Specification for Wire Rope

API SPECIFICATION 9A
TWENTY-SIXTH EDITION, MAY 2011

EFFECTIVE DATE: NOVEMBER 1, 2011

ERRATA, OCTOBER 2012

AMERICAN PETROLEUM INSTITUTE

Specification for Wire Rope

Upstream Segment

API SPECIFICATION 9A
TWENTY-SIXTH EDITION, MAY 2011

EFFECTIVE DATE: NOVEMBER 1, 2011

ERRATA, OCTOBER 2012

AMERICAN PETROLEUM INSTITUTE

Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

Figures

Tables

Introduction

This standard was developed in response to worldwide demand for minimum specifications for ropes for use on equipment and machinery associated with the petroleum and natural gas industries.

In recognition of equipment already in use and originally designed to accommodate rope sizes (nominal rope diameters) based on “English” units, some of the more common “converted SI unit” sizes have also been included.

In addition, and in recognition of equipment already in use and designed to operate with ropes having specific rope grades (e.g. IPS), based on “U.S.” wire levels, these grades have also been included in order to give prominence to the required minimum values of breaking force associated with these grades and help to ensure that existing design safety levels are maintained.

Having due regard to size and breaking force for a particular rope class or construction, in some cases it is possible to safely substitute a U.S. customary size and grade with one based solely on SI units and grade, and vice-versa. To assist in this process, this standard gives a size range for each nominal rope diameter and equivalent minimum breaking forces (converted from U.S. customary units) for comparison, although it is recommended that the equipment designer or rope manufacturer (or other competent person) is consulted prior to ordering a substitute rope.

It should also be noted that a particular design of rope may be capable of offering a higher breaking force value than the one specified either in the relevant table in this standard or by the manufacturer in their catalogue. In such cases, a higher minimum breaking force value (or actual breaking force value if the rope has already been manufactured and tested) may be provided by the manufacturer before an order is placed.

Designers of new equipment are encouraged to select ropes having the preferred SI units and grades.

To complement this standard, ISO 17893 covering definitions, designation, and classification has been prepared.

Specification for Wire Rope

1 Scope

This standard specifies the minimum requirements and terms of acceptance for the manufacture and testing of steel wire ropes not exceeding rope grade 2160 for the petroleum and natural gas industries. The following products are covered by this specification:

— wire rope,

— bright- or drawn-galvanized wire rope,

— well-measuring wire, and

— well-measuring strand.

Typical applications include tubing 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, mast-raising lines, guideline tensioner lines, riser tensioner lines, and mooring and anchor lines. Ropes for lifting slings and cranes, and wire for well-measuring and strand for well-servicing, are also included.

The minimum breaking forces for the more common sizes, grades, and constructions of stranded rope are given in tables. However, this standard does not restrict itself to the classes covered by those tables. Other types, such as ropes with compacted strands and compacted (swaged) ropes, may also conform with its requirements. The minimum breaking force values for these ropes are provided by the manufacturer.

For information only, other tables present the minimum breaking forces for large diameter stranded and spiral ropes (i.e. spiral strand and locked coil), while approximate nominal length masses for the more common stranded rope constructions and large diameter stranded and spiral ropes are also given.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2232:1990 [1], *Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes—Specifications*

ISO 4345, *Steel wire ropes—Fiber main cores—Specification*

ISO 4346, *Steel wire ropes for general purposes—Lubricants—Basic requirements*

ISO 6892-1, *Metallic materials—Tensile testing—Method of test a room temperature*

ISO 7500-1, *Metallic materials—Verification of static uniaxial testing machines—Part 1: Tension/compression testing machines—Verification and calibration of the force-measuring system*

ISO 7800, *Metallic materials—Wire—Simple torsion test*

ISO 7801, *Metallic materials—Wire—Reverse bend test*

ISO 17893, *Steel wire ropes—Vocabulary, designation and classification*

[1] International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, www.iso.org.

3 Terms and Definitions

For the purposes of this document, the terms and definitions given in ISO 17893 apply.

4 Requirements

4.1 Material

4.1.1 Wire

The wires for stranded ropes and well-servicing strand of carbon steel shall, before rope fabrication, conform to the diameter, tensile, torsion, and when applicable, zinc-coating requirements specified in Annex A.

The methods of test for wires of tensile strength grades 1370 N/mm^2, 1570 N/mm^2, 1770 N/mm^2, 1960 N/mm^2, and 2160 N/mm^2 shall be in accordance with those given in ISO 2232.

The methods of test for wires of tensile strength grades Levels 2, 3, 4, and 5 shall be in accordance with Annex B.

For those ropes where a rope grade is applicable, the tensile strength grade of the wires shall be subject to the limits given in Table 1.

NOTE The minimum breaking force values of those ropes of grades 1770, 1960, and 2160 as covered by the tables are calculated on the basis of rope grade and not individual wire tensile strength grades or levels.

Table 1—Range of Wire Tensile Strength Grades

Rope Grade	Wire Tensile Strength Grades N/mm^2
1770	1570 or Level 2 to 1960 or Level 4
1960	1770 or Level 3 to 2160 or Level 5
2160	1960 or Level 4 to 2160 or Level 5
IPS	Level 2 or 1570 to Level 4 or 1960
EIP	Level 3 or 1770 to Level 5 or 2160
EEIP	Level 4 or 1960 to Level 5 or 2160

For those ropes (e.g. larger diameter ropes) where a rope grade is not applicable, the tensile strength grades of the wires shall be one, or a combination, of those given in Annex A.

All wires of the same nominal diameter in the same wire layer shall be of the same tensile strength grade.

Well-measuring wire and wires used in the manufacture of well-servicing strand shall normally be of carbon steel but other materials (e.g. stainless steel) may be used.

The purchaser should specify any particular material requirements.

4.1.2 Core

Cores of stranded ropes shall normally be of steel or fiber, although other types, such as composites (e.g. steel plus fibers or plastics) or cores made of solid polymer, may also be supplied.

The purchaser should specify the type of core.

Fiber cores shall conform to ISO 4345.

The fiber cores for single-layer stranded ropes larger than 8 mm diameter shall be doubly closed (i.e. from yarn into strand and from strand into rope). Natural fiber cores shall be treated with an impregnating compound to inhibit rotting and decay.

Steel cores shall be either an independent wire rope (IWRC) or wire strand (WSC).

Steel cores of single-layer stranded ropes larger than 12 mm diameter shall be an IWRC, unless specified otherwise.

4.1.3 Lubricant

Lubricants shall conform to ISO 4346.

4.2 Rope Manufacture

4.2.1 General

In stranded ropes, all the wire layers in a strand shall have the same direction of lay. The lay lengths of corresponding wire layers in strands of the same size, construction, and strand layer shall be uniform.

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

The rope ends shall be secured such that they are prevented from unlaying.

4.2.2 Wire Joints

Diameters shall be continuous, but, for wires other than well-measuring wires, if joints are necessary in wires over 0.4 mm they shall have their ends joined by brazing or welding.

For stranded ropes, the minimum distance between joints within one strand shall be 18 $\times$ rope diameter (d).

For spiral ropes, the minimum distance between joints in any wire layer shall be 36 $\times$ diameter of the wire layer.

Wires up to and including 0.4 mm may be joined by twisting or by ends being simply inserted into the strands' formation.

4.2.3 Preformation and Postformation

Stranded ropes shall be preformed or postformed or both, unless specified otherwise by the purchaser.

NOTE Some parallel-closed ropes and rotation-resistant ropes may be nonpreformed.

4.2.4 Construction

The rope construction shall be either one of those covered in Annex C or as stated by the manufacturer.

The constructions of compacted strand ropes, compacted (swaged) ropes, large diameter (i.e. over 60 mm) stranded ropes, and spiral ropes (i.e. spiral strand and full-locked coil) shall be stated by the manufacturer.

Where only the rope class is specified by the purchaser, the construction supplied shall be stated by the manufacturer.

For well-servicing strand, the construction shall be either 1 $\times$ 16M or 1 $\times$ 19M or as stated by the manufacturer.

4.2.5 Rope Grade

The rope grades for the more common classes and sizes of stranded ropes shall be as given in Annex C.

Intermediate grades may be supplied by agreement between the purchaser and the manufacturer or supplier.

NOTE Not all ropes (e.g., large diameter stranded ropes and spiral ropes) will necessarily have a nominated rope grade.

4.2.6 Wire Finish

The finish of the wires shall be uncoated (bright), zinc-coated class B, or zinc-coated class A.

For ropes of bright wire finish, substitution of bright wires by zinc-coated wires shall be limited to inner wires, center wires, filler wires, and core wires.

For ropes of zinc-coated wire finish, all of the wires shall be zinc-coated, including those of any steel core.

Where zinc-coated is specified, this may also include zinc alloy Zn95/Al5.

4.2.7 Direction and Type of Rope Lay

The direction and type of rope lay for stranded ropes shall be one of the following:

a) right ordinary lay (sZ) [2],

b) left ordinary lay (zS) [3],

c) right lang lay (zZ) [4],

d) left lang lay (sS) [5],

e) right alternate lay (aZ) [6],

f) left alternate lay (aS) [7].

Well-servicing strand shall be left lay (S).

Spiral ropes (i.e., spiral strand and full-locked coil) shall be either right (Z) or left lay (S).

The direction and type of rope lay should be specified by the purchaser.

4.2.8 Designation and Classification

For the purposes of this standard, the designation and classification systems according to ISO 17893 shall apply.

---

2 Formerly referred to as right-hand ordinary (designated RHO) and right regular lay (designated RRL).

3 Formerly referred to as left-hand ordinary (designated LHO) and left regular lay (designated LRL).

4 Formerly referred to as right-hand langs (designated RHL) or right lang lay (designated RLL).

5 Formerly referred to as left-hand langs (designated LHL) or left lang lay (designated LLL).

6 Formerly designated RAL.

7 Formerly designated LAL.

4.3 Diameter

4.3.1 General

The nominal diameter shall be that by which the wire, strand, or rope is designated.

4.3.2 Tolerance

When measured in accordance with 5.2.3, the measured (actual) diameter of stranded ropes shall be within the tolerances given in Table 2.

Table 2—Tolerances on Rope Diameter (Stranded Rope)

Nominal Rope Diameter d mm	Tolerance as Percentage of Nominal Diameter	
	Ropes with Strands That are Exclusively of Wire or Incorporate Solid Polymer Centers	Ropes with Strands That Incorporate Fiber Centers
$2 \leq d < 4$	$^{+8}_{0}$	$^{+9}_{0}$
$4 \leq d < 6$	$^{+7}_{0}$	$^{+9}_{0}$
$6 \leq d < 8$	$^{+6}_{0}$	$^{+8}_{0}$
≥ 8	$^{+5}_{0}$	$^{+7}_{0}$

When measured in accordance with 5.2.3, the measured (actual) diameter of spiral ropes shall be within $^{+5}_{0}$ % of the nominal diameter.

When measured in accordance with 5.2.3, the measured (actual) diameter of well-servicing strand shall be within the tolerances given in Annex D.

4.3.3 Difference Between Diameter Measurements

For stranded and spiral ropes, the difference between any two of the four measurements taken in accordance with 5.2.3 and expressed as a percentage of the nominal diameter shall not exceed the values given in Table 3.

Table 3—Permissible Differences Between Any Two Diameter Measurements

Nominal Rope Diameter d mm	Ropes with Strands That are Exclusively of Wire or Incorporate Solid Polymer Centers and Spiral Ropes %	Ropes with Strands That Incorporate Fiber Centers %
$2 \leq d < 4$	7	—
$4 \leq d < 6$	6	8
$6 \leq d < 8$	5	7
≥ 8	4	6

4.4 Lay Length

For single-layer ropes of 6 × 7 class, the length of lay of the finished rope shall not exceed 8 × rope diameter (d).

For other single-layer ropes with round strands (except those with three or four strands), parallel-lay closed ropes and rotation-resistant ropes with round strands or shaped strands, the length of lay of the finished rope shall not exceed 7.25 × rope diameter (d).

For single-layer ropes with shaped strands, e.g., triangular strand, the length of lay of the finished rope shall not exceed 10 × rope diameter (d).

For well-servicing strand, the length of lay of the finished strand shall not exceed 10 × strand diameter (d).

4.5 Breaking Force

4.5.1 Well-measuring Wire

The minimum breaking force for a given diameter of well-measuring wire shall be as given in C.1.

When tested in accordance with the method specified in J.2, the measured breaking force shall be greater than or equal to the minimum breaking force.

4.5.2 Well-servicing Strand

The minimum breaking force for a given diameter and construction shall be either of the following:

a) as given in Annex D, or

b) as stated by the manufacturer.

When tested in accordance with Method 1 (see 5.2.4.1), the measured breaking force shall be greater than or equal to the minimum breaking force.

4.5.3 Stranded Ropes and Spiral Ropes

4.5.3.1 General

The minimum breaking force, F_{min}, for a given rope diameter and construction shall be either of the following:

a) as given in Annex C for stranded ropes, or

b) as stated by the manufacturer.

NOTE 1 Values of minimum breaking force for large diameter stranded and spiral ropes are given for information in Annex E.

For those ropes covered in Annex C, the minimum breaking force of intermediate rope diameters shall be calculated with the respective minimum breaking force factors in accordance with Annex F.

When tested in accordance with Method 1 of 5.2.4.1, the measured breaking force, F_{m}, shall be greater than or equal to the minimum breaking force, F_{min}.

Breaking force testing requirements shall be in accordance with Table 4.

NOTE 2 The requirements for breaking force take into account the following: a) the rope size; b) whether or not ropes are produced in series, i.e. repeatedly produced; c) whether or not the minimum breaking force factor is consistent throughout a range of diameters; d) whether or not the manufacturer is operating a quality system in accordance with ISO 9001, certified by an accredited third-party certification body.

4.5.3.2 Ropes Produced in Series—Manufacturer Operating a Quality System in Accordance with ISO 9001, Certified by an Accredited Third-party Certification Body

The manufacturer shall be able to provide the results from type testing in accordance with the sampling and acceptance criteria given in Annex G.

Type testing shall be repeated on any rope that has its design changed in any way which results in a modified (e.g. increased) breaking force. If the same design, apart from wire tensile strength grades, is used for ropes of a lower grade or lower breaking force, or both, than the one which has successfully passed the type testing requirements, it shall not be necessary to repeat the tests on those ropes provided the breaking force is calculated with the same spinning loss.

Subsequent production lengths of ropes produced in series shall be deemed to conform to the breaking force requirements when the manufacturer has satisfactorily completed the following on a sample from every 20th production length:

a) the appropriate type tests (see Annex G), and

b) a periodic breaking force test in accordance with Method 1 or one of the alternative methods, known as Methods 2 and 3 (see 5.2.4.2 and 5.2.4.3).

Table 4—Breaking Force Testing Requirements

Rope Diameter d mm	Minimum Breaking Force Factor	Manufacturer Operating a Quality System in Accordance with ISO 9001, Certified by an Accredited Third-party Certification Body	Manufacturer NOT Operating a Quality System in Accordance with ISO 9001, Certified by an Accredited Third-party Certification Body
$d \leq 60$	Same factor throughout a sub-group of rope diameters.	Breaking force test in accordance with 5.2.4.1 (Method 1) on a sample from each production length; or, if produced in series, type testing in accordance with H.1.1 plus periodic test in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.3 (Method 3) on a sample from every 20th production length relating to the sub-group of diameters.	Breaking force test in accordance with 5.2.4.1 (Method 1) on a sample from each production length.
	Different factor throughout a sub-group of rope diameters.	Breaking force test in accordance with 5.2.4.1 (Method 1) on a sample from each production length; or, if produced in series, type testing in accordance with G.1.2 plus periodic test in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.1 (Method 3) on a sample from every 20th production length of a given rope diameter and construction.	Breaking force test in accordance with 5.2.4.1 (Method 1) on a sample from each production length.
$d > 60$		Breaking force test in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.3 (Method 3) on a sample from each production length, or either of the following: a) if produced in series, type testing in accordance with H.2 plus periodic test in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.3 (Method 3) on a sample from every 20th production length; or b) if produced for supply as a set of ropes of the same design for a specific installation, the alternative breaking force testing and sampling as also given in G.2.	Breaking force test in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.3 (Method 3) on a sample from each production length.

NOTE The result from Method 1 is known as measured breaking force. The result from Method 2 is known as calculated measured (post-spin) breaking force. The result from Method 3 is known as calculated measured (pre-spin) breaking force.

4.6 Length

For those ropes not forming part of an assembly, the actual length of rope supplied shall be the specified nominal length subject to the following tolerances.

a) Up to and including 400 m: $^{+5}_{0}$ % of the specified length.

b) Over 400 m, up to and including 1000 m: $^{+20}_{0}$ m.

c) Over 1000 m: $^{+2}_{0}$ % of the specified length.

The rope shall be measured under no load.

Ropes required with smaller length tolerance should be the subject of agreement between the purchaser and the manufacturer.

5 Verification of Requirements and Test Methods

5.1 Processes Requiring Validation

The completed wire, strand, and wire rope covered in this specification are subject to physical testing and do not require validation of the processes used in manufacturing.

5.2 Stranded Ropes and Spiral Ropes

5.2.1 Materials

Compliance with the wire, core, and lubricant requirements shall be through a visual verification of the inspection documents supplied with the wire, core, and lubricant.

5.2.2 Rope Manufacture

Compliance with the requirements for wire joints and preformation shall be through visual verification.

5.2.3 Test on Rope for Diameter

Diameter measurements shall be taken on a straight portion of rope, either under no tension or a tension not exceeding 5 % of the minimum breaking force, at two positions spaced at least 1 m apart. At each position, two measurements, at right angles, of the circumscribed circle diameter shall be taken. The measuring equipment shall extend over at least two adjacent strands (see Figure 1). The average of these four measurements shall be the measured diameter.

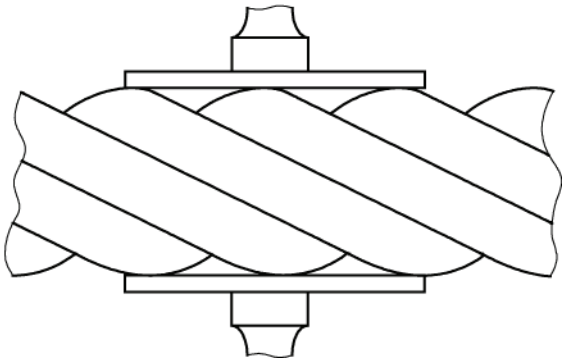


Figure 1—Method of Measuring Rope Diameter

5.2.4 Test on Rope for Breaking Force

5.2.4.1 Method 1—Measured Breaking Force

The method shall be in accordance with Annex H.

The rope shall be deemed to have satisfied the breaking force requirement when the measured breaking force reaches or exceeds the minimum value.

When the minimum breaking force is not reached, three additional tests may be carried out, one of which shall achieve or exceed the minimum breaking force value.

5.2.4.2 Method 2—Calculated Measured (Post-spin) Breaking Force

Add together the measured breaking forces of all individual wires after they have been removed from the rope and multiply this value by either of the following:

a) the spinning loss factor derived from Annex I, or

b) the partial spinning loss factor obtained from the results of type testing.

