Specification for Wire Rope

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CONTENTS

Tables

FOREWORD

The bar notations identify parts of this standard that have been changed from the previous API edition.

This specification is under the jurisdiction of the API Committee on Standardization of Drilling and Servicing Equipment.

This standard shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.

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.*

ASTM[1]

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.*

ISO[2]

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

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

[2]International 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./ft²	kg/m²
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./ft²	kg/m²
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 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. ± 1/16 in. (203 mm ± 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 1/8 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 x 7 constructions, or ten wire in 6 x 37 classification, or fifteen wires in 6 x 61 classification, or twenty wires in 6 x 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:

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

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 flattened 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 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 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 97 1/2% of the nominal strength as shown in the applicable table. If the first specimen fails at a value below the 97 1/2% 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)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength				
Wire Size Nominal Diameter		Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.
in.	mm	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.
0.010	025	17	76	17	76	241	20	89	21	93	222	21	93	23	102	202	23	102	25	111	176
0.011	028	20	89	22	98	219	23	102	25	111	202	26	116	28	125	183	28	125	30	133	150
0.012	030	24	107	26	116	201	28	125	30	133	185	31	138	33	147	168	33	147	35	156	146
0.013	033	28	125	30	133	185	33	147	35	155	171	36	160	38	169	155	39	173	41	182	135
0.014	036	33	147	35	156	172	38	169	40	178	159	42	187	44	196	144	45	200	47	209	126
0.015	038	38	169	40	178	161	44	196	46	205	148	48	214	50	222	134	52	231	54	240	117
0.016	041	43	191	45	200	150	50	222	52	231	139	55	245	57	254	126	59	262	62	276	109
0.017	043	49	218	51	227	142	56	249	58	258	130	61	271	65	289	118	66	294	70	311	103
0.018	046	55	245	57	254	134	62	276	66	294	124	69	307	73	325	112	74	329	78	347	97
0.019	048	60	267	64	285	126	70	311	74	329	117	77	342	81	360	106	83	369	87	387	93
0.020	051	67	298	71	316	120	77	342	81	360	110	85	378	89	396	100	92	409	96	427	87
0.021	053	74	329	78	347	114	85	378	89	396	105	94	418	98	436	95	100	445	106	471	83
0.022	056	81	360	85	378	109	94	418	98	436	101	102	454	108	480	90	110	489	116	516	79
0.023	058	89	396	93	414	105	102	454	108	480	96	112	498	118	525	86	121	538	127	565	75
0.024	061	97	431	101	449	100	111	494	117	520	92	122	543	128	569	82	132	587	138	614	71
0.025	064	104	463	110	489	96	120	534	126	560	88	133	592	139	618	78	142	632	150	667	58
0.026	066	113	503	119	529	92	130	578	136	605	85	143	636	151	672	75	154	685	162	721	55
0.027	069	122	543	128	569	88	140	623	148	658	82	154	685	162	721	72	166	738	174	774	53
0.028	071	131	583	137	609	86	151	672	159	707	79	166	738	174	774	69	178	792	188	836	50
0.029	074	140	623	148	658	83	162	721	170	756	76	177	787	187	832	66	191	850	201	894	58
0.030	076	150	667	158	703	80	173	770	181	805	73	190	845	200	890	64	205	912	215	956	55
0.031	079	160	712	168	747	77	184	818	194	863	71	203	903	213	947	62	218	970	230	1,023	54
0.032	081	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	084	181	805	191	850	72	209	930	219	974	67	229	1,019	241	1,072	57	247	1,099	259	1,1550	50
0.034	086	192	854	202	898	70	221	983	233	1,036	65	244	1,085	256	1,139	56	261	1,151	275	1,223	49
0.035	089	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	091	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	094	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	097	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	099	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	102	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	104	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	107	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	109	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	112	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

