

<b>BROOKHAVEN NATIONAL LABORATORY</b> Safety & Health Services Division	NUMBER <b>IH72200</b>
	REVISION <b>FINAL Rev9</b>
<b>INDUSTRIAL HYGIENE GROUP</b> Standard Operating Procedure	DATE <b>06/15/07</b>
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Subject: <b>Respirator Selection for Non-Radiological Hazards</b>	

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### 1.0 PURPOSE & SCOPE

**Purpose:** This document sets the policy of the SHSD IH group in adopting, developing and using Assigned Protection Factors (APF) and standardizes the policy for selecting respiratory protective equipment for non-radiological hazards. This process is used in the selection of the adequate respirator type as part of an effective respiratory protection program. This SOP is to be used in conjunction with the BNL Subject Area *Respiratory Protection* <https://sbms.bnl.gov/standard/23/2300t011.htm>.

The program complies with OSHA 29CFR1910.134 (*Respiratory Protection*) and ANSI Z88.2-1992 [*ANSI Withdrawn*] (*American National Standard for Respiratory Protection*). In this SOP, BNL adopts APF from those sources and the NIOSH *Respirator Decision Logic* APFs, the ANSI Z88.2-2002 *Draft American National Standard for Respiratory Protection* and the 29CFR1910.134 (*Respiratory Protection, Final Rule 08/24/2006*).

This document describes a procedure for selecting the most appropriate respiratory protective device by considering available equipment options and the hazard and severity of airborne non-radiological contaminants present in the workplace. The goal of the procedure is to provide a uniform methodology in selecting equipment to provide protection to workers using the respiratory equipment and to maintain compliance with exposure standards.

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**Scope:** The scope of this SOP is for non-radiological hazards (such as chemical dusts, fumes, mists, and vapors, lead, toxic metals, and asbestos). It is not intended or approved for use in selecting radiological hazards respiratory protective equipment. It is not for assigning radiological assigned protection factors for equipment. This SOP does not cover issuing respiratory protective equipment. Issuance of respiratory protective equipment is governed by Radiological Control Division procedures.

## **2.0 RESPONSIBILITIES**

- 2.1 This program is implemented through the SHSD Industrial Hygiene Group Leader and the *Respiratory Protection Program Administrator (RPPA)*.
- 2.2 Members of the SHSD Industrial Hygiene Group and other BNL organizations, with qualifications meeting Section 7 of this procedure, follow this document in the respirator selection process. It is the responsibility of persons selecting respiratory protective equipment to comply with all provisions in the BNL Respiratory Protection Program and this SOP.
- 2.3 **Hazard Analysis during selection of respirators:** It is the responsibility of persons selecting respiratory protective equipment to:
  - 2.3.1 Use the appropriate personal protective equipment while performing field evaluations of the work process, when needed.
  - 2.3.2 Obtain all required training and qualification for hazards present in areas where field evaluations will be done (such as lead, asbestos, chemicals, or radioactive contamination).
  - 2.3.3 Comply with all work planning and work permit system requirements when entering areas to obtain information to select the correct respiratory protective equipment.
- 2.4 The person using this procedure is responsible to ensure that information they provide on respirator selection is integrated into the work planning documentation for the work being done.

## **3.0 DEFINITIONS**

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**Air Purifying:** A respirator that removes specific air contaminants by passing ambient air through a air-purifying element (filter, cartridge, canister).

**Assigned Protection Factor (APF):** The expected workplace level of respiratory protection that would be provided by a properly functioning respirator or class of respirators to properly fitted and trained users. (*Definition from ANSI Z88.2-1992. See Attachment 9.2.*)

**Breathing Air, Grade D:** Air supplied in SCBA or airline systems that meets ANSI/CGA G-7.1-1989: Oxygen 19.5-23.5%; Hydrocarbons 5mg/m<sup>3</sup>; Carbon monoxide 10 ppm, Carbon Dioxide 1000 ppm, and lack of noticeable odor.

#### **Chemical Hazard Types**

**Dust:** An aerosol consisting of mechanically produced solid particles derived from the breaking up of larger particles. Dusts generally have a larger particle size when compared to fumes.

**Fumes:** Solid aerosols formed by condensation of a gas or vapor. Fumes generally have a smaller particle size than dusts.

**Gas:** The gaseous phase of matter that normally exists in a gaseous state at room temperature

**Mist:** An aerosol composed of liquid particles.

**Vapor:** The gaseous phase of matter that normally exists in a liquid or solid state at room temperature.

**Continuous flow respirator:** Atmosphere-supplying respirator providing a continuous flow of air to the respiratory inlet covering.

**Demand Mode:** A negative pressure, atmosphere-supplying respirator that admits air to the face-piece only when a negative pressure is created inside the face-piece by inhalation.

**Disposable Respirators:** A respirator discarded after the end of use, after excessive resistance or physical damage, or when odor breakthrough or other warning indicators render the respirator unsuitable for further use.

**Filtering Face-piece:** A particulate respirator with a filter as an integral part of the face-piece or with the entire face-piece composed of the filtering medium.

**End-of-Service-life indicator:** A system that warns the user of the approach of the end of adequate respiratory protection.

**HEPA (High Efficiency Particulate air):** A filter capable of removing at least 99.97% mono-dispersed particulates 0.3 micron in diameter. The NIOSH equivalent is N100, R100, and P100.