The partial spinning loss factor used in the calculation shall be the lowest of the three values obtained from type testing.

In the case of triangular strand ropes, the triangular center of the strand may be considered as an individual wire.

Test the wires in accordance with the wire tensile test specified in B.2 or in ISO 6892.

NOTE The result from this test is known as the “calculated measured (post-spin) breaking force.”

When this method (i.e., Method 2) is used for the periodic test (see Table 4) and the calculated measured (post-spin) breaking force value is less than the intended minimum breaking force value, carry out another test using Method 1.

If the measured (actual) breaking force in this second test fails to meet the intended minimum breaking force value, de-rate the minimum breaking force to a value not exceeding the measured (actual) breaking force value and repeat the type testing using Method 1.

In such cases, either de-rate the rope grade in line with the de-rated minimum breaking force value or delete it from the rope designation.

5.2.4.3 Method 3—Calculated Measured (Pre-spin) Breaking Force

Add together the measured breaking forces of all the individual wires before they are laid into the rope and multiply this value by the total spinning loss factor obtained from the results of type testing. The total spinning loss factor used in the calculation shall be the lowest of the three values obtained from type testing.

The wires shall be tested in accordance with the wire tensile test specified in ISO 6892.

NOTE The result from this test is known as the “calculated measured (pre-spin) breaking force.”

When this method (i.e., Method 3) is used for the periodic test (see Table 4) and the calculated measured (pre-spin) breaking force value is less than the intended minimum breaking force value, carry out another test using Method 1.

If the measured (actual) breaking force in this second test fails to meet the intended minimum breaking force value, de-rate the minimum breaking force to a value not exceeding the measured (actual) breaking force value and repeat the type testing using Method 1.

In such cases, either de-rate the rope grade in line with the de-rated minimum breaking force value or delete it from the rope designation.

5.2.5 Tests on Wires from the Rope

When tests, if any, are required to be performed on wires taken from the rope after fabrication, and unless specified otherwise by the purchaser, sampling, test methods, and acceptance criteria shall be in accordance with Annex I.

If tests on the wires are required to be carried out, this should be stated in the purchaser's order.

5.3 Tests on Well-measuring Wire

The tests shall consist of a simultaneous elongation and tensile test and a separate torsion test. Testing methods and acceptance criteria shall be in accordance with Annex J.

5.4 Tests on Well-servicing Strands

The tests shall consist of a measured diameter in accordance with 5.2.3 and a breaking force test in accordance with 5.2.4.1.

5.5 Facilities for Witnessing Tests

The manufacturer shall offer the purchaser or purchaser's representative all necessary facilities for the witnessing of tests (when these are performed) or for the examination of records of type tests in order to be assured of compliance with this standard, or both.

Test lengths required by the purchaser should be ordered as additional lengths.

6 Information for Use

6.1 Certificate

6.1.1 General

A certificate shall confirm conformance with this standard and, unless specified otherwise by the purchaser, shall give at least the following information:

a) certificate number,

b) name and address of the manufacturer,

c) rope designation or rope description,

d) minimum breaking force,

e) date of issue of the certificate and authentication.

NOTE See Annex K for information that should be provided by the purchaser.

Quantity and nominal length of rope may also be included.

The certificate shall enable traceability of the rope.

6.1.2 Test Results

When actual test results are required to be certified (see above), the certificate shall additionally give either Item a) or Item b) or both, as follows:

a) breaking force test on rope—state which value, i.e.,

   1) measured breaking force, or

   2) calculated measured (post-spin) breaking force, or

   3) calculated measured (pre-spin) breaking force;

b) tests on wires—

   1) number of wires tested,

   2) nominal dimension of wire,

   3) measured dimension of wire (diameter or height of profile),

   4) breaking force of wire,

   5) tensile strength of wire (based on nominal dimension),

   6) number of torsions completed (and test length),

   7) mass of coating.

6.2 Packaging and Marking

6.2.1 Packaging

Ropes shall be supplied in coils or on reels at the discretion of the manufacturer.

The purchaser should specify any particular packaging requirements.

Rotation-resistant ropes should be supplied on reels.

6.2.2 Marking

The rope manufacturer's or supplier's name and address, certificate number if appropriate (see 6.1), length, and rope designation shall be legibly and durably marked on a tag attached to each coil or a plate attached to each reel of rope.

Annex A
(normative)

Dimensional and Mechanical Properties of Round Wires (Before Rope Fabrication)

A.1 Tensile Strength Grades 1370 N/mm^2, 1570 N/mm^2, 1770 N/mm^2, 1960 N/mm^2, and 2160 N/mm^2

The permitted variations in tensile strengths of non-alloyed steel wires shall not exceed the nominal values by an amount greater than those given in Table A.1. The values of tensile strength grade are the lower (minima) limits for each tensile strength grade.

Table A.1—Permitted Variations in Tensile Strength

Nominal Diameter mm	**Permitted Variation in Tensile Strength Above Nominal** N/mm^2
$0.2 \leq \delta < 0.5$	390
$0.5 \leq \delta < 1.0$	350
$1.0 \leq \delta < 1.5$	320
$1.5 \leq \delta < 2.0$	290
$2.0 \leq \delta < 3.5$	260
$3.5 \leq \delta < 7.0$	250

In the case of alloy steel wires, the maximum values shall be no greater than the minimum value plus 15 %.

The diameter tolerances, minimum number of torsions, and minimum masses of coating shall be in accordance with the values given in Table A.2.

NOTE The values in Table A.2 are based on ISO 2232 with an extended size range and additional tensile strength grades at the lower and higher ends.

Table A.2—Diameter Tolerances, Minimum Number of Torsions, and Minimum Masses of Zinc for Tensile Strength Grades 1370 N/mm^2, 1570 N/mm^2, 1770 N/mm^2, 1960 N/mm^2, and 2160 N/mm^2

Nominal Diameter of Wire	Tolerance		Minimum Number of Torsions Based on 100δ									Min. Mass Zn	
	Bright and Galv. or Zn95/Al5	Galv. or Zn95/Al5	Bright and Galvanized or Zn95/Al5					Galvanized or Zn95/Al5				Galv. or Zn95/Al5	
	Quality B	Quality A	Quality B					Quality A					
mm	mm		Tensile Strength Grade (N/mm^2)									g/m^2	
			1370	1570	1770	1960	2160	1370	1570	1770	1960	B	A
$0.20 \leq \delta < 0.25$	±0.008	—										20	
$0.25 \leq \delta < 0.30$	±0.008	—										30	
$0.30 \leq \delta < 0.40$	±0.01	±0.025										30	
$0.40 \leq \delta < 0.50$	±0.01	±0.025										40	75
$0.50 \leq \delta < 0.55$	±0.015	±0.03	34	30	28	25	23					50	90
$0.55 \leq \delta < 0.60$	±0.015	±0.03	34	30	28	25	23					50	90
$0.60 \leq \delta < 0.65$	±0.015	±0.03	34	30	28	25	23					60	120
$0.65 \leq \delta < 0.70$	±0.015	±0.03	34	30	28	25	23					60	120
$0.70 \leq \delta < 0.75$	±0.015	±0.03	34	30	28	25	23		21	19	17	60	120
$0.75 \leq \delta < 0.80$	±0.015	±0.03	34	30	28	25	23		21	19	17	60	120
$0.80 \leq \delta < 0.85$	±0.015	±0.03	34	30	28	25	22		21	19	17	60	140
$0.85 \leq \delta < 0.90$	±0.015	±0.03	34	30	28	25	22		21	19	17	60	140
$0.90 \leq \delta < 0.95$	±0.015	±0.03	34	30	28	25	22		21	19	17	70	150
$0.95 \leq \delta < 1.00$	±0.015	±0.03	34	30	28	25	22		21	19	17	70	150
$1.00 \leq \delta < 1.10$	±0.02	±0.04	33	29	26	23	21		20	18	13	80	160
$1.10 \leq \delta < 1.20$	±0.02	±0.04	33	29	26	23	21		20	18	13	80	160
$1.20 \leq \delta < 1.30$	±0.02	±0.04	33	28	25	22	20		18	15	10	90	170
$1.30 \leq \delta < 1.40$	±0.02	±0.04	33	28	25	22	19		18	15	10	90	170
$1.40 \leq \delta < 1.50$	±0.02	±0.04	33	28	25	22	19		18	15	10	100	180
$1.50 \leq \delta < 1.60$	±0.02	±0.04	33	28	25	22	19		18	15	10	100	180
$1.60 \leq \delta < 1.70$	±0.02	±0.04	33	28	25	22	19		18	15	10	100	200
$1.70 \leq \delta < 1.80$	±0.02	±0.05	33	28	25	22	19		18	15	10	100	200
$1.80 \leq \delta < 1.90$	±0.025	±0.05	32	27	24	21	18		17	14	9	100	200
$1.90 \leq \delta < 2.00$	±0.025	±0.05	32	27	24	21	18		17	14	9	110	215
$2.00 \leq \delta < 2.10$	±0.025	±0.05	32	27	24	21	18		17	14	9	110	215
$2.10 \leq \delta < 2.20$	±0.025	±0.06	32	27	24	21	18		17	14	9	110	215
$2.20 \leq \delta < 2.30$	±0.025	±0.06	31	27	24	21	18	20	17	14	9	125	230
$2.30 \leq \delta < 2.40$	±0.025	±0.06	30	27	24	21	18	20	17	14	9	125	230
$2.40 \leq \delta < 2.50$	±0.025	±0.06	29	26	23	20	18	19	15	12	7	125	230
$2.50 \leq \delta < 2.60$	±0.025	±0.06	29	26	23	20	18	19	15	12	7	125	230
$2.60 \leq \delta < 2.70$	±0.025	±0.06	29	26	23	20	18	19	15	12	7	125	230
$2.70 \leq \delta < 2.80$	±0.025	±0.06	29	26	23	20	18	19	15	12	7	135	240
$2.80 \leq \delta < 2.90$	±0.03	±0.07	28	26	23	20	18	19	15	12	7	135	240

Table A.2 (*continued*)

Nominal Diameter of Wire	Tolerance		Minimum Number of Torsions Based on 100δ									Min. Mass Zn	
	Bright and Galv. or Zn95/Al5	Galv. or Zn95/Al5	Bright and Galvanized or Zn95/Al5					Galvanized or Zn95/Al5				Galv. or Zn95/Al5	
	Quality B	Quality A	Quality B					Quality A					
mm	mm		Tensile Strength Grade (N/mm²)									g/m²	
			1370	1570	1770	1960	2160	1370	1570	1770	1960	B	A
2.90 ≤ δ < 3.00	±0.03	±0.07	28	26	23	20	18	18	15	12	7	135	240
3.00 ≤ δ < 3.10	±0.03	±0.07	27	25	21	18	16	18	12	8	5	135	240
3.10 ≤ δ < 3.20	±0.03	±0.07	27	25	21	18	16	13	12	8	5	135	240
3.20 ≤ δ < 3.30	±0.03	±0.07	27	25	21	18	16	13	12	8	5	135	250
3.30 ≤ δ < 3.40	±0.03	±0.07	27	25	21	18	16	13	12	8	5	135	250
3.40 ≤ δ < 3.50	±0.03	±0.07	27	25	21	18	16	13	12	8	5	135	250
3.50 ≤ δ < 3.60	±0.03	±0.07	26	24	20	16	14	11	10	6	5	135	250
3.60 ≤ δ < 3.70	±0.03	±0.07	26	24	20	16	14	11	10	6	5	135	260
3.70 ≤ δ < 3.80	±0.03	±0.07	25	23	19	15	13	11	8	6	5	135	260
3.80 ≤ δ < 3.90	±0.03	±0.07	24	22	18	14	12	11	7	6	4	135	260
3.90 ≤ δ < 4.00	±0.03	±0.07	24	22	18	14	12	10	7	6	4	135	260
4.00 ≤ δ < 4.20	±0.03	±0.08	23	21	17	13	11	9	6	6	4	150	275
4.20 ≤ δ < 4.40	±0.03	±0.08	21	19	15	11		8	6	5	4	150	275
4.40 ≤ δ < 4.60	±0.03	±0.08	20	18	14	10		7	6	5		150	275
4.60 ≤ δ < 4.80	±0.03	±0.08	18	16	12	8		6	5	4		150	275
4.80 ≤ δ < 5.00	±0.03	±0.08	17	14	11	7		5	4	3		150	275
5.00 ≤ δ < 5.20	±0.03	±0.08	17	14	11	7		5	4	3		150	300
5.20 ≤ δ < 5.40	±0.03	±0.08	14	12	10			5	4	3		160	300
5.40 ≤ δ < 5.60	±0.04	±0.09	12	10	8			4	3	2		160	300
5.60 ≤ δ < 5.80	±0.04	±0.09	10	8	6			3	2	2		160	300
5.80 ≤ δ < 6.00	±0.04	±0.09	8	6	6			3	2	2		160	300
6.00 ≤ δ < 6.25	±0.04	±0.09	8	6	6			3	2	2		160	300
6.25 ≤ δ < 6.50	±0.04	±0.09	7	6	5			2	2			160	300
6.50 ≤ δ < 6.75	±0.04	±0.09	6	5	4			2	2			160	300
6.75 ≤ δ < 7.00	±0.04	±0.10	6	5	4			2	2			160	300

A.2 Tensile Strength Grades Levels 2, 3, 4, and 5

The diameter tolerances of bright and drawn galvanized wires shall be in accordance with Table A.3.

The diameter tolerances of final galvanized wires shall be in accordance with Table A.4.

The individual minimum breaking loads of bright and drawn galvanized wires and minimum number of torsions shall be in accordance with Table A.5.

The individual minimum breaking loads and torsions of final galvanized wires shall be in accordance with those given in Table A.5—subject to a reduction of 10 %.

The maximum values of tensile strength shall be no more than 207 N/mm^2 (30,000 lb/in.^{2}) greater than the minimum values.

The minimum masses of zinc for drawn galvanized and final galvanized wires shall be in accordance with Table A.6 and Table A.7, respectively.

Table A.3—Diameter Tolerances for Bright and Drawn Galvanized Wires

Nominal Diameter of Wire		Total Variation			
		Minus		Plus	
mm	(in.)	mm	(in.)	mm	(in.)
$0.25 \leq \delta \leq 0.64$	$(0.010 \leq \delta \leq 0.025)$	0.01	(0.0003)	0.02	(0.0007)
$0.64 < \delta \leq 1.50$	$(0.025 < \delta \leq 0.060)$	0.01	(0.0005)	0.03	(0.001)
$1.50 < \delta \leq 2.36$	$(0.060 < \delta \leq 0.093)$	0.03	(0.001)	0.03	(0.001)
$2.36 < \delta \leq 3.61$	$(0.093 < \delta \leq 0.142)$	0.03	(0.001)	0.04	(0.0015)
$3.61 < \delta \leq 5.08$	$(0.142 < \delta \leq 0.200)$	0.04	(0.0015)	0.05	(0.002)
$5.08 < \delta \leq 6.35$	$(0.200 < \delta \leq 0.250)$	0.05	(0.002)	0.05	(0.002)

Table A.4—Diameter Tolerances for Final Galvanized Wires

Nominal Diameter of Wire		Total Variation			
		Minus		Plus	
mm	(in.)	mm	(in.)	mm	(in.)
$0.64 \leq \delta \leq 1.55$	$(0.025 \leq \delta \leq 0.061)$	0.03	(0.001)	0.03	(0.001)
$1.55 < \delta \leq 2.01$	$(0.061 < \delta \leq 0.079)$	0.05	(0.002)	0.05	(0.002)
$2.01 < \delta \leq 3.61$	$(0.079 < \delta \leq 0.142)$	0.08	(0.003)	0.08	(0.003)
$\delta > 3.61$	$(\delta > 0.142)$	0.10	(0.004)	0.10	(0.004)

Table A.5—Minimum Breaking Force and Minimum Number of Torsions for Levels 2, 3, 4, and 5

Nominal Diameter of Wire		Level 2			Level 3			Level 4			Level 5		
		Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion
mm	(in.)	N	(lb)		N	(lb)		N	(lb)		N	(lb)	
0.25	0.010	76	17	254	89	20	234	98	22	218	107	24	190
0.28	0.011	93	21	231	107	24	213	120	27	198	129	29	173
0.30	0.012	111	25	212	129	29	195	142	32	182	151	34	158
0.33	0.013	129	29	195	151	34	180	651	37	168	178	40	146
0.36	0.014	151	34	181	173	39	167	191	43	156	205	46	136
0.38	0.015	173	39	169	200	45	156	218	49	145	236	53	126
0.41	0.016	196	44	158	227	51	146	249	56	136	267	60	118
0.43	0.017	222	50	149	254	57	137	280	63	128	302	68	111
0.46	0.018	249	56	141	285	64	130	316	71	121	338	76	105
0.48	0.019	276	62	133	320	72	123	351	79	114	378	85	100
0.51	0.020	307	69	126	351	79	116	387	87	108	418	94	94
0.53	0.021	338	76	120	387	87	111	427	96	103	458	103	90
0.56	0.022	369	83	115	427	96	106	467	105	98	503	113	86
0.58	0.023	405	91	110	467	105	101	512	115	94	552	124	82
0.61	0.024	440	99	105	507	114	97	556	125	90	600	135	78
0.64	0.025	476	107	101	547	123	93	605	136	86	649	146	75
0.66	0.026	516	116	97	592	133	89	654	147	83	703	158	72
0.69	0.027	556	125	93	641	144	86	703	158	80	756	170	70
0.71	0.028	596	134	90	689	155	83	756	170	77	814	183	67
0.74	0.029	641	144	87	738	166	80	810	182	74	872	196	65
0.76	0.030	685	154	84	787	177	77	867	195	72	934	210	62
0.79	0.031	729	164	81	841	189	75	925	208	69	996	224	60
0.81	0.032	778	175	78	894	210	72	983	221	67	1059	238	58
0.84	0.033	827	186	76	952	214	70	1045	235	65	1125	253	57
0.86	0.034	876	197	74	1010	227	68	1112	250	63	1192	268	55
0.89	0.035	930	209	72	1068	240	66	1174	264	61	1263	284	53
0.91	0.036	983	221	70	1130	254	64	1245	280	60	1339	301	52
0.94	0.037	1036	233	68	1192	268	62	1312	295	58	1410	317	50
0.97	0.038	1094	246	66	1259	283	61	1383	311	56	1486	334	49
0.99	0.039	1152	259	64	1326	298	59	1454	327	55	1566	352	48
1.02	0.040	1210	272	62	1392	313	57	1530	344	53	1646	370	46
1.04	0.041	1272	286	61	1463	329	56	1606	361	52	1726	388	45
1.07	0.042	1334	300	59	1535	345	55	1686	379	51	1810	407	44
1.09	0.043	1397	314	58	1606	361	53	1766	397	50	1899	427	43
1.12	0.044	1459	328	57	1681	378	52	1846	415	48	1988	447	42
1.14	0.045	1526	343	55	1757	395	51	1930	434	47	2077	467	41
1.17	0.046	1592	358	54	1833	412	50	2015	453	46	2166	487	40
1.19	0.047	1664	374	53	1913	430	49	2104	473	45	2260	508	39
1.22	0.048	1735	390	52	1993	448	48	2193	493	44	2357	530	38
1.24	0.049	1806	406	51	2077	467	47	2282	513	43	2455	552	38
1.27	0.050	1877	422	50	2162	486	46	2375	534	42	2553	574	37
1.30	0.051	1953	439	49	2246	505	45	2469	555	42	2655	597	36
1.32	0.052	2028	456	48	2335	525	44	2566	577	41	2758	620	35
1.35	0.053	2108	474	47	2424	545	43	2664	599	40	2865	644	35
1.37	0.054	2184	491	46	2513	565	42	2762	621	39	2971	668	34

