



## Standard Test Method for Motor Life Evaluation of a Built-In (Central Vacuum) Vacuum Cleaner<sup>1</sup>

This standard is issued under the fixed designation F 884; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method is limited to motor life evaluation of central vacuum cleaners.

1.2 This test method provides a test to determine operating life of the motor, before servicing is needed, by an accelerated laboratory procedure. The motor is tested while mounted and is operated in central vacuum cleaner.

1.3 The values as stated in inch-pound units are to be regarded as the standard. The values in parentheses are for information only.

1.4 *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:

E 337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)<sup>2</sup>

F 431 Specification for Air Performance Measurement Plenum Chamber for Vacuum Cleaners<sup>3</sup>

F 608 Test Method for Evaluation of Carpet-Embedded Dirt Removal Effectiveness of Household Vacuum Cleaners<sup>3</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *failure*—motor stoppage.

3.1.2 *motor life*—limited by the failure of the motor. Any failure integral with motor, such as armature assembly, field assembly, housing(s), bearings, motor cooling fan and primary air moving fan, or both, brush assemblies, motormounted nonresettable thermal protection devices, or any other component judged to be integral with the motor, shall be judged as motor stoppage.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee F-11 on Vacuum Cleaners and is the direct responsibility of Subcommittee F11.30 on Durability-Reliability.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 11.03.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.07.

### 4. Significance and Use

4.1 The test results provide an indication of the motor life of an electric vacuum cleaner in operating life. The end of the motor life will be judged in accordance with Section 3.

### 5. Apparatus and Materials

5.1 *Voltage Regulator*—The regulator must be capable of maintaining  $120 \pm 2$  V rms with a waveform that is essentially sinusoidal with 3 % maximum harmonic distortion for the duration of the test.

5.2 *Voltmeter*, to provide measurements accurate to within  $\pm 1$  %

5.3 *Timer and Switch*—The timer and switch will have the capacity to control off/on duty cycle of the cleaner during the life test.

5.4 *Sharp Edge Orifice Plate*—The orifice, 0.75 in. (19.05 mm) in diameter, shall be in accordance with the figure illustrating orifice plate detail in Specification F 431.

5.5 *Wattmeter*, to provide measurements accurate to within 1 %.

5.6 *Plenum Chamber*, in accordance with the plenum chamber described in Specification F 431.

5.7 *Water Manometer*, or equivalent instrument measuring in increments of 0.1 in. (2.54 mm).

5.8 *Barometer*, with an accuracy to  $\pm 0.05$  in. (1.27 mm) Hg, capable of measuring uncorrected barometric pressure (test station pressure) with scale division 0.02 in. (0.51 mm) or finer.

5.9 *Thermometer*, having a range from 18 to 80°F (–8 to 27°C) and graduated in 1°F (0.5°C) increments.

5.10 *Psychrometer*—The psychrometer shall meet the requirements of Test Method E 337 with thermometers graduated in increments of 1°F (0.5°C).

5.11 *Test Fixture*—Any suitable surface that will support the vacuum cleaner in the normal operating position.

### 6. Sampling

6.1 Test a minimum of three units (or a larger sample size if desired) of any model. Select all samples at random in accordance with good statistical practice. Results shall provide

an 80 % confidence level within  $\pm 10$  % of the mean value. If not, test additional samples or reduce the results by the penalty factor as calculated in 7.9.

## 7. Procedures for Motor Life Evaluation

7.1 Determine initial performance as follows:

7.1.1 Connect the manometer (or equivalent) to the plenum chamber. Install a new filter bag in the test cleaner, if required, before conducting performance tests.

7.1.2 With a minimum length of 2 in. inside diameter tubing sealed to the plenum chamber and to the cleaner, and without an orifice plate in the holder, energize the cleaner rated at 110 to 120 V at  $120 \pm 2$  V, 60 Hz, for 5 min to stabilize motor temperatures. If the rated voltage of the vacuum cleaner is other than 110 to 120 V, run it at the rated voltage of  $\pm 2$  V rms.

