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Specification
for

CNSE Respiratory Protection Program

REVISION

Rev No.	DCN No.	Change Summary	Release Date	DCN Initiator	Document Owner
4	DCN0764	Changes made to Section 7; Removal of Appendices B & D; Renaming of other Appendices and Updating Appendix references.	2-20-12	S. Traudt	R. Segura

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1. PURPOSE AND SCOPE

To provide written procedures governing the use of respiratory protective equipment at the College of Nanoscale Science and Engineering (CNSE) facility.

The provisions of this program apply to any and all use of respiratory equipment at the CNSE facility.

This Respiratory Protection Program provides procedures to be followed in accordance with the Occupational Safety and Health Administration's (OSHA) Part 29 Code of Federal Regulations (CFR) 1910.134.

1.1 Scope

This program applies to CNSE employees/students, tenant employees, contractors and sub-contractor who may be performing an activity or operation within the facility that requires the use of Respiratory Protection.

Tenant employees, contractors and sub-contractors may comply with their own organization's program provided that it meets and/or exceeds the minimum requirements set forth in this procedure.

CNSE employees/students, tenant employees, contractors and sub-contractors will be notified of the requirement to follow this program and are required to comply with the restrictions and limitations imposed upon them by CNSE during site activities.

2. DEFINITIONS

2.1 **Air-Purifying Respirator:** a respirator with an air purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air purifying element.

2.2 **Airline Respirator**: a respirator which is supplied air from fixed gas cylinders located throughout the facility.

2.3 **Assigned Protection Factor**: means the workplace level of respiratory protection that a respirator or class of respirators is expected to provide to employees when the employer implements a continuing, effective respiratory protection program as specified by this section.

2.4 **Canister or Cartridge**: a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

2.5 **EHS**: Environmental Health and Safety Department.

2.6 **End of Service Life Indicator (ESLI)**: a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

2.7 **Filter or air purifying element**: a component used in respirators to remove solids or liquid aerosols from the inspired air.

2.8 **Tight-fitting Respirator**: a respiratory inlet covering that forms a complete seal with the face.

3. RESPONSIBILITIES

3.1 EHS Department

3.1.1 The EHS Manager shall be designated as the Administrator of the CNSE Site Written Respirator Program.

3.1.2 The EHS Department is responsible for evaluating those tasks for which respiratory protection is thought to be necessary, determining the degree of hazard posed by the potential exposure, determining whether engineering or administrative controls are feasible to eliminate or reduce employee exposure, and for specifying the minimum respiratory protective equipment for each task.

3.1.3 The EHS Department shall be responsible for coordinating the medical screening, fit testing, and training for all respirator users at the site.

3.1.4 The EHS Department shall maintain and update as necessary a current list of all employees who are certified for respirator use, to include the name of the employee; employee's department; type, make and model, and size of respirator for which the employee is certified, and expiration date of certification.

3.1.5 The EHS Department shall perform periodic audits of areas and tasks which require the use of respirators in order to assure compliance with this specification.

3.1.6 The EHS Department shall periodically evaluate this specification in accordance with Section 14.

3.1.7 The EHS Department shall be the sole approval authority for the approval of respirator (manufacturer types and models) which shall be authorized for use at the site. The EHS Department shall maintain a list of all approved respirators for the site.

3.2 Supervisor/Department Manager/Professor (Supervisor)

3.2.1 The Supervisor is responsible for ensuring that the policies and procedures specified in this document are fully implemented and adhered to throughout his/her organization.

3.2.2 The Supervisor shall notify the EHS Manager of any changes to processes, procedures, or equipment which may require the use of respiratory protection or changes to the current respirator requirements.

3.2.3 The Supervisor shall ensure that each employee under his supervision using a respirator is certified in accordance with Section 7 of this specification. In addition, it shall be the responsibility of the Supervisor/Professor to ensure that certified users who are temporarily unable to wear a respirator are not allowed to perform those tasks for which a respirator is required. Some of the reasons include but are not limited to, medical reasons, or facial hair that interferes with the seal of the respirator or valve function.

3.2.4 Supervisors shall ensure proper respirator equipment maintenance and storage. Supervisors shall ensure that adequate storage facilities exist for individual respirators.

3.2.5 Supervisors shall be aware of the tasks (under their control) which require the use of respiratory protection and that the employees engaged in such tasks wear the appropriate respirators.

3.3 Employee (Respirator User)

3.3.1 The Employee shall wear the appropriate respirator as required by this specification.

3.3.2 The Employee shall guard against mechanical damage to the respirator, clean the respirator as instructed, and store the respirator in a clean and sanitary location.

3.3.3 The employee shall immediately report any malfunction or deficiency of the respirator to their Supervisor.

3.3.4 The Employee shall immediately make their Supervisor aware of any medical condition, which may affect their ability to properly and safely use a respirator in the performance of their job.

3.4 Purchasing Manager

3.4.1 Shall ensure that only respirators approved for use by the EHS Department are purchased.

3.4.2 Shall ensure that only breathing air cylinders of Grade D quality are purchased.

4. ASSOCIATED DOCUMENTS

4.1 **EHS-00015-F1** - Respirator Medical Evaluation Questionnaire

4.2 **EHS-00015-F2** - Medical Determination for Respirator Use

4.3 **EHS-00015-F3** - In House Breathable Air System Inspection Log

4.4 **EHS-00015-F4** - Scott Air-Pak and SCBA Inspection Log

5. RESPIRATOR SELECTION

5.1 The EHS Department shall designate activities for which respirator usage is either required or authorized.

5.2 Prior to the selection of a respirator for a certain task, the EHS Department shall perform an evaluation of the potential hazard. This evaluation may be based upon industrial hygiene sampling, historical data, industry standards, professional judgment, or a combination of these elements.

5.3 The following criteria shall also be considered when selecting respirators:

- Physical state of the contaminant;
- Toxicity of the contaminant;
- Warning properties of the contaminant;
- OSHA Permissible Exposure Limits and/or ACGIH Threshold Limit Values of the contaminant;
- Effectiveness of the respirator against the contaminant of concern;
- Estimated concentration (actual and potential) of the contaminant in the work area and assigned protection factor;
- Time required to complete the task;
- General work area environment (open area, ventilation, engineering controls);

- Other possible contaminants in the work area or the potential for oxygen deficiency;
- Known limitations of the respirator; and/or
- Comfort, fit, and employee acceptance of the respirator.

