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Specification for Wire Rope

API SPECIFICATION 9A
TWENTY-FOURTH EDITION, JUNE 1, 1995



American Petroleum Institute
1220 L Street, Northwest
Washington, D.C. 20005



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Exploration and Production Department

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**American
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Institute**





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Specification for Wire Rope

1 Scope

1.1 PURPOSE

The purpose of this specification is to provide standards for wire rope in the minimum number of grades of material and types of construction to adequately meet the requirements of the petroleum industry. It is not represented that wire rope manufactured in accordance with this specification will render service for any stated period of time, due to the many factors of service application that will affect its life.

Wire rope covered by this specification is suitable for the following oil-field uses: rod and tubing pull lines, rod hanger lines, sand lines, cable-tool drilling and clean out lines, cable-tool casing lines, rotary drilling lines, winch lines, horse head pumping unit lines, torpedo lines, well-measuring wire, well-measuring strand, offshore mooring lines, mast raising lines, guideline tensioner lines, and riser tensioner lines.

Typical applications for these services and recommended practices for field use are given in API RP 9B: Recommended Practice on Application, Care, and Use of Wire Rope for Oil-Field Service, which covers sizes and constructions, field care and use, recommended design features, evaluation of rotary drilling lines, and field troubles and their causes.

1.2 COVERAGE

This specification covers (1) bright (uncoated), galvanized, and drawn-galvanized wire rope of various grades and construction, (2) mooring wire rope, (3) torpedo lines, (4) well-measuring wire, (5) well-measuring strand, (6) galvanized wire guy strand, and (7) galvanized structural rope and strand.

2 REFERENCES

API

1. RP 9B *Recommended Practice on Application, Care, and Use of Wire Rope for Oilfield Service.*

ASTM¹

2. A-474 *Aluminum Coated Steel Wire Strand.*
3. A-475 *Zinc-Coated Steel Wire Strand.*
4. A-586 *Zinc-Coated Steel Structural Strand.*
5. A-603 *Zinc-Coated Steel Structural Wire Rope.*

ISO²

6. Std 2232-1973, *Drawn Wire for General Purpose Non-Alloy Steel Wire Ropes—Specifications.*

¹American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

²International Organization for Standardization. Publications available from American National Standards Institute, 1430 Broadway, New York, New York 10018.

3 Material

3.1 WIRE

Wire used in the manufacture of wire rope shall be made from

- a. acid or basic open-hearth steel
- b. basic oxygen steel, or
- c. electric furnace steel.

The wire will have the mechanical properties hereinafter specified as level 2, level 3, level 4, or level 5.

3.2 WIRE PROPERTIES BEFORE AND AFTER FABRICATION

Wire tested before and after fabrication shall meet different tensile and torsional requirements as specified in Tables 4 and 5.

3.3 GALVANIZED WIRE ROPE

Galvanized wire rope shall be made of galvanized rope wire having a coating of zinc applied after final cold drawing, either by the electro-deposition process or by the hot-galvanizing process. The minimum weight of zinc coating shall be as specified in Table 1.

Table 1—Weight of Zinc Coating for Galvanized Rope Wire

(1)		(2)	(3)	(4)
Diameter of Wire		Minimum Weight of Zinc Coating		
in.	mm	oz./ft ²	kg/m ²	
0.028 to 0.047	0.71 to 1.19	0.20	0.06	
0.048 to 0.054	1.22 to 1.37	0.40	0.12	
0.055 to 0.063	1.40 to 1.60	0.50	0.15	
0.064 to 0.079	1.63 to 2.01	0.60	0.18	
0.080 to 0.092	2.03 to 2.34	0.70	0.21	
0.093 and larger	2.36 and larger	0.80	0.24	

3.4 DRAWN-GALVANIZED WIRE ROPE

Drawn-galvanized wire rope shall be made of galvanized rope wire having a coating of zinc, applied at an intermediate stage of the wire drawing operation, either by the electro-deposition process or by the hot-galvanizing process. The minimum weight of zinc coating shall be as specified in Table 2.

Table 2—Weight of Zinc Coating for Drawn-Galvanized Rope Wire

(1)		(2)	(3)	(4)
Diameter of Wire		Minimum Weight of Zinc Coating		
in.	mm	oz./ft ²	kg/m ²	
0.018 to 0.028	0.46 to 0.71	0.10	0.03	
0.029 to 0.060	0.74 to 1.52	0.20	0.06	
0.061 to 0.090	1.55 to 2.29	0.30	0.09	
0.091 to 0.140	2.31 to 3.56	0.40	0.12	

4 Properties and Tests for Wire and Wire Rope

4.1 SELECTION OF TEST SPECIMENS—AFTER FABRICATION

4.1.1 For the test of individual wires, and of rope, a section 10 ft. (3.05 m) long shall be cut from a finished piece of unused and undamaged wire rope. After fabrication wire tests should meet the requirements of Table 4.

4.1.2 From each strand there shall be selected and tested certain wires as follows:

- a. The total number to be tested shall be equal to the number of wires in any one strand.
- b. They shall be selected from all strands of the rope.
- c. The specimens shall be selected from all locations or positions so that they would constitute a complete composite strand exactly similar to a regular strand in the rope.
- d. The specimen for all "like-positioned" wires to be selected so as to use as nearly as possible an equal number from each strand.

Note: Whenever "like-positioned" wires are mentioned it will be understood to mean wires symmetrically placed in a strand. For example, in Warrington all the outside wires are not necessarily "like-positioned" since in the outside layer are placed alternately large and small wires. All large wires are "like positioned" with respect to each other and all small wires are "like positioned" with respect to each other.

4.1.3 Any unsymmetrically placed wires, or marker wires are to be disregarded entirely. Center wires are subject to the same stipulations that apply to symmetrical wires.

4.2 SELECTION OF TEST SPECIMENS—BEFORE FABRICATION

Selection and testing of wire prior to rope fabrication will be adequate to ensure the after-fabrication wire rope breaking strength and wire requirements can be met. Prior to fabrication wire tests should meet the requirements of Table 5.

4.3 CONDUCT OF TESTS

4.3.1 The tests shall be so run and records kept in such a manner that the results of each of the various tests on any one specimen are associated and may be studied separately from other specimens.

4.3.2 If, when making any individual wire test on any wire, the first specimen fails, not more than two additional specimens from the same wire shall be tested. If the average of any two tests shows acceptance, it shall be used as the value to represent the wire. The test for the rope may be terminated at any time sufficient failures have occurred to be cause for rejection.

4.3.3 The purchaser may at his expense test all of the wires if desired.

4.4 TENSILE REQUIREMENTS OF INDIVIDUAL WIRE

4.4.1 Specimens shall not be less than 18 in. (457 mm) long, and the distance between the grips of the testing machine shall not be less than 12 in. (305 mm). The speed of the movable head of the testing machine, under no load, shall not exceed 1 in. per min. (0.4 mm per sec.). Any specimen breaking within $\frac{1}{4}$ in. (6.35 mm) of the jaws may be disregarded and a retest performed.

Note: The diameter of wire can more easily and accurately be determined by placing the wire specimen in the test machine and applying a load not over 25 per cent of the breaking strength of the wire.

4.4.2 The breaking strength of either bright (uncoated) or drawn-galvanized wires of various grades shall meet or exceed the values shown in Table 4 or Table 5 for the size wire being tested. Wire tested after rope fabrication allows one wire in 6 × 7 classification, or three wires in 6 × 19 and 8 × 19 classifications and 18 × 7 and 19 × 7 constructions, or six wires in 6 × 37 classification, or nine wires in 6 × 61 classification, or twelve wires in 6 × 91 classification wire rope fall below, but not more than 10 per cent below, the specified minimum tensile strength for the individual wire being tested. If when making the specified test, any wires fall below, but not more than 10 per cent below, the individual minimum, additional wires from the same rope shall be tested until there is cause for rejection as provided for in Par. 4.3.2 or until all of the wires in the rope have been tested. Tests of individual wires in galvanized wire rope and of individual wires in strand cores and in independent wire rope cores are not required.

4.5 TORSIONAL REQUIREMENTS OF INDIVIDUAL WIRE

4.5.1 The standard distance between the jaws of the testing machine is 8 in. $\pm \frac{1}{16}$ in. (203 mm \pm 1 mm). In order to save time during tests, the distance between the jaws of the testing machine may be shortened to as small as 100 wire diameters (less than 8 inches) (203 mm). One end of the wire is to be rotated with respect to the other end at a uniform speed not to exceed sixty 360-deg. (6.28 rad) revolutions per minute, until breakage occurs. The machine must be equipped with an automatic counter to record the number of revolutions causing breakage. One jaw shall be fixed axially and the other jaw movable axially and arranged for applying tension weights to wire under test. Tests in which breakage occurs within $\frac{1}{4}$ in. (3.18 mm) of the jaw may be disregarded.

4.5.2 In the torsion test, the wires being tested must meet the values for the respective grades and sizes as covered by Table 4 or Table 5. In wire tested after rope fabrication, it will be permissible for two wires in 6 × 7 classification, or five wires in 6 × 19 and 8 × 19 classifications and 18 × 7 and

19 × 7 constructions, or ten wire in 6 × 37 classification, or fifteen wires in 6 × 61 classification, or twenty wires in 6 × 91 classification rope to fall below, but not more than 30 per cent below, the specified minimum number of twists for the individual wire being tested.

4.5.3 During the torsion test, tension weights as shown in Table 3 shall be applied to the wire being tested.

Table 3—Applied Tension for Torsion Tests

(1)	(2)	(3)	(4)
Wire Size Nominal Diameter (in)	(mm)	Minimum Applied Tension* (lb)	(N)
0.011 to 0.016	0.28 to 0.42	1	4
0.017 to 0.020	0.43 to 0.52	2	9
0.021 to 0.030	0.53 to 0.77	4	18
0.031 to 0.040	0.78 to 1.02	6	27
0.041 to 0.050	1.03 to 1.28	8	36
0.051 to 0.060	1.29 to 1.53	9	40
0.061 to 0.070	1.54 to 1.79	11	49
0.071 to 0.080	1.80 to 2.04	13	58
0.081 to 0.090	2.05 to 2.30	16	71
0.091 to 0.100	2.31 to 2.55	19	85
0.101 to 0.110	2.56 to 2.80	21	93
0.111 to 0.120	2.81 to 3.06	23	102
0.121 to 0.130	3.07 to 3.31	25	111
0.131 to 0.140	3.32 to 3.57	26	116
0.141 to 0.150	3.58 to 3.82	28	125
0.151 to 0.160	3.83 to 4.07	30	133
0.161 to 0.170	4.08 to 4.33	32	142
0.171 to 0.180	4.34 to 4.58	34	151
0.181 to 0.190	4.59 to 4.84	36	160
0.191 to 0.200	4.85 to 5.09	38	169
0.201 to 0.210	5.10 to 5.34	40	178
0.211 to 0.220	5.35 to 5.60	42	187
0.221 to 0.230	5.61 to 5.85	44	196
0.231 to 0.240	5.86 to 6.10	46	205
0.241 to 0.250	6.11 to 6.35	48	214

*Weights shall not exceed twice the minimums listed.

4.5.4 The minimum torsions for individual bright (uncoated) or drawn-galvanized wire of the grades and sizes shown in Column 7, 12, 17 and 22 of Table 4 and Column 5, 8, 11 and 14 of Table 5 shall be the number of 360-deg. (6.28 rad) revolutions in an 8-inch (203 mm) length that the wire must withstand before breakage occurs. Torsion tests of individual wires in galvanized wire rope and of individual wires in strand cores and independent wire rope cores are not required.

4.5.5 When the distance between the jaws of the testing machine is different than 8 in. (203 mm), as permitted by Par. 4.5.1 the minimum torsions shall be adjusted in direct proportion to the change in jaw spacing as determined by the following formula:

$$T_A = (T_L \times L_A) \div L_L \quad (1)$$

Where:

T_A = minimum torsions for the adjusted spacing.

T_L = minimum torsions for 8 in. (203 mm) jaw spacing as

given in Table 4 for size and grade of wire.

L_A = distance between testing machine jaws for adjusted spacing, inches (mm).

L_L = 8 in. (203 mm).

4.6 NOMINAL STRENGTH REQUIREMENTS FOR WIRE ROPE

4.6.1 The nominal strength of the various grades of finished wire rope with fiber core shall be as specified in Tables 6, 7, and 13.

4.6.2 The nominal strength of the various grades of wire rope having a strand core or an independent wire rope core shall be as specified in Tables 8, 9, 10, 11, 12 and 14.

4.6.3 The nominal strength of the various types of flat-tensioned strand wire rope shall be specified in Table 15.

4.6.4 The nominal strength of the various grades of wire rope made with drawn-galvanized wire shall be as specified in Tables 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15.

Note: As shown in Tables 6 through 15, the specified nominal strength values of drawn galvanized wire rope are the same as those for bright wire rope, whereas those for galvanized wire rope are 90 per cent of the bright wire rope strengths. Further, drawn galvanized wire rope is made of individual wires having the same size limits see (Par. 5.4.1) and the same mechanical properties (see Table 4) as bright (uncoated) wires.

4.6.5 The nominal strength of the various grades of wire rope made with galvanized to finished size wire is 90% of the bright wire rope nominal strength.

4.6.6 When testing finished wire rope tensile test specimens to their breaking strength, suitable sockets shall be attached by the method described under the headings "Seizing" and "Socketing" of the Section entitled "Field Care and Use of Wire Rope," RP 9B. For test purposes, it is recommended that the size of the socket be $\frac{1}{4}$ in. (6.35 mm) larger than the diameter of the wire rope under test. Other comparable holding mechanisms may be used.

4.6.7 Test specimen length shall not be less than 3 ft. (0.91 m) between sockets for wire ropes up to 1-in. (25.4 mm) diameter, inclusive, and not less than 5 ft. (1.52 m) between sockets for wire ropes $1\frac{1}{8}$ -in. (28.6 mm) to 3 in. (77 mm) diameter. On wire ropes larger than 3 in. (77 mm), the clear length of the test specimen shall be at least 20 times the rope diameter. The test result may be disregarded if the failure is within 2" (50.8 mm) of the holding mechanism.

4.6.8 Due to the variables that exist in both sample preparation and testing procedures, it is difficult to determine the true strength. Recognizing this difficulty, the actual breaking strength during test shall be at least 97½% of the nominal strength as shown in the applicable table. If the first specimen fails at a value below the 97½% nominal strength value, a second test shall be made, and if the second test meets the strength requirements, the wire rope shall be accepted.

Table 4—Mechanical Properties of Individual Rope Wires—After Fabrication

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	Level 3					Level 4					Level 5				
Wire Size Nominal Diameter in.	mm	Bright (Uncoated)					Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Bright (Uncoated) or Drawn-Galvanized Breaking Strength						
		Average					Average					Average					Average						
		Individual Minimum	Minimum	N	Min. Tor.	Min. Tor.	Individual Minimum	Minimum	N	Min. Tor.	Min. Tor.	Individual Minimum	Minimum	N	Min. Tor.	Min. Tor.	Individual Minimum	Minimum	N	Min. Tor.	Min. Tor.		
0.010	0.25	17	76	17	76	241	20	89	21	93	222	21	93	23	102	202	23	102	25	111	176		
0.011	0.28	20	89	22	98	219	23	102	25	111	202	26	116	28	125	183	28	125	30	133	160		
0.012	0.30	24	107	26	116	201	28	125	30	133	185	31	138	33	147	168	33	147	35	156	146		
0.013	0.33	28	125	30	133	185	33	147	35	156	171	36	160	38	169	155	39	173	41	182	135		
0.014	0.36	33	147	35	156	172	38	169	40	178	159	42	187	44	196	144	45	200	47	209	126		
0.015	0.38	38	169	40	178	161	44	196	46	205	148	48	214	50	222	134	52	231	54	240	117		
0.016	0.41	43	191	45	200	150	50	222	52	231	139	55	245	57	254	126	59	262	62	276	109		
0.017	0.43	49	218	51	227	142	56	249	58	258	130	61	271	65	289	118	66	294	70	311	103		
0.018	0.46	55	245	57	254	134	62	276	66	294	124	69	307	73	325	112	74	329	78	347	97		
0.019	0.48	60	267	64	285	126	70	311	74	329	117	77	342	81	360	106	83	369	87	387	93		
0.020	0.51	67	298	71	316	120	77	342	81	360	110	85	378	89	396	100	92	409	96	427	87		
0.021	0.53	74	329	78	347	114	85	378	89	396	105	94	418	98	436	95	100	445	106	471	83		
0.022	0.56	81	360	85	378	109	94	418	98	436	101	102	454	108	480	90	110	489	116	516	79		
0.023	0.58	89	396	93	414	105	102	454	108	480	96	112	498	118	525	86	121	538	127	565	75		
0.024	0.61	97	431	101	449	100	111	494	117	520	92	122	543	128	569	82	132	587	138	614	71		
0.025	0.64	104	463	110	489	96	120	534	126	560	88	133	592	139	618	78	142	632	150	667	68		
0.026	0.66	113	503	119	529	92	130	578	136	605	85	143	636	151	672	75	154	685	162	721	65		
0.027	0.69	122	543	128	569	88	140	623	148	658	82	154	685	162	721	72	166	738	174	774	63		
0.028	0.71	131	583	137	609	86	151	672	159	707	79	166	738	174	774	69	178	792	188	836	60		
0.029	0.74	140	623	148	658	83	162	721	170	756	76	177	787	187	832	66	191	850	201	894	58		
0.030	0.76	150	667	158	703	80	173	770	181	805	73	190	845	200	890	64	205	912	215	956	55		
0.031	0.79	160	712	168	747	77	184	818	194	863	71	203	903	213	947	62	218	970	230	1,023	54		
0.032	0.81	171	761	179	796	74	196	872	206	916	68	215	956	227	1,010	59	232	1,032	244	1,085	51		
0.033	0.84	181	805	191	850	72	209	930	219	974	67	229	1,019	241	1,072	57	247	1,099	259	1,150	50		
0.034	0.86	192	854	202	898	70	221	983	233	1,036	65	244	1,085	256	1,139	56	261	1,161	275	1,223	49		
0.035	0.89	204	907	214	952	68	234	1,041	246	1,094	63	257	1,143	271	1,205	54	277	1,232	291	1,294	47		
0.036	0.91	215	956	227	1,010	67	248	1,103	260	1,156	61	273	1,214	287	1,277	52	293	1,303	309	1,374	45		
0.037	0.94	227	1,010	239	1,063	65	261	1,161	275	1,223	59	288	1,281	302	1,343	50	309	1,374	325	1,446	43		
0.038	0.97	240	1,068	252	1,121	63	276	1,228	290	1,290	58	303	1,348	319	1,419	49	326	1,450	342	1,521	43		
0.039	0.99	253	1,125	265	1,179	61	291	1,294	305	1,357	56	319	1,419	335	1,490	47	343	1,526	361	1,606	41		
0.040	1.02	265	1,179	279	1,241	59	305	1,357	321	1,428	54	335	1,490	353	1,570	46	361	1,606	379	1,686	40		
0.041	1.04	279	1,241	293	1,303	58	321	1,428	337	1,499	53	352	1,566	370	1,646	45	378	1,681	398	1,770	39		
0.042	1.07	293	1,303	308	1,370	56	336	1,495	354	1,575	52	370	1,646	388	1,726	43	397	1,766	417	1,855	37		
0.043	1.09	306	1,361	322	1,432	55	352	1,566	370	1,646	50	387	1,721	407	1,810	42	416	1,850	438	1,948	36		
0.044	1.12	320	1,423	336	1,495	54	369	1,641	387	1,721	49	405	1,801	425	1,890	41	436	1,939	458	2,037	36		

