National Institute for Occupational Safety and Health National Personal Protective Technology Laboratory P.O. Box 18070 Pittsburgh, PA 15236		
Procedure No. RCT-ASR-STP-0105A	Revision: 1.1	Date: 27 September 2005

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 level of protection provided by 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 G, Section 84.63(a)(c)(d), and Subpart J, Section 84.150, Table 8; Volume 60, Number 110, June 8, 1995.

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 2.)

3.1.2. A Helicoid calibrated pressure gauge and connecting fittings or equivalent. (see Figure 2.)

3.1.3. Air regulator, Model 8, from Matheson Gas Products or equivalent. (see Figure 2.)

3.1.4. Two channel thermal tip recording system (Gould Model No. RS3200) with carrier amplifier (Model No. 136-4615-35) or equivalent. (see Figure 2. and Figure 4.)

3.1.5. Anthropometric test head with tube for measuring breathing resistance and air flows (Sierra Engineering Co. Model 428) or equivalent. (see Figure 1. and Figure 2.)

Approvals:	1st Level	2nd Level	3rd Level

3.1.6. Temperature compensated pressure transducer (Validyne Engineering Model No. DP45) or equivalent. (see Figure 1., Figure 2., and Figure 3.)

3.1.7. Mechanical breather with 622 kg. m/min. cam as per U.S. BOM. drawings C-1748 (3/l7/69) breathing machine and B-1198 (3/6/69) breathing cam.(see Figure 1. and Figure 2.)

3.1.8. Dwyer Slant Manometer 0-3", F. W. Dwyer Manufacturing Co., Michigan City, Indiana or equivalent. (see Figure 1. and Figure 3.)

3.1.9. Digital stopwatch, calibrated to hundredths of a minute (Cronus Precision Products, Inc.) 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-minute warmup.

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 source as shown

in (Figure 3.). A pinch clamp, used for slight pressure changes, is placed inline with two equal lengths of tubing for the manometer and transducer connections as shown in (Figure 5.).

5.1.2. Connect the transducer cable to the carrier amplifier in the chart recorder shown in (Figure 4). 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 the chart recorder pen is at 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. 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.

5.3. Assemble the apparatus as shown in Figure 2.

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. 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 breathing 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. (see Figure 2.)

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. (see Figure 2.)

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 recorder at 20 mm/sec and run the breathing machine a minimum of 3 cycles for each hose length and pressure range requested by the manufacturer.

5.10. If the unit being tested is a constant-flow pressure-demand unit, then also perform a test for maximum flow using the minimum hose length and the maximum pressure as per NIOSH procedure RCT-ASR-STP-0105 (procedure for continuous-flow respirator flow rate determination).

5.11. See Requirement for minimum performance requirements.

5.12. Data Analysis

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

5.12.2. 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. 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.

5.12.3. 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 G, Section 84.63(a)(c)(d), and Subpart J, Section 84.150, Table 8; 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.

84.150 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.

7.2. All videotapes and photographs of the actual test being performed, or of the tested 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.