5.4 Based upon the evaluation of the criteria in Sections 5.2 and 5.3, decision logic (Appendix A) shall be applied in order to select the appropriate type of respirator for the task.

5.5 Respirators shall not be used in lieu of feasible engineering and/or administrative controls.

6. ASSIGNED PROTECTION FACTORS (APFS)

6.1 Employers must use the assigned protection factors listed in the table below to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

Table -- Assigned Protection Factors

Type of Respirator	Quarter Mask	Half Mask	Full Face-piece	Helmet/ Hood	Loose-Fitting Face-piece
1. Air-Purifying Respirator	5	10	50	.....	.....
2. Powered Air-Purifying Respirator (PAPR)	.....	50	1,000	[4]25/1,000	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	25/1,000	25
• Pressure-demand or other positive-pressure mode	.....	50	1,000	.....	.....
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	.....	10	50	50	.....
• Pressure-demand or other positive-pressure mode (e.g., open/closed circuit)	.....	.....	10,000	10,000	.....

7. CERTIFICATION OF RESPIRATOR USERS

7.1 Employees who are required to wear a respirator in the performance of their duties at the site shall be certified in accordance with this section and prior to the use of the respirator.

7.2 Initial Certification shall consist of the following components:

7.2.1 **Medical Screening**: includes completion of the medical questionnaire (EHS-00015-F1), pulmonary function test, and respirator physical by the CNSE contracted medical provider.

7.2.2 **Respirator Fit Test**: employees shall be fit tested by the CNSE contracted medical provider in accordance with OSHA regulation for each type of tight-fitting respirator which they are expected to use. Fit-testing is not required for hood type respirators.

7.2.3 **Respirator Training**: employees shall be trained as outlined in Section 10.

7.3 Continued Certification shall consist of the following components:

7.3.1 **Annual Medical Screening**: completion of the medical questionnaire (EHS-00015-F1), and medical review of the findings by the company physician. A full or partial physical may need to be performed at the discretion of the contracted medical provider.

7.3.2 **Annual Respirator Fit Test**: employees shall be fit tested by the CNSE contracted medical provider in accordance with OSHA regulation for each type of tight-fitting respirator which they are required to use. Fit-testing is not required for hood type respirators.

7.3.3 **Annual Respirator Training**: employees shall be trained as outlined in Section 10.

7.4 Respirator Certification may be revoked or suspended for the following reasons:

7.4.1 Failure of the employee to successfully complete any or all of the initial or continued certification components as outlined in Sections 7.2 or 7.3.

7.4.2 If the employee reports either signs or symptoms of a medical condition which is related to the ability of the employee to wear a respirator.

7.5 Contracted medical provider will provide confirmation or employee's annual respirator medical clearance and fit test results. EHS will notify Supervisors when their employees have attained/not attained medical certification for respirator use. The original shall be retained in the employee's file in the EHS Department.

7.6 Employees who are unable to successfully complete the certification process shall not be allowed to perform those tasks for which a respirator is required.

7.7 If an employee is unable to be certified to wear a respirator, the EHS Department shall notify the employee's Supervisor and Manager. If the

Manager is unable to accommodate this restriction, the appropriate Human Resources Representative shall be notified. The Human Resources Representative shall then arrange a meeting between the Human Resources Representative, the employee's Supervisor, the employee's Manager, and the, EHS Manager in order to resolve the problems resulting from the lack of certification.

8. RESPIRATOR USAGE

8.1 Respirators shall only be used by employees who are certified to wear a respirator as described in Section 7 above.

8.2 The employee shall select the appropriate respirator for the task to be performed. The table listed in Appendix B shall be referenced to determine the appropriate respirator.

8.2.1 Appendix B lists the minimum respirator requirements. A respirator with a greater protection factor may be substituted for that listed in Appendix B provided that the respirator is approved for use, and the employee is certified for that respirator. Example: An airline respirator may be used in place of an air-purifying respirator; or a SCBA may be used in place of an airline system.

8.2.2 The type of respiratory protection required can be changed or downgraded based on air monitoring results that determine due to the effectiveness of the purging procedure or other engineering control that the risk can be controlled, declassifying the inhalation hazard.

8.2.3 However, respiratory requirements can remain unchanged if the task and/or person performing the task changes or if the EHS department determine that the risk is unchanged or uncontrolled.

8.3 Tight-fitting respirators shall not be worn by employees who have facial hair which comes between the sealing surface of the respirator face-piece and the employee's face, or facial hair that interferes with the valve function of the respirator.

8.4 If an employee wears corrective lenses, they shall obtain respirator spectacle inserts through the EHS Department. The corresponding type of spectacle insert shall be used with the type of respirator worn.

9. PROCEDURE FOR CHANGING AIR PURIFYING RESPIRATOR CARTRIDGES

9.1 Respirator cartridges with End of Service Life Indicators (ESLI) shall be changed immediately upon indication of the ELSI in accordance with the manufacturer's instructions. The ESLI must be visible to the user during respirator use.

9.2 Respirators cartridges without ELSI shall be changed in accordance with the table listed in Appendix B or prior to being worn.

9.3 The user of the respirator shall immediately leave the contaminated area and change the respirator cartridges if he/she detects vapor or gas breakthrough (odor, taste), or changes in breathing resistance.

10. PROCEDURE FOR USING AIR-PURIFYING, AIRLINE, AND SCBA RESPIRATORS

There exists a variety of situations in which a respirator may be used, providing the wearer with protection from nuisance levels to toxic levels of contaminants. Essentially CNSE authorizes the use of three types of respirators: Air-Purifying, Air-Line and Self-Contained Breathing Apparatus (SCBA). Each of these three respirator types has their own capabilities and limitations.

10.1 Air Purifying Respirators

10.1.1 This type of respirator is most useful in eliminating "unwanted" or nuisance type contaminants and **cannot** be used in emergency situations involving toxic levels of contaminant. The device includes a half-mask (which covers the chin, mouth, and nose) or a full-mask assembly (covers the entire face), and a pair of air-purifying cartridges. CNSE also authorizes a disposable air-purifying type which has permanently affixed cartridges, in which the entire assembly is disposed of after a single use. When the wearer of an air-purifying respirator inhales, the contaminated air is drawn through the cartridge which, depending upon the cartridge selected, removes the hazardous vapors, gas and/or particulate matter from the air before it enters the body.

