



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

Procedure No. RCT-APR-STP-0036	Revision: 1.1	Date: 27 June 05
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DETERMINATION OF CHLORINE DIOXIDE SERVICE LIFE TEST,
AIR-PURIFYING RESPIRATORS
STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedure for ensuring that the level of protection provided by the chlorine dioxide service life requirements on chemical cartridges and gas masks air-purifying 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, 84.63(a)(c)(d), Subpart I, Section 84.110(c), Subpart L, Section 84.190(b), and Subpart KK, Section 84.1157; Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Chlorine Dioxide Service Life Test, Air-Purifying 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/MATERIAL

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

- 3.1.1. Miller Nelson Research Model 401 Flow-Temperature-Humidity Control System or equivalent.
- 3.1.2. Interscan Corporation Model 1330 Chlorine Dioxide detector or equivalent.
- 3.1.3. Radiometer America Multi-Titration System, Model DTS 800, or equivalent.
- 3.1.4. "The Gilibrator", Primary Standard Airflow Calibrator or equivalent.
- 3.1.5. Brooks Rotameter, R 215-D for cartridges and R 215-B for canisters.
- 3.1.6. Gilian Gil-Air-3 Sampling Pump, or equivalent.
- 3.1.7. Fisher Scientific Gas washing bottle or bubbler, catalog # 03-036 or equivalent.
- 3.1.8. Erlenmeyer flasks, 250 to 500 milliliters (ml).

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level
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- 3.1.9. Glacial Acetic Acid.
- 3.1.10. Potassium Iodide (KI) (granular).
- 3.1.11. Boric Acid (granular).
- 3.1.12. Starch, Soluble Potato, Powder.
- 3.1.13. Sodium Thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$) (granular).
- 3.1.14. Sodium Chlorite Anhydrous (Flakes).
- 3.1.15. Vaisala model HMI 31 humidity indicator.
- 3.1.16. Chlorine cylinder, 99% purity.
- 3.1.17. Certified 5 ppm Cl_2 in Nitrogen cylinder.
- 3.1.18. Electronic balance with accuracy of 0.001 grams (g).
- 3.1.19. Pipets, 1-10 ml.
- 3.2. Chlorine dioxide generator. The generator consists of a 1½"-2" inch diameter PVC pipe tee. The tee is equipped with reducing adapters to ½" on both ends, and the top has a clamped removable stopper for filling the tee with sodium chlorite. A small piece of nylon (i.e. panty hose material) is placed over both ends to prevent the sodium chlorite from escaping.
- 3.3. Test fixture for mounting cartridges and canisters. The test fixture used is specific to each manufacturer depending on how the cartridge, canister, or powered air-purifying respirator (PAPR), mouth bit, etc. is mounted to the facepiece. The T-end has a 29/42 ground glass joint glued in place. Canisters are tested with their connections glued into the ground glass joint. In most cases the cartridge cups of the respirator are affixed by hot melt glue to PVC pipe tee of appropriate size. PAPR cartridges and canisters are tested on their blower units if possible, or on suitable substitutions, if the unit is too large for the test chamber.
- 3.4. The test chamber consists of a 12" x 11½" x 7" air tight box, made of ½" plexiglass with 2 hinge type locks on the door opening lined with gasket material. A ½" hole is located on the backside of the test chamber for the introduction of the test concentration and a 1 ½" hole on the top for the exit of the test fixture and to detect the breakthrough concentration. This fixture is not commercially available.
- 3.5. Resistance tester consisting of a vacuum source capable of delivering 85 liters per minute (lpm), a 6-inch slant manometer, and a 29/42 female ground glass joint. The resistance testers currently being used are located on the silica dust chamber.

