



Standard Test Method for Wear Testing of Polymeric Materials Used in Total Joint Prostheses¹

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1. Scope

1.1 This test method describes a laboratory method for evaluating the wear properties of combinations of materials that are being considered for use as bearing surfaces of human total joint prostheses. The body of this standard contains general methods which apply to all types of prosthesis wear applications while individual annexes describe specific wear test methods and clinical validation criteria tailored to each distinct wear application (for example, linear reciprocating motion, ball-cup (“hip-type”) wear, delamination wear, etc.). It is the intent of this test method to rank materials, within each wear application, for polymer wear rates under simulated physiological conditions. It must be recognized, however, that contact geometries and wear motions are simplified using such methods. This test method, therefore, represents only an initial stage in the full wear characterization of a candidate material.

1.2 All candidate materials should be tested in an appropriate joint simulator apparatus using prototype prostheses before being used in clinical trials in patients. The tests described in this test method are used to quickly and reliably screen material combinations for wear performance in different orthopaedic wear applications prior to committing them to more expensive and time-consuming joint simulator testing. In addition, these simplified tests can be used to relate material, surface finish, or other parameters to wear behavior on a more practical basis than is possible in joint simulator tests.

2. Referenced Documents

2.1 ASTM Standards:

D 883 Definitions of Terms Relating to Plastics²

F 75 Specification for Cast Cobalt-Chromium-Molybdenum Alloy for Surgical Implant Applications³

F 86 Practice for Surface Preparation and Marking of Metallic Surgical Implants³

F 648 Specification for Ultra-High-Molecular-Weight Poly-

ethylene Powder and Fabricated Form for Surgical Implants³

F 799 Specification for Thermomechanically Processed Cobalt-Chrome-Molybdenum Alloy for Surgical Implants³

F 1537 Specification for Wrought Cobalt-28-Chromium-6 Molybdenum Alloy for Surgical Implants³

F 2025 Practice for Gravimetric Measurement of Polymeric Components for Wear Assessment³

G 40 Terminology Relating to Erosion and Wear⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *wear*—for the purpose of this test method, the progressive loss of material from the polymer specimen as a result of the oscillating motion against the counterface under load. Wear may be generated by several mechanisms including adhesion, two or three body abrasion, surface fatigue, or other processes.

3.1.2 *wear rate*—the volume of material lost due to wear per unit of sliding distance (or per million wear cycles if complex motion patterns result in a non-uniform sliding distance across the specimen; see 4.3).

4. Significance and Use

4.1 This test method is intended to be performed in conjunction with pin-on-flat wear machines or similar machines that are designed to evaluate simplified specimen geometries.

4.2 This test method is designed to evaluate combinations of materials with respect to the amount of polymer wear, where quantifiable wear occurs primarily on the polymeric component. With some combinations of materials, significant wear of the counterface may occur, with subsequent embedding of counterface debris particles in the polymer. Such an occurrence will render the weight loss of the polymer specimen unreliable as an indicator of the polymer wear.

4.3 Wear is reported as volume loss of the polymeric specimen as a function of sliding distance; however, if the sliding distance is not constant across the polymeric specimen surface due to complex motion patterns, wear may be reported as volume loss of the polymeric specimen as a function of wear cycles (in which case a “wear cycle” shall be defined). Volume

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 Materials Test Methods.

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 13.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.02.