Designation: D 6205 – 98

Standard Practice for Calibration of the James Static Coefficient of Friction Machine[1]

This standard is issued under the fixed designation D 6205; 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 practice covers the testing of the James Machine for reproducibility and repeatability of static coefficient of friction, relative to a standard reference interface consisting of the working surfaces of Borco[2] board and standard leather shoe sole material. The practice provides basis data on the stability of the James Machine to ensure accurate static coefficient of friction determinations over time and repeated use and for determining if the James Machine is mechanically calibrated and properly aligned.

1.2 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 2047 Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine[3]

D 2825 Terminology Relating to Polishes and Related Materials[3]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[4]

E 178 Practice for Dealing with Outlying Observations[4]

E 456 Terminology Relating to Quality Statistics[4]

2.2 *Federal Specification:*

KK-L-165C Leather, Cattlehide, Vegetable Tanned and Chrome Tanned, Impregnated, and Soles[5]

3. Terminology

3.1 *Definitions:* For general definitions, see Test Method D 2047 and Terminology D 2825.

3.1.1 *James Static Coefficient of Friction (JSCOF)*, *n*—static coefficient of friction as measured by the James machine in accordance with Test Method D 2047.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Borco*, *n*—special 5-ply vinyl drawing board cover.

3.2.2 *reference surface, Borco standard leather system*, *n*—working interface of the set consisting of the white side of the Borco material, mounted as described in this practice, and the standard leather shoe sole material, mounted on a precision shoe pad as described in this practice.

3.2.3 *standard test sequence*, *n*—series of not less than eight consecutive James Static Coefficient of Friction (JSCOF) determinations made on the Borco/standard leather system in accordance with this practice.

4. Summary of Practice

4.1 The performance of the James Machine, in the standard configuration for the determination of James Static Coefficient of Friction (JSCOF), is tested relative to a standard working interface consisting of the surface of white Borco material in contact with a standard leather shoe pad. The static coefficient of friction values generated provide a basis to establish the reproducibility and repeatability of the mechanical configuration of the James Machine and determine whether the machine remains within the calibration limits.

5. Significance and Use

5.1 This practice is used to calibrate the James Machine for determination of static coefficient of friction of polish surfaces in accordance with Test Method D 2047. Over considerable time and repeated use the James Machine tends to become somewhat mechanically out of calibration, giving self-evident

[1] This practice is under the jurisdiction of ASTM Committee D-21 on Polishes and is the direct responsibility of Subcommittee D21.06 on Slip Resistance.

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[2] Borco is a registered trademark for a Danish product imported into the United States by Sierra Group, a division of Wallace Leisure Products, Inc. Available from Papyro-Tex A/S, DK-2730, Herlev, Denmark; distributed in North America through drafting and office supply stores under the trade names “Borco,” “Vyco,” and “Altex” board covers.

[3] *Annual Book of ASTM Standards*, Vol 15.04.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

[5] Available from Standardization Documents Order Desk, Bldg 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Atten: NPODS.

anomalous JSCOF readings. The periodic accumulation and comparison of data generated by this practice provides an indication of when the machine is no longer within the calibration limits and can no longer be expected to provide accurate and reliable data.

6. Interferences (Troubleshooting)

6.1 Deviations in calibration data and anomalies in machine reproducibility and repeatability are due to the following interferences:

6.1.1 *Contamination of the Test Surfaces*—These are most commonly due to fingerprints or other soils on the working leather surface or the working surface of the Borco board, or the presence of residual materials on the Borco board from use of an improper cleaning solution. Generally, contamination of the working surfaces will result in low JSCOF readings.

6.1.2 *Irregular Test Table Transport*—This problem is most common on James Machines that derive test table transport from manual cranking, which may not be smooth and uniform, but it may also be caused by grit and dirt in the drive mechanism or on the transport guides of the test table. Test table movement that is not smooth and uniform will provide low JSCOF readings.

6.1.3 *Improper Rate of Test Table Transport*—Even when uniform, the use of an improper rate of test table transport will result in changes in the JSCOF. This is most often seen in manually cranked test table transports, where the rate of travel is difficult to judge subjectively. Many motor driven test tables have an electrical motor speed control which adjusts the rate of table travel, and this can be inadvertently moved out of adjustment. Too rapid a rate of travel will result in high JSCOF readings, and too slow a rate of travel will result in low readings.

