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Title: Standard Test Method for Airflow Resistance of Infant Products

1.0 Scope:

1.1 This Test Method is intended to quantify the resistance to airflow in soft materials and infant products. This test method does not include pass/fail criteria, which are left to individual product sub-committees to incorporate into their product-specific standards, with reference to this test method.

2.0 Summary of Test Method

2.1 A probe is configured to simulate the face of an infant with two breathing holes simulating the nares of an infant nose. Using the probe, a load is applied to a test specimen. Using a vacuum pump, airflow is applied through the probe to the specimen. Pressure is measured with and without the probe being applied to the specimen.

2.2 Airflow resistance can be expressed as the measured pressure at each of the test locations. Conclusions can be drawn from either individual test results at each location or all locations or from a calculation of average and standard deviation at the test location(s).

3.0 Significance and Use

3.1 In the infant environment, soft items can lead to respiratory hazards if the infant's facepresses against the surface. To avoid such hazards, products used with infants should be firm enough to resist conforming to the shape of an infant's face (where practicable) or provide sufficient airflow through the product. This test method characterizes and measures the airflow resistance of products used with infants.

3.2 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.

4.0 Apparatus: (refer to figures 1 through 5)

4.1 Test platform that is rigid and flat and which has a smooth surface large enough to support the test specimen (see 6.0) during testing.

4.2 Test stand for attachment of a device to guide the probe in a vertical travel direction. The test stand should be able to stand alone or be secured to the test platform so that it does not affect the test measurements and results.

4.3 Hemispherical Probe – 3.0 +/- 0.05 in (76.2 +/- 1.5 mm) diameter hemisphere made from a non-porous material with a smooth surface and a threaded stud protruding from the center of the flat surface long enough to attach to a vertical guide. The probe and its two breathing passages simulate the configuration of an infant's face. See figures 2, 3 and 4. Metal or plastic material is suggested. If hardwood is used, the pores must be filled.

4.4 Device for applying a fixed load onto the probe such as a weight. An example of a fixed weight at 10 Newtons (1,000 grams mass) is illustrated in figure 1.

Figure 1
1,000 grams mass = 10 Newtons weight

4.5Extension fixture or equivalent, if necessary, to allow thick test specimens to fit under the probe.

4.6 A differential pressure gauge for measuring pressure in the probe circuit, with a range of at least 0 to 20 inches of water and a resolution of at least 0.01 inches of water. A digital manometer is recommended, appropriate for measuring the pressure range of interest. (0 to -20 inches of water) with a resolution of at least .01 inches of water.

4.7 Vacuum pump capable of maintaining a flow of 2.0 LPM (litres per minute) through the flowmeter and probe.

4.8 Flowmeter capable of measuring 2 LPM +/- 0.1 LPM.

4.9 Needle valve 1 inline with vacuum source

4.10 Needle valve 2 inline with probe.

4.11 Tubing connections – All tubing connections shall have a minimum inside diameter of 4 mm. The breathing passages in the probe are 0.125 inches (3.175 mm) in diameter and the connecting fittings shall be at least 0.125 inches (3.175 mm in diameter.