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. Normal laboratory safety practices must be observed. This includes safety precautions described in the current ALOSH Facility Laboratory Safety Manual.
 - 4.2.1. Safety glasses, lab coats, and hard-toe shoes must be worn at all times.
 - 4.2.2. Work benches must be maintained free of clutter and non-essential test equipment.
 - 4.2.3. When handling any glass laboratory equipment, lab technicians and personnel must wear special gloves which protect against lacerations or punctures.
- 4.3. CHLORINE DIOXIDE BENCH TEST FOR CARTRIDGES
 - 4.3.1. Resistance to air flow will be taken before and after each test (see 84.203).
 - 4.3.2. Three "as received" cartridges (or pairs of cartridges) will be tested at 64 lpm, continuous air flow, 50 ± 5 percent RH (RH), approximately 25 degrees Celsius ($^{\circ}\text{C}$), and 500 ppm ClO_2 .
 - 4.3.3. Two cartridges or pairs of cartridges will be equilibrated at room temperature by passing 25 percent RH air through them at 25 lpm for 6 hours and then testing them at 25 percent RH, approximately 25°C , and 64 lpm continuous air flow rate containing 500 ppm ClO_2 .
 - 4.3.4. Two cartridges or pairs of cartridges will be equilibrated at room temperature by passing 85 percent RH air through them at 25 lpm for 6 hours and then testing them at 85 percent RH, approximately 25°C , and 64 lpm continuous air flow rate containing 500 ppm ClO_2 .
- 4.4. CHLORINE DIOXIDE BENCH TEST FOR CANISTERS
 - 4.4.1. Three "as received" canisters will be tested at 64 lpm, continuous air flow, 50 ± 5 percent RH, approximately 25°C , containing 1000 ppm ClO_2 for chin style canisters.
 - 4.4.2. Two canisters will be equilibrated at room temperature by passing 25 percent RH air through them at 64 lpm for 6 hours and then testing them at 25 percent RH, approximately 25°C , and 64 lpm continuous air flow rate containing 1000 ppm ClO_2 for chin style canisters.

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4.4.3. Two canisters will be equilibrated at room temperature by passing 85 percent RH air through them at 64 lpm for 6 hours and then testing them at 85 percent RH, approximately 25°C, and 64 lpm continuous air flow rate containing 1000 ppm ClO₂ for chin style canisters.

4.5. CHLORINE DIOXIDE BENCH TESTS FOR PAPR CARTRIDGES/CANISTERS

4.5.1. Resistance and airflows for tight fitting PAPR will be taken before and after each test. Airflows only for loose fitting PAPR will be taken before and after each test.

4.5.2. Three cartridges (or pairs of cartridges) will be tested at 115 lpm for tight fitting PAPR or 170 lpm for loose fitting PAPR hood or helmet continuous air flow, approximately 25°C, and 50 ± 5 percent RH with 500 ppm ClO₂. Tight fitting only PAPR gas mask canisters will be tested at 115 lpm at 1000 ppm ClO₂.

4.5.3. Two cartridges (or pairs of cartridges) will be equilibrated by passing 115 lpm for tight fitting PAPR or 170 lpm for loose fitting PAPR hood or helmet, continuous air flow through them at approximately 25°C, and 25 percent RH for six hours. They will then be tested at 115 or 170 lpm continuous air flow, approximately 25°C, 25 ± 5 percent RH, 500 ppm ClO₂. Tight fitting only PAPR gas mask canisters will be tested at 115 lpm at 1000 ppm ClO₂.

4.5.4. Two cartridges (or pairs of cartridges) will be equilibrated by passing 115 lpm for tight fitting PAPR or 170 lpm for PAPR loose fitting hood or helmet, continuous air flow through them at 25°C, and 85 percent RH for six hours. They will then be tested at 115 or 170 lpm continuous air flow, 25°C, 85 ± 5 percent RH, 500 ppm ClO₂. Tight fitting only PAPR gas mask canisters will be tested at 115 lpm at 5000 ppm ClO₂.

4.6 **Please refer to Material Safety Data Sheets and the NIOSH Health and Safety Manual for the proper protection and care in handling, storing, and disposing of the chemicals and gases used in this procedure.**

4.7 **CHLORINE DIOXIDE GAS IS POTENTIALLY EXPLOSIVE ABOVE A CONCENTRATION OF 3900 PPM.**

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. Follow individual instruction manuals for set up and maintenance of equipment used in this procedure prior to beginning testing. Malfunctioning equipment must be repaired or replaced and properly set up and calibrated before starting all tests.

