 10 % lower than values listed.

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



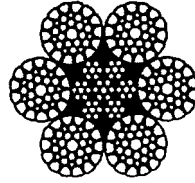
TABLE 26 Classification 6×19 Compacted Strand (CS)

Cross Section Examples		Construction of Rope				Construction of Strand			
		Item		Quantity		Item		Quantity	
 6x26 Warrington Seale Compacted Strand IWRC	Strands		6		Wires		15 to 26		
	Outer Strands		6		Outer Wires		7 to 12		
	Layer of Strands		1		Layer of Wires		2 to 3		
	Wires in Rope		90 to 156						
	Typical Examples				Number of Outer Wires				
	Rope		Strand		Total		Per Strand		
	6x19S		1-9-9		54		9		
	6x21F		1-5-5F-10		60		10		
	6x26WS		1-5-(5+5)-10		60		10		
	6x19W		1-6-(6+6)		72		12		
	6x25F		1-6-6F-12		72		12		
Diameter		Approx. Mass		Minimum Breaking Force				Diameter Range	
in.	[mm]	lb/ft	[kg/m]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
3/8		0.282	0.419	8.30		9.13		0.375	0.394
	10	0.310	0.462		85.3		91.5	0.394	0.413
	11	0.376	0.559		98.1		113	0.433	0.455
7/16		0.383	0.571	11.2		12.3		0.438	0.459
	12	0.447	0.665		114		127	0.472	0.496
1/2		0.501	0.745	14.6		16.1		0.500	0.525
	13	0.525	0.781		147		157	0.512	0.537
	14	0.609	0.906		169		183	0.551	0.579
9/16		0.634	0.943	18.5		20.4		0.563	0.591
	16	0.782	1.164	22.7		25.0		0.625	0.656
	18	0.795	1.183		217		228	0.630	0.661
5/8		1.006	1.497		275		298	0.709	0.744
	19	1.121	1.668		302		323	0.748	0.785
	20	1.127	1.677	32.4		35.6		0.750	0.788
3/4		1.242	1.848		333		355	0.787	0.827
	22	1.503	2.236		398		423	0.866	0.909
	24	1.534	2.282	43.8		48.2		0.875	0.919
7/8		1.788	2.661		487		518	0.945	0.992
	26	2.003	2.981	56.9		62.6		1.000	1.050
	28	2.099	3.123		576		610	1.024	1.075
1		2.434	3.622		655		700	1.102	1.157
	30	2.535	3.772	71.5		78.7		1.125	1.181
	32	3.130	4.657	87.9		96.7		1.250	1.313
1 1/8		3.179	4.731		844		914	1.260	1.323
	34	3.787	5.635	106		117		1.375	1.444
	36	4.024	5.988		1060		1120	1.417	1.488
1 1/2		4.507	6.706	125		138		1.500	1.575
	38	4.967	7.392		1290		1320	1.575	1.654
	40	5.289	7.871	146		161		1.625	1.706
1 5/8		6.011	8.944		1500		1590	1.732	1.819
	42	6.134	9.128	169		186		1.750	1.838
	44	7.042	10.479	192		211		1.875	1.969
1 3/4		7.153	10.644		1880		1890	1.890	1.984
	46	8.012	11.923	217		239		2.000	2.100
	48	8.395	12.492		2130		2220	2.047	2.150
2 1/8		9.045	13.460	243		267		2.125	2.231
	50	9.736	14.488		2470		2574	2.205	2.315
	52	10.140	15.090	272		299		2.250	2.363

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



TABLE 27 Classification 6×36 Compacted Strand (CS)

