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: F1409 – 23

Standard Test Method for Straight Line Movement of Vacuum Cleaners While Cleaning Carpets[1]

This standard is issued under the fixed designation F1409; 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 a measurement of the relative work required to move an upright, canister, stick, or combination vacuum cleaner in a straight line with forward and backward stroking on a selection of typical carpeted surfaces.

1.1.1 This test method measures only the horizontal component of work required to move the vacuum cleaner on carpet.

1.2 This test method can be used in the testing of household and commercial vacuum cleaners.

1.3 This test method measures the relative work needed to move the vacuum cleaner with its motor or motors in operation.

1.4 This test method applies to the vacuum cleaning of carpets only.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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.*

NOTE 1—The F11.21 subcommittee is actively pursuing new market relevant carpets with the assistance of the carpet industry. Section 12 has been revised to remove carpets that are no longer available (that is, plush, Frieze).

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. Referenced Documents

2.1 *ASTM Standards:*[2]

F608 Test Method for Evaluation of Carpet Embedded Dirt Removal Effectiveness of Household/Commercial Vacuum Cleaners

F655 Specification for Test Carpets and Pads for Vacuum Cleaner Testing (Withdrawn 2022)[3]

F884 Test Method for Motor Life Evaluation of a Built-In (Central Vacuum) Vacuum Cleaner

F922 Test Method for Motor Life Evaluation of an Electric Motorized Nozzle

F1038 Test Method for Motor Life Evaluation of a Canister, Hand-held, Stick, and Utility Type Vacuum Cleaner Without a Driven Agitator

F1334 Test Method for Determining A-Weighted Sound Power Level of Vacuum Cleaners

3. Summary of Test Method

3.1 Mobility equipment is to be constructed and used to push the vacuum cleaner back and forth on the test carpet in a prescribed manner during the test. The mobility equipment is to employ a handle clamp assembly with a strain gauge, to be attached to the vacuum cleaner handle. This strain gauge measures the horizontal forces involved in moving only the vacuum on the test carpet.

3.2 Simultaneously, the incremental distance that the vacuum cleaner moves is also monitored and collected. The force and distance measurements are then used for calculating the work required to push and pull the vacuum on the test carpet.

3.3 The design of the mobility equipment used in this method is left to the user to develop and construct as there are numerous design approaches that may be employed for this evaluation. The mobility equipment may be designed to move the vacuum automatically or manually. Photographs of one

[1] This test method is under the jurisdiction of ASTM Committee F11 on Vacuum Cleaners and is the direct responsibility of Subcommittee F11.20 on Performance (Test Methods).

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[2] 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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design used in the industry to move the vacuum without the assistance of a technician is provided in Figs. 1-3. It is highly recommended that data acquisition and computerization, with a data sampling rate of at least ten samples per second, be utilized to improve the speed and accuracy of data measurements.

4. Significance and Use

4.1 This test method measures the horizontal component of the relative work required by the user during the cleaning operation for the movement of a vacuum cleaner in the home or other cleaning location on standardized laboratory carpeting. Work is determined from the forces measured in the horizontal direction only by the mobility equipment.

4.2 This measurement is relative to the work performed by the user of vacuum cleaners and may be used for comparison between vacuum cleaners.

4.3 The relation between actual vacuum cleaner usage and the method of operation is valid only if the vacuum cleaner user operates the vacuum cleaner properly and in accordance with the manufacturer's instructions.

5. Apparatus

5.1 *Mobility Equipment,* to move the vacuum cleaner for measuring and determining relative work. This equipment is to be designed and developed by the user.

5.2 *Calibration Weights*—Precision weights for calibrating the force measuring instrumentation. At least three calibration weights shall be employed to check and ensure linear calibration of the instrumentation. The precision weights are based on the maximum rating of the load cell/strain gauge that is used, and shall include a 5 lb weight, a half-scale weight, and a full-scale weight.

5.3 *Test Carpets,* as specified in Specification F655. Test carpets shall be stored in a vertical position with no weight on the test surface.

NOTE 2—The test carpets for relative work testing should be limited to that use and not used for other tests such as cleanability.

5.4 *Padding,* beneath test carpet, as specified in Specification F655.

5.5 *Temperature and Humidity Indicators,* to provide temperature measurements accurate to ±1 °F (±0.5 °C) and ±2 % relative humidity.