Figure 2 Figure 3

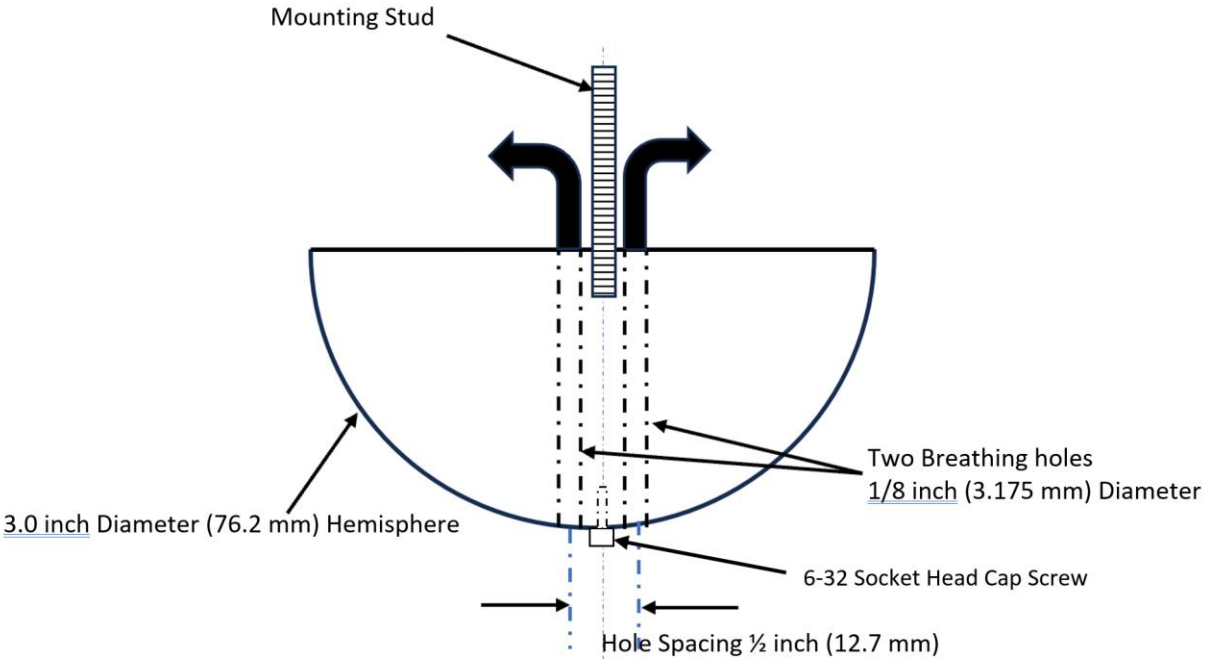

Figure 4

4.12.1 A vacuum pump is connected to Needle Valve 1;

4.12.2 Needle Valve 1 is connected to the outlet (top) of the flowmeter and used to adjust the flow rate

4.12.3 The inlet (bottom) of the flowmeter is connected to Needle Valve 2 and the Manometer;

4.12.4 The other side of Needle Valve 2 is connected to the weighted probe.

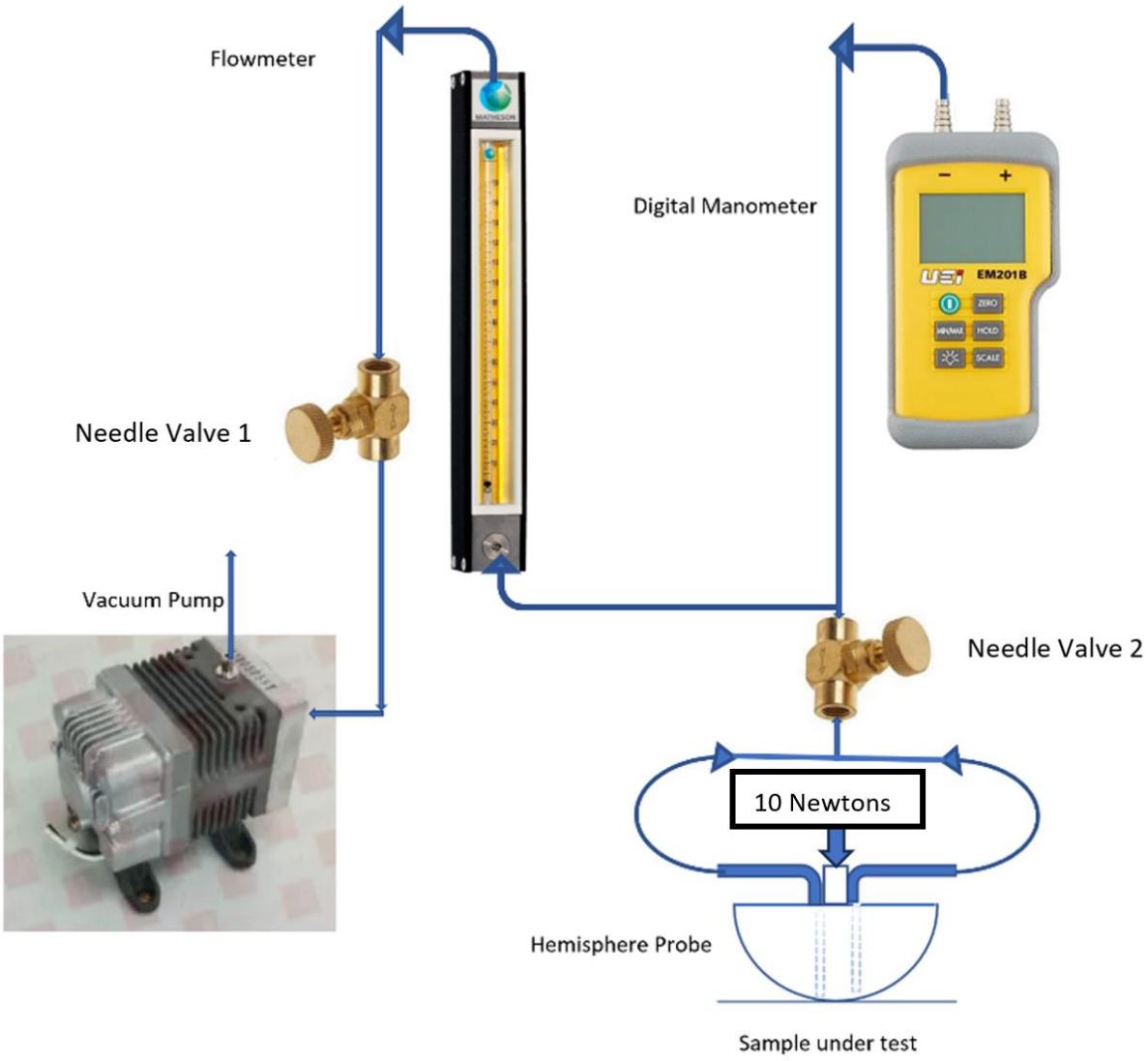

Figure 5 – Schematic diagram of apparatus

5.0 Test Specimen

5.1 The test specimen can be either a sample of material, a product component or a finished product.

5.2 The dimensions of the test specimen shall be at least 8 in (203 mm) in length and width. For materials, components, and products that, because of their size or configuration, do not allow for at least this size test specimen, the largest size shall be obtained. Record the sample size.

6.0 Calibration and Standardization

6.1 Ensure that all measurement equipment has been properly calibrated.

6.2 No testing shall be conducted within 48 h of manufacturing of the test specimen.

6.3 The test specimen to be tested shall be preconditioned in a room with an ambient temperature of 73° +/- 9° F (23° +/-5° C) and relative humidity between 40% and 60% for at least 24 h prior to testing. Testing shall then be conducted within this temperature and humidity range.

6.4 All testing per this method shall be conducted on the same test specimen.

7.0 Procedure

7.1 Place the test specimen on the test platform in one of the manufacturer's recommended use orientations. If the product has multiple manufacturer's recommended use orientations, repeat the test for each orientation. If there is no recommended orientation, the test specimen can be placed in what is considered to be its intended use orientation.

7.2 Secure the test specimen so that it cannot move~~,~~ and in a manner that does not affect the test measurements or test results.

7.3 Test location selection – Select three test locations at least 3 in (76.2mm) apart, if possible, based on potential positions for the child's face on the test specimen.

7.4 Record all test locations and note any deviations due to the inability to maintain the 3 in (76.2mm) separation of test locations.

7.5 Starting with the first test location, align the linear travel of the probe so that the travel is perpendicular to the specimen surface location to be tested.

7.6 Zero the manometer to negate any effect of resistance through the probe and tubing.

7.7 Start the vacuum pump and adjust needle valve 1 to set the flow at 2.0 LPM +/- 0.1 LPM.