8. FIGURES

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

8.2. Flow Rate Determination Test Set-up. (Figure 2.)

8.3. Balancing the Transducer and Recorder Set-up. (Figure 3.)

8.4. Balanced Recorder. (Figure 4.)

8.5. Tubing Set-up for Balancing Recorder. (Figure 5.)

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: _____

_____

_____

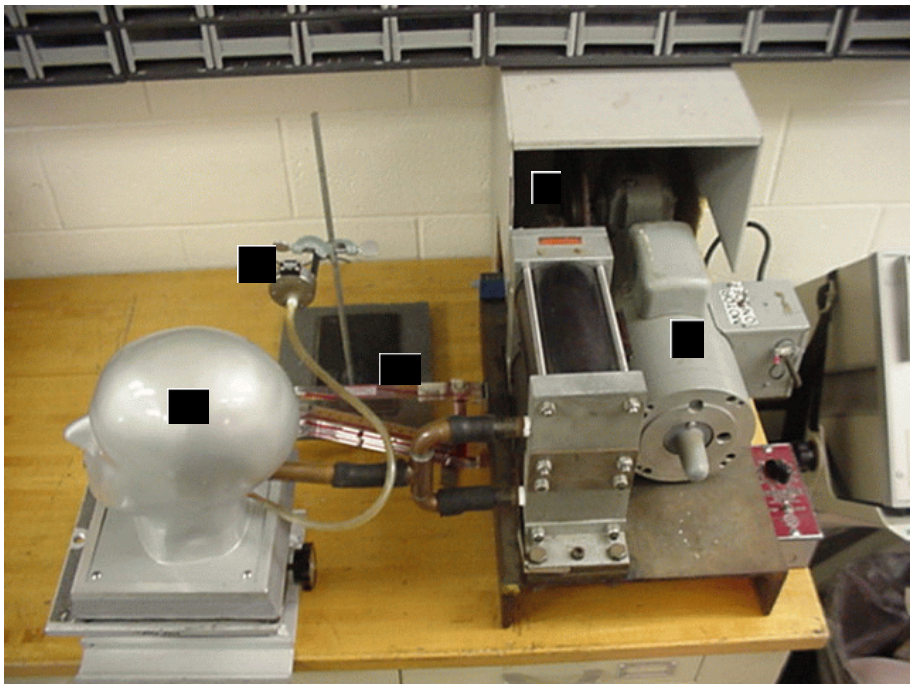
_____

_____

Test Engineer: _____ Pass_____ Fail_____