Table A.5 (*continued*)

Nominal Diameter of Wire		Level 2			Level 3			Level 4			Level 5		
		Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion
mm	(in.)	N	(lb)		N	(lb)		N	(lb)		N	(lb)	
1.40	0.055	2264	509	45	2607	586	41	2865	644	38	3082	693	33
1.42	0.056	2349	528	44	2700	607	41	2967	667	38	3194	718	33
1.45	0.057	2429	546	43	2793	628	40	3074	691	37	3305	743	32
1.47	0.058	2513	565	43	2891	650	39	3180	715	36	3421	769	32
1.50	0.059	2598	584	42	2989	672	38	3287	739	36	3536	795	31
1.52	0.060	2687	604	41	3091	695	38	3398	764	35	3652	821	30
1.55	0.061	2776	624	40	3194	718	37	3509	789	35	3772	848	30
1.57	0.062	2865	644	40	3296	741	37	3625	815	34	3896	876	29
1.60	0.063	2958	665	39	3398	764	36	3741	841	33	4021	904	29
1.63	0.064	3047	685	38	3505	788	35	3856	867	33	4146	932	28
1.65	0.065	3145	707	38	3616	813	35	3977	894	32	4275	961	28
1.68	0.066	3238	728	37	3723	837	34	4097	921	32	4404	990	28
1.70	0.067	3336	750	37	3834	862	34	4217	948	31	4533	1019	27
1.73	0.068	3434	772	36	3945	887	33	4341	976	31	4666	1049	27
1.75	0.069	3532	794	36	4061	913	33	4466	1004	30	4804	1080	26
1.78	0.070	3634	817	35	4177	939	32	4595	1033	30	4942	1111	26
1.80	0.071	3736	840	35	4297	966	32	4724	1062	29	5080	1142	26
1.83	0.072	3839	863	34	4412	992	31	4853	1091	29	5218	1173	25
1.85	0.073	3941	886	34	4533	1019	31	4986	1121	29	5360	1205	25
1.88	0.074	4048	910	33	4657	1047	30	5120	1151	28	5507	1238	24
1.91	0.075	4154	934	33	4777	1074	30	5528	1182	28	5653	1271	24
1.93	0.076	4266	959	32	4906	1103	30	5395	1213	27	5800	1304	24
1.96	0.077	4372	983	32	5031	1131	29	5533	1244	27	5947	1337	23
1.98	0.078	4484	1008	31	5160	1160	29	5676	1276	27	6098	1371	23
2.01	0.079	4599	1034	31	5289	1189	28	5818	1308	26	6254	1406	23
2.03	0.080	4710	1059	30	5418	1218	28	5960	1340	26	6410	1441	22
2.06	0.081	4826	1058	30	5551	1248	28	6107	1373	26	6565	1476	22
2.08	0.082	4942	1111	30	5685	1278	27	6254	1406	25	6721	1511	22
2.11	0.083	5062	1138	29	5822	1309	27	6405	1440	25	6886	1548	22
2.13	0.084	5182	1165	29	5956	1339	27	6552	1473	25	7046	1584	21
2.16	0.085	5302	1192	29	6098	1371	26	6708	1508	24	7210	1621	21
2.18	0.086	5422	1219	28	6236	1402	26	6859	1542	24	7375	1658	21
2.21	0.087	5547	1247	28	6378	1434	26	7014	1577	24	7544	1696	21
2.24	0.088	5671	1275	28	6521	1466	25	7175	1613	23	7713	1734	20
2.26	0.089	5796	1303	27	6668	1499	25	7330	1648	23	7882	1772	20
2.29	0.090	5925	1332	27	6810	1531	25	7490	1684	23	8055	1811	20
2.31	0.091	6049	1360	27	6957	1564	24	7655	1721	23	8229	1850	20
2.34	0.092	6183	1390	26	7108	1598	24	7820	1758	22	8407	1890	19
2.36	0.093	6312	1419	26	7259	1632	24	7984	1795	22	8585	1930	19
2.39	0.094	6445	1449	26	7410	1666	24	8149	1832	22	8763	1970	19
2.41	0.095	6579	1479	25	7562	1700	23	8318	1870	22	8945	2011	19
2.44	0.096	6712	1509	25	7717	1735	23	8491	1909	21	9127	2052	18
2.46	0.097	6845	1539	25	7873	1770	23	8660	1947	21	9310	2093	18
2.49	0.098	6983	1570	25	8033	1806	23	8834	1986	21	9496	2135	18
2.51	0.099	7121	1601	24	8189	1841	22	9012	2026	21	9683	2177	18

Table A.5 (*continued*)

Nominal Diameter of Wire		Level 2			Level 3			Level 4			Level 5		
		Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion
mm	(in.)	N	(lb)		N	(lb)		N	(lb)		N	(lb)	
2.54	0.100	7264	1633	24	8349	1877	22	9185	2065	20	9875	2220	18
2.57	0.101	7401	1664	24	8513	1914	22	9363	2105	20	10,066	2263	18
2.59	0.102	7544	1696	24	8678	1951	22	9545	2146	20	10,262	2307	17
2.62	0.103	7686	1728	23	8843	1988	21	9723	2186	20	10,453	2350	17
2.64	0.104	7833	1761	23	9007	2025	21	9910	2228	20	10,653	2395	17
2.67	0.105	7980	1794	23	9176	2063	21	10,093	2269	19	10,849	2439	17
2.69	0.106	8126	1827	23	9345	2101	21	10,279	2311	19	11,049	2484	17
2.72	0.107	8273	1860	22	9514	2139	21	10,466	2353	19	11,249	2529	16
2.74	0.108	8425	1894	22	9688	2178	20	10,657	2396	19	11,454	2575	16
2.77	0.109	8576	1928	22	9861	2217	20	10,844	2438	19	11,658	2621	16
2.79	0.110	8727	1962	22	10,035	2256	20	11,040	2482	18	11,867	2668	16
2.82	0.111	8878	1996	22	10,213	2296	20	11,231	2525	18	12,076	2715	16
2.84	0.112	9034	2031	21	10,391	2336	20	11,427	2569	18	12,285	2762	16
2.87	0.113	9190	2066	21	10,568	2376	19	11,623	2613	18	12,494	2809	15
2.90	0.114	9345	2101	21	10,746	2416	19	11,823	2658	18	12,708	2857	15
2.92	0.115	9505	2137	21	10,929	2457	19	12,023	2703	18	12,926	2906	15
2.95	0.116	9661	2172	21	11,111	2498	19	12,223	2748	17	13,139	2954	15
2.97	0.117	9826	2209	20	11,298	2540	19	12,428	2794	17	13,357	3003	15
3.00	0.118	9986	2245	20	11,485	2582	18	12,632	2840	17	13,580	3053	15
3.02	0.119	10,146	2281	20	11,672	2624	18	12,837	2886	17	13,798	3102	15
3.05	0.120	10,310	2318	20	11,858	2666	18	13,046	2933	17	14,025	3153	14
3.07	0.121	10,475	2355	20	12,050	2709	18	13,255	2980	17	14,247	3203	14
3.10	0.122	10,644	2393	19	12,241	2752	18	13,464	3027	17	14,474	3254	14
3.12	0.123	10,813	2431	19	12,432	2795	18	13,678	3075	16	14,701	3305	14
3.15	0.124	10,978	2468	19	12,628	2839	18	13,891	3123	16	14,932	3357	14
3.18	0.125	11,151	2507	19	12,824	2883	17	14,105	3171	16	15,163	3409	14
3.20	0.126	11,320	2545	19	13,019	2927	17	14,323	3220	16	15,395	3461	14
3.23	0.127	11,494	2584	19	13,215	2971	17	14,541	3269	16	15,630	3514	14
3.25	0.128	11,667	2623	18	13,415	3016	17	14,758	3318	16	15,866	3567	13
3.28	0.129	11,841	2662	18	13,615	3061	17	14,981	3368	16	16,102	3620	13
3.30	0.130	12,018	2702	18	13,820	3107	17	15,203	3418	15	16,342	3674	13
3.33	0.131	12,192	2741	18	14,025	3153	17	15,426	3468	15	16,582	3728	13
3.35	0.132	12,370	2781	18	14,229	3199	16	15,653	3519	15	16,822	3782	13
3.38	0.133	12,552	2822	18	14,434	3245	16	15,879	3570	15	17,067	3837	13
3.40	0.134	12,730	2862	18	14,643	3292	16	16,106	3621	15	17,312	3892	13
3.43	0.135	12,913	2903	17	14,852	3339	16	16,333	3672	15	17,561	3948	13
3.45	0.136	13,095	2944	17	15,061	3386	16	16,564	3724	15	17,810	4004	13
3.48	0.137	13,282	2986	17	15,270	3433	16	16,800	3777	15	18,059	4060	13
3.51	0.138	13,464	3027	17	15,483	3481	16	17,031	3829	14	18,312	4117	12
3.53	0.139	13,651	3069	17	15,697	3529	15	17,267	3882	14	18,562	4173	12

Table A.5 (*continued*)

Nominal Diameter of Wire		Level 2			Level 3			Level 4			Level 5		
		Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion
mm	(in.)	N	(lb)		N	(lb)		N	(lb)		N	(lb)	
3.56	0.140	13,838	3111	17	15,915	3578	15	17,503	3935	14	18,819	4231	12
3.58	0.141	14,025	3153	17	16,128	3626	15	17,743	3989	14	19,073	4288	12
3.61	0.142	14,216	3196	17	16,346	3675	15	17,983	4043	14	19,331	4346	12
3.63	0.143	14,407	3239	16	16,569	3725	15	18,223	4097	14	19,589	4404	12
3.66	0.144	14,598	3282	16	16,787	3774	15	18,468	4152	14	19,851	4463	12
3.68	0.145	14,790	3325	16	17,009	3824	15	18,713	4207	14	20,114	4522	12
3.71	0.146	14,985	3369	16	17,232	3874	15	18,957	4262	14	20,376	4581	12
3.73	0.147	15,181	3413	16	17,458	3925	15	19,202	4317	13	20,643	4641	12
3.76	0.148	15,377	3457	16	17,681	3975	14	19,451	4373	13	20,910	4701	11
3.78	0.149	15,572	3501	16	17,908	4026	14	19,700	4429	13	21,177	4761	11
3.81	0.150	15,773	3546	16	18,139	4078	14	19,954	4486	13	21,448	4822	11
3.84	0.151	15,973	3591	15	18,366	4129	14	20,203	4542	13	21,720	4883	11
3.86	0.152	16,173	3636	15	18,597	4181	14	20,456	4599	13	21,991	4944	11
3.89	0.153	16,373	3681	15	18,828	4233	14	20,714	4657	13	22,267	5006	11
3.91	0.154	16,578	3727	15	19,064	4286	14	20,968	4714	13	22,542	5068	11
3.94	0.155	16,782	3773	15	19,295	4338	14	21,226	4772	13	22,818	5130	11
3.96	0.156	16,987	3819	15	19,531	4391	14	21,488	4831	13	23,098	5193	11
3.99	0.157	17,192	3865	15	19,771	4445	14	21,746	4889	13	23,379	5256	11
4.01	0.158	17,401	3912	15	20,007	4498	13	22,009	4948	12	23,659	5319	11
4.04	0.159	17,605	3958	15	20,247	4552	13	22,271	5007	12	23,944	5383	11
4.06	0.160	17,814	4005	14	20,487	4606	13	22,538	5067	12	24,228	5447	10
4.09	0.161	18,028	4053	14	20,732	4661	13	22,805	5127	12	24,513	5511	10
4.11	0.162	18,237	4100	14	20,972	4715	13	23,072	5187	12	24,802	5576	10
4.14	0.163	18,450	4148	14	21,217	4770	13	23,339	5247	12	25,091	5641	10
4.17	0.164	18,664	4196	14	21,462	4825	13	23,610	5308	12	25,380	5706	10
4.19	0.165	18,877	4244	14	21,711	4881	13	23,881	5369	12	25,674	5772	10
4.22	0.166	19,095	4293	14	21,960	4937	13	24,153	5430	12	25,967	5838	10
4.24	0.167	19,309	4341	14	22,209	4993	13	24,428	5492	12	26,261	5904	10
4.27	0.168	19,527	4390	14	22,458	5049	13	24,704	5554	12	26,555	5970	10
4.29	0.169	19,749	4440	14	22,707	5105	12	24,980	5616	12	26,853	6037	10
4.32	0.170	19,967	4489	14	22,961	5162	12	25,260	5679	11	27,151	6104	10
4.34	0.171	20,189	4539	13	23,214	5219	12	25,536	5741	11	27,453	6172	10
4.37	0.172	20,412	4589	13	23,472	5277	12	25,816	5804	11	27,756	6240	10
4.39	0.173	20,634	4639	13	23,726	5334	12	26,101	5868	11	28,058	6308	10
4.42	0.174	20,857	4689	13	23,984	5392	12	26,386	5932	11	28,360	6376	10
4.45	0.175	21,084	4740	13	24,242	5450	12	26,670	5996	11	28,667	6445	9
4.47	0.176	21,306	4790	13	24,504	5509	12	26,955	6060	11	28,974	6514	9
4.50	0.177	21,533	4841	13	24,766	5568	12	27,240	6124	11	29,286	6584	9
4.52	0.178	21,764	4893	13	25,029	5627	12	27,529	6189	11	29,593	6653	9
4.55	0.179	21,991	4944	13	25,291	5686	12	27,818	6254	11	29,904	6723	9
4.57	0.180	22,222	4996	13	25,554	5745	12	28,111	6320	11	30,220	6794	9
4.60	0.181	22,454	5048	13	25,821	5805	12	28,405	6386	11	30,531	6864	9
4.62	0.182	22,685	5100	13	26,088	5865	11	28,698	6452	11	30,847	6935	9
4.65	0.183	22,916	5152	12	26,354	5925	11	28,992	6518	11	31,167	7007	9
4.67	0.184	23,152	5205	12	26,626	5986	11	29,286	6584	10	31,483	7078	9

Table A.5 (*continued*)

Nominal Diameter of Wire		Level 2			Level 3			Level 4			Level 5		
		Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion
mm	(in.)	N	(lb)		N	(lb)		N	(lb)		N	(lb)	
4.70	0.185	23,388	5258	12	26,897	6047	11	29,584	6651	10	31,803	7150	9
4.72	0.186	23,623	5311	12	27,168	6108	11	29,882	6718	10	32,123	7212	9
4.75	0.187	23,859	5364	12	27,440	6169	11	30,184	6786	10	32,448	7295	9
4.78	0.188	24,099	5418	12	27,711	6230	11	30,487	6854	10	32,773	7368	9
4.80	0.189	24,339	5472	12	27,987	6292	11	30,785	6921	10	33,098	7441	9
4.83	0.190	24,575	5525	12	28,263	6354	11	31,092	6990	10	33,422	7514	9
4.85	0.191	24,820	5580	12	28,543	6417	11	31,394	7058	10	33,751	7588	9
4.88	0.192	25,060	5634	12	28,819	6479	11	31,701	7127	10	34,081	7662	8
4.90	0.193	25,305	5689	12	29,099	6542	11	32,008	7196	10	34,410	7736	8
4.93	0.194	25,549	5744	12	29,379	6605	11	32,319	7266	10	34,739	7810	8
4.95	0.195	25,794	5799	12	29,659	6668	11	32,626	7335	10	35,072	7885	8
4.98	0.196	26,039	5854	12	29,944	6732	11	32,937	7405	10	35,411	7961	8
5.00	0.197	26,283	5909	11	30,229	6796	10	33,249	7475	10	35,744	8036	8
5.03	0.198	26,532	5965	11	30,513	6860	10	33,565	7546	10	36,082	8112	8
5.05	0.199	26,781	6021	11	30,798	6924	10	33,880	7617	10	36,420	8188	8
5.08	0.200	27,030	6077	11	31,087	6989	10	34,196	7688	9	36,758	8264	8
5.11	0.201	27,280	6133	11	31,372	7053	10	34,512	7759	9	37,101	8341	8
5.13	0.202	27,533	6190	11	31,661	7118	10	34,828	7830	9	37,443	8418	8
5.16	0.203	27,787	6247	11	31,954	7184	10	35,148	7902	9	37,786	8495	8
5.18	0.204	28,040	6304	11	32,244	7249	10	35,468	7974	9	38,128	8572	8
5.21	0.205	28,294	6261	11	32,537	7315	10	35,793	8047	9	38,475	8650	8
5.23	0.206	28,547	6418	11	32,831	7381	10	36,113	8119	9	38,822	8728	8
5.26	0.207	28,805	6476	11	33,124	7447	10	36,438	8192	9	39,169	8806	8
5.28	0.208	29,063	6534	11	33,422	7514	10	36,763	8265	9	39,520	8885	8
5.31	0.209	29,321	6592	11	33,720	7581	10	37,092	8339	9	39,872	8964	8
5.33	0.210	29,579	6650	11	34,018	7648	10	37,417	8412	9	40,223	9043	8
5.36	0.211	29,837	6708	11	34,316	7715	10	37,746	8486	9	40,579	9123	8
5.38	0.212	30,100	6767	11	34,614	7782	10	38,075	8560	9	40,930	9202	8
5.41	0.213	30,362	6826	11	34,917	7850	10	38,408	8635	9	41,286	9282	8
5.44	0.214	30,624	6885	11	35,219	7918	10	38,742	8710	9	41,647	9363	7
5.46	0.215	30,887	6944	10	35,522	7986	9	39,071	8784	9	42,002	9443	7
5.49	0.216	31,154	7004	10	35,824	8054	9	39,409	8860	9	42,363	9524	7
5.51	0.217	31,416	7063	10	36,131	8123	9	39,743	8935	9	42,723	9605	7
5.54	0.218	31,683	7123	10	36,438	8192	9	40,081	9011	9	43,088	9687	7
5.56	0.219	31,950	7183	10	36,745	8261	9	40,419	9087	9	43,448	9768	7
5.59	0.220	32,221	7244	10	37,052	8330	9	40,757	9163	8	43,813	9850	7
5.61	0.221	32,488	7304	10	37,363	8400	9	41,100	9240	8	44,182	9933	7
5.64	0.222	32,760	7365	10	37,670	8469	9	41,438	9316	8	44,547	10,015	7
5.66	0.223	33,031	7426	10	37,981	8539	9	41,780	9393	8	44,916	10,098	7
5.69	0.224	33,302	7487	10	38,297	8610	9	42,127	9471	8	45,285	10,181	7
5.72	0.225	33,574	7548	10	38,609	8680	9	42,470	9548	8	45,654	10,264	7
5.74	0.226	33,845	7609	10	38,924	8751	9	42,816	9626	8	46,028	10,348	7
5.77	0.227	34,121	7671	10	39,240	8822	9	43,163	9704	8	46,402	10,432	7
5.79	0.228	34,396	7733	10	39,556	8893	9	43,510	9782	8	46,775	10,516	7
5.82	0.229	34,672	7795	10	39,872	8964	9	43,862	9861	8	47,149	10,600	7

