Designation: F 595 – 01 (Reapproved 2005)

An American National Standard

Standard Test Methods for Vacuum Cleaner Hose—Durability and Reliability (All-Plastic Hose)[1]

This standard is issued under the fixed designation F 595; 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 These test methods cover the determination of the effect of anticipated stresses and strains that vacuum cleaner hoses will receive in normal use.

1.2 These test methods apply to all-plastic, nonelectric vacuum cleaner hoses for household use.

NOTE 1—For information on plastic wire-reinforced, nonelectric vacuum cleaner hoses for household use, refer to Test Methods F 450.

1.3 These test methods are individual tests as agreed upon between the hose manufacturer and the vacuum cleaner manufacturer.

1.4 The following tests are included:

	Section
Torsional flex	6
Hot and cold flex with aging (optional)	7
Abrasion (external surface) (optional)	8
Flex	9
Pull test on hose fittings with aging	10
Crush	11

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, which 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 638 Test Method for Tensile Properties of Plastics

D 695 Test Method for Compressive Properties of Rigid Plastics

F 395 Terminology Relating to Vacuum Cleaners

F 450 Test Methods for Vacuum Cleaner Hose—Durability and Reliability (Plastic Wire Reinforced)

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology F 395.

4. Significance and Use

4.1 These test methods can be used by buyers of vacuum cleaner hose to specify the test criteria the hose must meet to be acceptable for their purposes.

5. Sampling

5.1 The sample size shall be one that is mutually agreed upon between the hose manufacturer and the vacuum cleaner manufacturer.

TEST METHODS

6. Torsional Flex

6.1 *Scope*—This test method covers the determination of resistance to failure while twisting under stress in a bend.

6.2 *Apparatus*—The apparatus shown in Fig. 1 is suitable for this test method with the following provisions:

6.2.1 Means to rotate test mandrels in an inverted vertical position at 30 ± 2 rpm, one clockwise and the other counterclockwise operating at identical rates.

6.2.2 Suitable clamp to attach both ends of sample hose to mandrels without causing failure at the clamp during the test.

6.2.3 Test mandrel with diameter same as inside diameter of hose with a 0.078-in. (2.0-mm) radius at the ends of the mandrel (see Fig. 1).

6.2.4 Instrument to measure cycles to failure or to a specified end point.

6.3 *Test Specimen*—The specimen shall be a length of hose 30 ± 1 in. (762 ± 25 mm) long without fittings.

6.4 *Conditioning*—Condition the specimen at 68 to 81°F (20 to 27°C) ambient temperature for not less than 1 h prior to the test.

[1] These methods are under the jurisdiction of ASTM Committee F11 on Vacuum Cleaners, and are the direct responsibility of Subcommittee F11.30 on Durability-Reliability.

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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.

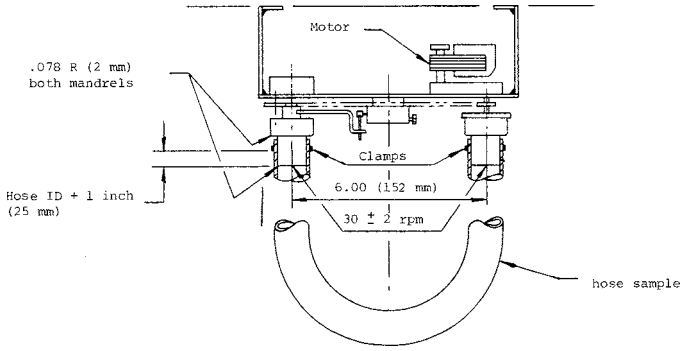


FIG. 1 Schematic for Torsional Flex Test

6.5 *Procedure*:

6.5.1 Conduct the tests at 68 to 81°F (20 to 27°C).

6.5.2 Clamp both ends of the test specimen to the test mandrels as shown in Fig. 1.

6.5.3 Set the measuring instrument at zero or record initial reading.

6.5.4 Test the specimen by rotating at 30 ± 2 rpm until failure or to a specified end point.

6.5.5 Failure may be evidenced by a broken reinforcing wire, tear, or hole that penetrates the hose jacket, or a collapsed coil or ply for a lined-type hose, or any combination thereof.

