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National Personal Protective Technology Laboratory
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DETERMINATION OF INHALATION AIRFLOW RESISTANCE, PRESSURE-DEMAND, TYPE C AND CE, SUPPLIED-AIR RESPIRATORS STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedures for ensuring the airflow resistance requirements for a Type C and CE, Demand and Pressure-Demand, Supplied-Air Respirators meet the minimum performance requirements set forth in 42 CFR, Part 84, Subpart J, Section 84.157(a)(b).

2. GENERAL

This STP describes the Determination of Inhalation Airflow Resistance, Pressure-Demand, Type C and CE, Supplied-Air Respirators test in sufficient detail that a person knowledgeable in the appropriate technical field can select equipment with the necessary resolution, conduct the test, and determine whether or not the product passes the test.

3. EQUIPMENT/MATERIALS

3.1. The list of necessary test equipment and materials follows:

3.1.1. A 300 cubic foot gas cylinder of compressed air or equivalent.

3.1.2. A Helicoid calibrated pressure gauge and connecting fittings or equivalent.

3.1.3. Air regulator, Model 8, from Matheson Gas Products or equivalent.

3.1.4. National Instruments NI USB-9215A Portable USB-Based DAQ with Simultaneous Sampling; LabVIEW 2013; Dell Optiplex 755 Personal Computer, SCBA test software

3.1.5. ISI Anthropometric Test heads with tube for measuring breathing resistance and air flows - Model SR-085 or equivalent.

3.1.6. Temperature compensated pressure transducer (Validyne Engineering Model No. DP45) or equivalent.

3.1.7. Mechanical breather with 622 kg. m/min. cam as per U.S. B. of M. drawings C-1748 (3/l7/69) breathing machine and B-1198 (3/6/69) breathing cam or equivalent.

3.1.8. Dwyer Slant Manometer 0-3", F. W. Dwyer Manufacturing Co., Michigan City, Indiana or equivalent.

3.1.9. Setra Datum 2000 Model 239 digital manometer – accuracy: ± 0.01%R ± 1 digit, or equivalent

4. TESTING REQUIREMENTS AND CONDITIONS

4.1. Prior to beginning any testing, all measuring equipment employed has been calibrated in accordance with the testing laboratory's calibration procedure and schedule. All measuring equipment utilized for this testing must have been calibrated using a method traceable to recognized international standards when available.

5. PROCEDURE

5.1. Perform pre-test balancing of transducer and recording system.

5.1.1. Connect the transducer to be used during testing in parallel with a manometer. Attach the manometer and transducer to a pressure regulated air supply. A pinch clamp, used for slight pressure changes, is placed in-line with two equal lengths of tubing for the manometer and transducer connections. An alternate method to generate low pressures for calibration is to use the Dwyer model A-396A calibration pump or equivalent.

5.1.2. Connect the transducer cable to the CD-19A demodulator, and then connect the demodulator to the National Instruments DAQ. The DAQ is then connected to the PC via USB port. Turn the system on and press the Calibration button. After the calibration screen appears, with no load applied to the transducer, press the Zero button to set the zero-pressure point.

5.1.3. Apply a pressure of 0.5 inches of water to the transducer/manometer system. Check that the demodulator reads 0.5 inches, and adjust if necessary. Then check that the waveform displayed is at 0.5 inches, and adjust the LabVIEW readout if necessary.

5.1.4. Repeat step 5.1.3 with the pressures of 1.0, 1.5, and 2.0 inches of water until each pressure point reads correctly on the waveform. No adjustments should be necessary at this point.

5.1.5. Verify that the pressures are correct, by applying pressures for 1.5, 0.5 and 0.0 inches of water in descending order ensuring each pressure point reads correctly on the waveform. If adjustments are necessary, then repeat the calibration process for all pressures.

5.1.6. After the calibration sequence is complete, remove the pressure source from the system.

5.2. Assemble the apparatus as shown in Figure 1. Mount the pressure transducer where

shock and vibration are minimal.

5.3. Mount facepiece on anthropometric head, taking care not to block resistance port below and left of nose, particularly if a nosecup is used.

5.4. Connect regulator or breathing tube to facepiece. Do not connect head to breathing machine. Turn on breathing machine and use a timer to determine that the cam is operating at 24 rpm. (This will give a 40 lpm volume). When calibrated, turn breathing machine off.

5.5. Assemble respirator using maximum hose length. Connect the anthropometric head with the facepiece to the breathing machine.

5.6. Turn on the air supply to the respirator and set it to the minimum specified pressure.

5.7. Turn on breathing machine for three complete cycles to obtain inhalation resistance. (See Data Analysis). Then turn off breathing machine but leaving the air pressure turned on.

5.8. With the air supply pressure still turned on connect transducer port from head-form to a manometer to obtain static pressure in facepiece.

5.9. Repeat steps 5.6 thru 5.9 with minimum hose length and maximum pressure.

5.10. When testing has been completed, shut off breathing machine and air supply pressure, and disconnect transducer from head.

5.11. Data Analysis

5.11.1. Take the peak values of the inhalation readings from the LabVIEW system and read resistance in inches of water column height.

5.11.2. For pressure-demand units the inhalation resistance cannot fall below the zero-pressure baseline. A negative spike is allowed as long as there is no area between the point where the spike goes negative and the point where it returns to positive.