10.1.2 Air-Purifying Respirators should be used:

- Against contaminants with good warning properties such as hydrogen fluoride, hydrogen bromide, chlorine, hydrogen chloride, sulfuric acid, particulates, nitrogen trifluoride, ammonia, C5F8/C4F6, sulfur dioxide;

- Against contaminants that are less than 10 (half-face) or 50 (full-face) times the Permissible Exposure Limit (PEL).
- Against materials that the filter or cartridge is designed to protect against.

10.1.3 Air-Purifying Respirators should not be used:

- In oxygen-deficient atmospheres;
- Against highly toxic substances, such materials can include; Arsine, Fluorine, Diborane, Dichlorosilane, Germane, Phoshine, Silane and Ozone;
- Against materials with poor warning properties, such as Carbon Monoxide and Nitrogen Monoxide; and/or
- Against irritants without proper eye protection.

10.1.4 How to put on/don an Air-Purifying Respirator:

- Check valves to be sure that they are clean, flexible, and free of cracks or holes;
- Check the face-piece to be sure that it is free of defects;
- Screw appropriate cartridge into the inhalation port connectors;
- Adjust the harness straps to the “full out” position; and
- Place respirator on face, chin first.

10.1.5 How to put on/don a Half-Mask Air-Purifying Respirator:

- Position the narrow portion of the respirator on the nose bridge and place the harness behind the top of the head so that the top strip rests across the top of the head and the bottom strip above the ears.
- Hook the bottom strap behind the neck, below the ears.
- Adjust the upper headband straps by holding the respirator face-piece with one hand and pulling the elastic material in the appropriate direction with the other. Do not over tighten.
- Tighten the lower headband straps to obtain a comfortable fit and good seal.

10.1.6 How to put on/don a Full-Face Air-Purifying Respirator:

- Pull the harness and straps over and behind the head.
- Tighten (in order), the neck straps, temple straps, and then the forehead straps.
- Adjust the position of the face-piece on the face and readjust the straps to obtain a comfortable fit and a good seal.

NOTE: For a mask with a head harness, follow the same procedure; tightening the lower straps first, and then the head harness.

10.1.7 Perform a positive and negative pressure seal check:

a. Positive Pressure Seal Check

Cover the exhalation port with one hand and gently exhale into the face-piece. A slight pressure should be built up inside the face-piece with no evidence of outward leakage. If air leaks are detected, readjust the respirator and repeat the seal check.

b. Negative Pressure Seal Check

Completely cover cartridges with hands, being careful not to apply pressure on the cartridges, and inhale gently. If the face-piece collapses slightly and no air leaks are detected between the face and face seal, a good fit has been obtained. If the face-piece does not collapse and/or air leaks are detected, readjust the respirator and repeat the seal check.

10.1.8 Cartridges

- Whenever the wearer either experiences increased difficulty in breathing, or senses irritation, odor, or taste while inhaling, the wearer shall immediately exit the contaminated area and replace the cartridges.

- The cartridges are labeled and color-coded to indicate the contaminants for which they will protect against. You should always read the information on your cartridges before using them to ensure that they are correct for the application. Cartridges are specific to the manufacturer, make, and model of respirator for which they have been approved by NIOSH. Do not interchange cartridges between manufacturers.

- Some of the common types of cartridges which are used at the CNSE Site are:

Cartridge Label Color	Protection Against
Black	Organic vapor
Yellow	Organic vapor Chlorine Hydrogen Chloride Hydrogen Fluoride Sulfur Dioxide
Olive Green	Mercury Vapor Chlorine
Magenta	Particulates and aerosols
Magenta/Olive Green	Organic vapor Chlorine Hydrogen Chloride Hydrogen Fluoride Sulfur Dioxide Chlorine Dioxide Formaldehyde, Ammonia, Methylamine, Particulates and aerosols

10.1.9 Care

The respirator must be cleaned and inspected after each day's use. Remove the cartridges, wash the unit in warm water and let dry at room temperature. The respirator must be stored in a sealable plastic container in a dry location to ensure that it remains clean and serviceable.

10.2 Air-Line Respirators

10.2.1 The Air-Line respirator system at the CNSE site consists of a mask equipped with a pressure demand regulating valve, SKA-PAK auxiliary emergency escape cylinder, a small diameter air hose, connected to a manifold, back to a pressure reducing regulator, and finally connected to one or more high pressure compressed air cylinders in cascade.

10.2.2 The system is of the pressure-demand type. With this system a small positive pressure is always maintained in the face-piece, even on inhalation. The demand valve opens to supply air when the positive pressure decreases to a certain level as the result of inhalation. The leakage is always outward if a poor face-piece is maintained.

10.2.3 Since the wearer's travel distances and direction is limited by the hose connection, this respirator must not be used in atmospheres Immediately Dangerous to Life and Health (IDLH). In addition, this limitation is necessary because the air-line is entirely dependent upon an air supply

that is not carried by the wearer of the respirator. If the air supply fails, the wearer must immediately exit from the hazardous atmosphere.

10.2.4 SKA-PAKS, an auxiliary emergency-escape cylinder, will be worn whenever air-line respirators are required (R) for use according to Appendix B - Required and Authorized Respirator Usage. These cylinders provide approximately a 5 minutes air supply to be used for emergency escape from the hazardous atmosphere.

10.2.5 How to put on and operate the in-house airline:

- Always check the system pressure prior to hook up. If the cylinder pressure is less than full, change all of the cylinders in that system.
- Always clean the mask before and after each use. After use, store the mask within a re-sealable plastic bag within its cabinet.
- Don SKA-PAK
    a. Put on SKA-PAK 5-minute breathing air harness
    b. Connect the air supply hose to the in-house airline manifold and turn on open/shutoff valve.
    c. Connect SKA-PAK air hose to the air supply hose.
- Don Face Mask
    a. Put face-piece on the chin first, pull head harness over and behind the head
    b. Securely tighten the straps of the facemask
    c. Perform a user seal check by blocking the opening of the facemask with your hand and then inhaling
    d. If air leaks can be detected, reposition the mask and straps and repeat the user seal check until acceptable
    e. Attach the air line regulator to the facemask by aligning keyed tabs and turning a quarter turn until it locks into place
    f. After initial breath, adjust purge valve as needed
- When the system is depleted the system alarm will activate. If the alarm activates, take immediate measures to place whatever it is that you are doing into a safe state.