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

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength				
Wire Size Nominal Diameter		Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.
in.	mm	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.
0.045	1.14	334	1,486	352	1,566	52	385	1,712	405	1,801	48	423	1,882	445	1,979	40	455	2,024	479	2,131	35
0.046	1.17	349	1,552	367	1,632	51	402	1,788	422	1,877	48	442	1,966	464	2,064	39	475	2,113	499	2,220	34
0.047	1.19	365	1,624	383	1,704	50	419	1,864	441	1,962	47	461	2,051	485	2,157	38	495	2,202	521	2,317	33
0.048	1.22	380	1,690	400	1,779	49	437	1,944	459	2,042	46	481	2,139	505	2,246	37	517	2,300	543	2,415	32
0.049	1.24	396	1,761	416	1,850	48	455	2,024	479	2,131	45	500	2,224	526	2,340	36	538	2,393	566	2,518	32
0.050	1.27	411	1,828	433	1,926	48	474	2,108	498	2,215	44	521	2,317	547	2,433	35	560	2,491	588	2,615	31
0.051	1.30	428	1,904	450	2,002	47	492	2,188	518	2,304	43	541	2,406	569	2,531	34	582	2,589	612	2,722	30
0.052	1.32	445	1,979	467	2,077	46	512	2,277	538	2,393	42	563	2,504	591	2,629	34	605	2,691	636	2,829	29
0.053	1.35	462	2,055	486	2,162	45	531	2,362	559	2,486	41	584	2,598	614	2,731	33	628	2,793	660	2,936	29
0.054	1.37	479	2,131	503	2,237	44	551	2,451	579	2,575	40	605	2,691	637	2,833	32	651	2,896	685	3,047	28
0.055	1.40	496	2,206	522	2,322	43	571	2,540	601	2,673	39	628	2,793	660	2,936	31	676	3,007	710	3,158	27
0.056	1.42	515	2,291	541	2,406	42	592	2,633	622	2,767	39	650	2,891	684	3,042	31	700	3,114	736	3,274	27
0.057	1.45	532	2,366	560	2,491	41	612	2,722	644	2,865	38	674	2,998	708	3,149	30	724	3,220	762	3,389	26
0.058	1.47	551	2,451	579	2,575	41	634	2,820	666	2,962	37	697	3,100	733	3,260	29	750	3,336	788	3,505	26
0.059	1.50	569	2,531	599	2,664	40	655	2,913	689	3,065	36	721	3,207	757	3,367	29	775	3,447	815	3,625	25
0.060	1.52	589	2,620	619	2,753	39	678	3,016	712	3,167	36	745	3,314	783	3,483	28	800	3,558	842	3,745	24
0.061	1.55	608	2,704	640	2,847	38	700	3,114	736	3,274	35	769	3,421	809	3,598	27	827	3,678	869	3,865	23
0.062	1.57	628	2,793	660	2,936	38	722	3,211	760	3,380	35	795	3,536	835	3,714	27	854	3,799	898	3,994	23
0.063	1.60	648	2,882	682	3,034	37	745	3,314	783	3,483	34	820	3,647	862	3,834	26	881	3,919	927	4,123	23
0.064	1.63	668	2,971	702	3,122	36	768	3,416	808	3,594	33	845	3,759	889	3,954	26	909	4,043	955	4,248	22
0.065	1.65	689	3,065	725	3,225	36	793	3,527	833	3,705	33	872	3,879	916	4,074	25	937	4,168	985	4,381	22
0.066	1.68	710	3,158	746	3,318	35	816	3,630	858	3,816	32	898	3,994	944	4,199	25	965	4,292	1,015	4,515	22
0.067	1.70	731	3,251	769	3,421	35	840	3,736	884	3,932	32	924	4,110	972	4,323	24	994	4,421	1,044	4,644	21
0.068	1.73	753	3,349	791	3,518	34	865	3,848	909	4,043	31	952	4,234	1,000	4,448	24	1,023	4,550	1,075	4,782	21
0.069	1.75	774	3,443	814	3,621	34	890	3,959	936	4,163	31	979	4,355	1,029	4,577	23	1,053	4,684	1,107	4,924	20
0.070	1.78	797	3,545	837	3,723	33	916	4,074	962	4,279	30	1,007	4,479	1,059	4,710	23	1,083	4,817	1,139	5,066	20
0.071	1.80	819	3,643	861	3,830	33	942	4,190	990	4,404	30	1,035	4,604	1,089	4,844	22	1,113	4,951	1,171	5,209	20
0.072	1.83	841	3,741	885	3,936	32	967	4,301	1,017	4,524	29	1,064	4,733	1,118	4,973	22	1,144	5,089	1,202	5,346	19
0.073	1.85	864	3,843	908	4,039	32	994	4,421	1,044	4,644	29	1,093	4,862	1,149	5,111	22	1,175	5,226	1,235	5,493	19
0.074	1.88	887	3,945	933	4,150	31	1,021	4,541	1,073	4,773	29	1,122	4,991	1,180	5,249	21	1,207	5,369	1,269	5,645	18
0.075	1.91	911	4,052	957	4,257	31	1,047	4,657	1,101	4,897	29	1,152	5,124	1,212	5,391	21	1,239	5,511	1,303	5,796	18
0.076	1.93	935	4,159	983	4,372	30	1,075	4,782	1,131	5,031	29	1,183	5,262	1,243	5,529	20	1,271	5,653	1,337	5,947	18
0.077	1.96	958	4,261	1,008	4,484	30	1,103	4,906	1,159	5,155	28	1,213	5,395	1,275	5,671	20	1,304	5,800	1,370	6,094	17
0.078	1.98	983	4,372	1,033	4,595	29	1,131	5,031	1,189	5,289	28	1,244	5,533	1,308	5,818	20	1,337	5,947	1,405	6,249	17
0.079	2.01	1,008	4,484	1,060	4,715	29	1,159	5,155	1,219	5,422	27	1,275	5,671	1,341	5,965	19	1,371	6,098	1,441	6,410	17