**Loose-fitting face-piece:** A respiratory inlet covering that is designed to form only a partial seal with the face or no seal with the face, e.g. hood or helmet.

**Occupational Exposure Limit (OEL):** The lower of ACGIH TLV®, Ceiling, STEL® or OSHA PEL.

**PAPR:** Powered air-supplying respirators.

**Pressure-demand respirator:** A positive pressure atmosphere-supplying respirator that admits air to the face-piece when the positive pressure is reduced inside the face-piece by inhalation.

**Program Administrator:** A person designated by the IH Group Leader or SHSD management to administer this procedure.

**Qualified Selector:** A person who has demonstrated competency, in accordance with Section 7, to perform this procedure.

**SAR:** Supplied-air respirator.

**SCBA:** Self-contained breathing apparatus

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*Tight-fitting face-piece:* A respiratory inlet covering that is designed to form a complete seal with the face.

## **4.0 PREREQUISITES**

- 4.1 **Qualifications:** See Section 7 *Implementation and Training*. Do not perform work using this procedure without meeting that Section's training and qualification requirements.

## **5.0 PRECAUTIONS**

- 5.1 **Personal Protective Equipment (PPE):** The respirator selection process does not in itself expose the selector to any hazard. Personal protective equipment is not required unless needed to enter hazardous areas to observe workplace conditions.
- 5.2 **Hazard Determination:** The respirator selection process does not cause exposure to any chemical, physical, or radiological hazards. The person performing this procedure may conduct hazard assessment in areas where hazards (such as lead, asbestos, chemicals, or radioactive contamination) may be present.
- 5.3 **Work Planning:** All requirements of work permits and work planning system reviews must be met in performing this procedure.
- 5.4 **Job Risk Assessment:** Consult the *Job Risk Assessment* for the risk analysis of this operation based on the hazards and controls:
- SHSD-JRA-05 for the field review portions of this SOP and
  - SHSD-JRA-14 for the Administrative portion of the SOP. .
- 5.5 **Environmental Impact and Waste Disposal:** This technique does not have adverse impact on the environment. No waste or environmental contamination is generated in this process.

## **6.0 PROCEDURE**

- 6.1 **Determine the airborne concentration:** Measure or calculate the maximum expected workplace concentration of contaminants by measurement by:

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- 6.1.1 NIOSH approved integrated sampling methodology,
- 6.1.2 Calibrated direct reading instrumentation, or
- 6.1.3 Calculation of maximum concentration based on use rate and atmospheric conditions.

Follow accepted methodology described in SHSD IH Group SOPs for use of direct reading instrument use and integrated sampling collection, processing (chain of custody) and exposure analysis. Because activities in the work area may vary during the shift and hazard concentrations could change, the monitoring should cover conditions possible throughout a full work shift.

6.2 **Hierarchy of Controls:** When making recommendations for hazard controls, use the following hierarchy prior to recommending respiratory protection:

- Elimination or substitution of the hazards where feasible
- Engineering controls where feasible
- Work practices and administration controls that limit worker exposures, and
- Personal Protective Equipment

6.3 **Selection of respirator style:** Select the appropriate parameters of the respiratory device to be used by considering the hazards of the contaminant and the ability of the respirator to filter, adsorb, or eliminate the hazard from the breathing zone. Selection factors to consider include:

- **Respirator face piece style:** Half face tight fitting, full face tight fitting, hood, or helmet
- **Mode of operation:** Negative pressure or positive pressure
- **Mechanisms of protection:** Air purifying or air supplying
- **Special Provisions or Regulations:** Fire Fighting (NFPA-SCBA), military/police actions (DOE-Avon).

6.4 **Consider the physical, environmental, and chemical use conditions at the work area when specifying respirator type and the impact of respirator use on the work, including:**

- Worker activity: Continuous or intermittent work; Light, medium, or heavy work.
- Frequency of use: Routine, non-routine, emergency or rescue use
- Access to the hazardous area, especially impact on the escape of workers if an emergency occurs and access of rescue operations.

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- Respirator characteristics, capabilities, and limitations: especially flow rate; compatibility of facepiece and components with the hazard, impact of environmental conditions on ability to wear equipment (humidity/heat),
  - Physical, chemical, and toxicological properties of the contaminant(s): including physical state (gas, vapor, particulate/dust, fume, and mist), including: oxygen deficient atmospheres; atmospheres immediately dangerous to life and health; combination of hazard classes; odor threshold and warning properties; and eye irritant potential.
  - The person's ability to wear or use the equipment and negative impact of the equipment on the operation, including: facial hair, vision impairment (need for glasses, reduction in field of view, etc.), and communication ability.
- 6.5 If an air purifying cartridge or canister is selected:
- 6.5.1 Check that cartridges are approved for the hazards by checking these sources:
- 6.5.1.1 A good source of the type of cartridge to select cartridges (based on chemical name) is the Online NIOSH Pocket Guide to *Chemical Hazards* at <http://www.cdc.gov/niosh/npg/npgd0000.html>. A sample of a page from this web site is attached as *Attachment 9.3*.
- 6.5.1.2 See the *BNL Recommended Equipment for Specific Hazards* in *Attachment 9.1* which provides a list of the approved respiratory protection equipment for common BNL hazards by class of hazard.
- 6.5.1.3 See *Attachment 9.4* for the color code table and product ordering numbers for the two main vendors at BNL.
- 6.5.2 Determine the **end-of-service life** based on the best available information including from the respirator manufacturer, chemical manufacturer. See Attachment 9.5 for references to manufacturers EOSL calculators.
- 6.6 Determine the APF from *Attachment 9.2* for the proposed respirator style.
- 6.7 Confirm that the respirator will provide adequate protection using Formula.6. If Formula 6 is less than the Occupational Exposure Limit (OEL), then the respirator type and cartridge (if applicable) may be selected.

