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	REVISION FINAL Rev12
Subject: Respirator Selection for Non-Radiological Hazards	DATE 05/02/11
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1.0 PURPOSE & SCOPE

Purpose: This document sets the SHSD IH group policy in selecting respiratory protective equipment for non-radiological hazards. This SOP is to be used in conjunction with the BNL Subject Area *Personal Protective Equipment & Respiratory Protection*.

The program complies with dopts Assigned Protection Factors from OSHA 29CFR1910.134 (*Respiratory Protection*), ANSI Z88.2-1992 [*ANSI Withdrawn*] (*American National Standard for Respiratory Protection*) and the NIOSH *Respirator Decision Logic* and the 29CFR1910.134.

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.

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 for use in selecting respiratory protective equipment for radiological hazards.

This SOP does not cover issuing respiratory protective equipment. Issuance of respiratory protective equipment is governed by Radiological Control Division procedures.

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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 BNL organization professionals, 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 and 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

Air Purifying: A respirator that removes specific air contaminants by passing ambient air through an 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 a system that meets ANSI/CGA G-7.1-1989: Oxygen 19.5-23.5%; Hydrocarbons 5mg/m³; Carbon monoxide 10 ppm, Carbon Dioxide 1000 ppm, and lack of noticeable odor.

Chemical Hazard Types

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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

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

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4.0 PREREQUISITES

4.1 **Qualifications:** See Section 7 *Implementation and Training*.

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
 - Site *Office Work* JRA 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 type(s) of airborne hazards by reviewing the work planning documentation (e.g. Work Permit, Experimental Safety Review, Job Risk Assessment, Job Hazard Analysis, Standard Operating Procedure, Health & Safety Plan) and other pertinent documents (e.g. Safety Data Sheet of ingredients (MSDS)).
- 6.2 **Determine the airborne concentration:** Measure or calculate the maximum expected workplace concentration of contaminants by measurement by:
- 6.2.1 NIOSH approved integrated sampling methodology,

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- 6.2.2 Calibrated direct reading instrumentation, or
- 6.2.3 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, evaluate the conditions possible throughout a full work shift.

6.3 **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

6.4 **Determination if respiratory protection is required.** Follow the requirements and guidance in Attachment 9.1 to determine the employee exposure concentrations that require respiratory protection.

6.5 **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. Use Attachment 9.1, and the sources of information from NIOSH and manufacturers listed in Attachments 9.2 to 9.5. 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).

6.6 **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

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- Access to the hazardous area, especially impact on the escape of workers if an emergency occurs and access of rescue operations.
- 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.

6.7 If an air purifying cartridge or canister is selected:

6.7.1 Check that cartridges are approved for the hazards by checking these sources.

- 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>. A sample of a page from this web site is attached as *Attachment 9.3*.
- See *Attachment 9.4* for the color code table and product ordering numbers for the two main vendors at BNL.

6.7.2 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.

6.8 Determine the APF from *Attachment 9.2* for the proposed respirator style.

6.9 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.

Formula 6: A respirator is acceptable for use when"

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

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6.10 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/m³) is present with Lead (OEL= 0.050 mg/m³), 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/m³), Lead (OEL= 0.050 mg/m³), 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:

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

6.11 Document the equipment selection on the *Respirator Selection Form* located in the BNL SBMS subject area *Personal Protective Equipment & Respirators*
https://sbms.bnl.gov/sbmsearch/subjarea/119/119_Exh17.cfm?ExhibitID=7498

7.0 IMPLEMENTATION AND TRAINING

Respirator selection shall be performed by persons who have demonstrated the competence and have met the qualification criteria set in Attachment 9.6

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*.
- 8.4 *RCD-FS-SOP-4002, Rev 5*.

The only official copy is on-line at the SHSD IH Group website.
 Before using a printed copy, verify that it is current by checking the document issue date on the website.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure	NUMBER IH72200
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9.0 ATTACHMENTS

- 9.1 *Requirements & Guidance for Respirator Selection for Non-Radiological 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 *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 04/04/02 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 05/13/02 Industrial Hygienist Group Leader
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
QA Representative / Date: <i>none</i>	Training Coordinator / Date: <i>none</i>	Filing Code: IH52.05
Facility Support Rep. / Date: P. Burke, J. Durnan, C. Weilandics <i>05/2002</i>	Environ. Compliance Rep. / Date: <i>none</i>	Original Publication Effective Date: 05/13/02
ISM Review - Hazard Categorization <input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low/Skill of the craft	Validation: <input type="checkbox"/> Formal Walkthrough <input checked="" type="checkbox"/> Desk Top Review <input type="checkbox"/> SME Review Name / Date:	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 03/30/10 Hard Copy files updated: 03/30/10 Document Control: 03/30/10

Revision Log
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" 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: Rev 1 Revised APFs for agreement with RCD SOP-4002 and to reflect the OSHA proposed APFs. SME Reviewer/Date: R. Selvey 11/05/03 (signature/date on file)
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: Rev 2 Add Qualification specifications in Attachment 9.5. SME Reviewer/Date: R. Selvey 4/15/04 (signature/date on file)

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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: Rev 3 Add new definitions. Added text in 6.7 on additive OELs. Attachment 9.1 revised to add more particulates. Added Attachments 9.4 and 9.5. SME Reviewer/Date: R. Selvey 7/09/04 (signature/date on file)
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: Rev 4 Revised Section 7 training requirements. Updated Section 10 to new format. SME Reviewer/Date: R. Selvey 10/31/05 (signature/date on file)
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 checked="" type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev 5 Revised Attachment 9.2 to include the newly adopted Assigned Protection Factors from OSHA. SME Reviewer/Date: (signature/date on file) R. Selvey 08/29/06
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: Rev 6 Correct typo in Attachment 9.2 Assigned Protection Factors from OSHA for helmet/hood. SME Reviewer/Date: R. Selvey 10/23/06 (signature/date on file)
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 checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev 7 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. SME Reviewer/Date: J. Peters 1/10/07 (signature/date on file); Reviewer/Date: R. Selvey 1/12/07 (signature/date on file)
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 checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev 8 Added Section 6.3 on Hierarchy of Controls. (Based on 10CFR851 Gap Analysis) SME Reviewer/Date: R. Selvey 03/20/07 (signature/date on file)
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 checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev 9 Revised the end-of-service life calculator links in Attachment 9.5. SME Reviewer/Date: R. Selvey 06/15/07 (signature/date on file)
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" 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 checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev10 Updated links in 5.3 and 6.5.11. Added Reference 8.4. Updated Attachment 9.2 with revised ASPF for RCD-4002. Updated Attachment 9.4. SME Reviewer/Date: R. Selvey 03/30/10 (signature/date on file)
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 checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev11: Edited Section 6.4; 6.6.1.2; and 7. Replaced Attachment 9.1 with more a comprehensive table that includes requirements and guidance. Fiberglass recommendations specified in 9.1. Revised Attachment 9.5. Deleted Attachment 9.6. SME Reviewer/Date: R. Selvey 06/15/10 (signature/date on file)
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 checked="" type="checkbox"/> Corrective/preventive actions to non-conformances <input type="checkbox"/> none of the above Section/page and Description of change: Rev12: Added Step 6.1. Made text revision in Section 1 for clarity. SME Reviewer/Date: R. Selvey 05/02/11 (signature/date on file)

