**Purpose**

These references are intended to address comprehensively the issues of; evaluating the potential hazards, communicating information concerning these hazards, and establishing appropriate guidelines, and protective measures for employees. These guidelines were developed to be used as a quick reference for field applications and do not supersede or replace any US Production Safety Standards. ALWAYS refer to the appropriate Safety Standard and/or unit operating procedure for detailed work practices and procedures.

**Scope**

All LLC Companies including, Blanchard Industrial, LLC, GIS Engineering, LLC, Grand Isle Shipyard, Inc., and GWIS, Mack Steel, NuWave, Sun Industries, Valvemax, Discovery Industries, Inc.; hereafter identified as "Company".

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# ABRASIVE BLASTING

**Health Hazards**

Health hazards associated with dust generated by abrasive blasting may include:

- Lead dust from paint coatings can affect the blood, kidneys, reproductive organs and nervous system.
- Cadmium dust from paint coatings can cause, gastrointestinal, kidney and respiratory ailments (including lung cancer).
- Product residue may also create health hazards. Consult the MSDS for the product being removed.
- Respirable silica is produced when using silica sand. Lung diseases, (including cancer) are associated with chronic exposure to respirable silica.

**PPE**

Unless Industrial Hygiene air monitoring has been conducted to determine alternative PPE, the following is recommended:

- NIOSH-approved Type CE blasting hood with cape for the blaster.
- When blasting in an enclosed area (e.g. four-sided tarped areas), other personnel in the enclosure must wear, at a minimum, a half-face, air-purifying respirator with HEPA cartridges or disposable P-100 filtering facepiece respirator unless an exposure evaluation has been conducted.. If silica sand is not used or lead paint action levels are not triggered, half-face respirators with HEPA cartridges are acceptable if an exposure evaluation has been conducted.
- When blasting in an open area, all personnel within 30 feet of the blasting operation must wear, at a minimum, a half-face, air-purifying respirator with HEPA cartridges or disposable P-100 filtering facepiece respirator unless an exposure evaluation has been conducted.. If silica sand is not used or lead paint action levels are not triggered, a P95 filtering facepiece respirator is required as a minimum. Some environmental/ work conditions may require upgrading the PPE.
- Hearing protection is required for personnel at or near the blasting operation.

**Barricades**

- Where feasible, barricade a minimum of 50’ from blasting area unless containment is used.

**Work Practice Controls**

- Be aware of possible back injuries when loading blasting pots. Bags weighing more than 50 pounds should be lifted by two workers. When handling bags, avoid twisting or lifting bags above shoulder height to prevent injuries to the back.

**DECON**

- Wash hands and face before eating, drinking, smoking or leaving the facility.

**Other Precautions/Requirements**

- Ensure that breathing air compressors and associated equipment are properly located and sized for the job.

**Air Monitoring Requirements**

- No specific IH requirements unless lead or cadmium-containing paint is being removed.

# REMOVING ASBESTOS-CONTAINING INSULATION AND BUILDING MATERIALS

**(Primarily OSHA Class I and II work)**

**CAUTION!**
The work covered in this IH Procedure must be performed by qualified asbestos abatement contractors or in the case of re-jacketing, by specially trained workers.

**Health Hazards**

Asbestos health hazards become most dangerous when friable. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felts are considered non-friable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut, abraded or sawed, or if they are broken during demolition operations. Proven hazards include:

- Possible lung disease (Health risks are increased for cigarette smokers)
- Possible lung cancer (Health risks are increased for cigarette smokers)
- Possible mesothelioma (Cancer of chest cavity lining)

**PPE**

- For enclosures, Powered Air-Purifying Respirators (PAPRs) and disposable coveralls are required for removing asbestos-containing materials (ACM) or Possible ACM (PACM) such as insulation, fireproofing, building materials, etc.
- Half-Face Air-Purifying Respirators (HFAPRs) and disposable coveralls are required for the following tasks involving ACM or PACM:

  - Patching and/or repairing
  - Brake and clutch linings
  - Wrapping Pipe insulation with poly
  - Removing transite, floor/roofing tile, mastic, insulation, fire resistant drywall
  - Removing friable or damaged gaskets with hand tools
  - Cleaning up debris
  - Installing metal jacketing or insulation

- Asbestos abatement workers must wear white disposable coveralls as an outer layer while working with ACM and blue disposable coveralls as an outer layer when leaving the regulated area and while in transit to Decon. Use tape to seal gloves to wrist and rubber boots to pants leg.

**Barricade and Sign Requirements**

- A barricaded perimeter must be established at least 25’ from any of the above activities.
- Signs and labels shall identify the material which is present, its location, and appropriate work practices which, if followed, will ensure that Asbestos Containing Material (ACM) and/or Presumed Asbestos Containing Material (PACM) will not be disturbed. The employer shall ensure that employees working in and adjacent to regulated areas comprehend the warning signs.

**DANGER: ASBESTOS**
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
**RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA**

**Work Practice Controls**

- Every reasonable effort should be made to remove hot lines from service prior to asbestos work.
- Insulation must be in good condition prior to re-jacketing. Loose or damaged insulation must be repaired prior to re-jacketing.
- Use every precaution to avoid breaking transite building panels during removal.
- Consult with IH for asbestos removal in buildings.
- Disposal of ACM/PACM must be handled by the asbestos abatement contractor.
- If employees working immediately adjacent to a Class I asbestos jobs are exposed to asbestos due to the inadequate containment of such job, their employer shall either remove the employees from the area until the enclosure breach is repaired; or perform an initial exposure assessment pursuant to 1926.1101(f).

**DECON**

- A full shower decon is required after all tasks covered in this IH Procedure except re-jacketing.
- Shower decon stations are not required for personnel entering a regulated area for purposes of inspection or valve-turning as long as no abatement is taking place during the entry. However, HEPA vacuuming of disposable coveralls before removal and on-site hand and face wash are required.

**Air Monitoring Requirements**

- Air monitoring is required for all tasks covered in this IH Procedure except re-jacketing.

**Training**

Asbestos Awareness Training is required for employees whose work activities may contact Asbestos Containing Material (ACM) or Presumed Asbestos Containing Material (PACM) but do not disturb the ACM or PACM during their work activities.

- 32 hour asbestos abatement worker training is required for all tasks covered in this IH Procedure except:
- Removing roof tile (8 hr task-specific training)
- Removing asphaltic pipe wrap (2 hr task-specific training)
- Re-jacketing (16 hr task-specific training)

**Other Precautions/ Requirements**

- Personnel entering an asbestos regulated area must wear the same type of respirator and PPE as the workers in the regulated area.
- The asbestos abatement contractor must complete a job assessment checklist prior to beginning work.
- EPA requires no visible emissions from regulated ACM/PACM to the outside air.
- If one cubic yard or more of ACM is to be removed, DEQ/ADEM requires proper notification 10 days prior to beginning work.