6.6 *Report*—The report shall include the following:

6.6.1 Number of cycles to failure or to a specified end point, whichever occurs first,

6.6.2 Type of failure,

6.6.3 Ambient temperature,

6.6.4 Description of specimen, and

6.6.5 Number of specimens tested.

7. Hot and Cold Flex with Aging (Optional)

7.1 *Scope*—This test method covers the determination of the effect of temperature and flexing upon a hose sample.

7.2 *Apparatus*:

7.2.1 *Air-Circulating Oven or Environmental Chamber*, to maintain 156°F (69°C) controlled to ±2°F (±1°C).

7.2.2 *Cold Box*, able to maintain 20°F (–6.7°C) controlled to ±1°F (±0.5°C).

7.3 *Test Specimen*—The specimen shall be a length of hose in which the length in inches or millimetres shall be determined as follows:

$$11.2 \times \text{inside diameter, in inches, } + 2 \text{ in.}$$

$$(11.2 \times \text{inside diameter, in millimetres, } + 51 \text{ mm})$$

7.4 *Conditioning*—Condition the specimens at an ambient temperature of 68 to 81°F (20 to 27°C) for not less than 1 h prior to test.

7.5 *Procedure*:

7.5.1 Bend a specimen in a "U" shape and tie the ends together at a position 1 in. (25 mm) from the ends as shown in Fig. 2.

7.5.2 Place the specimen into the oven, which has been brought to a steady test temperature of 156 ± 2°F (69 ± 1°C), and soak the specimen for 20½ h.

7.5.3 Remove the specimen from the oven and allow 30 min for it to come to equilibrium with the ambient temperature in accordance with 7.4.

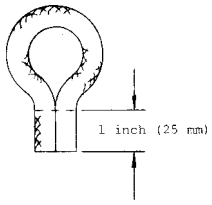


FIG. 2 Hose Position During Heat and Cold Soak

7.5.4 Next place the specimen in the cold box, which has been brought to a steady temperature of 20 ± 1°F (–6.7 ± 0.5°C) for 2 h.

7.5.5 Remove the specimen from the cold box, untie, and immediately flex it 360 deg, three times, 1 s per flex, as shown in Fig. 3.

7.5.6 Failure may be evidenced by a broken reinforcing wire, tear, or hole that penetrates the hose jacket, or a collapsed coil or ply for a lined-type hose, or any combination thereof.

7.5.7 Retie the hose in its original position.

7.5.8 Allow 1 h for conditioning as specified in 7.4 before starting the next cycle.

7.5.9 Consider the steps covered in 7.5.1-7.5.7 as one cycle. Conduct four complete, successive cycles; then permit the specimens to remain at ambient conditions for the unused balance of a 7-day period. Repeat until failure occurs or until a specified end point is reached, whichever occurs first.

7.6 *Report*—The report shall include the following:

7.6.1 Number of cycles to failure or to a specified end point, whichever occurs first,

7.6.2 Condition of the specimen,

7.6.3 Ambient test temperature,

7.6.4 Description of specimen, and

7.6.5 Number of specimens tested.

8. Abrasion—External Surface (Optional)

8.1 *Scope*—This test method covers measurement of the wear characteristics of a vacuum cleaner hose subjected to an abrasive surface.

8.2 *Apparatus*:

8.2.1 *Special Abrasion Test Fixture*, as described in Fig. 4 to produce a rate of 20 ± 1 cycles/min.

8.2.2 *Cylindrical Segment*, as described in Fig. 5.

8.2.3 *Test Weight*, 16 ± 0.1 oz (454 ± 2.8 g) with provision to attach to the specimen.