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

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength				
Wire Size Nominal Diameter		Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.
in.	mm	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.
0.080	2.03	1,033	4,595	1,085	4,825	29	1,188	5,284	1,248	5,551	27	1,307	5,814	1,374	6,112	19	1,405	6,249	1,477	6,570	16
0.081	2.06	1,058	4,706	1,112	4,945	29	1,217	5,413	1,279	5,689	27	1,339	5,956	1,407	6,258	19	1,439	6,401	1,513	6,730	16
0.082	2.08	1,083	4,817	1,139	5,065	29	1,246	5,542	1,310	5,827	26	1,371	6,098	1,441	6,410	18	1,473	6,552	1,549	6,890	16
0.083	2.11	1,110	4,937	1,166	5,185	28	1,276	5,676	1,342	5,969	26	1,404	6,245	1,476	6,565	18	1,509	6,712	1,587	7,059	16
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	1,544	6,868	1,624	7,224	15
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	1,580	7,028	1,662	7,393	15
0.086	2.18	1,189	5,289	1,249	5,555	27	1,367	6,080	1,437	6,392	25	1,503	6,685	1,581	7,032	18	1,617	7,192	1,699	7,557	15
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	1,654	7,357	1,738	7,731	15
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	1,691	7,522	1,777	7,904	15
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	1,728	7,686	1816	8,078	15
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	1,766	7,855	1856	8,255	15
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	1,804	8,024	1896	8,433	15
0.092	2.34	1,355	6,027	1,425	6,338	25	1,558	6,930	1,638	7,285	23	1,714	7,624	1,802	8,015	16	1,843	8,198	1937	8,616	14
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	1,882	8,371	1978	8,798	14
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	1,921	8,545	2019	8,981	14
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	1,961	8,723	2061	9,167	14
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	2,001	8,900	2103	9,354	13
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	2,041	9,078	2145	9,541	13
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	2,082	9,261	2188	9,732	13
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	2,123	9,443	2231	9,923	13
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	2,165	9,630	2276	10,124	13
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	2,206	9,812	2320	10,319	13
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	2,249	10,004	2365	10,520	12
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	2,291	10,190	2409	10,715	12
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	2,335	10,386	2455	10,920	12
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	2,378	10,577	2500	11,120	12
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	2,422	10,773	2546	11,325	12
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	2,466	10,969	2592	11,529	12
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	2,511	11,169	2539	11,738	12
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	2,555	11,365	2587	11,952	12
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	2,601	11,569	2,735	12,165	12
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	2,647	11,774	2,783	12,379	12
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	2,693	11,978	2,331	12,592	12
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	2,739	12,183	2,379	12,805	11
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	2,786	12,392	2,928	13,024	11

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

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength				
Wire Size Nominal Diameter		Individual Minimum		Average Minimum			Individual Minimum		Average Minimum			Individual Minimum		Average Minimum			Individual Minimum		Average Minimum		
in.	mm	lb	N	lb	N	Min. Tor.	lb	N	lb	N	Min. Tor.	lb	N	lb	N	Min. Tor.	lb	N	lb	N	Min. Tor.
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	2,77[illegible]	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	2,733	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	13,957	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	12,885	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	15,251	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	3,655	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	14,273	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	15,305	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	14,423	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)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength				
Wire Size Nominal Diameter		Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.
in.	mm	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.
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
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	4,761	21,177	5,005	22,262	6
0.152	3.86	3,545	15,768	3,727	16,578	14	4,076	18,130	4,286	19,054	13	4,484	19,945	4,714	20,968	7	4,820	21,439	5,068	22,542	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	4,881	21,711	5,131	22,823	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	4,941	21,978	5,195	23,107	6
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	5,002	22,249	5,258	23,388	6
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	5,063	22,520	5,323	23,677	6
0.157	3.99	3,768	16,760	3,962	17,623	14	4,334	19,278	4,556	20,255	13	4,767	21,204	5,011	22,289	7	5,125	22,796	5,387	23,961	6
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	5,186	23,067	5,452	24,250	6
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	5,248	23,343	5,518	24,544	6
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	5,311	23,623	5,583	24,833	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	5,373	23,899	5,649	25,127	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	5,437	24,184	5,715	25,420	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	5,500	24,464	5,782	25,718	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	5,563	24,744	5,849	26,016	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	5,628	25,033	5,916	26,314	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	5,692	25,318	5,984	26,617	5
0.167	4.24	4,232	18,824	4,450	19,794	13	4,868	21,653	5,118	22,755	12	5,355	23,819	5,629	25,038	6	5,756	25,603	6,052	26,919	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	5,821	25,892	6,119	27,217	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	5,886	26,181	6,188	27,524	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	5,951	26,470	6,257	27,831	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	6,018	26,768	6,326	28,138	5
0.172	4.37	4,474	19,900	4,704	20,923	12	5,145	22,885	5,409	24,059	11	5,659	25,171	5,949	26,461	6	6,084	27,062	6,396	28,449	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	6,150	27,355	6,466	28,761	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	6,217	27,653	6,535	29,068	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	25,003	6,146	27,337	6	6,284	27,951	6,606	29,383	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	25,283	6,212	27,631	6	6,351	28,249	6,677	29,699	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	25,559	6,277	27,920	6	6,419	28,552	6,749	30,020	5
0.178	4.52	4,771	21,221	5,015	22,307	12	5,486	24,402	5,768	25,656	11	6,034	25,839	6,344	28,218	6	6,487	28,854	6,819	30,331	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	6,555	29,157	6,891	30,651	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	6,624	29,464	6,964	30,976	5
0.181	4.60	4,922	21,893	5,174	23,014	12	5,660	25,176	5,950	26,456	11	6,226	27,693	6,546	29,117	6	6,692	29,766	7,036	31,296	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	6,613	29,415	6	6,762	30,077	7,108	31,616	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	6,832	30,389	7,182	31,946	5
0.184	4.67	5,075	22,574	5,335	23,730	11	5,836	25,959	6,136	27,293	10	6,419	28,552	6,749	30,020	5	6,901	30,696	7,255	32,270	5