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Attachment 9.1 (Rev 06/16/10)

Requirements & Guidance for Respirator Selection for Non-Radiological Hazards

Hazard	Condition Requiring Respiratory Protection	
Chemicals (Toxic and Hazardous substances)	Any chemical listed in the 2005 edition of ACGIH TLVs® and BEIs® Any chemical listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 or 1910.1001 – 1500.	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the ACGIH Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs®.</p> <p>Any airborne concentration in excess of the OSHA Limit for Air Contaminants expressed as: Permissible Exposure Limit; 8-hour Time Weighted Average; Short Term Exposure Limit; Ceiling; or Acceptable maximum peak as listed in the current 29CFR1910.1000 Tables Z-1, Z-2, Z-3 or 1910.1001 – 1500.</p> <p>Respirator Requirement: Provide employee an appropriate respirator during: (i) Periods necessary to install or implement feasible engineering and work-practice controls. (ii) Work operations, such as maintenance and repair activities or reactor cleaning, for which the employer establishes that engineering and work-practice controls are not feasible. (iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits, and (iv) Emergencies.</p>
2-Acetylaminofluorene	OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of TLVs® and BEIs® or .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Acrylonitrile.	OSHA 29CFR 1910.1045 - Acrylonitrile.	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1045(h)(2) (ii) If air-purifying respirators (chemical-cartridge or chemical-canister types) are used: (A) The air-purifying canister or cartridge must be replaced prior to the expiration of its service life or at the completion of each shift, whichever occurs first. (B) A label must be attached to the cartridge or canister to indicate the date</p>

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Hazard		Condition Requiring Respiratory Protection
		and time at which it is first installed on the respirator.
4- Aminodiphenyl	OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Inorganic arsenic.	OSHA 29CFR 1910.1018 - Inorganic arsenic.	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1018(h)(3) Respirator selection. (i) Employers must: (B) Ensure that employees do not use half mask respirators for protection against arsenic trichloride because it is absorbed rapidly through the skin. (C) Provide HEPA filters for powered and non-powered air-purifying respirators. (D) Select for employee use: (1) Air-purifying respirators that have a combination HEPA filter with an appropriate gas-sorbent cartridge or canister when the employee's exposure exceeds the permissible exposure level for inorganic arsenic and the relevant limit for other gases. (2) Front-or back-mounted gas masks equipped with HEPA filters and acid gas canisters or any full facepiece supplied-air respirators when the inorganic arsenic concentration is at or below 500 mg/m³; and half mask air-purifying respirators equipped with HEPA filters and acid gas cartridges when the inorganic arsenic concentration is at or below 100 µg/m³. (ii) Employees required to use respirators may choose, and the employer must provide, a powered air-purifying respirator if it will provide proper protection. In addition, the employer must provide a combination dust and acid-gas respirator to employees who are exposed to gases over the relevant exposure limits.</p>
Asbestos	OSHA 29CFR 1910.1001 General Industry use of: chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1001(c) Permissible exposure limit (PELS) (1) Time-weighted average limit (TWA). The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fibers per cubic centimeter of air as an eight (8)-hour time-weighted average (TWA) as determined by the method prescribed in Appendix A to this section, or by an equivalent method. (2) Excursion limit. The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc) as averaged over a sampling period of thirty (30) minutes as determined by the method prescribed in Appendix A to this section, or by an equivalent method.</p>

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Hazard	Condition Requiring Respiratory Protection
asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered in a material containing more than 1% asbestos	<p>Respirator Requirement: 1910.1001(e)(4) Each person entering a regulated area shall be supplied with and required to use a respirator, selected in accordance with paragraph (g)(2) of this section.</p> <p>1910.1001(f)(1) (iii) For the following operations, wherever feasible engineering controls and work practices that can be instituted are not sufficient to reduce the employee exposure to or below the <u>TWA and/or excursion limit</u>, reduce employee exposure to or below 0.5 fiber per cubic centimeter of air (as an eight-hour time-weighted average) or 2.5 fibers/cc for 30 minutes (short-term exposure) and shall supplement them by the use of any combination of respiratory protection, work practices and feasible engineering controls that will reduce employee exposure to or below the TWA and to or below the excursion limit: Coupling cutoff in primary asbestos cement pipe manufacturing; sanding in primary and secondary asbestos cement sheet manufacturing; grinding in primary and secondary friction product manufacturing; carding and spinning in dry textile processes; and grinding and sanding in primary plastics manufacturing.</p> <p>1910.1001(g)(2) Respirator program. (ii) Provide an employee with a tight-fitting, powered air-purifying respirator (PAPR) instead of a negative pressure respirator when the employee chooses to use a PAPR and it provides adequate protection to the employee.</p> <p><u>1910.1001(g)(3)(i)</u> employers must <u>not select or use filtering facepiece respirators for protection against asbestos fibers.</u> (ii) Provide <u>HEPA filters</u> for powered and non-powered air-purifying respirators.</p>
OSHA 29CFR 1926.1101 Asbestos for Construction	<p>Exposure Level /Events triggering Required Respiratory Protection: 1926.1101(c) Permissible exposure limits (PELS). (1) Time-weighted average limit (TWA). The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fibers per cubic centimeter of air as an eight (8) hour time-weighted average (TWA), as determined by the method prescribed in Appendix A to this section, or by an equivalent method. (2) Excursion limit. The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc) as averaged over a sampling period of thirty (30) minutes, as determined by the method prescribed in Appendix A to this section, or by an equivalent method.</p> <p>Respirator Requirement: 1926.1101(e)(4) Respirators. All persons entering a regulated area where employees are required to wear respirators. 1926.1101(g)(2)(v) Wherever the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the <u>permissible exposure limit and/or excursion limit</u>, the employer shall use them to reduce employee exposure to the lowest levels attainable by these controls and shall supplement them by the use of respiratory protection.</p> <p>1926.1101(h) Respiratory protection. (1) Respirators must be used during: (i) Class I asbestos work.; (ii) Class II asbestos work when ACM is not removed in a substantially intact state.; (iii) Class II and III asbestos work that is not performed using wet methods, except for removal of ACM from sloped roofs when a negative-exposure assessment has been conducted and ACM is removed in an intact state. (iv) Class II and III asbestos work for which a negative-exposure assessment has not been conducted. (v) Class III asbestos work when TSI or surfacing ACM or PACM is being disturbed. (vi) Class IV asbestos work performed within regulated areas where employees who are performing other work are required to use respirators. (vii) Work operations covered by this section for which employees are exposed above the TWA</p>

