Cordage Institute
International Standard

MULTIFILAMENT POLYPROPYLENE (MFP) FIBER CORD/ROPE Solid Braid Constructions

CI 1320-06
May 2006
Supercedes CI 1320-99 April 1999

1. Scope

1.1 This standard covers solid braid multifilament polypropylene cordage and rope for general, utility, industrial, commercial and consumer use and should be used in conjunction with CI 1201.

1.2 This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to select a size to meet working load requirements, establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to its use. The working load limits and design factors are provided as guidelines only.

1.3 In the event of any conflict between the text of this document and any references cited, the text of this document takes preference.

2. Referenced Documents

2.1 CI 1201: Fiber Rope – General Standards. This standard contains requirements for ordering, materials, manufacturing, product identification, physical properties, performance, testing, packaging, labeling, quality assurance, end item inspection and certification that are applicable to this standard, unless otherwise specified.

2.2 CI 1202: Terminology. This standard contains definitions of terms used in Cordage Institute standards and guidelines.

2.3 CI 1401: Safe Use Guidelines. This document provides important information regarding working load limits for specific applications.

2.4 CI 1500: Test Methods for Fiber Ropes. This standard provides both the general and special test methods to determine rope physical properties.

3. Terminology

3.1 Definitions – for definitions of terms used in this and other standards, refer to CI 1202.

3.2 Multifilament Polypropylene (MFP): Fibers having an average tenacity greater than 6.5 grams/denier.

3.3 Units: The values stated in inch-pounds are to be regarded as standard. The values in SI units are provided for use where required.

4. Ordering Information

4.1 Unless otherwise stated or included in a purchase order, ordering information shall meet the requirements of CI 1201.

5. Material

5.1 The rope shall be fabricated from continuous flat multifilament polypropylene fiber of suitable strength to meet all the requirements of this standard.

5.2 No extraneous materials shall be added for the purpose of weighting the rope. Extractable matter of the finished rope shall not exceed 5%.

6. Manufacturing

6.1 The rope shall be a cylindrical braid in which each strand alternately passes under and over one or more of the other strands of the rope while all strands are rotating around the axis with the same direction of rotation.

6.2 If core yarns are used, the weight of the core shall not exceed 25% of the total weight of the rope. The core may be of any construction.

6.3 Mixing of fibers from different manufacturers or different types or grades shall not be permitted in the cover. Multifilament fibers used in the core may differ from those used in the cover braid.

6.4 The use of an internal marker or a surface yarn maker shall be the only exception to the strand-to-strand uniformity requirement.

7. Product Identification

7.1 The manufacturer may use colored synthetic yarn(s), in accordance with CI 1201, to identify his product.

7.2 When required, a printed, marker tape shall be used in accordance with CI 1201.

8. Physical Properties

8.1 The physical properties of the rope shall meet or exceed those listed in Table 1.

9. Performance Requirements

9.1 Performance requirements beyond the scope of this document shall be established by a mutual agreement between the buyer and the seller.

10. Packaging and Labeling

10.1 Unless otherwise stated or included in a purchase order, the packaging and labeling of the products shall meet the requirements of CI 1201.

11. Quality Assurance

11.1 Unless otherwise specified, Quality Assurance of the product including sampling, end item inspection, performance testing, and certification shall meet the requirements of CI 1201.

12. Special Requirements

12.1 Requirements beyond the scope of this document shall be established by a mutual agreement between the buyer and the seller.

13. Key Words

13.1 Polypropylene rope, multifilament polypropylene rope, cord, rope.

⚠ WARNING

The use of rope and cordage products has inherent safety risks which are subject to highly variable conditions and which may change over time. Compliance with standards and guidelines of the Cordage Institute does not guarantee safe use under all circumstances, and the Institute disclaims any responsibility for accidents which may occur. If the user has any questions or uncertainties about the proper use of rope or cordage or about safe practices, consult a professional engineer or other qualified individual.