5.2. After the manufacturer's specified warmup period, calibrate the ClO₂ analyzer using the chlorine certified gas cylinder containing the 5 ppm standard as follows:

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- 5.2.1 With a tee in line on the gas cylinder, insert the intake tubing from the analyzer into the tee.
- 5.2.1. Specific calibration of the analyzer for chlorine dioxide is contained in the instruction manual. A certified 5 ppm chlorine cylinder is used to calibrate the ClO₂ analyzer. The monitor response will be lower with Cl₂ than it would be with ClO₂. This difference is expressed as a response ratio of (Cl₂/ClO₂). Refer to the specific section of the analyzer instruction manual for the numerical value of the response ratio, formula, and span instruction details.
- 5.2.2. When monitoring the breakthrough concentration during testing, a charcoal filter supplied with the analyzer is required for sampling of the chlorine dioxide gas. This filter is replenished with distilled water at specific times. Please refer to this section of the manual for more detailed instructions.
- 5.3. Prepare solutions:
 - 5.3.1. 2% Potassium Iodide: Dissolve 20g KI in 1 liter distilled water.
 - 5.3.2. 0.1 Normal (N) Sodium Thiosulfate Solution: Dissolve 24.82g sodium thiosulfate in 1 liter of distilled water. Commercially purchased certified sodium thiosulfate solutions may be used.
 - 5.3.3. 0.005N Sodium Thiosulfate Solution: Dissolve 1.241g sodium thiosulfate in 1 liter of distilled water.
 - 5.3.4. 0.0025N Sodium Thiosulfate Solution: Dissolve 0.6205g sodium thiosulfate in 1 liter of distilled water.
 - 5.3.5. 0.0005N Sodium Thiosulfate Solution: Dissolve 0.1241g sodium thiosulfate in 1 liter of distilled water.
 - 5.3.6. Starch Indicator: Weigh 1g boric acid and add to 100 ml of distilled water, bring to a boil.
 - 5.3.6.1 Weigh 1-2g potato starch, add cold water to make a paste.
 - 5.3.6.2 Add to boiling water and continue to boil for 1 minute.
 - 5.3.6.3 Discard when starch solution becomes cloudy.
 - 5.3.7. Fill chlorine dioxide generator with sodium chlorite flakes. Replace stopper and clamp into place. Generator should be full, but not tightly packed. A small piece of nylon (panty hose material) is placed over the ends to prevent the sodium chlorite from escaping. The generator is installed directly inline, before the test box.

- 5.4. Set up test equipment as shown in Figure 1. In addition to the humidity reading controlled by the Miller Nelson system, the Vaisala HMI 31 humidity indicator sensor is inserted into the air stream via a tee set-up directly prior to the introduction of the gas. This set up is not shown on Figure 1. The humidity reading obtained at this point takes into account tubing length and outside hood air temperature.
- 5.5. Turn on:
 - 5.5.1. Miller Nelson Unit.
 - 5.5.2. Air and water supplies.
 - 5.5.3. Cl₂ cylinder.
- 5.6. Establish the test concentration for approximately 500 ppm Cl₂. The chlorine concentration must be established before the ClO₂ concentration can be generated.
- 5.7. Measure 100 ml of the 2% KI solution into the gas bubbler. Attach Gil-Air 3 sampling pump to intake side of the gas bubbler. Connect outlet side of bubbler to Gilibrator. Check 1 lpm flow of the pump pulling through the potassium iodide solution. This setting will be used to sample the chlorine dioxide concentration.
- 5.8. Adjust the rotameter to the appropriate setting necessary to obtain the desired concentration of 500 ppm Cl₂. For testing at higher airflows or concentrations, a rotameter delivering a higher flow rate will need to be used.
- 5.9. Connect tubing from the sample side of gas bubbler into the Gil-Air pump and tubing from the inlet side of the gas bubbler into the test gas concentration.
- 5.10. Turn Gil-Air pump on and sample at 1 lpm for 2 minutes. The KI solution should change to yellow in the presence of chlorine.
- 5.11. Remove the gas bubbler, and transfer the solution into an Erlenmeyer flask.
- 5.12. Rinse the gas bubbler with distilled water and transfer the washings into the flask.
- 5.13. Titrate the solution with 0.0025N sodium thiosulfate until it is pale yellow.
- 5.14. Add 5 ml of starch indicator. Solution will turn dark blue.
- 5.15. Continue the titration until the blue color just disappears.
- 5.16. Calculate the concentration of Cl₂ in air using the following formula:
$$15.3 \times \text{ml of } .0025\text{N Na}_2\text{S}_2\text{O}_3 = \text{ppm Cl}_2$$
- 5.17. Once the Cl₂ concentration upstream of the chlorine dioxide generator has been established, direct the air-gas mixture through the generator. The generator is installed inline, directly before the test box.