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Hazard	Condition Requiring Respiratory Protection
	<p>or excursion limit. (viii) Emergencies.</p> <p>1926.1101(h)(3)(i)(A) employers must <u>not select or use filtering facepiece respirators for use against asbestos fibers.</u> (B) Provide HEPA filters for powered and non-powered air-purifying respirators. (ii) Employers must provide an employee with tight-fitting, powered air-purifying respirator (PAPR) instead of a negative pressure respirator when the employee chooses to use a PAPR and it provides adequate protection to the employee. (iii) Employers must provide employees with an air-purifying half mask respirator, other than a filtering facepiece respirator, whenever the employees perform: (A) Class II or Class III asbestos work for which no negative exposure assessment is available. (B) Class III asbestos work involving disturbance of TSI or surfacing ACM or PACM. (iv) Employers must provide employees with:(A) A tight-fitting powered air-purifying respirator or a full facepiece, supplied-air respirator operated in the pressure-demand mode and equipped with either HEPA egress cartridges or an auxiliary positive-pressure, self-contained breathing apparatus (SCBA) whenever the employees are in a regulated area performing Class I asbestos work for which a negative exposure assessment is not available and the exposure assessment indicates that the exposure level will be at or below 1 f/cc as an 8-hour time-weighted average (TWA). (B) A full facepiece supplied-air respirator operated in the pressure-demand mode and equipped with an auxiliary positive-pressure SCBA whenever the employees are in a regulated area performing Class I asbestos work for which a negative exposure assessment is not available and the exposure assessment indicates that the exposure level will be above 1 f/cc as an 8-hour TWA.</p>
Asphyxiants, Simple, i.e. ODH	<p>Respirator Requirement: When Oxygen levels are less than 19.5%, no air purifying respirators shall be used. Acceptable respirators are Supplied Air, full face, escape bottle; Self Contained Breathing Apparatus; Escape device.</p>
Benzene	<p>OSHA 29CFR 1910.1028 - Benzene.</p> <p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1028(c) Permissible exposure limits (PELs) (1) Time-weighted average limit (TWA). The employer shall assure that no employee is exposed to an airborne concentration of benzene in excess of one part of benzene per million parts of air (1 ppm) as an 8-hour time-weighted average. (2) Short-term exposure limit (STEL). The employer shall assure that no employee is exposed to an airborne concentration of benzene in excess of five (5) ppm as averaged over any 15 minute period.</p> <p>Respirator Requirement: 1910.1028(g)(2)(ii) For air-purifying respirators, replace the air-purifying element at the expiration of its service life or at the beginning of each shift in which such elements are used, whichever comes first. (iii) If NIOSH approves an air-purifying element with an end-of- service-life indicator for benzene, such an element may be used until the indicator shows no further useful life.</p> <p>1910.1028(g)(3)(i)(B) Provide employees with any organic vapor gas mask or any self-contained breathing apparatus with a full facepiece to use for escape. (C) Use an organic vapor cartridge or canister with powered and non-powered air-purifying respirators, and a chin-style canister with full facepiece gas masks. (D) Ensure that canisters used with non-powered air-purifying respirators have a minimum service life of four hours when tested at 150 ppm benzene at a flow rate of 64 liters per minute (LPM), a temperature of 25 [deg]C, and a relative humidity of 85%; for canisters used with tight-fitting or loose-</p>

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Hazard	Condition Requiring Respiratory Protection
	fitting powered air-purifying respirators, the flow rates for testing must be 115 LPM and 170 LPM, respectively. (ii) Any employee who cannot use a negative-pressure respirator must be allowed to use a respirator with less breathing resistance, such as a powered air-purifying respirator or supplied-air respirator.
Benzidine OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
1,3-Butadiene OSHA 29CFR 1910.1051 - 1.3- Butadiene.	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1051(c) Permissible exposure limits (PELs). (1) Time-weighted average (TWA) limit. The employer shall ensure that no employee is exposed to an airborne concentration of BD in excess of one (1) part BD per million parts of air (ppm) measured as an eight (8)-hour time-weighted average. (2) Short-term exposure limit (STEL). The employer shall ensure that no employee is exposed to an airborne concentration of BD in excess of five parts of BD per million parts of air (5 ppm) as determined over a sampling period of fifteen (15) minutes.</p> <p>Respirator Requirement: 1910.1051(f)(1)(ii) Wherever the feasible engineering controls and work practices which can be instituted are not sufficient to reduce employee exposure to or below the <u>8-hour TWA or STEL</u>, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (h) of this section. 1910.1051(h)(2)(ii) If air-purifying respirators are used, replace the air-purifying filter elements according to the replacement schedule set for the class of respirators listed in Table 1 of this section, and at the beginning of each work shift. (iii) Instead of using the replacement schedule listed in Table 1 of this section, the employer may replace cartridges or canisters at 90% of their expiration service life, provided the employer: (A) Demonstrates that employees will be adequately protected by this procedure. (B) Uses BD breakthrough data for this purpose that have been derived from tests conducted under worst-case conditions of humidity, temperature, and air-flow rate through the filter element, and the employer also describes the data supporting the cartridge-or canister-change schedule, as well as the basis for using the data in the employer's respirator program. (iv) A label must be attached to each filter element to indicate the date and time it is first installed on the respirator. (v) If NIOSH approves an end-of-service-life indicator (ESLI) for an air-purifying filter element, the element may be used until the ESLI shows no further useful service life or until the element is replaced at the beginning of the next work shift, whichever occurs first. (vi) Regardless of the air-purifying element used, if an employee detects the odor of BD, the employer must replace the air-purifying element immediately.</p>

