National Institute for Occupational Safety and Health
National Personal Protective Technology Laboratory
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DETERMINATION OF AIRFLOW - DEMAND AND PRESSURE-DEMAND, TYPE C AND CE, SUPPLIED-AIR RESPIRATORS STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedures for ensuring that the air flow requirements on Type C and CE, Demand and Pressure-Demand, Supplied-Air Respirators submitted for Approval, Extension of Approval, or examined during Certified Product Audits, meet the minimum certification standards set forth in 42 CFR, Part 84, Subpart J, Section 84.150, Table 8.

2. GENERAL

This STP describes the Determination of Airflow - Demand and 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. (see Figure 1)

3.1.2. A Helicoid calibrated pressure gauge and connecting fittings or equivalent. (see Figure 1)

3.1.3. Air regulator, Model 8, from Matheson Gas Products or equivalent. (see Figure 1)

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. Mechanical breather with 622 Kg m/min. cam as per U.S. BOM Drawings C-1748 (3/17/69) Breathing Machine and B-1198 (3/6/69) Breathing Cam

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

3.1.7. Validyne Engineering model DP45-20 transducer used with Validyne Engineering model CD-19A carrier demodulator mounted in the Validyne MC1-333 module case. Pressure range up to 3.5 inches of water - accuracy: ± 0.5%

F.S.

3.1.8. 3-Liter lung in bottle with plastic tubing, Hans Rudolph Co. part number CM 1435 or equivalent.

3.1.9. Electric Timer, calibrated to hundredths of a minute (Precision Scientific Company) or equivalent

3.1.10. Dwyer Slant Manometer 0-3", F. W. Dwyer Manufacturing Co., Michigan City, Indiana or 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, confirm that 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 pressure at 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. Take precautions to mount the pressure transducer in a manner that isolates it from shock and vibration, in particular, that which is induced by the breathing machine and the operation of the SCBA.

5.3. Calibrate the breathing machine to 24 rpm with a stopwatch which gives 40 lpm. The breathing machine contains a cycle counter for obtaining exact and total cycle counts and is used to make precise corrections at end of test.

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

5.5. Connect the anthropometric head to the breathing machine. (see Figure 1.)

5.6. Mount the pressure transducer where shock and vibration are minimal. Secure the transducer to a ring stand and connect the transducer to the recorder. (see Figure 1.)

5.7. Attach breathing tube from facepiece to the air regulating valve, control valve, or orifice. The maximum length of air supply hose is attached to a cylinder of respirable air by way of a "T" with gauge and air regulator and the other end to the air regulating valve, control valve, or orifice.

5.8. Adjust the regulator until the desired pressure is reached using the minimum pressure with the maximum hose length and the maximum pressure with the minimum hose length.

5.9. Start the breathing machine and turn on the LabVIEW recorder. Run the breathing machine a minimum of 3 cycles for each hose length and pressure range requested by the manufacturer.

5.10. Data Analysis

5.10.1. The peak valves of the inhalation tracings shall remain positive with respect to the base-line (zero) established at the time the LabView system is calibrated.

5.10.2. The breathing machine cam has a peak flow rate of 115 lpm; therefore, if the indication portion of the breathing curve remains positive, the flow is greater than 115 lpm.

Note: This test should be done on a minimum of two respirators, or more if additional testing is required (42 CFR, Part 84, Section 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 84.150, Table 8.

84.150 Air-supply line tests; minimum requirements.

Air supply lines employed on Types C and CE supplied-air respirators shall meet the minimum test requirements set forth in Table 8 of this subpart.

The air-supply hose, detachable couplings, and demand valve of the demand class or pressure-demand valve of the pressure-demand class for Type C supplied-air respirators, demand and pressure-demand classes, shall be capable of delivering respirable air at a rate of not less than 115 liters (4-cubic feet) per minute to the respiratory-inlet covering at an inhalation resistance not exceeding 50 millimeters (2 inches) of water column height measured in the respiratory-inlet covering with any combination of air-supply pressure and length of hose within the applicant's specified range of pressure and length of hose. The air-flow rate and resistance to inhalation shall be measured while the demand or pressure-demand valve is actuated 24 times per minute by a source of intermittent suction. The maximum rate of flow to the respiratory-inlet covering shall not exceed 425 liters (15 cubic feet) per minute under the specified operating conditions.

7. RECORDS\TEST SHEETS

7.1. All test data will be recorded on the AIRFLOW - DEMAND AND PRESSURE-DEMAND, TYPE C AND CE, SUPPLIED-AIR RESPIRATORS test data sheet.

8. FIGURES

8.1. Flow Rate Determination Breathing Machine Set-up. (Figure 1.)

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

Project No : _____ Date:

Company :

Respirator Type:

Reference: 42 CFR, Part 84, Subpart J, Section 84.150, Table 8.