PROJECT NO. : _____ DATE: _____

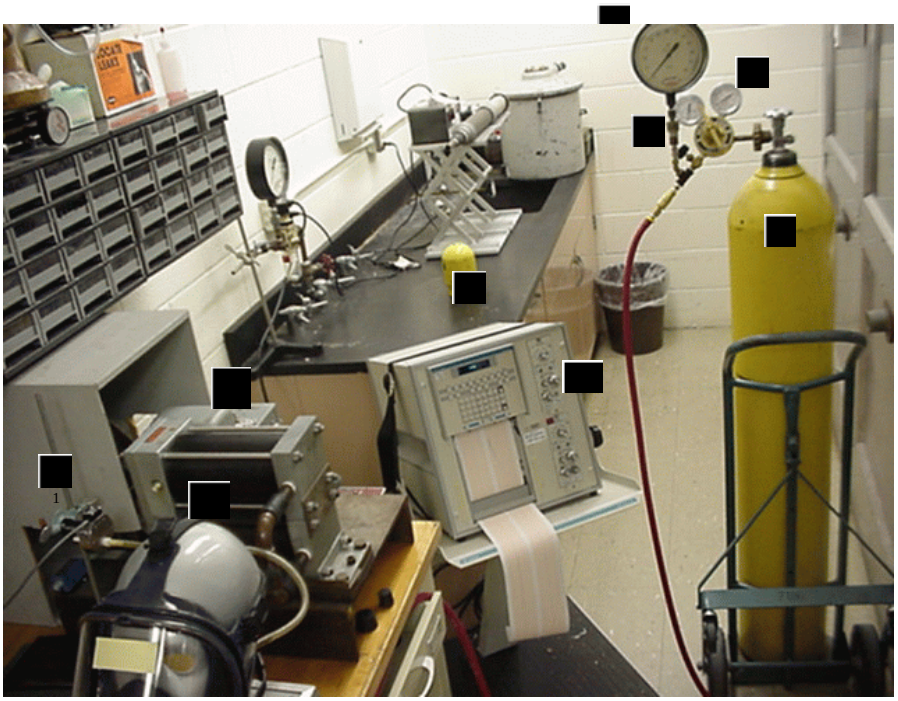
EVENT	HOSE LENGTH	# OF CONN.	PSIG	FLOW LPM	RESIS. " H_2O	STATIC RES." H_2O



1. Transducer
2. Slant Manometer
3. Test Head
4. Breathing Machine
5. Cam

Flow Rate Determination Breathing Machine Set-up

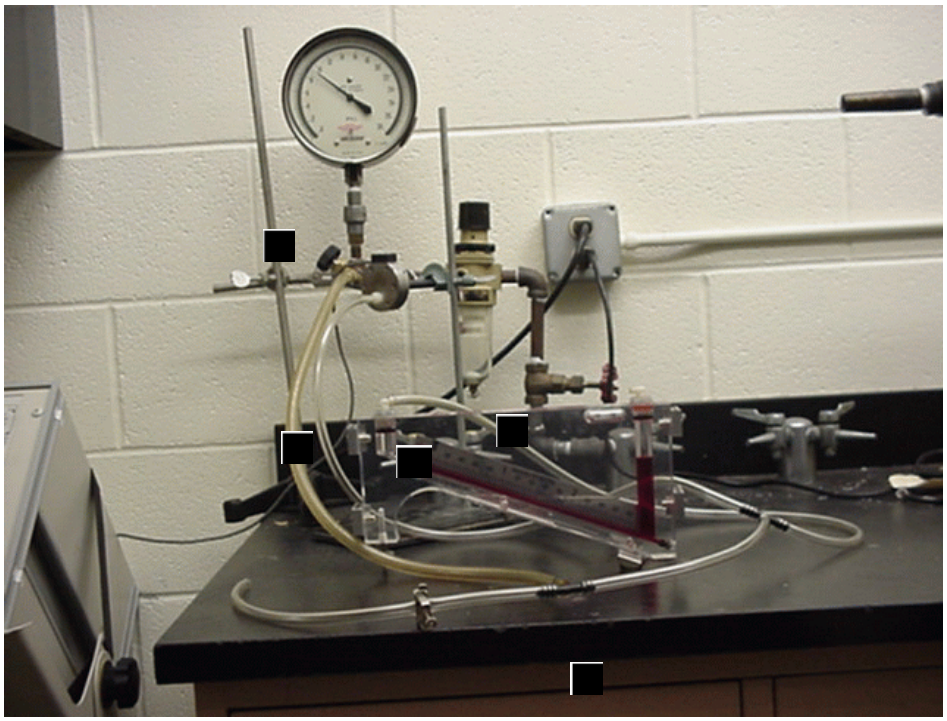
Figure 1



1. Transducer
2. Breathing Machine
3. Test Head
4. Recorder
5. Carrier Amplifier
6. Compressed Air Cylinder
7. Regulator
8. Gauge
9. Fitting