7.1.3 With the cleaner operating at a constant rated voltage, insert the 0.75-in. (19.05-mm) diameter sharp-edge orifice into the holder on the orifice box.

7.1.4 Record the manometer reading as soon as the reading stabilizes.

7.1.4.1 Take reading as soon as the manometer reaches a true peak (Note 1). Allow the vacuum cleaner system to operate at open orifice. Take all readings within 10 s of the orifice plate insertion.

NOTE 1—On higher manometer readings, the liquid level may peak, and drop and peak again a second time. The second peak is the true peak reading. A person conducting the test for the first time should observe at least one run before recording data.

7.1.5 Record the wattage of cleaner on the plenum chamber. The wattage reading is used to monitor the cleaner load.

7.1.6 Monitor the wattage, the suction, or both, daily and measure on the plenum chamber every 168 h to ensure that a load is maintained; that no mechanical problem has developed; that performance has not degraded by more than 40 %, or a combination of these. If degradation exceeds 40 %, see 7.7.1 and 7.7.2.

7.2 Install the cleaner on the test fixture with a 0.75-in. (19.05-mm) diameter sharp-edge orifice in the cleaner inlet opening.

7.3 If various settings are provided, set the motor speed setting and the suction regulator, or a combination of these, in accordance with the manufacturer's specified setting for using the cleaner on the level loop test carpet. The setting shall be the same as that which is used for the cleanability of embedded dirt carpet test in Test Method F 608.

7.4 If the cleaner under test is equipped with a disposable filter bag or reusable filter bag, it should be replaced or cleaned every 168 h of cycling time during the life test. The manufacturer's recommended cleaning procedure is to be used whenever specified in instruction booklets. Where no procedure is specified, replace reusable filters. When a new or cleaned filter is placed in the cleaner, check the cleaner on the plenum chamber for degradation of performance in accordance with 7.7.1 and 7.7.2.

7.5 Perform all tests in a controlled ambient atmosphere with a dry-bulb temperature from 68 to 81°F (20 to 27°C) and a relative humidity of 30 to 50 %.

7.6 Operate the cleaner at the voltage specified in 7.1.2 from a remote on/off switch and timer with a duty cycle of 8 min of operation, followed by 2 min off.

7.7 Test for degradation of performance every 168 h of cycling time.

7.7.1 *Air Flow*—In accordance with the procedure in Annex A1, use the suction at the start of the test as the base for determining the 40 % degradation of performance (see 7.1.4).

7.7.2 If degradation is present, determine and correct the cause. Replace any part, except the motor or its integral parts to bring the system within performance limits, and continue the test until the motor stops.

7.8 Judge the end of the test in conformity with Section 3. Express life in terms of "on" hours only.

7.9 Calculate an estimate of the population mean in accordance with the following procedure:

7.9.1 Calculate sample mean for units tested and confidence interval half-width.

$$\bar{x} = \sum_{i=1}^n x_i \qquad h = \frac{ts}{\sqrt{n}}$$

where:

$\bar{x}$  = mean of sample,

$n$  = sample size,

$x_i$  = life, in hours of "on" time, for each sample tested,

$h$  = half-width of confidence interval,

$t$  = value from  $t$  distribution table for 80 % ( $t_{0.80}$ ) confidence level and  $df = n - 1$  (see Test Method F 608, Table A3.1), and

$s$  = standard deviation of sample.

7.9.2 Compare sample mean and confidence interval half-width to determine if a penalty factor is required:

A: If  $h \leq 0.1 \bar{x}$ , use  $\bar{x}$  as published value.

B: If  $h > 0.1 \bar{x}$ , test additional units to meet confidence level or use following penalty factor ( $\Delta$ ):

$$\Delta = h - 0.1\bar{x}$$

Use  $\bar{x} - \Delta$  as published value.

## 8. Precision and Bias

8.1 *Precision*—A meaningful precision statement cannot be made due to the number of components in the motor, each of which could constitute failure of the motor.

8.2 *Bias*—Bias does not apply because there is no standard reference for comparison.

## 9. Keywords

9.1 central vacuum; degraded; failure; life evaluation; motor