- 5.18. Allow 5-10 minutes to elapse and take air sample down stream of the generator at the rate of 1 lpm for two (2) minutes through the gas bubbler containing 100 ml of 2% KI solution.
- 5.19. Transfer the contents to a 500 ml wide-mouth Erlenmeyer flask.
- 5.20. Titrate it to a straw yellow color using 0.0025N sodium thiosulfate.
- 5.21. Add 5 ml starch solution, continue titration to the disappearance of the blue color.
- 5.21.1. Record ml of reagent used.
- 5.22. Calculate the combined concentration of chlorine dioxide and chlorine gas in air using the formula:
- $$30.586 \times \text{ml } .0025\text{N Na}_2\text{S}_2\text{O}_3 = \text{Combined ClO}_2 \text{ and Cl}_2 \text{ concentration.}$$
- 5.23. To determine the ClO₂ concentration, add 5 ml glacial acetic acid to the above solution and titrate it with 0.005N Na₂S₂O₃ to the disappearance of the blue color. Record ml used.
- 5.24. Calculate the ClO₂ concentration using the formula:
- $$15.292 \times \text{ml } 0.005\text{N Na}_2\text{S}_2\text{O}_3 = \text{ppm ClO}_2$$
- 5.25. To determine the chlorine gas concentration use the formula:
- $$(\text{ppm of combined ClO}_2 \text{ and Cl}_2 - \text{ppm ClO}_2)/2 = \text{ppm Cl}_2$$
- 5.26. If ClO₂ concentration is not the desired concentration, adjust rotameter setting and repeat titration steps.
- 5.27. Once the test concentration has been established, testing may begin. It is recommended to run the as received tests and the preconditioned 25% tests first, as the high humidity decreases the life of the sodium chlorite.
- 5.28. Weigh the cartridge or canister and record the weight.
- 5.29. Take inhalation and exhalation resistance of the cartridge or canister mounted on the facepiece at 85 lpm. See Sections 84.122, 84.203, 84.1157, Title 42, Code of Federal Regulations, Part 84 for breathing resistance requirements. Take airflows of PAPR cartridge or canister mounted on blower assembly.
- 5.30. Mount cartridge or canister onto test fixture and place in testing chamber.
- 5.31. Direct challenge concentration airflow into test chamber. Start timer. Mount small piece of tygon tubing onto the outlet of the test fixture. Insert intake tubing of detector into a slit cut into the side wall of the tubing to allow the detector to sample at the flow rate of

the detector without interference from airflow back pressure. Monitor and record upstream and downstream temperatures throughout testing. Record breakthrough values and times.

- 5.32. The average chlorine dioxide gas concentration must be determined throughout the test.
- 5.33. Withdraw an air sample of the test concentration in the test box or upstream of the test cartridges at the rate of 1 lpm for a 10 minute period (the first ten minutes of the test) and pass it through a gas bubbler containing 100 ml 2% KI solution.
- 5.34. Transfer the contents to an Erlenmeyer flask and titrate the solution to a straw yellow using 0.1N Na₂S₂O₃.
- 5.35. Add 5 ml starch indicator and continue titration until disappearance of the blue color.
- 5.36. Calculate the combined chlorine dioxide and chlorine concentration by the following formula:

$$246.8 \times \text{ml } 0.1\text{N Na}_2\text{S}_2\text{O}_3 = [\text{ClO}_2 + \text{Cl}_2] \text{ ppm}$$
- 5.37. Add 5 ml glacial acetic acid to the solution and titrate with 0.1N Na₂S₂O₃ until disappearance of blue color.
- 5.38. Calculate the average ClO₂ concentration for the ten minute period by the following formula:

$$61.17 \times \text{ml } 0.1\text{N Na}_2\text{S}_2\text{O}_3 = \text{ppm ClO}_2$$
- 5.39. To obtain the average chlorine dioxide concentration for the entire test period, repeat steps 5.33 through 5.38 every 12-15 minutes. Average the combined concentrations for determination of the corrected service life time.
- 5.40. Run test until breakthrough of 0.1 ppm is observed or minimum service life is surpassed depending on type of cartridge or canister tested.
- 5.41. Dismount cartridge or canister, weigh and record final weight, and take final inhalation and exhalation resistance and PAPR airflows.
- 5.42. Calculate the corrected service life at 500 ppm for cartridges or 1000 ppm for canisters using the following formula:

$$\frac{\text{average of actual ClO}_2 \text{ conc. (ppm)} \times \text{time (minutes)}}{\text{Desired test concentration (500 ppm or 1000 ppm)}} = \text{corrected service life (min.)}$$
- 5.43. Shut off chlorine cylinder.
- 5.44. Disconnect chlorine tubing from rotameter to prevent contamination of humidity sensor.
- 5.45. Allow clean air to purge through system for 10 - 15 minutes.
- 5.46. Turn off air and water supply to Miller Nelson system.

