



National Institute for Occupational Safety and Health  
National Personal Protective Technology Laboratory  
P.O. Box 18070  
Pittsburgh, PA 15236

Procedure No. RCT-ASR-STP-0123

Revision: 1.1

Date: 21 September 2005

DETERMINATION OF GAS FLOW MEASUREMENTS - OPEN-CIRCUIT,  
DEMAND AND PRESSURE-DEMAND, SELF-CONTAINED BREATHING APPARATUS  
STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedures for ensuring that the level of protection provided by the gas flow requirements on Open-Circuit, Demand and Pressure-Demand, Self-Contained Breathing Apparatus (SCBA) 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 G, Section 84.63(a)(c)(d), and Subpart H, Section 84.93, Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Gas Flow Measurements - Open-Circuit, Demand and Pressure-Demand, Self-Contained Breathing Apparatus 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. Two channel thermal tip recording system (Gould Model No. RS3200) with carrier amplifier (Model No. 13-4615-35) or equivalent.

|            |                       |                       |                       |
|------------|-----------------------|-----------------------|-----------------------|
| Approvals: | 1 <sup>st</sup> Level | 2 <sup>nd</sup> Level | 3 <sup>rd</sup> Level |
|            |                       |                       |                       |



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



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



- 3.1.4. Spencer Turbo Compressor (Catalog No. 075-1/3-Bushnell Machinery Co.) or equivalent.

- 3.1.5. Pneumatic with 200 mesh screen (U.S. BOM drawing Pr-0011-13 (9/16/69) as shown in Figure 2.) or equivalent.



- 3.1.6. High Pressure Test Stand. A test stand incorporating four Weksler calibrated pressure gauges (two 0-10,000 psig and two 0-3,000 psig). or equivalent.

**Equipment Required for Alternate Test Procedure**

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



- 3.1.8. Hastings Mass Flow meter Model AHL-25 (Teledyne Hastings - Raydist) or equivalent.



- 3.1.9. Spencer Turbo Compressor (Catalog No. 075-1/3-Bushnell Machinery Co.) or equivalent.



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



3.1.11. High Pressure Test Stand. A test stand incorporating four Weksler calibrated pressure gauges (two 0-10,000 psig and two 0-3,000 psig), or equivalent.

#### 4. TESTING REQUIREMENTS AND CONDITIONS

- 4.1. Prior to beginning any testing, all measuring equipment to be used must have been calibrated in accordance with the manufacturer's calibration procedure and schedule. At a minimum, all measuring equipment utilized for this testing must have been calibrated within the preceding 12 months using a method traceable to the National Institute of Standards and Technology (NIST).
- 4.2. The compressed gas cylinder must meet all applicable Department of Transportation requirements for cylinder approval as well as for retesting/requalification.
- 4.3. Normal laboratory safety practices must be observed. This includes all safety precautions described in the current ALOSH Facility Laboratory Safety Manual.
  - 4.3.1. Safety glasses, lab coats, and hard-toe shoes must be worn at all times.
  - 4.3.2. Work benches must be maintained free of clutter and non-essential test equipment.
  - 4.3.3. When handling any glass laboratory equipment, lab technicians and personnel must wear special gloves which protect against lacerations or punctures.

#### 5. PROCEDURE

Note: Reference Section 3 for equipment, model numbers and manufacturers. For calibration purposes use those described in the manufacturer's operation and maintenance manuals.

- 5.1. Assemble unit without the cylinder as per manufacturer's instructions with the facepiece mounted on an anthropometric head. (See Figure 1.)
- 5.2. Connect a pressure tap in the head to a transducer which in turn is connected to a strip-chart recorder for determining facepiece pressure.
- 5.3. A pneumatic is connected in line between the anthropometric head and an adjustable vacuum source. The pneumatic is connected to another transducer which is also connected to the strip-chart recorder for recording the amount of airflow through the facepiece.

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|--------------------------------|---------------|-------------------------|--------------|
| Procedure No. RCT-ASR-STP-0123 | Revision: 1.1 | Date: 21 September 2005 | Page 5 of 14 |
|--------------------------------|---------------|-------------------------|--------------|

- 5.4. Charge the test stand to a pressure equal to full cylinder pressure.
- 5.5. Connect the test stand in place of the cylinder.
- 5.6. The vacuum source is adjusted during the test to maintain zero pressure inside the facepiece for pressure-demand units and minus (-) two inches of water pressure for demand units.
- 5.7. For the duration of the test, both facepiece pressure and air flow through the facepiece are simultaneously recorded on the strip-chart recorder for calculation and record purposes.
- 5.8. Repeat the above procedure with the test stand charged to 500 psig.
- 5.9. Data Analysis
  - 5.9.1. Determine the amount of recorder pen deflection from the strip chart tracing that is monitoring airflow through the facepiece.
  - 5.9.2. Multiply the pen deflection by the recorder attenuation and determine the airflow by using the flow graph for the pneumatic.

