Designation: F 1326 – 96

Standard Test Method for Measuring Maximum Dry Volume of Utility Vacuum Cleaners[1]

This standard is issued under the fixed designation F 1326; 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 is applicable to any vacuum cleaner that is classified as a utility vac.

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.*

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

2. Significance and Use

2.1 This test method describes a procedure to determine the maximum functional dry volume that the utility vac is capable of collecting.

3. Apparatus

3.1 *Voltmeter*, to measure input to the cleaner, to provide measurements accurately to within ±1 %.

3.2 *Voltage regulator system*, to control the input voltage to the cleaner. The regulator shall be capable of maintaining 120 ± 1 V rms with a wave form that is essentially sinusoidal with 3 % maximum harmonic distortion.

3.3 *Temperature and humidity indicators*, to provide temperature measurements accurate to within ±1°F (±½ °C) and humidity measurements accurate to within ±2 % relative humidity.

3.4 *Weighing Scale*, the scale shall be accurate to 4 oz (114 g) and have a weighing capacity of at least 120 lbs. (54.4 Kg).

4. Materials

4.1 Water.

5. Sampling

5.1 Test a sample of each basic model until a 90 % confidence level (about the mean) is established within ±5 % of the mean value. Test a minimum of three samples. Select all samples at random in accordance with good statistical practice.

NOTE 1—See Appendix X1 for a method for determining 90 % confidence level.

6. Conditioning

6.1 *Test Room*—The test room should be maintained at 70°F ± 5°F (21°C ± 3°C) and 45 to 55 % relative humidity.

6.2 Condition the water in accordance with 6.1.

7. Procedure

7.1 *Dry Pick Up Capacity*:

7.1.1 Calculate the volume in gallons of the dust drum using the appropriate formulas, neglecting all projections into the drum.

7.1.2 Calculate all projections into the drum using the appropriate formulas in gallons.

7.1.3 Subtract the total projection volumes from the dirt drum volume to arrive at the maximum dry volume. Round down to the nearest ¼ gal (0.936 L).

7.1.4 Record the maximum functional volume in gallons (litres) within ¼ gal (0.936 L).

8. Procedure

8.1 *Dry Pick Up Capacity (Alternative Method)*:

8.1.1 An alternative method is allowed when the shape of the vacuum cleaner is irregular, and the calculations of Section 6 become complex.

8.1.1.1 Block the inlet of the dust drum and fill it with water.

8.1.1.2 Line the projections into the drum with an appropriate water-proof material and submerse into the dust drum.

8.1.1.3 Allow the excess water to flow out of the dust drum and then measure the volume of the water remaining in the dust drum. Round down to the nearest ¼ gal.

8.1.1.4 Record the maximum functional volume in gallons (litres) within ¼ gal (0.936 L).

8.1.1.5 Repeat steps 8.1.1-8.1.1.4 two more times. The average of the three tests represents the maximum dry functional volume that the utility vacuum is capable of collecting.

9. Precision and Bias [2]

9.1 *Precision*—These statements are based on an interlaboratory test involving six laboratories and four units. The range

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[2] Supporting data are available from ASTM Headquarters. Request RR-F11-1009.

of maximum functional volume of the units was from 4.8 to 14.6 gal.

9.1.1 *Repeatability*, single-operator-laboratory, multi-day:

9.1.1.1 Repeatability for dry volume values of 5 gal and under, the standard deviation within a laboratory divided by the average (coefficient of variation) was found to be 1.4 % or less. Two values from a sample of three should be considered suspect at the 95 % confidence level) if they differ by more than 4 %. The percent difference equals:

$$(\text{larger} - \text{smaller})/(\text{larger}) \times 100) \tag{1}$$

9.1.1.2 Repeatability for dry volume values of over 5 gal, the standard deviation within a laboratory divided by the average (coefficient of variation) was found to be 0.8 % or less. Two values from a sample of three should be considered suspect (at the 95 % confidence level) if they differ by more than 2.3 %. The percent difference equals:

$$(\text{larger} - \text{smaller})/(\text{larger}) \times 100) \tag{2}$$

9.1.2 *Reproducibility*, multi laboratory, multi-day:

9.1.2.1 *Reproducibility*—the standard deviation divided by the average (coefficient of variation) with a single unit tested in different laboratories was found to be 7.8 % or less. Two such values should be considered suspect (at the 95 % confidence level) if they differ by more than 22 %.