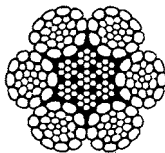
Cross Section Examples		Construction of Rope				Construction of Strand				
		Item		Quantity		Item		Quantity		
	6×36 Compacted Strand	Strands		6		Wires		27 to 49		
		Outer Strands		6		Outer Wires		12 to 18		
		Layer of Strands		1		Layer of Wires		27 to 49		
		Wires in Rope		156 to 276						
		Typical Examples				Number of Outer Wires				
		Rope		Strand		Total		Per Strand		
		6×31WS		1–6–(6+6)–12		72		12		
		6×36WS		1–7–(7+7)–14		84		14		
		6×41WS		1–8–(8+8)–16		96		16		
		6×41SF		1–8–8–8F–16		96		16		
6×49SWS		1–8–8–(8+8)–16		96		16				
6×46WS		1–9–(9+9)–18		108		18				
Diameter		Approx. Mass		Minimum Breaking Force				Diameter Range		
in.	[mm]	lb/ft	[kg/m]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.	
3⁄8		0.282	0.419	8.30		9.13		0.375	0.394	
	10	0.310	0.462				85.3	91.5	0.394	0.413
	11	0.376	0.559				98.1	113	0.433	0.455
7⁄16		0.383	0.571	11.2		12.3		0.438	0.459	
	12	0.447	0.665				114	127	0.472	0.496
1⁄2		0.501	0.745	14.6		16.1		0.500	0.525	
	13	0.525	0.781				147	157	0.512	0.537
	14	0.609	0.906				169	183	0.551	0.579
9⁄16		0.634	0.943	18.5		20.4		0.563	0.591	
5⁄8		0.782	1.164						0.625	0.656
	16	0.795	1.183				217	228	0.630	0.661
	18	1.006	1.497		275	298	0.709	0.744		
3⁄4		1.121	1.668	32.4		35.6		0.748	0.785	
	19	1.127	1.677				302	323	0.750	0.788
	20	1.242	1.848				333	355	0.787	0.827
7⁄8		1.503	2.236	43.8		48.2		0.866	0.909	
	22	1.534	2.282				398	423	0.875	0.919
1		1.788	2.661	56.9		62.6		0.945	0.992	
	24	2.003	2.981				487	518	0.945	0.992
	26	2.099	3.123				576	610	1.000	1.050
1 1⁄8		2.434	3.622	71.5		78.7		1.024	1.075	
1 1⁄4		2.535	3.772				655	700	1.102	1.157
	32	3.130	4.657				844	914	1.250	1.313
	36	3.179	4.731		844	914	1.260	1.323		
1 3⁄8		3.787	5.635	106		117		1.375	1.444	
	40	4.024	5.988				1060	1120	1.417	1.488
1 1⁄2		4.507	6.706	125		138		1.500	1.575	
	44	4.967	7.392				1290	1320	1.575	1.654
	48	5.289	7.871				1500	1590	1.625	1.706
1 5⁄8		6.011	8.944	146		161		1.732	1.819	
1 3⁄4		6.134	9.128				186	1890	1.750	1.838
	52	7.042	10.479				211		1.875	1.969
	56	7.153	10.644		1880	1890	1.890	1.984		
2		8.012	11.923	217		239		2.000	2.100	
	60	8.395	12.492				2130	2220	2.047	2.150
2 1⁄8		9.045	13.460	243		267		2.125	2.231	
	64	9.736	14.488				2470	2574	2.205	2.315
2 1⁄4		10.140	15.090	272		299		2.250	2.363	

Note—To convert to kilonewtons (kN), multiply tons by 8.896.





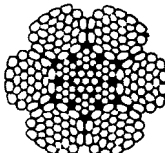
TABLE 28 Classification 6×19 Swaged Rope (SW)