7.8 With the probe elevated above the sample, adjust needle valve 2 to set the vacuum on the manometer to 1.0 inch (2.54 cm) of water

7.9 Zero the manometer. (This negates any effect of resistance through the probe and tubing.)

7.10 Advance the probe toward the surface of the specimen, at a rate not exceeding 0.1 in per sec, until the force reaches 2.24 lbf (10 N). Wait 30 seconds for the pressure to stabilize.

7.11 Record the measured pressure.

7.12 Repeat 8.8 through 8.11 two more times at the first test location, allowing 5 min recovery time between each test.

Note 1: Products with loose or granular fill shall be shaken between tests to distribute the fill material.

7.13 Repeat 7.10 through 7.12 at each of the other two test locations, allowing at least 5 min recovery time between each test.

NOTE 2: For additional guidance on performing steps 7.6 through 7.11, a supplemental video is available at https://vimeo.com/896372878?share=copy

9.0 Report

9.1 Report all test specimen sizes, test locations and individual test results.

9.2 Report and explain any deviations from the specified test specimen size and test locations.

10.0 Precision and Bias

10.1 Products that have a defined shape such as a foam pad with fabric cover can be expected to yield multiple measurements with a standard deviation within 5 percent of the average.

10.2 Products with a more irregular shape may have poorer repeatability, typically with a standard deviation within 20 percent of the average.

11.0 Keywords

Infant, airflow,

12. Appendix

12.1 Test Method rationale – The probe and test conditions are selected to simulate the interaction between a sleeping infant and a surface in the sleep environment.

12.1.1 The probe is designed to simulate the configuration of a small infant's face, which is approximately 3 inches (76.2 mm) across the cheek bones. Breathing holes are designed to simulate an infant upper airway.

12.1.2 A load of 2.25 lbf (10 N) represents the weight of a small infant's head.

12.1.3 An air flow rate of 2 litres per minute (LPM) represents an infant's typical breathing peak flow rate.

12.2 Standardizing the probe and tubing pressure drop - The probe and associated tubing and connections have their own contribution to the measured airflow resistance. To standardize the contribution of the probe, tubing and connections, valve 2 is used to add a little resistance to the probe, raising it to 1 inch of water. Trimming the probe resistance to a standard value assures that all probe/tubing/tee fitting assemblies will have uniform airflow resistance.