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	
			Level 2				Level 3				Level 4				Level 5							
			Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)		Bright (Uncoated)			
			Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or		Drawn-Galvanized or			
			Breaking Strength		Breaking Strength		Breaking Strength		Breaking Strength		Breaking Strength		Breaking Strength		Breaking Strength		Breaking Strength		Breaking Strength			
			Individual	Average	Individual	Average	Individual	Average	Individual	Average	Individual	Average	Individual	Average	Individual	Average	Individual	Average	Individual	Average	Individual	Average
			Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum	Minimum
			lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N
			Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.
Wire Size	Nonmetal Diameter	in.	mm																			
	0.0045	1.14	334	1,486	352	1,566	52	1,712	405	1,801	48	423	1,882	445	1,979	40	455	2,024	479	2,131	35	
	0.0046	1.17	349	1,552	367	1,632	51	1,788	422	1,877	48	442	1,966	464	2,064	39	475	2,113	499	2,220	34	
	0.0047	1.19	365	1,624	383	1,704	50	1,864	441	1,962	47	461	2,051	485	2,157	38	495	2,202	521	2,317	33	
	0.0048	1.22	380	1,690	400	1,779	49	1,944	459	2,042	46	481	2,139	505	2,246	37	517	2,300	543	2,415	32	
	0.0049	1.24	396	1,761	416	1,850	48	2,024	479	2,131	45	500	2,224	526	2,340	36	538	2,393	566	2,518	32	
	0.0050	1.27	411	1,828	433	1,926	48	2,108	498	2,215	44	521	2,317	547	2,433	35	560	2,491	588	2,615	31	
	0.0051	1.30	428	1,904	450	2,002	47	2,188	518	2,304	43	541	2,406	569	2,531	34	582	2,589	612	2,722	30	
	0.0052	1.32	445	1,979	467	2,077	46	2,277	538	2,393	42	563	2,504	591	2,629	34	605	2,691	636	2,829	29	
	0.0053	1.35	462	2,055	486	2,162	45	2,362	559	2,486	41	584	2,598	614	2,731	33	628	2,793	660	2,936	29	
	0.0054	1.37	479	2,131	503	2,237	44	2,451	579	2,575	40	605	2,691	637	2,833	32	651	2,896	685	3,047	28	
	0.0055	1.40	496	2,206	522	2,322	43	2,540	601	2,673	39	628	2,793	660	2,936	31	676	3,007	710	3,158	27	
	0.0056	1.42	515	2,291	541	2,406	42	2,633	622	2,767	39	650	2,891	684	3,042	31	700	3,114	736	3,274	27	
	0.0057	1.45	532	2,366	560	2,491	41	2,722	644	2,865	38	674	2,998	708	3,149	30	724	3,220	762	3,389	26	
	0.0058	1.47	551	2,451	579	2,575	41	2,820	666	2,962	37	697	3,100	733	3,260	29	750	3,336	788	3,505	26	
	0.0059	1.50	569	2,531	599	2,664	40	2,913	689	3,065	36	721	3,207	757	3,367	29	775	3,447	815	3,625	25	

Table 4—Mechanical Properties of Individual Rope Wires—After Fabrication (Continued)

Wire Size Nominal Diameter in. mm	Level 2				Level 3				Level 4				Level 5			
	Bright (Uncoated)				Bright (Uncoated)				Bright (Uncoated)				Bright (Uncoated)			
	Drawn-Galvanized Breaking Strength Average Minimum				Drawn-Galvanized Breaking Strength Average Minimum				Drawn-Galvanized Breaking Strength Average Minimum				Drawn-Galvanized Breaking Strength Average Minimum			
	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N
	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.	Min.	Tor.
0.080	2.03	1,033	4,595	1,085	4,826	29	1,188	5,284	1,248	5,551	27	1,307	5,814	1,374	6,112	19
0.081	2.06	1,058	4,706	1,112	4,946	29	1,217	5,413	1,279	5,689	27	1,339	5,956	1,407	6,258	19
0.082	2.08	1,083	4,817	1,139	5,066	29	1,246	5,542	1,310	5,827	26	1,371	6,098	1,441	6,410	18
0.083	2.11	1,110	4,937	1,166	5,186	28	1,276	5,676	1,342	5,969	26	1,404	6,245	1,476	6,565	18
0.084	2.13	1,136	5,053	1,194	5,311	28	1,306	5,809	1,372	6,103	26	1,436	6,387	1,510	6,716	18
0.085	2.16	1,162	5,169	1,222	5,435	28	1,337	5,947	1,405	6,249	25	1,470	6,539	1,546	6,877	18
0.086	2.18	1,189	5,289	1,249	5,556	27	1,367	6,080	1,437	6,392	25	1,503	6,685	1,581	7,032	18
0.087	2.21	1,216	5,409	1,278	5,685	27	1,398	6,218	1,470	6,539	25	1,538	6,841	1,616	7,188	18
0.088	2.24	1,243	5,529	1,307	5,814	27	1,429	6,356	1,503	6,685	24	1,573	6,997	1,653	7,353	17
0.089	2.26	1,270	5,649	1,336	5,943	26	1,462	6,503	1,536	6,832	24	1,607	7,148	1,689	7,513	17
0.090	2.29	1,299	5,778	1,365	6,072	26	1,493	6,641	1,569	6,979	24	1,642	7,304	1,726	7,677	17
0.091	2.31	1,326	5,898	1,394	6,201	26	1,525	6,783	1,603	7,130	23	1,678	7,464	1,764	7,846	17
0.092	2.34	1,355	6,027	1,425	6,338	25	1,558	6,930	1,638	7,286	23	1,714	7,624	1,802	8,015	16
0.093	2.36	1,384	6,156	1,454	6,467	25	1,591	7,077	1,673	7,442	23	1,750	7,784	1,840	8,184	16
0.094	2.39	1,413	6,285	1,485	6,605	25	1,624	7,224	1,708	7,597	23	1,786	7,944	1,878	8,353	16
0.095	2.41	1,442	6,414	1,516	6,743	24	1,658	7,375	1,743	7,753	22	1,823	8,109	1,917	8,527	16
0.096	2.44	1,471	6,543	1,547	6,881	24	1,692	7,526	1,778	7,909	22	1,861	8,278	1,957	8,705	15
0.097	2.46	1,501	6,676	1,577	7,014	24	1,726	7,677	1,814	8,069	22	1,898	8,442	1,996	8,878	15
0.098	2.49	1,531	6,810	1,609	7,157	24	1,761	7,833	1,851	8,233	22	1,936	8,611	2,036	9,056	15
0.099	2.51	1,561	6,943	1,641	7,299	23	1,795	7,984	1,887	8,393	21	1,975	8,785	2,077	9,238	15
0.100	2.54	1,592	7,081	1,674	7,446	23	1,830	8,140	1,924	8,558	21	2,013	8,954	2,117	9,416	15
0.101	2.57	1,622	7,215	1,706	7,588	23	1,866	8,300	1,962	8,727	21	2,052	9,127	2,158	9,599	15
0.102	2.59	1,654	7,357	1,738	7,731	23	1,902	8,460	2,000	8,896	21	2,092	9,305	2,200	9,786	15
0.103	2.62	1,685	7,495	1,771	7,877	22	1,938	8,620	2,038	9,065	20	2,131	9,479	2,241	9,968	15
0.104	2.64	1,717	7,637	1,805	8,029	22	1,974	8,780	2,076	9,234	20	2,172	9,661	2,284	10,159	15
0.105	2.67	1,749	7,780	1,839	8,180	22	2,011	8,945	2,115	9,408	20	2,212	9,839	2,326	10,346	14
0.106	2.69	1,781	7,922	1,873	8,331	22	2,048	9,110	2,154	9,581	20	2,253	10,021	2,369	10,537	14
0.107	2.72	1,814	8,069	1,907	8,482	21	2,086	9,279	2,192	9,750	20	2,294	10,204	2,412	10,729	14
0.108	2.74	1,847	8,215	1,941	8,634	21	2,124	9,448	2,232	9,928	19	2,336	10,391	2,456	10,924	14
0.109	2.77	1,880	8,362	1,976	8,789	21	2,162	9,617	2,272	10,106	19	2,377	10,573	2,499	11,116	14
0.110	2.79	1,913	8,509	2,011	8,945	21	2,200	9,786	2,312	10,284	19	2,420	10,764	2,544	11,316	13
0.111	2.82	1,946	8,656	2,046	9,101	21	2,239	9,959	2,353	10,466	19	2,462	10,951	2,588	11,511	13
0.112	2.84	1,980	8,807	2,082	9,261	20	2,278	10,133	2,394	10,649	19	2,505	11,142	2,633	11,712	13
0.113	2.87	2,014	8,958	2,118	9,421	20	2,317	10,306	2,435	10,831	18	2,548	11,334	2,678	11,912	13
0.114	2.90	2,048	9,110	2,154	9,581	20	2,356	10,479	2,476	11,013	18	2,592	11,529	2,724	12,116	13

Table 4—Mechanical Properties of Individual Rope Wires—After Fabrication (Continued)

Wire Size Nominal Diameter in. mm	Level 2					Level 3					Level 4					Level 5				
	Bright (Uncoated)					Bright (Uncoated)					Bright (Uncoated)					Bright (Uncoated)				
	Drawn-Galvanized Breaking Strength					Drawn-Galvanized Breaking Strength					Drawn-Galvanized Breaking Strength					Drawn-Galvanized Breaking Strength				
	Individual Minimum	Average Minimum	Min.	Tor.		Individual Minimum	Average Minimum	Min.	Tor.		Individual Minimum	Average Minimum	Min.	Tor.		Individual Minimum	Average Minimum	Min.	Tor.	
	lb	N	lb	N		lb	N	lb	N		lb	N	lb	N		lb	N	lb	N	
0.115 2.92	2,084	9,270	2,190	9,741	20	2,396	10,657	2,518	11,200	18	2,635	11,720	2,771	12,325	13	2,833	12,601	2,979	13,251	11
0.116 2.95	2,118	9,421	2,226	9,901	20	2,436	10,835	2,560	11,387	18	2,679	11,916	2,817	12,530	12	2,880	12,810	3,028	13,469	11
0.117 2.97	2,154	9,581	2,264	10,070	19	2,477	11,018	2,604	11,583	18	2,724	12,116	2,864	12,739	12	2,928	13,024	3,078	13,691	11
0.118 3.00	2,189	9,737	2,301	10,235	19	2,517	11,196	2,647	11,774	17	2,769	12,317	2,911	12,948	12	2,977	13,242	3,129	13,918	11
0.119 3.02	2,224	9,892	2,338	10,399	19	2,558	11,378	2,690	11,965	17	2,814	12,517	2,958	13,157	12	3,024	13,451	3,180	14,145	11
0.120 3.05	2,260	10,052	2,376	10,568	19	2,599	11,560	2,737	12,156	17	2,860	12,721	3,006	13,371	12	3,074	13,673	3,232	14,376	10
0.121 3.07	2,296	10,213	2,414	10,737	19	2,641	11,747	2,777	12,352	17	2,906	12,926	3,055	13,589	12	3,123	13,891	3,283	14,603	10
0.122 3.10	2,333	10,377	2,453	10,911	18	2,683	11,934	2,821	12,548	17	2,951	13,126	3,103	13,802	11	3,173	14,114	3,335	14,834	10
0.123 3.12	2,370	10,542	2,492	11,084	18	2,725	12,121	2,865	12,744	17	2,998	13,335	3,152	14,020	11	3,222	14,331	3,388	15,070	10
0.124 3.15	2,406	10,702	2,530	11,253	18	2,768	12,312	2,910	12,944	17	3,045	13,544	3,201	14,238	11	3,273	14,558	3,441	15,306	9
0.125 3.18	2,444	10,871	2,570	11,431	18	2,811	12,503	2,955	13,144	16	3,092	13,753	3,250	14,456	11	3,324	14,785	3,494	15,541	9
0.126 3.20	2,481	11,035	2,609	11,605	18	2,854	12,695	3,000	13,344	16	3,140	13,967	3,301	14,683	11	3,374	15,008	3,548	15,782	9
0.127 3.23	2,519	11,205	2,649	11,783	18	2,897	12,886	3,045	13,544	16	3,187	14,176	3,351	14,905	11	3,426	15,239	3,602	16,022	9
0.128 3.25	2,557	11,374	2,689	11,961	17	2,941	13,082	3,091	13,749	16	3,235	14,389	3,401	15,128	10	3,478	15,470	3,656	16,262	9
0.129 3.28	2,595	11,543	2,729	12,139	17	2,984	13,273	3,138	13,958	16	3,284	14,607	3,452	15,354	10	3,530	15,701	3,711	16,507	9
0.130 3.30	2,634	11,716	2,770	12,321	17	3,029	13,473	3,185	14,167	16	3,333	14,825	3,503	15,581	10	3,582	15,933	3,766	16,751	9
0.131 3.33	2,672	11,885	2,810	12,499	17	3,074	13,673	3,232	14,376	16	3,381	15,039	3,555	15,813	10	3,635	16,168	3,821	16,996	8
0.132 3.35	2,711	12,059	2,851	12,681	17	3,119	13,873	3,279	14,585	15	3,431	15,261	3,607	16,044	10	3,687	16,400	3,877	17,245	8
0.133 3.38	2,751	12,236	2,893	12,868	17	3,164	14,073	3,326	14,794	15	3,481	15,483	3,659	16,275	10	3,741	16,640	3,933	17,494	8
0.134 3.40	2,790	12,410	2,934	13,050	17	3,210	14,278	3,374	15,008	15	3,530	15,701	3,712	16,511	9	3,795	16,880	3,989	17,743	8
0.135 3.43	2,830	12,588	2,976	13,237	16	3,256	14,483	3,422	15,221	15	3,580	15,924	3,764	16,742	9	3,849	17,120	4,047	18,001	8
0.136 3.45	2,870	12,766	3,018	13,424	16	3,301	14,683	3,471	15,439	15	3,631	16,151	3,817	16,978	9	3,904	17,365	4,104	18,255	8
0.137 3.48	2,911	12,948	3,061	13,615	16	3,347	14,887	3,519	15,653	15	3,683	16,382	3,871	17,218	9	3,959	17,610	4,162	18,513	8
0.138 3.51	2,951	13,126	3,103	13,802	16	3,394	15,097	3,568	15,870	15	3,733	16,604	3,925	17,458	9	4,014	17,854	4,220	18,771	8
0.139 3.53	2,992	13,308	3,146	13,993	16	3,441	15,306	3,617	16,088	14	3,785	16,836	3,979	17,699	9	4,069	18,099	4,277	19,024	8
0.140 3.56	3,033	13,491	3,189	14,185	16	3,489	15,519	3,667	16,311	14	3,837	17,067	4,033	17,939	8	4,125	18,348	4,337	19,291	7
0.141 3.58	3,074	13,673	3,232	14,376	16	3,535	15,724	3,717	16,533	14	3,889	17,298	4,089	18,188	8	4,181	18,597	4,395	19,549	7
0.142 3.61	3,116	13,860	3,276	14,572	16	3,583	15,937	3,767	16,756	14	3,942	17,534	4,144	18,433	8	4,237	18,846	4,455	19,816	7
0.143 3.63	3,158	14,047	3,320	14,767	15	3,632	16,155	3,818	16,982	14	3,995	17,770	4,199	18,677	8	4,294	19,100	4,514	20,078	7
0.144 3.66	3,200	14,234	3,364	14,963	15	3,680	16,369	3,868	17,205	14	4,048	18,006	4,256	18,931	8	4,351	19,353	4,575	20,350	7
0.145 3.68	3,242	14,420	3,408	15,159	15	3,728	16,582	3,920	17,436	14	4,102	18,246	4,312	19,180	8	4,409	19,611	4,635	20,616	7
0.146 3.71	3,285	14,612	3,453	15,359	15	3,777	16,800	3,971	17,663	14	4,155	18,481	4,369	19,433	8	4,466	19,865	4,696	20,888	7
0.147 3.73	3,328	14,803	3,498	15,559	15	3,827	17,022	4,023	17,894	14	4,209	18,722	4,425	19,682	8	4,525	20,127	4,757	21,159	7
0.148 3.76	3,371	14,994	3,543	15,759	15	3,876	17,240	4,074	18,121	13	4,264	18,966	4,482	19,936	8	4,583	20,385	4,819	21,435	7
0.149 3.78	3,413	15,181	3,589	15,964	15	3,925	17,458	4,127	18,357	13	4,318	19,206	4,540	20,194	7	4,642	20,648	4,880	21,706	6

Table 4—Mechanical Properties of Individual Rope Wires—After Fabrication (Continued)