- Clean up of fallen ACM/PACM insulation must be performed immediately by an asbestos contractor firm.

**Emergencies**

- In the event of accidental exposures to asbestos fibers, (as may be the case if insulation jacketing is accidentally damaged) take the following steps:
  - Keep the worker at the worksite and HEPA vacuum the worker (if possible). The workers should over suit with disposable coveralls and wash their hands and face (or at a minimum, wipe with wet cloth).
  - Issue clean clothing to the worker and decontaminate or dispose of contaminated clothing. The asbestos contractor must document completion of decon on the sign in/sign out log.
- In the event that a worker experiences a medical emergency within an asbestos regulated area:
  - Proceed with normal plant emergency notifications.
  - Inform First Responders of the affected worker's level of evident asbestos contamination.
  - Removal of outer garment and/or HEPA vacuuming of the worker's clothing are suggested, but not required, as appropriate decon.
  - Primary medical care should not be delayed for the sake of decon.

# REMOVING ASBESTOS-CONTAINING GASKETS AND VALVE PACKING AND TOWER TRAY PACKING

**(Typically OSHA "Class III" work)**

**CAUTION!**
**This procedure applies only to removing non-friable materials with hand tools. Removal of deteriorated materials or removal with power tools must be performed by an asbestos abatement contractor.**

## Asbestos Health Hazards

- Possible lung disease (health risks are increased for cigarette smokers)
- Possible lung cancer (health risks are increased for cigarette smokers)
- Possible mesothelioma (cancer of chest cavity lining)

## PPE

- No specific IH requirements.

## Work Practice Controls

- Gaskets:
  - Thoroughly wet gasket with amended water or solvent prior to removal.
  - Remove wet gasket and immediately place it in an asbestos-labeled disposal container.
  - Any scraping to remove residue must be performed wet.
  - Removal of deteriorated gaskets or removal with power tools must be performed by an asbestos abatement contractor.
- Valve Packing:
  - Valve packing removal by a water lance must be performed in a heavy plastic bag.
  - The bag must be sealed around the valve to prevent packing and/or water from exiting the bag.
- Tower Tray Packing
  - If the tower tray can be removed without disturbing the asbestos tape, asbestos requirements do not have to be followed until the tape is removed from the tray.
  - If the tape can be removed intact, thoroughly wet the tape with amended water, remove the tape and immediately place the tape in an asbestos-labeled container.
  - If the tape cannot be removed intact, it must be removed by an asbestos abatement contractor.
- Final disposal of asbestos gaskets, packing or tape waste must be handled as per US Production Waste Handling Guidelines.

## DECON

- No specific IH requirements.

## Air Monitoring Requirements

- No specific IH requirements.

## Training

- 2 hour training specific to the tasks to be performed by the workers.

**Other Standards and Procedures**

- Southeast Division's Asbestos Projects Guideline

**Other Precautions/Requirements**

- No specific IH requirements

**Emergencies**

- No specific IH requirements

# HANDLING STREAMS CONTAINING > 0.1% BENZENE

**Health Hazards**

- Skin, eye & respiratory irritant
- Headache, dizziness & nausea
- Possible bone marrow diseases including anemia & leukemia after long-term exposures

**Jobs with Benzene Exposure potential if conducted on Benzene containing equipment**

- Manual Tank Gauging and/or Sampling
- Tank/Vessel Entry
- Installing Anodes in Tanks for Cathodic Protection
- Blinding Equipment
- Draining/Purging Equipment
- Removing Valves/Piping
- Pump/Compressor Maintenance or Repair
- Changing glycol filters/strainers
- Removing mole sieve/catalyst

**PPE**

- Respirators
  - 0.5 - 4 ppm = Half face air purifying respirator with organic vapor cartridge
  - 5 - 25 ppm = Full face air purifying respirator with organic vapor cartridge
  - Over 25 ppm or unknown concentration = Supplied Air (hoseline, or in emergencies SCBA)
- Skin protection for probable hand contact
  - Use Nitrile gloves
  - Chemical-resistant clothing (e.g. coated disposable coveralls) and boots for probable body contact with benzene containing liquids
- Eye protection
  - Chemical goggles or face shields for probable splashes

**Barricade Requirements**

- Establish a “regulated area” (for example, with red “Danger” tape) and post signs where benzene concentrations are expected to exceed 0.5 ppm
- Routine or planned work must have signs posted

**Work Practice Controls**

- Identify if stream contains> 0.1% benzene.
- Opening equipment
  - All equipment an associated piping, drums, etc. that normally contains >0.1% benzene must be depressurized and drained before opening.
  - Benzene-containing equipment must be prepared to the extent feasible prior to opening to minimize the potential for personnel exposure. Preferred equipment preparation steps include:
- Drain liquids to closed systems wherever possible.
- Clear equipment by steaming out, flushing with water, or purging with nitrogen.

- If equipment cannot be cleared so that benzene is less than 0.5 ppm at a bleeder, then a restricted area must be established and proper PPE used prior to opening equipment.
- Entry or work inside gas test vessels that have contained >0.1% benzene requires gas testing for benzene. If benzene is greater than 0.5 ppm:
    - Wash/prepare and test again, or
    - Classify the vessel as a "regulated area" and enter with the respiratory protection and skin contact precautions listed above.
- If residual sludge/liquids are present, conduct periodic gas test to ensure that benzene levels remain within limits or the respiratory protection in use. Supplied air may be necessary for sludge removal work.

**DECON**

- Wash contaminated skin immediately with soap and water.
- Wash contaminated clothing separately.

**Air Monitoring**

- Gas testing is required for:
    - Entering equipment
    - Reducing respiratory protection before or after opening equipment
    - Spill and leak cleanup.

**Training**

- Annual Benzene Hazard Awareness training is required for workers who are potentially exposed over 0.5 ppm.

**Other Standards and Procedures**

- OSHA Benzene Standards (29 CFR 1910.1028 and 29 CFR 1926.1128)

**Emergencies**

- In the event of an emergency or uncontrolled release, workers exposed to benzene or experiencing significant sustained skin contact with liquids containing benzene must undergo OSHA required urinalysis at the end of the shift per the emergency medical procedure.
- In the event of an emergency or uncontrolled release, "regulated areas" should be established where feasible. The emergency response should not be delayed only to establish a "regulated area".

# WORKING IN EXCAVATIONS

**Health Hazards**

Substances that may be present in excavations that may cause adverse health effects include:

- Asbestos or other insulation
- Hydrocarbon liquids
- Benzene-containing liquids
- Corrosives

**PPE**

- No specific requirements unless contaminated soil is encountered.
- Respirator fit testing and medical qualification should be considered to prevent work stoppage in the event that contaminated soils are encountered.
- Consider having respirators, gloves, coveralls and rubber boots on hand to prevent work stoppage in the event that contaminated soil is encountered.