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

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength					Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength				
Wire Size Nominal Diameter		Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.	Individual Minimum		Average Minimum		Min.
in.	mm	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.
0.185	4.70	5,127	22,805	5,389	23,970	11	5,896	26225	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	26488	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	26755	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	27017	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	27288	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	27555	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	27831	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	28098	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	28369	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	28645	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	28916	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	29197	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	29472	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	29753	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	30028	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	30309	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	30589	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	30869	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	28,48.	10	7,004	31154	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	31438	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	29,00.	10	7,132	31723	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	32008	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	32297	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	32586	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	32875	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	33169	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	33458	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	30,85.	10	7,587	33747	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	34045	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	34339	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,.18	31,66.	10	7,786	34632	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,.79	31,932	10	7,853	34930	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	35228	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	35526	8,397	37,350	9	8,786	39,080	9,236	41,082	5	9,445	42,01.1	9,929	44,164	4
0.219	5.56	7,003	31,149	7,363	32,75.	10	8,054	35824	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)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
			Level 2 Bright (Uncoated) or Drawn-Galvanized				Level 3 Bright (Uncoated) or Drawn-Galvanized					Level 4 Bright (Uncoated) or Drawn-Galvanized					Level 5 Bright (Uncoated) or Drawn-Galvanized				
Wire Size Nominal Diameter		Breaking Strength Individual Minimum		Average Minimum		Min.	Breaking Strength Individual Minimum		Average Minimum		Min.	Breaking Strength Individual Minimum		Average Minimum		Min.	Breaking Strength Individual Minimum		Average Minimum		Min.
in.	mm	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.	lb	N	lb	N	Tor.
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
0.221	5.61	7,121	31,674	7,487	33,302	10	8,190	36,429	8,610	38,297	9	9,009	40,072	9,471	42,127	4	9,685	43,079	10,181	45,285	4
0.222	5.64	7,181	31,941	7,549	33,578	10	8,257	36,727	8,681	38,613	9	9,083	40,401	9,549	42,474	4	9,765	43,435	10,265	45,659	4
0.223	5.66	7,240	32,204	7,612	33,858	10	8,326	37,034	8,752	38,929	9	9,158	40,735	9,628	42,825	4	9,846	43,795	10,350	46,037	4
0.224	5.69	7,300	32,470	7,674	34,134	10	8,395	37,341	8,825	39,254	9	9,234	41,073	9,708	43,181	4	9,926	44,151	10,436	46,419	4
0.225	5.72	7,359	32,733	7,737	34,414	10	8,463	37,643	8,897	39,574	9	9,309	41,406	9,787	43,535	4	10,007	44,511	10,521	46,797	4
0.226	5.74	7,419	33,000	7,799	34,690	10	8,532	37,950	8,970	39,899	9	9,385	41,744	9,867	43,888	4	10,089	44,876	10,607	47,180	4
0.227	5.77	7,479	33,267	7,863	34,975	10	8,601	38,257	9,043	40,223	9	9,461	42,083	9,947	44,244	4	10,171	45,241	10,693	47,562	4
0.228	5.79	7,540	33,538	7,926	35,255	10	8,671	38,569	9,115	40,544	9	9,537	42,421	10,027	44,600	4	10,253	45,605	10,779	47,945	4
0.229	5.82	7,600	33,805	7,990	35,540	10	8,740	38,876	9,188	40,858	9	9,614	42,763	10,108	44,960	4	10,335	45,970	10,865	48,328	4
0.230	5.84	7,651	34,076	8,053	35,820	10	8,810	39,187	9,262	41,197	9	9,691	43,106	10,187	45,312	4	10,418	46,339	10,952	48,714	4
0.231	5.87	7,722	34,347	8,118	36,109	10	8,879	39,494	9,335	41,522	9	9,768	43,448	10,268	45,672	4	10,501	46,708	11,039	49,101	4
0.232	5.89	7,782	34,614	8,182	36,394	10	8,950	39,810	9,408	41,847	9	9,845	43,791	10,349	46,032	4	10,584	47,078	11,126	49,488	4
0.233	5.92	7,844	34,890	8,246	36,678	9	9,021	40,125	9,483	42,180	9	9,923	44,138	10,431	46,397	4	10,667	47,447	11,214	49,880	4
0.234	5.94	7,905	35,161	8,311	36,967	9	9,091	40,437	9,557	42,510	9	10,001	44,484	10,513	46,762	4	10,750	47,816	11,302	50,271	4
