



Designation: F3410 – 19 (Reapproved 2024)

Standard Test Method for Testing Fiber Rope Used in Water Sports¹

This standard is issued under the fixed designation F3410; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method is intended for ropes used in the application of towing inflatables or other towable products (excluding handled ropes).

1.2 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 Definitions of Terms Specific to This Standard:

2.1.1 *breaking force, n*—maximum force recorded during a break test on a rope.

2.1.2 *cycled breaking force, n*—breaking force of a rope that has been cycled from initial tension to a specified peak cyclic force for a specified number of cycles before the break test.

2.1.3 *initial tension, n*—low-tension force applied in cyclic loading.

2.1.4 *reference tension, n*—low tension applied while measuring diameter or circumference and the length of the linear density specimen.

3. Significance and Use

3.1 This test method provides a means of determining the breaking strength (breaking force) of rope. It is not intended to evaluate the data with regard to the quality of the rope.

¹ This test method is under the jurisdiction of ASTM Committee F27 on Snow and Water Sports and is the direct responsibility of Subcommittee F27.80 on Water Sports Equipment.

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4. Apparatus

4.1 Force Application Test Machine:

4.1.1 The test machine used for determining breaking force shall have sufficient force capacity, bed length, and stroke to conduct the tests as specified here. The test machine shall be capable of applying the force at a specified rate in a continuous and essentially constant manner throughout the entire stroke required to break the rope specimen.

4.1.2 The test machine shall be long enough to accommodate the specimen length given in 6.1.

4.1.3 The test machine shall be equipped with a force-measuring and indicating device. The force-measuring and indicating device shall be accurate within $\pm 1\%$ of the estimated breaking force of the test specimen over the entire intended force range. The force-indicating device shall temporarily or permanently preserve a record of the maximum force experienced during the test.

4.2 Diameter-Measuring Device:

4.2.1 If calipers are used, place the caliper feet in contact with at least two strand crowns along each side of the rope and apply a moderate compression. Secure the caliper feet in this position. Remove the calipers from the rope. Measure the distance between the caliper feet with a suitable calibrated scale.

4.2.2 If a calibrated measuring tape is used, wrap it around the rope, apply a moderate tension, and read the circumference while it is still in contact with the rope and calculate the diameter.

5. Samples for Testing

5.1 *Conditions and Attachments*—Ropes shall be tested in the condition as offered for sale.

5.2 *Number of Samples*—Four samples of each rope are required for each type and rating.

6. Specimen Preparation

6.1 For types of rope not normally spliced, the rope specimen shall be terminated by a method that is typically used for the type and size of rope, as recommended by the manufacturer or as specified in the particular standard or specification, which is applicable to that rope type.

6.1.1 The rope specimen shall have a clear distance of at least 1 ft (0.3 m) between grips or rope specimen terminations.

6.2 Rope specimens should be fixed in a capstan style fixture with a minimum distance as specified in 6.1.1.

6.3 In preparation for wet testing, the entire specimen shall be soaked in fresh water or saltwater (depending on the test) for a period of between 22 and 26 h and shall be tested as soon as practical after removal from the water. If there is a delay of more than 12 but less than 24 h after soaking, the specimen shall be soaked for 2 h before testing. If there is a delay of more than 24 h, the original soaking procedure shall be repeated. The water temperature shall be between 59 and 77°F (15 and 25°C).

6.4 In preparation for ultraviolet (UV) testing, the entire specimen shall be subjected to 110 h of exposure to UV rays of one reflector spot (RS) sunlamp or equivalent UV lamps at a distance of 19 in. (483 mm) and a black panel temperature of 140°F (60°C) or exposed to the equivalent UV exposure of 2 MJ/m².

7. Calibration

7.1 The force-indicating device shall be calibrated by a recognized independent calibration agency. The calibration shall be done with a reference load cell traceable to applicable national standards. This calibration shall have been conducted within the previous twelve months. An original certificate attesting to this calibration, certified by the calibration agency shall be available for examination, and a copy of this test certificate shall be made available upon request.