**Work Practice Controls**

- No additional IH requirements.

**DECON**

- No specific IH requirements unless contaminated soil is encountered.

**Other Precautions/Requirements**

- If contaminated soil is encountered, stop work and notify the Company Contact. Work should only proceed with skin PPE, respiratory protection and training appropriate for the hazard encountered. See the hazard-specific IH procedures for guidance.
- Entry Permits are required for excavations 4 feet or more in depth or if a worker's head must be below grade to perform the assigned task.
- Gas testing is required if any liquid other than water (i.e., hydrocarbons) is visible in the excavation or if unusual odors are detected.
- Insulation and suspected asbestos-containing cemented materials (transite, fibrous sewer pipes) should be tested to determine if it contains asbestos. If so, abatement workers will be required to remove the asbestos.

**Air Monitoring**

- No specific IH requirements.

**Training**

Workers must be trained to look for the following hazards:

- Hydrocarbon liquids
- Benzene-containing liquids
- Asbestos-containing materials
- Acids
- Caustics

Workers must receive HAZCOM training and training in the use of PPE for these substances if they are to work with them.

**Other Standards and Procedures**
OSHA Trenching and Shoring Standards 29 CFR 1926.651 & 652

# HEAT STRESS

**Health Hazards**
Heat stress occurs when the total heat load on the body exceeds the body's capacity to cool itself. The progressive effects are:

- Heat Rash: Red skin rash & discomfort
- Heat Cramps: Cramps in arms, legs or abdomen
- Heat Exhaustion: Headache, nausea, and clammy, moist skin
- Heat Collapse: Fainting
- Heat Stroke: Unconsciousness and hot, dry skin. High body temperature.

**PPE**
Personal cooling devices may be necessary see table below.

**Barricade Requirements**
No specific IH Requirements

**Work Practice Controls**
The table below outlines work practice recommendations for controlling heat stress.

| Category | Ambient Temp (°F) Wearing regular clothing[1] | Ambient Temp (°F) Wearing PPE [2] | Action Steps |
|---|---|---|---|
| I | <90 | <70 | None required |
| II | 90 - 100 | 70 - 90 | Drink plenty of water. 1 cup of water is recommended every 20 min. Take periodic breaks. Supervision shall monitor workers for signs of heat stress. |
| III | 100 - 110 | 90 - 100 | All requirements for II, plus at least one of the following as appropriate for the work in progress:<br>More frequent rest breaks in cooler area.<br>Shading, if working in the sun.<br>Reflective barriers for radiant heat.<br>Temporary insulation<br>Spot cooling (fan or air conditioning)<br>Personal cooling devices (cooling vests or vortex tubes)<br>Supplied air respirators. |
| IV | >110 | >100 | All requirements for II, plus:<br>Job-specific work/rest schedule (see Work/Rest Guide below.<br>One of the options listed for III. |

Regular clothing means FRCs, cotton coveralls, long-sleeve shirt & pants, hard hat, work shoes.

Use of PPE (e.g., rain suits and chemical protective suits) may interfere with the body's ability to cool itself. Use the Safety Standards and IH Guidelines to determine when this type of PPE is required. PPE means rain suits, impermeable coveralls, over suiting with disposable coveralls, welding leathers, etc.

**Guidelines for Work/Rest Schedules**

| Work Load with Regular Work Clothes for Acclimatized Workers (Temp = °F) | | | Work/Rest Schedule in Each Hour | |
|---|---|---|---|---|
| **Light** | **Moderate** | **Heavy** | **Work** | **Rest** |
| 95° | 90° | 85° | Continuous | |
| 100° | 95° | 90° | 75% | 25% |
| 105° | 100° | 95° | 50% | 50% |
| 110° | 105° | 100° | 25% | 75% |

| Work Load with PPE for Acclimatized Workers (Temp = °F) | | | Work/Rest Schedule in Each Hour | |
|---|---|---|---|---|
| **Light** | **Moderate** | **Heavy** | **Work** | **Rest** |
| 85° | 80° | 75° | Continuous | |
| 90° | 85° | 80° | 75% | 25% |
| 95° | 90° | 85° | 50% | 50% |
| 100° | 95° | 90° | 25% | 75% |

**DECON**

- No specific IH requirements.

**Other Precautions/Requirements**

The following factors will reduce workers' heat tolerance:

- Medications such as Diuretics
- Blood Pressure medication
- Anti-histamines, Aspirin
- Antidepressants
- Neuroleptics
- Alcohol consumption
- Overweight

Workers' heat tolerance can be increased by gradually increasing the period of time spent in high heat environments (acclimatization).

**Air Monitoring**

- Temperature measurements may be required to confirm correct procedures.

**Training**

- Personnel should receive heat stress awareness training annually, prior to summer.

# WELDING AND THERMAL CUTTING

Hotwork is defined in this Industrial Hygiene Guideline as:

- Arc and oxy-fuel welding, brazing and silver soldering.
- Arc gouging (air-arc), plasma-arc, and oxy-fuel cutting or burning.
- Any construction, maintenance or repair procedure that requires heating base or filler metal to a molten state or that rapidly oxidizes metal.

## HEALTH HAZARDS

Primary health hazards that may affect welders, welder's helpers and other personnel working in close proximity to hotwork include:

- Fumes from base or filler metal:
  - Iron oxide
  - Nickel
  - Copper
  - Manganese
  - Chromium
  - Copper
  - Zinc
- Gases:
  - Carbon Monoxide (CO)
  - Ozone
  - Nitrogen oxides
- Contaminants from surface coatings and/or residue:
  - Lead
  - Cadmium
  - Zinc
  - $SO_2$
- Decomposition products from coatings or chlorinated solvents.
- Ultraviolet radiation (UV) causes flash burn of the eyes.
- Noise (particularly during arc gouging)

## PPE

- Protection from thermal burns which may include:
  - coveralls
  - leather glove
  - sleeves
  - capes
  - aprons
- Personnel working in close proximity must have adequate eye protection to prevent flash burn.
- Prevent unprotected viewing of the arc with appropriate lenses, curtains or barriers.
- Hearing protection is required during arc gouging and when near welding machines.