0.235	5.97	7,957	35,437	8,375	37,252	9	9,162	40,753	9,632	42,843	9	10,078	44,827	10,594	47,122	4	10,834	48,190	11,390	50,663	4
0.236	5.99	8,029	35,713	8,441	37,546	9	9,233	41,068	9,707	43,177	8	10,157	45,178	10,677	47,491	4	10,918	48,563	11,478	51,054	4
0.237	6.02	8,091	35,989	8,505	37,830	9	9,304	41,384	9,782	43,510	8	10,235	45,525	10,759	47,856	4	11,002	48,937	11,566	51,446	4
0.238	6.05	8,153	36,265	8,571	38,124	9	9,376	41,704	9,856	43,839	8	10,314	45,877	10,842	48,225	4	11,087	49,315	11,655	51,841	4
0.239	6.07	8,215	36,540	8,637	38,417	9	9,448	42,025	9,932	44,178	8	10,393	46,228	10,925	48,594	4	11,172	49,693	11,744	52,237	4
0.240	6.10	8,278	36,821	8,702	38,706	9	9,519	42,341	10,007	44,511	8	10,472	46,579	11,009	48,968	4	11,256	50,067	11,834	52,638	3
0.241	6.12	8,340	37,096	8,768	39,000	9	9,591	42,661	10,083	44,849	8	10,550	46,926	11,092	49,337	4	11,342	50,449	11,924	53,038	3
0.242	6.15	8,404	37,381	8,834	39,294	9	9,664	42,985	10,160	45,192	8	10,630	47,282	11,176	49,717	4	11,427	50,827	12,013	53,434	3
0.243	6.17	8,456	37,657	8,900	39,587	9	9,736	43,306	10,236	45,530	8	10,709	47,634	11,259	50,080	4	11,513	51,210	12,103	53,834	3
0.244	6.20	8,529	37,937	8,967	39,885	9	9,809	43,630	10,313	45,872	8	10,790	47,994	11,344	50,458	4	11,600	51,597	12,194	54,239	3
0.245	6.22	8,593	38,222	9,033	40,179	9	9,882	43,955	10,388	46,206	8	10,870	48,350	11,428	50,832	4	11,685	51,975	12,285	54,644	3
0.246	6.25	8,657	38,506	9,101	40,481	9	9,955	44,280	10,465	46,548	8	10,950	48,706	11,512	51,205	4	11,772	52,362	12,376	55,048	3
0.247	6.27	8,720	38,787	9,168	40,779	9	10,029	44,609	10,543	46,895	8	11,031	49,066	11,597	51,583	4	11,859	52,749	12,467	55,453	3
0.248	6.30	8,785	39,076	9,235	41,077	9	10,102	44,934	10,620	47,238	8	11,112	49,426	11,682	51,962	4	11,946	53,136	12,558	55,858	3
0.249	6.32	8,848	39,356	9,302	41,375	9	10,176	45,263	10,698	47,585	8	11,193	49,786	11,767	52,340	4	12,032	53,518	12,650	56,267	3
0.250	6.35	8,912	39,641	9,370	41,678	9	10,249	45,588	10,775	47,927	8	11,275	50,151	11,853	52,722	4	12,120	53,910	12,742	56,676	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		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength		
in.	mm	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)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Wire Size Nominal Diameter		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength		
in.	mm	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.
0.050	1.27	422	1,877	50	486	2,162	45	534	2,375	42	574	2,553	37
0.051	1.30	439	1,953	49	505	2,246	45	555	2,469	42	597	2,655	36
0.052	1.32	456	2,028	48	525	2,335	44	577	2,566	41	620	2,758	35
0.053	1.35	474	2,108	47	545	2,424	43	599	2,664	40	644	2,865	35
0.054	1.37	491	2,184	46	565	2,513	42	621	2,762	39	668	2,971	34
0.055	1.40	509	2,264	45	586	2,607	41	644	2,865	38	693	3,082	33
0.056	1.42	528	2,349	44	607	2,700	41	667	2,967	38	718	3,194	33
0.057	1.45	546	2,429	43	628	2,795	40	691	3,074	37	743	3,305	32
0.058	1.47	565	2,513	43	650	2,891	39	715	3,180	36	769	3,421	32
0.059	1.50	584	2,598	42	672	2,989	38	739	3,287	36	795	3,536	31
0.060	1.52	604	2,687	41	695	3,091	38	764	3,398	35	821	3,652	30
0.061	1.55	624	2,776	40	718	3,194	37	789	3,509	35	848	3,772	30
0.062	1.57	644	2,865	40	741	3,296	37	815	3,625	34	876	3,896	29
0.063	1.60	665	2,958	39	764	3,398	36	841	3,741	33	904	4,021	29
0.064	1.63	685	3,047	38	788	3,505	35	867	3,856	33	932	4,146	28
0.065	1.65	707	3,145	38	813	3,616	35	894	3,977	32	961	4,275	28
0.066	1.68	728	3,238	37	837	3,723	34	921	4,097	32	990	4,404	28
0.067	1.70	750	3,336	37	862	3,834	34	948	4,217	31	1,019	4,533	27
0.068	1.73	772	3,434	36	887	3,945	33	976	4,341	31	1,049	4,666	27
0.069	1.75	794	3,532	36	913	4,061	33	1,004	4,466	30	1,080	4,804	26
0.070	1.78	817	3,634	35	939	4,177	32	1,033	4,595	30	1,111	4,942	26
0.071	1.80	840	3,736	35	966	4,297	32	1,062	4,724	29	1,142	5,080	26
0.072	1.83	863	3,839	34	992	4,412	31	1,091	4,853	29	1,173	5,218	25
0.073	1.85	886	3,941	34	1,019	4,533	31	1,121	4,986	29	1,205	5,360	25
0.074	1.88	910	4,048	33	1,047	4,657	30	1,151	5,120	28	1,238	5,507	24
0.075	1.91	934	4,154	33	1,074	4,777	30	1,182	5,258	28	1,271	5,653	24
0.076	1.93	959	4,266	32	1,103	4,906	30	1,213	5,395	27	1,304	5,800	24
0.077	1.96	983	4,372	32	1,131	5,031	29	1,244	5,533	27	1,337	5,947	23
0.078	1.98	1,008	4,484	31	1,160	5,160	29	1,276	5,676	27	1,371	6,098	23
0.079	2.01	1,034	4,599	31	1,189	5,289	28	1,308	5,818	26	1,406	6,254	23
0.080	2.03	1,059	4,710	30	1,218	5,418	28	1,340	5,960	26	1,441	6,410	22
0.081	2.06	1,085	4,826	30	1,248	5,551	28	1,373	6,107	26	1,476	6,565	22
0.082	2.08	1,111	4,942	30	1,278	5,685	27	1,406	6,254	25	1,511	6,721	22
0.083	2.11	1,138	5,062	29	1,309	5,822	27	1,440	6,405	25	1,548	6,886	22
0.084	2.13	1,165	5,182	29	1,339	5,956	27	1,473	6,552	25	1,584	7,046	21
0.085	2.16	1,192	5,302	29	1,371	6,098	26	1,508	6,708	24	1,621	7,210	21
0.086	2.18	1,219	5,422	28	1,402	6,236	26	1,542	6,859	24	1,658	7,375	21
0.087	2.21	1,247	5,547	28	1,434	6,378	26	1,577	7,014	24	1,696	7,544	21
0.088	2.24	1,275	5,671	28	1,466	6,521	25	1,613	7,175	23	1,734	7,713	20
0.089	2.26	1,303	5,796	27	1,499	6,668	25	1,648	7,330	23	1,772	7,882	20