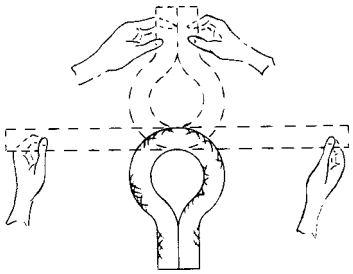
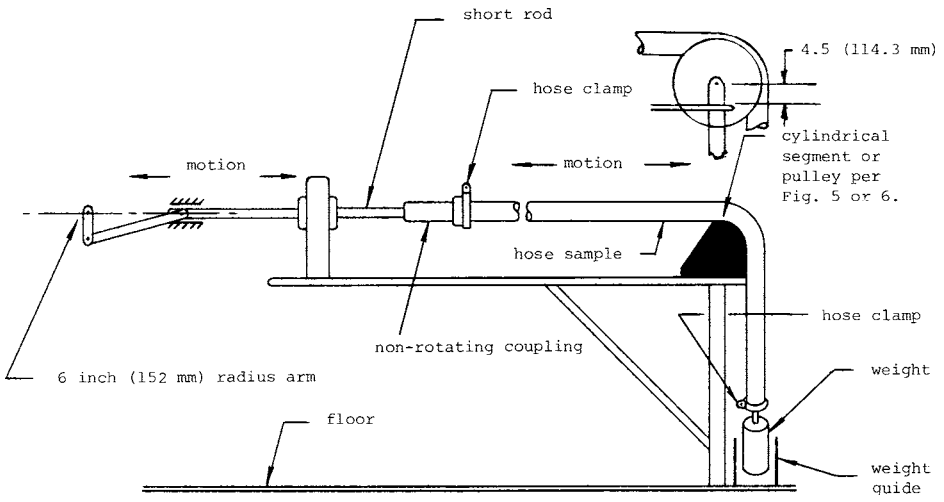


FIG. 3 Hose Flex Cycle



NOTE 1—Abrasion set up shown.

FIG. 4 Abrasion and Flex Test Fixture

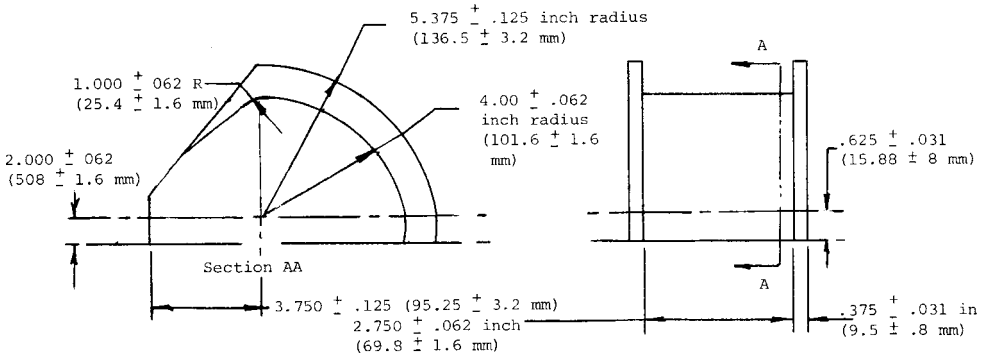


FIG. 5 Cylindrical Segment (Abrasion Test)

8.2.4 *Abrasive Paper*, wet-dry, 500-grit, for abrasion test surface.[3]

8.2.5 *Instrument*, to measure cycles to failure or to a specified end point.

8.2.6 *Weight Guide*, to prevent weight from swinging during test cycling.

8.2.7 *Clamps*, suitable for attaching the hose to the mechanism coupling on one end and attaching the weight to the other end without causing failure of the hose at these clamps.

8.3 *Test Specimen*—The specimen shall be a full-length hose, or a length of hose suitable for the test unit.

8.4 *Conditioning*—Condition the specimen at 68 to 81°F (20 to 27°C) ambient temperature for not less than 1 h prior to test.