**Respiratory Protection**

Unless Industrial Hygiene air monitoring has been conducted to determine alternative PPE, the following is recommended: (With the exception of work in open areas on clean, uncoated carbon steel, some form of respiratory protection is required during all hotwork at the facility.)

| **Open Air (Including fab tents with flow through ventilation)** | **Carbon/ low alloy** | **Alloy** | **Specialty* (monel, inconel, high alloy)** |
|---|---|---|---|
| *Stick welding* | N/A | HF or P100 | HF or P100 |
| *MIG/TIG* | N/A | HF or P100 | HF or P100 |
| *Galvanized* welding/cutting* | HF | N/A | N/A |
| *Torch cutting* | N/A | N/A | N/A |
| *Arc-gouging* | N/A | HF or P100 | FF |

**requires grinding prior to hotwork. If not, lead procedures apply.*

| **Confined Space/Enclosed** | **>2000 cfm** | **<2000 cfm** | **Surface residue/sour service** |
|---|---|---|---|
| *All stick* | HF | SA | SA |
| *TIG/MIG* | HF | SA | SA |
| *Torch cutting* | HF | SA | SA |
| *Arc-gouging* | SA (gouger) | SA (all) | SA |

**NOTE**: Specific requirements may apply when working with MONEL metal. Contact IH.

| **Shop Work** | **Local Exhaust >100 fpm** | **<100 fpm** |
|---|---|---|
| *Welding/cutting* | N/A | HF (unless clean carbon steel) |
| *Galvanized or leaded coating* | Not recommended in shop | Not allowed in shop |
| *Arc gouging* | Not recommended in shop | Not allowed in shop |
| *Plasma cutting* | Contact IH | Not allowed in shop |

HF = Half face, air purifying respirator
FF = Full face, air purifying respirator
HEPA = High efficiency particulate air cartridge
SA = Supplied Air

**NOTE:** SA and personal oxygen monitors are required for inert gas welding in small spaces.

**Surface Preparation**

- Grinding, power wire bushing, sanding or other power-driven means of removing non-leaded coatings from metal prior to hotwork: Half face, air purifying respirator with HEPA catridges or single use dust/mist respirators (e.g. 3M 8293).

**Barricade Requirements**

- No specific IH requirements.

**Work Practice Controls**

- Arrange work area or place welding curtains to prevent flash burn (UV radiation) directly from arc and reflective surfaces.

**NOTE:** Reflective surfaces behind a welder can reflect the arc into the welder's hood. The UV radiation may reflect from the backside of the hood lens into the welder's eyes.

**DECON**

- No additional requirements.

# NON-ASBESTOS INSULATION WORK

**Health Hazards**

Over exposure to kaowool, ceramic fibers, mineral wool, fiberglass and other non-asbestos insulation may be associated with the following health effects:

- Respiratory tract irritation
- Lung disease
- Skin irritation
- Eye irritation

The Company has established an Occupational Exposure Limit (OEL) of 0.2 fiber/cc, 8-hr Time Weighted Average, for refractory ceramic fibers.

**PPE**

Removal, repair and installation of fibrous insulation materials require the following PPE. Unless Industrial Hygiene air monitoring has been conducted to determine alternative PPE:

- Half-face, air-purifying respirator with HEPA or dust/mist cartridges or Filtering facepiece (P 100 dust mask)
- Disposable coveralls
- Goggles
- Gloves
- Exceptions:
    - Respiratory protection is not required for handling insulation during stress relieving in outdoor environments. Installing non-fibrous or block insulation does not require respiratory protection unless the insulation is being cut, sawn, broken or torn and there is appreciable release of fibers.

**Barricade Requirements**

- As necessary to exclude unprotected bystanders.

**Work Practice Controls**

- When removing insulation, place it in plastic bags and lower it to the ground. Do not allow insulation to free-fall to ground.
- Wetting of insulation may be necessary to limit exposures of unprotected bystanders to nuisance dust/fibers.

**Decon**

- Face and hand decon is recommended to reduce skin and eye irritation

**Other Precautions/Requirements**

- No specific IH Requirements.

**Air Monitoring Requirements**

- Contractors should collect representative air samples to evaluate exposure of their employees.

**Training**

- HAZCOM training on the hazards of non-asbestos insulation is required annually.

# LEAD WORK

These requirements apply to activities that disturb lead metal or surface coatings containing >0.1% lead.

**Sources of Lead**

- Paints
- Arc gouging rods
- Lead linings of equipment in acid service
- Junction station insulation
- Electrical solder/conduit
- Zinc or galvanized metals

**Health Hazards**

- Lead poisoning affects the blood, kidneys, reproductive organs and central nervous system.
- Symptoms of overexposure include headache, stomach cramps, dizziness, drowsiness, tremors, numbness, and muscular aches.

**PPE**

- Unless engineering controls are employed, all lead work requires: 1) Protective clothing that is removed prior to leaving the facility and, 2) work gloves, and 3) *respiratory protection as described below:*
    - *Abrasive Blasting* - Supplied air minimum of a (e.g. Bullard Model 77 or 88 blasting helmet). In enclosed or confined spaces, the blasting helmet must be equipped with a tight-fitting face piece.
    - *Hotwork (arc gouging/rosebud)* - Full-face, air-purifying respirator with HEPA cartridges. Supplied air with a tight fitting face piece must be worn in enclosed or confined spaces.
    - *Power Sanding and Grinding* - Half-face, air-purifying respirator with HEPA cartridges. Full-face is required for overhead work. Work in confined spaces <u>may</u> require supplied air.
    - <u>*Miscellaneous Tasks -*</u> These tasks are often <u>not</u> considered lead work:
        - Hand sanding/chipping/ scraping
        - Clean-up <u>SMALL</u> amounts of paint debris (handful of chips)
        - Some needle gunning
        - Wet abrasive blasting/hydro-blasting
        - Chemical stripping
        - Bolt busting/rivet shearing
    - <u>*Overhead work and/or several people working together at these tasks requires the following PPE*</u>:
        - Half-face, air-purifying respirator with HEPA cartridges, coveralls, and/face wash..

- *Electrical Line Splicing and Lead Jacketing In Confined/Enclosed Spaces*
  - Half-face, air-purifying respirator with HEPA cartridges
  - Local exhaust or dilution ventilation

- Use of engineering controls to reduce respiratory protection requirements: (The following control options may be used to reduce respiratory protection requirements. Check with Industrial Hygiene before proceeding to ensure that the proposed control option is appropriate for the job.)
  - Wetting agents and water sprays
  - Vacuum blasting
  - Local exhaust or dilution ventilation
  - Power tool vacuum systems
  - Wet abrasive blasting
  - Long handled (3 ft.) torch

**Barricade Requirements**

- Lead work areas must be barricaded.
  - A minimum 10 foot perimeter is required for power tool grinding, sanding, buffing, hotwork, etc.
  - A minimum 50 foot perimeter is required for abrasive blasting.
  - Signs are required at each access to the barricaded area and at any approach to the barricaded area reading:

**Warning: Lead Work Area, Poison,**
**No Smoking or Eating**

**Work Practice Controls**

- Check paints/coatings for lead before disturbing.
- Colorimetric field tests ("Lead Check" sticks) are useful for "positive" (>1%) determinations.
- Laboratory analysis is required for "negative" (<0.1%) determinations.
- When lead levels in waste/debris is expected to exceed 5 ppm (by TCLP), contain waste with plastic and appropriate labels.
- Clean up and disposal of waste/debris shall be conducted as soon as possible using appropriate labeled containers.
- Eating, smoking, drinking and carrying exposed tobacco products are not allowed in lead work areas.