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		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength		
in.	mm	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.
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	21	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		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength		
in.	mm	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.	lb	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	2,985	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	3,195	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	3,545	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	3,635	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	4,195	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		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength		
in.	mm	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.	lb	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		Level 2 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 3 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 4 Bright (Uncoated) or Drawn-Galvanized Breaking Strength			Level 5 Bright (Uncoated) or Drawn-Galvanized Breaking Strength		
in.	mm	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.	lb	N	Tor.
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 x 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 Strength					
Nominal Diameter		Approx. Mass		Plow Steel			Improved Plow Steel		
in.	mm	lb/ft	kg/m	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 x 19 and 6 x 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 Strength								
Nominal Diameter		Approx. Mass		Plow Steel			Improved Plow Steel			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	0.42	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 x 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 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	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 x 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	88,800	390	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 x 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 x 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 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
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	59.0	88.7	2,290,000	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 x 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 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
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 x 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 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
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 x 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		
in.	mm	lb/ft	kg/m	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 x 25 "B", 6 x 27 "H", 6 x 30 "G", 6 x 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		
in.	mm	lb/ft	kg/m	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 x 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 x 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 x 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 x 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 x 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 x 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 x 7 and 19 x 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 x 7 or 7 x 7 wire rope. This produces a rotation-resistant characteristic.* See Tables 13 and 14 and Figures 29 and 30.

5.1.8 6 x 25 Style "B", 6 x 27 Style "H", 6 x 30 Style "G" and 6 x 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:

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

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 x 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.

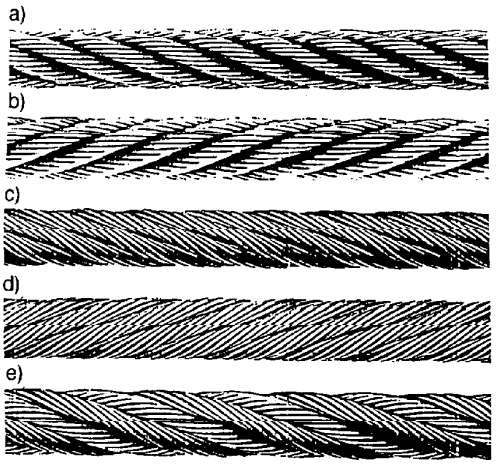


Figure 1—A comparison of typical wire rope lays: a) right regular lay, b) left regular lay, c) right lang lay, d) left lang lay, e) right alternate lay.

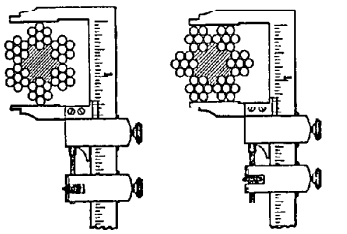
5.3.2 For 6 x 19, 6 x 37, 6 x 61, 6 x 91, and 8 x 19 wire rope, the lay of the finished rope shall not exceed 7¼ times the nominal diameter.

5.3.3 For 18 x 7 and 19 x 7 wire rope, the lay of the finished rope shall not exceed 7¼ times the nominal diameter.

5.3.4 For flattened strand rope designations 6 x 25 "B", 6 x 27 "H", 6 x 30 "G" and 6 x 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).



Correct way to measure the diameter of wire rope. *Incorrect way to measure the diameter of wire rope.*

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: ±2½%.

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)
		Total Variation			
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.

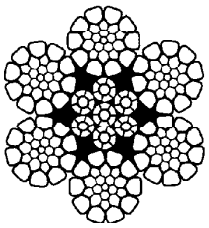


Figure 3—6 x 26 Warrington Seale Compacted Strand IWRC

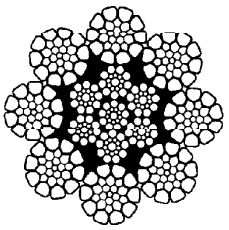


Figure 4—8 x 26 Warrington Seale Compacted Strand IWRC

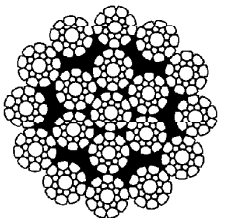


Figure 5—19 x 19 Seale Compacted Strand

COMPACTED STRAND WIRE ROPE

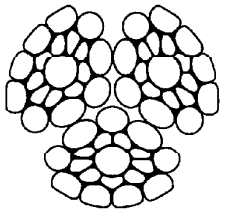


Figure 6—3 x 19 Seale Compacted (Swaged)