Table A.5 (*continued*)

Nominal Diameter of Wire		Level 2			Level 3			Level 4			Level 5		
		Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion	Minimum Breaking Force		Torsion
mm	(in.)	N	(lb)		N	(lb)		N	(lb)		N	(lb)	
5.84	0.230	34,948	7857	10	40,192	9036	9	44,209	9939	8	47,527	10,685	7
5.87	0.231	35,228	7920	10	40,508	9107	9	44,560	10,018	8	47,905	10,770	7
5.89	0.232	35,504	7982	10	40,828	9179	9	44,911	10,097	8	48,283	10,855	7
5.92	0.233	35,784	8045	9	41,153	9252	9	45,267	10,177	8	48,661	10,940	7
5.94	0.234	36,064	8108	9	41,473	9324	9	45,623	10,257	8	49,044	11,026	7
5.97	0.235	36,345	8171	9	41,798	9397	9	45,975	10,336	8	49,426	11,112	7
5.99	0.236	36,629	8235	9	42,123	9470	8	46,335	10,417	8	49,809	11,198	7
6.02	0.237	36,910	8298	9	42,447	9543	8	46,691	10,497	8	50,191	11,284	7
6.05	0.238	37,194	8362	9	42,772	9616	8	47,051	10,578	8	50,578	11,371	7
6.07	0.239	37,479	8426	9	43,101	9690	8	47,411	10,659	8	50,965	11,458	7
6.10	0.240	37,764	8490	9	43,426	9763	8	47,772	10,740	8	51,352	11,545	6
6.12	0.241	38,048	8554	9	43,755	9837	8	48,132	10,821	8	51,744	11,633	6
6.15	0.242	38,337	8619	9	44,089	9912	8	48,497	10,903	8	52,131	11,720	6
6.17	0.243	38,622	8683	9	44,418	9986	8	48,857	10,984	8	52,522	11,808	6
6.20	0.244	38,911	8748	9	44,751	10,061	8	49,226	11,067	8	52,918	11,897	6
6.22	0.245	39,200	8813	9	45,080	10,135	8	49,591	11,149	7	53,309	11,985	6
6.25	0.246	39,494	8879	9	45,414	10,210	8	49,955	11,231	7	53,705	12,074	6
6.27	0.247	39,783	8944	9	45,752	10,286	8	50,325	11,314	7	54,101	12,163	6
6.30	0.248	40,076	9010	9	46,086	10,361	8	50,694	11,397	7	54,497	12,252	6
6.32	0.249	40,366	9075	9	46,424	10,437	8	51,063	11,480	7	54,893	12,341	6
6.35	0.250	40,659	9141	9	46,757	10,512	8	51,437	11,564	7	55,293	12,431	6

Table A.6—Minimum Masses of Zinc for Drawn Galvanized Wire Levels 2, 3, 4, and 5

Nominal Diameter of Wire		Minimum Mass of Zinc Coating	
mm	(in.)	g/m^2	(oz/ft^2)
0.46 to 0.72	(0.018 to 0.028)	30	(0.10)
0.73 to 1.53	(0.029 to 0.060)	60	(0.20)
1.54 to 2.29	(0.061 to 0.090)	90	(0.30)
2.30 to 3.56	(0.091 to 0.140)	120	(0.40)

Table A.7—Minimum Masses of Zinc for Final Galvanized Wire Levels 2, 3, 4, and 5

Nominal Diameter of Wire		Minimum Mass of Zinc Coating	
mm	(in.)	g/m^2	(oz/ft^2)
0.72 to 1.20	(0.028 to 0.047)	60	(0.20)
1.21 to 1.38	(0.048 to 0.054)	120	(0.40)
1.39 to 1.61	(0.055 to 0.063)	150	(0.50)
1.62 to 2.01	(0.064 to 0.079)	180	(0.60)
2.02 to 2.34	(0.080 to 0.092)	210	(0.70)
2.35 and larger	(0.093 and larger)	240	(0.80)

Annex B
(normative)

Methods of Wire Testing for Levels 2, 3, 4, and 5

B.1 Diameter Test

The diameter shall be determined from two measurements in two perpendicular directions on the same section and the same diametrical plane using a measuring instrument, e.g., a micrometer, accurate to 0.01 mm.

B.2 Tensile Test

Specimens shall not be less than 450 mm (18 in.) long, and the distance between the grips of the testing machine shall not be less than 305 mm (12 in.). The speed of the movable head of the testing machine, under no load, shall not exceed 0.5 mm/s (1 in./min). Any specimen breaking within 6 mm ($^1/_4$ in.) of the jaws may be disregarded and a retest performed.

B.3 Torsion Test

The distance between the jaws of the testing machine shall be 203 mm ± 1 mm (8 in. ± $^1/_{16}$ in.). In order to save time during tests, the distance may be shortened to as small as 100 wire diameters.

One end of the wire shall be rotated with respect to the other end at uniform speed not to exceed sixty 360° revolutions per minute, until breakage occurs.

The machine shall 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 3 mm ($^1/_8$ in.) of the jaw may be discounted.

During the torsion test, tension weights as shown in Table B.1 shall be applied to the wire being tested. Tension weights shall not exceed twice the minimum values given in Table B.1.

When the distance between the jaws of the testing machine is other than 203 mm, the minimum torsion values given in Table A.5 shall be adjusted in direct proportion to the change in jaw spacing.

B.4 Zinc-coating Tests

The determination of mass of zinc shall be carried out in accordance with Annex A of ISO 2232:1990. An adhesion test shall be carried out in accordance with Annex B of ISO 2232:1990.

Table B.1—Applied Tension for Torsion Tests

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

Annex C
(normative)

Tables of Breaking Forces for the More Common Classes, Sizes, and Grades of Stranded Ropes Up to and Including 60 mm Diameter

The following tables give the breaking forces of the more common classes, sizes, and grades of stranded ropes up to and including 60 mm diameter.

Higher values of minimum breaking force than those given in the tables may be guaranteed by the manufacturer.

NOTE 1 The equivalent minimum breaking force values in kilonewtons for rope grades IPS, EIP, and EEIP are given for comparison with the minimum breaking force values for grades 1770, 1960, and 2160.

NOTE 2 The conversion factor from short tons to kilonewtons is 8.896.

NOTE 3 The values of nominal length mass are approximate and are given for information.

Table C.1—Class 6 × 7 Fiber Core

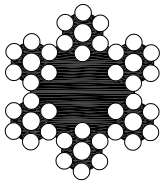
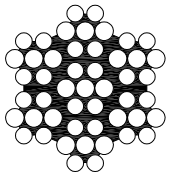
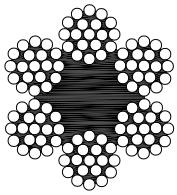
Typical Cross Section						Typical Construction					
						Rope Construction	Strand Construction			Outer Wires	
										Total	Per Strand
						6 × 7-FC	1-6			36	6
Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})					
		min.	max.			Grade 1770	Grade 1960	Grade IPS		Grade EIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	(short tons)	kN	(short tons)
6		6.00	6.36	12.4		21.2	23.4				
(6.35)	(1/4)	6.35	6.73		(0.09)			23.5	(2.64)	25.8	(2.90)
7		7.00	7.42	16.9		28.8	31.9				
(7.94)	(5/16)	7.94	8.42		(0.15)			36.5	(4.10)	40.1	(4.51)
8		8.00	8.40	22.1		37.6	41.6				
9		9.00	9.45	27.9		47.6	52.7				
(9.5)	(3/8)	9.53	10.0		(0.21)			52.1	(5.86)	57.4	(6.45)
10		10.0	10.5	34.5		58.8	65.1				
11		11.0	11.6	41.7		71.1	78.7				
(11.1)	(7/16)	11.1	11.7		(0.29)			70.5	(7.93)	77.6	(8.72)
12		12.0	12.6	49.7		84.6	93.7				
(12.7)	(1/2)	12.7	13.3		(0.37)			91.6	(10.3)	101	(11.3)
13		13.0	13.7	58.3		99.3					
14		14.0	14.7	67.6		115	110				
(14.3)	(9/16)	14.3	15.0		(0.47)		128	116	(13.0)	127	(14.3)
(15.9)	(5/8)	15.9	16.7		(0.58)			141	(15.9)		
16		16.0	16.8	88.3		150	167				
18		18.0	18.9	112		190	211				
19		19.0	20.0	125		212	235				
(19.1)	(3/4)	19.1	20.0					202	(22.7)	222	(25.0)
20		20.0	21.0	138	(0.84)	235	260				
22		22.0	23.1	167		284	315				
(22.2)	(7/8)	22.2	23.3		(1.15)			273	(30.7)	301	(33.8)
24		24.0	25.2	199		338	375				
(25.4)	(1)	25.4	26.7		(1.50)			353	(39.7)	389	(43.7)
26		26.0	27.3	233		397	440				
28		28.0	29.4	270		461	510				
(28.6)	(1 1/8)	28.6	30.0		(1.89)			443	(49.8)	488	(54.8)
(31.8)	(1 1/4)	31.8	33.3		(2.34)			543	(61.0)	597	(67.1)
32		32.0	33.6	353		602	666				
(34.9)	(1 3/8)	34.9	36.7		(2.83)			650	(73.1)	715	(80.4)
35		35.0	36.8	423		720	797				
36		36.0	37.8	447		762	843				
38		38.0	39.9	498		849	940				
(38.1)	(1 1/2)	38.1	40.0		(3.37)			767	(86.2)	843	(94.8)
40		40.0	42.0	552		940	1040				

Table C.2—Class 6 × 7 Steel Core

Typical Cross Section						Typical Construction					
						Rope Construction	Strand Construction	Outer Wires			
								Total	Per Strand		
						6 × 7-WSC 6 × 7-IWRC	1-6 1-6	36 36	1 1		
Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})					
		min.	max.			Grade 1770	Grade 1960	Grade IPS		Grade EIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	(short tons)	kN	(short tons)
6		6.00	6.36	13.8		22.9	25.3				
(6.35)	(1/4)	6.35	6.73		(0.11)			25.3	(2.84)	27.8	(3.12)
7		7.00	7.42	18.8		31.1	34.5				
(7.94)	(5/16)	7.94	8.42		(0.17)			39.2	(4.41)	43.1	(4.85)
8		8.00	8.40	24.6		40.7	45.0				
9		9.00	9.45	31.1		51.5	57.0				
(9.5)	(3/8)	9.53	10.0		(0.24)			56.0	(6.30)	61.6	(6.93)
10		10.0	10.5	38.4		63.5	70.4				
11		11.0	11.6	46.5		76.9	85.1				
(11.1)	(7/16)	11.1	11.7		(0.33)			75.8	(8.52)	83.4	(9.37)
12		12.0	12.6	55.3		91.5	101				
(12.7)	(1/2)	12.7	13.3		(0.43)			98.7	(11.1)	109	(12.2)
13		13.0	13.7	64.9		107	119				
14		14.0	14.7	75.3		125	138				
(14.3)	(9/16)	14.3	15.0		(0.55)			125	(14.0)	137	(15.4)
(15.9)	(5/8)	15.9	16.7		(0.68)			152	(17.1)	167	(18.8)
16		16.0	16.8	98.3		163	180				
18		18.0	18.9	124		206	228				
19		19.0	20.0	139		229	254				
(19.1)	(3/4)	19.1	20.0		(0.98)			217	(24.4)	238	(26.8)
20		20.0	21.0	154		254	281				
22	(7/8)	22.0	23.1	186		308	341				
(22.2)	(7/8)	22.2	23.3		(1.33)			294	(33.0)	323	(36.3)
24		24.0	25.2	221		366	405				
(25.4)	(1)	25.4	26.7		(1.73)			380	(42.7)	418	(47.0)
26		26.0	27.3	260		430	476				
28		28.0	29.4	301		498	552				
(28.6)	(1 1/8)	28.6	30.0		(2.19)			476	(53.5)	524	(58.9)
(31.8)	(1 1/4)	31.8	33.3		(2.71)			584	(65.6)	642	(72.2)
32		32.0	33.6	393		651	721				
(34.9)	(1 3/8)	34.9	36.7		(3.28)			699	(78.6)	770	(86.5)
35		35.0	36.8	470		778	778				
36		36.0	37.8	498		824	912				
38		38.0	39.9	554		918	1020				
(38.1)	(1 1/2)	38.1	40.0		(3.90)			825	(92.7)	907	(102)
40		40.0	42.0	614		1020	1130				

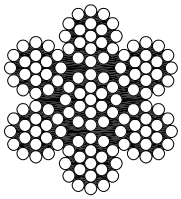
NOTE For smaller diameters with wire strand core (WSC), breaking force factor K_3 may be used in the calculation of minimum breaking force. The values of breaking force given in the table are for ropes with independent wire rope core (IWRC) using K_2.

Table C.3—Class 6 × 19M Fiber Core

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	6 × 19M-FC	1-6/12	72	12

Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass	Minimum Breaking Force (F_{min})	
		min.	max.		Grade 1770	Grade 1960
mm	(in.)	mm	mm	kg/100 m	kN	kN
3		3.00	3.24	3.11	4.89	5.42
4		4.00	4.28	5.54	8.69	9.63
5		5.00	5.35	8.65	13.6	15.0
6		6.00	6.36	12.5	19.6	21.7
7		7.00	7.42	17.0	26.6	29.5
8		8.00	8.40	22.1	34.8	38.5
9		9.00	9.45	28.0	44.0	48.7
(9.5)	(3/8)	9.53	10.0			
10		10.0	10..5	34.6	54.3	60.2
11		11.0	11.6	41.9	65.8	72.8
(11.1)	(7/16)	11.1	11.7			
12		12.0	12.6	49.8	78.2	86.6
(12.7)	(1/2)	12.7	13.3			
13		13.0	13.7	58.5	91.8	102
14		14.0	14.7	67.8	107	118
(14.3)	(9/16)	14.3	15.0			
(15.9)	(5/8)	15.9	16.7			
16		16.0	16.8	88.6	139	154
18		18.0	18.9	112	176	195
19		19.0	20.0	125	196	217
(19.1)	(3/4)	19.1	20.0			
20		20.0	21.0	138	217	241
22		22.0	23.1	167	263	291
(22.2)	(7/8)	22.2	23.3			
24		24.0	25.2	199	313	347
(25.4)	(1)	25.4	26.7			
26		26.0	27.3	234	367	407
28		28.0	29.4	271	426	472
(28.6)	(1 1/8)	28.6	30.0			
(31.8)	(1 1/4)	31.8	33.3			
32		32.0	33.6	354	556	616

Table C.4—Class 6 × 19M Steel Core

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	6 × 19M-WSC	1-6/12	72	12
	6 × 19M-IWRC	1-6/12	72	12

Nominal rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass	Minimum Breaking Force (F_{min})	
		min.	max.		Grade 1770	Grade 1960
mm	(in.)	mm	mm	kg/100m	kN	kN
8		8.00	8.40	24.7	37.6	41.6
9		9.00	9.45	31.2	47.6	52.7
(9.5)	($^3/_8$)	9.53	10.0			
10		10.0	10.5	38.6	58.8	65.1
11		11.0	11.6	46.7	71.1	78.7
(11.1)	($^7/_{16}$)	11.1	11.7			
12		12.0	12.6	55.6	84.6	93.7
(12.7)	($^1/_2$)	12.7	13.3			
13		13.0	13.7	65.2	99.3	110
14		14.0	14.7	75.7	115	128
(14.3)	($^9/_{16}$)	14.3	15.0			
(15.9)	($^5/_8$)	15.9	16.7			
16		16.0	16.8	98.8	150	167
18		18.0	18.9	125	190	211
19		19.0	20.0	139	212	235
(19.1)	($^3/_4$)	19.1	20.0			
20		20.0	21.0	154	235	260
22		22.0	23.1	187	284	315
(22.2)	($^7/_8$)	22.2	23.3			
24		24.0	25.2	222	338	375
(25.4)	(1)	25.4	26.7			
26		26.0	27.3	261	397	440
28		28.0	29.4	303	461	510
(28.6)	(1 $^1/_8$)	28.6	30.0			
(31.8)	(1 $^1/_4$)	31.8	33.3			
32		32.0	33.6	395	602	666

NOTE For smaller diameters with wire strand core (WSC), breaking force factor K_3 may be used in the calculation of minimum breaking force. The values of breaking force given in the table are for ropes with independent wire rope core (IWRC) using K_2.