Cross Section Examples		Construction of Rope		Construction of Strand		
		Item	Quantity	Item	Quantity	
 6x26 Warrington Compacted (Swaged) IWRC		Strands	6	Wires	15–26	
		Outer Strands	6	Outer Wires	7–12	
		Layer of Strands	1	Layer of Wires	2–3	
		Wires in Rope (excluding steel core)	90–156			
		Typical Examples		Number of Outer Wires		
Rope		Strand	Total	per Strand		
6x19S		1–9–9	54	9		
6x21F		1–5–5F–10	60	10		
6x26WS		1–5–(5+5)–10	60	10		
6x19W		1–6–(6+6)	72	12		
6x25F		1–6–6F–12	72	12		
Diameter		Approx. Mass		Minimum Breaking Force	Diameter Range	
in.	[mm]	lb/ft	[kg/m]	EIP Tons	Min. in.	Max. in.
1/2	12.7	0.55	0.826	15.5	0.500	0.525
9/16	14.3	0.70	1.045	19.6	0.563	0.591
5/8	15.9	0.87	1.290	24.2	0.625	0.656
3/4	19.1	1.25	1.858	34.9	0.750	0.788
7/8	22.2	1.70	2.529	47.4	0.875	0.919
1	25.4	2.22	3.303	62.0	1.000	1.050
1 1/8	28.6	2.81	4.181	73.5	1.125	1.181
1 1/4	31.8	3.47	5.161	90.0	1.250	1.313
1 3/8	34.9	4.20	6.245	106	1.375	1.444
1 1/2	38.1	4.99	7.432	130	1.500	1.575

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

Note—Also called compacted rope.

TABLE 29 Classification 6×36 Swaged Rope (SW)

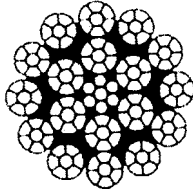
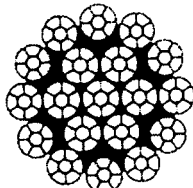
Cross Section Examples			Construction of Rope		Construction of Strand	
 6×31 Warrington Seale Compacted (Swaged) IWRC			Item	Quantity	Item	Quantity
			Strands	6	Wires	27–49
			Outer Strands	6	Outer Wires	12–18
			Layer of Strands	1	Layer of Wires	3–4
			Wires in Rope (excluding steel core)	156–276		
			Typical Examples		Number of Outer Wires	
			Rope	Strand	Total	per Strand
			6×31WS	1–6–(6+6)–12	72	12
			6×36WS	1–7–(7+7)–14	84	14
			6×41WS	1–8–(8+8)–16	96	16
			6×41SF	1–8–8–8F–16	96	16
			6×49SWS	1–8–8–(8+8)–16	96	16
			6×46WS	1–9–(9+9)–18	108	18
Diameter			Approx. Mass	Minimum Breaking Force	Diameter Range	
in.	[mm]	lb/ft	[kg/m]	EIP Tons	Min. in.	Max. in.
1/2	12.7	0.55	0.826	15.5	0.500	0.525
9/16	14.3	0.70	1.045	19.6	0.563	0.591
5/8	15.9	0.87	1.290	24.2	0.625	0.656
3/4	19.1	1.25	1.858	34.9	0.750	0.788
7/8	22.2	1.70	2.529	47.4	0.875	0.919
1	25.4	2.22	3.303	62.0	1.000	1.050
1 1/8	28.6	2.81	4.181	73.5	1.125	1.181
1 1/4	31.8	3.47	5.161	90.0	1.250	1.313
1 3/8	34.9	4.20	6.245	106	1.375	1.444
1 1/2	38.1	4.99	7.432	130	1.500	1.575

Note—To convert to kilonewtons (kN), multiply tons by 8.896.

Note—Also called compacted rope.



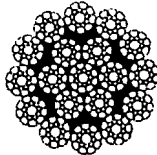
TABLE 30 Classification 19×7 Compacted Strand (CS) Rotation Resistant—Category 2