Wire Size Nominal Diameter in.	(1)	(2)	Level 2				(6)	(7)	(8)	Level 3				(11)	(12)	(13)	Level 4				(16)	(17)	(18)	Level 5				(20)	(21)	(22)	
			Bright (Uncoated) or Drawn-Galvanized							Bright (Uncoated) or Drawn-Galvanized							Bright (Uncoated) or Drawn-Galvanized							Bright (Uncoated) or Drawn-Galvanized							
			Individual Minimum	N	Average Minimum	Min. Tor.				Individual Minimum	N	Average Minimum	Min. Tor.				Individual Minimum	N	Average Minimum	Min. Tor.				Individual Minimum	N	Average Minimum	Min. Tor.				Individual Minimum
0.150	3.81	3.457	15,377	3,635	16,168	15	3,976	17,685	4,180	18,593	13	4,374	19,456	4,598	20,452	7	4,701	20,910	4,943	21,986	6	4,761	21,177	5,005	22,262	6	4,820	21,439	5,068	22,542	6
0.151	3.84	3.501	15,572	3,681	16,373	14	4,026	17,908	4,232	18,824	13	4,428	19,696	4,656	20,710	7	4,820	21,439	5,068	22,542	6	4,881	21,711	5,131	22,823	6	4,941	21,978	5,195	23,107	6
0.152	3.86	3.545	15,768	3,727	16,578	14	4,076	18,130	4,286	19,064	13	4,484	19,945	4,714	20,968	7	4,941	21,978	5,195	23,107	6	5,002	22,249	5,258	23,388	6	5,063	22,520	5,323	23,677	6
0.153	3.89	3.589	15,964	3,773	16,782	14	4,127	18,357	4,339	19,300	13	4,541	20,198	4,773	21,230	7	5,063	22,520	5,323	23,677	6	5,125	22,796	5,387	23,961	6	5,186	23,067	5,452	24,250	6
0.154	3.91	3.634	16,164	3,820	16,991	14	4,179	18,588	4,393	19,540	13	4,596	20,443	4,832	21,493	7	5,186	23,067	5,452	24,250	6	5,248	23,343	5,518	24,544	6	5,311	23,623	5,583	24,833	5
0.155	3.94	3.679	16,364	3,867	17,200	14	4,230	18,815	4,446	19,776	13	4,653	20,697	4,891	21,755	7	5,311	23,623	5,583	24,833	5	5,373	23,899	5,649	25,127	5	5,437	24,184	5,715	25,420	5
0.156	3.96	3.724	16,564	3,914	17,409	14	4,281	19,042	4,501	20,020	13	4,710	20,950	4,952	22,026	7	5,437	24,184	5,715	25,420	5	5,500	24,464	5,782	25,718	5	5,563	24,744	5,849	26,016	5
0.157	3.99	3.768	16,760	3,962	17,623	14	4,334	19,278	4,556	20,265	13	4,767	21,204	5,011	22,289	7	5,563	24,744	5,849	26,016	5	5,628	25,033	5,916	26,314	5	5,692	25,318	5,984	26,617	5
0.158	4.01	3.814	16,965	4,010	17,836	14	4,386	19,509	4,610	20,505	12	4,824	21,457	5,072	22,560	7	5,692	25,318	5,984	26,617	5	5,756	25,603	6,052	26,919	5	5,821	25,892	6,119	27,217	5
0.159	4.04	3.859	17,165	4,057	18,046	14	4,438	19,740	4,666	20,754	12	4,882	21,715	5,132	22,827	7	5,784	25,727	6,080	27,044	6	5,886	26,181	6,188	27,524	5	5,951	26,470	6,257	27,831	5
0.160	4.06	3.905	17,369	4,105	18,259	13	4,491	19,976	4,721	20,999	12	4,940	21,973	5,194	23,103	6	5,951	26,470	6,257	27,831	5	6,018	26,768	6,326	28,138	5	6,084	27,062	6,396	28,449	5
0.161	4.09	3.952	17,578	4,154	18,477	13	4,544	20,212	4,778	21,253	12	4,999	22,236	5,255	23,374	6	6,084	27,062	6,396	28,449	5	6,150	27,355	6,466	28,761	5	6,217	27,653	6,535	29,068	5
0.162	4.11	3.998	17,783	4,203	18,695	13	4,597	20,447	4,833	21,497	12	5,057	22,494	5,317	23,650	6	6,217	27,653	6,535	29,068	5	6,284	27,951	6,606	29,383	5	6,351	28,249	6,677	29,699	5
0.163	4.14	4,044	17,988	4,252	18,913	13	4,651	20,688	4,889	21,746	12	5,116	22,756	5,378	23,921	6	6,351	28,249	6,677	29,699	5	6,419	28,552	6,749	30,020	5	6,487	28,854	6,819	30,331	5
0.164	4.17	4,091	18,197	4,301	19,131	13	4,704	20,923	4,946	22,000	12	5,175	23,018	5,441	24,202	6	6,487	28,854	6,819	30,331	5	6,555	29,157	6,891	30,651	5	6,624	29,464	6,964	30,976	5
0.165	4.19	4,138	18,406	4,350	19,349	13	4,759	21,168	5,003	22,253	12	5,235	23,285	5,503	24,477	6	6,624	29,464	6,964	30,976	5	6,692	29,766	7,036	31,296	5	6,762	30,077	7,108	31,616	5
0.166	4.22	4,186	18,619	4,400	19,571	13	4,814	21,413	5,060	22,507	12	5,294	23,548	5,566	24,758	6	6,762	30,077	7,108	31,616	5	6,832	30,389	7,182	31,946	5	6,901	30,696	7,255	32,270	5
0.167	4.24	4,232	18,824	4,450	19,794	13	4,868	21,653	5,118	22,765	12	5,355	23,819	5,629	25,038	6	6,901	30,696	7,255	32,270	5	6,971	31,009	7,328	32,599	5	7,041	31,321	7,401	32,641	5
0.168	4.27	4,280	19,037	4,500	20,016	13	4,923	21,898	5,175	23,018	12	5,415	24,086	5,693	25,322	6	7,041	31,321	7,401	32,641	5	7,111	31,634	7,471	32,964	5	7,182	31,946	7,542	33,277	5
0.169	4.29	4,329	19,255	4,551	20,243	13	4,977	22,138	5,233	23,276	11	5,476	24,357	5,756	25,603	6	7,182	31,946	7,542	33,270	5	7,253	32,270	7,613	33,599	5	7,324	32,599	7,684	33,920	5
0.170	4.32	4,377	19,469	4,601	20,465	13	5,033	22,387	5,291	23,534	11	5,537	24,629	5,821	25,892	6	7,253	32,270	7,613	33,599	5	7,324	32,599	7,684	33,920	5	7,395	32,921	7,755	34,241	5
0.171	4.34	4,426	19,687	4,652	20,692	12	5,089	22,636	5,349	23,792	11	5,597	24,895	5,885	26,176	6	7,395	32,921	7,684	33,920	5	7,466	33,242	7,826	34,562	5	7,537	33,563	7,897	34,883	5
0.172	4.37	4,474	19,900	4,704	20,923	12	5,145	22,885	5,409	24,039	11	5,659	25,171	5,949	26,461	6	7,466	33,242	7,684	33,920	5	7,537	33,563	7,897	34,883	5	7,608	33,874	7,968	35,204	5
0.173	4.39	4,523	20,118	4,755	21,150	12	5,201	23,134	5,467	24,317	11	5,721	25,447	6,015	26,755	6	7,537	33,563	7,897	34,883	5	7,608	33,874	7,968	35,204	5	7,679	34,185	8,039	35,525	5
0.174	4.42	4,572	20,336	4,806	21,377	12	5,257	23,383	5,527	24,584	11	5,784	25,727	6,080	27,044	6	7,679	34,185	8,039	35,525	5	7,750	34,496	8,110	35,846	5	7,821	34,807	8,191	36,167	5
0.175	4.45	4,622	20,559	4,859	21,613	12	5,314	23,637	5,586	24,847	11	5,846	26,003	6,146	27,337	6	7,750	34,496	8,110	35,525	5	7,821	34,807	8,191	36,167	5	7,892	35,118	8,262	36,488	5
0.176	4.47	4,670	20,772	4,910	21,840	12	5,371	23,890	5,647	25,118	11	5,909	26,283	6,212	27,631	6	7,892	35,118	8,262	36,488	5	7,963	35,428	8,333	36,809	5	8,034	35,739	8,404	37,130	5
0.177	4.50	4,720	20,995	4,962	22,071	12	5,429	24,148	5,707	25,385	11	5,971	26,559	6,277	27,920	6	8,034	35,739	8,404	37,130	5	8,105	36,050	8,475	37,451	5	8,176	36,361	8,546	37,772	5
0.178	4.52	4,771	21,221	5,015	22,307	12	5,486	24,402	5,768	25,636	11	6,034	26,839	6,344	28,218	6	8,176	36,361	8,546	37,772	5	8,247	36,673	8,617	38,093	5	8,318	36,984	8,688	38,414	5
0.179	4.55	4,820	21,439	5,068	22,542	12	5,544	24,660	5,828	25,923	11	6,098	27,124	6,410	28,512	6	8,318	36,984	8,688	38,414	5	8,389	37,285	8,759	38,735	5	8,459	37,596	8,830	39,056	5
0.180	4.57	4,871	21,666	5,121	22,778	12	5,601	24,913	5,889	26,194	11	6,162	27,409	6,478	28,814	6	8,459	37,596	8,830	39,056	5	8,530	37,907	8,901	39,377	5	8,601	38,218	9,023	40,000	5
0.181	4.60	4,922	21,893	5,174	23,014	12	5,660	25,176	5,950	26,466	11	6,226	27,693	6,546	29,117	6	8,601	38,218	9,023	40,000	5	8,692	38,529	9,094	40,321	5	8,763	38,840	9,165	40,642	5
0.182	4.62	4,973	22,120	5,228	23,254	12	5,718	25,434	6,012	26,741	10	6,291	27,982	6,623	29,415	6	8,763	38,840	9,165	40,642	5	8,832	39,293	9,235	40,963	5	8,903	39,604	9,306	41,284	5
0.183	4.65	5,023	22,342	5,281	23,490	11	5,777	25,696	6,073	27,013	10	6,355	28,267	6,681	29,717	6	8,903	39,604	9,306	41,284	5	8,978	39,915	9,377	41,605	5	9,049	40,226	9,448	411	

Table 4—Mechanical Properties of Individual Rope Wires—After Fabrication (Continued)

Wire Size Nominal Diameter in.	(2)	Level 2						(7)	Level 3						(12)	Level 4						Level 5					
		Bright (Uncoated)							Min. Tor.	Bright (Uncoated)						Min. Tor.	Bright (Uncoated)						Min. Tor.				
		Drawn-Galvanized Breaking Strength								Min. Tor.	Drawn-Galvanized Breaking Strength						Min. Tor.	Drawn-Galvanized Breaking Strength						Min. Tor.			
		Individual Minimum	Average Minimum	N	lb	Min. Tor.	Individual Minimum				Average Minimum	N	lb	Min. Tor.				Individual Minimum	Average Minimum	N	lb	Min. Tor.			Individual Minimum	Average Minimum	N
0.185	4.70	5.127	22,805	5.389	23,970	11	5.896	26,225	6.198	27,569	10	6.485	28,845	6.817	30,322	5	6.971	31,007	7.329	32,599	5						
0.186	4.72	5.178	23,032	5.444	24,215	11	5.955	26,488	6.261	27,849	10	6.550	29,134	6.886	30,629	5	7.041	31,318	7.403	32,929	5						
0.187	4.75	5.230	23,263	5.498	24,455	11	6.015	26,755	6.323	28,125	10	6.616	29,428	6.956	30,940	5	7.113	31,639	7.477	33,258	5						
0.188	4.78	5.283	23,499	5.553	24,700	11	6.074	27,017	6.386	28,405	10	6.683	29,726	7.025	31,247	5	7.184	31,954	7.552	33,591	5						
0.189	4.80	5.335	23,730	5.609	24,949	11	6.135	27,288	6.449	28,685	10	6.748	30,015	7.094	31,554	5	7.255	32,270	7.627	33,925	5						
0.190	4.83	5.387	23,961	5.663	25,189	11	6.195	27,555	6.513	28,970	10	6.815	30,313	7.165	31,870	5	7.326	32,586	7.702	34,258	5						
0.191	4.85	5.441	24,202	5.720	25,443	11	6.257	27,831	6.577	29,254	10	6.882	30,611	7.234	32,177	5	7.398	32,906	7.778	34,597	5						
0.192	4.88	5.493	24,433	5.775	25,687	11	6.317	28,098	6.641	29,539	10	6.949	30,909	7.305	32,493	5	7.470	33,227	7.854	34,935	4						
0.193	4.90	5.547	24,673	5.831	25,936	11	6.378	28,369	6.706	29,828	10	7.016	31,207	7.376	32,808	5	7.543	33,551	7.929	35,268	4						
0.194	4.93	5.600	24,909	5.888	26,190	11	6.440	28,645	6.770	30,113	10	7.084	31,510	7.448	33,129	5	7.615	33,872	8.005	35,606	4						
0.195	4.95	5.654	25,149	5.944	26,439	11	6.501	28,916	6.835	30,402	10	7.152	31,812	7.518	33,440	5	7.688	34,196	8.082	35,949	4						
0.196	4.98	5.708	25,389	6.000	26,688	11	6.564	29,197	6.900	30,691	10	7.220	32,115	7.590	33,760	5	7.762	34,525	8.160	36,296	4						
0.197	5.00	5.761	25,625	6.057	26,942	10	6.626	29,472	6.966	30,985	10	7.288	32,417	7.662	34,081	5	7.835	34,850	8.237	36,638	4						
0.198	5.03	5.816	25,870	6.114	27,195	10	6.689	29,753	7.032	31,278	10	7.357	32,724	7.735	34,405	5	7.909	35,179	8.315	36,985	4						
0.199	5.05	5.870	26,110	6.172	27,453	10	6.751	30,028	7.097	31,567	10	7.427	33,035	7.807	34,726	5	7.983	35,508	8.393	37,332	4						
0.200	5.08	5.925	26,354	6.229	27,707	10	6.814	30,309	7.164	31,865	10	7.496	33,342	7.880	35,050	5	8.057	35,838	8,471	37,679	4						
0.201	5.11	5.980	26,599	6.286	27,960	10	6.877	30,589	7,229	32,155	10	7.565	33,649	7.953	35,375	5	8.132	36,171	8.550	38,030	4						
0.202	5.13	6.035	26,844	6.345	28,223	10	6.940	30,869	7.296	32,453	10	7.634	33,956	8,026	35,700	5	8.208	36,509	8,628	38,377	4						
0.203	5.16	6.091	27,093	6.403	28,481	10	7.004	31,154	7.364	32,755	10	7.704	34,267	8,100	36,029	5	8.283	36,843	8,707	38,729	4						
0.204	5.18	6.146	27,337	6.462	28,743	10	7.068	31,438	7.430	33,049	10	7.775	34,583	8,173	36,354	5	8.358	37,176	8,786	39,080	4						
0.205	5.21	6.202	27,586	6.520	29,001	10	7.132	31,723	7.498	33,351	10	7.846	34,899	8,248	36,687	5	8.434	37,514	8,866	39,436	4						
0.206	5.23	6.258	27,836	6.578	29,259	10	7.196	32,008	7.566	33,654	10	7.916	35,210	8,322	37,016	5	8.510	37,852	8,946	39,792	4						
0.207	5.26	6.314	28,085	6.638	29,526	10	7.261	32,297	7.633	33,952	10	7.987	35,526	8,397	37,350	5	8.586	38,191	9,026	40,148	4						
0.208	5.28	6.371	28,338	6.697	29,788	10	7.326	32,586	7.702	34,258	10	8.058	35,842	8,472	37,683	5	8.663	38,533	9,107	40,508	4						
0.209	5.31	6.427	28,587	6.757	30,055	10	7.391	32,875	7.771	34,565	10	8.131	36,167	8,547	38,017	5	8.740	38,876	9,188	40,868	4						
0.210	5.33	6.484	28,841	6.816	30,318	10	7.457	33,169	7.839	34,868	10	8.202	36,482	8,622	38,351	5	8.817	39,218	9,269	41,229	4						
0.211	5.36	6.540	29,090	6.876	30,584	10	7.522	33,458	7.908	35,175	10	8.274	36,803	8,698	38,689	5	8.895	39,565	9,351	41,593	4						
0.212	5.38	6.598	29,348	6.936	30,851	10	7.587	33,747	7.977	35,482	10	8.346	37,123	8,774	39,027	5	8.972	39,907	9,432	41,954	4						
0.213	5.41	6.655	29,601	6.997	31,123	10	7.654	34,045	8,046	35,789	10	8,419	37,448	8,851	39,369	5	9,050	40,254	9,514	42,318	4						
0.214	5.44	6,713	29,859	7.057	31,390	10	7.720	34,339	8,116	36,100	10	8,492	37,772	8,928	39,712	5	9,129	40,606	9,597	42,687	4						
0.215	5.46	6,770	30,113	7.118	31,661	10	7,786	34,632	8,186	36,411	9	8,564	38,093	9,004	40,050	5	9,207	40,953	9,679	43,052	4						
0.216	5.49	6,829	30,375	7.179	31,932	10	7,853	34,930	8,255	36,718	9	8,639	38,426	9,082	40,397	5	9,286	41,304	9,762	43,421	4						
0.217	5.51	6,886	30,629	7.240	32,204	10	7,920	35,228	8,326	37,034	9	8,712	38,751	9,158	40,735	5	9,365	41,656	9,845	43,791	4						
0.218	5.54	6,945	30,891	7.301	32,475	10	7,987	35,526	8,397	37,350	9	8,786	39,080	9,236	41,082	5	9,445	42,011	9,929	44,164	4						
0.219	5.56	7,003	31,149	7.363	32,751	10	8,054	35,824	8,468	37,666	9	8,860	39,409	9,314	41,429	5	9,524	42,363	10,012	44,533	4						

Table 4—Mechanical Properties of Individual Rope Wires—After Fabrication (Continued)