- If conditions in the workplace require emergency evacuation during respirator use follow these steps:

    a. Open the cylinder valve by turning the valve knob to the full counterclockwise position

    b. Breathe normally to initiate emergency use respirator

    c. Disconnect the air supply hose from the airline connection hose

    d. Egress to an area with safe and breathable atmosphere

    e. When in a safe, breathable atmosphere; doff the face-piece, close the cylinder valve by pushing in and rotating the valve clockwise

    f. Remove the respirator from service and tag for changing, inspection and cleaning

- When your use of the system is completed, shut off the air supply at the manifold, and properly clean and store the facemask, hoses, and SKA-PAK.

- If your use of the system has brought the system pressure to below 500 psi, change the air-line system compressed air cylinders.

- Bring any system problems to the immediate attention of your supervisor and ensure that they are addressed as soon as possible.

- This system is to be used only in situations or environments that **are not** Immediately Dangerous to Life or Health (IDLH).

10.3 Self-Contained Breathing Apparatus (SCBA)

10.3.1 At CNSE, the Scott Air-Pack SCBA is utilized. The Scott Air-Pack is a pressure-demand unit supplying the wearer with up to 30 minutes of clean air. Pressure-demand means that there is always a constant flow of air to the face-piece, to maintain a positive pressure within, and the flow increases as you inhale (demand air).

10.3.2 The Scott Air-Pak SCBA respirator system consists of the pressure cylinder containing a mixture of Grade D breathing air (21% oxygen). The regulator assembly, the harness assembly, and the face mask. The SCBA features a regulator attached to the face-piece. The entire unit weighs approximately 30 lbs., and is secured in place (cylinder on back) by shoulder and chest straps. This is the appropriate respirator for emergency situations requiring clean, non-contaminated air.

10.3.3 How to put on and operate the SCBA:

- Remove the Air-Pak from its' wall-mounted case.
- Check the cylinder gauge to ensure that it indicates "FULL". If not, replace the cylinder before use.
- Put on the apparatus as you would a coat, with the cylinder valve pointing down and the flat portion of the harness against your back. Obtain assistance donning SCBA if necessary.
- Connect the waist buckle, and adjust the shoulder straps by pulling forward and down on the two side-mounted shoulder straps.
- Fully depress the center of the donning switch on the top of the regulator, then release.
- Slowly open the cylinder valve fully. You will hear and feel the Vibralert alarm in the face-piece start and stop. There will be no free flow of air at this time.

NOTE: If the donning switch has not been depressed prior to opening the cylinder valve, the alarm will not activate due to air flowing freely from the face-piece.

- With the neck strap adjusted to the full outward position, fold the head harness back over the lens.
- Place the mask on, chin first. Pull the head harness over the head and tighten the neck straps, and then the top straps. Ensure that the harness is fully extended behind the head and the mask is correctly positioned.
- Inhale sharply and air will be supplied to the face-piece.
- Ensure that the purge valve is rotated to the full closed position (pointer on knob is upward). Fully depress and hold the center of the donning switch on the top of the regulator. Inhale slowly and hold your breath. There should be no leakage of air detected and the face-piece drawn slightly to the face.

NOTE: If leakage is detected, readjust the face-piece and repeat this step. If the purge valve is adjusted to produce flow, it will not be possible to perform this seal check.

- Remove finger from donning switch and inhale sharply. The respirator should function normally and supply air during the user's inhalation.

NOTE: If the purge switch is adjusted to produce flow, it may not be possible to reset the donning switch by inhaling.

WARNING: When the Vibralert alarm activates, it warns the user that 20 - 25% of the full cylinder pressure remains, or that there is a malfunction in the primary breathing circuit. **If this occurs, leave the area immediately.**

NOTE: Should the airflow be partially or completely cut-off during use, fully open the purge valve (red knob on regulator) by turning it counterclockwise (pointer of knob pointing down). **Leave the area immediately.**

- After use, to stop the airflow from the face-piece, fully depress the donning switch on the top of the regulator and release.

- Decontaminate the apparatus, if necessary. Clean and disinfect the face-piece and regulator using an isopropanol wipe, and replace the used air cylinder with a full cylinder.

11. RESPIRATOR USE UNDER SPECIAL CONDITIONS

11.1 Dangerous Atmospheres

If respiratory protective equipment usage in atmospheres "immediately dangerous to life or health"(IDLH) is anticipated, special preparations must be made.

11.2 Procedures must cover at least the following:

- Individuals designated to enter into dangerous atmospheres must have training with the proper equipment, i.e., self-contained breathing apparatus (SCBA) or airline with 5 minute escape pack.

- Designation and provision of a standby individual, equipped with proper rescue equipment, who must be present in a nearby safe area for possible emergency rescue.

- Provision for communication between persons in the dangerous atmosphere and the standby person must be made. Communication may be visual or by voice, signal line, telephone, radio, or other suitable means. Other important data such as toxicologic information and emergency telephone numbers should also be included.

NOTE: The above situations would typically be handled by a trained Emergency Response Team member, and are not expected to be encountered during normal operations.

11.3 Confined Spaces

11.3.1 Confined spaces are defined as, spaces that are large enough for an employee to bodily enter and perform assigned work, but has limited or restricted means for entry or exit, and is not designed for continuous employee occupancy. In many cases, confined spaces contain toxic air contaminants, are deficient in oxygen, or both. As a result, special precautions must be taken. Each such entry must be individually planned with the EHS Department.

11.3.2 When choosing the appropriate respirator for work in a confined space, the following factors should be considered:

- Air purifying respirators may be worn in a confined space only if the tests show that the atmosphere contains adequate oxygen and that air contaminants are well below permissible exposure levels. While individuals wearing these types of respirators are in a confined space, the atmosphere must be monitored continuously.

- Airline supplied-air respirators may be worn in a confined space only if the tests show that the atmosphere contains adequate oxygen and that air contaminants are well below levels immediately dangerous to life or health. While individuals wearing these types of respirators are in a confined space, the atmosphere must be monitored continuously.

- If the atmosphere in a confined space is immediately dangerous to life or health due to a high concentration of air contaminants or oxygen deficiency, those entering the space must wear a positive pressure SCBA or an airline system equipped with an escape bottle certified for IDLH conditions.

11.4 Low and High Temperature

11.4.1 Use of respiratory protective equipment in low temperatures can create several problems. The lenses of the full face-piece equipment may fog due to condensation of the water vapor in the exhaled breath. Coating the inner surface of the lens with an anti-fogging compound will reduce fogging. Nose cups that direct the warm, moist exhaled air through the exhalation valve without passing over the lens are available from the manufacturer for insertion into the full face-piece. At low temperatures, the exhalation valve can freeze onto the valve seat due to the moisture in the exhaled air. The user will be aware when this situation occurs by the

increased pressure in the face-piece. When unsticking the valve, be careful not to tear the rubber diaphragm.