**DECON**

- Workers may not wear personal clothing (except socks and underwear) under protective clothing unless the personal clothing is to be removed in the Facility and laundered as "lead contaminated."
- Face and hands must be washed and outer garments must be decontaminated (HEPA-vacuumed) upon exiting the barricaded area. Compressed air may not be used for personal decon.
- Showers are required at the end of the shift before donning street clothes.
- Work clothes must be placed in containers labeled "lead contaminated clothing" and laundered separately from other clothing.
- Boots worn during the lead work must not be worn out of the facility unless HEPA-vacuumed and wet-wiped clean.

**Other Precautions/Requirements**

- The following requirements must be met if entry by non-lead workers to a lead work area is required:
    - Lead work must be stopped.
    - Personnel entering the lead work area must wear disposable coveralls or clothing that will not be worn home and will be laundered separately.
    - Respirators equipped with HEPA cartridges are required if the tasks to be performed will create airborne dust.
    - Decontamination requirements listed below apply with the exception that showers are not required.
    - Medical surveillance is required for all personnel who will perform lead work.

**Air Monitoring**

- Contractors performing lead work must collect representative air samples to evaluate exposure of their employees to lead:

**Training**

- Lead workers must receive annual HAZCOM training in lead.

# PAINTING

**NOTE:** This IH Guideline does not apply to application of paints/coating containing ***lead***. Use of ***lead*** containing paints/coatings requires Industrial Hygiene approval.

**Health Hazards**
Consult MSDS for specific health hazard information.

| PAINT/ COATING TYPE | HEALTH HAZARDS | USUAL THINNER or SOLVENT | HEALTH HAZARDS |
|---|---|---|---|
| **Epoxy Resin** | Skin, eye and respiratory irritation and sensitization. Eye corrosion on contact. Skin irritation may be severe. | Glycydal and Glycol Ethers, butyl alcohol, xyelene, toluene, MAK, MIBK, MEK | Glycol ethers may cause reproductive effects. Other solvents cause headache, dizziness, nausea and de-fat the skin. Prolonged exposures may result in liver and kidney disease. |
| **Polyurethane Resin (Isocyanate catalyzed) Also called "aliphatic/ acrylic polyurethane."** | Eye and respiratory irritation and allergic sensitization. | Naphtha & xylene | Eye and respiratory irritation, headache, dizziness, nausea and de-fatting of the skin. Prolonged exposures may result in central nervous system ailments. |
| **Alkyd Enamel & Paint (Solvent-based)** | Skin, eye and respiratory irritation | Naphtha & mineral spirits | Headache, dizziness, nausea and de-fatting of the skin. |
| **Latex Enamel & Paint (Water-based)** | Skin, and respiratory irritation (low hazard) | Water | None |
| **Acrylic Enamel (usually auto paint)** | Skin, eye and respiratory irritation | Toluene & xylene | Headache, dizziness, nausea and de-fatting of the skin. |
| **Paint Strippers** | Possible severe skin, eye and respiratory irritation. Headache, dizziness, nausea and de-fatting of the skin. | N/A | N/A |

**NOTE:** Burning of any of the above coatings can produce extremely toxic chemicals. Consult with Industrial Hygiene before intentionally burning paint.

**PPE**

**Solvent-based paint (alkyd and acrylic) and Epoxy or Urethane-based paint (two-pack systems)**

- Spray painting outdoors
  - Half-face, air-purifying respirators (with organic vapor cartridges and mist prefilters). This requirement applies to the painter and personnel within 25 feet of spray painting.
  - Butyl rubber or nitrile gloves as needed (e.g., nitrile glove liner)
- Spray painting in confined or enclosed spaces
  - Full-face supplied air respirators.
  - Butyl rubber or nitrile gloves (e.g., nitrile glove liner).
  - If over spray is dense enough to contaminate clothing, wear goggles, face shield and coveralls.
- Brush/roller application outdoors
  - Butyl rubber or nitrile gloves as needed (e.g., nitrile glove liner)
- Brush/roller application in confined or enclosed spaces
  - Half-face, air-purifying respirators (with organic vapor cartridges).
  - Butyl rubber or nitrile gloves as needed (e.g., nitrile glove liner)
- Mixing and Clean-up
  - Face shield or goggles
  - Butyl rubber or nitrile gloves as needed (e.g., nitrile glove liner)

**Chemical Paint Strippers**

- Outdoor work
  - Half-face, air-purifying respirators (with organic vapor cartridges and mist prefilters).
  - Chemical-resistant gloves. Contact IH for the correct gloves for the stripper being used.
- Work in confined or enclosed spaces
  - Chemical-resistant gloves. Contact IH for the correct gloves for the stripper being used.
  - Chemical-resistant suits.

**Epoxy Grouting**

- Application
  - Half-face, air-purifying respirators (with organic vapor cartridges).
  - Chemical-resistant gloves.
- Mixing and Clean-up
  - Face shield or goggles
  - Chemical-resistant gloves.
  - Half-face, air-purifying respirators (with organic vapor cartridges) may be required

**Barricade Requirements**

- Restrict access within 25 feet of outdoor Epoxy or Polyurethane spray-painting operations to personnel wearing the same PPE as the painter.
- Restrict access within 25 feet of outdoor Epoxy or Polyurethane spray-painting operations to personnel wearing the same PPE as the painter.

**Work Practice Controls**

- Mixing and clean up should be conducted in well-ventilated areas.

**DECON**

- Thoroughly wash face and hands with soap and water before taking breaks or lunch and before leaving the facility.
- Epoxy resins and any component of epoxy coating systems should be washed off the skin immediately with soap and water.
- Do not use solvents to remove epoxy-based materials from the skin. These solvents may increase the penetration of the resin into the skin and increase the possibility of irritation and sensitization.

**Other Precautions/Requirements**

- Forced ventilation is required when applying paints and coatings in enclosed or confined spaces.
- Work with high-solvent coatings in enclosed or confined spaces may create a hazardous situation due to exceeding the LEL and/or to high concentrations of toxic vapor. Contact Industrial Hygiene and Safety for guidance.

**Air Monitoring**

- Contractors applying Solvent-based paint (alkyd and acrylic) and Epoxy or Urethane-based paint/coatings (two-pack systems) should collect representative air samples to evaluate exposure of their employees to toxic materials contained in the paints/coatings.

**Training**

- Workers must receive HazCom training for the paints and coatings with which they will be working.

# PERSONAL MONITORS

**NOTE:**
1. Personal monitors are used to alert personnel to elevated concentrations of hazardous substances so quick action can be taken.
2. Personal monitors are to be used as alarm devices only.
3. Personal monitors are not to be used instead of a gas test.
4. Personal monitors are not to be used where IDLH levels are expected unless supplied air respirators are worn.

