National Institute for Occupational Safety and Health
National Personal Protective Technology Laboratory
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Procedure No. RCT-ASR-STP-0120	Revision: 1.1	Date: 12 September 2005

DETERMINATION OF POSITIVE PRESSURE - OPEN-CIRCUIT, 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 breathing resistance requirements on Open-Circuit, 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 84.70(a)(2)(ii), and 84.90(a); Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Positive Pressure - Open-Circuit, 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.

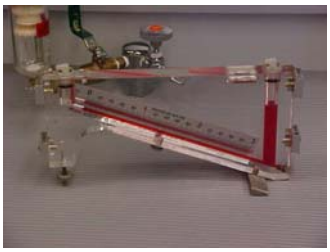
Approvals:	1st Level	2nd Level	3rd Level

3.1.2. 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.

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

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

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



3.1.6. Dwyer Slant Manometer 0-3", F. W. Dwyer Manufacturing Co., Michigan City, Indiana 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. Turn on recorder and allow at least 30-minutes warm up.

PRE-TEST BALANCING OF TRANSDUCER AND RECORDER

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. A pinch clamp, used for slight pressure changes, is placed inline with two equal lengths of tubing for the manometer and transducer connections.

5.1.2. Connect the transducer cable to the carrier amplifier in the chart. Calibrate the

recorder and carrier amplifier per instruction manual. Press the 5 mm/sec chart speed button. With no load applied to the transducer/manometer system, adjust the "POSITION" potentiometer on the chart recorder until the pen is at the mid-scale position. Press the STOP button on the chart recorder.

5.1.3. Apply a pressure of 0.5 inches of water to the transducer/manometer system. Press the 5 mm/sec chart speed button. Adjust the "CAL" potentiometer on the carrier amplifier until the pen on the chart recorder is at the next bold line left of mid-scale position. This represents 0.5 inches of water. Press the STOP button on the chart recorder.

5.1.4. Reduce the pressure to 0.0 inches of water to the transducer/manometer system. Press the 5 mm/sec chart speed button and check that the chart recorder pen is at the zero mid-scale position. Make any necessary adjustments. Press the STOP button on the chart recorder.

5.1.5. Repeat steps 5.1.3 and 5.1.4 with a pressures of 1.0 , 1.5, and 2.0 inches of water until no adjustments are necessary at the "CAL" potentiometer on the carrier amplifier.

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. Fill SCBA cylinder with air to pressure as noted in the instruction manual. Make sure the pressure is within the DOT certified pressure range. A "+" indicates that the DOT pressure may be exceeded by 10%.

5.4. Assemble respirator. Mount facepiece on anthropometric head, taking care not to block resistance port below and left of nose, particularly if a nosecup is used. Make sure that the face seal is leak tight by blocking-off inhalation port of facepiece and inhaling through the breathing tube port exiting back of head. After building up several inches of negative pressure hold breath several seconds, which will enable you to determine if a leak is present. If there is a leak, readjust headstraps and facepiece position and repeat leak test until a seal is obtained.

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

5.6. Zero the recorder base-line to mid point of chart paper. (While this is being done the transducer should be connected to the recorder but the transducer should not have any load on it).

5.7. Connect the anthropocentric head with the facepiece to the breathing machine. Connect transducer to resistance port with a short length of tubing. Open cylinder valve full and

open main line valve full. Make sure the by-pass valve is closed.

5.8. Record all attenuation and speed settings directly on chart paper. Turn on breathing machine and recorder simultaneously, and let operate at 1 mm/sec for the duration of the breathing cycles (service time). Take at least three separate tracings of several of the cycles at 20 mm/sec during the duration of the breathing cycles. (1-cycle includes the inhalation and exhalation breathing phases).

5.9. When tracings are complete - Turn off breathing machine, recorder, and cylinder valve on SCBA and then bleed down high-pressure air trapped in breathing hose by opening the by-pass valve, then shut the by-pass off.

