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.

Designation: F2754/F2754M – 21

Standard Test Method for Measurement of Camber, Cast, Helix, and Direction of Helix of Coiled Wire[1]

This standard is issued under the fixed designation F2754/F2754M; 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 covers the various standard methods that are used for measuring camber, cast, helix, and helix direction. The wire may be coiled with or without a spool.

1.2 This test method applies to round wire that has a diameter between 0.0127 to 4.78 mm [0.0005 to 0.188 in.]. It also applies to flat or shaped wire.

1.3 This test method does not apply to superelastic nitinol wire. It does apply to the as-drawn condition of nitinol wire.

1.4 This test method does not apply to the measurement of the straightness of straightened to length wire and tubing.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.6 *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.*

1.7 *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 Fig. 1(a) through Fig. 1(e) illustrate the physical meaning of cast, helix, direction of helix, and camber.

2.2 *Definitions:*

2.2.1 *camber*—the deflection in the width direction of a flat or shaped wire, Fig. 1(e).

2.2.2 *cast*—the maximum diameter of coiled wire when one complete circumference rests completely on a flat surface such as a table, workbench, or floor, Fig. 1(a).

2.2.3 *helix*—there are two common methods for measuring helix—free end lift and hanging helix. These definitions are defined by Fig. 1(b) and Fig. 1(c), respectively.

2.2.3.1 *helix (free end lift)*—the maximum lift of the free end of the wire when laid on a flat surface, Fig. 1(b).

2.2.3.2 *helix (hanging helix)*—the maximum distance between two adjacent coils of wire, Fig. 1(c). A hanging helix can also be measured by suspending the coils.

2.2.4 *helix direction*—can be left or right-handed depending upon how the wire was coiled, Fig. 1(d).

2.2.4.1 *left-handed helix*—the wire is coiled in a counterclockwise direction, Fig. 2(a).

2.2.4.2 *right-handed helix*—the wire is coiled in a clockwise direction, Fig. 2(b).

3. Summary of Test Method

3.1 The maximum diameter of at least one complete circumference is measured using a linear scale while it is resting completely flat on a flat surface such as a table, workbench, or floor (cast measurement). The maximum lift of the free end of the wire when laid on a flat surface is the free end lift helix and is measured using a linear scale. A hanging helix can be measured using a linear scale while the wire is being suspended (hanging helix free end lift). Camber is the offset in the width dimension of a flat or shaped wire and can also be measured using a linear scale while the wire is resting on a flat surface. Alternatively, a coordinate measurement machine or optical comparator may be used. Helix direction is the direction in which the wire has been coiled.

4. Significance and Use

4.1 The process of coiling wire causes the wire to take on a curvature from the process of being mechanically deformed into a coiled geometry. The curvature in the wire is permanent unless the wire is straightened. It will affect how the coiled wire will react when it is subjected to additional wire forming