8.5 *Procedure*:

8.5.1 Conduct the tests at 68 to 81°F (20 to 27°C).

8.5.2 Clamp a new sheet of standard wet-dry, 500-grit, abrasive paper to the cylinder.

8.5.3 Clamp the specimen to the mechanism coupling. Attach the weight and place in the weight guide. The weight shall be in free suspension throughout the cycle.

8.5.4 Set the measuring instrument to zero or record the initial reading.

8.5.5 Cycle the specimen against the surface of the abrasive paper until failure of the jacket or to a specified end point.

8.5.6 Failure is a hole in jacket.

8.6 *Report*—The report shall include the following:

8.6.1 Number of cycles to failure or to a specified end point, whichever occurs first,

8.6.2 Description of failure,

8.6.3 Ambient test temperature,

8.6.4 Description of specimen, and

8.6.5 Number of pieces tested.

9. Flex

9.1 *Scope*—This test method covers the determination of the vacuum cleaner hose's resistance to bending under an applied stress.

9.2 *Apparatus*:

9.2.1 Same mechanism described in 8.2.1 and Fig. 4, except driving arm rotating at 36 ± 1 cycles/min and cylindrical segment replaced with pulley.

9.2.2 *Pulley*, cold-rolled, steel grooved, as described in Fig. 6.

9.2.3 *Test Weight*, 80 ± 1 oz (2268 ± 28 g) with provision to attach to the specimen.

[3] Wet-dry, 500-grit, Tri-M-Ite abrasive paper, available from 3M Co., St. Paul, MN, has been found suitable for this purpose.

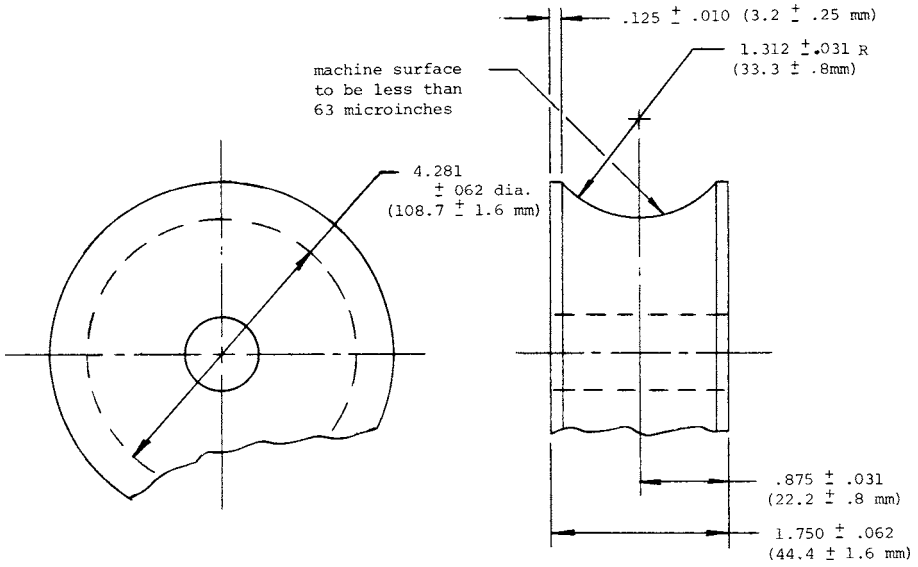


FIG. 6 Pulley Flex Test Fixture

9.2.4 *Weight Guide*, to prevent weight from swinging during test cycling.

9.2.5 *Instrument*, to measure cycles to failure or to a specified end point.

9.2.6 *Clamps*, suitable for attaching the hose to the mechanism coupling on one end and attaching the weight to the other end without causing failure of the hose at these clamps.

9.3 *Test Specimen*—The specimen shall be a full-length hose, or a length of hose suitable for the test unit.

9.4 *Conditioning*—Condition the specimen at 68 to 81°F (20 to 27°C) ambient temperature for not less than 1 h prior to test.