Hazard	Condition Requiring Respiratory Protection																		
	<p>1910.1051(h)(3) Respirator selection. (i) The employer must select appropriate respirators from Table 1 of this section.</p> <p style="text-align: center;">TABLE 1.—MINIMUM REQUIREMENTS FOR RESPIRATORY PROTECTION FOR AIRBORNE BD</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Concentration of airborne BD (ppm) or condition of use</th> <th style="width: 50%;">Minimum required respirator</th> </tr> </thead> <tbody> <tr> <td>Less than or equal to 5 ppm (5 times PEL)</td> <td>(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 4 hours.</td> </tr> <tr> <td>Less than or equal to 10 ppm (10 times PEL) ...</td> <td>(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 3 hours.</td> </tr> <tr> <td>Less than or equal to 25 ppm (25 times PEL) ...</td> <td>(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 2 hours. (b) Any powered air-purifying respirator equipped with approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every 2 hours. (c) Continuous flow supplied air respirator equipped with a hood or helmet.</td> </tr> <tr> <td>Less than or equal to 50 ppm (50 times PEL) ...</td> <td>(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every (1) hour. (b) Powered air-purifying respirator equipped with a tight-fitting facepiece and an approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every (1) hour.</td> </tr> <tr> <td>Less than or equal to 1,000 ppm (1,000 times PEL). Greater than 1000 ppm unknown concentration, or firefighting.</td> <td>(a) Supplied air respirator equipped with a half mask of full facepiece and operated in a pressure demand or other positive pressure mode. (b) Self-contained breathing apparatus equipped with a full facepiece and operated in a pressure demand or other positive pressure mode. (c) Any supplied air respirator equipped with a full facepiece and operated in a pressure demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure demand or other positive pressure mode.</td> </tr> <tr> <td>Escape from IDLH conditions</td> <td>(a) Any positive pressure self-contained breathing apparatus with an appropriate service life.</td> </tr> <tr> <th style="width: 50%;">Concentration of airborne BD (ppm) or condition of use</th> <th style="width: 50%;">Minimum required respirator</th> </tr> <tr> <td></td> <td>(b) A air-purifying full facepiece respirator equipped with a front or back mounted BD or organic vapor canister.</td> </tr> </tbody> </table> <p>NOTES: Respirators approved for use in higher concentrations are permitted to be used in lower concentrations. Full facepiece is required when eye irritation is anticipated.</p>	Concentration of airborne BD (ppm) or condition of use	Minimum required respirator	Less than or equal to 5 ppm (5 times PEL)	(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 4 hours.	Less than or equal to 10 ppm (10 times PEL) ...	(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 3 hours.	Less than or equal to 25 ppm (25 times PEL) ...	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 2 hours. (b) Any powered air-purifying respirator equipped with approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every 2 hours. (c) Continuous flow supplied air respirator equipped with a hood or helmet.	Less than or equal to 50 ppm (50 times PEL) ...	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every (1) hour. (b) Powered air-purifying respirator equipped with a tight-fitting facepiece and an approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every (1) hour.	Less than or equal to 1,000 ppm (1,000 times PEL). Greater than 1000 ppm unknown concentration, or firefighting.	(a) Supplied air respirator equipped with a half mask of full facepiece and operated in a pressure demand or other positive pressure mode. (b) Self-contained breathing apparatus equipped with a full facepiece and operated in a pressure demand or other positive pressure mode. (c) Any supplied air respirator equipped with a full facepiece and operated in a pressure demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure demand or other positive pressure mode.	Escape from IDLH conditions	(a) Any positive pressure self-contained breathing apparatus with an appropriate service life.	Concentration of airborne BD (ppm) or condition of use	Minimum required respirator		(b) A air-purifying full facepiece respirator equipped with a front or back mounted BD or organic vapor canister.
Concentration of airborne BD (ppm) or condition of use	Minimum required respirator																		
Less than or equal to 5 ppm (5 times PEL)	(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 4 hours.																		
Less than or equal to 10 ppm (10 times PEL) ...	(a) Air-purifying half mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 3 hours.																		
Less than or equal to 25 ppm (25 times PEL) ...	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 2 hours. (b) Any powered air-purifying respirator equipped with approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every 2 hours. (c) Continuous flow supplied air respirator equipped with a hood or helmet.																		
Less than or equal to 50 ppm (50 times PEL) ...	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every (1) hour. (b) Powered air-purifying respirator equipped with a tight-fitting facepiece and an approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every (1) hour.																		
Less than or equal to 1,000 ppm (1,000 times PEL). Greater than 1000 ppm unknown concentration, or firefighting.	(a) Supplied air respirator equipped with a half mask of full facepiece and operated in a pressure demand or other positive pressure mode. (b) Self-contained breathing apparatus equipped with a full facepiece and operated in a pressure demand or other positive pressure mode. (c) Any supplied air respirator equipped with a full facepiece and operated in a pressure demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure demand or other positive pressure mode.																		
Escape from IDLH conditions	(a) Any positive pressure self-contained breathing apparatus with an appropriate service life.																		
Concentration of airborne BD (ppm) or condition of use	Minimum required respirator																		
	(b) A air-purifying full facepiece respirator equipped with a front or back mounted BD or organic vapor canister.																		
Beryllium	<p>DOE 10CFR.850 Elemental beryllium and any insoluble beryllium compound or alloy containing 0.1 percent beryllium or greater that may be released as an airborne particulate.</p> <p>Exposure Level /Events triggering Required Respiratory Protection: 10 CFR 850.22 Permissible exposure limit. The responsible employer must assure that no worker is exposed to an airborne concentration of beryllium greater than the permissible exposure limit established in 29 CFR 1910.1000, as measured in the worker's breathing zone by personal monitoring, or a more stringent TWA PEL that may be promulgated by the Occupational Safety and Health standard. § 850.23 Action level. (a) The responsible employer must include in its CBDPP an action level that is no greater than <u>0.2 ug/m³</u>, calculated as an 8-hour TWA exposure, as measured in the worker's breathing zone by personal monitoring. (b) If an airborne concentration of beryllium is at or above the action level, the responsible employer must implement §§ 850.24(c) (periodic monitoring), 850.25 (exposure reduction and minimization), 850.26 (regulated areas), 850.27 (hygiene facilities and practices), 850.28 (<u>Respiratory Protection</u>), 850.29 (protective clothing and equipment), and 850.38 (warning signs) of this part.</p> <p>Respirator Requirement: 10 CFR 850.28(a) establish a respiratory protection program that complies with the respiratory</p>																		