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Formula 6: A respirator is acceptable for use when”

$$(\text{Airborne Concentration}) \div (\text{APF}) < (\text{Occupational Exposure Limit})$$

- 6.8 When multiple contaminants are present, select the equipment based on protection for most hazardous contaminant. However, the selected equipment must also be applicable for all other hazards.

Example 1: if Mercury (OEL= 0.025 mg/m<sup>3</sup>) is present with Lead (OEL= 0.050 mg/m<sup>3</sup>), the appropriate APR selection (if airborne concentrations permit) is Mercury (most Hazardous) adsorbent cartridge vapor for Hg. But because the mercury cartridge is not protective of lead, additional HEPA filtration is required, i.e. a combination cartridge.

Example 2: if Mercury (OEL= 0.025 mg/m<sup>3</sup>), Lead (OEL= 0.050 mg/m<sup>3</sup>), and Methanol (OEL= 200 ppm) are all present in the atmosphere, the appropriate APR selection (if airborne concentrations permit) is Mercury (most Hazardous) adsorbent cartridge vapor for Hg, HEPA filtration for Lead, and organic vapor cartridge for Methanol. If such a multiple purpose assemble is not available, then air supplied respiratory protection would be needed. Note: OEL are set for single chemical substance exposure. In cases of mixed compounds, you may need to be lower the OEL if there is an additive effect from two or more hazards acting together. The base formula is:

$$\frac{C_1}{T1} + \frac{C_2}{T2} + \dots + \frac{C_n}{Tn} \quad \text{sum is not to exceed 1}$$

- 6.9 Document the equipment selection on the *Respirator Selection Form* located in the BNL SBMS subject area *Respiratory Protection* <https://sbms.bnl.gov/standard/23/2303e011.doc>. A sample is listed as Attachment 9.4.

## **7.0 IMPLEMENTATION AND TRAINING**

- 7.1 For all BNL personnel, the IH Group Leader or Respiratory Protection Program Administrator shall set the qualification criteria of persons to select non-radiological equipment and use APFs under this program. Respirator selection shall be performed by persons who have demonstrated the competence to satisfactorily perform the tests as evidenced by experience and training. All persons must have met the qualification criteria set in IH50300 *BNL IH Program and IH Group Training & Qualification Matrix* and the specific criteria in 7.2.

- 7.2 The qualification criteria for a use of this SOP are:

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- 7.2.1 An overall knowledge of respiratory protection principles and completion of the BNL courses (or equivalent) in APR/PAPR and SCBA.
- 7.2.2 Specific knowledge of this procedure, OSHA 29CFR1910.134 and ANSI Z88.2. This can be gained from work experience or specialized training courses.
- 7.2.3 Demonstrated competency in applying APFs in the selection of respiratory protection.
- 7.2.4 The documentation of personnel qualification is to be made on Attachment 9.7.

## **8.0 REFERENCES**

- 8.1 Occupational Safety and Health Administration, OSHA 29CFR1910.134 (*Respiratory Protection*) Final Rule 08/24/2006.
- 8.2 American National Standard Institute (ANSI) Z88.2. (*American National Standard for Respiratory Protection*).
- 8.3 National Institute for Occupational Safety and Health, NIOSH Respirator Decision Logic DHHS/NIOSH Publication No. 97-108.

## **9.0 ATTACHMENTS**

- 9.1 *BNL Recommended Equipment for Specific Hazards*
- 9.2 *BNL Adopted Assigned Protection Factors (APF) for Non-Radiological Hazards*
- 9.3 *Sample of Online NIOSH Pocket Guide to Chemical Hazards*
- 9.4 *NIOSH Classifications for Respiratory Protection Equipment*
- 9.5 *End-of-Service Life Calculations*
- 9.6 *Sample of SBMS Respiratory Protection: Respirator Selection Form*
- 9.7 *SHSD Non-Radiological Respirator Qualification record*

## **10.0 DOCUMENTATION**

Document Development and Revision Control Tracking		
Prepared By: <i>(signature/date on file)</i> R. Selvey <b>04/04/02</b> Certified Industrial Hygienist	Reviewed By / Date: <i>(signature/date on file)</i> N. Bernholz 04/26/02 Certified Industrial Hygienist	Approved By / Date: <i>(signature/date on file)</i> R. Selvey <b>05/13/02</b> Industrial Hygienist Group Leader