5.6 *Voltmeter,* to measure input voltage to the vacuum cleaner, capable of providing measurements accurate within ±1 %.

5.7 *Voltage Regulator System,* to control input voltage to the vacuum cleaner. The regulator system shall be capable of maintaining the vacuum cleaner's rated voltage <1 % and rated frequency <1 Hz having a wave form that is essentially sinusoidal with 3 % maximum harmonic distortion for the duration of the test.

5.8 *Rotating Agitator Reference Cleaner,* for calibrating test carpets (see 7.1.3).

5.9 *Straight Air Canister Reference Cleaner,* for calibrating test carpets (see 7.1.3).

6. Sampling

6.1 A minimum of three units of the same model vacuum cleaner, selected at random in accordance with good statistical practice, shall constitute the population sample.

6.1.1 To determine the best estimate of the total relative work for the population of the vacuum cleaner model being tested, the arithmetic mean of the relative work of the sample

FIG. 1 ASTM Mobility Equipment

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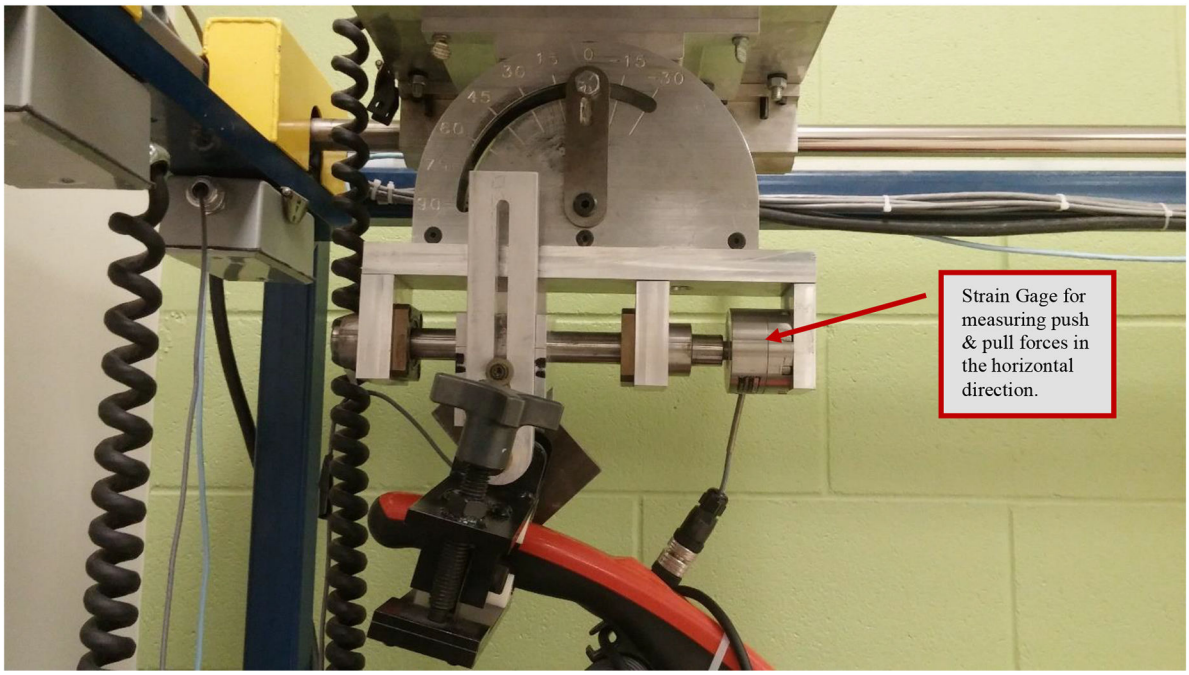

FIG. 2 Strain Gauge and Handle Clamp

FIG. 3 Motion Drive and Data Collection Computer

from the population shall be established by testing it to a 90 % confidence level within 5 % of the mean.

6.1.2 Annex A1 provides a procedural example for determining the 90 % confidence level and when the sample size shall be increased (see Note 3).

NOTE 3—See Annex A1 for method of determining 90 % confidence level.

7. Preparation of Apparatus and Test Cleaner

7.1 *Preconditioning for New Test Carpet Samples:*

7.1.1 Cut a sample of each test carpet to a size of 27 in. by 72 in. (690 mm by 1830 mm) minimum. If the warp direction or "lay" of the carpet can be determined, it shall be in the 72 in. direction. Carpets shall be bound on all sides.

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