6.1.4 *Wear or Binding*—Wear or binding at the following bearing surfaces will result in deviations from calibration and loss of machine repeatability: upper strut pivot, upper strut ball bearings, back plate, strut rack and pinion gear assembly, lower strut pivot, and shoe pad cups for lower strut pivots. These problems are most often the result of the normal, repeated use of the James Machine, but they can also be caused by heavy impacts, improper use, improper periodic cleaning and lubrication, or inadequate protection of the machine from dirt. Wear resulting in excessive play in the bearing surfaces will results in lower JSCOF readings. Sporadic binding of the bearing surfaces and pivot points will result in loss of machine reproducibility and repeatability. Consistent binding of the bearing or pivot surfaces can result in high JSCOF readings.

6.1.5 *Test Table not Flat*—Test tables are warped out of flatness by either heavy impacts onto the table, storage of heavy items on the edges of the test table, or storage of the James Machine with the weight and strut in the upright position resting on the test table. This practice does not test for flatness of the test table, and this property must be independently assessed, either visually or by use of a machinist's dial gage attached to the strut rack gear to test the traversing test table. Lack of adequate test table flatness will result in poor reproducibility of data as a function of the test specimen (tile) placement on the table.

6.1.6 *Test Table not Level*—This problem is usually caused by normal wear of the table transport guides, but it may also result from an impact on the table or improper use of the test table for storage. A test table which is not level will result in abnormal JSCOF readings. The deviation from accurate JSCOF readings will depend on the magnitude and direction of the deviation of the test table from level.

6.1.7 *Excess Play or Movement in the Strut Rack Gear*—This results from wear in the strut rack and pinion gear assembly, loss of lubricant, or use of an improper lubricant in the gear box. Care must be taken that there is enough freedom in the movement of the strut rack gear so that the vertical motion of the strut rack gear is not impeded. Excess play in a direction either parallel or perpendicular to the plane of normal motion of the strut (or in any direction perpendicular to the vertical motion of the strut rack gear) will result in low JSCOF readings.

6.1.8 *Test Table Travel is not Orthogonal to the Plane of Strut Motion*—This is usually caused by excessive movement in the strut rack gear assembly in a direction perpendicular to the plane of normal strut motion (see 6.1.7), binding or excessive movement in at least one of the upper strut pivots (see 6.1.4), or normal wear or misalignment of the test table transport guides (see 6.1.6). This problem results in low JSCOF readings, since the slipping motion of the shoe pad on the test surface is compounded by a skewing action (greater lateral forces are applied at the interface than are recorded by the linear table displacement shown on the JSCOF chart).