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Hazard	Condition Requiring Respiratory Protection
	<p>protection program requirements of 29 CFR 1910.134 (b) provide respirators to workers who: (1) Are exposed to an airborne concentration of beryllium <u>at or above the action level</u>, or (2) Are performing tasks for which analyses indicate the potential for exposures at or above the action level. (c) Include in the respiratory protection program any beryllium-associated worker who requests to use a respirator for protection against airborne beryllium, regardless of measured exposure levels. (d) The responsible employer must select for use by workers: (1) Respirators approved by the NIOSH if NIOSH approved respirators exist for a specific DOE task; or (2) Respirators that DOE has accepted under the DOE Respiratory Protection Acceptance Program if NIOSH-approved respirators do not exist for specific DOE tasks.</p>
Cadmium OSHA 29CFR 1910.1027 - Cadmium	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1027(c) "Permissible Exposure Limit (PEL)." The employer shall assure that no employee is exposed to an airborne concentration of cadmium in excess of five micrograms per cubic meter of air (5 ug/m³), calculated as an eight-hour time-weighted average exposure (TWA).</p> <p>Respirator Requirement: 1910.1027(f)(1)(iv) Wherever engineering and work practice controls are required and are not sufficient to reduce employee exposure to or below the <u>PEL or, where applicable, the SECAL</u>, implement such controls to reduce exposures to the lowest levels achievable. Supplement controls with respiratory protection and the PEL. 1910.1027(g)(3)(i)(A) Select, and provide to employees, the appropriate respirators specified in 29 CFR 1910.134. (B) Provide employees with full facepiece respirators when they experience eye irritation. (C) Provide HEPA filters for powered and non-powered air-purifying respirators. (ii) Provide an employee with a powered air-purifying respirator instead of a negative-pressure respirator when an employee who is entitled to a respirator chooses to use this type of respirator and such a respirator provides adequate protection to the employee.</p>
bis-Chloromethyl ether. OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Chromium (VI) OSHA 29CFR 1910.1026 - Chromium (VI)	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1026(c) Permissible exposure limit (PEL). The employer shall ensure that no employee is exposed to an airborne concentration of chromium (VI) in excess of 5 micrograms per cubic meter of air (5 µg/m³), calculated as an 8-hour time-weighted average (TWA).</p> <p>Respirator Requirement: 1910.1026(g)(2) <i>Respiratory protection program</i>. Where respirator use is required by this section, the employer shall institute a respiratory protection program in accordance with § 1910.134, which covers each</p>

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Hazard		Condition Requiring Respiratory Protection
		employee required to use a respirator.
bis-Chloromethyl ether CAS No. 542881;	OSHA 29CFR 1910.1003 - 13 Carcinogens	Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 . Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.
1,2-dibromo-3-chloropropane	OSHA 29CFR 1910.1044 - 1,2-dibromo-3-chloropropane.	Exposure Level /Events triggering Required Respiratory Protection: 1910.1044(c) Permissible exposure limit - (1) Inhalation. The employer shall assure that no employee is exposed to an airborne concentration of DBCP in excess of 1 part DBCP per billion parts of air (ppb) as an 8-hour time-weighted average. (2) Dermal and eye exposure. The employer shall assure that no employee is exposed to eye or skin contact with DBCP. Respirator Requirement: 1910.1044(h)(3)(i) Select, and provide to employees, the appropriate atmosphere-supplying respirator specified in 29 CFR 1910.134. (ii) Provide employees with one of the following respirator options to use for entry into, or escape from, unknown DBCP concentrations: (A) A combination respirator that includes a supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure or continuous-flow mode, as well as an auxiliary self-contained breathing apparatus (SCBA) operated in a pressure-demand or positive-pressure mode. (B) An SCBA with a full facepiece operated in a pressure-demand or other positive-pressure mode.
3,3'-Dichlorobenzidine (and its salts) CAS No. 91941	OSHA 29CFR 1910.1003 - 13 Carcinogens	Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 . Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.
4-Dimethylamino azo-benzene	OSHA 29CFR 1910.1003 - 13 Carcinogens	Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2,

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Hazard		Condition Requiring Respiratory Protection
CAS No. 60117		<p>or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Ethyleneimine CAS No. 151564	OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Ethylene oxide	OSHA 29CFR 1910.1047 - Ethylene oxide.	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1047(c) "Permissible exposure limits" (1) "8-hour time-weighted average (TWA)." The employer shall ensure that no employee is exposed to an airborne concentration of EtO in excess of one (1) part EtO per million parts of air (1 ppm) as an (8)-hour time-weighted average (8-hour TWA). (2) "Excursion limit." The employer shall ensure that no employee is exposed to an airborne concentration of EtO in excess of 5 parts of EtO per million parts of air (5 ppm) as averaged over a sampling period of fifteen (15) minutes.</p> <p>Respirator Requirement: 1910.1047(g)(3)(i) Select, and provide to employees, the appropriate respirators specified in of 29 CFR 1910.134; however, employers must <u>not select or use half masks</u> of any type because EtO may cause eye irritation or injury. (ii) Equip each air-purifying, full facepiece respirator with a front-or back-mounted canister approved for protection against ethylene oxide. (iii) For escape, provide employees with any respirator permitted for use under paragraphs (g)(3)(i) and (ii) of this standard.</p>
Fiberglass (Synthetic Vitreous Fibers) Continuous Filament glass fibers	BNL Requirements & Guidance on Respiratory Protection	<p>Exposure Level /Events triggering Required Respiratory Protection:</p> <p>Any airborne concentration in excess of the ACGIH Threshold Limit Value (Synthetic Vitreous Fibers): Continuous Filament glass fibers 1 f/cc and 5 mg/m³ TWA-8 Glass wool fibers; Rock wool fibers ; Slag wool fibers ; and Special purpose glass fibers 1 f/cc TWA-8 Refractory ceramic fibers 0.2 f/cc TWA-8</p> <p>Any airborne concentration in excess of the OSHA PEL: Fiberglass is regulated under the PNOR (particulates not otherwise regulated) PEL of 15 mg/m(3) (5 mg/m(3) Respirable). TABLE Z-3 Mineral Dusts</p>

