



Designation: F1978 – 22

Standard Test Method for Measuring Abrasion Resistance of Metallic Thermal Spray Coatings by Using the Taber Abraser¹

This standard is issued under the fixed designation F1978; 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 quantifies the abrasion resistance of metallic coatings produced by thermal spray processes on flat metallic surfaces. It is intended as a means of characterizing coatings used on surgical implants.

1.2 This test uses the Taber Abraser,² which generates a combination of rolling and rubbing to cause wear to the coating surface. Wear is quantified as cumulative weight loss.

1.3 This test method is limited to flat, rigid specimens that do not react significantly with water and do not undergo a phase transformation or chemical reaction between room temperature and 100 °C in air.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 *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.*

1.6 *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.*

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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² Trademarked. The sole source of supply of the apparatus known to the committee at this time is Taber Industries, North Tonawanda, NY 14120 USA. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

2. Referenced Documents

2.1 *ASTM Standards*:³

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

G195 Guide for Conducting Wear Tests Using a Rotary Platform Abraser

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *abraser, n*—instrument that is designed to determine the resistance of surfaces to composite rolling and rubbing action.

3.1.2 *particle shedding, n*—loss of surface particles and fragments from a coating.

3.1.3 *thermal spray coating, n*—coating produced by spraying melted or softened powder or wire by means of combustible gases, plasma, or two-wire arc.

3.1.4 *weight loss, n*—amount of mass removed by the test apparatus over the course of testing.

4. Summary of Test Method

4.1 This test method uses a Taber Abraser with H-22 Calibrate (trademarked) wheels² and the 250 g mass of the abrading head without added weights. A specimen is abraded using rotary rubbing action under controlled conditions of pressure and abrasive action. The test specimen, mounted on a turntable platform, turns on a vertical axis against the sliding rotation of two abrading wheels. The wheels shall be mounted in such a way that when they are in contact with the rotating test specimen, they rotate in opposing directions. One abrading wheel rubs the specimen outward toward the periphery and the other inward toward the center while a vacuum system removes wear debris during the test. The resulting abrasion

³ 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.

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

marks form a pattern of crossed arcs over an area of approximately 30 cm². Specimens are abraded, cleaned ultrasonically, dried, cooled, and weighed for a set number (2, 5, 10, and 100) of cumulative rotational cycles. The specimens are weighed after each iteration, and the weight loss is the measure of abrasive wear to the specimen.

5. Significance and Use

5.1 This test method provides a means to evaluate the resistance to particle shedding of a thermal spray coating. Such particle shedding might occur during surgical insertion of an implant or as the result of micromotion of the implant after insertion.

5.2 This abrasion test method may be useful for quality control analysis of a coating, and it can be used to evaluate the effects of processing variables, such as substrate preparation before coating, surface texture, coating technique variables, or postcoating treatments, any of which may influence the susceptibility of the coating to particle shedding.

5.3 This abrasion test method is for flat plate-shaped specimens of a size sufficient that the wheels of the abrader do not leave the surface of the specimen. It is not recommended for devices with other shapes or sizes.

6. Apparatus

6.1 *Taber Abraser* (Fig. 1), or equivalent as described in Guide G195, with abrading head of 250 g mass and no added weights, and consisting of the following elements:

6.1.1 A specimen turntable platform, which is removable, that includes a rubber pad and centrally located threaded post and nut.

6.1.2 A motor capable of rotating the turntable platform at a speed of either 72 r/min $\pm$ 2 r/min or 60 r/min $\pm$ 2 r/min.

6.1.3 A pair of abrading heads, which include the pivoted arm and flanged holder to which the abrasive wheel is attached.

6.1.4 A vacuum suction system and vacuum pickup nozzle to remove debris and abrasive particles from the specimen surface during testing. A vacuum suction level of 100 shall be used and the vacuum suction force shall be 13.7 kPa or greater, as measured by a vacuum gauge at the vacuum pickup nozzle port. The height of the vacuum pickup nozzle shall be adjustable.

6.1.5 A counter to record the number of abrasion cycles (revolutions) made by the turntable platform.

6.2 *H-22 Taber Calibrate Wheels*,² vitrified based, consisting of hard particles embedded in a binder material.

6.2.1 The wheels shall be cylindrically shaped; 12.7 mm $\pm$ 0.3 mm thick; include an axial hole 16.0 mm $\pm$ 0.1 mm to allow the wheel to be mounted to the flanged holder on the pivoted arm; and have an external diameter of 51.9 mm $\pm$ 0.5 mm when new, and in no case less than 44.4 mm.

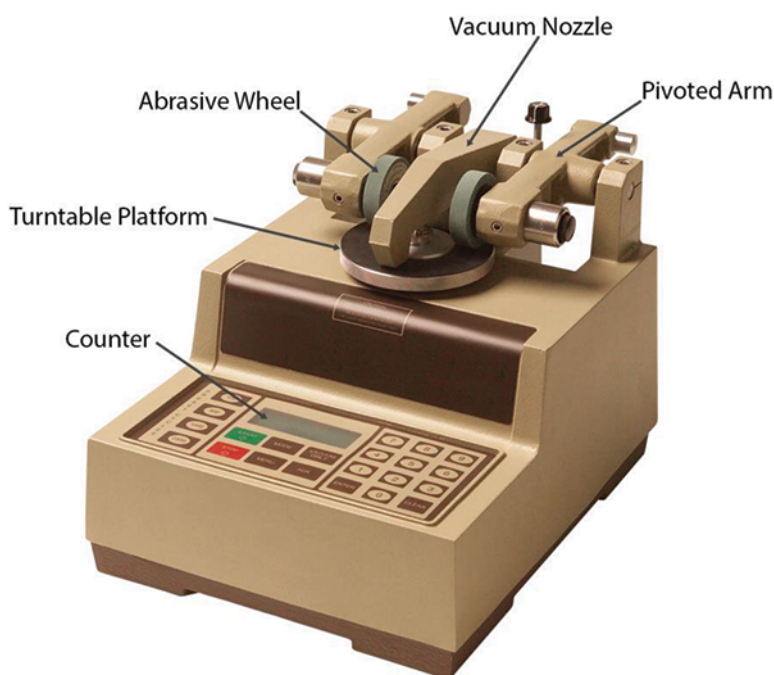
6.3 *Taber Wheel Refacer*,² or equivalent.

6.4 *Ultrasonic Cleaning Unit*, for cleaning specimens after abrading.

6.5 *Drying Oven*, capable of operation at 100 °C $\pm$ 2 °C, for drying specimens.

6.6 *Analytical Balance*, capable of weighing specimens with a resolution of 0.0001 g.

6.7 *Infrared Thermometer* (optional), to measure temperature of specimens before weighing.



NOTE 1—Vacuum suction system not shown.

FIG. 1 Taber Abraser