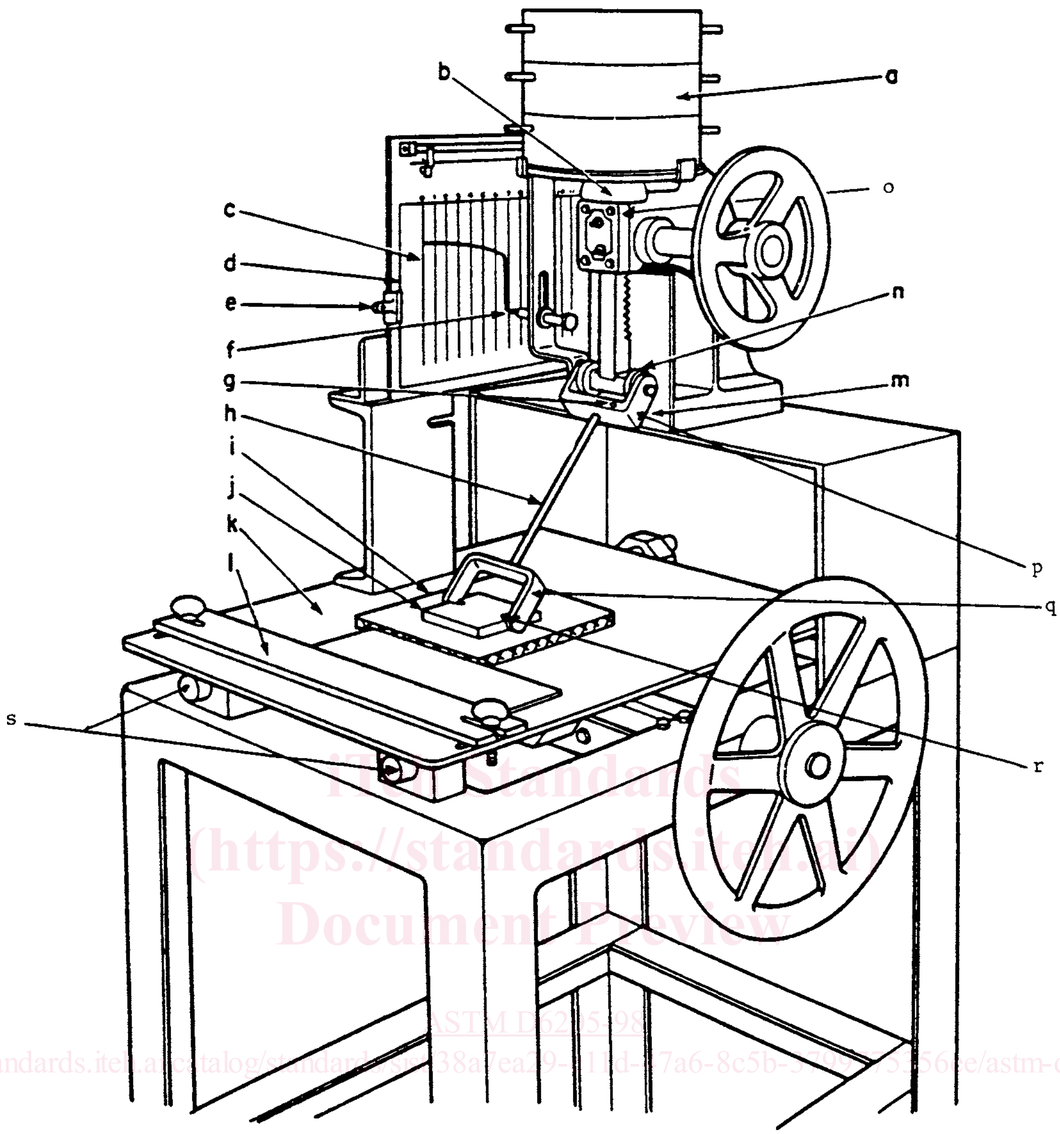
6.1.9 *Chart Board (or JSCOF Chart) is not in a Plane Parallel to the Plane of the Strut Motion*—This problem is usually due to a heavy impact on the chart board, but it can also be due to the use of a pad of JSCOF charts (rather than an individual sheet) attached to the chart board. The magnitude and sign of deviations in JSCOF readings that result from this problem depend on the magnitude and direction of the deviation of the chart board references planes from a parallel configuration with respect to the plane of strut motion.

6.1.10 *Warped, or "Out of True" Back Plate, Chart Board, Strut Arm, or Strut Rack Gear*—Though this problem can be the result of heavy impact, it is most commonly the result of not maintaining the James Machine in a controlled temperature environment. The James Machine is a complex assembly of parts that are rigidly held in alignment by bead welds or bolts. Since many of the parts are constructed of different metals, temperature changes (and the different coefficients of thermal expansion) will result in very large forces being applied to the joints or to the components themselves. This can result in a distortion or warping of the parts, particularly those which are large or have at least one long dimension.

7. Apparatus

7.1 *James Machine*[6,7]—See Fig. 1.

[6] The sole source of supply of the James Machine known to the committee at this time is Quadra, Inc., 1833 Oakdale Ave., Racine, WI 53405; (414)-637-6525. Machine shop-drawings for the construction of the James machine are available from Chemical Specialities Manufacturers Association, 1913 Eye Street, NW, Washington, DC 20006; (202)-872-8110.



a—Weights
b—Cushion
c—JSCOF Chart
d—Chart Board
e—Spring Clip
f—Recording Pencil
g—Set Screw
h—Strut Arm
i—Specimen
j—Shoe Pad
k—Test Table
l—Retaining Bar
m—Back Plate
n—Upper Strut Pivot and Ball Bearing Rollers
o—Gear Box (Rack and Pinion Gear, Strut Rack Gear)
p—Upper Strut
q—Lower Strut
r—Lower Strut Pivot and Shoe Pad Pivot Cups
s—Transport Guides

FIG. 1 James Machine