11.4.2 Respirator usage in hot environments can put additional stress on the user. The stress can be minimized by using a light-weight respirator with low breathing resistance. An airline type atmosphere-supplying respirator equipped with a vortex tube can be used. Since the vortex tube may either cool or warm the supplied air (depending on the connection and setting), this protection scheme can be used in both hot and cold environments.

12. CLEANING, INSPECTION AND MAINTENANCE OF RESPIRATORS

General

12.1 Respirators shall be stored in a clean and sanitary location, which is convenient to the area in which their use is required.

12.2 Respirators shall be inspected by the user both prior to and after each use.

12.3 Respirators which are found to be defective shall not be used. Defective respirators shall be turned-in to the employee's supervisor with a written description of the deficiency. Employees shall not attempt to repair defective respirators.

12.4 At a minimum, respirators which are assigned to individual employees shall be cleaned and disinfected after each use in accordance with the manufacturer's instructions.

12.4.1 Respirators that are shared (SCBA's) should follow Appendix D -Scott Multi-Wash Mini General Cleaner and Disinfectant Instructions.

12.4.2 Respirators which are found to be dirty during the pre-use inspection shall be cleaned by the employee prior to use.

12.5 Respirators shall be stored in a manner to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. Respirators shall also be packed or stored in such a manner as to prevent deformation of the face-piece and exhalation valve.

12.6 Pre/Post-use Inspection of Air Purifying Respirators

12.6.1 Face-piece, check for:

a) Excessive dirt.

b) Cracks, tears, or holes.

c) Distortion (allow face-piece to sit free from any constraints and observe if distortion appears).

d) Cracked, scratched, or loose-fitting lenses.

12.6.2 Headstraps, check for:

a) Breaks or tears.

b) Loss of elasticity.

c) Broken or malfunctioning buckles or attachments.

d) Excessively worn serrations on the head harness which might allow the face-piece to slip.

12.6.3 Inhalation valve and exhalation valve, check for:

a) Detergent residue, dust particles, or dirt on valve or valve seat (clean & sanitize as necessary).

b) Cracks, tears or distortion in the valve material or valve seat.

c) Missing or defective valve cover.

12.6.4 Filter Elements:

a) Proper filter selected for the hazard.

b) NIOSH approval designation

c) Missing or worn gaskets

d) Worn threads

e) Cracks or dents in the filter housing

12.6.5 Air purifying respirators, which are stored with the cartridges, shall be placed in plastic bags in order to prevent them from becoming dirty and/or contaminated.

12.7 Pre/Post-use Inspection of In-House Airline System

12.7.1 Face-piece, check for:

a) Excessive dirt.

b) Cracks, tears, or holes.

c) Distortion (allow face-piece to sit free from any constraints and observe if distortion appears).

d) Cracked, scratched, or loose-fitting faceshield.

12.7.2 Headstraps, check for:

a) Breaks or tears.

b) Loss of elasticity.

c) Broken or malfunctioning buckles or attachments.

d) Excessively worn serrations on the head harness which might allow the face-piece to slip.

12.7.3 Breathing Hose (airline):

a) Excessive dirt.

b) Cracks, tears, breaks, kinks, or holes.

c) Broken, loose, or worn fittings

12.7.4 Air Supply System (cylinder):

a) Tightness of connections

b) Delivery pressure between 60 - 115 psi.

c) Cylinder pressure greater than 500 psi.

d) The green LED light on the alarm is on.

12.7.5 SKA PAKS-5 minute emergency breathing air apparatus:

a) Cylinder FULL

b) Harness functional

12.7.6 The airline hoses shall also be stored in their assigned locations, with the ends of the hose coupled together.

12.7.7 Air used in supplied air respirators and in SKA-PAKS shall meet grade D specifications for breathing air.

12.7.8 Compressed oxygen shall not be used in systems designed for compressed air.

12.7.9 Airline couplings shall be incompatible with other gas or compressed air systems in order to prevent accidental hookup to non-respirable gas or oxygen.

12.7.10 House compressed air shall not be used as breathing air in respirators.

12.7.11 Compressed breathing air cylinders shall be made available to individual user groups.

12.8 Pre/Post-use Inspection of Self Contained Breathing Apparatus (SCBA).

12.8.1 Face-piece, check for:

a) Excessive dirt.

b) Cracks, tears, or holes.

c) Distortion (allow face-piece to sit free from any constraints and observe if distortion appears).

d) Cracked, scratched, or loose-fitting faceshield.

12.8.2 Headstraps, check for:

a) Breaks or tears.

b) Loss of elasticity.

c) Broken or malfunctioning buckles or attachments.

d) Excessively worn serrations on the head harness which might allow the face-piece to slip.

12.8.3 Breathing Hose, check for:

a) Excessive dirt.

b) Cracks, tears, breaks, kinks, or holes.

c) Broken, loose, or worn fittings.

d) Tightness of connections.

12.8.4 Air Supply System (cylinder), check for:

a) Tightness of connections.

b) Cylinder is FULL.

12.8.5 In addition to pre/post-use inspections, SCBA's shall be inspected at monthly intervals.

12.8.6 The EHS Department shall ensure that the monthly inspections of the SCBA's are performed. If the monthly inspections of the SCBA's are performed by an outside vendor, the EHS Department shall review the findings of the inspection and shall initiate appropriate action to resolve all deficiencies which are noted.

12.8.7 The Emergency Response Team (ERT) shall be responsible for performing the monthly inspection of all SCBAs at the site. The inspections shall be performed in accordance with both the procedure outlined in Appendix C of this specification, and according to the schedule outlined in EHS-00023.

12.8.8 At a minimum, SCBA's shall be cleaned and disinfected after each use. If during the course of the weekly inspection an SCBA is found to be dirty, it shall be cleaned at the time of the inspection. Appendix D - Scott Multi-Wash Mini General Cleaner and Disinfectant Instructions.

12.8.9 Compressed oxygen shall not be used in equipment designed for compressed air.

12.8.10 Air used in SCBA cylinders shall, minimally meet Grade D specifications for breathing air.

12.8.11 After use, the authorized user is responsible for delivering the used or empty cylinders to the gas cylinder storage area, and for ensuring that the SCBA is decontaminated, inspected, a new cylinder installed, and the SCBA placed back in its storage cabinet.