Wire Size Nominal Diameter in.	(1)	(2)	Level 2						Level 3						Level 4						Level 5						(21)	(22)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
			Bright (Uncoated)						Bright (Uncoated) or Drawn-Galvanized						Bright (Uncoated) or Drawn-Galvanized						Bright (Uncoated) or Drawn-Galvanized																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
			Individual Minimum	Individual Minimum	Average Minimum	Min. Tor.	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N	lb	N			lb	N	lb	N	lb	N	lb	N																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
0.220	5.59	7.063	31.416	7.425	33.026	10	8.122	36.127	8.538	37.977	9	8.934	39.738	9.392	41.776	4	9.604	42.719	10.096	44.907	4	9.885	43.079	10.181	45.285	4	9.765	43.435	10.265	45.659	4	9.846	43.795	10.350	46.037	4	9.926	44.151	10.436	46.419	4	10.007	44.511	10.521	46.797	4	10.089	44.876	10.607	47.180	4	10.171	45.241	10.693	47.562	4	10.253	45.605	10.779	47.945	4	10.335	45.970	10.865	48.328	4	10.418	46.339	10.952	48.714	4	10.501	46.708	11.039	49.101	4	10.584	47.078	11.126	49.488	4	10.667	47.447	11.214	49.880	4	10.750	47.816	11.302	50.271	4	10.834	48.190	11.390	50.663	4	10.918	48.563	11.478	51.054	4	11.002	48.937	11.566	51.446	4	11.087	49.315	11.655	51.841	4	11.172	49.693	11.744	52.237	4	11.256	50.067	11.834	52.638	3	11.342	50.449	11.924	53.038	3	11.427	50.827	12.013	53.434	3	11.513	51.210	12.103	53.834	3	11.600	51.597	12.194	54.239	3	11.685	51.975	12.285	54.644	3	11.772	52.362	12.376	55.048	3	11.859	52.749	12.467	55.453	3	11.946	53.136	12.558	55.858	3	12.032	53.518	12.650	56.267	3	12.120	53.910	12.742	56.676	3	12.208	54.298	12.833	57.077	3	12.296	54.685	12.924	57.486	3	12.384	55.073	13.012	57.895	3	12.472	55.461	13.100	58.304	3	12.560	55.850	13.188	58.713	3	12.648	56.239	13.276	59.122	3	12.736	56.620	13.364	59.531	3	12.824	57.008	13.452	59.940	3	12.912	57.396	13.540	60.349	3	13.000	57.784	13.628	60.758	3	13.088	58.172	13.716	61.167	3	13.176	58.560	13.804	61.576	3	13.264	58.948	13.892	61.985	3	13.352	59.336	13.980	62.394	3	13.440	59.724	14.068	62.803	3	13.528	60.112	14.156	63.212	3	13.616	60.500	14.244	63.621	3	13.704	60.888	14.332	64.030	3	13.792	61.276	14.420	64.439	3	13.880	61.664	14.508	64.848	3	13.968	62.052	14.596	65.257	3	14.056	62.440	14.684	65.666	3	14.144	62.828	14.772	66.075	3	14.232	63.216	14.860	66.484	3	14.320	63.604	14.948	66.893	3	14.408	63.992	15.036	67.302	3	14.496	64.380	15.124	67.711	3	14.584	64.768	15.212	68.120	3	14.672	65.156	15.300	68.529	3	14.760	65.544	15.388	68.938	3	14.848	65.932	15.476	69.347	3	14.936	66.320	15.564	69.756	3	15.024	66.708	15.652	70.165	3	15.112	67.096	15.740	70.574	3	15.200	67.484	15.828	70.983	3	15.288	67.872	15.916	71.392	3	15.376	68.260	16.004	71.801	3	15.464	68.648	16.092	72.210	3	15.552	69.036	16.180	72.619	3	15.640	69.424	16.268	73.028	3	15.728	69.812	16.356	73.437	3	15.816	70.200	16.444	73.846	3	15.904	70.588	16.532	74.255	3	15.992	70.976	16.620	74.664	3	16.080	71.364	16.708	75.073	3	16.168	71.752	16.796	75.482	3	16.256	72.140	16.884	75.891	3	16.344	72.528	16.972	76.299	3	16.432	72.916	17.060	76.708	3	16.520	73.304	17.148	77.117	3	16.608	73.692	17.236	77.526	3	16.696	74.080	17.324	77.935	3	16.784	74.468	17.412	78.344	3	16.872	74.856	17.500	78.753	3	16.960	75.244	17.588	79.162	3	17.048	75.632	17.676	79.571	3	17.136	76.020	17.764	79.980	3	17.224	76.408	17.852	80.389	3	17.312	76.796	17.940	80.798	3	17.400	77.184	18.028	81.207	3	17.488	77.572	18.116	81.616	3	17.576	77.960	18.204	82.025	3	17.664	78.348	18.292	82.434	3	17.752	78.736	18.380	82.843	3	17.840	79.124	18.468	83.252	3	17.928	79.512	18.556	83.661	3	18.016	79.900	18.644	84.070	3	18.104	80.288	18.732	84.479	3	18.192	80.676	18.820	84.888	3	18.280	81.064	18.908	85.297	3	18.368	81.452	19.000	85.706	3	18.456	81.840	19.088	86.115	3	18.544	82.228	19.176	86.524	3	18.632	82.616	19.264	86.933	3	18.720	83.004	19.352	87.342	3	18.808	83.392	19.440	87.751	3	18.896	83.780	19.528	88.160	3	18.984	84.168	19.616	88.569	3	19.072	84.556	19.704	88.978	3	19.160	84.944	19.792	89.387	3	19.248	85.332	19.880	89.796	3	19.336	85.720	19.968	90.205	3	19.424	86.108	20.056	90.614	3	19.512	86.496	20.144	91.023	3	19.600	86.884	20.232	91.432	3	19.688	87.272	20.320	91.841	3	19.776	87.660	20.408	92.250	3	19.864	88.048	20.496	92.659	3	19.952	88.436	20.584	93.068	3	20.040	88.824	20.672	93.477	3	20.128	89.212	20.760	93.886	3	20.216	89.600	20.848	94.295	3	20.304	89.988	20.936	94.704	3	20.392	90.376	21.024	95.113	3	20.480	90.764	21.112	95.522	3	20.568	91.152	21.200	95.931	3	20.656	91.540	21.288	96.340	3	20.744	91.928	21.376	96.749	3	20.832	92.316	21.464	97.158	3	20.920	92.704	21.552	97.567	3	21.008	93.092	21.640	97.976	3	21.096	93.480	21.728	98.385	3	21.184	93.868	21.816	98.794	3	21.272	94.256	21.904	99.203	3	21.360	94.644	21.992	99.612	3	21.448	95.032	22.080	100.021	3	21.536	95.420	22.168	100.430	3	21.624	95.808	22.256	100.839	3	21.712	96.196	22.344	101.248	3	21.800	96.584	22.432	101.657	3	21.888	96.972	22.520	102.066	3	21.976	97.360	22.608	102.475	3	22.064	97.748	22.696	102.884	3	22.152	98.136	22.784	103.293	3	22.240	98.524	22.872	103.702	3	22.328	98.912	22.960	104.111	3	22.416	99.300	23.048	104.520	3	22.504	99.688	23.136	104.929	3	22.592	100.076	23.224	105.338	3	22.680	100.464	23.312	105.747	3	22.768	100.852	23.400	106.156	3	22.856	101.240	23.488	106.565	3	22.944	101.628	23.576	106.974	3	23.032	102.016	23.664	107.383	3	23.120	102.404	23.752	107.792	3	23.208	102.792	23.840	108.201	3	23.296	103.180	23.928	108.610	3	23.384	103.568	24.016	109.019	3	23.472	103.956	24.104	109.428	3	23.560	104.344	24.192	109.837	3	23.648	104.732	24.280	110.246	3	23.736	105.120	24.368	110.655	3	23.824	105.508	24.456	111.064	3	23.912	105.896	24.544	111.473	3	24.000	106.284	24.632	111.882	3	24.088	106.672	24.720	112.291	3	24.176	107.060	24.808	112.700	3	24.264	107.448	24.896	113.109	3	24.352	107.836	24.984	113.518	3	24.440	108.224	25.072	113.927	3	24.528	108.612	25.160	114.336	3	24.616	109.000	25.248	114.745	3	24.704	109.388	25.336	115.154	3	24.792	109.776	25.424	115.563	3	24.880	110.164	25.512	115.972	3	24.968	110.552	25.600	116.381	3	25.056	110.940	25.688	116.790	3	25.144	111.328	25.776	117.199	3	25.232	111.716	25.864	117.608	3	25.320	112.104	25.952	118.017	3	25.408	112.492	26.040	118.426	3	25.496	112.880	26.128	118.835	3	25.584	113.268	26.216	119.244	3	25.672	113.656	26.304	119.653	3	25.760	114.044	26.392	120.062	3	25.848	114.432	26.480	120.471	3	25.936	114.820	26.568	120.880	3	26.024	115.208	26.656	121.289	3	26.112	115.596	26.744	121.698	3	26.200	115.984	26.832	122.107	3	26.288	116.372	26.920	122.516	3	26.376	116.760	27.008	122.925	3	26.464	117.148	27.096	123.334	3	26.552	117.536	27.184	123.743	3	26.640	117.924	27.272	124.152	3	26.728	118.312	27.360	124.561	3	26.816	118.700	27.448	124.970	3	26.904	119.088	27.536	125.379	3	26.992	119.476	27.624	125.788	3	27.080	119.864	27.712	126.197	3	27.168	120.252	27.800	126.606	3	27.256	120.640	27.888	127.015	3	27.344	121.028	27.976	127.424	3	27.432	121.416	28.064	127.833	3	27.520	121.804	28.152	128.242	3	27.608	122.192	28.240	128.651	3	27.696	122.580	28.328	129.060	3	27.784	122.968	28.416	129.469	3	27.872	123.356	28.504	129.878	3	27.960	123.744	28.592	130.287	3	28.048	124.132	28.680	130.696	3	28.136	124.520	28.768	131.105	3	28.224	124.908	28.856	131.514	3	28.312	125.296	28.944	131.923	3	28.400	125.684	29.032	132.332	3	28.488	126.072	29.120	132.741	3	28.576	126.460	29.208	133.150	3	28.664	126.848	29.296	133.559	3	28.752	127.236	29.384	133.968	3	28.840	127.624	29.472	134.377	3	28.928	128.012	29.560	134.786	3	29.016	128.400	29.648	135.195	3	29.104	128.788	29.736	135.604	3	29.192	129.176	29.824	136.013	3	29.280	129.564	29.912	136.422	3	29.368	129.952	30.000	136.831	3	29.456	130.340	30.088	137.240	3	29.544	130.728	30.176	137.649	3	29.632	131.116	30.264	138.058	3	29.720	131.504	30.352	138.467	3	29.808	131.892	30.440	138.876	3	29.896	132.280	30.528	139.285	3

Table 5—Mechanical Properties of Individual Rope Wires (Before Fabrication)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Wire Size Nominal Diameter in.	mm	Level 2		Level 3		Level 4		Level 5		Level 5		Level 5	
		lb	N	Tor.	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.
0.010	0.25	17	76	254	20	89	234	22	98	218	24	107	190
0.011	0.28	21	93	231	24	107	213	27	120	198	29	129	173
0.012	0.30	25	111	212	29	129	195	32	142	182	34	151	158
0.013	0.33	29	129	195	34	151	180	37	165	168	40	178	146
0.014	0.36	34	151	181	39	173	167	43	191	156	46	205	136
0.015	0.38	39	173	169	45	200	156	49	218	145	53	236	126
0.016	0.41	44	196	158	51	227	146	56	249	136	60	267	118
0.017	0.43	50	222	149	57	254	137	63	280	128	68	302	111
0.018	0.46	56	249	141	64	285	130	71	316	121	76	338	105
0.019	0.48	62	276	133	72	320	123	79	351	114	85	378	100
0.020	0.51	69	307	126	79	351	116	87	387	108	94	418	94
0.021	0.53	76	338	120	87	387	111	96	427	103	103	458	90
0.022	0.56	83	369	115	96	427	106	105	467	98	113	503	86
0.023	0.58	91	405	110	105	467	101	115	512	94	124	552	82
0.024	0.61	99	440	105	114	507	97	125	556	90	135	600	78
0.025	0.64	107	476	101	123	547	93	136	605	86	146	649	75
0.026	0.66	116	516	97	133	592	89	147	654	83	158	703	72
0.027	0.69	125	556	93	144	641	86	158	703	80	170	756	70
0.028	0.71	134	596	90	155	689	83	170	756	77	183	814	67
0.029	0.74	144	641	87	166	738	80	182	810	74	196	872	65
0.030	0.76	154	685	84	177	787	77	195	867	72	210	934	62
0.031	0.79	164	729	81	189	841	75	208	925	69	224	996	60
0.032	0.81	175	778	78	201	894	72	221	983	67	238	1,059	58
0.033	0.84	186	827	76	214	952	70	235	1,045	65	253	1,125	57
0.034	0.86	197	876	74	227	1,010	68	250	1,112	63	268	1,192	55
0.035	0.89	209	930	72	240	1,068	66	264	1,174	61	284	1,263	53
0.036	0.91	221	983	70	254	1,130	64	280	1,245	60	301	1,339	52
0.037	0.94	233	1,036	68	268	1,192	62	295	1,312	58	317	1,410	50
0.038	0.97	246	1,094	66	283	1,259	61	311	1,383	56	334	1,486	49
0.039	0.99	259	1,152	64	298	1,326	59	327	1,454	55	352	1,566	48
0.040	1.02	272	1,210	62	313	1,392	57	344	1,530	53	370	1,646	46
0.041	1.04	286	1,272	61	329	1,463	56	361	1,606	52	388	1,726	45
0.042	1.07	300	1,334	59	345	1,535	55	379	1,686	51	407	1,810	44
0.043	1.09	314	1,397	58	361	1,606	53	397	1,766	50	427	1,899	43
0.044	1.12	328	1,459	57	378	1,681	52	415	1,846	48	447	1,988	42
0.045	1.14	343	1,526	55	395	1,757	51	434	1,930	47	467	2,077	41
0.046	1.17	358	1,592	54	412	1,833	50	453	2,015	46	487	2,166	40
0.047	1.19	374	1,664	53	430	1,913	49	473	2,104	45	508	2,260	39
0.048	1.22	390	1,735	52	448	1,993	48	493	2,193	44	530	2,357	38
0.049	1.24	406	1,806	51	467	2,077	47	513	2,282	43	552	2,455	38

Table 5—Mechanical Properties of Individual Rope Wires (Before Fabrication) (Continued)

(1)	(2)	(3)	Level 2		(5)	(6)	Level 3		(8)	(9)	Level 4		(11)	(12)	Level 5		(14)
Wire Size Nominal Diameter	mm	in.	Bright (Uncoated) or Drawn-Galvanized Breaking Strength	N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength	N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength	N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength	N	Tor.
0.050	1.27		422	1,877	50	486	2,162	46	534	534	2,375	42	574	574	2,553	42	37
0.051	1.30		439	1,953	49	505	2,246	45	555	555	2,469	42	597	597	2,655	41	36
0.052	1.32		456	2,028	48	525	2,335	44	577	577	2,566	41	620	620	2,758	40	35
0.053	1.35		474	2,108	47	545	2,424	43	599	599	2,664	40	644	644	2,865	39	34
0.054	1.37		491	2,184	46	565	2,513	42	621	621	2,762	39	668	668	2,971	38	33
0.055	1.40		509	2,264	45	586	2,607	41	644	644	2,865	38	693	693	3,082	37	32
0.056	1.42		528	2,349	44	607	2,700	40	667	667	2,967	37	718	718	3,194	36	31
0.057	1.45		546	2,429	43	628	2,793	39	691	691	3,074	36	743	743	3,305	35	30
0.058	1.47		565	2,513	43	650	2,891	38	715	715	3,180	35	769	769	3,421	34	29
0.059	1.50		584	2,598	42	672	2,989	37	739	739	3,287	34	795	795	3,536	33	28
0.060	1.52		604	2,687	41	695	3,091	36	764	764	3,398	33	821	821	3,652	32	27
0.061	1.55		624	2,776	40	718	3,194	35	789	789	3,509	32	848	848	3,772	31	26
0.062	1.57		644	2,865	40	741	3,296	34	815	815	3,625	31	876	876	3,896	30	25
0.063	1.60		665	2,958	39	764	3,398	33	841	841	3,741	30	904	904	4,021	29	24
0.064	1.63		685	3,047	38	788	3,505	32	867	867	3,856	29	932	932	4,146	28	23
0.065	1.65		707	3,145	38	813	3,616	31	894	894	3,977	28	961	961	4,275	27	22
0.066	1.68		728	3,238	37	837	3,723	30	921	921	4,097	27	990	990	4,404	26	21
0.067	1.70		750	3,336	37	862	3,834	29	948	948	4,217	26	1,019	1,019	4,533	25	20
0.068	1.73		772	3,434	36	887	3,945	28	976	976	4,341	25	1,049	1,049	4,666	24	19
0.069	1.75		794	3,532	36	913	4,061	27	1,004	1,004	4,466	24	1,080	1,080	4,804	23	18
0.070	1.78		817	3,634	35	939	4,177	26	1,033	1,033	4,595	23	1,111	1,111	4,942	22	17
0.071	1.80		840	3,736	35	966	4,297	25	1,062	1,062	4,724	22	1,142	1,142	5,080	21	16
0.072	1.83		863	3,839	34	992	4,412	24	1,091	1,091	4,853	21	1,173	1,173	5,218	20	15
0.073	1.85		886	3,941	34	1,019	4,533	23	1,121	1,121	4,986	20	1,205	1,205	5,360	19	14
0.074	1.88		910	4,048	33	1,047	4,657	22	1,151	1,151	5,120	19	1,238	1,238	5,507	18	13
0.075	1.91		934	4,154	33	1,074	4,777	21	1,182	1,182	5,258	18	1,271	1,271	5,653	17	12
0.076	1.93		959	4,266	32	1,103	4,906	20	1,213	1,213	5,395	17	1,304	1,304	5,800	16	11
0.077	1.96		983	4,372	32	1,131	5,031	19	1,244	1,244	5,533	16	1,337	1,337	5,947	15	10
0.078	1.98		1,008	4,484	31	1,160	5,160	18	1,276	1,276	5,676	15	1,371	1,371	6,098	14	9
0.079	2.01		1,034	4,599	31	1,189	5,289	17	1,308	1,308	5,818	14	1,406	1,406	6,254	13	8
0.080	2.03		1,059	4,710	30	1,218	5,418	16	1,340	1,340	5,960	13	1,441	1,441	6,410	12	7
0.081	2.06		1,085	4,826	30	1,248	5,551	15	1,373	1,373	6,107	12	1,476	1,476	6,565	11	6
0.082	2.08		1,111	4,942	30	1,278	5,685	14	1,406	1,406	6,254	11	1,511	1,511	6,721	10	5
0.083	2.11		1,138	5,062	29	1,309	5,822	13	1,440	1,440	6,405	10	1,548	1,548	6,886	9	4
0.084	2.13		1,165	5,182	29	1,339	5,956	12	1,473	1,473	6,552	9	1,584	1,584	7,046	8	3
0.085	2.16		1,192	5,302	29	1,371	6,098	11	1,508	1,508	6,708	8	1,621	1,621	7,210	7	2
0.086	2.18		1,219	5,422	28	1,402	6,236	10	1,542	1,542	6,859	7	1,658	1,658	7,375	6	1
0.087	2.21		1,247	5,547	28	1,434	6,378	9	1,577	1,577	7,014	6	1,696	1,696	7,544	5	0
0.088	2.24		1,275	5,671	28	1,466	6,521	8	1,613	1,613	7,175	5	1,734	1,734	7,713	4	0
0.089	2.26		1,303	5,796	27	1,499	6,668	7	1,648	1,648	7,330	4	1,772	1,772	7,882	3	0