Table C.5—Class 6 × 37M Fiber Core

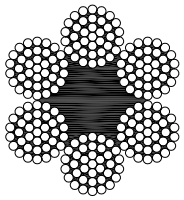
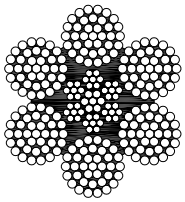
Typical Cross Section					Typical Construction			
					Rope Construction	Strand Construction	Outer Wires	
							Total	Per Strand
					6 × 37M-FC	1-6/12/18	108	18
Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass	Minimum Breaking Force (F_{min})			
		min.	max.		Grade 1770	Grade 1960		
mm	(in.)	mm	mm	kg/100m	kN	kN		
5		5.00	5.35	8.65	13.9	14.6		
6		6.00	6.36	12.5	18.8	20.8		
7		7.00	7.42	17.0	25.6	28.3		
8		8.00	8.40	22.1	33.4	37.0		
9		9.00	9.45	28.0	42.3	46.8		
(9.5)	(3/8)	9.53	10.0					
10		10.0	10.5	34.6	52.2	57.8		
11		11.0	11.6	41.9	63.2	70.0		
(11.1)	(7/16)	11.1	11.7					
12		12.0	12.6	49.8	75.2	83.3		
(12.7)	(1/2)	12.7	13.3					
13		13.0	13.7	58.5	88.2	97.7		
14		14.0	14.7	67.8	102	113		
(14.3)	(9/16)	14.3	15.0					
(15.9)	(5/8)	15.9	16.7					
16		16.0	16.8	88.6	134	148		
18		18.0	18.9	112	169	187		
19		19.0	20.0	125	188	209		
(19.1)	(3/4)	19.1	20.0					
20		20.0	21.0	138	209	231		
22		22.0	23.1	167	253	280		
(22.2)	(7/8)	22.2	23.3					
24		24.0	25.2	199	301	333		
(25.4)	(1)	25.4	26.7					
26		26.0	27.3	239	353	391		
28		28.0	29.4	271	409	453		
(28.6)	(1 1/8)	28.6	30.0					
(31.8)	(1 1/4)	31.8	33.3					
32		32.0	33.6	354	535	592		
(34.9)	(1 3/8)	34.9	36.7					
35		35.0	36.8	424	640	708		
36		36.0	37.8	448	677	749		
38		38.0	39.9	500	754	835		
(38.1)	(1 1/2)	38.1	40.0					
40		40.0	42.0	554	835	925		

Table C.6—Class 6 × 37M Steel Core

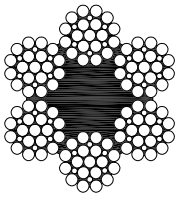
Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	6 × 37M-WSC	1-6/12/18	108	18
	6 × 37M-IWRC	1-6/12/18	108	18

Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass	Minimum Breaking Force (F_{min})	
		min.	max.		Grade 1770	Grade 1960
mm	(in.)	mm	mm	kg/100m	kN	kN
8		8.00	8.40	24.4	39.2	43.4
9		9.00	9.45	30.9	49.6	54.9
(9.5)	(3/8)	9.53	10.0			
10		10.0	10.5	38.1	61.2	67.8
11		11.0	11.6	46.1	74.1	82.1
(11.1)	(7/16)	11.1	11.7			
12		12.0	12.6	54.9	88.2	97.7
(12.7)	(1/2)	12.7	13.3			
13		13.0	13.7	64.4	95.4	106
14		14.0	14.7	74.7	111	126
(14.3)	(9/16)	14.3	15.0			
(15.9)	(5/8)	15.9	16.7			
16		16.0	16.8	97.5	145	160
18		18.0	18.9	123	183	203
19		19.0	20.0	138	204	226
(19.1)	(3/4)	19.1	20.0			
20		20.0	21.0	152	226	250
22		22.0	23.1	184	273	303
(22.2)	(7/8)	22.2	23.3			
24		24.0	25.2	219	325	360
(25.4)	(1)	25.4	26.7			
26		26.0	27.3	258	382	423
28		28.0	29.4	299	443	490
(28.6)	(1 1/8)	28.6	30.0			
(31.8)	(1 1/4)	31.8	33.3			
32		32.0	33.6	390	578	640
(34.9)	(1 3/8)	34.9	36.7			
35		35.0	36.8	467	692	766
36		36.0	37.8	494	732	810
38		38.0	39.9	550	815	903
(38.1)	(1 1/2)	38.1	40.0			
40		40.0	42.0	610	903	1000

NOTE For smaller diameters with wire strand core (WSC), breaking force factor K_3 may be used in the calculation of minimum breaking force. The values of breaking force given in the table are for ropes with independent wire rope core (IWRC) using K_2.

Table C.7—Class 6 × 19 Fiber Core

Typical Cross Section



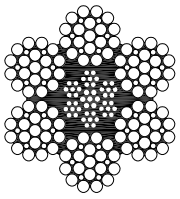
Typical Construction

Rope Construction	Strand Construction	Outer Wires	
		Total	Per Strand
6 × 19S-FC	1-9-9	54	9
6 × 21F-FC	1-5F-5-10	60	10
6 × 26WS-FC	1-5-5F-10	60	10
6 × 19W-FC	1-6-6+6	72	12
6 × 25F-FC	1-6-6F-12	72	12

Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})								
		min.	max.			Grade 1770	Grade 1960	Grade 2160	Grade IPS		Grade EIP		Grade EEIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	kN	(short tons)	kN	(short tons)	kN	(short tons)
6		6.00	6.36	12.9		21.0	23.3	25.7						
(6.35)	(1/4)	6.35	6.73		(0.11)				24.4	(2.74)	26.8	(3.01)		
7		7.00	7.42	17.6		28.6	31.7	34.9						
(7.94)	(5/16)	7.94	8.42		(0.16)				37.9	(4.26)	41.7	(4.69)		
8		8.00	8.40	23.0		37.4	41.4	45.6						
9		9.00	9.45	29.1		47.3	52.4	57.7						
(9.5)	(3/8)	9.53	10.0		(0.24)				54.3	(6.10)	59.7	(6.71)	65.7	(7.38)
10		10.0	10.5	35.9		58.4	64.7	71.3						
11		11.0	11.6	43.3		70.7	78.3	86.2						
(11.1)	(7/16)	11.1	11.7		(0.32)				73.6	(8.27)	81.0	(9.10)	89.0	(10.0)
12		12.0	12.6	51.7		84.1	93.1	103						
(12.7)	(1/2)	12.7	13.3		(0.42)				95.2	(10.7)	105	(11.8)	115	(12.9)
13		13.0	13.7	60.7		98.7	109	120						
14		14.0	14.7	70.4		114	127	140						
(14.3)	(9/16)	14.3	15.0		(0.53)				120	(13.5)	133	(14.9)	145	(16.3)
(15.9)	(5/8)	15.9	16.7		(0.66)				149	(16.7)	164	(18.4)	180	(20.2)
16		16.0	16.8	91.9		150	166	182						
18		18.0	18.9	116		189	210	231						
19		19.0	20.0	130		211	233	257						
(19.1)	(3/4)	19.1	20.0		(0.95)				212	(23.8)	233	(26.2)	256	(28.8)
20		20.0	21.0	144		234	259	285						
22		22.0	23.1	174		283	313	345						
(22.2)	(7/8)	22.2	23.3		(1.29)				286	(32.2)	315	(35.4)	347	(39.0)
24		24.0	25.2	207		336	373	411						
(25.4)	(1)	25.4	26.7		(1.68)				372	(41.8)	409	(46.0)	450	(50.6)
26		26.0	27.3	243		395	437	482						
28		28.0	29.4	281		458	507	559						
(28.6)	(1 1/8)	28.6	30.0		(2.13)				468	(52.6)	515	(57.9)	566	(63.6)
(31.8)	(1 1/4)	31.8	33.3		(2.63)				575	(64.6)	633	(71.1)	696	(78.2)
32		32.0	33.6	368		598	662	730						
(34.9)	(1 3/8)	34.9	36.7		(3.18)				691	(77.7)	761	(85.5)	836	(94.0)
35		35.0	36.8	440		716	792	873						
36		36.0	37.8	465		757	838	924						
38		38.0	39.9	518		843	934	1030						
(38.1)	(1 1/2)	38.1	40.0		(3.78)				818	(92.0)	898	(101)	987	(111)
40		40.0	42.0	574		935	1040	1140						
(41.3)	(1 5/8)	41.3	43.3		(4.44)				952	(107)	1050	(118)	1150	(129)
44		44.0	46.2	695		1130	1250	1380						
(44.5)	(1 3/4)	44.5	46.7		(5.15)				1100	(124)	1210	(136)	1330	(150)
45		45.0	47.3	727		1180	1310	1440						
(47.6)	(1 7/8)	47.6	50.0		(5.91)				1250	(141)	1380	(155)	1520	(171)
48		48.0	50.4	827		1350	1490	1640						
(50.8)	(2)	50.8	53.3		(6.73)				1420	(160)	1570	(176)	1730	(194)
51		51.0	53.6	934		1520	1680	1850						
52		52.0	54.6	971		1580	1750	1930						
(54.0)	(2 1/8)	54.0	56.7		(7.60)				1590	(179)	1750	(197)	1930	(217)
56		56.0	58.8	1130		1830	2030	2240						
(57.2)	(2 1/4)	57.2	60.0		(8.52)				1780	(200)	1960	(220)	2150	(242)
60		60.0	63.0	1290		2100	2330	2570						

Table C.8—Class 6 × 19 Steel Core

Typical Cross Section

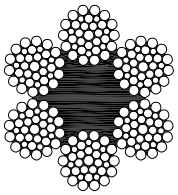


Typical Construction

Rope Construction	Strand Construction	Outer Wires	
		Total	Per Strand
6 × 19S-IWRC	1-9-9	54	9
6 × 21F-IWRC	1-5F-5-10	60	10
6 × 26WS-IWRC	1-5-5F-10	60	10
6 × 19W-IWRC	1-6-6+6	72	12
6 × 25F-IWRC	1-6-6F-12	72	12

Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})								
		min.	max.			Grade 1770	Grade 1960	Grade 2160	Grade IPS		Grade EIP		Grade EEIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	kN	(short tons)	kN	(short tons)	kN	(short tons)
6		6.00	6.36	14.4		22.7	25.1	27.7						
(6.35)	(1/4)	6.35	6.73		(0.12)				26.2	(2.94)	30.2	(3.40)		
7		7.00	7.42	19.6		30.9	34.2	37.7						
(7.94)	(5/16)	7.94	8.42		(0.18)				40.7	(4.58)	46.9	(5.27)		
8		8.00	8.40	25.6		40.3	44.7	49.2						
9		9.00	9.45	32.4		51.0	56.5	62.2						
(9.5)	(3/8)	9.53	10.0		(0.26)				58.4	(6.56)	67.2	(7.55)	73.8	(8.30)
10		10.0	10.5	40.0		63.0	69.8	76.9						
11		11.0	11.6	48.4		76.2	84.4	93.0						
(11.1)	(7/16)	11.1	11.7		(0.35)				79.1	(8.89)	90.7	(10.2)	99.6	(11.2)
12		12.0	12.6	57.6		90.7	100	111						
(12.7)	(1/2)	12.7	13.3		(0.46)				102	(11.5)	118	(13.3)	130	
13		13.0	13.7	67.6		106	118	130						(14.6)
14		14.0	14.7	78.4		124	137	151						
(14.3)	(9/16)	14.3	15.0		(0.58)				129	(14.5)	149	(16.8)	165	(18.5)
(15.9)	(5/8)	15.9	16.7		(0.72)				157	(17.7)	183	(20.6)	202	(22.7)
16		16.0	16.8	102		161	179	197						
18		18.0	18.9	130		204	226	249						
19		19.0	20.0	144		227	252	278						
(19.1)	(3/4)	19.1	20.0		(1.04)				228	(25.6)	262	(29.4)	288	(32.4)
20		20.0	21.0	160		252	279	308						
22		22.0	23.1	194		305	338	372						
(22.2)	(7/8)	22.2	23.3		(1.41)				308	(34.6)	354	(39.8)	390	(43.8)
24		24.0	25.2	230		363	402	443						
(25.4)	(1)	25.4	26.7		(1.85)				399	(44.9)	460	(51.7)	506	(56.9)
26		26.0	27.3	270		426	472	520						
28		28.0	29.4	314		494	547	603						
(28.6)	(1 1/8)	28.6	30.0		(2.34)				503	(56.5)	578	(65.0)	636	(71.5)
(31.8)	(1 1/4)	31.8	33.3		(2.89)				617	(69.4)	711	(79.9)	782	(87.9)
32		32.0	33.6	410		645	715	787						
(34.9)	(1 3/8)	34.9	36.7		(3.49)				743	(83.5)	854	(96.0)	943	(106)
35		35.0	36.8	490		772	855	942						
36		36.0	37.8	518		817	904	997						
38		38.0	39.9	578		910	1010	1110						
(38.1)	(1 1/2)	38.1	40.0		(4.16)				880	(98.9)	1010	(114)	1110	(125)
40		40.0	42.0	640		1010	1120	1230						
(41.3)	(1 5/8)	41.3	43.3		(4.88)				1020	(115)	1170	(132)	1300	(146)
44		44.0	46.2	774		1220	1350	1490						
(44.5)	(1 3/4)	44.5	46.7		(5.66)				1180	(133)	1360	(153)	1500	(169)
45		45.0	47.3	810		1280	1410	1560						
(47.6)	(1 7/8)	47.6	50.0		(6.49)				1350	(152)	1550	(174)	1710	(192)
48		48.0	50.4	922		1450	1610	1770						
(50.8)	(2)	50.8	53.3		(7.39)				1530	(172)	1760	(198)	1930	(217)
51		51.0	53.6	1040		1640	1810	2000						
52		52.0	54.6	1080		1700	1890	2080						
(54.0)	(2 1/8)	54.0	56.7		(8.34)				1710	(192)	1970	(221)	2160	(243)
56		56.0	58.8	1250		1980	2190	2410						
(57.2)	(2 1/4)	57.2	60.0		(9.35)				1910	(215)	2200	(247)	2420	(272)
60		60.0	63.0	1440		2270	2510	2770						

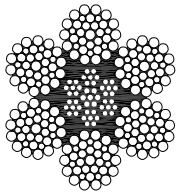
Table C.9—Class 6 × 36 Fiber Core

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	6 × 31WS-FC	1-6-6+6-12	72	12
	6 × 36WS-FC	1-7-7+7-14	84	14
	6 × 41WS-FC	1-8-8+8-16	96	16
	6 × 41SF-FC	1-8-8-8F-16	96	16
	6 × 49SWS-FC	1-8-8-8+8-16	96	16
	6 × 46WS-FC	1-9-9+9-18	108	18

Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})								
		min.	max.			Grade 1770	Grade 1960	Grade 2160	Grade IPS		Grade EIP		Grade EEIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	kN	(short tons)	kN	(short tons)	kN	(short tons)
(6.35)	(1/4)	6.35	6.73		(0.11)				24.4	(2.74)	26.8	(3.01)		
7		7.00	7.42	18.0		28.6	31.7	34.9						
(7.94)	(5/16)	7.94	8.42		(0.16)				37.9	(4.26)	41.7	(4.69)		
8		8.00	8.40	23.5		37.4	41.4	45.6						
9		9.00	9.45	29.7		47.3	52.4	57.7						
(9.5)	(3/8)	9.53	10.0		(0.24)				54.3	(6.10)	59.7	(6.71)	65.7	(7.38)
10		10.0	10.5	36.7		58.4	64.7	71.3						
11		11.0	11.6	44.4		70.7	78.3	86.2						
(11.1)	(7/16)	11.1	11.7		(0.32)				73.6	(8.27)	81.0	(9.10)	89.0	(10.0)
12		12.0	12.6	52.8		84.1	93.1	103						
(12.7)	(1/2)	12.7	13.3		(0.42)				95.2	(10.7)	105	(11.8)	115	(12.9)
13		13.0	13.7	62.0		98.7	109	120						
14		14.0	14.7	71.9		114	127	140						
(14.3)	(9/16)	14.3	15.0		(0.53)				120	(13.5)	133	(14.9)	145	(16.3)
(15.9)	(5/8)	15.9	16.7		(0.66)				149	(16.7)	164	(18.4)	180	(20.2)
16		16.0	16.8	94.0		150	166	182						
18		18.0	18.9	119		189	210	231						
19		19.0	20.0	132		211	233	257						
(19.1)	(3/4)	19.1	20.0		(0.95)				212	(23.8)	233	(26.2)	256	(28.8)
20		20.0	21.0	147		234	259	285						
22		22.0	23.1	178		283	313	345						
(22.2)	(7/8)	22.2	23.3		(1.29)				286	(32.2)	315	(35.4)	347	(39.0)
24		24.0	25.2	211		336	373	411						
(25.4)	(1)	25.4	26.7		(1.68)				372	(41.8)	409	(46.0)	450	(50.6)
26		26.0	27.3	248		395	437	482						
28		28.0	29.4	288		458	507	559						
(28.6)	(1 1/8)	28.6	30.0		(2.13)				468	(52.6)	515	(57.9)	566	(63.6)
(31.8)	(1 1/4)	31.8	33.3		(2.63)				575	(64.6)	633	(71.1)	696	(78.2)
32		32.0	33.6	376		598	662	730						
(34.9)	(1 3/8)	34.9	36.7		(3.18)				691	(77.7)	761	(85.5)	836	(94.0)
35		35.0	36.8	450		716	792	873						
36		36.0	37.8	476		757	838	924						
38		38.0	39.9	530		843	934	1030						
(38.1)	(1 1/2)	38.1	40.0		(3.78)				818	(92.0)	898	(101)	987	(111)
40		40.0	42.0	587		935	1040	1140						
(41.3)	(1 5/8)	41.3	43.3		(4.44)				952	(107)	1050	(118)	1150	(129)
44		44.0	46.2	711		1130	1250	1380						
(44.5)	(1 3/4)	44.5	46.7		(5.15)				1100	(124)	1210	(136)	1330	(150)
45		45.0	47.3	743		1180	1310	1440						
(47.6)	(1 7/8)	47.6	50.0		(5.91)				1250	(141)	1380	(155)	1520	(171)
48		48.0	50.4	846		1350	1490	1640						
(50.8)	(2)	50.8	53.3		(6.73)				1420	(160)	1570	(176)	1730	(194)
51		51.0	53.6	955		1520	1680	1850						
52		52.0	54.6	992		1580	1750	1930						
(54.0)	(2 1/8)	54.0	56.7		(7.60)				1590	(179)	1750	(197)	1930	(217)
56		56.0	58.8	1150		1830	2030	2240						
(57.2)	(2 1/4)	57.2	60.0		(8.52)				1780	(200)	1960	(220)	2150	(242)
60		60.0	63.0	1320		2100	2330	2570						

Table C.10—Class 6 × 36 Steel Core

Typical Cross Section

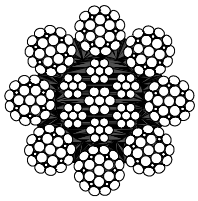


Typical Construction

Rope Construction	Strand Construction	Outer Wires	
		Total	Per Strand
6 × 31WS-IWRC	1-6-6+6-12	72	12
6 × 36WS-IWRC	1-7-7+7-14	84	14
6 × 41WS-IWRC	1-8-8+8-16	96	16
6 × 41SF-IWRC	1-8-8-8F-16	96	16
6 × 49SWS-IWRC	1-8-8-8+8-16	96	16
6 × 46WS-IWRC	1-9-9+9-18	108	18