13. RESPIRATOR TRAINING

13.1 Employees shall be trained in the proper use of respirators and the CNSE Respirator Program as part of the initial certification and recertification. Employees who have not received this training shall not be allowed to perform those tasks for which a respirator is required.

13.2 EHS-00027 EHS Training Specification outlines the departments/groups requiring respirator training.

13.3 <u>Initial respirator training</u> shall include, at a minimum, the following components

13.3.1 Why the respirator(s) is/are necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

13.3.2 What the limitations of the respirators are;

13.3.3 How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

13.3.4 How to inspect, put on and remove, use and check the seals of the respirator;

13.3.5 What the procedures are for maintenance and storage of the respirator;

13.3.6 How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

13.3.7 The general requirements of this specification.

13.4 In order to maintain certification, employees must attend an annual refresher training which, at a minimum, will cover the components listed in Section 13.3.

13.5 In addition to the annual training requirement, affected employees shall be retrained whenever:

13.5.1 Changes in the workplace or the type of respirator render the previous training obsolete;

13.5.2 Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill;

13.5.3 Any other situation arises in which retraining appears to be necessary in order to ensure safe respirator use.

14. PROGRAM EVALUATION

14.1 This specification shall formerly be reviewed by the EHS department annually, at a minimum.

14.2 Continuous evaluation of the respirator program shall be accomplished by:

14.2.1 Periodic audits by the EHS Department of user groups and tasks which require respirator usage.

14.2.2 Feedback from training classes, ERT Incident Critiques and other forums.

14.2.3 Review of incident and accident reports.

15. RECORDS

All records required by this specification such as medical evaluations, fit test results and training certification shall be kept on file by the EHS Department for a minimum of ten years.

16. APPENDICES

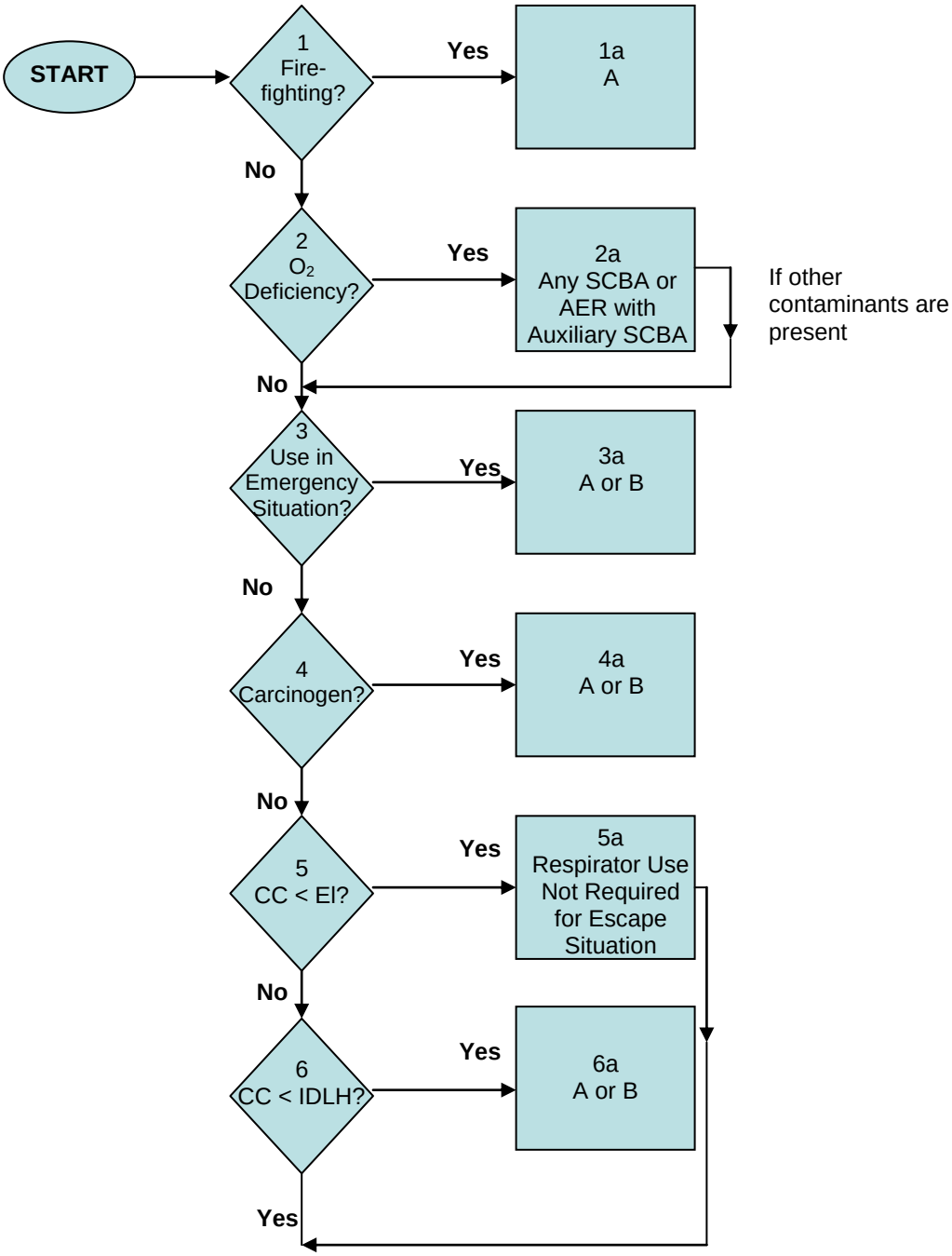
16.1 **Appendix A** - Respirator Selection Decision Tree

16.2 **Appendix B** - Required and Authorized Respirator Usage

16.3 **Appendix C** - Inspection of Scott Air-Pak and Self Contained Breathing Apparatus (SCBA)

16.4 **Appendix D** - Scott Multi-Wash Mini General Cleaner and Disinfectant Instructions