8. Procedure

8.1 *Determine Diameter Size and Length of Each Prepared Rope Specimen:*

8.1.1 Place the prepared rope specimen in the test machine and apply the reference tension.

8.1.2 *Reference Tension:*

$$RT_p = 50 * d^2 \quad (1)$$

where:

RT_p = reference tension in pounds
 d = diameter in inches.

8.1.3 With the rope under tension, measure the diameter at three or more points along the length of the rope and average the measurements.

8.1.4 If the average diameter measurement differs from the nominal diameter used to calculate the reference tension by more than 10 %, recalculate the reference tension and repeat 8.1.3.

8.1.5 Record the average diameter.

8.2 *Determine Uncycled Strength (Breaking Force):*

8.2.1 *Purpose*—This test method determines the strength of a rope that has not been subjected to cycling. Standards and specifications of rope properties are for new, unused ropes. Old and used ropes may be tested using these methods but may produce different breaking strengths.

8.2.2 Place the prepared rope specimen in the test machine.

8.2.3 Increase the force applied to the rope until it breaks.

8.2.4 The rate of travel of the pulling crosshead during the break test shall be such that the rope is loaded to 20 % of its estimated breaking force in not less than 2 s nor more than 200

s. The crosshead shall continue to move at approximately that rate of travel without pause until the rope breaks.

8.2.5 Record the breaking force (maximum force applied to the rope). Record the point at which the rope broke, that is, mid-length, towards attachment, etc.

8.3 *Determine Cycled Strength (Breaking Force):*

8.3.1 *Purpose*—The strength of a rope can change during the first several force cycles. Generally, the average break strength increases, and the statistical scatter of break strength decreases because of the application of a few force cycles, as the rope elements become more aligned.

8.3.2 As per 8.2, plus the following:

8.3.3 Cycle the rope ten times from a trough cyclic force equal to the initial tension to a peak cyclic force equal to 20 % of the estimated breaking force.

8.3.3.1 *Initial Tension:*

$$IT_p = 200 * d^2 \quad (2)$$

where:

IT_p = initial tension in pounds
 d = diameter in inches

8.3.4 During cycling, the rate of travel of the testing machine moving crosshead may be adjusted to achieve the required rate of travel prescribed in 8.2.4.

8.3.5 On the eleventh cycle, apply force to the rope at the rate prescribed in 8.2.4 until it breaks.

8.3.6 Record the breaking force (maximum force applied to the rope). Record the point at which the rope broke; see 8.2.5.

8.4 *Wet and UV Uncycled Strength:*

8.4.1 *Purpose*—The uncycled strength of some ropes are affected by exposure to fresh water, saltwater and UV. This test method determines the strength of a rope that has been soaked in fresh water or saltwater for 24 h or exposed to UV but has not been subjected to cycling.

8.4.2 The rope specimen shall be prepared as described in 6.1 and 6.2 and exposed to water as described in 6.3 or exposed to UV as described in 6.4.

8.4.3 *Test Procedure*—As in 8.2.2, 8.2.3, and 8.2.4.

8.4.4 Record the breaking force as in 8.2.5.

8.5 *Wet and UV Cycled Strength:*

8.5.1 *Purpose*—The cycled strength of some ropes are affected by exposure to fresh water, saltwater and UV. This test method determines the strength of a rope that has been soaked in fresh water or saltwater for 24 h or exposed to UV that has been subjected to cycling.

8.5.2 The rope specimen shall be prepared as described in 6.1 and 6.2 and exposed to water as described in 6.3 or exposed to UV as described in 6.4.

8.5.3 *Test Procedure*—As in 8.3.2, 8.3.3, 8.3.4, and 8.3.5.

8.5.4 Record the breaking force as in 8.3.6.

9. Report

9.1 Report the following information:

9.1.1 This designation, ASTM F3410;

9.1.2 Brand, length, diameter, and tensile strength rating;

9.1.3 Test type, breaking strength, and any other information recorded for each test; and



Documents

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