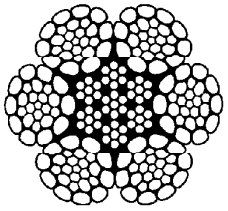


Figure 7—6 x 26 Warrington Compacted (Swaged) IWRC

COMPACTED (SWAGED) WIRE ROPE

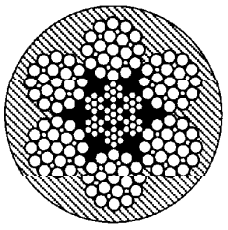


Figure 8—Plastic Coated Wire Rope

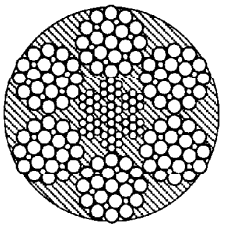


Figure 9—6 x 25 Plastic Filled Wire Rope

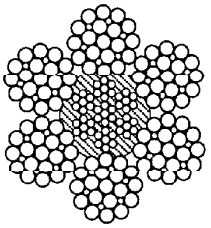


Figure 10—Plastic Coated IWRC Wire Rope

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 x 7 classification, shown in Fig. 11, should be ordered only with fiber core. Wire ropes of 6 x 19 classification, shown in Fig. 12 through 15, and 6 x 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 x 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.

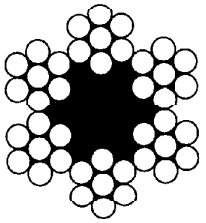


Figure 11—6 x 7 FC

6 x 7 CLASSIFICATION

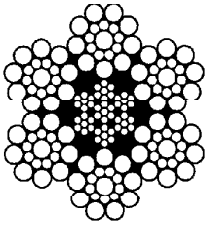


Figure 12—6 x 19 Seale IWRC

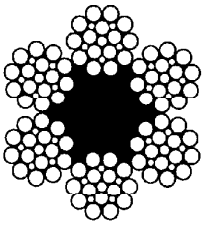


Figure 13—6 x 21 Filler Wire FC

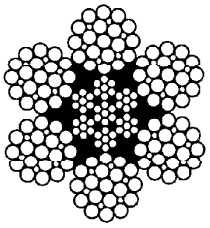


Figure 14—6 x 25 Filler Wire IWRC

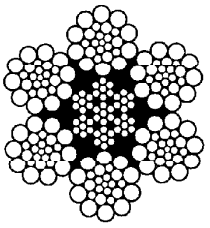


Figure 15—6 x 26 Warrington Seale IWRC

6 x 19 CLASSIFICATION

TYPICAL WIRE ROPE CONSTRUCTIONS

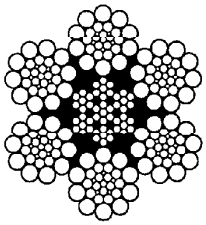


Figure 16—6 x 31 Filler Wire Seale IWRC

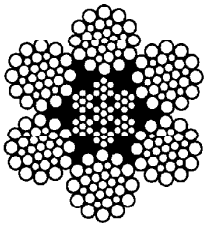


Figure 17—6 x 31 Warrington Seale IWRC

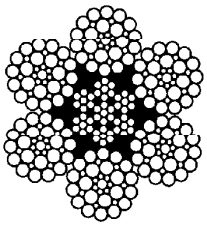


Figure 18—6 x 36 Seale Filler Wire IWRC

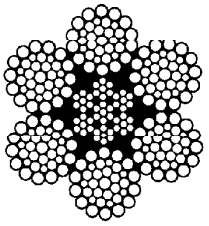


Figure 19—6 x 36 Warrington Seale IWRC

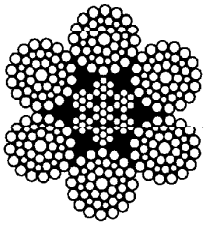


Figure 20—6 x 41 Warrington Seale IWRC

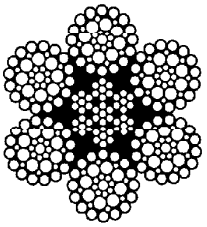


Figure 21—6 x 41 Seale Filler Wire IWRC

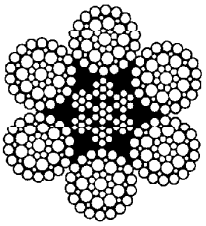


Figure 22—6 x 46 Seale Filler Wire IWRC

6 x 37 CLASSIFICATION

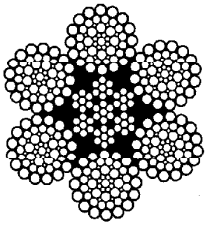


Figure 23—6 x 57 Seale Filler Wire Seale IWRC

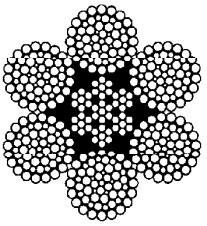


Figure 24—6 x 61 Filler Wire Warrington Seale IWRC

6 x 61 CLASSIFICATION

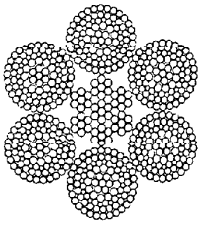


Figure 25—6 x 91 with Independent Wire Rope Core (Two-Operation Strand)

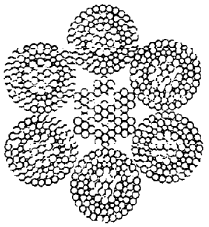


Figure 26—6 x 103 with Independent Wire Rope Core (Two-Operation Strand)