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Hazard	Condition Requiring Respiratory Protection
	<p>Respirator Requirement: Respirator required for any airborne concentration in excess of the current <u>OSHA PEL</u> and/or the <u>2005 ACGIH TLV®</u>. Provide employee an appropriate respirator during: (i) Periods necessary to install or implement feasible engineering and work-practice controls. (ii) Work operations, such as maintenance and repair activities or reactor cleaning, for which the employer establishes that engineering and work-practice controls are not feasible. (iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits, and (iv) Emergencies. When exposure is in excess of the TLV or PEL, do not use a filtering facepiece respirator.</p> <p>Respirator Guidance: A respirator is recommended for any application of glass wool, rock wool, and slag wool fiber for thermal building insulation, especially in area with limited ventilation when the anticipated airborne concentration is above background levels. Appropriate respiratory protection is filtering facepiece respirator; air purifying half or full face negative pressure respirator; or powered air purifying respirator. When exposure is in excess of the TLV or PEL, do not use a filtering facepiece respirator.</p>
Formaldehyde	<p>OSHA 29CFR 1910.1048 - Formaldehyde.</p> <p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1048(c) Permissible Exposure Limit (PEL) - (1) TWA: The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds 0.75 parts formaldehyde per million parts of air (0.75 ppm) as an 8-hour TWA. (2) Short Term Exposure Limit (STEL): The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds two parts formaldehyde per million parts of air (2 ppm) as a 15-minute STEL</p> <p>Respirator Requirement: 1910.1048(g)(2)(ii) if air-purifying respirators with chemical cartridges or canisters that do not contain end-of-service-life indicators approved by the NIOSH, replace these cartridges or canisters as specified by paragraphs (d)(3)(iii)(B)(1) and (B)(2) of 29 CFR 1910.134, or at the end of the workshift, whichever condition occurs first. (A) Replace the cartridge after three (3) hours of use or at the end of the workshift, whichever occurs first, unless the cartridge contains a NIOSH-approved end-of-service-life indicator (ESLI) to show when breakthrough occurs. (B) Unless the canister contains a NIOSH-approved ESLI to show when breakthrough occurs, replace canisters used in atmospheres up to 7.5 ppm (10xPEL) every four (4) hours and industrial-sized canisters used in atmospheres up to 75 ppm (100xPEL) every two (2) hours, or at the end of the workshift, whichever occurs first.</p> <p>1910.1048(g)(3)(i)(A) Select, and provide to employees, the appropriate respirators specified in 29 CFR 1910.134. (B) Equip each air-purifying, full facepiece respirator with a canister or cartridge approved for protection against formaldehyde. (ii) Employers may substitute an air-purifying, half mask respirator for an air-purifying, full facepiece respirator when they equip the half mask respirator with a cartridge approved for protection against formaldehyde and provide the affected employee with effective gas-proof goggles. (iii) Employers must provide employees who have difficulty using negative pressure respirators with powered air-purifying respirators that affords adequate protection against formaldehyde exposures.</p>
Lead	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1025(c) Permissible exposure limit (PEL).</p>

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Hazard	Condition Requiring Respiratory Protection
	<p>1910.1025 - Lead.</p> <p>(1) The employer shall assure that no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air (50 ug/m(3)) averaged over an 8-hour period. (2) If an employee is exposed to lead for more than 8 hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Maximum permissible limit (in ug/m(3)) = 400 divided by hours worked in the day. (3) When respirators are used to supplement engineering and work practice controls to comply with the PEL and all the requirements of paragraph (f) have been met, employee exposure, for the purpose of determining whether the employer has complied with the PEL, may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.</p> <p>Respirator Requirement: 1910.1025(f)(3)(i)(A) Select appropriate respirators specified in 29 CFR 1910.134. (B) Provide employees with full facepiece respirators instead of half mask respirators for protection against lead aerosols that cause eye or skin irritation at the use concentrations. (C) Provide HEPA filters for powered and non-powered air-purifying respirators. (ii) Employers must provide employees with a powered air-purifying respirator (PAPR) instead of a negative pressure respirator selected according to paragraph (f)(3)(i) of this standard when an employee chooses to use a PAPR and it provides adequate protection to the employee as specified by paragraph (f)(3)(i) of this standard.</p>
methyl chloromethyl ether CAS No. 107302	<p>OSHA 29CFR 1910.1003 - 13 Carcinogens</p> <p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Methylene Chloride	<p>OSHA 29CFR 1910.1052 - Methylene Chloride.</p> <p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1052(c) Permissible exposure limits (PELs) (1) Eight-hour time-weighted average (TWA) PEL. The employer shall ensure that no employee is exposed to an airborne concentration of MC in excess of twenty-five parts of MC per million parts of air (25 ppm) as an 8-hour TWA. (2) Short-term exposure limit (STEL). The employer shall ensure that no employee is exposed to an airborne concentration of MC in excess of one hundred and twenty-five parts of MC per million parts of air (125 ppm) as determined over a sampling period of fifteen minutes.</p> <p>Respirator Requirement: 1910.1052(g)(3)(i) Select appropriate atmosphere-supplying respirator specified in 29 CFR 1910.134; however, employers must <u>not select or use half masks</u> of any type because MC may cause eye irritation or damage. (ii) For emergency escape, provide employees with one of the following respirator options: A self-contained</p>

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Hazard		Condition Requiring Respiratory Protection
		breathing apparatus operated in the continuous-flow or pressure-demand mode; or a gas mask with an organic vapor canister.
Methylenedianiline	OSHA 29CFR 1910.1050 - Methylenedianiline	Exposure Level /Events triggering Required Respiratory Protection: 1910.1050(c) Permissible exposure limits (PEL). The employer shall assure that no employee is exposed to an airborne concentration of MDA in excess of ten parts per billion (10 ppb) as an 8-hour time-weighted average or a STEL of 100 ppb. Respirator Requirement: 1910.1050(h)(3)(i)(A) Select appropriate respirators specified in 29 CFR 1910.134. (B) Provide HEPA filters for powered and non-powered air-purifying respirators. (C) For escape, provide employees with one of the following respirator options: Any self-contained breathing apparatus with a full facepiece or hood operated in the positive-pressure or continuous-flow mode; or a full facepiece air-purifying respirator. (D) Provide a combination HEPA filter and organic vapor canister or cartridge with powered or non-powered air-purifying respirators when MDA is in liquid form or used as part of a process requiring heat. (ii) Any employee who cannot use a negative-pressure respirator must be given the option of using a positive-pressure respirator, or a supplied-air respirator operated in the continuous-flow or pressure-demand mode.
alpha-Naphthylamine CAS No. 134327;	OSHA 29CFR 1910.1003 - 13 Carcinogens	Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 . Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.
beta-Naphthylamine CAS No. 91598;	OSHA 29CFR 1910.1003 - 13 Carcinogens	Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 . Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.
4-Nitrobiphenyl	OSHA 29CFR	Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the