#### **Alternate Test Procedure**

- 5.10. Assemble unit as per manufacturer's instructions with the facepiece mounted on an anthropometric head. (See Figure 1.)
- 5.11. Connect a pressure tap in the head to the slant manometer for determining facepiece pressure.
- 5.12. Connect a mass flow meter in line between the anthropometric head and an adjustable vacuum source, keeping airflow path as straight as possible.
- 5.13. Charge the test stand to a pressure equal to full cylinder pressure.
- 5.14. Connect the test stand in place of the cylinder.
- 5.15. The vacuum source is adjusted during the test to maintain zero pressure inside the facepiece for pressure-demand units and minus (-) two inches of water pressure for demand units.
- 5.16. Flow measurements are taken directly from the mass flow meter.
- 5.17. Repeat the above procedure with the test stand charged to 500 psig.
- 5.18. Data Analysis for Alternate Test Procedure
  - 5.18.1. Analysis is not necessary since the mass flow meter is designed to accurately

measure mass flow without corrections or compensations for gas pressure or temperature.

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 G, Section 84.63(a)(c)(d), and Subpart H, Section 84.93, Volume 60, Number 110, June 8, 1995.

6.2. This test establishes the standard procedure for ensuring that:

84.63 Test requirements; general.

(a) Each respirator and respirator component shall when tested by the applicant and by the Institute, meet the applicable requirements set forth in subparts H through L of this part.

(c) In addition to the minimum requirements set forth in subparts H through L of this part, the Institute reserves the right to require, as a further condition of approval, any additional requirements deemed necessary to establish the quality, effectiveness, and safety of any respirator used as protection against hazardous atmospheres.

(d) Where it is determined after receipt of an application that additional requirements will be required for approval, the Institute will notify the applicant in writing of these additional requirements, and necessary examinations, inspections, or tests, stating generally the reasons for such requirements, examinations, inspections, or tests.

84.93 Gas flow test; open-circuit apparatus.

(a) A static-flow test will be performed on all open-circuit apparatus.

(b) The flow from the apparatus shall be greater than 200 liters per minute when the pressure in the facepiece of demand-apparatus is lowered by 51 mm. (2 inches) water-column height when full container pressure is applied.

(c) Where pressure demand apparatus are tested, the flow will be measured at zero gage pressure in the facepiece.

(d) Where apparatus with compressed-breathing-gas containers are tested, the flow test shall also be made with 3,450 kN/m.<sup>2</sup> (500 psig.) container pressure applied.

7. RECORDS\TEST SHEETS

7.1. All test data will be recorded on the GAS FLOW TEST, OPEN-CIRCUIT, SELF-CONTAINED BREATHING APPARATUS test data sheet.

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|--------------------------------|---------------|-------------------------|--------------|
| Procedure No. RCT-ASR-STP-0123 | Revision: 1.1 | Date: 21 September 2005 | Page 7 of 14 |
|--------------------------------|---------------|-------------------------|--------------|

- 7.2. All videotapes and photographs of the actual test being performed, or of the test equipment shall be maintained in the task file as part of the permanent record.
- 7.3. All equipment failing any portion of this test will be handled as follows:
- 7.3.1. If the failure occurs on a new certification application, or extension of approval application, send a test report to the RCT Leader and prepare the hardware for return to the manufacturer.
  - 7.3.2. If the failure occurs on hardware examined under an Off-the-Shelf Audit the hardware will be examined by a technician and the RCT Leader for cause. All equipment failing any portion of this test may be sent to the manufacturer for examination and then returned to NIOSH. However, the hardware tested shall be held at the testing laboratory until authorized for release by the RCT Leader, or his designee, following the standard operating procedures outlined in Procedure for Scheduling, and Processing Post-Certification Product Audits, RB-SOP-0005-00.

### GAS FLOW TEST, OPEN-CIRCUIT, SELF-CONTAINED BREATHING APPARATUS

Project No : \_\_\_\_\_ Date: \_\_\_\_\_

Company : \_\_\_\_\_

Respirator Type: \_\_\_\_\_

Reference: 42 CFR, Part 84, Subpart H, Section 84.93.

Requirement: (a) A static-flow test will be performed on all open-circuit apparatus.

(b) The flow from the apparatus shall be greater than 200 liters per minute when the pressure in the facepiece of demand-apparatus is lowered by 51 mm. (2 inches) water-column height when full container pressure is applied.