Table 5—Mechanical Properties of Individual Rope Wires (Before Fabrication) (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Wire Size Nominal Diameter in.	mm	Level 2		Level 3		Level 4		Level 5		Level 6		Level 7	
		Bright (Uncoated) or Drawn-Galvanized Breaking Strength lb	N	Bright (Uncoated) or Drawn-Galvanized Breaking Strength lb	N	Bright (Uncoated) or Drawn-Galvanized Breaking Strength lb	N	Bright (Uncoated) or Drawn-Galvanized Breaking Strength lb	N	Bright (Uncoated) or Drawn-Galvanized Breaking Strength lb	N	Bright (Uncoated) or Drawn-Galvanized Breaking Strength lb	N
0.090	2.29	1,332	5,925	27	1,531	6,810	25	1,684	7,490	23	1,811	8,055	20
0.091	2.31	1,360	6,049	27	1,564	6,957	24	1,721	7,655	23	1,850	8,229	20
0.092	2.34	1,390	6,183	26	1,598	7,108	24	1,758	7,820	22	1,890	8,407	19
0.093	2.36	1,419	6,312	26	1,632	7,259	24	1,795	7,984	22	1,930	8,585	19
0.094	2.39	1,449	6,445	26	1,666	7,410	24	1,832	8,149	22	1,970	8,763	19
0.095	2.41	1,479	6,579	25	1,700	7,562	23	1,870	8,318	22	2,011	8,945	19
0.096	2.44	1,509	6,712	25	1,735	7,717	23	1,909	8,491	21	2,052	9,127	18
0.097	2.46	1,539	6,845	25	1,770	7,873	23	1,947	8,660	21	2,093	9,310	18
0.098	2.49	1,570	6,983	25	1,806	8,033	23	1,986	8,834	21	2,135	9,496	18
0.099	2.51	1,601	7,121	24	1,841	8,189	22	2,026	9,012	21	2,177	9,683	18
0.100	2.54	1,633	7,264	24	1,877	8,349	22	2,065	9,185	20	2,220	9,875	18
0.101	2.57	1,664	7,401	24	1,914	8,513	22	2,105	9,363	20	2,263	10,066	18
0.102	2.59	1,696	7,544	24	1,951	8,678	22	2,146	9,545	20	2,307	10,262	17
0.103	2.62	1,728	7,686	23	1,988	8,843	21	2,186	9,723	20	2,350	10,453	17
0.104	2.64	1,761	7,833	23	2,025	9,007	21	2,228	9,910	20	2,395	10,653	17
0.105	2.67	1,794	7,980	23	2,063	9,176	21	2,269	10,093	19	2,439	10,849	17
0.106	2.69	1,827	8,126	23	2,101	9,345	21	2,311	10,279	19	2,484	11,049	17
0.107	2.72	1,860	8,273	22	2,139	9,514	20	2,353	10,466	19	2,529	11,249	16
0.108	2.74	1,894	8,425	22	2,178	9,688	20	2,396	10,657	19	2,575	11,454	16
0.109	2.77	1,928	8,576	22	2,217	9,861	20	2,438	10,844	19	2,621	11,658	16
0.110	2.79	1,962	8,727	22	2,256	10,035	20	2,482	11,040	18	2,668	11,867	16
0.111	2.82	1,996	8,878	22	2,296	10,213	20	2,525	11,231	18	2,715	12,076	16
0.112	2.84	2,031	9,034	21	2,336	10,391	20	2,569	11,427	18	2,762	12,285	16
0.113	2.87	2,066	9,190	21	2,376	10,568	19	2,613	11,623	18	2,809	12,494	15
0.114	2.90	2,101	9,345	21	2,416	10,746	19	2,658	11,823	18	2,857	12,708	15
0.115	2.92	2,137	9,505	21	2,457	10,929	19	2,703	12,023	18	2,906	12,926	15
0.116	2.95	2,172	9,661	21	2,498	11,111	19	2,748	12,223	17	2,954	13,139	15
0.117	2.97	2,209	9,826	20	2,540	11,298	19	2,794	12,428	17	3,003	13,357	15
0.118	3.00	2,245	9,986	20	2,582	11,485	18	2,840	12,632	17	3,053	13,580	15
0.119	3.02	2,281	10,146	20	2,624	11,672	18	2,886	12,837	17	3,102	13,798	15
0.120	3.05	2,318	10,310	20	2,666	11,858	18	2,933	13,046	17	3,153	14,025	14
0.121	3.07	2,355	10,475	20	2,709	12,050	18	2,980	13,255	17	3,203	14,247	14
0.122	3.10	2,393	10,644	19	2,752	12,241	18	3,027	13,464	17	3,254	14,474	14
0.123	3.12	2,431	10,813	19	2,795	12,432	18	3,075	13,678	16	3,305	14,701	14
0.124	3.15	2,468	10,978	19	2,839	12,628	18	3,123	13,891	16	3,357	14,932	14
0.125	3.18	2,507	11,151	19	2,883	12,824	17	3,171	14,105	16	3,409	15,163	14
0.126	3.20	2,545	11,320	19	2,927	13,019	17	3,220	14,323	16	3,461	15,395	14
0.127	3.23	2,584	11,494	19	2,971	13,215	17	3,269	14,541	16	3,514	15,630	14
0.128	3.25	2,623	11,667	18	3,016	13,415	17	3,318	14,758	16	3,567	15,866	13
0.129	3.28	2,662	11,841	18	3,061	13,615	17	3,368	14,981	16	3,620	16,102	13

Table 5—Mechanical Properties of Individual Rope Wires (Before Fabrication) (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Wire Size Nominal Diameter	in.	mm	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.
0.130	3.30	2.702	12,018	18	3,107	13,820	17	3,418	15,203	15	3,674	16,342	13
0.131	3.33	2,741	12,192	18	3,153	14,025	17	3,468	15,426	15	3,728	16,582	13
0.132	3.35	2,781	12,370	18	3,199	14,229	16	3,519	15,653	15	3,782	16,822	13
0.133	3.38	2,822	12,552	18	3,245	14,434	16	3,570	15,879	15	3,837	17,067	13
0.134	3.40	2,862	12,730	18	3,292	14,643	16	3,621	16,106	15	3,892	17,312	13
0.135	3.43	2,903	12,913	17	3,339	14,852	16	3,672	16,333	15	3,948	17,561	13
0.136	3.45	2,944	13,095	17	3,386	15,061	16	3,724	16,564	15	4,004	17,810	13
0.137	3.48	2,986	13,282	17	3,433	15,270	16	3,777	16,800	15	4,060	18,059	13
0.138	3.51	3,027	13,464	17	3,481	15,483	16	3,829	17,031	14	4,117	18,312	12
0.139	3.53	3,069	13,651	17	3,529	15,697	15	3,882	17,267	14	4,173	18,562	12
0.140	3.56	3,111	13,838	17	3,578	15,915	15	3,935	17,503	14	4,231	18,819	12
0.141	3.58	3,153	14,025	17	3,626	16,128	15	3,989	17,743	14	4,288	19,073	12
0.142	3.61	3,196	14,216	17	3,675	16,346	15	4,043	17,983	14	4,346	19,331	12
0.143	3.63	3,239	14,407	16	3,725	16,569	15	4,097	18,223	14	4,404	19,589	12
0.144	3.66	3,282	14,598	16	3,774	16,787	15	4,152	18,468	14	4,463	19,851	12
0.145	3.68	3,325	14,790	16	3,824	17,009	15	4,207	18,713	14	4,522	20,114	12
0.146	3.71	3,369	14,985	16	3,874	17,232	15	4,262	18,957	14	4,581	20,376	12
0.147	3.73	3,413	15,181	16	3,925	17,458	15	4,317	19,202	13	4,641	20,643	12
0.148	3.76	3,457	15,377	16	3,975	17,681	14	4,373	19,451	13	4,701	20,910	11
0.149	3.78	3,501	15,572	16	4,026	17,908	14	4,429	19,700	13	4,761	21,177	11
0.150	3.81	3,546	15,773	16	4,078	18,139	14	4,486	19,954	13	4,822	21,448	11
0.151	3.84	3,591	15,973	15	4,129	18,366	14	4,542	20,203	13	4,883	21,720	11
0.152	3.86	3,636	16,173	15	4,181	18,597	14	4,599	20,456	13	4,944	21,991	11
0.153	3.89	3,681	16,373	15	4,233	18,828	14	4,657	20,714	13	5,006	22,267	11
0.154	3.91	3,727	16,578	15	4,286	19,064	14	4,714	20,968	13	5,068	22,542	11
0.155	3.94	3,773	16,782	15	4,338	19,295	14	4,772	21,226	13	5,130	22,818	11
0.156	3.96	3,819	16,987	15	4,391	19,531	14	4,831	21,488	13	5,193	23,098	11
0.157	3.99	3,865	17,192	15	4,445	19,771	14	4,889	21,746	13	5,256	23,379	11
0.158	4.01	3,912	17,401	15	4,498	20,007	13	4,948	22,009	12	5,319	23,659	11
0.159	4.04	3,958	17,605	15	4,552	20,247	13	5,007	22,271	12	5,383	23,944	11
0.160	4.06	4,005	17,814	14	4,606	20,487	13	5,067	22,538	12	5,447	24,228	10
0.161	4.09	4,053	18,028	14	4,661	20,732	13	5,127	22,805	12	5,511	24,513	10
0.162	4.11	4,100	18,237	14	4,715	20,972	13	5,187	23,072	12	5,576	24,802	10
0.163	4.14	4,148	18,450	14	4,770	21,217	13	5,247	23,339	12	5,641	25,091	10
0.164	4.17	4,196	18,664	14	4,825	21,462	13	5,308	23,610	12	5,706	25,380	10
0.165	4.19	4,244	18,877	14	4,881	21,711	13	5,369	23,881	12	5,772	25,674	10
0.166	4.22	4,293	19,095	14	4,937	21,960	13	5,430	24,153	12	5,838	25,967	10
0.167	4.24	4,341	19,309	14	4,993	22,209	13	5,492	24,428	12	5,904	26,261	10
0.168	4.27	4,390	19,527	14	5,049	22,458	13	5,554	24,704	12	5,970	26,555	10
0.169	4.29	4,440	19,749	14	5,105	22,707	12	5,616	24,980	12	6,037	26,853	10

Table 5—Mechanical Properties of Individual Rope Wires (Before Fabrication) (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Wire Size Nominal Diameter in.	mm	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.	lb	Bright (Uncoated) or Drawn-Galvanized Breaking Strength N	Tor.
0.170	4.32	4,489	19,967	14	5,162	22,961	12	5,679	25,260	11	6,104	27,151	10
0.171	4.34	4,539	20,189	13	5,219	23,214	12	5,741	25,536	11	6,172	27,453	10
0.172	4.37	4,589	20,412	13	5,277	23,472	12	5,804	25,816	11	6,240	27,756	10
0.173	4.39	4,639	20,634	13	5,334	23,726	12	5,868	26,101	11	6,308	28,058	10
0.174	4.42	4,689	20,857	13	5,392	23,984	12	5,932	26,386	11	6,376	28,360	10
0.175	4.45	4,740	21,084	13	5,450	24,242	12	5,996	26,670	11	6,445	28,667	9
0.176	4.47	4,790	21,306	13	5,509	24,504	12	6,060	26,955	11	6,514	28,974	9
0.177	4.50	4,841	21,533	13	5,568	24,766	12	6,124	27,240	11	6,584	29,286	9
0.178	4.52	4,893	21,764	13	5,627	25,029	12	6,189	27,529	11	6,653	29,593	9
0.179	4.55	4,944	21,991	13	5,686	25,291	12	6,254	27,818	11	6,723	29,904	9
0.180	4.57	4,996	22,222	13	5,745	25,554	12	6,320	28,111	11	6,794	30,220	9
0.181	4.60	5,048	22,454	13	5,805	25,821	12	6,386	28,405	11	6,864	30,531	9
0.182	4.62	5,100	22,685	13	5,865	26,088	11	6,452	28,698	11	6,935	30,847	9
0.183	4.65	5,152	22,916	12	5,925	26,354	11	6,518	28,992	11	7,007	31,167	9
0.184	4.67	5,205	23,152	12	5,986	26,626	11	6,584	29,286	10	7,078	31,483	9
0.185	4.70	5,258	23,388	12	6,047	26,897	11	6,651	29,584	10	7,150	31,803	9
0.186	4.72	5,311	23,623	12	6,108	27,168	11	6,718	29,882	10	7,222	32,123	9
0.187	4.75	5,364	23,859	12	6,169	27,440	11	6,786	30,184	10	7,295	32,448	9
0.188	4.78	5,418	24,099	12	6,230	27,711	11	6,854	30,487	10	7,368	32,773	9
0.189	4.80	5,472	24,339	12	6,292	27,987	11	6,921	30,785	10	7,441	33,098	9
0.190	4.83	5,525	24,575	12	6,354	28,263	11	6,990	31,092	10	7,514	33,422	9
0.191	4.85	5,580	24,820	12	6,417	28,543	11	7,058	31,394	10	7,588	33,751	9
0.192	4.88	5,634	25,060	12	6,479	28,819	11	7,127	31,701	10	7,662	34,081	8
0.193	4.90	5,689	25,305	12	6,542	29,099	11	7,196	32,008	10	7,736	34,410	8
0.194	4.93	5,744	25,549	12	6,605	29,379	11	7,266	32,319	10	7,810	34,739	8
0.195	4.95	5,799	25,794	12	6,668	29,659	11	7,335	32,626	10	7,885	35,072	8
0.196	4.98	5,854	26,039	12	6,732	29,944	11	7,405	32,937	10	7,961	35,411	8
0.197	5.00	5,909	26,283	11	6,796	30,229	10	7,475	33,249	10	8,036	35,744	8
0.198	5.03	5,965	26,532	11	6,860	30,513	10	7,546	33,565	10	8,112	36,082	8
0.199	5.05	6,021	26,781	11	6,924	30,798	10	7,617	33,880	10	8,188	36,420	8
0.200	5.08	6,077	27,030	11	6,989	31,087	10	7,688	34,196	9	8,264	36,758	8
0.201	5.11	6,133	27,280	11	7,053	31,372	10	7,759	34,512	9	8,341	37,101	8
0.202	5.13	6,190	27,533	11	7,118	31,661	10	7,830	34,828	9	8,418	37,443	8
0.203	5.16	6,247	27,787	11	7,184	31,954	10	7,902	35,148	9	8,495	37,786	8
0.204	5.18	6,304	28,040	11	7,249	32,244	10	7,974	35,468	9	8,572	38,128	8
0.205	5.21	6,361	28,294	11	7,315	32,537	10	8,047	35,793	9	8,650	38,475	8
0.206	5.23	6,418	28,547	11	7,381	32,831	10	8,119	36,113	9	8,728	38,822	8
0.207	5.26	6,476	28,805	11	7,447	33,124	10	8,192	36,438	9	8,806	39,169	8
0.208	5.28	6,534	29,063	11	7,514	33,422	10	8,265	36,763	9	8,885	39,520	8
0.209	5.31	6,592	29,321	11	7,581	33,720	10	8,339	37,092	9	8,964	39,872	8

Table 5—Mechanical Properties of Individual Rope Wires (Before Fabrication) (Continued)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Wire Size Nominal Diameter in.	mm	Level 2		Level 3		Level 4		Level 5		Level 6		Level 7	
		Bright (Uncoated) Breaking Strength lb	Bright (Uncoated) Breaking Strength N	Bright (Uncoated) Breaking Strength lb	Bright (Uncoated) Breaking Strength N	Bright (Uncoated) Breaking Strength lb	Bright (Uncoated) Breaking Strength N	Bright (Uncoated) Breaking Strength lb	Bright (Uncoated) Breaking Strength N	Bright (Uncoated) Breaking Strength lb	Bright (Uncoated) Breaking Strength N	Bright (Uncoated) Breaking Strength lb	Bright (Uncoated) Breaking Strength N
0.210	5.33	6,650	29,579	11	7,648	34,018	10	8,412	37,417	9	9,043	40,223	8
0.211	5.36	6,708	29,837	11	7,715	34,316	10	8,486	37,746	9	9,123	40,579	8
0.212	5.38	6,767	30,100	11	7,782	34,614	10	8,560	38,075	9	9,202	40,930	8
0.213	5.41	6,826	30,362	11	7,850	34,917	10	8,635	38,408	9	9,282	41,286	8
0.214	5.44	6,885	30,624	10	7,918	35,219	10	8,710	38,742	9	9,363	41,647	7
0.215	5.46	6,944	30,887	10	7,986	35,522	9	8,784	39,071	9	9,443	42,002	7
0.216	5.49	7,004	31,154	10	8,054	35,824	9	8,860	39,409	9	9,524	42,363	7
0.217	5.51	7,063	31,416	10	8,123	36,131	9	8,935	39,743	9	9,605	42,723	7
0.218	5.54	7,123	31,683	10	8,192	36,438	9	9,011	40,081	9	9,687	43,088	7
0.219	5.56	7,183	31,950	10	8,261	36,745	9	9,087	40,419	9	9,768	43,448	7
0.220	5.59	7,244	32,221	10	8,330	37,052	9	9,163	40,757	8	9,850	43,813	7
0.221	5.61	7,304	32,488	10	8,400	37,363	9	9,240	41,100	8	9,933	44,182	7
0.222	5.64	7,365	32,760	10	8,469	37,670	9	9,316	41,438	8	10,015	44,547	7
0.223	5.66	7,426	33,031	10	8,539	37,981	9	9,393	41,780	8	10,098	44,916	7
0.224	5.69	7,487	33,302	10	8,610	38,297	9	9,471	42,127	8	10,181	45,285	7
0.225	5.72	7,548	33,574	10	8,680	38,609	9	9,548	42,470	8	10,264	45,654	7
0.226	5.74	7,609	33,845	10	8,751	38,924	9	9,626	42,816	8	10,348	46,028	7
0.227	5.77	7,671	34,121	10	8,822	39,240	9	9,704	43,163	8	10,432	46,402	7
0.228	5.79	7,733	34,396	10	8,893	39,556	9	9,782	43,510	8	10,516	46,775	7
0.229	5.82	7,795	34,672	10	8,964	39,872	9	9,861	43,862	8	10,600	47,149	7
0.230	5.84	7,857	34,948	10	9,036	40,192	9	9,939	44,209	8	10,685	47,527	7
0.231	5.87	7,920	35,228	10	9,107	40,508	9	10,018	44,560	8	10,770	47,905	7
0.232	5.89	7,982	35,504	10	9,179	40,828	9	10,097	44,911	8	10,855	48,283	7
0.233	5.92	8,045	35,784	9	9,252	41,153	9	10,177	45,267	8	10,940	48,661	7
0.234	5.94	8,108	36,064	9	9,324	41,473	9	10,257	45,623	8	11,026	49,044	7
0.235	5.97	8,171	36,345	9	9,397	41,798	9	10,336	45,975	8	11,112	49,426	7
0.236	5.99	8,235	36,629	9	9,470	42,123	8	10,417	46,335	8	11,198	49,809	7
0.237	6.02	8,298	36,910	9	9,543	42,447	8	10,497	46,691	8	11,284	50,191	7
0.238	6.05	8,362	37,194	9	9,616	42,772	8	10,578	47,051	8	11,371	50,578	7
0.239	6.07	8,426	37,479	9	9,690	43,101	8	10,659	47,411	8	11,458	50,965	7
0.240	6.10	8,490	37,764	9	9,763	43,426	8	10,740	47,772	8	11,545	51,352	6
0.241	6.12	8,554	38,048	9	9,837	43,755	8	10,821	48,132	8	11,633	51,744	6
0.242	6.15	8,619	38,337	9	9,912	44,089	8	10,903	48,497	8	11,720	52,131	6
0.243	6.17	8,683	38,622	9	9,986	44,418	8	10,984	48,857	8	11,808	52,522	6
0.244	6.20	8,748	38,911	9	10,061	44,751	8	11,067	49,226	8	11,897	52,918	6
0.245	6.22	8,813	39,200	9	10,135	45,080	8	11,149	49,591	7	11,985	53,309	6
0.246	6.25	8,879	39,494	9	10,210	45,414	8	11,231	49,955	7	12,074	53,705	6
0.247	6.27	8,944	39,783	9	10,286	45,752	8	11,314	50,325	7	12,163	54,101	6
0.248	6.30	9,010	40,076	9	10,361	46,086	8	11,397	50,694	7	12,252	54,497	6
0.249	6.32	9,075	40,366	9	10,437	46,424	8	11,480	51,063	7	12,341	54,893	6
0.250	6.35	9,141	40,659	9	10,512	46,757	8	11,564	51,437	7	12,431	55,293	6