5.10. Retrieve the tracings on chart paper for data analysis.

5.11. Data Analysis

5.11.1 The recorder produces a trace showing the inhalation (negative) and exhalation (positive) breathing resistance. `For this test` the inhalation phase is the component for analysis. With a chart speed of 20 mm/sec., the inhalation phase should measure approximately 50 mm.

5.11.2. For a pressure-demand unit the peak valves of the inhalation tracings shall remain positive with respect to the base-line (zero) established at the time the recorder is calibrated. (See Figure 2.) At a speed of 20 mm/sec, 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 G, Section 84.63(a)(c)(d), and Subpart H, Section 84.70(a)(2)(ii), and 84.90(a); 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.

84.70 Self-contained breathing apparatus; description.

(a) Self-contained breathing apparatus, including all completely assembled, portable, self-contained devices designed for use as respiratory protection during entry into and escape from or escape only from hazardous atmospheres, are described as follows:

(2) Open-circuit apparatus. An apparatus of the following types from which exhalation is vented to the atmosphere and not rebreathed:

(ii) Pressure-demand-type apparatus. An apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during both inhalation and exhalation.

84.90 Breathing resistance test; inhalation.

(a) Resistance to inhalation airflow will be measured in the facepiece or mouthpiece while the apparatus is operated by a breathing machine as described in 84.88.

6.3. Pressure-demand type apparatus.

This test establishes the standard procedure for ensuring that an apparatus in which the pressure inside the facepiece in relation to the immediate environment is positive during both inhalation and exhalation and is done at full cylinder pressure to the point at which the inhalation portion drops below the baseline during the rated service time test.

7. RECORDS\TEST SHEETS

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

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.

POSITIVE PRESSURE TEST, OPEN-CIRCUIT,
SELF-CONTAINED BREATHING APPARATUS

Project No. : _____ Date: _____

Company : _____

Respirator Type: _____

Reference: 42 CFR Part 84, Subpart H, Section 84.70(a)(2)(ii), and 84.90(a)

Requirements: 84.70(a)(2)(ii) Pressure-Demand Type Breathing Apparatus - An apparatus in which the pressure inside the face piece in relation to the immediate environment is positive during both inhalation and exhalation.

84.90(a) Resistance to inhalation airflow will be measured in the facepiece or mouthpiece while the apparatus is operated by a breathing machine as described in 84.88.

Procedure: A breathing machine with a 622 kg. -m./min. Cam operating at 24 rpm with a 40 lpm volume (115 lpm peak flow) is connected to an anthropometric head for cycling. A pressure tap in the head is connected to a transducer which in turn is connected to a strip chart recorder for determining the pressure in the face piece.

Results:

Facepiece pressure

Unit #1 > or = ambient _____ ; < ambient _____ ;

Unit #2 > or = ambient _____ ; < ambient _____ ;

Comments:

_____

_____

_____

_____

_____

Test Engineer: _____ PASS_____ FAIL_____

Figure 1

Test Set-up for Measuring Inhalation Breathing Resistance.