APPENDIX A
RESPIRATOR SELECTION DECISION TREE



APPENDIX B
REQUIRED AND AUTHORIZED RESPIRATOR USAGE

Task/Activity/Operation	Respirator Type			Minimum Cartridge Change Schedule for Air-Purifying Respirator
	Air Purifying Respirator	Airline/Air Supplied Respirator	SCBA	
While handling or working on vacuum pumps or abatement/treatment units that have had previous contact with chemicals or gases.	R*1	A		Before Each Use
While transferring, pouring, dispensing, mixing, aspirating, or loading or unloading chemicals or wastes where there exists the potential for skin, eye and/or respiratory exposure. Tool sets include: photolithography; wet etching; CMP operations; copper plating operations; stripping, dipping, cleaning: of wafers/ parts/ equipment - Without local exhaust.	R	A		Before Each Use
While working or conducting maintenance in equipment where chemical contact or vapors are possible - Without local exhaust.	R	A		Before Each Use
Handling broken mercury-filled containers (i.e. thermometers, mercury vapor lamps). Area must be roped off and posted with signage.	A			
Conducting work/maintenance/cleaning or decontamination of/on chemical drains, vent lines, scrubbers or duct work (may require full body suit and supplied air under certain circumstances).	R*1	A		Before Each Use
Performing maintenance on process gas lines (which breaks the gas line integrity) within a secondary regulator box, Tool Gas Box, VMB, Gas Cabinet, Purifier Cabinet, or GIB (Highly Toxic*2) with local exhaust ventilation. Area must be roped off and posted with signage.		R*1	A	Not Applicable
Performing maintenance on process gas lines (which breaks the gas line integrity) within a secondary regulator box, Tool Gas Box, VMB, Gas Cabinet, Purifier Cabinet, or GIB (Corrosive or Toxic*3) with local exhaust ventilation. Area must be roped off and posted with signage.	R	A		Not Applicable
Corrosive/Toxic Gas Cylinder, Bubbler, or Pre-Cursor Change or Installation		R	A	Not Applicable
Flammable/Pyrophoric Gas Cylinder, Bubbler, or Pre-Cursor Change or Installation		R	A	Not Applicable
Maintenance/cleanouts of tool chambers containing toxic solid materials or harmful dusts such as Arsenic, etc. Note: Tyvek suits should be worn for Arsenic contaminated work.	R	A		Not Applicable

Task/Activity/Operation	Respirator Type			Minimum Cartridge Change Schedule for Air-Purifying Respirator
	Air Purifying Respirator	Airline/Air Supplied Respirator	SCBA	
Maintenance/cleanouts of tool chambers or vacuum pumps containing toxic, highly toxic, corrosive or oxidizing gaseous materials or harmful vapors. Chamber must be cycle purged 10 times before the open and air monitoring to prove the effectiveness of the purge must be performed. Local exhaust ventilation must be installed.		R*1	A	Not Applicable
Maintenance/cleanouts of EPI process chambers, forelines or vacuum pumps containing toxic, highly toxic, corrosive or oxidizing gaseous materials or harmful vapors. Process chamber, forelines and vacuum pumps must be cycle purged 10 times before the open and air monitoring to prove the effectiveness of the purge must be performed. Local exhaust ventilation must be installed.		R*1	A	Not Applicable
Maintenance/cleanouts of deposition type tool chambers containing toxic solid materials or harmful dusts such as Arsenic, etc.	R	A	A	Not Applicable
Gas leak			R	Not Applicable
Small chemical spill of known substance	R		A	Not Applicable
Chemical spill of unknown substance			R	Not Applicable

R – Required Respiratory Protection
A – Alternate Respiratory Protection

*1= Respiratory protection not required or can be downgraded if air monitoring has been performed to prove the effectiveness of the purging procedure or to declassify the inhalation hazard. Respiratory requirements may remain unchanged if the task and/or person performing the task changes, or if EHS determines that the risk is unchanged.

*2= Highly toxics include: Arsine, Fluorine, Diborane, Dichlorosilane, Germane, Phoshine, Silane, Ozone, Carbon Monoxide and Nitrogen Monoxide.

*3= Toxics and corrosives include: Hydrogen fluoride, hydrogen bromide, chlorine, hydrogen chloride, sulfuric acid, particulates, nitrogen trifluoride, ammonia, C5F8/C4F6, sulfur dioxide.

APPENDIX C
INSPECTION OF SCOTT AIR-PAK AND SELF CONTAINED BREATHING APPARATUS (SCBA)

I. **WEEKLY INSPECTION**

A. Breathing Air Cylinder

1. Ensure that the cylinder is secure within the harness.
2. Check that the cylinder pressure gauge is indicating “FULL” status.
3. Check that the cylinder valve is completely closed.
4. Check that the hose coupling to the cylinder is tight and properly connected.

B. Mask-Mounted Regulator

1. Ensure that the regulator is properly connected to the face-piece and that the lock tab on the regulator is in place.
2. Check the remote reading pressure gauge, the gauge should read zero.

C. Harness/Face-piece Assembly

1. Ensure that all straps on the Harness and Face-piece are adjusted to the “FULL OUT” position.
2. Ensure that the regulator purge valve is in the OFF position (knob pointer is upward).
3. Check the face-piece and harness for cleanliness, clean if necessary.
4. Check the integrity of the rubber to lens seal.

D. Voice Amplifier

1. Ensure that the Voice amplifier is operational by depressing the ON/OFF switch and observing that the green indicator light is lit, and a small hiss is heard. Place the voice amplifier in the OFF mode by depressing the ON/OFF switch and observing that the green indicator light goes out.

E. Complete the log sheet (EHS-00015-F4) and secure the SCBA in the case.

II. **MONTHLY INSPECTION** - Same as Weekly Inspection, and in addition:

A. Breathing Air Cylinder

1. Inspect for dents and gouges.
2. Check the Hydrostatic Inspection date on the cylinder, it should not be more than 5 years old.

B. Mask-Mounted Regulator

1. Turn on cylinder valve, check remote pressure gauge.
2. Listen for leaks throughout the system.
3. Turn off cylinder valve, Slowly vent the system by depressing the turning the red Purge Valve counterclockwise, and simultaneously listening for the audible Vibra-Alert alarm. Return the Purge Valve to the closed position by turning it clockwise.

C. Harness/Face-piece Assembly

1. Inspect face-piece for scratches, cracks, missing rubber, etc.
2. Wipe inside of mask and face-piece portion with an alcohol wipe.
3. Examine high pressure and regulator hoses for cracks and signs of wear.
4. Inspect harness straps for tears and frays.

D. Complete the log sheet (EHS-00015-F4) and secure the SCBA in the case.

APPENDIX D
SCOTT MULTI-WASH MINI GENERAL CLEANER AND DISINFECTANT INSTRUCTIONS

OVERVIEW:
The use of the Scott Multi-Wash Mini is a three-step process:

1. Thoroughly clean dirt and soil from parts with Scott Multi-Wash Mini.
2. Disinfect by completely wetting the surfaces with Scott Multi-Wash Mini. Wait ten minutes.
3. Thoroughly rinse with drinking (potable) water in a spray bottle. Completely dry and perform the appropriate regulator check for regulators.