Table 6—6 × 7 Classification Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Fiber Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Diameter		Approx. Mass		Nominal Strength					
				Plow Steel			Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
3/8	9.5	0.21	0.31	10,200	45.4	4.63	11,720	52.1	5.32
7/16	11.5	0.29	0.43	13,800	61.4	6.26	15,860	70.5	7.20
1/2	13	0.38	0.57	17,920	79.7	8.13	20,600	91.6	9.35
9/16	14.5	0.48	0.71	22,600	101	10.3	26,000	116	11.8
5/8	16	0.59	0.88	27,800	124	12.6	31,800	141	14.4
3/4	19	0.84	1.25	39,600	176	18.0	45,400	202	20.6
7/8	22	1.15	1.71	53,400	238	24.2	61,400	273	27.9
1	26	1.50	2.23	69,000	307	31.3	79,400	353	36.0

Table 7—6 × 19 and 6 × 37 Classification Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Fiber Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Nominal Diameter		Approx. Mass		Nominal Strength								
				Plow Steel			Improved Plow Steel			Extra Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.42	0.63	18,700	83.2	8.48	21,400	95.2	9.71	23,600	105	10.7
9/16	14.5	0.53	0.79	23,600	106	10.7	27,000	120	12.2	29,800	132	13.5
5/8	16	0.66	0.98	29,000	129	13.2	33,400	149	15.1	36,600	163	16.6
3/4	19	0.95	1.41	41,400	184	18.8	47,600	212	21.6	52,400	233	23.8
7/8	22	1.29	1.92	56,000	249	25.4	64,400	286	29.2	70,800	315	32.1
1	26	1.68	2.50	72,800	324	33.0	83,600	372	37.9	92,000	409	41.7
1 1/8	29	2.13	3.17	91,400	407	41.5	105,200	468	47.7	115,600	514	52.4
1 1/4	32	2.63	3.91	112,400	500	51.0	129,200	575	58.5	142,200	632	64.5
1 3/8	35	3.18	4.73				155,400	691	70.5	171,000	760	77.6
1 1/2	38	3.78	5.63				184,000	818	83.5	202,000	898	91.6
1 5/8	42	4.44	6.61				214,000	952	97.1	236,000	1050	107
1 3/4	45	5.15	7.66				248,000	1100	112	274,000	1220	124
1 7/8	48	5.91	8.80				282,000	1250	128	312,000	1390	142
2	52	6.72	10.0				320,000	1420	146	352,000	1560	160

Table 8—6 × 19 Classification Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Independent Wire Rope Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Nominal Diameter		Approx. Mass		Nominal Strength								
				Improved Plow Steel			Extra Improved Plow Steel			Extra Extra Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.46	0.68	23,000	102	10.4	26,600	118	12.1	29,200	130	13.2
9/16	14.5	0.59	0.88	29,000	129	13.2	33,600	149	15.2	37,000	165	16.8
5/8	16	0.72	1.07	35,800	159	16.2	41,200	183	18.7	45,400	202	20.6
3/4	19	1.04	1.55	51,200	228	23.2	58,800	262	26.7	64,800	288	29.4
7/8	22	1.42	2.11	69,200	308	31.4	79,600	354	36.1	87,600	389	39.7
1	26	1.85	2.75	89,800	399	40.7	103,400	460	46.9	113,800	506	51.6
1 1/8	29	2.34	3.48	113,000	503	51.3	130,000	678	59.0	143,000	636	64.9
1 1/4	32	2.89	4.30	138,800	617	63.0	159,800	711	72.5	175,800	782	79.8
1 3/8	35	3.50	5.21	167,000	743	75.7	192,000	854	87.1	212,000	943	96.2
1 1/2	38	4.16	6.19	197,800	880	89.7	228,000	1010	103	250,000	1112	113
1 5/8	42	4.88	7.26	230,000	1020	104	264,000	1170	120	292,000	1300	132
1 3/4	45	5.67	8.44	266,000	1180	121	306,000	1360	139	338,000	1500	153
1 7/8	48	6.50	9.67	304,000	1350	138	348,000	1550	158	384,000	1710	174
2	52	7.39	11.0	344,000	1630	156	396,000	1760	180	434,000	1930	197

Table 9—6 × 37 Classification Wire Rope Bright (Uncoated) or Drawn-Galvanized Wire,
Independent Wire Rope Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Nominal Strength												
Nominal Diameter		Approx. Mass		Improved Plow Steel			Extra Improved Plow Steel			Extra Extra Improved Plow Steel		
in.	mm	lb/ft	kg/m	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.46	0.68	23,000	102	10.4	26,600	118	12.1	29,200	130	13.2
9/16	14.5	0.59	0.88	29,000	129	13.2	33,600	149	15.2	37,000	165	16.8
5/8	16	0.72	1.07	35,800	159	16.2	41,200	183	18.7	45,400	202	20.6
3/4	19	1.04	1.55	51,200	228	23.2	58,800	262	26.7	64,800	288	29.4
7/8	22	1.42	2.11	69,200	308	31.4	79,600	354	36.1	87,600	389	39.7
1	26	1.85	2.75	89,800	399	40.7	103,400	460	46.9	113,800	506	51.6
1 1/8	29	2.34	3.48	113,000	503	51.3	130,000	578	59.0	143,000	636	64.9
1 1/4	32	2.89	4.30	138,800	617	63.0	159,800	711	72.5	175,800	782	79.8
1 3/8	35	3.50	5.21	167,000	743	75.7	192,000	854	87.1	212,000	943	96.2
1 1/2	38	4.16	6.19	197,800	880	89.7	228,000	1010	103	250,000	1112	113
1 5/8	42	4.88	7.26	230,000	1020	104	264,000	1170	120	292,000	1300	132
1 3/4	45	5.67	8.44	266,000	1180	121	306,000	1360	139	338,000	1500	153
1 7/8	48	6.50	9.67	304,000	1350	138	348,000	1550	158	384,000	1710	174
2	52	7.39	11.0	344,000	1530	156	396,000	1760	180	434,000	1930	197
2 1/8	54	8.35	12.4	384,000	1710	174	442,000	1970	200	488,000	2170	221
2 1/4	58	9.36	13.9	430,000	1910	195	494,000	2200	224	544,000	2420	247
2 3/8	60	10.4	15.5	478,000	2130	217	548,000	2440	249	604,000	2690	274
2 1/2	64	11.6	17.3	524,000	2330	238	604,000	2690	274	664,000	2950	301
2 5/8	67	12.8	19.0	576,000	2560	261	658,000	2930	299	728,000	3240	330
2 3/4	71	14.0	20.8	628,000	2790	285	736,000	3270	333	794,000	3530	360
2 7/8	74	15.3	22.8	682,000	3030	309	796,000	3540	361	864,000	3840	392
3	77	16.6	24.7	740,000	3290	336	856,000	3810	389	936,000	4160	425
3 1/8	80	18.0	26.8	798,000	3550	362	920,000	4090	417	1,010,000	4490	458
3 1/4	83	19.5	29.0	858,000	3820	389	984,000	4380	447	1,086,000	4830	493
3 3/8	87	21.0	31.3	918,000	4080	416	1,074,000	4780	487	1,164,000	5180	528
3 1/2	90	22.7	33.8	982,000	4370	445	1,144,000	5090	519	1,242,000	5520	563
3 3/4	96	26.0	38.7	1,114,000	4960	505	1,290,000	5740	585	1,410,000	6270	640
4	103	29.6	44.0	1,254,000	5580	569	1,466,000	6520	665	1,586,000	7050	720

Table 10—6 × 61 Classification Wire Rope, Bright (Uncoated) or
Drawn-Galvanized Wire, Independent Wire Rope Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Strength									
Nominal Diameter		Approx. Mass		Improved Plow Steel			Extra Improved Plow Steel		
in.	mm	lb/ft	kg/m	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
3 1/2	90	22.7	33.8	966,000	4300	438	1,110,000	4940	503
3 3/4	96	26.0	38.7	1,098,000	4880	498	1,264,000	5620	573
4	103	29.6	44.0	1,240,000	5520	562	1,426,000	6340	647
4 1/4	109	33.3	49.6	1,388,000	6170	630	1,598,000	7110	725
4 1/2	115	37.4	55.7	1,544,000	6870	700	1,776,000	7900	806
4 3/4	122	41.7	62.1	1,706,000	7590	774	1,962,000	8730	890
5	128	46.2	68.8	1,874,000	8340	850	2,156,000	9590	978

Table 11—6 × 91 Classification Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Independent Wire Rope Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Diameter		Approx. Mass		Nominal Strength					
				Improved Plow Steel			Extra Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
4	103	29.6	44.1	1,178,000	5240	534	1,354,000	6020	614
4 1/4	109	33.3	49.6	1,320,000	5870	599	1,518,000	6750	689
4 1/2	115	37.4	55.7	1,468,000	6530	666	1,688,000	7510	766
4 3/4	122	41.7	62.1	1,620,000	7210	735	1,864,000	8290	846
5	128	46.2	68.7	1,782,000	7930	808	2,048,000	9110	929
5 1/4	135	49.8	74.1	1,948,000	8670	884	2,240,000	9960	1016
5 1/2	141	54.5	81.1	2,120,000	9430	962	2,438,000	10800	1106
5 3/4	148	59.6	88.7	2,296,000	10200	1049	2,640,000	11700	1198
6	154	65.0	96.7	2,480,000	11000	1125	2,852,000	12700	1294

Table 12—8 × 19 Classification Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Independent Wire Rope Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Diameter		Approx. Mass		Nominal Strength					
				Improved Plow Steel			Extra Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.47	0.70	20,200	89.9	9.16	23,400	104	10.5
9/16	14.5	0.60	0.89	25,600	114	11.6	29,400	131	13.3
5/8	16	0.73	1.09	31,400	140	14.2	36,200	161	16.4
3/4	19	1.06	1.58	45,000	200	20.4	51,800	230	23.5
7/8	22	1.44	2.14	61,000	271	27.7	70,000	311	31.8
1	26	1.88	2.80	79,200	352	35.9	91,000	405	41.3
1 1/8	29	2.39	3.56	99,600	443	45.2	114,600	507	51.7

Table 13—18 × 7 Construction Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Fiber Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Diameter		Approx. Mass		Nominal Strength*					
				Improved Plow Steel			Extra Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.43	0.64	19,700	87.6	8.94	21,600	96.1	9.80
9/16	14.5	0.55	0.82	24,800	110	11.2	27,200	121	12.3
5/8	16	0.68	1.01	30,600	136	13.9	33,600	149	15.2
3/4	19	0.97	1.44	43,600	194	19.8	48,000	214	21.8
7/8	22	1.32	1.96	59,000	262	26.8	65,000	289	29.5
1	26	1.73	2.57	76,600	341	34.7	84,400	375	38.3
1 1/8	29	2.19	3.26	96,400	429	43.7	106,200	472	48.2
1 1/4	32	2.70	4.02	118,400	527	53.7	130,200	579	59.1
1 3/8	35	3.27	4.87	142,600	634	64.7	156,800	697	71.1
1 1/2	38	3.89	5.79	168,800	751	76.6	185,600	826	84.2

*These strengths apply only when a test is conducted with both ends fixed. When in use, the strength of these ropes may be significantly reduced if one end is free to rotate.

Table 14—19 × 7 Construction Wire Rope, Bright (Uncoated) or Drawn-Galvanized Wire, Wire Strand Core

See Section 6 for typical wire rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Strength*									
Nominal Diameter		Approx. Mass		Improved Plow Steel			Extra Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.45	0.67	19,700	87.6	8.94	21,600	96.1	9.80
9/16	14.5	0.58	0.86	24,800	110	11.2	27,200	121	12.3
5/8	16	0.71	1.06	30,600	136	13.9	33,600	149	15.2
3/4	19	1.02	1.52	43,600	194	19.8	48,000	214	21.8
7/8	22	1.39	2.07	59,000	262	26.8	65,000	289	29.5
1	26	1.82	2.71	76,600	341	34.7	84,400	375	38.3
1 1/8	29	2.30	3.42	96,400	429	43.7	106,200	472	48.2
1 1/4	32	2.84	4.23	118,400	527	53.7	130,200	579	59.1
1 3/8	35	3.43	5.10	142,600	634	64.7	156,800	697	71.1
1 1/2	38	40.8	6.07	168,800	751	76.6	185,600	826	84.2

*These strengths apply only when a test is conducted with both ends fixed. When in use, the strength of these ropes may be significantly reduced if one end is free to rotate.

Table 15—6 × 25 "B", 6 × 27 "H", 6 × 30 "G", 6 × 31 "V" Flattened Strand Construction Wire Rope Bright (Uncoated) or Drawn-Galvanized Wire Independent Wire Rope Core

See Section 6 for typical rope constructions.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Typical Nominal Strength*									
Nominal Diameter		Approx. Mass		Improved Plow Steel			Extra Imp. Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/2	13	0.47	0.70	25,400	113	11.5	28,000	125	12.7
9/16	14.5	0.60	0.89	32,000	142	14.5	35,200	157	16.0
5/8	16	0.74	1.10	39,400	175	17.9	43,400	193	19.7
3/4	19	1.06	1.58	56,400	251	25.6	62,000	276	28.1
7/8	22	1.46	2.17	76,000	330	34.5	83,800	373	38.0
1	26	1.89	2.81	98,800	439	44.8	108,800	484	49.3
1 1/8	29	2.39	3.56	124,400	553	56.4	137,000	609	62.1
1 1/4	32	2.95	4.39	152,600	679	69.2	168,000	747	76.2
1 3/8	35	3.57	5.31	183,600	817	83.3	202,000	898	91.6
1 1/2	38	4.25	6.32	216,000	961	98.0	238,000	1,060	108
1 5/8	42	4.99	7.43	254,000	1,130	115	280,000	1,250	127
1 3/4	45	5.74	8.62	292,000	1,300	132	322,000	1,430	146
1 7/8	48	6.65	9.90	334,000	1,490	151	368,000	1,640	167
2	52	7.56	11.2	378,000	1,680	171	414,000	1,840	188

5 Manufacture and Tolerances

5.1 STRAND CONSTRUCTION

5.1.1 6 × 7 classification wire ropes shall contain 6 strands that are made up of 3 through 14 wires of which no more than 9 are outside wires fabricated in one operation.* See Table 6 and Figure 11.

5.1.2 6 × 19 classification wire ropes shall contain 6 strands that are made up of 15 through 26 wires of which no more than 12 are outside wires fabricated in one operation.* See Tables 7 and 8 and Figures 12, 13, 14, and 15.

5.1.3 6 × 37 classification wire ropes shall contain 6

strands that are made up of 27 through 49 wires of which no more than 18 are outside wires fabricated in one operation.* See Tables 7 and 9 and Figures 16, 17, 18, 19, 20, 21, and 22.

5.1.4 6 × 61 classification wire ropes shall contain 6 strands that are made up of 50 through 74 wires of which no more than 24 are outside wires fabricated in one operation.* See Table 10 and Figures 23 and 24.

*One Operation Strand—When the center wire of the strand becomes so large (manufacturer's discretion) that it is considered undesirable, it is allowed to be replaced with a 7-wire strand manufactured in a separate stranding operation. This does not constitute a two operation strand and may be counted as a single wire.

5.1.5 6 × 91 classification wire ropes shall have six strands that are made up of 75 through 109 wires of which no more than 30 are outside wires. See Table 11 and Figures 25 and 26.

5.1.6 8 × 91 classification wire rope shall have 8 strands that are made up of 15 through 26 wires of which no more than 12 are outside wires fabricated in one. See Table 12 and Figures 27 and 28.

5.1.7 18 × 7 and 19 × 7 wire ropes shall contain 18 or 19 strands respectively. Each strand is made up of 7 wires. It is manufactured by counter-helically laying an outer 12 strand layer over an inner 6 × 7 or 7 × 7 wire rope. This produces a rotation-resistant characteristic.* See Tables 13 and 14 and Figures 29 and 30.

5.1.8 6 × 25 Style "B", 6 × 27 Style "H", 6 × 30 Style "G" and 6 × 31 Style "V" flattened strand wire rope shall have 6 strands with 24 wires fabricated in two operations around a semi triangular shaped center.* See Table 15 and Figures 31, 32, 33, and 34.

5.1.9 In wire rope, strands shall be continuous. If joints are necessary in individual wires, they shall be made, prior to fabrication of the strand, by brazing or electric welding. Joints shall be spaced in accordance with the formula:

$$J = 24D \quad (2)$$

Where:

J = minimum distance between joints in main wires in any one strand, inches (mm).

D = nominal diameter of wire rope, inches (mm).

5.1.10 Wire rope is most often furnished preformed, but can be furnished non-preformed, upon special request by the purchaser. A preformed rope is one which has the strands shaped to the helical form they assume in the finished rope before the strands have been fabricated into the rope. The strands of such preformed rope shall not spring from their normal position when the seizing bands are removed.

5.2 DIRECTION OF LAY

Wire rope shall be furnished right lay or left lay and regular lay or Lang lay as specified by the purchaser (see Fig. 1). If not otherwise specified on the purchase order, right lay, regular lay rope shall be furnished.