9.1.2.2 *Reproducibility*—the standard deviation divided by the average (coefficient of variation) with a single unit tested in different laboratories was found to be 3.1 % or less. Two such values should be considered suspect (at the 95 % confidence level) if they differ by more than 91.1 %.

9.2 *Bias*—No justifiable statement can be made on the bias of this test method for testing the properties listed. The true values of the properties cannot be established by acceptable referee methods.

10. Keywords

10.1 dry volume; filtration; utility vacuum cleaner

APPENDIX

(Nonmandatory Information)

X1. DETERMINATION OF 90 % CONFIDENCE INTERVAL

X1.1 The most common and ordinarily the best single estimate of the population mean μ is simply the arithmetic mean of the measurements. When a sample is taken from a population, the sample average will seldom be exactly the same as the population average; however, it is hoped to be fairly close so that the statement of confidence interval will bracket the true mean.

X1.2 The following procedure gives an interval which is expected to bracket μ, the true mean, 100(1 − α) % of the time. This provides a 100(1 − α) % confidence level. α is the chance of being wrong, therefore, 1 − α is the probability of being correct.

X1.2.1 Choose the desired confidence level, 1 − α.

X1.2.2 Compute Mean ($\bar{X}$):

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \tag{X1.1}$$

$$\text{Standard Deviation, } s = \sqrt{\frac{n \,\Sigma\, X_i^2 - (\Sigma\, X_i)^2}{n(n-1)}} \tag{X1.2}$$

where:
n = number of units.

X1.2.3 Compute the upper limit (X_μ) and the lower limit (X_L):

$$X_\mu = \bar{X} + ts/\sqrt{n} \tag{X1.3}$$

$$X_L = \bar{X} - ts/\sqrt{n}$$

where:
t = value from Table X1.1 at (1 − >α)/2.

X1.3 The interval from X_L to X_μ is a 100(1 − α) % confidence interval for the population mean; that is, we may assert with 100(1 − α) % confidence that $X_L < \mu < X_\mu$. It can be seen that as $n \to \infty$, $ts/\sqrt{n} \to 0$. Thus, a smaller confidence interval for the mean can be obtained by using larger samples. In application, we are interested in a 90 % confidence interval of the population mean (α = 0.10), and we desire the quantity $ts/\sqrt{n}$ to be less than some value, A. Values of $t_{(1-\alpha)/2} = t_{0.95}$ will be taken from Table X1.1 and used in the computation.

X1.4 *Procedure:*

X1.4.1 *Step 1*—Select three units for test as the minimum sample size.

X1.4.2 *Step 2*—Obtain unit scores by averaging three test runs meeting the expected repeatability in 9.1.1.

X1.4.3 *Step 3*—Compute $\bar{X}$ and s for the sample.

X1.4.4 *Step 4*—Compute A; $A = 5\ \%$ of $\bar{X}$ in accordance with the sampling statement of 5.

X1.4.5 *Step 5*—Look up $t_{0.95}$ for $n - 1$ degrees of freedom (df) in the table where n = number of units.

X1.4.6 *Step 6*—Compute $ts/\sqrt{n}$ for the sample and compare to A.

X1.4.7 *Step 7*—If $ts/\sqrt{n} > A$, select another unit for test which increases the sample size, and perform X1.4.2-X1.4.6 with the larger sample.

X1.4.8 *Step 8*—If $ts/\sqrt{n} < A$, a desired 90 % confidence interval has been obtained. The final X can be used as an estimate of the population mean.

X1.5 *Example of Data Chosen to Illustrate Determination of a Mean Maximum Functional Volume for a Model Vacuum Cleaner:*

X1.5.1 *Step 1*—Select three units for functional volume measurements, each to be run a minimum of three times.