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R. Selvey 11/05/03 (signature/date on file) SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
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R. Selvey 7/09/04 (signature/date on file) SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls  Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above Section/page and Description of change: Revised Section 7 training requirements. Updated Section 10 to new format.		
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Section/page and Description of change: Revised Attachment 9.2 to include the newly adopted Assigned Protection Factors from OSHA.		
<i>(signature/date on file) R. Selvey 08/29/06</i> SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
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Section/page and Description of change: Correct typo in Attachment 9.2 Assigned Protection Factors from OSHA for helmet/hood.		
<i>R. Selvey 10/23/06 (signature/date on file)</i> SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
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Section/page and Description of change: Added limitation for toxic dust hazard in Attachment 9.1 Require minimum full-face respirator for tasks generating fine silica particle exposure. Added 5.4 to link to the Job Risk Assessments.		
<i>J. Peters 1/10/07 (signature/date on file)</i> SME Reviewer/Date:	<i>R. Selvey 1/12/07 (signature/date on file)</i> Reviewer/Date:	Reviewer/Date:
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## Attachment 9.1

### BNL Recommended Equipment for Specific Hazards

Hazard Type	Example of Hazard	Approved Respirator Type(s)	Limitations
<b>Paint Spray</b>	Lacquers, Paints	APR, half/full face, Combo- OVC/Paint Cartridge or filter	Not for Paints containing Isocyanates without RPPA approval
		Supplied Air, full face	
		Supplied Air, full face, escape bottle	
		Self Contained Breathing Apparatus	
<b>Pesticides</b>	Dursban®, Pyrethrums	APR, half/full face, OVC/Pesticide	Not for Fumigants
		Supplied Air, full face	
		Supplied Air, full face, escape bottle	
		Self Contained Breathing Apparatus	
<b>Silica</b>	Concrete grinding, cutting, abrasion.	APR, full face, HEPA filter	For activities generating fine silica particles a minimum full-face respirator with HEPA filters is required.
		PAPR, full face, HEPA filter	
		PAPR, helmet, HEPA filter	
		PAPR, hood, HEPA filter	
		Supplied Air, full face	
		Supplied Air, full face, escape bottle	
		Self Contained Breathing Apparatus	
<b>Toxic Dust, Mist, Fumes</b>	Welding Fumes, Cadmium, Lead, Asbestos, Beryllium, some Biological Agents	APR, half face, dust filter	
		APR, full face, dust filter	
		APR, half face, HEPA filter	
		APR, full face, HEPA filter	
		PAPR, full face, HEPA filter	
		PAPR, helmet, HEPA filter	
		PAPR, hood, HEPA filter	
		Supplied Air, full face	
		Supplied Air, full face, escape bottle	
		Self Contained Breathing Apparatus	
<b>Organic Vapor/Gas</b>	Acetone, Isopropanol	PAPR, full face, HEPA filter	
		PAPR, helmet, HEPA filter	
		PAPR, hood, HEPA filter	
		Supplied Air, full face	
		Supplied Air, full face, escape bottle	
		Self Contained Breathing Apparatus	
		Self Contained Breathing Apparatus	
<b>Acid Gases</b>	Chlorine, Sulfur Dioxide Hydrogen Chloride	APR, half face, Acid Gas/OVC	
		APR, full face, Acid Gas/OVC	
		Supplied Air, full face	

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Hazard Type	Example of Hazard	Approved Respirator Type(s)	Limitations
		Supplied Air, full face, escape bottle Self Contained Breathing Apparatus	
<b>Special Hazard Gas/Vapors</b>	Ammonia, Mercury, Formaldehyde	APR, half/full face, Ammonia, Formaldehyde, Mercury cartridges (Special Order) Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus	
<b>Asphyxiants</b>	Nitrogen, Helium	Supplied Air, full face Supplied Air, full face, escape bottle Self Contained Breathing Apparatus Escape device, 5 minute compressed air Escape Device, 10 minute compressed air	Oxygen levels less than 19.5%

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## Attachment 9.2

### IH Group Adopted Assigned Protection Factors (APF) for Non-Radiological Hazards

Respirator Type	SHSD IHG IH72200 Adopted APF	References for SHSD APF Selection				
		RCD FS-SOP- 4002 Rev. 3	OSHA 29CFR1910 .134 (Adopted 2006)	NIOSH (Pocket Guide)	ANSI Z88.2- 1992	ANSI Z88.2- 2002 DRAFT
Filtering Facepiece (i.e. dust mask) <sup>(1)</sup>	<b>0</b>		10			
Air Purifying Respirator (APR)						
Half mask (APR) (Negative Pressure)	<b>10</b>	10	10	10	10	10
Full-Facepiece APR (Negative Pressure)	<b>50</b>	100	50	50	100	10
Powered Air Purifying Respirator (PAPR)						
Loose-fitting facepiece (PAPR) (Positive Pressure)	<b>25</b>	25	25			25
Half mask PAPR (Positive Pressure)	<b>50</b>	50	50	50	50	50
Full-Facepiece PAPR <sup>(2)</sup> (Positive Pressure)	<b>1000</b>	1,000	1000	50	1000	1000
Helmet / Hood PAPR <sup>(2)</sup> (Positive Pressure)	<b>25/1000<sup>(4)</sup></b>	1,000	25/1000 <sup>(4)</sup>			[1000]
Atmosphere Supplying / Airline (ASA)						
Half mask (ASA) (Demand)	<b>10</b>	10	10			
Full facepiece ASA (Demand)	<b>50</b>	100	50	100		
Half mask ASA (Continuous Flow)	<b>50</b>	50	50			250
Full Mask ASA (Continuous Flow)	<b>1000</b>		1000			
Half facepiece ASA (Pressure Demand)	<b>50</b>		50			
Full facepiece ASA (Pressure Demand or Continuous Flow)	<b>1000</b>	1,000	1000			1000
Loose-fitting facepiece ASA (Continuous Flow)	<b>25</b>	25	25			
Helmet / Hood ASA (Continuous Flow)	<b>25/1000<sup>(4)</sup></b>	1,000	25/1000 <sup>(4)</sup>	1000		