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Hazard	Condition Requiring Respiratory Protection
CAS No. 92933; 1910.1003 - 13 Carcinogens	<p>Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
N-Nitrosodimethyl amine CAS No. 62759 OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Paint Spray Lacquers, Paints BNL Guidance	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Recommendation (Guidance): Acceptable respirators are APR, half/full face, Combo- OVC/Paint Cartridge or filter (except for paints containing Isocyanates); Supplied Air, full face; Self Contained Breathing Apparatus.</p>
beta-Propiolactone CAS No. 57578 OSHA 29CFR 1910.1003 - 13 Carcinogens	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Requirement: 1910.1003(c)(4)(iv) Provide employee engaged in handling operations involving the carcinogens with a half face filter type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.</p>
Silica	<p>Exposure Level /Events triggering Required Respiratory Protection: Any airborne concentration in excess of the</p>

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Hazard	Condition Requiring Respiratory Protection
	<p>Threshold Limit Value expressed as 8-hour Time Weighted Average; Short Term Exposure Limit; or Ceiling as listed in the 2005 edition of ACGIH TLVs® and/or the OSHA PEL as listed in the current of OSHA 29CFR1910.1000 Tables Z-1, Z-2, or Z-3 .</p> <p>Respirator Recommendation (Guidance): For activities generating fine silica particles a minimum full-face respirator with HEPA filters is needed. Acceptable respirators are: HEPA filter on APR full face; PAPR full face; PAPR helmet; PAPR hood. Supplied Air full face; Self Contained Breathing Apparatus</p>
Vinyl chloride OSHA 29CFR 1910.1017 - Vinyl chloride	<p>Exposure Level /Events triggering Required Respiratory Protection: 1910.1017(c) Permissible exposure limit. (1) No employee may be exposed to vinyl chloride at concentrations greater than 1 ppm averaged over any 8-hour period, and (2) No employee may be exposed to vinyl chloride at concentrations greater than 5 ppm averaged over any period not exceeding 15 minutes. (3) No employee may be exposed to vinyl chloride by direct contact with liquid vinyl chloride.</p> <p>Respirator Requirement: 1910.1017(g)(3)(i)(A) Select appropriate respirators specified in 29 CFR 1910.134. (B) Provide an organic vapor cartridge that has a service life of at least one hour when using a chemical cartridge respirator at vinyl chloride concentrations up to 10 ppm. (C) Select a canister that has a service life of at least four hours when using a powered air-purifying respirator having a hood, helmet, or full or half facepiece, or a gas mask with a front-or back-mounted canister, at vinyl chloride concentrations up to 25 ppm. (ii) When air-purifying respirators are used: (A) Air-purifying canisters or cartridges must be replaced prior to the expiration of their service life or the end of the shift in which they are first used, whichever occurs first. (B) A continuous-monitoring and alarm system must be provided when concentrations of vinyl chloride could reasonably exceed the allowable concentrations for the devices in use. Such a system must be used to alert employees when vinyl chloride concentrations exceed the allowable concentrations for the devices in use.</p> <p>1910.1017(g)(4) Selection of respirators for vinyl chloride shall be as follows: (5) Where air-purifying respirators are used: (i) Air-purifying canisters or cartridges shall be replaced prior to the expiration of their service life or the end of the shift in which they are first used, whichever occurs first, and (ii) A continuous monitoring and alarm system shall be provided where concentrations of vinyl chloride could reasonably exceed the allowable concentrations for the devices in use. Such system shall be used to alert employees when vinyl chloride concentrations exceed the allowable concentrations for the devices in use. (6) Apparatus prescribed for higher concentrations may be used for any lower concentration.</p>

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Attachment 9.2

(Rev 06/16/10)

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.5	OSHA 29CFR1910 .134 (Adopted 2006)	NIOSH (Pocket Guide)	ANSI Z88.2- 1992	ANSI Z88.2- 2002 DRAFT
Filtering Facepiece (i.e. dust mask) ⁽¹⁾	0		10			
Air Purifying Respirator (APR)						
Half mask (APR) (Negative Pressure)	10	10	10	10	10	10
Full-Facepiece APR (Negative Pressure)	50	50	50	50	100	10
Powered Air Purifying Respirator (PAPR)						
Loose-fitting facepiece (PAPR) (Positive Pressure)	25	25	25			25
Half mask PAPR (Positive Pressure)	50	50	50	50	50	50
Full-Facepiece PAPR ⁽²⁾ (Positive Pressure)	1000	1,000	1000	50	1000	1000
Helmet / Hood PAPR ⁽²⁾ (Positive Pressure)	25/1000⁽⁴⁾	1,000	25/1000 ⁽⁴⁾			[1000]
Atmosphere Supplying / Airline (ASA)						
Half mask (ASA) (Demand)	10	10	10			
Full facepiece ASA (Demand)	50	100	50	100		
Half mask ASA (Continuous Flow)	50	50	50			250
Full Mask ASA (Continuous Flow)	1000		1000			
Half facepiece ASA (Pressure Demand)	50		50			
Full facepiece ASA (Pressure Demand or Continuous Flow)	1000	1,000	1000			1000
Loose-fitting facepiece ASA (Continuous Flow)	25	25	25			
Helmet / Hood ASA (Continuous Flow)	25/1000⁽⁴⁾	1,000	25/1000 ⁽⁴⁾	1000		
Self Contained Breathing Apparatus (SCBA)						
Half mask SCBA (Demand) ⁽³⁾	10	10	10			
Full facepiece SCBA (Demand) ⁽³⁾	50	100	50			
Full facepiece SCBA (Pressure Demand Open/Closed Circuit)	10,000	10,000		10,000	10,000	10,000
Helmet Hood SCBA (Demand)	50		50			
Military Mask- Avon F12 (Negative Pressure)	50			50		

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

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- (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 (Rev 06/16/10)