**Health Hazards**

- Personal monitors are commonly used to provide adequate warning for contaminants with acute health effects. $H_2S$ and CO are the most common contaminants for which personal monitors are used.

**PPE**

- No specific IH requirements

**Barricade/Sign Requirements**

- Areas requiring use of personal monitors for entry may need to be designated with signs/barricades.

**Work Practice Controls**

- Personal toxic gas monitor alarms are to be set at the PEL for the contaminant of concern.
- Oxygen monitor alarms are to be set at 20.9% oxygen.
- Personal monitors must be checked (bumped) daily, or prior to use, whichever is less frequent.
- A log of daily checks must be maintained. The log shall include the following information:
  - Date
  - Serial #
  - Alarm function (Y/N)
  - Time to alarm (<30 sec.)
  - Readout (when applicable)
- The daily check procedure is as follows:
- Use calibration gas with a minimum of 25 ppm $H_2S$ for calibrating $H_2S$ personal monitors.
- Use calibration gas with a minimum of 50 ppm CO for calibrating CO personal monitors.
- Use the regulator and calibration cup specified by the manufacturer.
- Connect the regulator, calibration cup and personal monitor to the gas cylinder.
- Open the calibration gas valve.
- Instrument must be recalibrated (by Instrument shop) if the alarm does not sound within 30 seconds or if the digital readout is off by more than 5 ppm.

**DECON**

- No specific IH requirements

**Other Precautions/Requirements**

- Industrial Hygiene or Safety must approve the type and acquisition of personal monitors.
- Contractors must ensure that personal monitors they use in the facility are checked daily and calibrated in accordance with the manufacturer's recommendations (as a minimum) by a qualified individual or facility with documentation available for review.

**Air Monitoring**

- No specific IH requirements

**Training**

- Each employee who must use a personal monitor shall receive training in:
- The use of the monitor and recognizing the alarm.
- Exposure limits and health effects of the contaminant of concern.

# PREPARING TO SEND EQUIPMENT OFFSITE

**Health Hazards**

- Equipment taken out of service for maintenance or repair may contain residual amounts of process chemicals. This can be particularly true of equipment that is difficult to clean out, such as pumps and valves.
- Personnel at mechanical work areas, commercial shops, and scrap facilities must be made aware of the health hazards associated with these chemicals to safely perform their work.

**PPE**

- No specific IH requirements

**Barricade Requirements**

- No specific IH requirements

**Work Practice Controls**

- All equipment must be stripped of insulation and asbestos-containing gaskets before being brought into a shop area.
- Clean equipment before sending offsite.
- If equipment cannot be cleaned or is known to contain significant residue, contact the appropriate Supervisor for handling/shipping precautions.
- A label or MSDS must be affixed to the equipment indicating previous contents.
- The label must identify the chemicals in or on the equipment as well as the appropriate hazard warning for these chemicals.
- Process personnel will attach an identifying label or MSDS to equipment before it is sent offsite.
- Mechanical personnel will verify that proper labeling is attached to equipment before moving it offsite.

**DECON**

- Any equipment sent offsite for maintenance, repair or scrap must be cleaned as thoroughly as possible.

**Other Precautions/Requirements**

- Normally Occurring Radioactive Material (NORM)
    - Contact Industrial Hygiene for a NORM survey of any equipment containing or possibly containing NORM.

**Air Monitoring**

- No specific IH requirements.

**Training**

- No specific IH requirements.

# NORMALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

**Emergency Procedures**

- In the event of an emergency (fire/explosion/release) that may include equipment labeled as NORM-containing:

**Health Hazards**

- Over exposure to NORM is a potential long-term exposure hazard. Delayed effects include cancer of the lungs, blood forming organs, and other organs.

**PPE**

- Disposable/launderable coveralls, gloves and boots are required for probable contact with scale, sludge or metal dust contaminated with NORM. **NOTE:** Incidental contact is not a hazard.
- Half-face, air-purifying respirators with HEPA cartridges are required when significant dust may be produced.
- Contact Industrial for guidance before opening or working with NORM-containing equipment.

**Sign/Barricade Requirements**

- Equipment containing NORM must be labeled or alternatively, records of NORM containing equipment must be maintained.

**Work Practice Controls**

- "Gas-Free" equipment in $C_1$ - $C_5$ service and leave it idle for 4 hours before opening.
- Avoid contaminating skin/clothing tools with scale, sludge or metal dust.
- Do not sand, grind, cut or weld internal surfaces of contaminated equipment without consultation with Industrial Hygiene.
- Minimize the spread of contaminated scale, sludge or dust with plastic ground covers and by wrapping equipment with plastic if it is to be moved.
- Collect solids in sealed containers (55 gallon drums) prior to washdown/cleaning of the work area.
- Contact the Regulatory Group before shipping NORM-contaminated equipment offsite to ensure that regulatory requirements are met.

**DECON**

- Wash face and hands at breaks, lunch and before leaving the work area.

**Other Precautions/Requirements**

- No specific Industrial Hygiene Requirements

**Monitoring Requirements**

- No specific Industrial Hygiene Requirements

**Training**

- Annual Awareness Training is required for employees who work with or near radiation.

# SILICA CONTAINING MATERIAL

**Health Hazards**

- Concrete, fireproofing, refractory, gunite and sand-based grout contain varying amount of crystalline silica. Breaking, mixing and applying these materials generates respirable silica dust which may contain crystalline quartz and/or cristobalite.
- Inhalation of crystalline silica can cause silicosis; a restrictive lung disease that can cause severe pulmonary impairment. Long-term exposures to respirable silica have also been identified with increased incidences of lung cancer.

**PPE**

PPE for tasks that disturb silica-containing material may include:

| TASK | PPE when using wet methods | PPE when using dry methods |
|---|---|---|
| Removing with hand-held pneumatic chippers.* | HFAPR with HEPA or disposable DMF. | FFAPR with HEPA. |
| Removing with jackhammers. | Disposable DMF (minimum requirement) | HFAPR with HEPA. |
| Cutting/breaking with concrete cutter, backhoe or other motorized equipment | None required | Disposable DMF (minimum requirement) |
| Mixing (bags or sacks) | N/A | HFAPR with HEPA or DMF. |
| Mixing (“Super Sacks”)<br>Mixers<br>Support | N/A<br>HF with HEPA<br>N/A | FFAPR with HEPA or DMF for worker at loading station.<br>HFAPR with HEPA or DMF for support crew (lift truck driver, etc.) |
| Clean-up | N/A | HFAPR with HEPA or DMF or disposable DMF. |
| Spray Application | FFAPR with HEPA. | N/A |

HF=Half-face, air-purifying respirator
FF=Full-face, air-purifying respirator
DMF=Dust/mist/fume cartridge
SA=Hose-line supplied air
Disposable DMF= P100, 3M 8293 or equivalent
Coveralls=Coveralls that are not worn home
HEPA = High Efficiency Particulate Air cartridge (purple or magenta) Refractory/gunnite that has been in hydrocarbon service, requires an organic vapor/acid gas (yellow) cartridge in addition to HEPA.