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Respirator Type	SHSD IHG IH72200 Adopted APF	References for SHSD APF Selection				
		RCD FS-SOP- 4002 Rev. 3	OSHA 29CFR1910 .134 (Adopted 2006)	NIOSH (Pocket Guide)	ANSI Z88.2- 1992	ANSI Z88.2- 2002 DRAFT
Self Contained Breathing Apparatus (SCBA)						
Half mask SCBA (Demand <sup>(3)</sup> )	<b>10</b>	10	10			
Full facepiece SCBA (Demand <sup>(3)</sup> )	<b>50</b>	100	50			
Full facepiece SCBA (Pressure Demand Open/Closed Circuit)	<b>10,000</b>	10,000		10,000	10,000	10,000
Helmet Hood SCBA (Demand)	<b>50</b>		50			
Military Mask- Avon F12 (Negative Pressure)	<b>50</b>			50		

- (1) Includes disposable filter fabric half mask (filtering facepiece in which the fabric is the sealing surface) and filtering facepiece half mask with foam insert sealing edges bonded to the filter.
- (2) Listed APF are for high-efficiency filters and sorbents (cartridges and canisters). With dust filters, an assigned protection factor of 100 is to be used due to the limitations of the filter.
- (3) Demand SCBA **shall not** be used for emergency situations such as fire fighting.
- (4) If the manufacturer provides evidence of 1000 APF or greater based on workplace testing, else the APF is assigned at 25.

NOTE: Assigned protection factors are not applicable for escape respirators. For combination respirators, e.g. airline respirators equipped with an air-purifying filter, the mode of operation in use will dictate the assigned protection factor to be applied.

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## Attachment 9.3

# Sample of Online NIOSH Pocket Guide to Chemical Hazards

### NIOSH Pocket Guide to Chemical Hazards

<b>Acetic acid</b>		CAS 64-19-7	
CH <sub>3</sub> COOH		RTECS <a href="#">AF1225000</a>	
<b>Synonyms &amp; Trade Names</b> Acetic acid (aqueous), Ethanoic acid, Glacial acetic acid (pure compound), Methanecarboxylic acid [Note: Can be found in concentrations of 5-8% in vinegar.]		<b>DOT ID &amp; Guide</b> 2790 <a href="#">153</a> (10-80% acid) 2789 <a href="#">132</a> (>80% acid)	
<b>Exposure Limits</b>	NIOSH REL: TWA 10 ppm (25 mg/m <sup>3</sup> ) ST 15 ppm (37 mg/m <sup>3</sup> )		
	OSHA PEL: TWA 10 ppm (25 mg/m <sup>3</sup> )		
IDLH 50 ppm See: <a href="#">64197</a>		Conversion 1 ppm = 2.46 mg/m <sup>3</sup>	
<b>Physical Description</b> Colorless liquid or crystals with a sour, vinegar-like odor. [Note: Pure compound is a solid below 62°F. Often used in an aqueous solution.]			
MW: 60.1	BP: 244°F	FRZ: 62°F	Sol: Miscible
VP: 11 mmHg	IP: 10.66 eV		Sp.Gr: 1.05
FLP: 103°F	UFL: 200°F - 100%	LEL: 4.8%	
Class II Combustible Liquid: Flammable	<b>SAMPLE</b>		Corrosive to
<b>Incompatibilities &amp; Reactivity</b> Strong oxidizers (especially chromates, permanganates, and persulfates.) Metals: Aluminum, zinc, tin, lead, copper, silver, mercury, bismuth, antimony, arsenic, selenium, tellurium, and selenium.			
<b>Measurement Methods</b> NIOSH <a href="#">1603</a> ; OSHA <a href="#">ID186SG</a> See: <a href="#">NMAM</a> or <a href="#">OSHA Methods</a>			
<b>Personal Protection &amp; Sanitation</b> Skin: Prevent skin contact (>10%) Eyes: Prevent eye contact		<b>First Aid</b> ( <a href="#">See procedures</a> ) Eye: Irrigate immediately Skin: Water flush immediately	