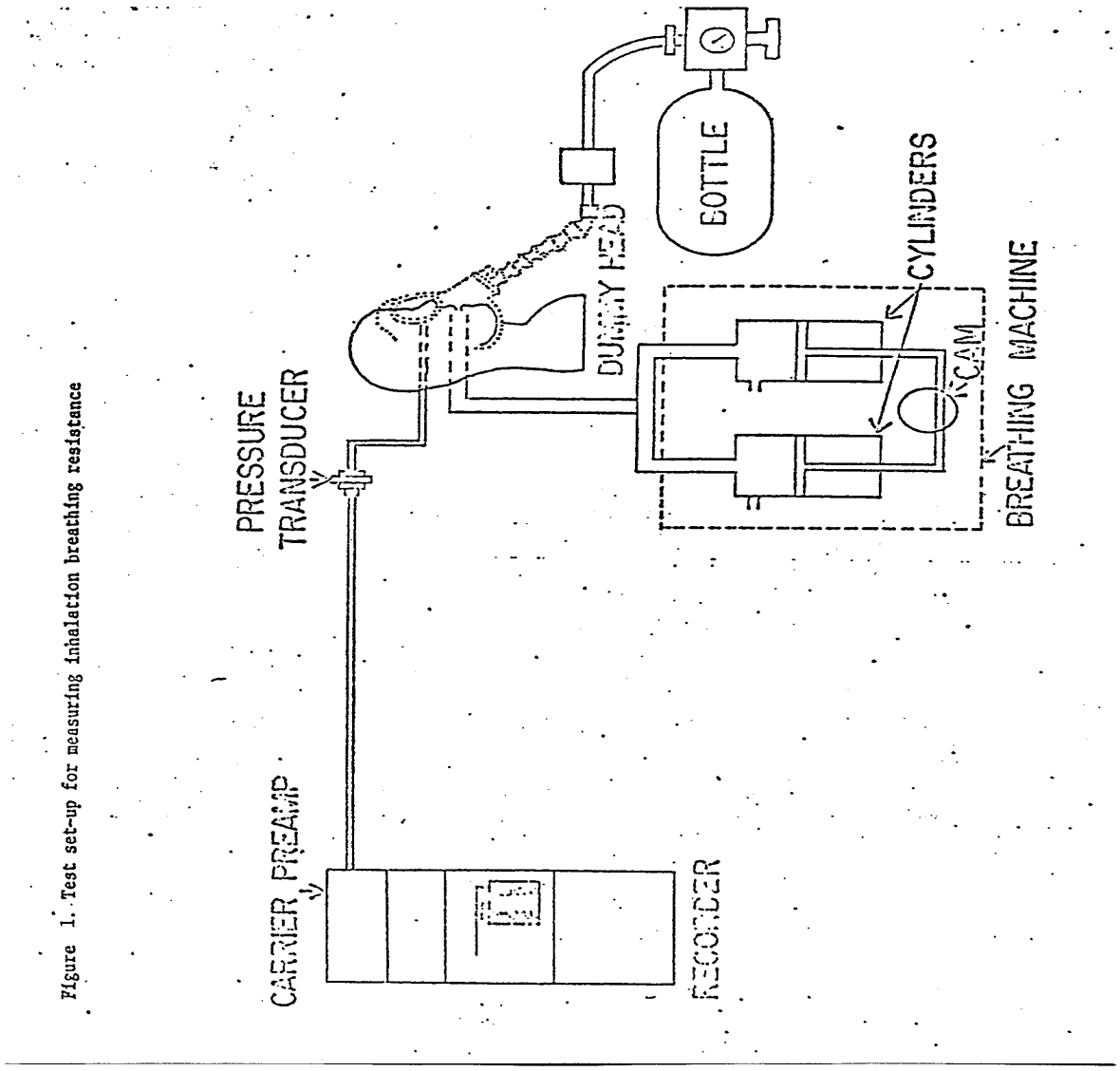


Figure 1. Test set-up for measuring inhalation breathing resistance

Figure 2

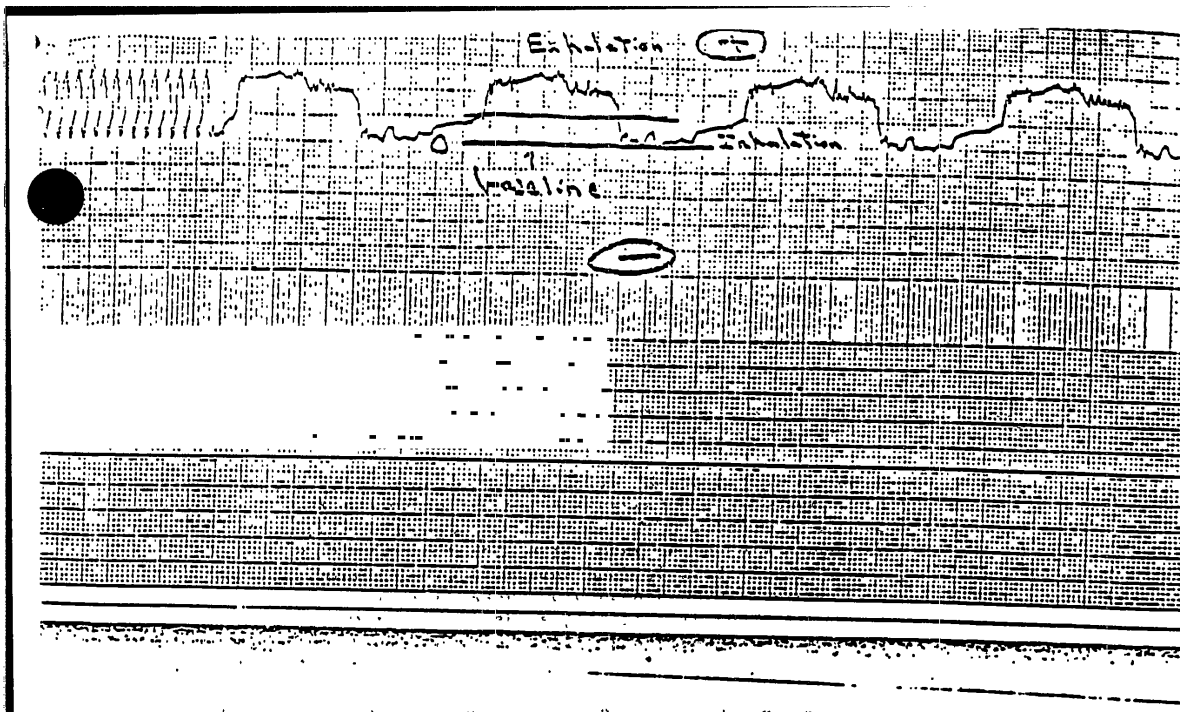