Cross Section Examples		Construction of Rope			Construction of Strand				
		Item		Quantity	Item		Quantity		
	18×7 Compacted Strand	Strands		17 to 18	Wires		5 to 7		
		Outer Strands		10 to 13	Outer Wires		4 to 6		
		Layer of Strands		2	Layer of Wires		1		
		Wires in Rope (excluding steel core)		85 to 126					
	19×7 Compacted Strand	Typical Examples			Number of Outer Wires				
		Rope	Strand	Total	Per Strand				
		17×7	1–6	66	6				
		18×7	1–6	72	6				
		19×7	1–6	72	6				
Diameter		Approx. Mass		Minimum Breaking Force			Diameter Range		
in.	[mm]	lb/ft	[kg/m]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
1/4	6	0.12	0.181		30.7		34.0	0.236	0.248
		0.14	0.203	3.74		4.11		0.250	0.263
5/16	7	0.17	0.247		39.8		44.1	0.276	0.289
		0.21	0.318	5.80		6.38		0.313	0.328
	8	0.22	0.323		54.2		60.0	0.315	0.331
		0.27	0.408		67.6		74.8	0.354	0.372
3/8	9	0.31	0.457	7.55		8.30		0.375	0.394
		0.34	0.504		84.3		93.3	0.394	0.413
	10	0.41	0.610		105		116	0.433	0.455
		0.42	0.622	10.2		11.2		0.438	0.459
7/16	11	0.49	0.726		121		133	0.472	0.496
		0.55	0.813	13.3		14.6		0.500	0.525
1/2	12	0.57	0.852		147		162	0.512	0.537
		0.66	0.988		167		185	0.551	0.579
9/16	13	0.69	1.029	16.8		18.5		0.563	0.591
		0.85	1.270	20.6		22.7		0.625	0.656
5/8	14	0.87	1.290		219		243	0.630	0.661
		1.10	1.633		278		308	0.709	0.744
	18	1.22	1.819		304		337	0.748	0.785
		1.23	1.829	29.4		32.4		0.750	0.788
3/4	19	1.35	2.016		336		372	0.787	0.827
		1.64	2.439		412		457	0.866	0.909
7/8	20	1.67	2.490	39.8		43.8		0.875	0.919
		1.95	2.903		476		541	0.945	0.992
1	24	2.19	3.252	51.7		56.9		1.000	1.050

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



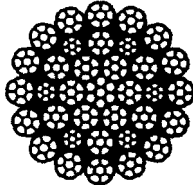
TABLE 31 Classification 19×19 Compacted Strand (CS) Rotation Resistant—Category 2

Cross Section Examples		Construction of Rope				Construction of Strand			
		Item		Quantity		Item		Quantity	
 19×19 Seale Compacted Strand	Strands		17 to 18		Wires		15 to 26		
	Outer Strands		10 to 13		Outer Wires		7 to 12		
	Layer of Strands		2		Layer of Wires		2 to 3		
	Wires in Rope (excluding steel core)		255 to 468						
	Typical Examples				Number of Outer Wires				
	Rope		Strand		Total		Per Strand		
	17×19S		1–9–9		99		9		
	18×19S		1–9–9		108		9		
	18×26WS		1–5–(5+5)–10		120		10		
	19×19S		1–9–9		108		9		
	19×26WS		1–5–(5+5)–10		120		10		
Diameter		Approx. Mass		Minimum Breaking Force				Diameter Range	
in.	[mm]	lb/ft	[kg/m]	EIP Tons	1960 [kN]	EEIP Tons	2160 [kN]	Min. in.	Max. in.
5⁄8		0.31	0.462	7.55		8.3		0.375	0.394
	10	0.34	0.509		84.3		93.3	0.394	0.413
	11	0.41	0.616		105		116	0.433	0.455
7⁄16		0.42	0.629	10.2		11.2		0.438	0.459
	12	0.49	0.733		121		133	0.472	0.496
1⁄2		0.55	0.821	13.3		14.6		0.500	0.525
	13	0.58	0.860		147		162	0.512	0.537
	14	0.67	0.998		160		180	0.551	0.579
9⁄16		0.70	1.039	16.8		18.5		0.563	0.591
5⁄8		0.86	1.283	20.6		22.7		0.625	0.656
	16	0.88	1.303		215		241	0.630	0.661
	18	1.11	1.649		266		299	0.709	0.744
	19	1.23	1.837		300		337	0.748	0.785
3⁄4		1.24	1.847	29.4		32.4		0.750	0.788
	20	1.37	2.036		335		376	0.787	0.827
	22	1.66	2.464		405		454	0.866	0.909
7⁄8		1.69	2.514	39.8		43.8		0.875	0.919
	24	1.97	2.932		482		540	0.945	0.992
1		2.21	3.284	51.7		56.9		1.000	1.050
	26	2.31	3.441		572		637	1.024	1.075
	28	2.68	3.991		662		743	1.102	1.157
1 1⁄8		2.79	4.156	65.0		71.5		1.125	1.181
1 1⁄4		3.45	5.131	79.9		87.9		1.250	1.313
	32	3.50	5.212		859		964	1.260	1.323
1 3⁄8		4.17	6.209	96.0		106		1.375	1.444
	36	4.43	6.597		1085		1218	1.417	1.488
1 1⁄2		4.97	7.389	114		125		1.500	1.575
	40	5.47	8.144		1340		1503	1.575	1.654
1 5⁄8		5.83	8.671	132		145		1.625	1.706