9.5 *Procedure*:

9.5.1 Conduct the tests at 68 to 81°F (20 to 27°C).

9.5.2 Clamp the specimen to the mechanism coupling. Attach the weight and place in the weight guide. The weight shall be in free suspension throughout the cycle.

9.5.3 Set the measuring instrument to zero or record the initial reading.

9.5.4 Run the test until failure or to a specified end point, whichever occurs first.

9.5.5 Failure may be evidenced by a broken reinforcing wire, tear, or hole that penetrates the hose jacket, or a collapsed coil or ply for a lined-type hose, or any combination thereof.

9.6 *Report*—The report shall include the following:

9.6.1 Number of cycles to failure or to a specified end point, whichever occurs first,

9.6.2 Type of failure,

9.6.3 Ambient test temperature,

9.6.4 Description of specimen,

9.6.5 Number of pieces tested, and

9.6.6 Record any permanent change in inside hose diameter.

10. Pull Test on Hose Fittings with Aging

10.1 *Scope*—This test method covers the determination of the ability of the vacuum cleaner hose fitting connection to withstand maximum forces during use.

10.2 *Apparatus*:

10.2.1 *Oven and Cold Box*, as specified in 7.2.

10.2.2 *Total Test Weight*, in 80 ± 0.5-oz (2268 ± 14-g) increments.

10.2.3 *Testing Machine (alternative to the dead weight)*—A properly calibrated machine of the constant-rate-of crosshead movement type meeting the requirements of Test Method D 638. See 10.5.3 for tensile method.

10.3 *Test Specimen*—The test specimen shall be a 1-ft (0.3-m) long section from each end of the hose containing cleaner attachment fittings, or the hose end fitting, or both. Its length shall conform to the requirements of 10.5.3.1 if the tension machine test method is used.

10.4 *Conditioning*—Prior to the test on fittings, age the specimens by performing the following heat/cold soak.

10.4.1 Place the specimens in a straight configuration, in an air-circulating oven at 156 ± 2°F (69 ± 1°C) for 20½ h.

10.4.2 Remove the specimens from the oven and allow 30 min for the specimens to come to equilibrium with an ambient temperature of 68 to 81°F (20 to 27°C).

10.4.3 Place the specimens in the cold box at 20 ± 1°F (−6.7 ± 0.5°C) for 2 h.

10.4.4 Remove the specimens from the cold box and allow 1 h for return to ambient temperature before conducting the pull test.

10.5 *Procedure*:

10.5.1 Conduct the tests at an ambient temperature of 68 to 81°F (20 to 27°C).

10.5.2 *Dead-Weight Method*:

10.5.2.1 Clamp the fitting of the specimen to the dead weight.

10.5.2.2 Holding the hose, lift the weight slowly. Hold off the floor for 1 min.

10.5.2.3 Continue increasing the load in 80-oz (2268-g) increments until failure or until a specified load is reached.

10.5.2.4 Test both ends.

10.5.3 *Tension Testing Machine Method*:

10.5.3.1 Select a specimen length short enough so that the end treatment is pulled off before the hose stretches the entire distance of travel of the instrument.

10.5.3.2 Fasten both ends of the hose firmly in the machine.

10.5.3.3 Stretch the specimen at the rate of 0.50 ± 0.2 in. (12.7 ± 5.1 mm)/min until the hose pulls away from the fitting. Note the force applied.

10.5.3.4 Repeat the test with slightly decreasing amounts of force until the greatest force applied to the specimen for 1 min without pulling the fitting from the hose is reached. Note this value.

10.5.3.5 If the hose fails before either the fitting or fitting to hose bond, report as hose failure and load applied.

10.6 *Report*—The report shall include the following:

10.6.1 Maximum weight or load supported without failure,

10.6.2 Location of failure,

10.6.3 Ambient test temperature,

10.6.4 Hose and fitting description, and

10.6.5 Number of specimens tested.

11. Crush Test

11.1 *Scope*—This test method covers the determination of the resistance to crushing of hose. This test requirement may not be required for most all-plastic hoses, as they will not take a permanent set under the crush load.