NOTE: Contact disinfectants such as Scott Multi-Wash Mini are only effective when applied to clean, nonporous surfaces. Scott Multi-Wash Mini must then remain in contact with the surface to be disinfected for at least 10 minutes.
THIS PROCEDURE IS TO BE CARRIED OUT AT ROOM TEMPERATURE.

SUPPLIES NEEDED:
Scott Multi-Wash Mini, water (preferably in a spray bottle), and optional-dry, lubricant free air supply of 30 psig or less for drying

PROCEDURE FOR REGULATOR:

1. Remove the breathing regulator from the face-piece by rotating the regulator 1/4 turn clockwise as described in the Operating and Maintenance Instructions supplied with the regulator
2. Remove any obvious dirt from the external surfaces of the regulator using Scott Multi-Wash Mini with a sponge or soft cloth.
3. Inspect the inside of the regulator assembly through the regulator opening. If dirt or soil is present, forward regulator to authorized Scott personnel for thorough cleaning.
4. If clean, depress the donning/air saver switch, close the purge knob by turning fully clockwise and spray a minimum of 6 full pumps of Scott Multi-Wash Mini into the regulator opening. Make sure to also wet the immediate area around the opening. Swirl to completely cover internal components. Turn regulator-opening face down and shake excess liquid out. Allow for 10 minutes of contact time to disinfect prior to rinsing.
5. Rinse regulator with drinking water using a spray bottle or running water. DO NOT SUBMERGE THE REGULATOR.
6. Shake excess water out of regulator and then completely air dry before use.

WARNING:
FAILURE TO RINSE AND TO COMPLETELY DRY THE REGULATOR ASSEMBLY AFTER DISINFECTION MAY CAUSE DAMAGE TO OR MALFUNCTION OF THE REGULATOR, WHICH MAY RESULT IN INJURY OR DEATH TO THE REGULATOR USER.

NOTE:
TO SPEED DRYING OF THE REGULATOR, GENTLY BLOW DRY WITH CLEAN, DRY BREATHING AIR OF 30 PSIG MAX. BE CERTAIN THE PRESSURE IS NO MORE THAN 30 PSIG. DO NOT USE SHOP AIR OR ANY OTHER AIR CONTAINING LUBRICANTS OR MOISTURE.

WARNING:
THE USE OF AIR AT HIGHER THAN 30 PSIG OR AIR CONTAINING CONTAMINANTS MAY DAMAGE THE REGULATOR WHICH MAY RESULT IN INJURY OR DEATH TO THE REGULATOR USER.

<u>REGULATOR CHECK</u>

FOR AIRLINE USERS:

1. Check to make sure the donning/air saver switch is fully depressed.
2. Check to make sure the purge knob is closed.
3. Reattach the regulator to air supply hose if removed for cleaning.
4. If airflow from the regulator is heard, detach from supply, repeat steps 1, 2, and 3. If airflow is still heard, tag unit for repair and remove from service.

5. Open the purge valve and observe the airflow from the regulator spray bar. Droplets of water indicate the regulator is not dry.

FOR SKA-PAK RESPIRATORS:

1. Check to make sure the donning/air saver switch is fully depressed.
2. Check to make sure the purge knob is closed.
3. Reattach the regulator to air supply hose or to respirator if removed for cleaning. If attached to respirator, slowly open the cylinder valve at least one (1) full turn.
4. If airflow from the regulator is heard, detach from air supply, repeat steps 1, 2, and 3. If airflow is still heard, tag unit for repair and remove from service.
5. Open the purge valve and observe the airflow from the regulator spray bar. Droplets of water indicate the regulator is not dry.

FOR SCBA RESPIRATORS:

1. Check to make sure the donning/air saver switch is fully depressed.
2. Check to make sure the purge knob is closed.
3. Reattach the regulator if removed for cleaning and check to make sure the respirator cylinder is at least 1/4 full.
4. Slowly open the cylinder valve at least one (1) full turn. If airflow from the regulator is heard, close the cylinder valve, repeat steps 1, 2 and 3. If airflow is still heard, close the cylinder valve fully, tag unit for repair and remove from service.

NOTE: On regulators equipped with the Vibralert alarm or bell alarm, the alarm will actuate immediately after cylinder valve is turned on. If the alarm does not actuate, tag unit for repair and remove from service.

WARNING:
IF THE VIBRALERT OR BELL ALARM FAILS TO ACTUATE OR DOES NOT STOP AFTER A BRIEF INTERVAL, DO NOT USE THE RESPIRATOR. REMOVE IT FROM SERVICE AND TAG FOR REPAIR BY AUTHORIZED PERSONNEL.

NOTE:
IF THE PRESSURE IN THE CYLINDER IS AT APPROXIMATELY 1/4 FULL, THE VIBRALERT OR BELL ALARM MAY CONTINUE TO OPERATE THROUGHOUT THE PROCEDURE. OPEN THE PURGE VALVE AND OBSERVE THE AIRFLOW FROM THE REGULATOR SPRAY BAR. DROPLETS OF WATER INDICATE THE REGULATOR IS NOT DRY.

NOTE:
THIS REGULATOR CHECK IS NOT INTENDED TO BE A COMPLETE FUNCTIONAL CHECK OF THE RESPIRATOR. USERS SHOULD PERFORM A REGULAR OPERATION INSPECTION CONTAINED IN THE OPERATION AND MAINTENANCE INSTRUCTIONS SUPPLIED WITH EACH RESPIRATOR BEFORE NEXT USE.

PROCEDURE FOR FACE-PIECE:

1. With the regulator removed, carefully wash the face-piece assembly with Scott Multi-Wash Mini and thoroughly rinse in clean water. Note: The nose cup is designed to be an integral part of the face-piece and does not need to be disassembled for cleaning and disinfecting.
2. Disinfect the face-piece by spraying 3 full pumps of Scott Multi-Wash Mini on the regulator side of mask and 3 full pumps on the face side of the mask, wetting entire mask including all rubber and plastic areas. Allow a 10-minute contact time to disinfect prior to rinsing.

NOTE: The Kevlar and nylon head harness are made of porous material. The Scott Multi-Wash is not effective on porous material.

3. Rinse with spray bottle.
4. Shake excess water off face-piece and then dry with a clean, lint free cloth or gently blow dry with clean, dry breathing air of 30 psig or less pressure. Do not use shop air or any other air containing lubricants or moisture.