Table 1. Physical Properties For General Purpose Use

Nominal Size[1] Diameter In.	(mm)	Industry Ref. Size (Dia.)	Linear Density[2] lbs/100′	(Kg/100m)	New Rope Min Breaking Strength[3] Lb.	(Kg)	(daN)	Design Factor[4] Range	Working Load Limits[5] Range Lbs 1/12	1/5
3/32	(2.4)	3	0.150	(0.223)	90	(40.8)	(40.0)	12-5	8	18
7/64	(2.8)	3.5	0.203	(0.303)	115	(51.0)	(50.0)	12-5	10	23
1/8	(3.2)	4	0.266	(0.395)	140	(63.3)	(62.0)	12-5	12	28
9/64	(3.6)	4.5	0.337	(0.501)	175	(79.6)	(78.1)	12-5	15	35
5/32	(4.0)	5	0.416	(0.619)	215	(98.0)	(96.1)	12-5	18	43
11/64	(4.4)	5.5	0.503	(0.748)	260	(118)	(116)	12-5	22	52
3/16	(4.8)	6	0.598	(0.890)	305	(139)	(136)	12-5	25	61
7/32	(5.6)	7	0.813	(1.21)	405	(184)	(180)	12-5	34	81
1/4	(6.4)	8	1.07	(1.59)	530	(241)	(236)	12-5	44	106
9/32	(7.1)	9	1.35	(2.01)	640	(290)	(284)	12-5	53	128
5/16	(7.9)	10	1.63	(2.43)	765	(347)	(340)	12-5	64	153
3/8	(9.5)	12	2.35	(3.50)	1,080	(490)	(480)	12-5	90	216
7/16	(11.1)	14	3.26	(4.85)	1,440	(653)	(641)	12-5	120	288
1/2	(12.7	16	4.25	(6.33)	1,845	(837)	(821)	12-5	154	369
5/8	(15.9)	20	6.64	(9.88)	2,870	(1,302)	(1,277)	12-5	239	574

[1] Diameter is approximate and is actually determined by linear density.
[2] Linear density is considered standard. Tolerances are 3/32”-5/16” inclusive ±10%; 3/8”-5/8” inclusive ±8%.
[3] New Rope Minimum Breaking Strength is based on data from a number of manufacturers and represents a value of 2 standard deviations below the mean, established by regression analysis.
[4] For critical applications, refer to Safe Use Guidelines CI 1401 (current) on page 5.
[5] Working Load Limit is determined by dividing the new rope Minimum Breaking Strength by the selected Design Factor. Important information is given in Appendix CI 1401.

Cordage Institute Guideline CI 1401-19 • Recommended Safety Practices for Use of Fiber Rope • June 2019

Purpose

This Guideline is provided to help in the selection and safer use of cordage products. Compliance with Cordage Institute Standards and Guidelines does not guarantee safe use under all circumstances, and the Institute disclaims any responsibility for any accidents that may occur.

1. Overview

There are inherent risks in the use of rope and cordage because such products are subject to highly variable conditions that change over time. Therefore, Design Factor selections and Working Load Limits must be calculated with consideration of exposure to risk and actual conditions of use for each application. If in doubt, consult an experienced engineer or other qualified individual regarding the design, application and selection of a rope product.

2. Minimum Breaking Strength

The Minimum Breaking Strength (MBS) is the force that a given rope is required to meet or exceed in a laboratory test when it is new and unused. MBS values are given in Cordage Institute Standards and individual manufacturers' specifications.

3. Working Load / Working Load Limit

The Working Load (WL) is the weight or force applied to rope or cordage in a given application.

The Working Load Limit (WLL) is a guideline for the maximum allowable capacity of a rope product in a particular application and should not be exceeded.

Applied loads higher than a specified WLL can overstress and damage fibers, resulting in premature rope failure. For optimal product performance and the safety of personnel and property, the Working Load of an application should not exceed the WLL.

4. Design Factors

The Design Factor (DF) is the ratio between the minimum breaking strength and working load, (MBS/WL). This value is the margin of safety for an application. For a particular application, the factors affecting rope behavior and the degrees of risk to life, personnel and property must be considered when setting a DF.

Commercial, industrial and "general use" consumers should determine a DF based on actual service conditions and establish operating procedures for a specific application. The consumer must also assess his application and determine any hazards that may exist.