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Wash skin: When contaminated (>10%) Remove: When wet or contaminated (>10%) Change: No recommendation Provide: Eyewash (>5%), Quick drench (>50%)	Breathing: Respiratory support Swallow: Medical attention immediately
<b>Respirator Recommendations</b> NIOSH/OSHA <b>Up to 50 ppm:</b> (APF = 25) Any supplied-air respirator operated in a continuous-flow mode <sup>£</sup> /(APF = 25) Any powered, air-purifying respirator with organic vapor cartridge(s) <sup>£</sup> /(APF = 50) Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s)/(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister/(APF = 50) Any self-contained breathing apparatus with a full facepiece/(APF = 50) Any supplied-air respirator with a full facepiece <b>Emergency or planned entry into unknown concentrations or IDLH conditions:</b> (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode/(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode <b>Escape:</b> (APF = 50) Any air-purifying respirator with a full facepiece and organic vapor canister/Any supplied-air respirator with a full facepiece	
<div style="border: 2px dashed red; border-radius: 15px; padding: 10px;"> <div style="background-color: #e0e0e0; padding: 20px; font-size: 48px; font-weight: bold; text-align: center; margin: 0 auto; width: 80%;">           SAMPLE         </div> </div>	
<b>Exposure Routes</b> inhalation,	
<b>Symptoms</b> Irritation eyes, skin, black skin, hyperkeratosis; conjunctivitis, chitis	
<b>Target Organs</b> Eyes, skin, respiratory system, teeth	
See also: <a href="#">INTRODUCTION</a> See ICSC CARD: <a href="#">0363</a>	

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## Attachment 9.4

### NIOSH Classifications for Respiratory Protection Equipment

#### Filters

Type	Description
<b>N95</b>	Filters at least 95% of airborne particles. Not resistant to oil.
<b>N99</b>	Filters at least 99% of airborne particles. Not resistant to oil.
<b>N100</b>	Filters at least 99.7% of airborne particles. Not resistant to oil.
<b>R95</b>	Filters at least 95% of airborne particles. Somewhat resistant to oil.
<b>R99*</b>	Filters at least 99% of airborne particles. Somewhat resistant to oil.
<b>R100*</b>	Filters at least 99.7% of airborne particles. Somewhat resistant to oil.
<b>P95</b>	Filters at least 95% of airborne particles. Strongly resistant to oil.
<b>P99*</b>	Filters at least 99% of airborne particles. Strongly resistant to oil.
<b>P100</b>	Filters at least 99.7% of airborne particles. Strongly resistant to oil.

\* No NIOSH approvals are held by this type of disposable particulate respirator.

#### Adsorbents

42 CFR 84.190 Chemical cartridge respirators: description. Type of chemical cartridge respirator <sup>1</sup> Maximum use concentration, parts per million ----- Ammonia..... 300 Chlorine..... 10 Hydrogen chloride..... 50 Methyl amine..... 100 Organic vapor..... <sup>2</sup> 1,000 Sulfur dioxide..... 50 Vinyl chloride..... 10 ----- <sup>1</sup> Not for use against gases or vapors with poor warning properties (except where MSHA or Occupational Safety and Health Administration standards may permit such use for a specific gas or vapor) or those which generate high heats of reaction with sorbent material in the cartridge. <sup>2</sup> Maximum use concentrations are lower for organic vapors which	MSHA/NIOSH have certified respirators for use against: (Reference: FR 49 No. 140, pages 29270-29272, July 19, 1984).  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">Gas/Vapor</th> <th style="text-align: left; border-bottom: 1px solid black;">Maximum Use Concentration</th> </tr> </thead> <tbody> <tr> <td>Mercury*</td> <td>0.5 mg/m<sup>3</sup></td> </tr> <tr> <td>Hydrogen sulfide*</td> <td>100 parts per million</td> </tr> <tr> <td>Chlorine dioxide</td> <td>1 part per million</td> </tr> <tr> <td>Formaldehyde</td> <td>30 parts per million</td> </tr> </tbody> </table> <p>*Respirators may be certified for gases and vapors with poor warning properties if there is a regulatory agency standard which permits their use and an effective end-of-service-life indicator is provided.</p>	Gas/Vapor	Maximum Use Concentration	Mercury*	0.5 mg/m <sup>3</sup>	Hydrogen sulfide*	100 parts per million	Chlorine dioxide	1 part per million	Formaldehyde	30 parts per million
Gas/Vapor	Maximum Use Concentration										
Mercury*	0.5 mg/m <sup>3</sup>										
Hydrogen sulfide*	100 parts per million										
Chlorine dioxide	1 part per million										
Formaldehyde	30 parts per million										

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produce atmospheres immediately hazardous to life or health at concentrations equal to or lower than this concentration.	
<b>Protected Against</b>	<b>Colors Assigned</b>
<b>Multipurpose</b>  <i>North 75SC: Defender Multi-Purpose Cartridge for Organic Vapor, Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Sulfide (Escape), Hydrogen Fluoride, Chlorine Dioxide, Ammonia, Methylamine and Formaldehyde.</i>	Olive  
<b>Acid gases</b>  <i>North N75002: Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Fluoride, Chlorine Dioxide, Formaldehyde Cartridge</i> <i>North RT21 Hydrogen Chloride, Hydrogen Fluoride, Sulfur Dioxide and Hydrogen Sulfide Cartridge with Real-Time ESLI (End-of-Service-Life Indicator)</i>	White.   
<b>Mercury</b> <i>North N750052</i>	Orange with indicator stripe  
<b>Organic vapor</b> <i>North N75001</i>	Black  
<b>Ammonia, Methylamine Cartridge</b> <i>North 75004</i> <i>North RT41 (with indicator strip)</i>	Green   
<b>Acid gas and organic vapors</b>  <i>North N75003: Organic Vapor, Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Fluoride, Chlorine Dioxide Cartridge</i> <i>North RT11 Organic Vapor Cartridge with Real-Time ESLI (End-of-Service-Life Indicator) for TDI</i>	Yellow   
<b>Radioactive materials, excepting tritium and noble gases</b> <i>North 7580P100- Plastic case</i> <i>North 75FFP100- filter body</i>	Purple (Magenta)   
<b>N95 Particulate</b> <i>North 7506N95</i>	