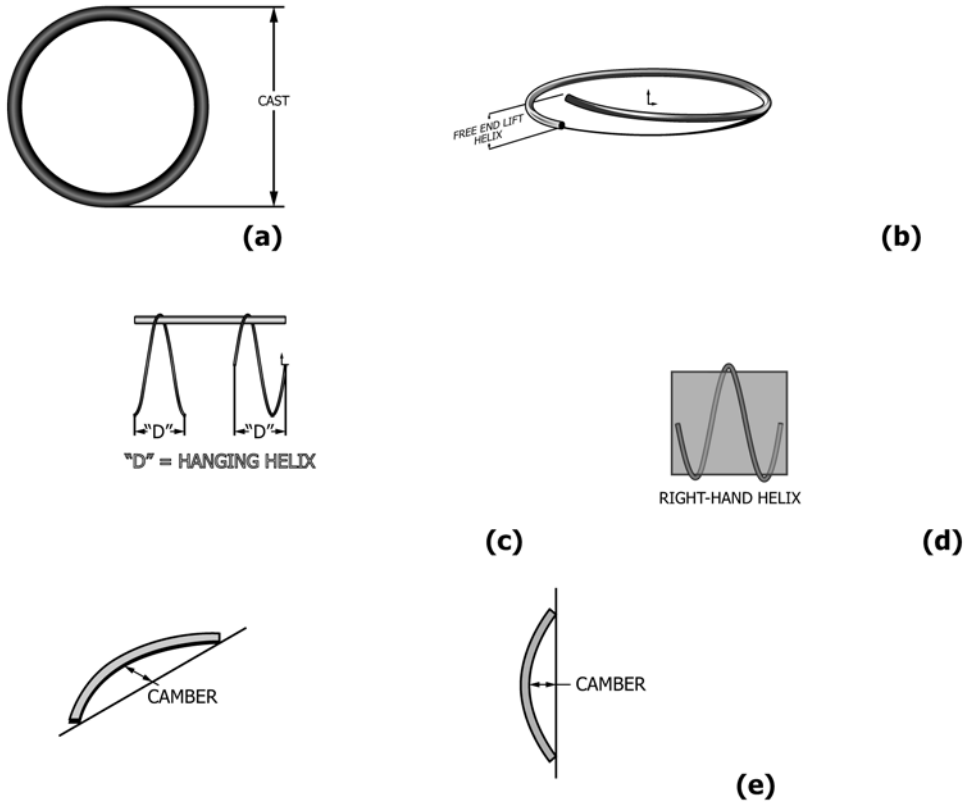
[1] This test method is under the jurisdiction of ASTM Committee F04 on Medical and Surgical Materials and Devices and is the direct responsibility of Subcommittee F04.15 on Material Test Methods.

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

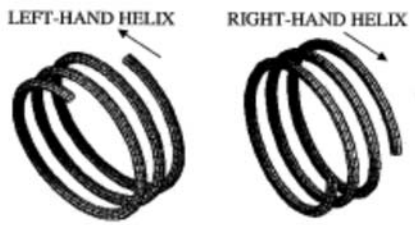
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NOTE 1—(a) Definition of cast; (b) definition of helix as measured by lift method; (c) definition of helix as measured by hanging method; (d) definition of helix direction; (e) definition of camber.

FIG. 1 Standard Definitions for Cast, Helix, and Camber of Spooled Wire



NOTE 1—(a) Definition of left-handed helix direction; (b) definition of right-handed helix direction.

FIG. 2 Standard Definition for Direction of Helix

operations. In addition, residual stresses induced from the coiling operation can cause elastic recoil or spring back in subsequent wire forming operations unless the material is straightened and stress relieved prior to forming. These residual stresses can create wide variations in the dimensions of components and/or parts that have been built using the coiled wire (cast).

4.2 The direction that the wire has been coiled affects how the wire will be taken off of the coil for subsequent wire forming operations (helix direction).

4.3 Lift or spacing between adjacent coils also affects how the wire will be taken off of the coil and can also affect the dimensions of components and/or parts that have been built using the coiled wire due to residual stresses (helix).

5. Apparatus

5.1 A linear scale is required for measurement of the cast of coiled wire. An alternate approach is to use a profilometer or coordinate measurement machine.

5.2 A template is useful for measuring the cast of coiled wire that is greater than 0.6 m [24 in.], Fig. 3. An alternative approach is to use a coordinate measurement machine or optical comparator.

5.3 Special equipment is not required for measurement of camber, helix, or the direction of helix.

6. Test Specimen

6.1 *Test Specimen for Measuring Cast:*

6.1.1 It is preferred to fixture the spool or coil in a suitable manner so it does not move as the wire is removed. It is important to keep a firm tension on the wire to prevent tangling which could alter the measurement.

6.1.2 Scrap the first 1.5 to 3 m [5 to 10 ft] of wire in order to eliminate any possible end effects and wire damage from being tied off. Ensure that the wire is easily coming off of the spool or coil without any crossing over of the wire.

6.1.3 Allow the uncoiled wire to naturally form at least one complete circle that rests completely flat on a level surface such as a smooth table, bench, or the floor.

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