5.3 LENGTH OF LAY

5.3.1 For 6 × 7 wire ropes, the lay of the finished rope shall not exceed 8 times the nominal diameter.

*One Operation Strand—When the center wire of the strand becomes so large (manufacturer's discretion) that it is considered undesirable, it is allowed to be replaced with a 7-wire strand manufactured in a separate stranding operation. This does not constitute a two operation strand and may be counted as a single wire.

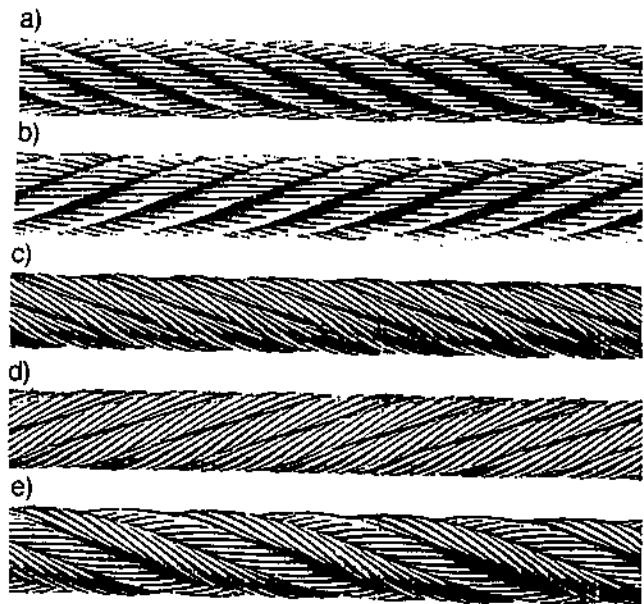


Figure 1—A comparison of typical wire rope lays: a) right regular lay, b) left regular lay, c) right lang lay, d) left lang lay, e) right alternate lay.

5.3.2 For 6 × 19, 6 × 37, 6 × 61, 6 × 91, and 8 × 19 wire rope, the lay of the finished rope shall not exceed $7\frac{1}{4}$ times the nominal diameter.

5.3.3 For 18 × 7 and 19 × 7 wire rope, the lay of the finished rope shall not exceed $7\frac{1}{4}$ times the nominal diameter.

5.3.4 For flattened strand rope designations 6 × 25 "B", 6 × 27 "H", 6 × 30 "G" and 6 × 31 "V", the lay of the finished rope shall not exceed 8 times the nominal diameter.

5.4 DIAMETER OF ROPES—TOLERANCE LIMITS

5.4.1 The diameter of a wire rope shall be the diameter of a circumscribing circle. The diameter shall be measured at least 5 ft (1.52 m) from properly seized end with a suitable caliper (see Fig. 2).

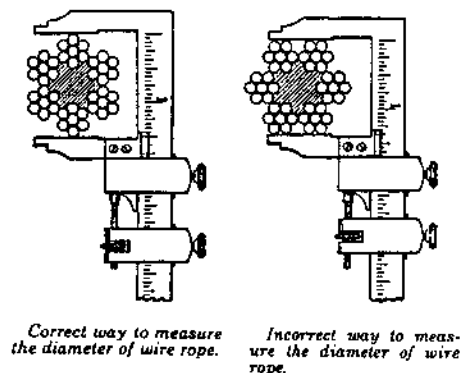


Figure 2—Measurement of Diameter

5.4.2 The diameter tolerance of wire rope shall be:

Nominal inch diameter: -0% to +5%

Nominal mm diameter: -1% to +4%

A question may develop as to whether or not the wire rope complies with the oversize tolerance. In such cases, the rope can be measured while a tension of not less than 10% nor more than 20% of the nominal strength is applied to the rope.

5.5 DIAMETER OF WIRE—TOLERANCE LIMITS

In separating the wire rope for gaging of wire, care must be taken to separate the various sizes of wire composing the different layers of bright (uncoated), drawn-galvanized, or galvanized wires in the strand. In like-positioned wires, total variations of wire diameters shall not exceed the values of Table 16.

5.6 FIBER CORES

For all wire ropes manufactured under this specification, all fiber cores shall be hard-twisted, best-quality, manila, sisal, polypropylene, or equivalent. The cores shall be of uniform diameter and hardness, effectively supporting the strands. Manila and sisal cores shall be thoroughly impregnated with a suitable lubricating compound free from acid. Jute cores shall not be used.

5.7 LENGTHS

Length of wire rope shall be specified by the purchaser.

5.7.1 If minimum length is critical to the application, it shall be specified and conform to the following tolerances.

- a. Less than and including 1300 ft (400 m) length: -0 to +5%.
- b. Over 1300 ft (400 m) length: 66 ft (20 m) plus 66 ft. (20 m) per each additional 3280 ft (1000 m) or part thereof.

5.7.2 If minimum length is not critical to the application, it shall conform to the following tolerances.

- a. Less than and including 1300 ft (400 m) length: $\pm 2\frac{1}{2}\%$.
- b. Over 1300 ft (400 m) length: ± 33 ft (10 m) plus ± 33 ft (10 m) per each additional 3280 ft (1000 m) or part thereof.

5.8 LUBRICATION

All wire rope, unless otherwise specified, shall be lubricated and impregnated in the manufacturing process with a suitable compound for the application in amounts best adapted to the application.

5.9 SPECIALITY ROPES**5.9.1 Compacted Strand Wire Rope**

Compacted strand wire rope is a wire rope manufactured from strands which have been compacted or reduced in diameter prior to laying strands around the core into a finished wire rope. See Figures 3, 4, and 5. There are various known methods for compacting, drawing the strand through a compacting die, roller reduction and rotary swaging are several examples. The compacting process flattens the surface of the outer wires and reforms internal wires of the strand to increase the metallic area of the strand. The result is a smoother bearing surface at the strand crowns and an increase in nominal strength over round strand rope of the same diameter and classification. For information on the exact nominal strength available on a particular rope, consult the manufacturer of the rope.

5.9.2 Compacted (Swaged) Wire Rope

The entire cross section of a rope is compacted or reduced in diameter following laying strands around to produce compacted or swaged wire rope. See Figures 6 and 7. Rotary swaging is the most common process for compacted rope although other processes may be used. The wires and strands of the rope are flattened to produce a relatively smooth and wear resistant outer surfaces. Compacted rope generally has good wear resistance, crushing resistance and high strength, however bending fatigue life may be reduced by the compacting process.

5.9.3 Plastic Coated Wire Rope

Various wire rope constructions are available with a plastic coating applied to the exterior of the rope. See Figure 8. Small diameter galvanized and stainless steel wire ropes with

Table 16—Wire Diameter Tolerance

(1)		(2)		(3)		(4)		(5)		(6)	
Wire Diameters				Uncoated (bright) and Drawn Galvanized Wires		Galvanized Wires					
inches	mm			inches	mm	inches	mm				
0.018 - 0.027	0.46 - 0.69			0.0015	0.038	—	—				
0.028 - 0.059	0.70 - 1.50			0.0020	0.051	0.0035	0.089				
0.060 - 0.092	1.51 - 2.34			0.0025	0.064	0.0045	0.114				
0.093 - 0.141	2.35 - 3.58			0.0030	0.076	0.0055	0.140				
0.142 and larger	3.59 and larger			0.0035	0.075	0.0075	0.190				

plastic coating are common. The plastic coating can provide protection against corrosion and in some cases reduce wear of the rope and other rigging components. Plastic coated rope can be difficult to inspect. Nominal strengths for plastic coated ropes are based on the diameter and grade of the rope prior to coating.

5.9.4 Plastic Filled Wire Rope

Plastic filled wire ropes are wire ropes in which internal spaces are filled with a matrix of plastic. The plastic extends to, or slightly beyond, the outer circumference of the rope. See Figure 9. Plastic filling may improve bending fatigue life

by reducing internal and external wear. Nominal strengths for plastic filled ropes are based on the diameter and grade of the rope prior to plastic filling.

5.9.5 Plastic Coated IWRC Wire Rope

Plastic coated IWRC wire rope is wire rope which incorporates a plastic coated or plastic filled IWRC. See Figure 10. The plastic coated or plastic filled IWRC reduced internal wear and may increase bending fatigue life. Nominal strength for plastic coated and plastic filled ropes are based on the diameter and grade of the rope with an uncoated or unfilled IWRC.

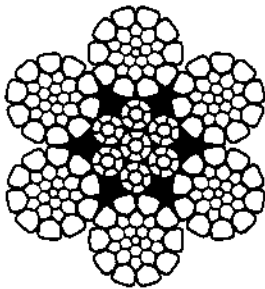


Figure 3—6 x 26 Warrington Seale
Compacted Strand IWRC

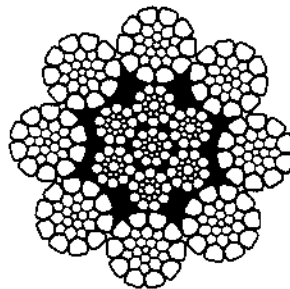


Figure 4—8 x 26 Warrington Seale
Compacted Strand IWRC

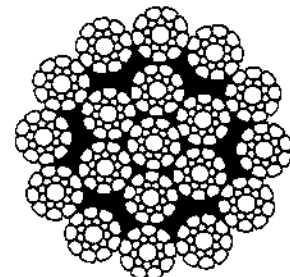


Figure 5—19 x 19 Seale
Compacted Strand

COMPACTED STRAND WIRE ROPE

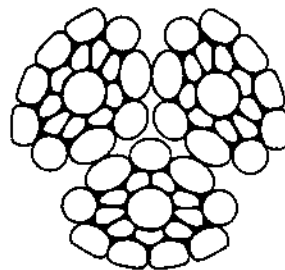


Figure 6—3 x 19 Seale
Compacted (Swaged)

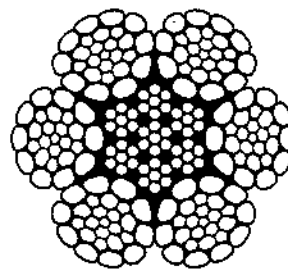


Figure 7—6 x 26
Warrington Compacted
(Swaged) IWRC

COMPACTED (SWAGED) WIRE ROPE

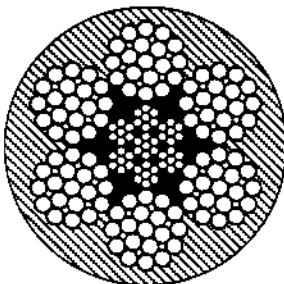


Figure 8—Plastic Coated Wire
Rope

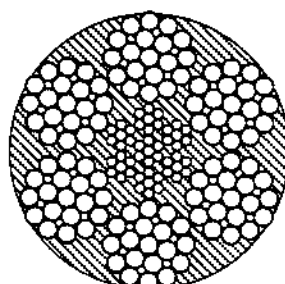


Figure 9—6 x 25 Plastic Filled
Wire Rope

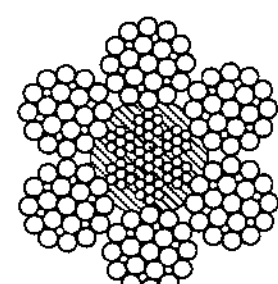


Figure 10—Plastic Coated IWRC
Wire Rope

6 Strand Construction

Strand construction shall be as specified by the purchaser. Fig. 11 to 34 inclusive, show typical strand constructions; however, strand constructions other than those illustrated in these figures are permissible under this specification. Wire rope of 6×7 classification, shown in Fig. 11, should be or-

dered only with fiber core. Wire ropes of 6×19 classification, shown in Fig. 12 through 15, and 6×37 classification, shown in Fig. 16 through 22, may be ordered with either fiber cores or IWRC (independent wire-rope cores). Wire ropes of 8×19 classification shown in Fig. 27 and 28 and flattened strand designations shown in Fig. 31, 32, 33 and 34 are available under this specification with IWRC only.

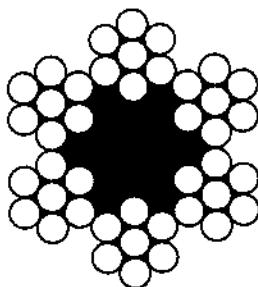


Figure 11— 6×7 FC

6×7 CLASSIFICATION

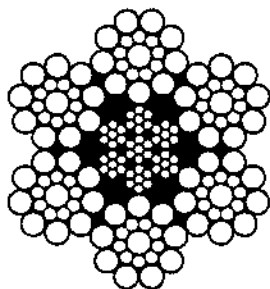


Figure 12— 6×19 Seale IWRC

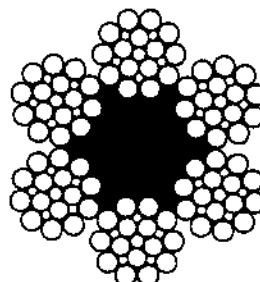


Figure 13— 6×21 Filler Wire FC

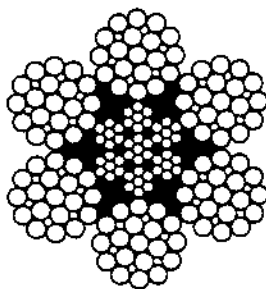


Figure 14— 6×25 Filler Wire IWRC

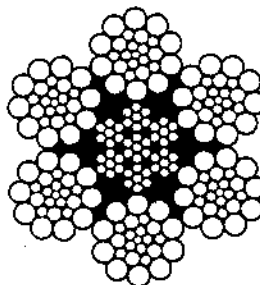


Figure 15— 6×26 Warrington Seale IWRC

6×19 CLASSIFICATION

TYPICAL WIRE ROPE CONSTRUCTIONS

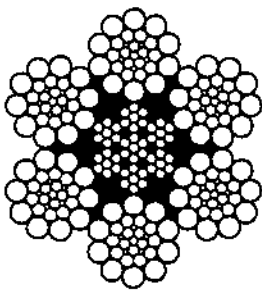


Figure 16—6 x 31 Filler
Wire Seale IWRC

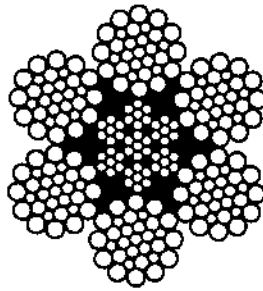


Figure 17—6 x 31
Warrington Seale IWRC

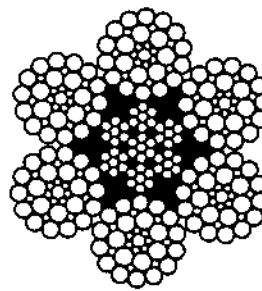


Figure 18—6 x 36 Seale
Filler Wire IWRC

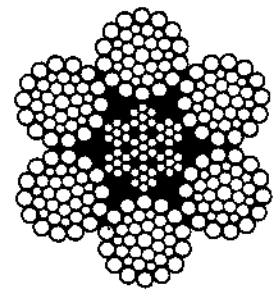


Figure 19—6 x 36
Warrington Seale IWRC

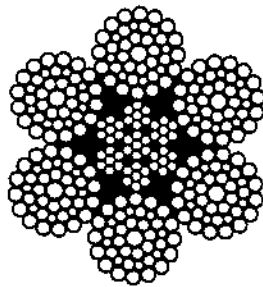


Figure 20—6 x 41
Warrington Seale IWRC

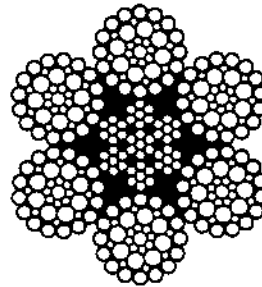


Figure 21—6 x 41 Seale
Filler Wire IWRC

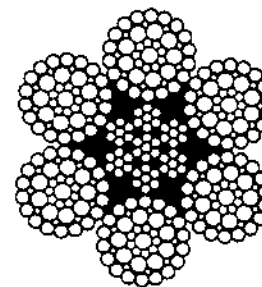


Figure 22—6 x 46 Seale
Filler Wire IWRC

6 x 37 CLASSIFICATION

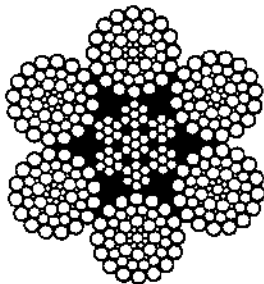


Figure 23—6 x 57 Seale
Filler Wire Seale IWRC

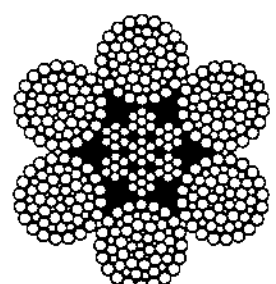


Figure 24—6 x 61 Filler Wire
Warrington Seale IWRC

6 x 61 CLASSIFICATION

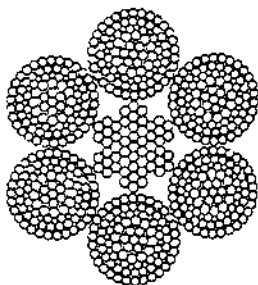


Figure 25—6 x 91 with In-
dependent Wire Rope Core
(Two-Operation Strand)

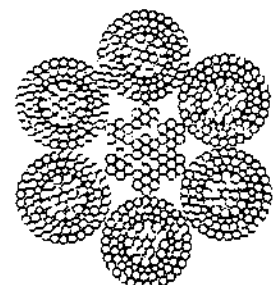


Figure 26—6 x 103 with In-
dependent Wire Rope Core
(Two-Operation Strand)

6 x 91 CLASSIFICATION

TYPICAL WIRE ROPE CONSTRUCTIONS

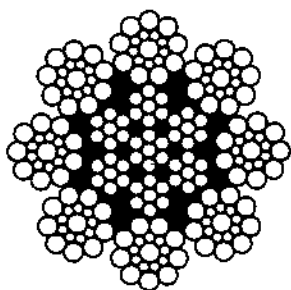


Figure 27—8 x 19 Seale
IWRC

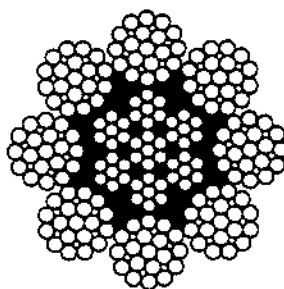


Figure 28—8 x 25 Filler
Wire IWRC

8 x 19 CLASSIFICATION

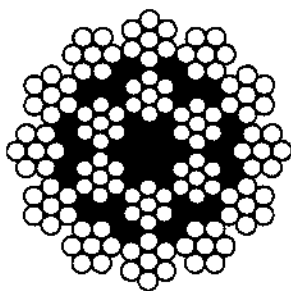


Figure 29—18 x 7 FC

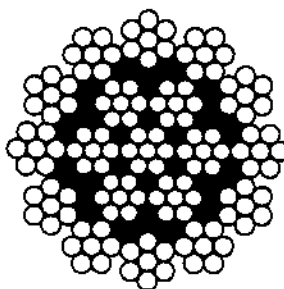


Figure 30—19 x 7

18 x 7 AND 19 x 7 CONSTRUCTION

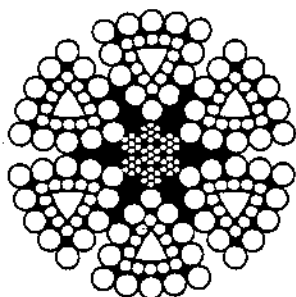


Figure 31—6 x 25 Style B
Flattened Strand IWRC

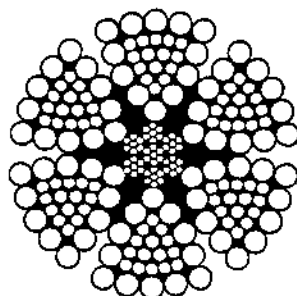


Figure 32—6 x 27 Style H
Flattened Strand IWRC

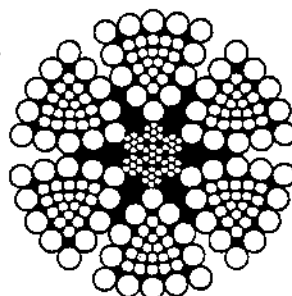


Figure 33—6 x 30 Style G
Flattened Strand IWRC

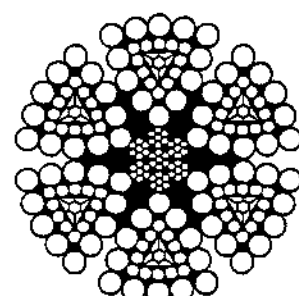


Figure 34—6 x 31 Style V
Flattened Strand IWRC

FLATTENED STRAND CONSTRUCTIONS

TYPICAL WIRE ROPE CONSTRUCTIONS

7 Mooring Wire Rope

7.1 SCOPE

This section covers wire rope used as anchor lines in spread mooring systems.

