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StandardTest Method for Tension Testing of Wire Ropes and Strand[1]

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1. Scope*

1.1 This test method covers the tension testing of wire ropes and strand at room temperature, specifically to determine the measured breaking force, yield strength, elongation, and modulus of elasticity. Methods described in this standard are not intended for other purposes.

1.2 The values stated in inch-pound units are to be regarded as 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 and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in Note 1 *and Note 2.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A586 Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand

A603 Specification for Zinc-Coated Steel Structural Wire Rope

A1023/A1023M Specification for Stranded Carbon Steel Wire Ropes for General Purposes

B6 Specification for Zinc

E4 Practices for Force Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

E8 Test Methods for Tension Testing of Metallic Materials

2.2 *ISO Standard*[3]

ISO 17558 Specification for Steel Wire Ropes – Socketing Procedures – Molten Metal and Resin Socketing

3. Terminology

3.1 The terminology relating to tensile testing in Terminology E6 applies to this test method. In addition, the following definitions for wire rope will apply:

3.2 *Definitions:*

3.2.1 *abrasion*—frictional surface wear on the wires of a wire rope.

3.2.2 *aggregate area*—see *area, metallic.*

3.2.3 *aggregate strength*—the strength derived by totaling the individual breaking strengths of the elements of the strand or rope. This strength does not give recognition to the reduction in strength resulting from the angularity of the elements in the rope, or other factors that may affect efficiency.

3.2.4 *area, metallic*—sum of the cross-sectional areas of all wires either in a wire rope or in a strand.

3.2.5 *breaking force*—the maximum load at which a tensile failure occurs in the sample of wire rope being tested.

3.2.5.1 *Discussion*—The term *breaking force* is synonymous with actual strength.

3.2.6 *cable*—a term loosely applied to wire rope, wire strand, and electrical conductors.

3.2.7 *center*—the axial member of a strand about which the wires are laid.

3.2.8 *classification*—group or family designation based on wire rope constructions with common strengths and weights listed under the broad designation.

3.2.9 *construction*—geometric design description of the wire rope's cross section. This includes the number of strands, the number of wires per strand, and the pattern of wire arrangement in each strand.

3.2.10 *core*—the axial member of a wire rope about which the strands are laid.

3.2.11 *fiber core*—cord or rope of vegetable or synthetic fiber used as the core of a rope.

3.2.12 *grade*—wire rope or strand classification by strength or type of material, that is, Class 3, Type 302 stainless, phosphor bronze, etc. It does not apply to strength of the individual wires used to manufacture the rope or strand.

3.2.13 *independent wire rope core (IWRC)*—a wire rope used as the core of a larger wire rope.

[1] This test method is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.03 on Steel Rod and Wire.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

***A Summary of Changes section appears at the end of this standard**

3.2.14 *inner wires*—all wires of a strand except the outer or cover wires.

3.2.15 *lay*—(*a*) the manner in which the wires in a strand or the strands in a rope are helically laid, or (*b*) the distance measured parallel to the axis of the rope (or strand) in which a strand (or wire) makes one complete helical convolution about the core (or center). In this connection, lay is also referred to as *lay length* or *pitch.*

3.2.16 *minimum breaking force*—specified value that the breaking force must meet or exceed in a prescribed test.

3.2.17 *modulus of elasticity*—the slope of the elastic portion of the stress-strain curve. The ratio of stress to corresponding strain below the proportional limit. This value is generally taken between 20 and 50 % of the minimum breaking force.

3.2.18 *socket*—generic name for a type of wire rope fitting.

3.2.19 *strand*—a plurality of round or shaped wires helically laid about a center.

3.2.20 *wire rope*—strands helically laid around a core.

3.2.21 *wire strand core (WSC)*—a wire strand used as the core of a wire rope.

3.2.22 *zinc-coated (galvanized) rope*—wire rope made up of zinc coated (galvanized) wire.

3.2.23 *zinc coated (galvanized) strand*—strand made up of zinc-coated (galvanized) wire.

4. Significance and Use

4.1 Wire rope tests are generally to be performed on new rope. The use of wire rope in any application can reduce individual wire strengths due to abrasion and nicking that will result in the wire rope strength being reduced. Damage to the outer wires will also lower the maximum strength achieved during tension testing.

4.2 The modulus of elasticity of wire rope is not considered to be a standard requirement at this time. The determination of this material property requires specialized equipment and techniques.

4.3 Rope to be tested should be thoroughly examined to verify that no external wire damage is present. If present, it should be noted. When possible, a new undamaged sample should be obtained for testing.

4.4 End attachments and their installation can directly affect breaking force achieved during testing. Any attachment that can be used to directly achieve the required rope breaking force can be used. Standard testing with a poured socket, using zinc, white metal or thermoset resin, has been considered the most efficient. Proficiency in attachment of any fitting can have a direct effect on the final test results.

5. Interferences

5.1 Visual examination of the sample for any damage to outer wires should be done. If any damage is evident, the sample should not be used.

5.2 Measurement of the rope or strand sample is necessary to document the size, length between end attachments, and length of lay of the rope if necessary. Further details regarding this will be discussed in test results.

5.3 The length of test specimen shall not be less than 3 ft, (0.91 m) between sockets for wire ropes up to 1 in. (25.4 mm) diameter, inclusive, and not less than 5 ft (1.52 m) between sockets for wire ropes 1⅛ in. (28.6 mm) to 3 in. (77 mm) diameter. On wire ropes larger than 3 in. (77 mm), the clear length of the test specimen shall be at least 20 times the rope diameter.

6. Apparatus

6.1 *Testing Machines*—Machines used for tension testing shall conform to the requirements of Practices E4. The loads used in determining tensile strength and yield strength shall be within loading range of the tensile machine as defined in Practices E4.

6.2 *Gripping Devices:*

6.2.1 *General*—Various types of gripping devices may be used to transmit the measured load applied by the testing machine to test specimens. To ensure axial tensile stress within the gage length, the axis of the test specimen should coincide with the center line of the heads of the machine. Any departure from this requirement may introduce bending stresses that are not included in the usual stress computation.

6.2.2 *Wedge Grips*—Testing machines usually are equipped with wedge grips. These wedge grips generally furnish a satisfactory means of gripping long specimens of ductile metal. If, however, for any reason, one grip of a pair advances farther than the other as the grips tighten, an undesirable bending stress may be introduced. When liners are used behind the wedges, they must be of the same thickness and their faces must be flat and parallel. For best results, the wedges should be supported over their entire lengths by the heads of the testing machine. This requires that liners of several thicknesses be available to cover the range of specimen thickness. For proper gripping, it is desirable that the entire length of the serrated face of each wedge be in contact with the specimen. Specially-designed round-shaped grips may have to be used for testing rope or strand. It is essential that all wires in the rope or strand are uniformly gripped when the load is applied.

6.2.3 *Conical Grips*—Conical grips are constructed so that when they are fitted together, a conical-shaped cavity exists which will hold a cone socket wire rope or strand and attachment (fitting).

7. Sample End Terminations

7.1 Poured sockets or swaged sockets are typically used in tensile tests. Properly prepared, they are 100% efficient. Other types of end terminations may be used as long as the required minimum breaking force is achieved. Refer to ISO 17558 for socketing procedures.

8. Procedure

8.1 Take measurements on the sample to determine the actual rope diameter and sample length between sockets before loading on the test machine.