**Barricade Requirements**

- Use barricades to restrict access to areas with visible dust clouds. Tarps and/or partial enclosures may also be useful in restricting the extent of the visible dust cloud.

**Work Practice Controls**

- Use a water mist to control dust whenever feasible. This technique reduces the respiratory protection requirements by one level. e.g., from full-face to half-face, or from half-face to disposable respirator. When possible, station workers upwind of mixing operations or other dust-generating activities.

**DECON**

- Workers should wash face and hands before taking breaks or lunch and before leaving the facility.

**Other Precautions/Requirements**

Enclosed or Confined Spaces

- All workers inside an enclosed or confined space during activities that generate silica dust will require respiratory protection.
- Concrete has a high percentage of silica and increased respiratory protection may be necessary for concrete chipping in enclosed or confined spaces (consult with Industrial Hygiene).
- Use general dilution ventilation (Coppus-type fans) in enclosed or confined spaces to reduce dust concentrations. Filter the exhaust air, or direct the exhaust air away from other workers.

**Air Monitoring**

- Contractors performing work that generates crystalline silica dust must collect representative air samples to evaluate exposure of their employees to airborne respirable silica.

**Training**

- Training is required prior to using silica-containing materials or working in an environment known to contain airborne concentrations of Silica.

**VENTILATION**

**Health Hazards**

- This Industrial Hygiene Guideline applies specifically to control of health hazards associated with the following tasks:
    - Hotwork (Welding, burning, cutting, arc gouging, etc.)
    - Spray painting
    - Confined space entry
    - Improper design or use of ventilation systems can lead to a false sense of confidence and potential overexposures to the contaminants of concern.

**PPE**

- Ventilation is used to reduce respiratory protection requirements from a supplied air respirator to a less cumbersome respirator. However, with the exception of work with lab hoods and hotwork in shops with local exhaust ventilation, some form of respiratory protection is generally required even when using ventilation.

**Barricade Requirements**

- No specific IH requirements.

**CONFINED SPACE VENTILATION REQUIREMENTS**

**Dilution Ventilation**

- Dilution ventilation is generated by placing an air moving device at one end (or the top) of a confined or enclosed space and pulling air though the space from a manway(s) or opening(s) in the space. The air moving performances values listed below are based on measurements collected during T/As at the Facility. The values for air driven units are lower than the published values for the equipment due to: 1) internal restrictions to air flow in the vessels and 2) reduced plant air pressure during high-use periods.

| TYPE | POWER SOURCE | AIR VOLUME |
|---|---|---|
| Axial fan (Coppus-type) | Air driven | 3,000 cfm |
| Venturi air horn | Air driven | 2,000 cfm |
| Centrifugal fan | Electrical | 7,000 cfm |
| Portable AC unit (typical 30 ton unit) | Electrical | 4,000 cfm |

**Installing a Dilution Ventilation System**

- Place air movers above the work to pull contaminants upward along with the natural upward ventilation in a vessel.
- Consider using air movers to push clean make-up air into vessels.
- Prevent contaminating make-up air by controlling sources near air intakes. These include motorized equipment exhaust (welding machines, cranes, compressors), lead/insulation work., exhaust air from other vessels, painting, gasoline powered fans/air movers.
- Ensure that air movers are tightly mounted to the vessel/manway. Use plywood adapters if necessary. Minimize air hose length to maximize air pressure available to air driven equipment.

- Provide at least one manway for makeup air for each air mover (minimum 20" manway).
- Do not block entry/exit routes of the vessels
- If possible arrange the air movers relative to the work so that contaminated air is drawn away from the worker's breathing zone and is replace by clean make-up air. The airflow pattern should look like this:

**Clean air → worker → contaminant → exhaust**

- Scaffolding, tower trays, baffles, etc. may restrict the flow of air, creating "dead spots". Supplemental/spot ventilation may be necessary to provide clean air to these areas. It may be necessary to control sources of make-up air to direct clean make-up air to the work areas.
- Electrically driven fans can provide more airflow than air-driven axial flow fans and can even at higher static pressures. This means more air with less noise.
- Visualize the airflow in the vessel and verify that the contaminated air is moving away for the worker by using smoke tubes. Contact Industrial Hygiene for assistance.
- Hearing protection may be necessary near air movers, especially near axial fans.

**Hotwork**

- 2,000 cfm per welder is required for hotwork in confined or enclosed spaces. If 2,000 cfm per welder cannot be achieved, local exhaust ventilation (see below) or supplied air respirators are required.

**Local Exhaust Ventilation**

- Local exhaust ventilation must provide a least 100 feet per minute (fpm) velocity at the arc/flame.
- Centrifugal fans are best suited to provide local exhaust because they can overcome the high static pressure loses associated with ductwork.

**Installing a Local Exhaust Ventilation System**

- Minimize duct lengths and unnecessary bends in the ductwork to maximize airflow.
- Utilize flanged hoods with inlet screens and 6" diameter ducts.
- Locate the hoods within 12" - 16" of the work.
- Locate hoods above the work when possible.

Contact Industrial Hygiene for assistance in confirming local exhaust performance.

**DECON**

- No specific Industrial Hygiene requirements.

**Other Precautions/Requirements**

- If ventilation is used to remove lead or other notable material, additional precautions may be needed to isolate or filter the exhaust.

**Air Monitoring**

- Lab hood face velocities must be measured annually and recorded on the "Laboratory Hood Survey Form" for that hood.
- Hoods must be resurveyed if there is any change in the hood location or ventilation system.