6 x 91 CLASSIFICATION

TYPICAL WIRE ROPE CONSTRUCTIONS

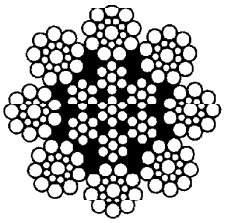


Figure 27—8 x 19 Seale IWRC

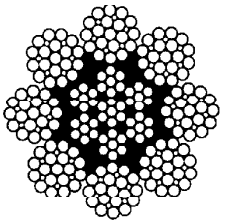


Figure 28—8 x 25 Filler Wire IWRC

8 x 19 CLASSIFICATION

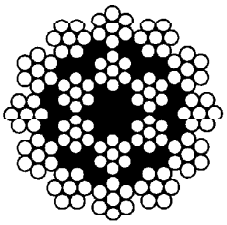


Figure 29—18 x 7 FC

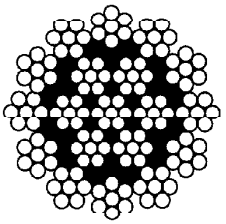


Figure 30—19 x 7

18 x 7 AND 19 x 7 CONSTRUCTION

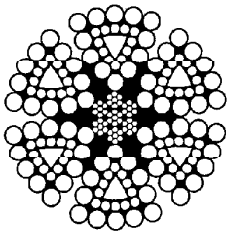


Figure 31—6 x 25 Style B Flattened Strand IWRC

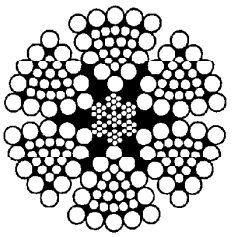


Figure 32—6 x 27 Style H Flattened Strand IWRC

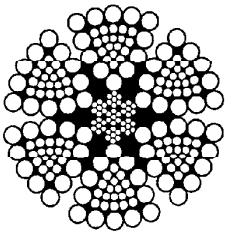


Figure 33 6 x 30 Style G Flattened Strand IWRC

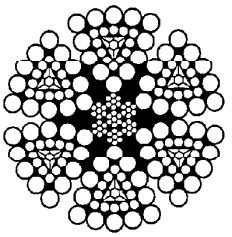


Figure 34 6 x 31 Style V Flattened Strand IWRC

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 x 19, 6 x 37, and 6 x 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 Diameter		Approximate Mass		Nominal Strength					
					Galvanized			Bright		
	in.	mm	lb/ft	kg/m	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
6 x 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
6 x 37	2 3/8	60	10.4	15.5	493,200	2,190	224	528,000	2,350	239
	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
6 x 61	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 1/4	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/mm^2.

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 x 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 x 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).

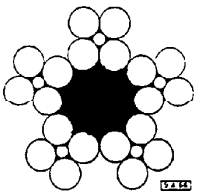


Figure 35—5 x 5 Construction Torpedo Line

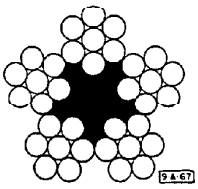


Figure 36—5 x 7 Construction Torpedo Line

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 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		
in.	mm	lb/100 ft	kg/100 m	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/8	3.18	2.21	3.29	1,120	4.98	0.51	1,290	5.74	0.59
9/64	3.57	2.80	4.16	1,410	6.27	0.64	1,620	7.21	0.74
5/32	3.97	3.46	5.15	1,740	7.74	0.79	2,000	8.90	0.91
3/16	4.76	4.98	7.41	2,490	11.08	1.13	2,860	12.72	1.30
1/4	6.35	8.86	13.91	4,380	19.48	1.99	5,030	22.37	2.28
5/16	7.94	13.80	20.54	6,780	30.16	3.08	7,790	34.65	3.53

Table 19—5 x 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		
in.	mm	lb/100 ft	kg/100 m	lb	kN	Metric Tonnes	lb	kN	Metric Tonnes
1/8	3.18	2.59	3.86	1,210	5.38	0.55	1,400	6.23	0.64
9/64	3.57	3.02	4.49	1,530	6.81	0.69	1,760	7.83	0.80
5/32	3.97	3.73	5.55	1,890	8.41	0.86	2,170	9.65	0.98
3/16	4.76	5.38	8.01	2,700	12.01	1.23	3,110	13.83	1.41
1/4	6.35	9.55	14.21	4,760	21.17	2.16	5,470	24.33	2.48
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)
				Improved Plow Steel			Extra Improved Plow Steel			Extra Extra Improved Plow Steel		
Minimum elongation (per 9.2):				1 1/2%			—*			—*		
Wire Diameter		Approximate Wire Weight		Nominal Strength		Min.	Nominal Strength		Min.	Nominal Strength		Min.
in (±0.001)	mm (±0.03)	lb/ft	kg/m	lb	kN	Tor.	lb	kN	Tor.	lb	kN	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	—*
0.103	2.67	0.030	0.043	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 ($1^6/_9$) and 1 × 19 ($1^6/_{12}$) 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 5¾ 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.

a. Name of manufacturer.
b. Reel number.
c. Specification 9A.
d. Length of rope, ft (m).
e. Diameter of rope, in (mm).
f. Type of construction (Warrington, Seale, Filler Wire or a combined pattern).
g. Lay (i.e.: RRL, RLL).
h. Grade (i.e.: improved plow steel or extra improved plow steel)
i. 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.

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