7.2 COMPLIANCE

Mooring wire rope shall comply with the provisions of

Sections 1, 3, 4, 5, 6, 12, and 13.

7.3 CONSTRUCTION

Wire rope for this use should be one-operation, right lay, regular lay, independent wire rope core, preformed, galvanized or bright.

Table 17—6 × 19, 6 × 37, and 6 × 61 Construction
Mooring Wire Rope, Independent Wire Rope Core

See Section 6 for typical wire rope constructions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Construction Classification	Nominal Strength										
	Nominal Diameter		Approximate Mass		Galvanized			Bright			
	in.	mm	lb/ft	kg/m	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes	
6 × 37	6 × 19	1	26	1.85	2.75	93,060	414	42.2	95,800	426	43.5
		1 ¹ / ₈	29	2.34	3.48	117,000	520	53.1	119,000	530	54.1
		1 ¹ / ₄	32	2.89	4.30	143,800	640	65.2	145,000	646	65.9
		1 ³ / ₈	35	3.50	5.21	172,800	769	78.4	174,000	773	78.8
		1 ¹ / ₂	38	4.16	6.19	205,200	913	93.1	205,000	911	92.9
		1 ⁵ / ₈	42	4.88	7.26	237,600	1,060	108	250,000	1,110	113
		1 ³ / ₄	45	5.67	8.44	275,400	1,230	125	287,000	1,280	130
		1 ⁷ / ₈	48	6.50	9.67	313,200	1,390	142	327,000	1,450	148
		2	52	7.39	11.0	356,400	1,590	162	369,000	1,640	167
		2 ¹ / ₈	54	8.35	12.4	397,800	1,770	180	413,000	1,840	188
		2 ¹ / ₄	58	9.36	13.9	444,600	1,980	202	461,000	2,050	209
		2 ³ / ₈	60	10.4	15.5	493,200	2,190	224	528,000	2,350	239
6 × 61	2 ¹ / ₂	64	11.6	17.0	543,600	2,420	247	604,000	2,690	274	
	2 ⁵ / ₈	67	12.8	18.6	595,800	2,650	270	658,000	2,930	299	
	2 ³ / ₄	71	14.0	20.9	649,800	2,890	295	736,000	3,270	333	
	2 ⁷ / ₈	74	15.3	22.7	705,600	3,140	320	796,000	3,540	361	
	3	77	16.6	24.6	765,000	3,400	347	856,000	3,810	389	
	3 ¹ / ₈	80	18.0	26.6	824,400	3,670	374	920,000	4,090	417	
	3 ¹ / ₄	83	19.5	28.6	885,600	3,940	402	984,000	4,380	447	
	3 ³ / ₈	87	21.0	31.4	952,200	4,240	432	1,074,000	4,780	487	
	3 ¹ / ₂	90	22.7	33.6	1,015,000	4,520	460	1,144,000	5,090	519	
	3 ³ / ₄	96	26.0	38.2	1,138,000	5,060	516	1,290,000	5,740	585	
	4	103	29.6	44.0	1,283,000	5,710	582	1,466,000	6,520	665	
	4 ¹ / ₈	109	33.3	49.3	1,438,000	6,400	652	1,606,000	7,140	728	
4 ¹ / ₂	115	37.4	54.9	1,598,000	7,110	725	1,774,000	7,890	805		
4 ³ / ₄	122	41.7	61.8	1,766,000	7,860	801	1,976,000	8,790	896		

Note: For tests see Paragraph 4.6.7.

7.4 NOMINAL STRENGTH

The nominal strength of galvanized and bright mooring wire rope shall be as specified in Table 17.

7.5 WIRE GRADE

For bright mooring wire ropes, the wire grade shall comply with the requirements for Level 4, Table 4 or ISO Std 2232 value of 1770 N/mm².

8 Torpedo Lines

8.1 CONSTRUCTION

Torpedo lines shall be bright (uncoated) or drawn galvanized.

Torpedo lines shall be right, regular lay. The lay of the finished rope shall not exceed 8 times the nominal diameter.

Torpedo lines shall be made either of five strands of five wires each, or five strands of seven wires each. The strands of the 5 × 5 construction shall have one center wire and four outer wires of one diameter, fabricated in one operation. The five strands shall be laid around one fiber or cotton core (see Fig. 35). The strands of the 5 × 7 construction shall have one center wire and six outer wires of one diameter, fabricated in

one operation. The strands shall be laid around one fiber or cotton core (see Fig. 36).

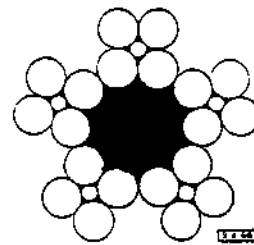


Figure 35—5 × 5 Construction Torpedo Line

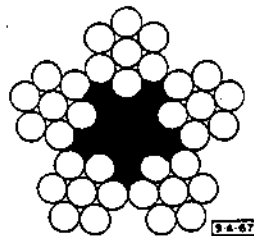


Figure 36—5 × 7 Construction Torpedo Line

8.2 WIRE REQUIREMENTS

The four outer wires in each strand of the 5 × 5 construction [both bright (uncoated) and drawn-galvanized] and all the wires in each strand of the 5 × 7 construction [both bright (uncoated) and drawn-galvanized] shall have breaking strengths as stipulated in Tables 4 and 5 for the specified grade and applicable wire size. The center wire of the 5 × 5 construction shall be hard drawn or annealed and shall not be required to meet the minimum breaking strength specified for the outer wires (the center wire represents about 5 per cent of the total metallic area of the rope and is substantially a filler wire). The only requirements applicable to the individual wires in torpedo lines are the breaking strengths.

8.3 NOMINAL STRENGTH

The nominal strength of torpedo lines shall be as specified in Tables 18 and 19.

When testing finished torpedo lines to their breaking

strength, suitable sockets or other acceptable means shall be used.

8.4 TEST SPECIMENS

The length of tension test specimens shall be not less than one foot (0.305 m) between attachments. If the first specimen fails at a value below the specified nominal strength, two additional specimens from the same rope shall be tested, one of which must comply with the nominal strength requirement.

8.5 ROPE DIAMETER

The diameter of the ropes shall be not less than the nominal diameter, nor more than $\frac{1}{64}$ in. (0.40 mm) over that diameter.

8.6 LENGTH

Torpedo-line lengths shall vary in 500-ft (152.4 m) multiples.

Table 18—5 × 5 Construction Torpedo Lines

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Diameter of Rope		Approx. Mass		Nominal Strength					
				Plow Steel			Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
$\frac{1}{8}$	3.18	2.21	3.29	1,120	4.98	0.51	1,290	5.74	0.59
$\frac{9}{64}$	3.57	2.80	4.16	1,410	6.27	0.64	1,620	7.21	0.74
$\frac{5}{32}$	3.97	3.46	5.15	1,740	7.74	0.79	2,000	8.90	0.91
$\frac{3}{16}$	4.76	4.98	7.41	2,490	11.08	1.13	2,860	12.72	1.30
$\frac{1}{4}$	6.35	8.86	13.91	4,380	19.48	1.99	5,030	22.37	2.28
$\frac{5}{16}$	7.94	13.80	20.54	6,780	30.16	3.08	7,790	34.65	3.53

Table 19—5 × 7 Construction Torpedo Lines

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Nominal Diameter of Rope		Approx. Mass		Nominal Strength					
				Plow Steel			Improved Plow Steel		
				lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
$\frac{1}{8}$	3.18	2.39	3.56	1,210	5.38	0.55	1,400	6.23	0.64
$\frac{9}{64}$	3.57	3.02	4.49	1,530	6.81	0.69	1,760	7.83	0.80
$\frac{5}{32}$	3.97	3.73	5.55	1,890	8.41	0.86	2,170	9.65	0.98
$\frac{3}{16}$	4.76	5.38	8.01	2,700	12.01	1.23	3,110	13.83	1.41
$\frac{1}{4}$	6.35	9.55	14.21	4,760	21.17	2.16	5,470	24.33	2.48
$\frac{5}{16}$	7.94	14.90	22.17	7,380	32.83	3.35	8,490	37.77	3.85

Table 20—Requirements for Well Measuring Wire, Bright or Drawn Galvanized Carbon Steel

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Minimum elongation (per 9.2):				Improved Plow Steel			Extra Improved Plow Steel			Extra Extra Improved Plow Steel		
				1½%			—*			—*		
Wire Diameter		Approximate Wire Weight		Nominal Strength			Nominal Strength			Nominal Strength		
in (± 0.001)	mm (± 0.03)	lb/ft	kg/m	lb	kN	Min. Tor.	lb	kN	Min. Tor.	lb	kN	Min. Tor.
0.066	1.68	0.012	0.018	811	3.61	32	960	4.27	—*	994	4.42	—*
0.072	1.83	0.014	0.021	961	4.27	29	1150	5.12	—*	1178	5.24	—*
0.082	2.08	0.018	0.027	1239	5.51	26	1460	6.49	—*	1517	6.75	—*
0.092	2.34	0.023	0.034	1547	6.88	23	1830	8.14	—*	1895	8.43	—*
0.105	2.67	0.030	0.045	1966	8.74	20	2360	10.50	—*	2449	10.89	—*
0.108	2.74	0.032	0.048	2109	9.38	19	2490	11.08	—*	2581	11.48	—*
0.125	3.18	0.042	0.062	2794	12.43	—*	3300	14.68	—*	3418	15.2	—*
0.128	3.25	0.044	0.065	2924	13.01	—*	3450	15.35	—*	3584	15.94	—*

*Values to be agreed upon between purchaser and manufacturer.

9 Well-Measuring Wire

9.1 REQUIREMENTS

Well-measuring wire shall be in accordance with Table 20. For well-measuring wire of other materials or coatings, refer to supplier for physical properties.

Well-measuring wire shall consist of one continuous piece of wire without brazing or welding of the finished wire. The wire shall be made from the best quality of specified grade of material, shall be of good workmanship, and shall be free from defects which might affect its appearance or serviceability. Coating on well-measuring wire shall be optional with the purchaser.

9.2 TESTING

A specimen of wire 3 ft (0.91 m) long shall be cut from each coil of well-measuring wire. One section of this specimen shall be tested for elongation and tensile strength simultaneously. The ultimate elongation shall be measured on a 10-in. (254 mm) length of specimen, at instant of rupture, which must occur within the 10-in. (254 mm) gage length. When determining elongation, a stress shall be imposed upon the wire equal to 100,000 psi (690 MPa) at which point the extensometer is applied. Directly to the reading of the extensometer shall be added 0.4 per cent to allow for the initial elongation occurring before application of the extensometer.

The remaining section of the 3-ft (0.91 m) test specimen shall be gaged for size and tested for torsional requirements in accordance with Paragraph 4.5.1 through 4.5.5, inclusive.

If, when making any individual test, the first specimen

fails, not more than two additional specimens from the same wire shall be tested. If the average of any two tests shows acceptance, it shall be used as the value to represent the wire.

9.3 PACKING, MARKING, INSPECTION, & REJECTION

Well-measuring wire shall be packed and marked in accordance with Section 12. Inspection and rejection thereof shall be in accordance with Section 13.

10 Well-Measuring Strand

10.1 CONSTRUCTION

Well-measuring strand shall be bright (uncoated) or drawn-galvanized.

Well-measuring strand shall be left lay. The lay of the finished strand shall not exceed 10 times the nominal diameter.

Well-measuring strands may be of various combinations of wires but are commonly furnished in both 1 × 16 (1⁶/₉) and 1 × 19 (1⁶/₁₂) constructions.

10.2 REQUIREMENTS

Well-measuring strands shall conform to the properties listed in Table 21.

10.3 TESTING

When testing finished strands to their breaking strength, suitable sockets or other acceptable means of holding small cords shall be used.

Table 21—Requirements for Well Servicing Strand Bright or Drawn Galvanized Carbon Steel

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Nominal Diameter	Minimum Diameter		Maximum Diameter		Approximate Weight		Galvanized Improved Plow Steel		Galvanized Extra Improved Plow Steel	
in	in	mm	in	mm	lb/ft	kg/m	lb	kN	lb	kN
3/16	0.188	4.775	0.201	5.105	0.073	0.109	4,200	18.7	4,700	20.9
7/32	0.219	5.563	0.232	5.893	0.100	0.149	5,900	26.2	6,600	29.4
1/4	0.250	6.350	0.265	6.731	0.127	0.189	7,300	32.5	8,200	36.5
5/16	0.313	7.950	0.329	8.357	0.220	0.327	11,100	49.4	12,500	55.6

11 Wire Guy Strand and Structural Rope and Strand

11.1 GALVANIZED WIRE GUY STRAND

Galvanized wire guy strand shall conform to ASTM A-475: Zinc-Coated Steel Wire Strand.

11.2 ALUMINIZED WIRE GUY STRAND

Aluminized wire guy strand shall conform to ASTM A-474: Aluminum Coated Steel Wire Strand.

11.3 GALVANIZED STRUCTURAL STRAND

Galvanized structural strand shall conform to ASTM A-586: Zinc-Coated Steel Structural Strand.

11.4 GALVANIZED STRUCTURAL ROPE

Galvanized structural rope shall conform to ASTM A-603: Zinc-Coated Steel Structural Wire Rope.

12 Packing and Marking

12.1 REEL PACKING

12.1.1 Finished wire rope, unless otherwise specified, shall be shipped on substantial round-head reels. Reels on which sand lines, drilling lines, or casing lines are shipped shall have round arbor holes 5 in. (127 mm) to 5 3/4 in. (146 mm) in diameter. When reel is full of rope, there shall be a clearance of not less than 2 in. (51 mm) between the full reel and the outside diameter of the flange.

12.1.2 The manufacturer shall protect the wire rope on reels with a water-resistant covering of built-up material, such as tar paper and burlap, or similar material, that will protect the rope from damage by moisture, dust, or dirt.

12.2 REEL MARKING*

The following data shall be plainly marked on the face of the wire-rope reel.

- Name of manufacturer.
- Reel number.
- Specification 9A.
- Length of rope, ft (m).
- Diameter of rope, in (mm).
- Type of construction (Warrington, Seale, Filler Wire or a combined pattern).
- Lay (i.e.: RRL, RLL).
- Grade (i.e.: improved plow steel or extra improved plow steel).
- Type of core (fiber, wire, plastic, or fiber and plastic).

13 Inspection and Rejection

Unless otherwise provided, the provisions of Appendix A shall apply.

*Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institute separately from the specification. The policy describing use of the monogram is contained in Appendix (B), herein. No other use of the monogram is permitted.

APPENDIX A—PURCHASER INSPECTION

A.1

The manufacturer will, on request of the purchaser, conduct tests as called for in this specification on reasonable notice from the purchaser, during which tests the manufacturer will afford opportunity to the purchaser's representative to be present.

A.2

A manufacturer delivering wire rope bearing the API marking and grade designation, warrants that such material complies with this specification. No rejections under this or any other specification are to be wound on reels bearing the API marking, or sold as API wire rope. When wire rope wound on reels bearing the API marking is rejected, the monogram shall be removed.

A.3

It is recommended that whenever possible, the purchaser, upon receipt, shall test all new wire rope purchased in accordance with this specification. If a rope fails to render satisfactorily service, it is impractical to retest such used rope. It is therefore required that the purchaser shall preserve at least one test specimen of all new rope purchased, length of specimen to be at least 10 ft (3.05 m), properly identified by reel

number, etc. Care must be taken that no damage will result by storage of specimen.

A.4

If the purchaser is not satisfied with the wire rope service, he shall send the properly preserved sample (Par. A.3) or a sample of the rope from an unused section to any testing laboratory mutually agreed upon by the purchaser and the manufacturer, with instructions to make a complete API test, and notify the manufacturer to afford him an opportunity to have a representative present. If the report indicates compliance with this specification, the purchaser shall assume cost of testing; otherwise the manufacturer shall assume the expense and make satisfactory adjustments not exceeding full purchase price of the rope. If the report indicates non-compliance with this specification, the testing laboratory shall forward a copy of the test report to the manufacturer.

A.5

The manufacturer is responsible for complying with all of the provisions of this specification. The purchaser may make any investigation necessary to satisfy himself of compliance by the manufacturer and may reject any material that does not comply with the specification.

APPENDIX B—USE OF THE API MONOGRAM

The marking requirements in Par. 12.2 apply to licensed manufacturers using the API monogram on products covered by this specification with the following revision:

In place of item c under Section 12.2, the manufacturer

shall place on each reel flange the API license number, the monogram, and the date of manufacture.

Ex: 9Axxxx Φ mo-yr