



Designation: F2819 – 24

Standard Test Methods for Measurement of Straightness of Bar, Rod, Tubing, and Wire to be Used for Medical Devices¹

This standard is issued under the fixed designation F2819; 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 standard covers the various test methods to be used for measurement of straightness of bar, rod, tubing, and wire. These test methods apply primarily to bar, rod, tubing, and wire that are ordered in the straightened and cut-to-length condition. They also apply to small diameter tubing and wire that has been specially processed to roll off a spool in the straightened condition.

1.2 These test methods apply to straightness of round wire that has a diameter between 0.05 and 4.78 mm (0.002 and 0.188 in.). They also apply to flatness (camber) of flat-shaped wire or ribbon with a maximum dimension between 0.05 and 4.78 mm (0.002 and 0.188 in.). For flatness (camber) measurement, refer to Test Method **F2754/F2754M**.

NOTE 1—The current version of Test Method **F2754/F2754M** covers a different diameter range (0.0127 to 4.78 mm (0.0005 to 0.188 in.)) and does not include superelastic NiTi. These exceptions would not affect the camber measurement as conducted by Test Method **F2754/F2754M**.

1.3 These test methods apply to straightness of round tubing that has an outer diameter between 0.05 and 6.35 mm (0.002 and 0.25 in.).

1.4 These test methods apply to straightness of round rod that has a diameter between 4.78 and 6.35 mm (0.188 and 0.25 in.). It also applies to flatness (camber) of flat and shaped rod with a maximum dimension between 4.78 and 6.35 mm (0.188 and 0.25 in.). For measurement of flatness (camber), refer to Test Method **F2754/F2754M**.

NOTE 2—The current version of Test Method **F2754/F2754M** covers a different diameter range (0.0127 to 4.78 mm (0.0005 to 0.188 in.)) and does not include superelastic NiTi. These exceptions would not affect the camber measurement as conducted by Test Method **F2754/F2754M**.

1.5 These test methods apply to straightness of round bar that has a diameter between 6.35 and 101.6 mm (0.25 and 4 in.). It also applies to flatness (camber) of flat and shaped bar with a maximum dimension between 6.35 and 101.6 mm (0.25

and 4 in.). For measurement of flatness (camber), refer to Test Method **F2754/F2754M**.

NOTE 3—The current version of Test Method **F2754/F2754M** covers a different diameter range (0.0127 to 4.78 mm (0.0005 to 0.188 in.)) and does not include superelastic NiTi. These exceptions would not affect the camber measurement as conducted by Test Method **F2754/F2754M**.

1.6 These test methods apply to ferrous and non-ferrous alloys including linear-elastic or superelastic nitinol. Refer to Terminology **F2005** for more details on NiTi terminology.

1.7 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.

1.8 *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.*

1.9 *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. Referenced Documents

2.1 ASTM Standards:²

F2005 Terminology for Nickel-Titanium Shape Memory Alloys

F2754/F2754M Test Method for Measurement of Camber, Cast, Helix, and Direction of Helix of Coiled Wire

2.2 Other Standards:³

GGG-P-463 U.S. Federal Specification: Plate, Surface (Granite)

¹ These test methods are under the jurisdiction of ASTM Committee **F04** on Medical and Surgical Materials and Devices and are the direct responsibility of Subcommittee **F04.15** on Material Test Methods.

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

³ Available from IHS, 321 Inverness Drive South Englewood, CO 80112, <http://www.global.ihs.com>.

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

3. Terminology

3.1 Figs. 1 and 2 show the physical meaning of straightness. Fig. 3 shows the definition of wobble in a straight wire or tube as it is being rotated.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *straightness*—deviation of an axis or surface element from linearity over a unit length in the unloaded (force and moment free) condition. A perfectly straight condition is shown in Fig. 1. A non-straight condition is shown in Fig. 2.

3.2.2 *wobble*—elliptical rotation observed in a small diameter wire or tube as it is being rotated around a central axis as is shown in Fig. 3.

4. Summary of Test Method

4.1 For bar, rod, tube, and wire, the deviation from the condition of resting flat on a smooth surface can be measured by using a quantitative or qualitative test method. Two quantitative and two qualitative methods are the gap and TIR (Total Indicator Readout) and inclined flat plate and finger roll tests, respectively

4.2 *Inclined Flat Plate Test (qualitative test method that can be made quantitative)*—A common method for measurement of straightness of wire or tubing with a diameter less than 4.78 mm (0.188 in.) is the inclined flat plate test. In this method, a sectioned piece of material is allowed to roll down an inclined table as is illustrated by Figs. 4 and 5. The material passes the test if it rolls freely down the table without stopping as is shown by Fig. 5.

4.3 *Finger Roll Test (qualitative test method)*—A second common method for measurement of straightness that is used for wire and tubing with a diameter less than 0.25 mm (0.010 in.) is the finger roll test. In this test, a cut length of wire or tubing is laid on a flat surface. A finger, pencil, pen, or plastic card is used to rotate the center of the sample back and forth on the flat surface. The opposite ends of the sample should rotate smoothly without wobble as is defined in 3.2.2 of these test methods.

4.4 *Gap Test (quantitative test method)*—A common quantitative method for measurement of straightness of wire with a diameter less than 4.78 mm (0.188 in.) is the gap test. It can also be used for rod with a diameter between 4.78 and 6.35 mm

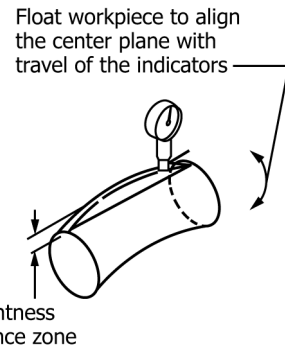


FIG. 2 Definition of a “Non-straight” Condition

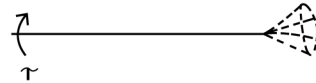


FIG. 3 Definition of Wobble in a Small Diameter Tube or Wire as it is Being Rotated

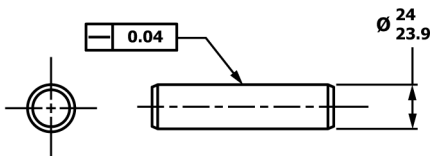


FIG. 4 Example of a Table and Granite Parallel Used to Measure Straightness by the Roll Test



FIG. 5 Example of Inclined Surface Table and Protractor Used to Measure Straightness by the Roll Test Method

Surface Straightness on a Cylindrical Feature



For both parts shown, the axis is straight but surface elements are not.

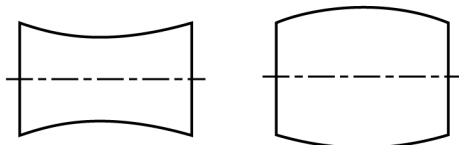


FIG. 1 Definition of a “Straight” Condition

(0.188 and 0.25 in.), tubing with diameter 0.05 to 6.35 mm (0.0002 to 0.25 in.), or bar with a diameter between 6.35 to 101.7 mm (0.25 to 4 in.). The gap test can be used to measure straightness. The gap test can also be used for flat or shaped wire and ribbon. In this method, a thickness gauge equal to the gap must not fit between the rod, tubing, or bar and flat surface at any point along its length when rolled or rotated 360°. The gap defines the straightness of the rod, tubing, or bar.