5.47. Turn off Miller Nelson system and analyzer.

6. PASS/FAIL CRITERIA

6.1. The criterion for passing this test is set forth in 42 CFR Part 84, Subpart G, 84.63(a)(c)(d), Subpart I, Section 84.110(c), Subpart L, Section 84.190(b), and Subpart KK, Section 84.1157; 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.

84.110 Gas masks; description.

(c) Gas masks for respiratory protection against gases and vapors other than those specified in paragraph (b) of this section, may be approved upon submittal of an application in writing for approval to the Respirator Branch listing the gas or vapor and suggested maximum use concentration for the specific type of gas mask. The Institute will consider the application and accept or reject it on the basis of effect on the wearer's health and safety and any field experience in use of gas masks for such exposures. If the application is accepted, the Institute will test such masks in accordance with the requirements of this subpart.

84.190 Chemical cartridge respirators: description.

(b) Chemical cartridge respirators for respiratory protection against gases or vapors, which are not specifically listed with their maximum use concentration, may be approved if the applicant submits a request for such approval, in writing, to the Institute. The Institute shall consider each such application and accept or reject the application after a review of the effects on the wearer's health and safety and in the light of any field experience in use of chemical cartridge respirators as protection against such hazards.

84.1157 Chemical cartridge respirators with particulate filters; performance requirements; general. Chemical cartridge respirators with particulate filters and the

individual components of each such device shall, as appropriate, meet the following minimum requirements for performance and protection:

(a) Breathing resistance test. (1) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a chemical cartridge respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with paragraphs (d) through (f) of this section

(2) The maximum allowable resistance requirements for chemical cartridge respirators are as follows:

Maximum Resistance
[mm. water-column height]

Type of chemical cartridge respirator	Inhalation		Exhalation
		Final ¹	
For gases, vapors, or gases and vapors, and dusts, fumes, and mists	50	70	20
For gases, vapors, or gases and vapors, and mists of paints, lacquers, and enamels	50	70	20

¹Measured at end of service life specified in Table 11 in subpart L of this part.

(b) Facepiece test. The facepiece test will be conducted as specified in 84.205.

(c) Lacquer and enamel mist tests; general. (1) Three respirators with cartridges containing or having attached to them, filters for protection against mists of paints, lacquers, and enamels shall be tested in accordance with the provisions of paragraph (f) of this section.

(2) In addition to the test requirements set forth in paragraph (c)(1) of this section, three such respirators will be tested against each aerosol in accordance with the provisions of paragraphs (d) and (e) of this section.

(d) Lacquer mist test. (1) Temperature in the test chamber will be approximately 25° C.

(2) Continuous airflow through the respirator will be 32 liters per minute for air-purifying respirators, and not less than 115 liters per minute to tight fitting facepieces and 170 liters per minute to loose-fitting hoods and helmets of powered air-purifying respirators.

(3) Airflow through the chamber will be 20-25 air changes per minute.

(4) The atomizer employed will be a No. 64-5 nozzle with setup 3, or equivalent, operating at 69 kN/m.² (10 pounds per square inch gauge).

(5) The test aerosol will be prepared by atomizing a mixture of one volume of clear cellulose nitrate lacquer and one volume of lacquer thinner. The lacquer described in Federal Specification TT-L-31, October 7, 1953, is an example of an acceptable lacquer. Copies of TT-L-31 may be inspected or obtained from the NIOSH, Respirator Branch, 1095 Willowdale Road, Morgantown, W.V. 26505-2888.

(6) The concentration of cellulose nitrate in the test aerosol will be 95-125 milligrams per cubic meter.

(7) The test aerosol will be drawn to each respirator for a total of 156 minutes for air-purifying respirators and 240 minutes for powered air-purifying respirators.