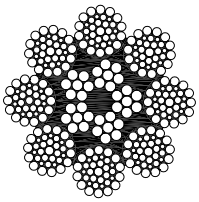
Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})								
		min.	max.			Grade 1770	Grade 1960	Grade 2160	Grade IPS		Grade EIP		Grade EEIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	kN	(short tons)	kN	(short tons)	kN	(short tons)
(6.35)	(1/4)	6.35	6.73		(0.12)				26.2	(2.94)	30.2	(3.40)		
7		7.00	7.42	20.0		30.9	34.2	37.7						
(7.94)	(5/16)	7.94	8.42		(0.18)				40.7	(4.58)	46.9	(5.27)		
8		8.00	8.40	26.2		40.3	44.7	49.2						
9		9.00	9.45	33.1		51.0	56.5	62.2						
(9.5)	(3/8)	9.53	10.0		(0.26)				58.4	(6.56)	67.2	(7.55)	73.8	(8.30)
10		10.0	10.5	40.9		63.0	69.8	76.9						
11		11.0	11.6	49.5		76.2	84.4	93.0						
(11.1)	(7/16)	11.1	11.7		(0.35)				79.1	(8.89)	90.7	(10.2)	99.6	(11.2)
12		12.0	12.6	58.9		90.7	100	111						
(12.7)	(1/2)	12.7	13.3		(0.46)				102	(11.5)	118	(13.3)	130	(14.6)
13		13.0	13.7	69.1		106	118	130						
14		14.0	14.7	80.2		124	137	151						
(14.3)	(9/16)	14.3	15.0		(0.58)				129	(14.5)	149	(16.8)	165	(18.5)
(15.9)	(5/8)	15.9	16.7		(0.72)				157	(17.7)	183	(20.6)	202	(22.7)
16		16.0	16.8	105		161	179	197						
18		18.0	18.9	133		204	226	249						
19		19.0	20.0	148		227	252	278						
(19.1)	(3/4)	19.1	20.0		(1.04)				228	(25.6)	262	(29.4)	288	
20		20.0	21.0	164		252	279	308						(32.4)
22		22.0	23.1	198		305	338	372						
(22.2)	(7/8)	22.2	23.3		(1.41)				308	(34.6)	354	(39.8)	390	(43.8)
24		24.0	25.2	236		363	402	443						
(25.4)	(1)	25.4	26.7		(1.85)				399	(44.9)	460	(51.7)	506	(56.9)
26		26.0	27.3	276		426	472	520						
28		28.0	29.4	321		494	547	603						
(28.6)	(1 1/8)	28.6	30.0		(2.34)				503	(56.5)	578	(65.0)	636	(71.5)
(31.8)	(1 1/4)	31.8	33.3		(2.89)				617	(69.4)	711	(79.9)	782	(87.9)
32		32.0	33.6	419		645	715	787						
(34.9)	(1 3/8)	34.9	36.7		(3.49)				743	(83.5)	854	(96.0)	943	(106)
35		35.0	36.8	501		772	855	942						
36		36.0	37.8	530		817	904	997						
38		38.0	39.9	591		910	1010	1110						
(38.1)	(1 1/2)	38.1	40.0		(4.16)				880	(98.9)	1010	(114)	1110	(125)
40		40.0	42.0	654		1010	1120	1230						
(41.3)	(1 5/8)	41.3	43.3		(4.88)				1020	(115)	1170	(132)	1300	(146)
44		44.0	46.2	792		1220	1350	1490						
(44.5)	(1 3/4)	44.5	46.7		(5.66)				1180	(133)	1360	(153)	1500	(169)
45		45.0	47.3	828		1280	1410	1560						
(47.6)	(1 7/8)	47.6	50.0		(6.49)				1350	(152)	1550	(174)	1710	(192)
48		48.0	50.4	942		1450	1610	1770						
(50.8)	(2)	50.8	53.3		(7.39)				1530	(172)	1760	(198)	1930	(217)
51		51.0	53.6	1060		1640	1810	2000						
52		52.0	54.6	1110		1700	1890	2080						
(54.0)	(2 1/8)	54.0	56.7		(8.34)				1710	(192)	1970	(221)	2160	(243)
56		56.0	58.8	1280		1980	2190	2410						
(57.2)	(2 1/4)	57.2	60.0		(9.35)				1910	(215)	2200	(247)	2420	(272)
60		60.0	63.0	1470		2270	2510	2770						

Table C.11—Class 8 × 19 Steel Core

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	8 × 19S-IWRC	1-9-9	72	9
	8 × 21F-IWRC	1-5F-5-10	80	10
	8 × 26WS-IWRC	1-5-5+5-10	80	10
	8 × 19W-IWRC	1-6-6+6	96	12
	8 × 25F-IWRC	1-6-6F-12	96	12

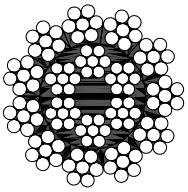
Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})								
		min.	max.			Grade 1770	Grade 1960	Grade 2160	Grade IPS		Grade EIP		Grade EEIP	
mm	(in.)	mm	mm	kg/ 100 m	(lb/ft)	kN	kN	kN	kN	(short tons)	kN	(short tons)	kN	(short tons)
(6.35)	(1/4)	6.35	6.73		(0.12)				26.2	(2.94)	30.2	(3.40)		
7		7.00	7.42	19.9		30.9	34.2	37.7						
(7.94)	(5/16)	7.94	8.42		(0.19)				40.7	(4.58)	46.9	(5.27)		
8		8.00	8.40	26.0		40.3	44.7	49.2						
9		9.00	9.45	33.0		51.0	56.5	93.0						
(9.5)	(3/8)	9.53	10.0		(0.27)				58.4	(6.56)	67.2	(7.55)	73.8	(8.30)
10		10.0	10.5	40.7		63.0	69.8	76.9						
11		11.0	11.6	49.2		76.2	84.4	93.0						
(11.1)	(7/16)	11.1	11.7		(0.37)				79.1	(8.89)	90.7	(10.2)	99.6	(11.2)
12		12.0	12.6	58.6		90.7	100	111						
(12.7)	(1/2)	12.7	13.3		(0.48)				102	(11.5)	118	(13.3)	130	(14.6)
13		13.0	13.7	68.8		106	118	130						
14		14.0	14.7	79.8		124	137	151						
(14.3)	(9/16)	14.3	15.0		(0.61)				129	(14.5)	149	(16.8)	165	(18.5)
(15.9)	(5/8)	15.9	16.7		(0.76)				157	(17.7)	183	(20.6)	202	(22.7)
16		16.0	16.8	104		161	179	197						
18		18.0	18.9	132		204	226	249						
19		19.0	20.0	147		227	252	278						
(19.1)	(3/4)	19.1	20.0		(1.09)				228	(25.6)	262	(29.4)	288	(32.4)
20		20.0	21.0	163		252	279	308						
22		22.0	23.1	197		305	338	372						
(22.2)	(7/8)	22.2	23.3		(1.48)				308	(34.6)	354	(39.8)	390	(43.8)
24		24.0	25.2	234		363	402	443						
(25.4)	(1)	25.4	26.7		(1.93)				399	(44.9)	460	(51.7)	506	(56.9)
26		26.0	27.3	275		426	472	520						
28		28.0	29.4	319		494	547	603						
(28.6)	(1 1/8)	28.6	30.0		(2.45)				503	(56.5)	578	(65.0)	636	(71.5)
(31.8)	(1 1/4)	31.8	33.3		(3.02)				617	(69.4)	711	(79.9)	782	(87.9)
32		32.0	33.6	417		645	715	787						
(34.9)	(1 3/8)	34.9	36.7		(3.66)				743	(83.5)	854	(96.0)	943	(106)
35		35.0	36.8	499		772	855	942						
36		36.0	37.8	527		817	904	997						
38		38.0	39.9	588		910	1010	1110						
(38.1)	(1 1/2)	38.1	40.0		(4.35)				880	(98.9)	1010	(114)	1110	(125)
40		40.0	42.0	651		1010	1120	1230						
(41.3)		41.3	43.3		(5.11)				1020	(115)	1170	(132)	1300	(146)
44	(1 5/8)	44.0	46.2	788		1220	1350	1490						
(44.5)		44.5	46.7		(5.95)				1180	(133)	1360	(153)	1500	(169)
45	(1 3/4)	45.0	47.3	824		1280	1410	1560						
(47.6)	(1 7/8)	47.6	50.0		(6.80)				1350	(152)	1550	(174)	1710	(192)
48		48.0	50.4	938		1450	1610	1770						
(50.8)	(2)	50.8	53.3		(7.73)				1530	(172)	1760	(198)	1930	(217)
51		51.0	53.6	1060		1640	1810	2000						
52		52.0	54.6	1100		1700	1890	2080						
(54.0)	(2 1/8)	54.0	56.7		(8.73)				1710	(192)	1970	(221)	2160	(243)
56		56.0	58.8	1280		1980	2190	2410						
(57.2)	(2 1/4)	57.2	60.0		(9.79)				1910	(215)	2200	(247)	2420	(272)
60		60.0	63.0	1470		2270	2510	2770						

Table C.12—Class 8 × 36 Steel Core

Typical Cross Section	Typical Construction		
	Rope Construction	Strand Construction	Outer Wires: Total / Per Strand
	8 × 31WS-IWRC 8 × 36WS-IWRC 8 × 41WS-IWRC	1-6-6+6-12 1-7-7+7-14 1-8-8+8-16	

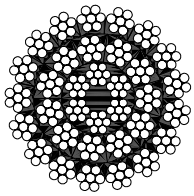
Nominal rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})								
		min.	max.			Grade 1770	Grade 1960	Grade 2160	Grade IPS		Grade EIP		Grade EEIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	kN	kN	kN	(short tons)	kN	(short tons)	kN	(short tons)
8		8.00	8.40	26.7		40.3	44.7	49.2						
9		9.00	9.45	33.8		51.0	56.5	62.2						
(9.5)	(3/8)	9.53	10.0		(0.27)				58.4	(6.56)	67.2	(7.55)	73.8	(8.30)
10		10.0	10.5	41.7		63.0	69.8	76.9						
11		11.0	11.6	50.5		76.2	84.4	93.0						
(11.1)	(7/16)	11.1	11.7		(0.37)				79.1	(8.89)	90.7	(10.2)	99.6	(11.2)
12		12.0	12.6	60.0		90.7	100	111						
(12.7)	(1/2)	12.7	13.3		(0.48)				102	(11.5)	118	(13.3)	130	(14.6)
13		13.0	13.7	70.5		106	118	130						
14		14.0	14.7	81.7		124	137	151						
(14.3)	(9/16)	14.3	15.0		(0.61)				129	(14.5)	149	(16.8)	165	(18.5)
(15.9)	(5/8)	15.9	16.7		(0.76)				157	(17.7)	183	(20.6)	202	(22.7)
16		16.0	16.8	107		161	179	197						
18		18.0	18.9	135		204	226	249						
19		19.0	20.0	151		227	252	278						
(19.1)	(3/4)	19.1	20.0		(1.09)				228	(25.6)	262	(29.4)	288	(32.4)
20		20.0	21.0	167		252	279	308						
22		22.0	23.1	202		305	338	372						
(22.2)	(7/8)	22.2	23.3		(1.48)				308	(34.6)	354	(39.8)	390	(43.8)
24		24.0	25.2	240		363	402	443						
(25.4)	(1)	25.4	26.7		(1.93)				399	(44.9)	460	(51.7)	506	(56.9)
26		26.0	27.3	282		426	472	520						
28		28.0	29.4	327		494	547	603						
(28.6)	(1 1/8)	28.6	30.0		(2.45)				503	(56.5)	578	(65.0)	636	(71.5)
(31.8)	(1 1/4)	31.8	33.3		(3.02)				617	(69.4)	711	(79.9)	782	(87.9)
32		32.0	33.6	427		645	715	787						
(34.9)	(1 3/8)	34.9	36.7		(3.66)				743	(83.5)	854	(96.0)	943	(106)
35		35.0	36.8	511		772	855	942						
36		36.0	37.8	540		817	904	997						
38		38.0	39.9	602		910	1010	1110						
(38.1)	(1 1/2)	38.1	40.0		(4.35)				880	(98.9)	1010	(114)	1110	(125)
40		40.0	42.0	667		1010	1120	1230						
(41.3)	(1 5/8)	41.3	43.3		(5.11)				1020	(115)	1170	(132)	1300	(146)
44		44.0	46.2	807		1220	1350	1490						
(44.5)	(1 3/4)	44.5	46.7		(5.92)				1180	(133)	1360	(153)	1500	(169)
45		45.0	47.3	844		1280	1410	1560						
(47.6)	(1 7/8)	47.6	50.0		(6.80)				1350	(152)	1550	(174)	1710	(192)
48		48.0	50.4	961		1450	1610	1770						
(50.8)	(2)	50.8	53.3		(7.73)				1530	(172)	1760	(198)	1930	(217)
51		51.0	53.6	1080		1640	1810	2000						
52		52.0	54.6	1130		1700	1890	2080						
(54.0)	(2 1/8)	54.0	56.7		(8.73)				1710	(192)	1970	(221)	2160	(243)
56		56.0	58.8	1310		1980	2190	2410						
(57.2)	(2 1/4)	57.2	60.0		(9.79)				1910	(215)	2200	(247)	2420	(272)
60		60.0	63.0	1500		2270	2510	2770						

Table C.13—Class 18 × 7

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	17 × 7-FC	1-6	66	6
	17 × 7-WSC	1-6	66	6
	18 × 7-FC	1-6	72	6
	18 × 7-WSC	1-6	72	6

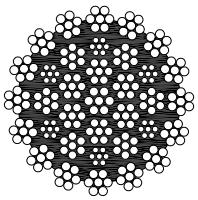
Nominal Rope Diameter		Diameter Tolerance		Approximate Nominal Length Mass				Minimum Breaking Force (F_{min})					
		min.	max.	Core—FC		Core—WSC		Grade 1770	Grade 1960	Grade IPS		Grade EIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kg/100 m	(lb/ft)	kN	kN	kN	(short tons)	kN	(short tons)
6		6.00	6.36	13.8		14.4		20.9	23.1				
(6.35)	(1/4)	6.35	6.73		(0.11)		(0.11)			22.3	(2.51)	24.6	(2.77)
7		7.00	7.42	18.7		19.6		28.4	31.5				
(7.94)	(5/16)	7.94	8.42		(0.17)		(0.18)			34.7	(3.90)	38.3	(4.30)
8		8.00	8.40	24.4		25.7		37.2	41.1				
9		9.00	9.45	30.9		32.5		47.0	52.1				
(9.5)	(3/8)	9.53	10.0		(0.24)		(0.26)			49.7	(5.59)	54.5	(6.15)
10		10.0	10.5	38.2		40.1		58.1	64.3				
11		11.0	11.6	46.2		48.5		70.2	77.8				
(11.1)	(7/16)	11.1	11.7		(0.33)		(0.35)			67.4	(7.58)	73.9	(8.33)
12		12.0	12.6	55.0		57.7		83.6	92.6				
(12.7)	(1/2)	12.7	13.3		(0.43)		(0.45)			87.6	(9.85)	95.8	(10.8)
13		13.0	13.7	64.6		67.8		98.1	109				
14		14.0	14.7	74.9		78.6		114	126				
(14.3)	(9/16)	14.3	15.0		(0.55)		(0.57)			110	(12.4)	121	(13.6)
(15.9)	(5/8)	15.9	16.7		(0.68)		(0.71)			136	(15.3)	149	(16.8)
16		16.0	16.8	97.8		103		149	165				
18		18.0	18.9	124		130		188	208				
19		19.0	20.0	138		145		210	232				
(19.1)	(3/4)	19.1	20.0		(0.97)		(1.02)			194	(21.8)	214	(24.0)
20		20.0	21.0	153		160		232	257				
22		22.0	23.1	185		194		281	311				
(22.2)	(7/8)	22.2	23.3		(1.32)		(1.39)			262	(29.5)	289	(32.5)
24		24.0	25.2	220		231		334	370				
(25.4)	(1)	25.4	26.7		(1.73)		(1.82)			341	(38.3)	375	(42.2)
26		26.0	27.3	258		271		392	435				
28		28.0	29.4	299		314		455	504				
(28.6)	(1 1/8)	28.6	30.0		(2.19)		(2.30)			429	(48.2)	472	(53.1)
(31.8)	(1 1/4)	31.8	33.3		(2.70)		(2.84)			527	(59.2)	579	(65.1)
32		32.0	33.6	391		411		594	658				
(34.9)	(1 3/8)	34.9	36.7		(3.27)		(3.43)			634	(71.3)	697	(78.4)
35		35.0	36.8	468		491		711	788				
36		36.0	37.8	495		520		752	833				
38		38.0	39.9	552		579		838	928				
(38.1)	(1 1/2)	38.1	40.0		(3.89)		(4.09)			751	(84.4)	826	(92.8)

Table C.14—Class 34(M) × 7

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	34(M) × 7-FC	1-6	102	6
	34(M) × 7-WSC	1-6	102	6
	36(M) × 7-FC	1-6	108	6
	36(M) × 7-WSC	1-6	108	6

Nominal Rope Diameter		Diameter Tolerance		Approximate Nominal Length Mass				Minimum Breaking Force (F_{min})					
		min.	max.	Core—FC		Core—WSC		Grade 1770	Grade 1960	Grade IPS		Grade EIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kg/100 m	(lb/ft)	kN	kN	kN	(short tons)	kN	(short tons)
10		10.0	10.5	39.0		40.1		56.3	62.3				
11		11.0	11.6	47.2		48.5		68.1	75.4				
(11.1)	(7/16)	11.1	11.7		(0.32)		(0.33)			69.5	(7.81)	77.0	(8.65)
12		12.0	12.6	56.2		57.7		81.1	89.8				
(12.7)	(1/2)	12.7	13.3		(0.42)		(0.43)			90.7	(10.2)	101	(11.3)
13		13.0	13.7	65.9		67.8		95.1	105				
14		14.0	14.7	76.4		78.6		110	122				
(14.3)	(9/16)	14.3	15.0		(0.53)		(0.55)			115	(12.9)	127	(14.3)
(15.9)	(5/8)	15.9	16.7		(0.66)		(0.68)			141	(15.9)	157	(17.7)
16		16.0	16.8	99.8		103		144	160				
18		18.0	18.9	126		130		182	202				
19		19.0	20.0	141		145		203	225				
(19.1)	(3/4)	19.1	20.0		(0.95)		(0.98)			205	(23.0)	226	(25.4)
20		20.0	21.0	156		160		225	249				
22		22.0	23.1	189		194		272	302				
(22.2)	(7/8)	22.2	23.3		(1.29)		(1.33)			278	(31.3)	308	(34.6)
24		24.0	25.2	225		231		324	359				
(25.4)	(1)	25.4	26.7		(1.69)		(1.74)			363	(40.8)	402	(45.2)
26		26.0	27.3	264		271		380	421				
28		28.0	29.4	306		314		441	489				
(28.6)	(1 1/8)	28.6	30.0		(2.14)		(2.20)			460	(51.7)	509	(57.2)
(31.8)	(1 1/4)	31.8	33.3		(2.64)		(2.72)			568	(63.8)	628	(70.6)
32		32.0	33.6	399		411		576	638				
(34.9)	(1 3/8)	34.9	36.7		(3.20)		(3.29)			687	(77.2)	761	(85.5)
35		35.0	36.8	478		491		690	764				
36		36.0	37.8	505		520		729	808				
38		38.0	39.9	563		579		813	900				
(38.1)	(1 1/2)	38.1	40.0		(3.80)		(3.91)			817	(91.8)	907	(102)
40		40.0	42.0	624				901	997				(119)
(41.3)	(1 5/8)	41.3	43.4		(4.46)		(4.59)			961	(108)	1060	
44		44.0	46.2	755				1090	1210				

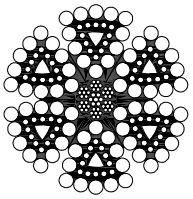
Table C.15—Class 35(W) × 7

Typical Cross Section	Typical Construction			
	Rope Construction	Strand Construction	Outer Wires	
			Total	Per Strand
	35(W) × 7	1-6	96	6
	40(W) × 7	1-6	108	6