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



TABLE 32 Classification 35×7 Compacted Strand (CS) Rotation Resistant—Category 1

Cross Section Examples		Construction of Rope				Construction of Strand			
		Item		Quantity		Item		Quantity	
		Strands		35		Wires		5 to 9	
		Outer Strands		16		Outer Wires		4 to 8	
		Layer of Strands		3		Layer of Wires		1	
		Wires in Rope		238					
		Typical Examples			Number of Outer Wires				
		Rope		Strand		Total		Per Strand	
		35×7		1–6		96		6	
Diameter		Approx. Mass		Minimum Breaking Force				Diameter Range	
in.	[mm]	lb/ft	[kg/m]	1960		2160		Min. in.	Max. in.
				Tons	[kN]	Tons	[kN]		
7/16	10	0.33	0.497		87.6		98.3	0.394	0.413
	11	0.40	0.601		105		118	0.433	0.455
		0.41	0.614	12.1		13.4		0.438	0.459
1/2	12	0.48	0.716		124		140	0.472	0.496
		0.54	0.802	15.4		17.4		0.500	0.525
	13	0.56	0.840		144		162	0.512	0.537
9/16	14	0.65	0.974		168		188	0.551	0.579
		0.68	1.015	19.7		22.0		0.563	0.591
		0.84	1.253	25.2		28.2		0.625	0.656
5/8	16	0.85	1.272		224		251	0.630	0.661
	18	1.08	1.610		274		308	0.709	0.744
	19	1.21	1.794		307		344	0.748	0.785
3/4		1.21	1.804	34.5		38.7		0.750	0.788
	20	1.34	1.988		341		382	0.787	0.827
	22	1.62	2.405		415		466	0.866	0.909
7/8		1.65	2.455	47.2		53.0		0.875	0.919
	24	1.92	2.863		491		555	0.945	0.992
		2.15	3.206	62.4		70.0		1.000	1.050
1	26	2.26	3.360		588		660	1.024	1.075
	28	2.62	3.896		676		758	1.102	1.157
		2.73	4.058	77.5		86.9		1.125	1.181
1 1/8		3.37	5.010	98.1		110		1.250	1.313
1 1/4	32	3.42	5.089		873		980	1.260	1.323
		4.07	6.062	117		124		1.375	1.444
	36	4.33	6.441		1110		1232	1.417	1.488
1 1/2		4.85	7.215	138		147		1.500	1.575
	40	5.34	7.952		1390		1521	1.575	1.654
		5.69	8.467	167		182		1.625	1.706

Note—To convert to kilonewtons (kN), multiply tons by 8.896.



Right regular  
(sZ)



Left regular  
(zS)



Right lang  
(zZ)



Left lang  
(sS)



FIG. 10 Regular (Ordinary Lay) and Lang Lay

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