(8) The total amount of unretained mist in the samples taken during testing, weighed as cellulose nitrate, shall not exceed 5 milligrams for an air-purifying respirator, 28 milligrams for a powered air-purifying respirator with tight-fitting facepiece, and 41 milligrams for a powered air-purifying respirator with loose-fitting hood or helmet.

(e) Enamel mist test. (1) Temperature in the test chamber will be approximately 25° C.

(2) Continuous airflow through the respirator will be 32 liters per minute for air-purifying respirators, and not less than 115 liters per minute to tight-fitting facepieces and 170 liters per minute to loose-fitting hoods and helmets of powered air-purifying respirators.

(3) Airflow through the chamber will be 20-25 air changes per minute.

(4) The atomizer employed will be a No. 64 nozzle with setup 1A, or equivalent, operating at 69 kN/m.² (10 pounds per square inch gauge).

(5) The test aerosol will be prepared by atomizing a mixture of 1 volume of white enamel and 1 volume of turpentine. The enamel described in Federal Specification TT-E-489b, May 12, 1953, with amendment-1 of 9 November 1955 is an example of an acceptable enamel. Copies of TT-E-489b may be inspected or obtained from the NIOSH, Respirator Branch, 1095 Willowdale Road, Morgantown, W.V. 26505-2888.

(6) The concentration of pigment in the test aerosol, weighed as ash, will be 95-125 milligrams per cubic meter.

(7) The test aerosol will be drawn to each respirator for a total of 156 minutes for air-purifying respirators and 240 minutes for power air-purifying respirators.

(8) The total amount of unretained mist in the samples taken during testing, weighed as ash, shall not exceed 1.5 milligrams for any air-purifying respirator, 8.3 milligrams for a powered air-purifying respirator with tight-fitting facepiece, and 12.3 milligrams for a powered air-purifying respirator with loose-fitting hood or helmet.

(f) Bench tests; gas and vapor tests. (1) Bench tests will be made in accordance with 84.207 and tested cartridges shall meet the minimum requirements set forth in Table 11

of Subpart L of this part. Cartridges will be equilibrated in accordance with paragraph (f)(2) of this section.

(2)(i) Two powered air-purifying cartridges or pairs of cartridges will be equilibrated at room temperature by passing 25 percent relative humidity air through them at the following flow rates (expressed in liters per minute (l.p.m.)) for 6 hours:

<u>Type of cartridge</u>	<u>Airflow rate, l.p.m.</u>
Powered air purifying with tight-fitting facepiece	115
Powered air purifying with loose-fitting hood or helmet	170

(ii) Two powered air-purifying cartridges or pairs of cartridges will be equilibrated by passing 85 percent relative humidity air through them at the flow rates stated in paragraph (f)(2)(i) of this section.