Note: This test should be done on a minimum of two respirators, or more if additional testing is required (42 CFR, Part 84, Sections 84.12, 84.30, and 84.60).

6. PASS\FAIL CRITERIA

6.1. The criterion for passing this test is set forth in 42 CFR, Part 84 Subpart J, Section 84.157(a)(b).

Reference.

84.157 Airflow resistance test; Type C supplied-air respirator, pressure-demand class; minimum requirements.

(a) The static pressure in the facepiece shall not exceed 38 mm. (1.5 inches) of water-column height.

(b) The pressure in the facepiece shall not fall below atmospheric at inhalation airflows less than 115 liters (4 cubic feet) per minute.

7. RECORDS\TEST SHEETS

7.1. Record the test data in a format that shall be stored and retrievable. Data to be reported as shown in attached data sheet.

AIRFLOW INHALATION RESISTANCE, PRESSURE-DEMAND CLASS, TYPE C AND CE, SUPPLIED-AIR RESPIRATORS

Project No : _____ Date: _____

Company : _____

Respirator Type: _____

Reference: 42 CFR, Part 84, Subpart J, Section 84.157(a)(b).

Requirement: (a) The static pressure in the facepiece shall not exceed 38 mm (1.5 inches) of H_20 col. Ht.

(b) The pressure in the facepiece shall not fall below atmospheric at inhalation airflows less that 115 1pm. (4 cfm.).

Results:

a. Static Pressure : _____

b. Inhalation Pressure at 115 lpm : _____

Comments:

_____

_____

_____

_____

_____

Test Engineer: _____ PASS_____ FAIL_____

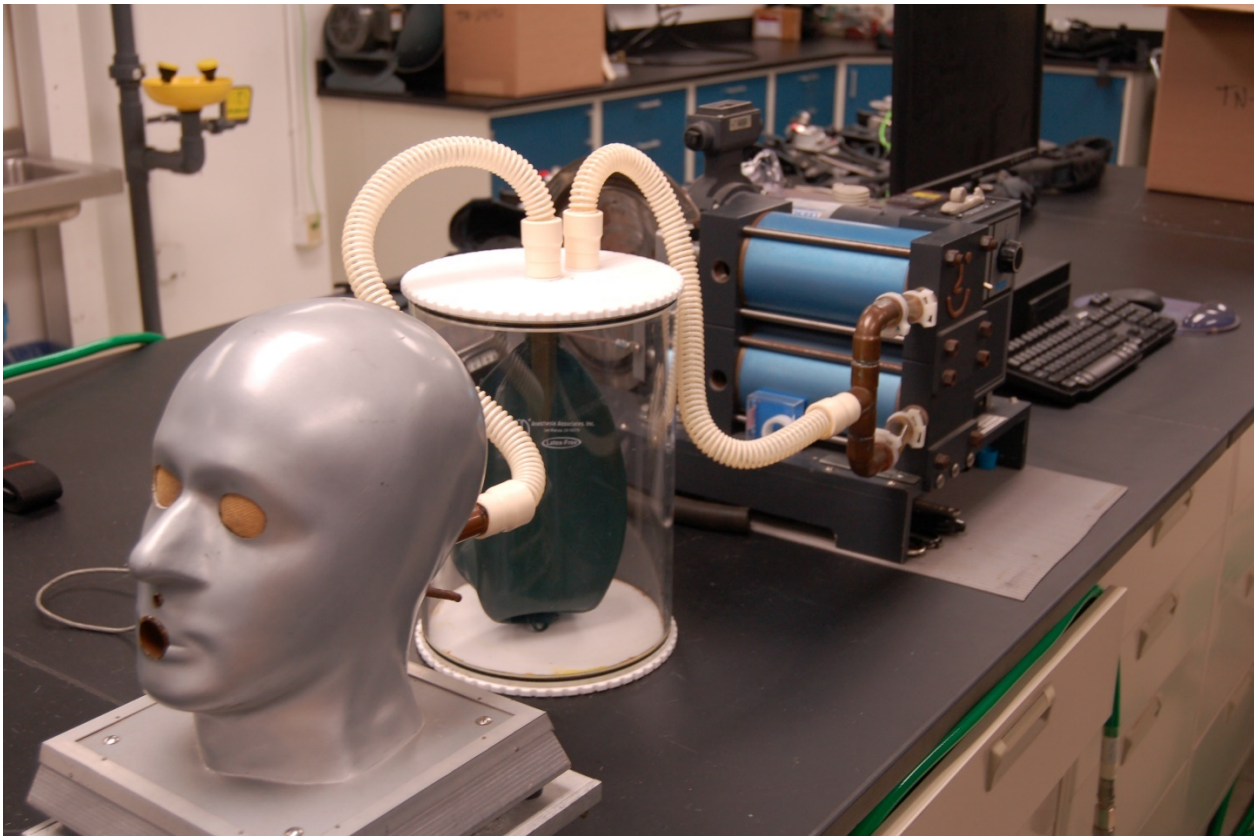

Figure 1: Breathing Machine Set-up

Revision History

Revision	Date	Reason for Revision
1.0	23 May 2001	Historic document
1.1	27 September 2005	Update header and format to reflect lab move from Morgantown, WV. No changes to method
1.2	10 June 2021	Updated NIOSH Logo. Updated test procedure and figures to reflect new PC based recording system using LabVIEW, and other procedural changes related to calibration.