Sample of Online NIOSH Pocket Guide to Chemical Hazards

Acetone						
Synonyms & Trade Names Dimethyl ketone, Ketone propane, 2-Propanone						
CAS No. 67-64-1	RTECS No. AL3150000		DOT ID & Guide 1090 127			
Formula (CH ₃) ₂ CO	Conversion 1 ppm = 2.38 mg/m ³		IDLH 2500 ppm [10%LEL] See: 67641			
Exposure Limits NIOSH REL : TWA 250 ppm (590 mg/m ³) OSHA PEL : TWA 1000 ppm (2400 mg/m ³)			Measurement Methods NIOSH 1300 , 2555 , 3800 ; OSHA 69 See: NMAM or OSHA Methods			
Physical Description Colorless liquid with a fragrant, mint-like odor.						
MW: 58.1	BP: 133°F	FRZ: -140°F	Sol: Miscible	VP: 180 mmHg	IP: 9.69 eV	
Sp.Gr: 0.79	Fl.P: 0°F	UEL: 12.8%	LEL: 2.5%			
Class IB Flammable Liquid: Fl.P. below 73°F and BP at or above 100°F.						
Incompatibilities & Reactivities Oxidizers, acids						
Exposure Routes inhalation, ingestion, skin and/or eye contact						
Symptoms irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis						
Target Organs Eyes, skin, respiratory system, central nervous system						
Personal Protection/Sanitation (See protection codes) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation			First Aid (See procedures) Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately			
Respirator Recommendations						
NIOSH						
Up to 2500 ppm: (APF = 10) Any chemical cartridge respirator with organic vapor cartridge(s)* (APF = 25) Any powered, air-purifying respirator with 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 = 10) Any supplied-air respirator* (APF = 50) Any self-contained breathing apparatus with a full facepiece						
Emergency or planned entry into unknown concentrations or IDLH conditions: (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 in combination with an auxiliary self-contained positive-pressure breathing apparatus						
Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister Any appropriate escape-type, self-contained breathing apparatus						
Important additional information about respirator selection						
See also: INTRODUCTION See ICSC CARD: 0087 See MEDICAL TESTS: 0002						

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Attachment 9.4

(Rev 06/16/10)

NIOSH Classifications for Respiratory Protection Equipment

Filters

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

<p>42 CFR 84.190 Chemical cartridge respirators: description. Type of chemical cartridge respirator¹ Maximum use concentration, parts per million</p> <p>-----</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Ammonia.....</td> <td style="text-align: right; padding: 2px;">300</td> </tr> <tr> <td style="padding: 2px;">Chlorine.....</td> <td style="text-align: right; padding: 2px;">10</td> </tr> <tr> <td style="padding: 2px;">Hydrogen chloride.....</td> <td style="text-align: right; padding: 2px;">50</td> </tr> <tr> <td style="padding: 2px;">Methyl amine.....</td> <td style="text-align: right; padding: 2px;">100</td> </tr> <tr> <td style="padding: 2px;">Organic vapor.....²</td> <td style="text-align: right; padding: 2px;">1,000</td> </tr> <tr> <td style="padding: 2px;">Sulfur dioxide.....</td> <td style="text-align: right; padding: 2px;">50</td> </tr> <tr> <td style="padding: 2px;">Vinyl chloride.....</td> <td style="text-align: right; padding: 2px;">10</td> </tr> </table> <p>-----</p> <p>¹ 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.</p> <p>² Maximum use concentrations are lower for organic vapors which produce atmospheres immediately hazardous to life or health at concentrations equal to or lower than this concentration.</p>	Ammonia.....	300	Chlorine.....	10	Hydrogen chloride.....	50	Methyl amine.....	100	Organic vapor..... ²	1,000	Sulfur dioxide.....	50	Vinyl chloride.....	10	<p>MSHA/NIOSH have certified respirators for use against: (Reference: FR 49 No. 140, pages 29270-29272, July 19, 1984).</p> <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/m³</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 ³	Hydrogen sulfide*	100 parts per million	Chlorine dioxide	1 part per million	Formaldehyde	30 parts per million
Ammonia.....	300																								
Chlorine.....	10																								
Hydrogen chloride.....	50																								
Methyl amine.....	100																								
Organic vapor..... ²	1,000																								
Sulfur dioxide.....	50																								
Vinyl chloride.....	10																								
Gas/Vapor	Maximum Use Concentration																								
Mercury*	0.5 mg/m ³																								
Hydrogen sulfide*	100 parts per million																								
Chlorine dioxide	1 part per million																								
Formaldehyde	30 parts per million																								

BNL - SHSD INDUSTRIAL HYGIENE GROUP	Respirator Selection for Non-Radiological Hazards	IH72200 Attachment
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Attachment 9.4 (Continued)
Cartridge Color Codes

Protected Against	Colors Assigned	Colors Assigned
Multipurpose <i>Multi-Purpose Cartridge for Organic Vapor, Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Sulfide (Escape), Hydrogen Fluoride, Chlorine Dioxide, Ammonia, Methylamine and Formaldehyde.</i>	Olive	
Acid gases <i>Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Fluoride, Chlorine Dioxide, Formaldehyde Cartridge</i>	White	
Mercury	Orange with indicator stripe	
Organic vapor	Black	
Ammonia, Methylamine Cartridge	Green	
Acid gas and organic vapors <i>Organic Vapor, Chlorine, Hydrogen Chloride, Sulfur Dioxide, Hydrogen Fluoride, Chlorine Dioxide Cartridge</i>	Yellow	
Radioactive materials, excepting tritium and noble gases, Asbestos, Lead, High toxicity Particulates	Purple (Magenta)	
N95 Particulate	No color code	

BNL - SHSD INDUSTRIAL HYGIENE GROUP	Respirator Selection for Non-Radiological Hazards	IH72200 Attachment
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Attachment 9.5

(Revision: 06/16/10)

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):

	US Dept. of Labor http://www.osha.gov/SLTC/etools/respiratory/change_schedule_testing.html
	US EPA http://www.trusterm.com/ectny/respiratory_advisor/oshfiles/h049.html
	North Safety Products EZGuide: CD request link
	MSA Cartridge Life Expectancy Calculator: http://webapps.msanet.com/cartlife/



HP-IHP-72200

Environmental, Safety, Health & Quality Directorate
SHSD Industrial Hygiene Group
IH72200 Attachment 9.6

Non-Radiological Hazard Respirator Selector Qualification Record

Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:	Qualification Number: HP-IHP- 72200
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Practical Skill Evaluation: Demonstration of Evaluation Methodology

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

Continued on page 2

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