Figure 2. Breathing Resistance Trace

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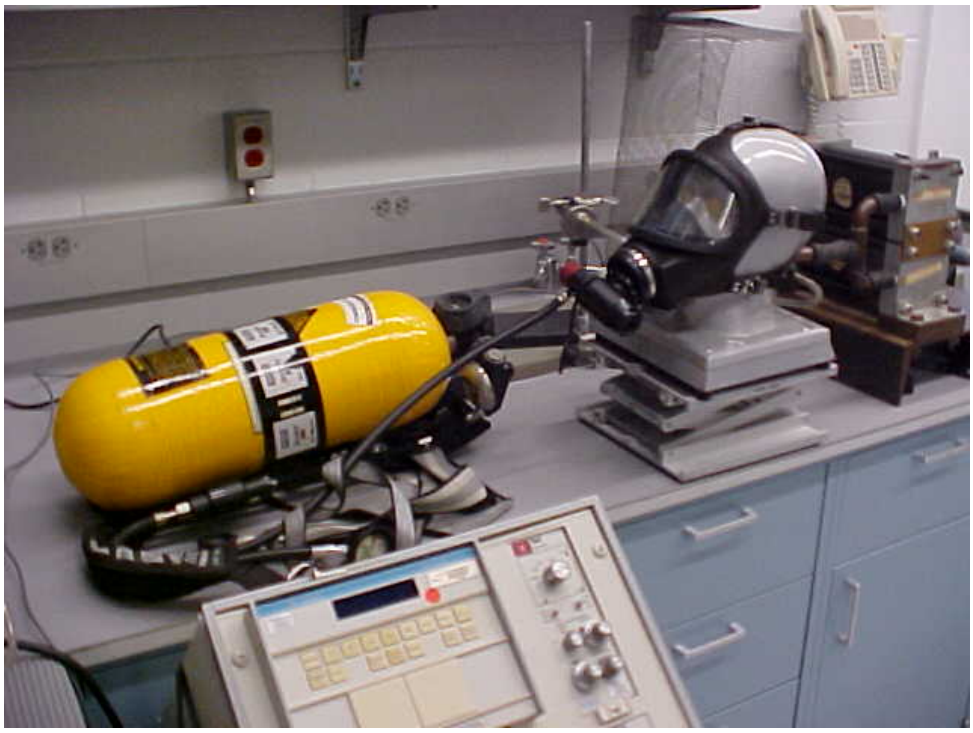