Nominal Rope Diameter		Diameter Tolerance		Minimum Breaking Force (F_{min})					
		min.	max.	Grade 1770		Grade 1960		Grade 2160	
mm	(in.)	mm	mm	kN	(short tons)	kN	(short tons)	kN	(short tons)
8		8.00	8.40	40.8	(4.52)	45.2	(5.08)	48.4	(5.44)
9		9.00	9.45	51.6	(5.80)	57.2	(6.43)	61.2	(6.88)
(9.5)	(3/8)	9.53	10.0						
10		10.0	10.5	63.7	(7.16)	70.6	(7.94)	75.6	(8.50)
11		11.0	11.6	77.1	(8.67)	85.4	(9.60)	91.5	(10.3)
(11.1)	(7/16)	11.1	11.7						
12		12.0	12.6	91.8	(10.3)	102	(11.5)	109	(12.3)
(12.7)	(1/2)	12.7	13.3						
13		13.0	13.7	108	(12.1)	119	(13.4)	128	(14.4)
14		14.0	14.7	125	(14.1)	138	(15.5)	148	(16.6)
(14.3)	(9/16)	14.3	15.0						
(15.9)	(5/8)	15.9	16.7						
16		16.0	16.8	163	(18.3)	181	(20.3)	194	(21.8)
18		18.0	18.9	206	(23.2)	229	(25.7)	245	(27.5)
19		19.0	20.0	230	(25.9)	255	(28.7)	273	(30.7)
(19.1)	(3/4)	19.1	20.0						
20		20.0	21.0	255	(28.7)	282	(31.7)	302	(33.9)
22		22.0	23.1	308	(33.9)	342	(38.4)	366	(41.1)
(22.2)	(7/8)	22.2	23.3						
24		24.0	25.2	367	(41.3)	406	(45.6)	435	(48.9)
(25.4)	(1)	25.4	26.7						
26		26.0	27.3	431	(48.4)	477	(53.6)	511	(57.4)
28		28.0	29.4	500	(56.2)	553	(62.6)	593	(66.7)
(28.6)	(1 1/8)	28.6	30.0						
(31.8)	(1 1/4)	31.8	33.3						
32		32.0	33.6	652	(73.3)	723	(81.3)	774	(87.0)
(34.9)	(1 3/8)	34.9	36.7						
35		35.0	36.8	781	(87.8)	864	(97.1)	926	(104)
36		36.0	37.8	826	(92.9)	914	(103)	980	(110)
38		38.0	39.9	920	(103)	1020	(115)	1090	(126)
(38.1)	(1 1/2)	38.1	40.0						
40		40.0	42.0	1020	(115)	1130	(127)	1210	(136)
(41.3)	(1 5/8)	41.3	43.3						

Table C.16—Class 6 × V25TS Steel Core

Typical Cross Section



Typical Construction

Rope Construction	Strand Construction	Outer Wires	
		Total	Per Strand
6 × V25	V-12/12	72	12
6 × V25B	3 × 2/12/12	72	12
6 × V25B	3 × 2-3F/12/12	72	12
6 × V25B	1-6K/12/12	72	12
6 × V28B	3 × 2-3F/12/15	90	15

Nominal Rope Diameter		Diameter Tolerance		Approx. Nominal Length Mass		Minimum Breaking Force (F_{min})			
		min.	max.			Grade IPS		Grade EIP	
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	(short tons)	kN	(short tons)
12		12.0	12.6						
(12.7)	($^1/_2$)	12.7	13.3	69.9	(0.47)	112	(12.6)	125	(14.0)
13		13.0	13.7						
14		14.0	14.7						
(14.3)	($^9/_{16}$)	14.3	15.0	89.3	(0.60)	142	(16.0)	157	(17.6)
(15.9)	($^5/_8$)	15.9	16.7	110	(0.74)	174	(19.6)	193	(21.7)
16		16.0	16.8						
18		18.0	18.9						
19		19.0	20.0						
(19.1)	($^3/_4$)	19.1	20.0	158	(1.06)	250	(28.1)	276	(31.0)
20		20.0	21.0						
22		22.0	23.1						
(22.2)	($^7/_8$)	22.2	23.3	216	(1.45)	338	(38.0)	373	(41.9)
24		24.0	25.2						
(25.4)	(1)	25.4	26.7	281	(1.89)	439	(49.4)	484	(54.4)
26		26.0	27.3						
28		28.0	29.4						
(28.6)	(1 $^1/_8$)	28.6	30.0	356	(2.39)	553	(62.2)	609	(68.5)
(31.8)	(1 $^1/_4$)	31.8	33.3	439	(2.95)	679	(76.3)	747	(84.0)
32		32.0	33.6						
(34.9)	(1 $^3/_8$)	34.9	36.7	531	(3.57)	818	(91.9)	898	(101)
35		35.0	36.8						
36		36.0	37.8						
38		38.0	39.9						
(38.1)	(1 $^1/_2$)	38.1	40.0	632	(4.25)	961	(108)	1060	(119)
40		40.0	42.0						
(41.3)	(1 $^5/_8$)	41.3	43.3	743	(4.99)	1130	(127)	1250	(140)
44		44.0	46.2						
(44.5)	(1 $^3/_4$)	44.5	46.7	862	(5.79)	1300	(146)	1430	(161)
45		45.0	47.3						
(47.6)	(1 $^7/_8$)	47.6	50.0	990	(6.65)	1490	(167)	1640	(184)
48		48.0	50.4						
(50.8)	(2)	50.8	53.3	1120	(7.56)	1680	(189)		
51		51.0	53.6					1840	(207)
52		52.0	54.6						
(54.0)	(2 $^1/_8$)	54.0	56.7	1270	(8.54)	1880	(211)	2060	(232)
56		56.0	58.8						
(57.2)	(2 $^1/_4$)	57.2	60.0	1420	(9.57)	2110	(237)	2310	(260)
60		60.0	63.0						
(60.3)	(2 $^3/_8$)	60.3	63.3	1590	(10.7)	2320	(261)	2550	(287)

Annex D
(normative)

Physical Dimensions and Mechanical Properties of Well-servicing Strand

Diameters, diameter tolerances, and minimum breaking forces shall be in accordance with Table D.1.

Table D.1—Diameters, Diameter Tolerances, and Minimum Breaking Forces

Nominal Diameter		Diameter Tolerance				Approximate Mass		Minimum Breaking Force			
		min.		max.				Grade IPS		Grade EIP	
mm	(in.)	mm	(in.)	mm	(in.)	kg/m	(lb/ft)	kN	(lb)	kN	(lb)
4.76	($^3/_{16}$)	4.775	(0.188)	5.105	(0.201)	0.109	(0.073)	18.7	(4200)	20.9	(4700)
5.56	($^7/_{32}$)	5.563	(0.219)	5.893	(0.232)	0.149	(0.100)	26.2	(5900)	29.4	(6600)
6.35	($^1/_4$)	6.350	(0.250)	6.731	(0.265)	0.189	(0.127)	32.5	(7300)	36.5	(8200)
7.94	($^5/_{16}$)	7.950	(0.313)	8.357	(0.329)	0.327	(0.220)	49.4	(11,100)	55.6	(12,500)

Annex E
(informative)

Large Diameter Ropes

See Table E.1 to Table E.3.

Table E.1—Class—Large Diameter, Six-stranded Rope

Nominal Rope Diameter		Diameter Range		Approximate Length Mass		Minimum Breaking Force	
		min.	max.				
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	(short tons)
63.5	(2 1/2)	63.5	66.7	1730	(11.6)	2950	(332)
66.7	(2 5/8)	66.7	70.0	1910	(12.8)	3240	(364)
69.9	(2 3/4)	69.9	73.4	2080	(14.0)	3530	(397)
73.0	(2 7/8)	73.0	76.7	2280	(15.3)	3840	(432)
76.2	(3)	76.2	80.0	2470	(16.6)	4160	(468)
79.4	(3 1/8)	79.4	83.4	2680	(18.0)	4490	(505)
82.6	(3 1/4)	82.6	86.7	2900	(19.5)	4830	(543)
85.7	(3 3/8)	85.7	90.0	3130	(21.0)	5180	(582)
88.9	(3 1/2)	88.9	93.3	3380	(22.7)	5520	(621)
95.3	(3 3/4)	95.3	100	3870	(26.0)	6270	(705)
102	(4)	102	107	4400	(44.0)	6340	(713)
108	(4 1/4)	108	113	4960	(49.6)	7110	(799)
114	(4 1/2)	114	120	5570	(55.7)	7900	(888)
121	(4 3/4)	121	127	6200	(62.1)	8730	(981)
127	(5)	127	133	6870	(68.8)	9590	(1078)
133	(5 1/4)	133	140	7410	(49.8)	9960	(1120)
140	(5 1/2)	140	147	8110	(54.5)	10,800	(1219)
146	(5 3/4)	146	153	8870	(59.6)	11,700	(1320)
152	(6)	152	160	9680	(65.0)	12,700	(1426)

NOTE The breaking force values above apply to ropes with bright or zinc-coated quality B wires. The values of breaking force for ropes with a heavier mass of coating than quality B may be lower than those given above.

Table E.2—Class—Large Diameter Spiral Strand

Nominal Rope Diameter		Diameter Range		Approximate Length Mass		Minimum Breaking Force	
		min.	max.				
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	(short tons)
102	(4)	102	107	5500	(37.0)	8830	(993)
108	(4 1/4)	108	113	5700	(38.3)	9810	(1100)
114	(4 1/2)	114	120	6600	(44.4)	11,000	(1240)
121	(4 3/4)	121	127	7300	(49.1)	12,300	(1380)
127	(5)	127	133	8200	(55.1)	13,500	(1520)
133	(5 1/4)	133	140	8800	(59.1)	14,700	(1650)
140	(5 1/2)	140	147	9600	(64.5)	16,700	(1880)
146	(5 3/4)	146	153	10,900	(73.2)	17,900	(2010)
152	(6)	152	160	11,600	(78.0)	19,700	(2210)

Table E.3—Class—Large Diameter Full-locked Coil

Nominal Rope Diameter		Diameter Range		Approximate Length Mass		Minimum Breaking Force	
		min.	max.				
mm	(in.)	mm	mm	kg/100 m	(lb/ft)	kN	(short tons)
76.2	(3)	76.2	80.0	3300	(22.2)	5450	(613)
82.6	(3 1/4)	82.6	86.7	3900	(26.2)	6480	(728)
88.9	(3 1/2)	88.9	93.3	4500	(30.2)	7450	(837)
95.3	(3 3/4)	95.3	100	5150	(34.6)	8540	(960)
102	(4)	102	107	5950	(40.0)	9850	(1110)
108	(4 1/4)	108	113	6600	(44.4)	10,100	(1140)
114	(4 1/2)	114	120	7300	(49.1)	12,200	(1370)
121	(4 3/4)	121	127	8250	(55.4)	13,800	(1550)
127	(5)	127	133	9100	(61.2)	15,100	(1700)
140	(5 1/2)	140	147	10,900	(73.3)	18,300	(2060)

Annex F
(normative)

Calculation of Minimum Breaking Force for Ropes in Accordance with Annex C—Rope Grades 1770, 1960, and 2160

The minimum breaking force, F_{min}, expressed in kilonewtons, shall be calculated using the following equation:

$$F_{\text{min}} = \frac{K \cdot d^{2} \cdot R_{\text{r}}}{1\ 000}$$

where

d is the nominal diameter of the rope, in millimeters;

R_{r} is the rope grade, in newtons per square millimeter;

K is the empirical factor for the minimum breaking force for a given rope class. (K_1 is the factor for ropes with a fiber core, K_2 that for ropes with an independent wire rope core and K_3 the factor for ropes with a wire strand core or center.)

Table F.1 summarizes the factors used in the calculation of minimum breaking force for those ropes covered by Table C.1 to Table C.16.

Table F.1—Factors for Stranded Wire Ropes for General Lifting Applications

Type of Rope	Class	Ropes with Fiber Core or Fiber Center			Ropes with Steel Core or Wire Strand Center					
		Nominal Length Mass Factor (Approx.)	Nominal Metallic Cross-sectional Area Factor	Minimum Breaking Force Factor	Nominal Length Mass Factor		Nominal Metallic Cross-sectional Area Factor		Minimum Breaking Force Factor	
		W_1	C_1	K_1	W_2	W_3	C_2	C_3	K_2	K_3
Single-layer round strand rope	6 × 7	0.345	0.369	0.332	0.384	0.384	0.432	0.432	0.359	0.388
	6 × 19	0.359	0.384	0.330	0.400		0.449		0.356	
	8 × 19	0.340	0.349	0.293	0.407		0.457		0.356	
	6 × 36	0.367	0.393	0.330	0.409		0.460		0.356	
	8 × 36	0.348	0.357	0.293	0.417		0.468		0.356	
	6 × 19M	0.346	0.357	0.307		0.381		0.418	0.332	0.362
	6 × 37M	0.346	0.357	0.295	0.381	0.381	0.418	0.418	0.319	0.346
Rotation-resistant rope	18 × 7	0.382		0.328		0.401		0.433		0.328
	34 (M) × 7	0.390		0.318		0.401		0.428		0.318
	35 (W) × 7					0.454		0.480		0.360 [a] 0.350 [b]

NOTE 1 The nominal length mass factors and nominal cross-sectional area factors are only for information.

NOTE 2 See ISO 17893 for calculation of nominal length mass, nominal metallic cross-sectional area, and minimum breaking force using the factors in this table.

NOTE 3 Spinning loss factor, k, is obtained by dividing K by C.

[a] Up to and including rope grade 1960.

[b] Greater than rope grade 1960 up to and including rope grade 2160.

Annex G
(normative)

Sampling and Acceptance Criteria for Type Testing of Ropes Produced in Series

G.1 Sizes Up to and Including 60 mm Diameter

G.1.1 Ropes Having Same Minimum Breaking Force Factor Throughout a Sub-group of Rope Diameters

The manufacturer shall divide the intended size range into sub-groups based on the following:

— nominal diameter up to and including 6 mm,

— over 6 mm up to and including 12 mm,

— over 12 mm up to and including 24 mm,

— over 24 mm up to and including 48 mm,

— over 48 mm up to and including 60 mm.

For each of the sub-groups representing the intended range and having the same construction, grade, and minimum breaking force factor, the manufacturer shall perform a breaking force test in accordance with 5.2.4.1 (Method 1) on a sample from each of three separate production lengths of rope of different nominal diameters.

If all three samples pass the test, all rope sizes within that sub-group of that particular rope construction, grade, and minimum breaking force factor shall be deemed to have satisfied the type testing requirements; otherwise, breaking force testing shall continue on a sample from each consecutive production length of rope within that sub-group until the above requirements are met.

G.1.2 Ropes Having Different Minimum Breaking Force Factors Throughout a Sub-group of Rope Diameters

The manufacturer shall perform a breaking force test in accordance with 5.2.4.1 (Method 1) on a sample from each of three separate production lengths of rope of the same nominal diameter.

If all three samples pass the test, that rope diameter and construction having that particular minimum breaking force factor shall be deemed to have satisfied the breaking force type testing requirements.

If one of the samples fails the test, the tests shall be repeated until the measured breaking forces of three consecutive production lengths of that rope diameter and construction meet or exceed the minimum breaking force value.

G.2 Sizes Over 60 mm Diameter

For each rope of a given diameter, construction and minimum breaking force, the manufacturer shall perform a breaking force test in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.3 (Method 3) on a sample from each of three separate production lengths.

If all three samples pass the test, that rope diameter and construction having that particular minimum breaking force shall be deemed to have satisfied the breaking force type testing requirements.

If one sample fails the test, the tests shall be repeated until the measured breaking forces of three consecutive production lengths of that rope diameter and construction meet or exceed the minimum breaking force value.

Alternatively, where the manufacturer intends to produce multiple production lengths of the same rope on the same closing machine with the same machine settings to the same design, the number of samples for breaking force testing may be calculated using the $\sqrt{N}-1$ rounded down to the next whole number with a minimum of 1, where N is the number of production lengths (i.e. closer loadings).

The ropes shall be deemed to comply if the measured breaking forces, when tested in accordance with 5.2.4.1 (Method 1), 5.2.4.2 (Method 2), or 5.2.4.3 (Method 3), meet or exceed the minimum value.

If one of the samples fails the test, tests shall be carried out on a sample from each of the remaining production lengths.

Only those ropes that pass the test shall be deemed to have satisfied the breaking force requirement.

Annex H
(normative)

Determination of Breaking Force (Method 1)

H.1 Testing Machine

The testing machine shall conform to the corresponding specifications given in ISO 7500-1.

H.2 Length of Test Piece

The minimum free test length, excluding terminations, shall be in accordance with Table E.1.

Table H.1—Test Lengths

Nominal Rope Diameter d mm	**Minimum Test Length** mm	
	Stranded Rope	Spiral Rope
$d \leq 6$	300	500
$6 < d \leq 20$	600	1000
$20 < d \leq 60$	$30d$	$50d$
$d > 60$	3000	

H.3 Selection of Test Piece

The test piece shall be representative of the rope as a whole. The selected test piece shall have its ends secured to ensure that the wires and strands remain undisturbed. Similarly secure the end of the rope from which the test piece is taken.

When cutting the test piece from the rope, neither the test piece nor the main part of the rope shall be damaged.

H.4 Method of Test

H.4.1 Preparation

Mount and secure the test piece in the machine so as to ensure that all wires in the rope are subjected to the force during the test.

If sockets or cones are to be used, socketing shall be in accordance with the appropriate ISO, or equivalent, procedure.

H.4.2 Procedure

After 80 % of the minimum breaking force of the rope has been applied, increase the force at a rate not more than 0.5 % of the minimum breaking force per second.

The measured breaking force is reached when no further increase in applied force is possible.

The test may be terminated without breaking the rope when the minimum breaking force is achieved or exceeded.

The test may be discounted where the rope fracture occurs within a distance equivalent of six rope diameters from the base of the grip or the termination and the intended minimum breaking force has not been reached.

Annex I
(informative)

Tests on Wires from the Rope (if Specified by the Purchaser)

I.1 General

If tests on wires are required to be carried out, these are usually in respect of diameter, tensile strength, and torsions; and, when applicable, zinc coating.

For the purposes of evaluating the test results, the manufacturer should indicate the nominal dimensions and tensile strength grades of the wires.

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

NOTE These requirements do not apply to compacted strand ropes and compacted (swaged) ropes.

I.2 Sampling

I.2.1 Stranded Rope

For each layer of strands, including those in the core, one strand of each construction within that layer shall be selected and the wires tested. If there are more than eight strands of the same diameter and construction in one layer, the wires from two strands of that diameter and construction shall be tested.

Unless specified otherwise, the samples of wires taken for tests shall not include filler or center wires.

I.2.2 Spiral Rope

Unless specified otherwise, the test pieces shall be obtained by separating the wires of each layer into groups. A group shall consist only of wires of the same type and size from a particular wire layer. Twenty-five percent of the wires from each group, with a minimum of three, shall be randomly selected and subjected to the required tests.

I.3 Test Methods and Acceptance Criteria

I.3.1 General

I.3.1.1 Stranded Ropes

For each requirement, a maximum of 5 % of wires tested, rounded up to the nearest whole number of wires, shall be permitted to lie outside the values specified.

When the same wire fails in more than one test (e.g., torsion and tensile), this is counted as one failure.