Figure 2

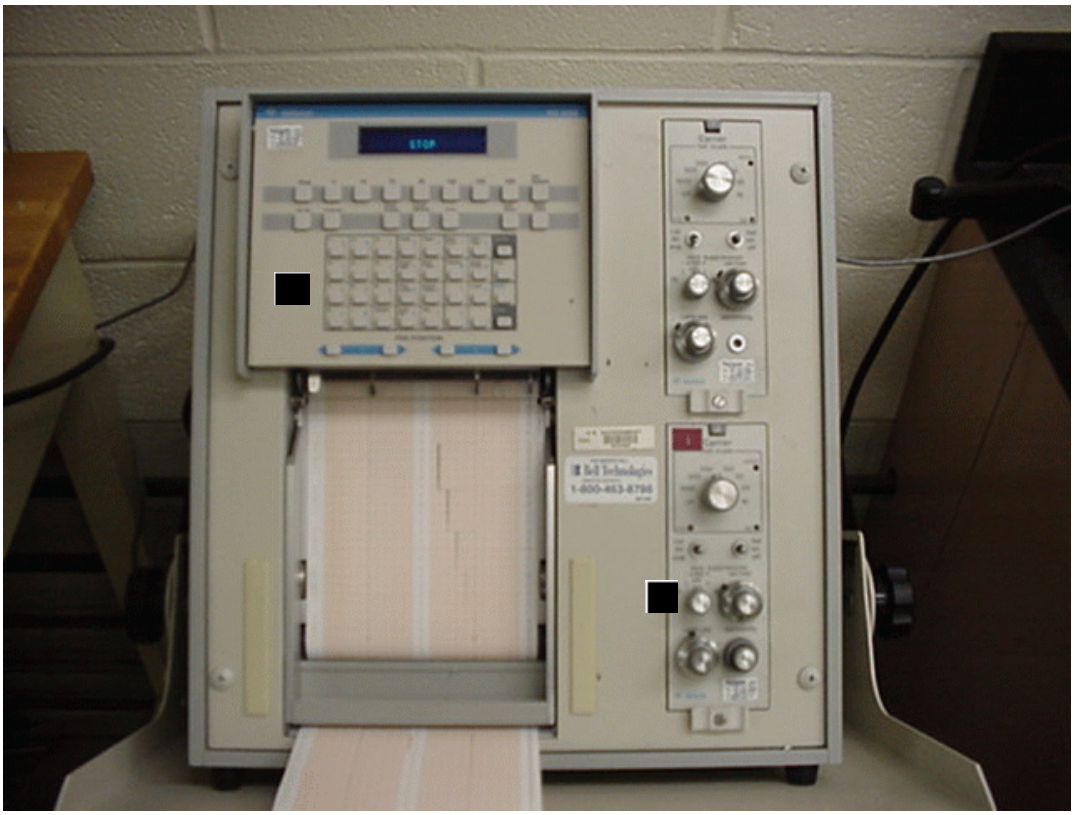
Flow Rate Determination Test Set-up



1. Transducer
2. Gauge
3. Regulator
4. Shut-off Valve
5. Slant Manometer
6. Pinch-Clamp

Figure 3

Balancing Transducer and Recorder Set-up



1. Two Channel Recorder
2. Carrier Amplifier

Figure 4

Balanced Recorder

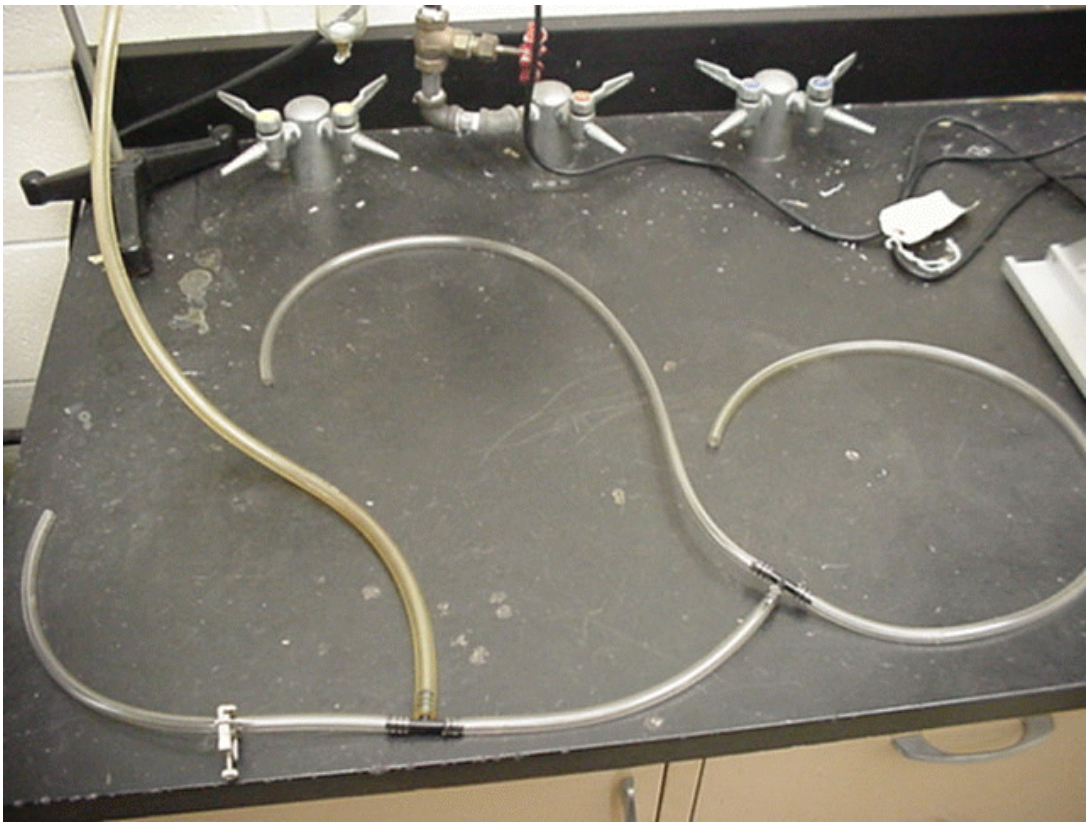


Figure 5 Tubing Set-up for Balancing Recorder

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