(c) Where pressure demand apparatus are tested, the flow will be measured at zero gage pressure in the facepiece.

(d) Where apparatus with compressed-breathing-gas containers are tested, the flow test shall also be made with 3,450 kN/m.<sup>2</sup> (500 psig.) container pressure applied.

Results:

|                               | <u>Unit #1 lpm</u> | <u>Unit #2 lpm</u> |
|-------------------------------|--------------------|--------------------|
| <b>Demand Unit:</b>           |                    |                    |
| Full cylinder pressure: _____ | _____              | _____              |
| 500 psig: _____               | _____              | _____              |
| <b>Pressure-Demand Unit:</b>  |                    |                    |
| Full cylinder pressure: _____ | _____              | _____              |
| 500 psig: _____               | _____              | _____              |

Comments:

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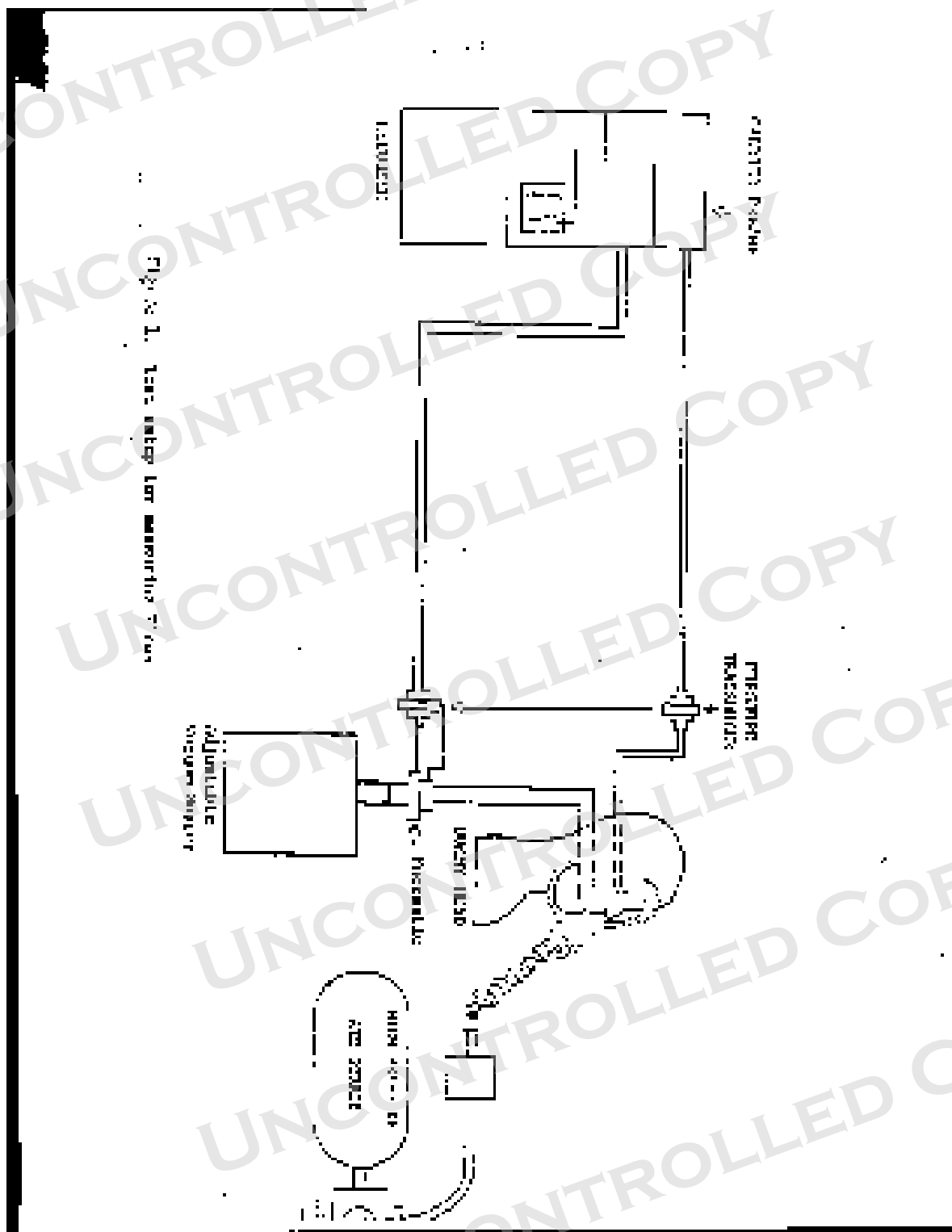