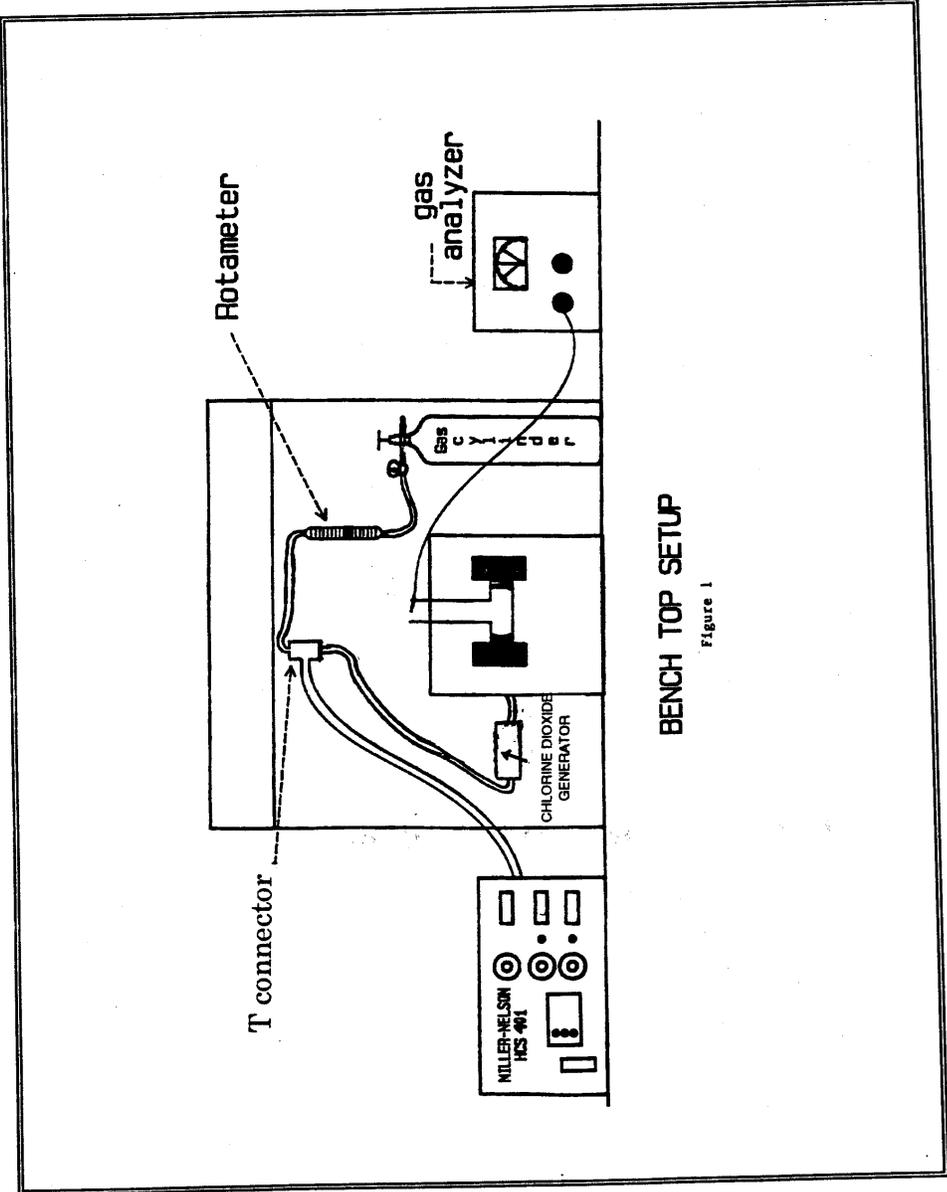
(iii) All cartridges will be resealed, kept in an upright position, at room temperatures, and tested within 18 hours.

7. RECORDS/TEST SHEETS

- 7.1. All test data will be recorded on the DETERMINATION OF CHLORINE DIOXIDE SERVICE LIFE 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. ATTACHMENTS

- 8.1 Bench Top Set-Up
- 8.2 Data Sheet





RB - RESPIRATOR CERTIFICATION TEAM
GAS & VAPOR RESPIRATOR TEST DATA SHEET (Ref.33-48,50,62) STP No.: [_____]

Task Number: TN- _____ Gas Name: _____
 Manufacturer: _____ Item Tested: _____

RESISTANCE	Maximum Allowable Resistance (mm of H ₂ O)				Actual Resistance (mm of H ₂ O)				Result
	Inhalation		Exhalation		Inhalation		Exhalation		
			Initial		Initial	Final	Initial	Final	
1									
2									
3									
4									
5									
6									
7									

Overall Results: Pass ___ Fail ___ Comment: _____

WEIGHTS AND AIRFLOWS	WEIGHTS (gm)				AIRFLOW (Lpm)				Conc. (ppm)
	Con'd				Test Rate		(PAPR Only)		
					RH%	Lpm	Initial	Final	
1									
2									
3									
4									
5									
6									
7									

Overall Results: Pass ___ Fail ___ Comment: _____

DATA TABLE	Test Cond.	Final Time (min)	Leakage (ppm)	Temperature (°C)		Corrected Time (min)
				Downstream	Upstream	
1						
2						
3						
4						
5						
6						
7						

Overall Results: Pass ___ Fail ___ Comment: _____
 Was all testing equipment in calibration throughout all testing: Yes ___ No ___
 Signature: _____ Date: _____

 <p>NIOSH <small>National Institute for Occupational Safety and Health</small></p> <p>RB - RESPIRATOR CERTIFICATION TEAM</p> <p>GAS & VAPOR RESPIRATOR TEST DATA SHEET (Ref.33-48,50,62) <i>Page 2</i></p> <p>Task Number: TN-_____ Gas Name: _____ STP No.: [_____]</p> <p>Manufacturer: _____ Item Tested: _____</p>

<p>Additional Comments:</p> <p style="text-align: center;">Signature: _____ Date: _____</p>

Revision History

Revision	Date	Reason for Revision
1.0	11 March 2002	Historic document
1.1	27 June 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method