As a rule, the more severe the application, the higher the DF needs to be. Selection of a DF in the general range between 5:1 and 12:1 is recommended**. This specific range of values does not apply to Life Safety ropes and/or rope products designed and manufactured for specific engineered services.** A design factor at the low end of this range should only be selected with expert knowledge of conditions and professional estimate of risk. DF at or above the high end of the range should be used for more severe conditions. When in doubt, always select the highest practical DF, or contact the manufacturer for additional guidance. Engineering assistance may be necessary to determine the service loads and risks and to set the appropriate DF. Expert guidance is strongly suggested when shock loads are possible and/or when the rope is used for lifting purposes.

Considerations in the Selection of a Design Factor

• Select a DF value supported by industry standards, best practices, and/or regulations.

• All components of the system should be considered when determining the DF

• Consider increasing the Design Factor if:

- Problems have previously been observed in similar applications
- Injury, death or loss of property may result if rope fails
- Loads are not accurately known
- High or continuous dynamic loads are anticipated (See Section 6)
- Shock loads are anticipated
- Extensive cyclic loads are likely to occur
- Tension is on the rope for long periods
- Knots are used, as knots reduce strength
- Operators are in training or are not well experienced
- Operation/use procedures are not well defined and/or controlled.
- Abrasion may occur from exposure to rough surfaces or cutting edges, or by contamination from dirt and grit.

Expert Guidance is Strongly Suggested for the Following Situations

• Rope is used constantly over pulleys or around a small bend.

• Rope is used at elevated temperature that may glaze, weaken or melt the fibers.

• Rope is used in the presence of hazardous chemicals.

• Rope is not new and is of unknown properties and/or prior use.

• Rope is not inspected frequently or adequately.

• Rope will be in service for long periods that may cause strength loss due to fatigue.

CI Guideline 2003 Fibers for Cable, Cordage, Rope and Twine explains some of the effects of elevated temperature and chemicals on synthetic fibers.

5. Calculation of Values

After the WL has been estimated and the DF for an application has been determined, a rope can be selected by calculating the necessary new rope Minimum Breaking Strength. The required MBS is determined by multiplying the Working Load by Design Factor. WL*DF=MBS. For example, an application with a Working Load of 3 tons and a Design Factor of 10 would require rope with MBS = 3*10 = 30 tons.

Similarly, the Working Load Limit of a new rope is determined by dividing the Minimum Breaking Strength by the Design Factor for a given application. MBS÷DF=WLL. Examples of WLL based on a DF are given in some individual Cordage Institute Standards. The WLL in CI standards are for new ropes with standard terminations.

6. Dynamic Loading

A dynamic load is any load that is not static, such as a live load or a wind load. If not properly taken into account, dynamic loading could shorten the service life of a rope and may even cause failure.

Dynamic load effects are influenced by the stiffness or modulus of the rope and are more severe when using low-stretch rope. Dynamic load effects are more severe on short sections of rope. In extreme dynamic loading cases, the forces sustained by the rope may be two, three or more times the static load.

When an object is moved the force on the rope increases due to acceleration or deceleration. The more rapidly or suddenly such actions occur, the greater the forces. Objects should be moved slowly and smoothly to minimize dynamic effects whenever possible.

When dynamic loading is anticipated, the Design Factor should be calculated based on the dynamic instead of the static load. The advice of a qualified individual should be used in calculating the Design Factor.

7. Recoil/Snapback Safety Warning

When a tensioned rope breaks, an attachment fails, or tension is suddenly released, the energy stored in the rope may cause it to recoil back in unpredictable directions with great force. The recoil may result in injury or death to persons in its path. Persons should never stand under, in line with or in the general path of rope under tension to avoid snapback injuries.

8. Special Applications

The DF ranges can be raised or lowered for applications where field experience has proven successful, where a recognized standard or specification exists, where qualified professionals have made a thorough engineering analysis of all conditions of use and/or a regulatory agency has granted specific permission. In such controlled cases, breaking strength, elongation, energy absorption, and other factors, including operating procedures, must be evaluated during the selection of the Design Factor.

When warning tags are provided by the product manufacturer, they should be attached to each rope per industry or application specific guidelines.

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