11.2 *Apparatus*:

11.2.1 *Total Dead Weight*, in convenient weight increments to apply a steady, nonimpact compression force.

11.2.2 *Testing Machine (alternative for the dead weight)*—A properly calibrated compression testing machine of the constant-rate-of-crosshead movement type meeting the requirements of Test Method D 695.

11.2.3 *Loading Plates*—The load shall be applied to the specimen through a 2½ in.– (63.5 mm)–wide plate with 0.062-in. (1.6-mm) radiused edges. Thickness of the plate shall not be less than 0.50 in. (12.7 mm).

11.3 *Test Specimen*—The specimen shall be a minimum length hose of 8 in. (203 mm), with force applied in the center of the specimen.

11.4 *Conditioning*—Condition the specimen at 68 to 81°F (20 to 27°C) prior to test for not less than 1 h.

11.5 *Procedure*:

11.5.1 Conduct tests at 68 to 81°F (20 to 27°C).

11.5.2 Measure the outside diameter of the specimen at the center.

11.5.3 *Dead Weight Method*:

11.5.3.1 Locate the hose with its axis parallel to the plane surface and loading plate (see Fig. 7).

11.5.3.2 Apply the dead test weight to the bearing plate at the hose center.

11.5.3.3 Apply a nonimpact load in convenient dead weight increments for 30 s, which results in a permanent deformation of 25 % reduction in the original diameter as measured after allowing a 30-min relaxation period.

11.5.4 *Compression Testing Machine Method*:

11.5.4.1 Set up compression fixture in testing machine.

11.5.4.2 Locate the hose area to be tested in a plane surface, then place loading plate with the hose axis parallel to the plate.

11.5.4.3 Apply the load at the rate of 0.50 ± 0.2 in. (12.7 ± 5.1 mm)/min until 25 % reduction in diameter is reached. Hold for 30 s. Stop the machine and remove the load. Allow 30 min for the test specimen to relax before measuring.

11.5.5 The hose may then be restored to its original shape after final reduction by hand only.

11.5.6 Calculate the percent reduction in diameter as follows:

$$\text{Percent reduction in diameter} = (\text{original} - \text{final minor diameter})/\text{original diameter}.$$

11.6 *Report*—The report shall include the following information:

11.6.1 Original diameter,

11.6.2 Load applied to produce 25 % permanent reduction,

11.6.3 Load applied and percent reduction in diameter if 25 % permanent reduction could not be obtained,

11.6.4 Percent reduction after restoration by hand.

12. Precision and Bias

12.1 *Precision*—No meaningful precision statement can be made due to the variability inherent in durability testing.

12.2 *Bias*—A bias statement cannot be applied to these test methods as there is no standard reference for comparison.

13. Keywords

13.1 all-plastic hose; vacuum cleaner; vacuum cleaner hose

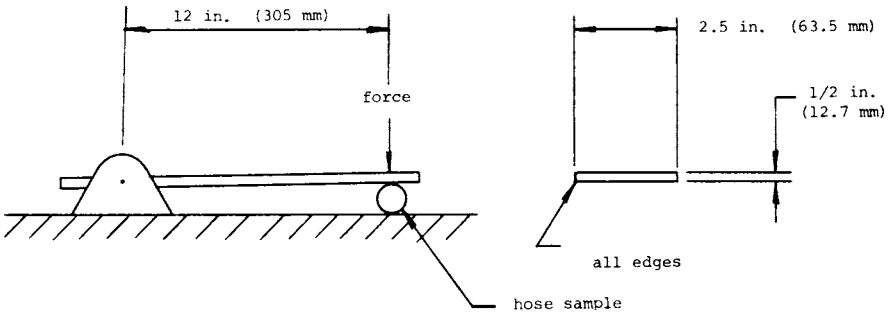


FIG. 7 Crush Test Fixture