# HANDLING EQUIPMENT/STREAMS CONTAINING STRETFORD SOLUTION (VANADIUM)

**Health Hazards**

Exposure is primarily due to dust, fumes, mists or dermal contact. The following symptoms may occur following short-term exposure:

- Dry mouth, metallic taste, green tongue
- Respiratory tract/mucous membrane irritation, lung damage asthma and shortness of breath
- Respiratory tract/mucous membrane irritation, lung damage asthma and shortness of breath
- Dermatitis and sensitization (allergic reaction)

**PPE**

- Respirators
  - 0.05 - 0.5 mg/m3 = Half-face air purifying respirator with HEPA cartridges
  - 0.5 - 2.5 = Full-face air purifying respirator with HEPA cartridges
  - Over 2.5 mg/m3 or unknown concentration = Supplied Air (hoseline, or in emergencies SCBA)
- Neoprene coated slicker suit or Chemical-resistant clothing (Kappler suits) for probable contact
- Rubber gloves, taped at sleeves
- Rubber boots taped at ankles for probable contact
- Chemical goggles or face shields for probable splashes

**Barricade Requirements**

- None required

**Work Practice Controls**

- Identify if stream/equipment contains Stretford solution or residue.
- Opening equipment
  - All equipment an associated piping, drums, etc. that normally contain Stretford solution must be depressurized and drained before opening.
  - Equipment must cleared when feasible by:
    - Equipment must cleared when feasible by Chemical cleaning prior to opening.
  - If requirement 1 cannot be met, establish a “restricted area” and use supplied air respirators and skin protection.
  - If requirement 2 cannot be met, establish a “restricted area” and use full-face air purifying respirators with HEPA filters and skin protection.
- Entry or cold work inside gas test vessels that have contained stretford solution:
  - Prepare equipment as described in requirements 1 and 2 above
  - Classify the vessel as a “restricted area” and enter with skin contact precautions listed above if skin contact probable.
  - If residual sludge/liquids are present, full body skin protection and full-face air purifying respirator or supplied air may be necessary for sludge removal work.

- Welding inside vessels that have been prepared by draining and caustic wash followed by water wash:
    - Monitor for SO2 during hot work
    - Use half-face air purifying respirators with acid gas cartridges with HEPA filters
    - Supply fire watch with water hose

- Welding, burning or grinding on equipment that has been in contact with Stretford solution requires air purifying respirator with acid gas cartridge with HEPA filter

**DECON**

- Wash contaminated skin immediately with soap and water.
- Wash contaminated clothing separately.

**Air Monitoring**

- Gas testing is required for H2S and SO2, in addition to LEL and O2 prior to:
    - Entering equipment
    - Reducing respiratory protection after opening equipment
    - Spill and leak cleanup

**Training**

- Hazard Awareness training is required for workers who are potentially exposed

**Other Standards and Procedures**

- Material Safety Data Sheet

**Other Precautions/Requirements**

- No specific IH requirements.

**Emergencies**

- No specific IH requirements

# GUIDELINES FOR RESPIRATORY PROTECTION

**Purpose**

Respirators are designed to provide breathable air to a person working in an atmosphere that contains airborne contaminants.

- Particulate
  - Dust (from grinding, sawing, filing, breaking, etc. of solid materials)
  - Mist (from spraying liquids into the air, e.g., spray painting)
  - Fume (formed by condensation of vaporized solids back into the solid state, e.g., welding fume)
- Gas Phase
  - Gases: These contaminants are gases at normal atmospheric temperature and pressure, e.g., CO, H2S.
  - Vapors: These contaminants are evaporated from liquids such as benzene, MEK, etc.

**Respirator Use**

- Respirator use increases the burden on the respiratory and cardiovascular system.
- Breathing air from compressors must be protected from contamination by:
- Carbon monoxide (CO), condensed hydrocarbon or carbon dioxide.
- Intake air may be contaminated from process leaks, engine exhaust, painting, welding, lead abatement, abrasive blasting, etc.
  - Breathing air cylinders may be mis-labeled or filled with the incorrect gases. This may result in asphyxiation.

**Respirator Selection**

There are two basic types of respirators:

- Air-purifying respirators use cartridges to remove contaminants from the air.
- Air-supplying (hoseline) respirators use bottled air or air from a breathing air compressor to provide clean air to the wearer.

Steps in selecting a respirator are:

- Identify the contaminant (from Unit Vessel Summaries, HazCom Manuals, drum labels, etc.)
- Evaluate the tasks to be performed (Vessel entry, Emergency Response clean-up, open air work, etc.)
- Consider the five critical criteria for respiratory selection in the following table:

| CRITERIA | PARAMETERS | DECISION |
|---|---|---|
| 1. Oxygen content | 20.9% to 23% is acceptable for air purifying respirators | If oxygen is not within parameters, supplied air is required. (Note: Highly Hazardous Entry) |
| 2. Warning properties | Odor or irritation at or below the exposure limit. (PEL) | If warning properties are insufficient, supplied air is required. (Such as: CO, $H_2S$) |
| 3. Cartridge | Air purifying respirators must be fitted with cartridges appropriate to the contaminant | If an appropriate cartridge is not available, supplied air is required. See table below. |
| 4. Concentration (Determined by gas test or monitoring.) | <10 times the exposure limit of the chemical. | And if 1., 2., & 3. are within parameters, half-face, air-purifying respirators may be used. |
| | <50 times the exposure limit. | If concentration <10% of exposure limit and 1., 2., & 3. are within parameters, full-face, air-purifying respirators may be used. |
| | >50 times the exposure limit, IDLH, unknown. | Supplied air is required. |
| 5. Eye irritation | Contaminant is a severe eye irritant | Full-face respirator (supplied air or air-purifying) is required with appropriate cartridges. |

The following cartridges for air-purifying respirators are available:

| COLOR | REMOVES | EXAMPLES |
|---|---|---|
| **Yellow** | Organic vapors and acid gases | General hydrocarbons including gasoline, benzene, toluene, 1,3-butadiene and sulfur dioxide, hydrogen chloride, sulfuric acid (prefilter for mist) |
| **Purple** | Dust, mist, and fume particulates | Asbestos, catalyst, welding fumes, coke dust, oil mist, cooling tower mist, lead, NORM. |
| **Green** | Ammonia and amines | Ammonia |

**Respirator Limitation**

- Know what the contaminants are before using any respirator, including supplied air. Skin absorption of the chemical and/or skin irritation or corrosion may occur with high contaminant concentrations. (e.g., methanol, MEK, TEL, benzene)
- Organic vapor cartridges are only good up to 1000 ppm, no matter what type of respirator.
- Cartridges for benzene must be changed daily

**Barricade Requirements**

- Use signs, barricades, or administrative controls to restrict access to areas where work is being conducted in supplied air.

**Work Practice Requirements**

- All respirator users' must be medically qualified and fit-tested annually prior to wearing a respirator.
- Respirators must be inspected by the wearer before each use and perform fit check (positive & negative).
- Respirators must be kept in "as new" condition. Replace damaged or worn respirators as necessary.
- Respirator cartridges must be changed whenever the respirator wearer notices a change such as an increase in breathing resistance or odor.

**DECON**

- Respirators must be cleaned, disinfected and dried after use and stored in a sealed plastic bag.

**Other Precautions/Requirements**

- When working with supplied air respirators, ensure that breathing air compressors, bottled air, and associated equipment are properly located, maintained and sized for the job.

**Air Monitoring**

- Gas test and or monitoring may be required to select and/or verify respirator selection.
- Frequent gas testing may be required if contaminant concentrations are not stable or predictable (i.e. residual liquid or sludge).

**Training**

- Initial and annual medical qualification, training and fit testing are required.
- Training and fit testing must be for the size, type and brand respirator to be worn on the job.