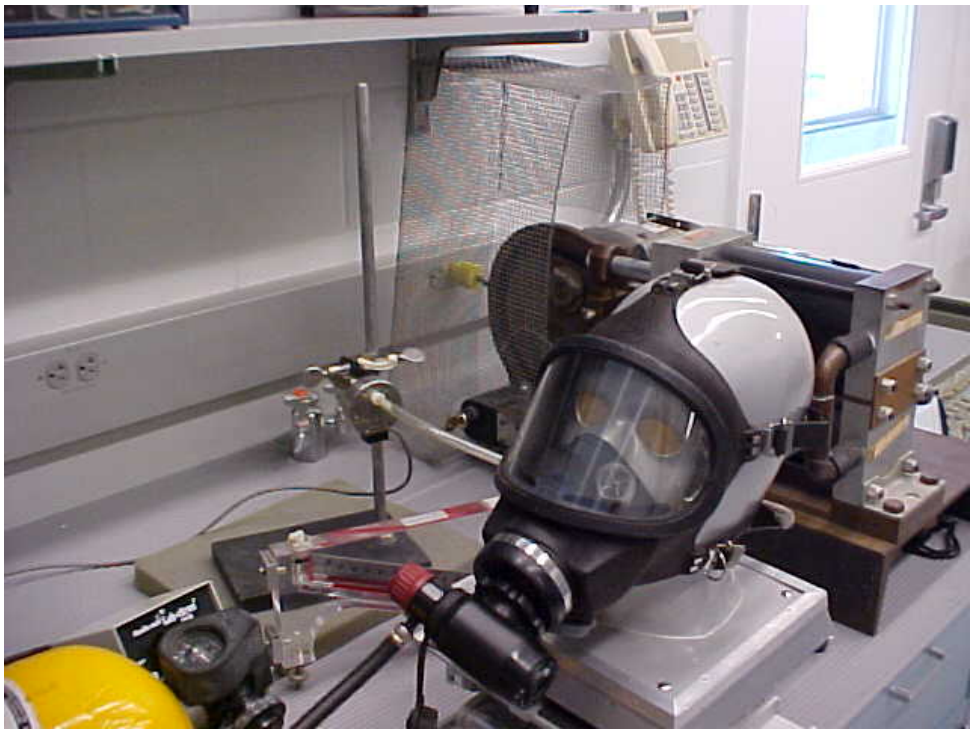

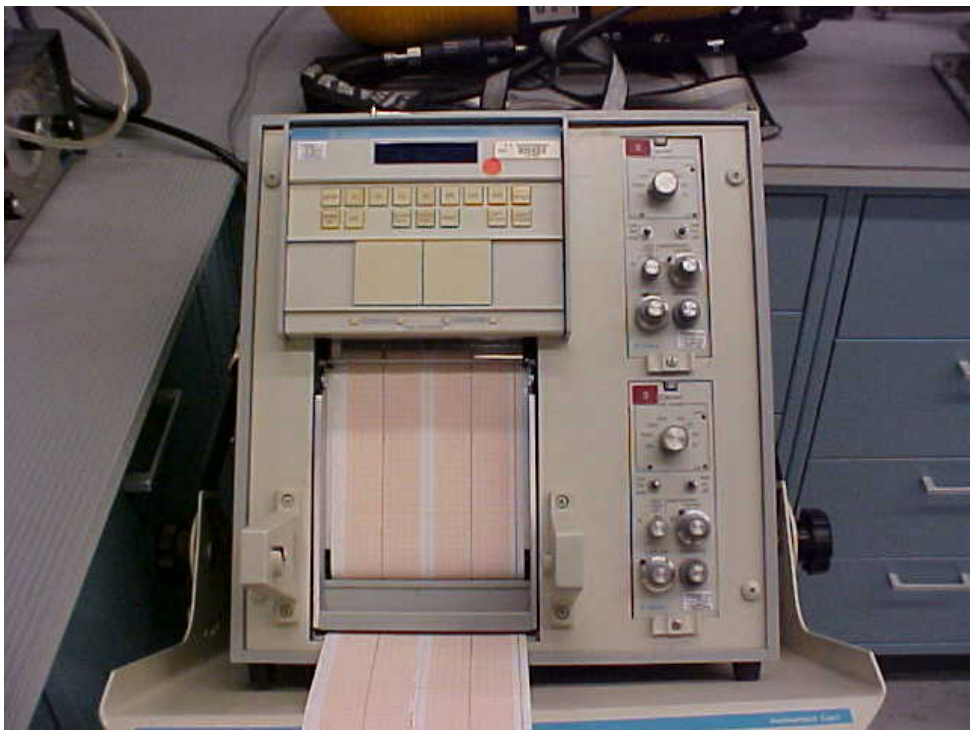

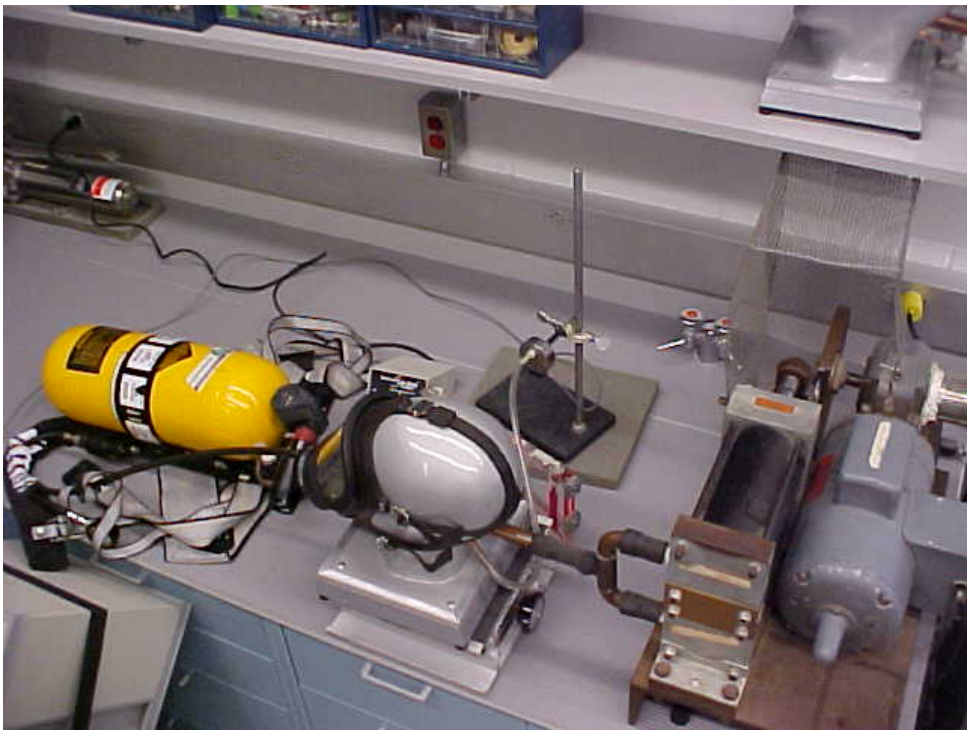

Revision History

Revision	Date	Reason for Revision
1.0	23 May 2001	Historic document
1.1	12 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method