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## Attachment 9.5

### End-of-Service Life Calculations

Occupational Safety and Health Administration (OSHA) does not allow reliance on odor thresholds and other warning properties solely as the basis for changing respirator chemical cartridges. OSHA requires implementing change out schedules for respirator cartridges based on objective data. Respirator manufacturers have developed service-life software for their cartridge respirator users (see links below). Workplace exposures and environmental conditions must first be determined and then entered into the service-life software to calculate breakthrough times. Most service-life software calculators are based on exposure from a single contaminant; however, most workplace exposures are from mixtures of chemicals. Some manufacturers, like 3M (Minnesota Mining and Manufacturing Company) have software that calculates change out schedules for chemical mixtures using OSHA's rules of thumb for computing breakthrough times for mixtures.

Refer to the following references for assistance in determining end of cartridge life (search the company's websites if the current links become out of date):

	<b>North Safety Products</b> <a href="#">EZGuide: CD request link</a>
	<b>MSA Cartridge Life Expectancy Calculator:</b> <a href="http://webapps.msanet.com/cartlife/">http://webapps.msanet.com/cartlife/</a>
	<b>3M Respirator Service Life Software</b> <a href="http://www.3m.com/occsafety/framesets/software_solutions.html">http://www.3m.com/occsafety/framesets/software_solutions.html</a>
	<b>AOSafety "Merlin™" Cartridge Changeout Program</b> <a href="http://www.aearoit.com/Merlin/">http://www.aearoit.com/Merlin/</a>
	<b>Survivair &amp; Willson Respirators (Christian Dalloz)</b> <a href="http://www.survivair.com/support/cartridge.asp">http://www.survivair.com/support/cartridge.asp</a>
	<b>Lab Safety</b> <a href="http://www.labsafety.com/store/assets/support_documents/ez196.pdf">http://www.labsafety.com/store/assets/support_documents/ez196.pdf</a>
	<b>Scott</b> <a href="http://www.scotthealthsafety.com/airpur.htm">http://www.scotthealthsafety.com/airpur.htm</a> No link found to a service life calculation.

Project Information		
Work Order #:	Job #:	Activity #:
Work Permit #:	RWP #:	Date(s) of Project:
Department:	Building:	Room/Area:
Scope of Work Contact Name:	Phone:	Pager:
<b>Attachment 9.6</b>		
<b>SAMPLE ONLY</b>		
Description of Area:		
Description of Work to be done:		
Line Management Approval by:		
Print	Signature	Date

Hazard Information	
Description of Hazard: (Including mechanism of generation of hazard)	
Hazard	Anticipated/Measured Air Concentration
Radiological: Isotope: _____ Particulate _____ Gas _____	
Chemical <input type="checkbox"/> Asbestos <input type="checkbox"/> Lead <input type="checkbox"/> Mercury <input type="checkbox"/> Other: _____	
Biological <input type="checkbox"/> Animal/Bird Droppings <input type="checkbox"/> Etiologic Agent <input type="checkbox"/> Other: _____	
Regulatory: <input type="checkbox"/> Voluntary Use <input type="checkbox"/> Precautionary <input type="checkbox"/> Nuisance Level <input type="checkbox"/> Required Use    Other: _____	<input type="checkbox"/> <Action Level <input type="checkbox"/> <PEL/TLV <input type="checkbox"/> >PEL/TLV <input type="checkbox"/> >IDLH
Hazard analysis: Concentration determined by: <input type="checkbox"/> Measurement <input type="checkbox"/> Calculation <input type="checkbox"/> Analogy to Similar Work	<input type="checkbox"/> MSDS Reviewed <input type="checkbox"/> Tour of Area
Hazard Analysis By:	
Print	Signature
Date	

Equipment Selection				
<u>Facepiece</u>	<input type="checkbox"/> Full face	<input type="checkbox"/> Half Face	<input type="checkbox"/> Hood	Other: _____
<u>Respirator Type</u>	<input type="checkbox"/> APR	<input type="checkbox"/> PAPR	<input type="checkbox"/> Air Line	<input type="checkbox"/> SCBA
<b>Cartridge(s)</b> <input type="checkbox"/> SINGLE <input type="checkbox"/> COMBO (Mark all needed elements)	<input type="checkbox"/> HEPA (Purple) <input type="checkbox"/> P-100 <input type="checkbox"/> N100 <input type="checkbox"/> Particulate <input type="checkbox"/> N95 <input type="checkbox"/> P95 <input type="checkbox"/> R95 <input type="checkbox"/> N99 <input type="checkbox"/> Organic Vapor (Black) <input type="checkbox"/> Organic Vapor/Acid Gas (Yellow) <input type="checkbox"/> Acid Gas (White)	<input type="checkbox"/> Multi-purpose (Olive) <input type="checkbox"/> Ammonia/Amine (Green) <input type="checkbox"/> Mercury/Chlorine (Orange) <input type="checkbox"/> Other: _____		
<u>End of Service on Cartridges</u>	<input type="checkbox"/> Replace at End of 8 hour Shift	<input type="checkbox"/> Change via ESL Indicator	Replace after _____ (minutes) (hours) (days) circle one	
<u>Cartridge Reuse:</u>	<input type="checkbox"/> Leave on face piece, tape inlet <input type="checkbox"/> Dispose after 1 use <input type="checkbox"/> Remove from face piece, store in separate bag		<b>Cartridge Disposal:</b>	
<u>Return of Face piece</u>	<input type="checkbox"/> Permanent Issue	<input type="checkbox"/> Destroy/Dispose after use	Return on:	
Respirator Equipment Specification Made By:				
Print		Signature		Date