I.3.1.2 Spiral Ropes

Wires from the rope conform to this standard if not more than one wire in any diameter group fails any of the tests specified. If two or more wires of any diameter group fail to pass any of the tests specified, all of the remaining wires of that group shall be tested in respect of the test in which these wires have failed; if the number of wires that fail these tests is less than two, the wires shall be deemed to conform.

When the same wire fails in more than one test (e.g., torsion and tensile), this shall count as one failure.

I.3.2 Dimension (Diameter or Height)

When tested in accordance with 5.1 of ISO 2232:1990, 5 % of the wires may exceed by up to 50 % the tolerance specified in Annex A of the present standard.

I.3.3 Tensile Strength

When tested in accordance with ISO 6892 or the method given in B.2 (for Levels 2, 3, 4, and 5), the measured values shall be in accordance with the values given in Annex A with an expanded tolerance of 50 N/mm^2 at the lower end.

For ropes with shaped (e.g., triangular) strands, the expanded tolerance at the lower end shall be equivalent to 5 % of the tensile strength grade of the wire.

I.3.4 Torsion

I.3.4.1 General

A length of 100d for the test piece between grips is preferred. If this length cannot be adopted, an alternative length may be chosen at the wire manufacturer's discretion (e.g., for wire Levels 2, 3, 4, and 5). In this case, the number of torsions which the wire shall withstand shall be proportional to the numbers specified for a test length of 100d.

I.3.4.2 Stranded Ropes

For ropes with round strands, when tested in accordance with ISO 7800 or the method given in B.2, as appropriate, the measured values of round wires of 0.5 mm diameter and larger shall be at least 85 % of the values specified in Annex A, rounded down to the next whole number.

For ropes with shaped strands with more than one layer of round wires in the strands, the values resulting from the above for round strands shall be reduced by one torsion each.

For ropes with shaped strands with only one layer of round wires in the strands, the values resulting from the above for round strands shall be reduced by two torsions each.

See I.3.5 for test on wires less than 0.5 mm diameter.

I.3.4.3 Spiral Ropes

When tested in accordance with ISO 7801, the measured values of round and shaped wires shall be at least 75 % of the pre-spin (before fabrication) values, rounded down to the next whole number.

I.3.5 Knot

This test shall apply to wires smaller than 0.5 mm diameter in substitution of the torsion test.

Each single wire with one simple knot shall withstand without breaking a force of at least 45 % of the force corresponding to the tensile strength grade.

I.3.6 Coating of Wires

I.3.6.1 Stranded Ropes

When measured in accordance with Annex A of ISO 2232:1990, the permissible reduction of mass of zinc or Zn 95/Al 5 coating from the pre-spin (before fabrication) minimum values shall not be more than the values given in Table I.1.

Table I.1—Permissible Reduction of Minimum Mass of Zinc Coating of Wires for Stranded Ropes

Minimum Mass Before Rope Fabrication g/m^2	Permissible Reduction After Rope Making g/m^2
<40	2
40 to < 80	4
80 to < 120	6
120 to < 160	8
160 to < 200	10
200 to < 300	15
300 to < 400	20
>400	25

I.3.6.2 Spiral Ropes

When measured in accordance with the method specified in Annex A of ISO 2232:1990, the actual mass of coating of shaped and round wires shall be at least 95 % and 92.5 %, respectively, of the pre-spin (before fabrication) minimum values.

Annex J
(informative)

Requirements for Bright or Drawn Galvanized Well-measuring Wire

J.1 Dimensional and Mechanical Properties

Diameters, diameter tolerances, minimum breaking forces and elongation shall be in accordance with Table J.1.

Table J.1—Diameters, Diameter Tolerances, Minimum Breaking Forces, Torsions, and Elongation

Wire Diameter		Approximate Mass		Grade IPS				Grade EIP				Grade EEIP			
				Breaking Force		Tor.	Elong.	Breaking Force		Tor. [a]	Elong. [a]	Breaking Force		Tor. [a]	Elong. [a]
				min.		min.	min.	min.		min.	min.	min.		min.	min.
mm ±0.03	in. ±0.001	kg/m	lb/ft	kN	lb		%	kN	lb		%	kN	lb		%
1.68	(0.066)	0.018	(0.012)	3.61	(81)	32	1 1/2	4.27	(960)	—	—	4.42	(994)	—	—
1.83	(0.072)	0.021	(0.014)	4.27	(961)	29	1 1/2	5.12	(1150)	—	—	5.24	(1178)	—	—
2.08	(0.082)	0.027	(0.018)	5.51	(1239)	26	1 1/2	6.49	(1460)	—	—	6.75	(1517)	—	—
2.34	(0.092)	0.034	(0.023)	6.88	(1547)	23	1 1/2	8.14	(1830)	—	—	8.43	(1895)	—	—
2.67	(0.105)	0.045	(0.030)	8.74	(1966)	20	1 1/2	10.50	(2360)	—	—	10.89	(2449)	—	—
2.74	(0.108)	0.048	(0.032)	9.38	(2109)	19	1 1/2	11.08	(2490)	—	—	11.48	(2581)	—	—
3.18	(0.125)	0.062	(0.042)	12.43	(2794)	— [a]	1 1/2	14.68	(3300)	—	—	15.20	(3418)	—	—
3.25	(0.128)	0.065	(0.044)	13.01	2924	— [a]	1 1/2	15.35	(3450)	—	—	15.94	(3584)	—	—

[a] Values to be agreed between purchaser and manufacturer.

J.2 Test Method

A specimen of wire approximately 1 m long shall be cut from each coil of well-measuring wire. One section of this wire shall be tested for elongation and tensile strength. The ultimate elongation shall be measured on a 250 mm length of specimen, at instant of rupture, which shall occur within the 250 mm gauge length. When determining elongation, a stress shall be imposed upon the wire equal to 690 N/mm^2 (100,000 psi) at which point the extensometer is applied. The reading of the extensometer should be increased by 0.4 % to allow for the initial elongation occurring before application of the extensometer.

The remaining section of the test specimen shall be measured for size and tested for torsional requirements in accordance with B.1 and B.3, respectively.

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

Annex K
(informative)

Information with Enquiry or Order

The following information should be provided by the purchaser when making an enquiry or placing an order:

a) reference to this standard,

b) quantity and length,

c) nominal diameter,

d) rope class or construction,

e) core type,

f) rope grade,

g) wire finish,

h) lay direction and type,

i) preformation,

j) lubrication,

k) any particular marking requirements,

l) any particular packing requirements,

m) minimum breaking force required.

Annex L
(informative)

Use of the API Monogram by Licensees

L.1 Scope

The API Monogram Program allows an API Licensee to apply the API Monogram to products. The API Monogram Program delivers significant value to the international oil and gas industry by linking the verification of an organization's quality management system with the demonstrated ability to meet specific product specification requirements. The use of the Monogram on products constitutes a representation and warranty by the Licensee to purchasers of the products that, on the date indicated, the products were produced in accordance with a verified quality management system and in accordance with an API product specification.

When used in conjunction with the requirements of the API License Agreement, API Q1, in its entirety, defines the requirements for those organizations who wish to voluntarily obtain an API license to provide API monogrammed products in accordance with an API product specification.

API Monogram Program licenses are issued only after an on-site audit has verified that the Licensee conforms to the requirements described in API Q1 in total, and the requirements of an API product specification. Customers/users are requested to report to API all problems with API monogrammed products. The effectiveness of the API Monogram Program can be strengthened by customers/users reporting problems encountered with API monogrammed products. A nonconformance may be reported using the API Nonconformance Reporting System available at https://ncr.api.org. API solicits information on new product that is found to be nonconforming with API-specified requirements, as well as field failures (or malfunctions), which are judged to be caused by either specification deficiencies or nonconformities with API-specified requirements.

This annex sets forth the API Monogram Program requirements necessary for a supplier to consistently produce products in accordance with API-specified requirements. For information on becoming an API Monogram Licensee, please contact API, Certification Programs, 1220 L Street, N. W., Washington, D.C. 20005 or call 202-962-4791 or by email at certification@api.org.

L.2 References

In addition to the referenced standards listed earlier in this document, this annex references the following standard:

API Specification Q1.

For Licensees under the Monogram Program, the latest version of this document shall be used. The requirements identified therein are mandatory.

L.3 API Monogram Program: Licensee Responsibilities

L.3.1 Maintaining a License to Use the API Monogram

For all organizations desiring to acquire and maintain a license to use the API Monogram, conformance with the following shall be required at all times:

a) the quality management system requirements of API Q1;

b) the API Monogram Program requirements of API Q1, Annex A;

c) the requirements contained in the API product specification(s) for which the organization desires to be licensed;

d) the requirements contained in the API Monogram Program License Agreement.

L.3.2 Monogrammed Product—Conformance with API Q1

When an API-licensed organization is providing an API monogrammed product, conformance with API-specified requirements, described in API Q1, including Annex A, is required.

L.3.3 Application of the API Monogram

Each Licensee shall control the application of the API Monogram in accordance with the following.

a) Each Licensee shall develop and maintain an API Monogram marking procedure that documents the marking/monogramming requirements specified by the API product specification to be used for application of the API Monogram by the Licensee. The marking procedure shall define the location(s) where the Licensee shall apply the API Monogram and require that the Licensee's license number and date of manufacture be marked on monogrammed products in conjunction with the API Monogram. At a minimum, the date of manufacture shall be two digits representing the month and two digits representing the year (e.g. 05-07 for May 2007) unless otherwise stipulated in the applicable API product specification. Where there are no API product specification marking requirements, the Licensee shall define the location(s) where this information is applied.

b) The API Monogram may be applied at any time appropriate during the production process but shall be removed in accordance with the Licensee's API Monogram marking procedure if the product is subsequently found to be nonconforming with API-specified requirements. Products that do not conform to API-specified requirements shall not bear the API Monogram.

c) Only an API Licensee may apply the API Monogram and its license number to API monogrammable products. For certain manufacturing processes or types of products, alternative API Monogram marking procedures may be acceptable. The current API requirements for Monogram marking are detailed in the API Policy Document, *Monogram Marking Requirements*, available on the API Monogram Program website at http://www.api.org/certifications/monogram/.

d) The API Monogram shall be applied at the licensed facility.

e) The authority responsible for applying and removing the API Monogram shall be defined in the Licensee's API Monogram marking procedure.

L.3.4 Records

Records required by API product specifications shall be retained for a minimum of five years or for the period of time specified within the product specification if greater than five years. Records specified to demonstrate achievement of the effective operation of the quality system shall be maintained for a minimum of five years.

L.3.5 Quality Program Changes

Any proposed change to the Licensee's quality program to a degree requiring changes to the quality manual shall be submitted to API for acceptance prior to incorporation into the Licensee's quality program.

L.3.6 Use of the API Monogram in Advertising

Licensee shall not use the API Monogram on letterheads or in any advertising (including company-sponsored web sites) without an express statement of fact describing the scope of Licensee's authorization (license number). The Licensee should contact API for guidance on the use of the API Monogram other than on products.

L.4 Marking Requirements for Products

L.4.1 General

These marking requirements apply only to those API Licensees wishing to mark their products with the API Monogram.

L.4.2 Product Specification Identification

Manufacturers shall mark equipment on the tag with the information identified in 6.2.2, as a minimum, including "API Spec 9A."

L.4.3 Units

As a minimum, equipment should be marked with U.S. customary (USC) units. Use of dual units [metric (SI) units and USC units] is acceptable.

L.4.4 Tags

Tags shall be made of a corrosion-resistant material and shall be located as indicated in 6.2.2. If the location is not identified, then L.3.3 a) shall apply.

The API Monogram shall be marked on the tag, in addition to the marking requirements of this specification.

L.4.5 License Number

The API Monogram license number shall not be used unless it is marked in conjunction with the API Monogram.

L.5 API Monogram Program: API Responsibilities

The API shall maintain records of reported problems encountered with API monogrammed products. Documented cases of nonconformity with API-specified requirements may be reason for an audit of the Licensee involved, (also known as audit for "cause").

Documented cases of specification deficiencies shall be reported, without reference to Licensees, customers or users, to API Subcommittee 18 (Quality) and to the applicable API Standards Subcommittee for corrective actions.

Bibliography

[1] ISO 9001, *Quality management systems—Requirements*

energy API

AMERICAN PETROLEUM INSTITUTE

2011 PUBLICATIONS ORDER FORM

Effective January 1, 2011. API Members receive a 30% discount where applicable. The member discount does not apply to purchases made for the purpose of resale or for incorporation into commercial products, training courses, workshops, or other commercial enterprises.

Online Orders **www.api.org/pubs**
Phone Orders **1-800-854-7179** (Toll-free in the U.S. and Canada) | **(+1) 303-397-7956** (Local and International)
Fax Orders **(+1) 303-397-2740**

Date: _____ ☐ **API Member** (Check if Yes)

Invoice To (☐ Check here if same as "Ship To")

Name:
Title:
Company:
Department:
Address:
City: State/Province:
Zip/Postal Code: Country:
Telephone:
Fax:
Email:

Ship To (UPS will not deliver to a P.O. Box)

Name:
Title:
Company:
Department:
Address:
City: State/Province:
Zip/Postal Code: Country:
Telephone:
Fax:
Email:

Quantity	Title	SO★	Unit Price	Total
	Spec 7F, Oil Field Chain and Sprockets		$112.00	
	Spec 7K, Drilling and Well Servicing Equipment		$176.00	
	RP 7L, Inspection, Maintenance, Repair, and Remanufacture of Drilling Equipment		$105.00	
	Spec 8A, Drilling and Production Hoisting Equipment		$105.00	
	RP 8B, Inspection, Maintenance, Repair, and Remanufacture of Hoisting Equipment		$80.00	
	Spec 8C, Specification for Drilling and Production Hoisting Equipment (PSL 1 and PSL 2)		$125.00	
	RP 9B, Application, Care, and Use of Wire Rope for Oil Field Service		$111.00	

☐ Payment Enclosed ☐ P.O. No. (Enclose Copy) _____

☐ Charge My IHS Account No. _____

☐ VISA ☐ MasterCard ☐ American Express
☐ Diners Club ☐ Discover

Credit Card No.:

Print Name (As It Appears on Card):

Expiration Date:

Signature:

Subtotal	
Applicable Sales Tax (see below)	
Rush Shipping Fee (see below)	
Shipping and Handling (see below)	
Total (in U.S. Dollars)	

★ To be placed on Standing Order for future editions of this publication, place a check mark in the SO column and sign here:

_____

Pricing and availability subject to change without notice.

Mail Orders – Payment by check or money order in U.S. dollars is required except for established accounts. State and local taxes, $10 processing fee, and 5% shipping must be added. Send mail orders to: **API Publications, IHS, 15 Inverness Way East, c/o Retail Sales, Englewood, CO 80112-5776, USA.**

Purchase Orders – Purchase orders are accepted from established accounts. Invoice will include actual freight cost, a $10 processing fee, plus state and local taxes.

Telephone Orders – If ordering by telephone, a $10 processing fee and actual freight costs will be added to the order.

Sales Tax – All U.S. purchases must include applicable state and local sales tax. Customers claiming tax-exempt status must provide IHS with a copy of their exemption certificate.

Shipping (U.S. Orders) – Orders shipped within the U.S. are sent via traceable means. Most orders are shipped the same day. Subscription updates are sent by First-Class Mail. Other options, including next-day service, air service, and fax transmission are available at additional cost. Call 1-800-854-7179 for more information.

Shipping (International Orders) – Standard international shipping is by air express courier service. Subscription updates are sent by World Mail. Normal delivery is 3-4 days from shipping date.

Rush Shipping Fee – Next Day Delivery orders charge is $20 in addition to the carrier charges. Next Day Delivery orders must be placed by 2:00 p.m. MST to ensure overnight delivery.

Returns – All returns must be pre-approved by calling the IHS Customer Service Department at 1-800-624-3974 for information and assistance. There may be a 15% restocking fee. Special order items, electronic documents, and age-dated materials are non-returnable.

THERE'S MORE WHERE THIS CAME FROM.

API Monogram® Licensing Program
Sales: (+1) 713-964-2662
Service: (+1) 202-962-4791
Fax: (+1) 202-682-8070
Email: certification@api.org
Web: www.api.org/monogram

API Quality Registrar (APIQR®)
- ISO 9001
- ISO/TS 29001
- ISO 14001
- OHSAS 18001
- API Spec Q1®
- API QualityPlus®
- Dual Registration

Sales: (+1) 713-964-2662
Service: (+1) 202-962-4791
Fax: (+1) 202-682-8070
Email: certification@api.org
Web: www.api.org/apiqr

API Individual Certification Programs (ICP®)
Sales: (+1) 713-964-2662
Service: (+1) 202-682-8064
Fax: (+1) 202-682-8348
Email: icp@api.org
Web: www.api.org/icp

API Engine Oil Licensing and Certification System (EOLCS)
Sales: (+1) 713-964-2662
Service: (+1) 202-682-8516
Fax: (+1) 202-962-4739
Email: eolcs@api.org
Web: www.api.org/eolcs

API Training Provider Certification Program (API TPCP™)
Sales: (+1) 713-964-2662
Service: (+1) 202-682-8075
Fax: (+1) 202-682-8070
Email: tpcp@api.org
Web: www.api.org/tpcp

API Perforator Design Registration Program
Sales: (+1) 713-964-2662
Service: (+1) 202-682-8490
Fax: (+1) 202-682-8070
Email: perfdesign@api.org
Web: www.api.org/perforators

API Credit Exchange (ACE™)
Service: (+1) 202-682-8192
Fax: (+1) 202-682-8070
Email: exchange@api.org
Web: www.api.org/ace

API Diesel Exhaust Fluid Certification Program
Phone: (+1) 202-682-8516
Fax: (+1) 202-962-4739
Email: info@apidef.org
Web: www.apidef.org

API WorkSafe™
Sales: (+1) 713-964-2662
Service: (+1) 202-682-8469
Fax: (+1) 202-682-8348
Email: apiworksafe@api.org
Web: www.api.org/worksafe

API-U
Phone: (+1) 202-682-8053
Fax: (+1) 202-682-8070
Email: training@api.org
Web: www.api-u.org

API Data™
Phone: (+1) 202-682-8499
Fax: (+1) 202-962-4730
Email: apidata@api.org
Web: www.APIDataNow.org

API Publications
Online: www.api.org/pubs
Phone: 1-800-854-7179
(Toll-free: U.S./Canada)
(+1) 303-397-7956
(Local/International)
Fax: (+1) 303-397-2740

API Standards
Phone: (+1) 202-682-8148
Fax: (+1) 202-962-4797
Email: standards.org
Web: www.api.org/standards

Request a Quotation: www.api.org/quote

energy API
AMERICAN PETROLEUM INSTITUTE

AMERICAN PETROLEUM INSTITUTE

1220 L Street, NW
Washington, DC 20005-4070
USA

202-682-8000

Additional copies are available online at www.api.org/pubs

Phone Orders:	1-800-854-7179	(Toll-free in the U.S. and Canada)
	303-397-7956	(Local and International)
Fax Orders:	303-397-2740	

Information about API publications, programs and services is available on the web at www.api.org.

Product No. G9A026