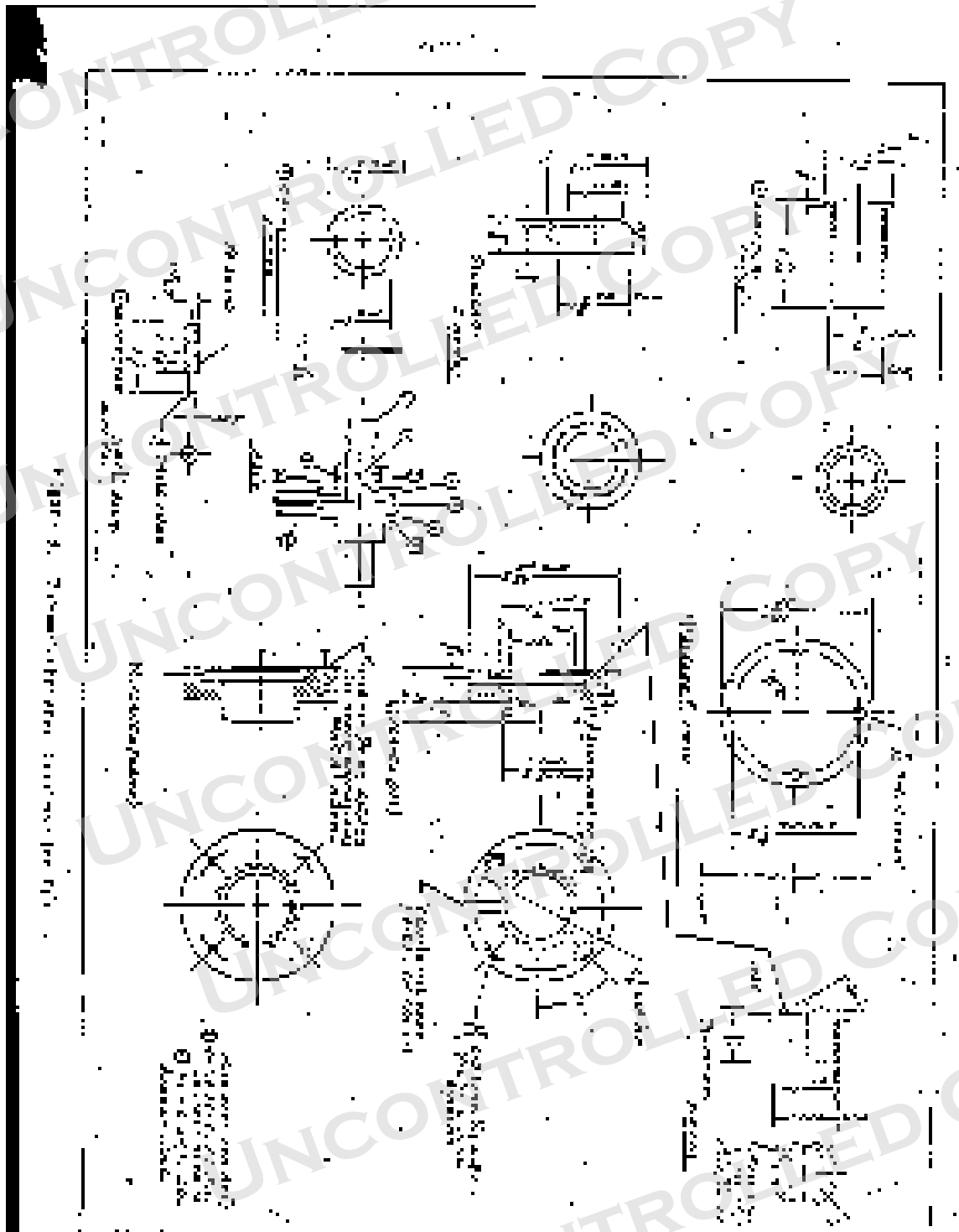
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Test Engineer: \_\_\_\_\_ Pass \_\_\_\_\_ Fail \_\_\_\_\_











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|--------------------------------|---------------|-------------------------|---------------|
| Procedure No. RCT-ASR-STP-0123 | Revision: 1.1 | Date: 21 September 2005 | Page 14 of 14 |
|--------------------------------|---------------|-------------------------|---------------|

### Revision History

| Revision | Date              | Reason for Revision                                                                      |
|----------|-------------------|------------------------------------------------------------------------------------------|
| 1.0      | 23 August 2002    | Historic document                                                                        |
| 1.1      | 21 September 2005 | Update header and format to reflect lab move from Morgantown, WV<br>No changes to method |
|          |                   |                                                                                          |
|          |                   |                                                                                          |