# ***Non-Radiological Hazard Respirator Selector Qualification Record***

## **Job Performance Measure (JPM) Completion Certificate**

Candidate's Name	Life Number:	Qualification Number:  <b>HP-IHP- 72200</b>
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**Practical Skill Evaluation: Demonstration of Evaluation Methodology**

	Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1.	<b>Determining the need for selection investigation</b>	Demonstrates knowledge that the selection investigation can be prompted by: worker's concern, line management requests, exposure monitoring data, or observation of other indicators. Includes: <ul style="list-style-type: none"> <li>• Engineering Controls and Admin Controls explored for feasibility</li> <li>• Voluntary Use versus Mandatory versus Regulatory</li> </ul>			
2.	<b>Conducts appropriate interviews</b>	Demonstrates knowledge in conducting interviews with supervision and workers to determine exposure characteristics, patterns, and duration. Includes: <ul style="list-style-type: none"> <li>• Review of Work Planning &amp; Control documents</li> <li>• Health and Safety Plans</li> <li>• Standard Operating Procedures,</li> <li>• Skill of Craft Documentation/ PPE Matrix Tables</li> </ul>			
3.	<b>Hazard Identification</b>	Demonstrates knowledge to correctly determine and document the type of airborne hazards, including: Chemical, Biological and (Radiological). Includes: <ul style="list-style-type: none"> <li>• Describes the types of health hazards from chemical and biological sources and the appropriate PPE as in Attachment 9.1</li> <li>• Implications of each type hazard on respirator selection</li> <li>• Compounding of different hazard types (such as particulates and vapors, biological agents and disinfectants).</li> <li>• Mixtures: Synergistic and Additive Effects</li> </ul>			
4.	<b>Measurement of hazard</b>	Knows how to properly measure employee exposure to hazardous airborne levels of chemical and biological hazards, find existing exposure data, or extrapolate from representative data.			
5.	<b>Other Hazards Contribution to exposure</b>	Understands the potential of surface contamination, airborne levels of other contaminants hazards as contributors to total exposure. <ul style="list-style-type: none"> <li>• Influence on personnel exposure</li> <li>• Influence on equipment and personnel decontamination</li> </ul>			
6.	<b>Regulatory Compliance</b>	Knows how to appropriately determine the effectiveness of different respirators types to satisfy: <ul style="list-style-type: none"> <li>• <i>Permissible Exposure Limits</i> and <i>Threshold Limit Values</i>®</li> <li>• Additive OELs calculations</li> <li>• The purpose of the Assigned Protection Factor, and where to find APF listings, see Attachment 9.2.</li> </ul>			

Continued on page 2

	Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
7.	<b>Equipment Selection</b>	Knows the theory, advantages, disadvantages, and limitations to consider in selecting the respirators, including: <ul style="list-style-type: none"> <li>• Face Piece- Half face, Full face, Hood, Helmet</li> <li>• Type of air supply- APR, PAPR, Airline, SCBA, etc.</li> <li>• Media: HEPA, Adsorbent, Combination, etc.</li> <li>• NIOSH certification on masks, fittings, cartridges, etc.</li> </ul> Knows sources of recommendations for respirator selection, such as the NIOSH Pocket Guide.			
8.	<b>Operating Parameters</b>	Knows the theory to establish operating parameters (safety envelope) for the respirator selected: <ul style="list-style-type: none"> <li>• Service Life for supplied air systems</li> <li>• Cartridge End of Service Life</li> <li>• Break-through time</li> <li>• Warning Properties</li> <li>• ODH</li> <li>• SAR testing for CO, Hydrocarbons/Oil, Humidity</li> <li>• SAR number and length of supply hoses</li> <li>• Employee characteristics- facial hair, eyeglasses, physical fitness.</li> </ul>			
9.	<b>Decontamination/ Storage</b>	Knows the proper post exposure handling of the respirator selected: <ul style="list-style-type: none"> <li>• Cartridge Disposal</li> <li>• Facepiece and equipment decontamination</li> <li>• Facepiece disinfection</li> <li>• Storage</li> </ul>			
10.	<b>Documentation</b>	Demonstrates how to correctly obtain and fill out SBMS <i>Respirator Selection Form</i> .			

**Practical Skill Evaluation: Demonstration of Knowledge by Evaluation of a Case Study**

	Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
11.	<b>Evaluation of a Hypothetical Exposure Scenario</b>	Scenario Title: _____ First Score: _____ Retest Score: _____			

I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:
----------------------	-------

I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date:
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