Requirement: The air-supply hose, detachable couplings, and demand valve of the demand class or pressure-demand valve of the pressure-demand class for Type C supplied-air respirators, demand and pressure-demand classes, shall be capable of delivering respirable air at a rate of not less than 115 liters (4-cubic feet) per minute to the respiratory-inlet covering at an inhalation resistance not exceeding 50 millimeters (2 inches) of water column height measured in the respiratory-inlet covering with any combination of air-supply pressure and length of hose within the applicant's specified range of pressure and length of hose. The air-flow rate and resistance to inhalation shall be measured while the demand or pressure-demand valve is actuated 24 times per minute by a source of intermittent suction. The maximum rate of flow to the respiratory-inlet covering shall not exceed 425 liters (15 cubic feet) per minute under the specified operating conditions.

Equipment:
Breathing Machine No.: _____
Transducer No.: _____
Preamp No.: _____
Gauge No.: _____

Comments: _____

_____

_____

_____

_____

Test Engineer: _____ Pass_____ Fail_____

PROJECT NO. : _____ **DATE:** _____

EVENT	HOSE LENGTH	# OF CONN.	PSIG	FLOW LPM	RESIS. " H_2O	STATIC RES." H_2O

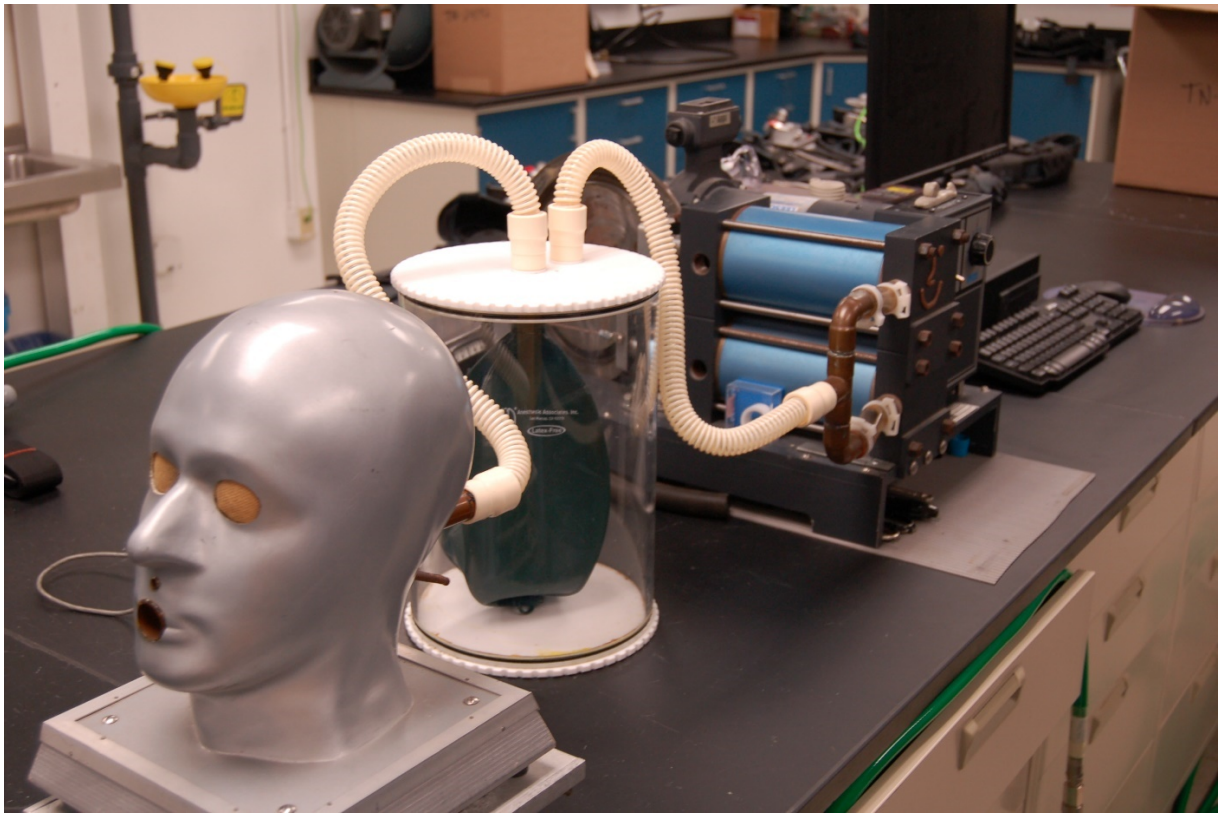

Figure 1: Flow Rate Determination Breathing Machine Set-up

Revision History

Revision	Date	Reason for Revision
1.0	2 July 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	9 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.