



Operations: Health

Heavy Metals Safe Work Practice

7	22-Mar-17	Revised – Issued for GoM Use	Metzler, Cheryl	Murray, Valerie
6	9-Mar-16	Revised - Issued for GoM Use	Industrial Hygiene Advisor	Health Manager
5	2-Mar-15	Revised - Issued for GoM Use	Industrial Hygiene Advisor	Health Manager
4	11-Mar-14	Revised - Issued for GoM Use	Health & Industrial Hygiene Team Leader	Director of Health and Safety
3	29-Aug-12	Revised - Issued for GoM Use	Health & Industrial Hygiene Team Leader	Director of Health and Safety
2	03-Apr-12	Revised - Issued for GoM Use	Health & Industrial Hygiene Team Leader	Director of Health and Safety
Rev	Date	Document Status	Custodian/Owner	Authority

Document Control Number	Number	Revision
	UPS-US-SW-GOM-HSE-DOC-00542-2	7

AMENDMENT RECORD

Amendment Date	Revision Number	Amender Initials	Amendment
22-Mar-17	7	CM	Added Beryllium and controls for power tooling.
9-Mar-16	6	DL	Updated PPE requirements for various jobs with heavy metals based on the monitoring data. Updated ventilation section 8.1 to align with OSHA 1910.252. Updated heavy metal exposure limits according to the latest ACGIH TLVs, OSHA PELs and NIOSH IDLH and RELs. Updated lead training requirement according to OSHA 1910.1025. Added environmental waste management procedure in the Reference section. And other editorial changes.
2-Mar-15	5	KT	Updated signage verbiage for cadmium and lead to align with applicable regulations. Changed formatting to align with Health and Safety SWP template.
11-Mar-14	4		Revised title to Heavy Metals Safe Work Practice and combined GoM Region Lead and Hexavalent Chromium SWPs (UPS-US-SW-GOM-HSE-DOC-00681-2). Any reference to lead or hexavalent chromium was changed to heavy metals. Section 1: Included types of heavy metals of concern in BP GoM, combined section 1.2, 1.3 and 3.1 of Lead SWP into section 1. Section 2: Changed to Key Responsibilities to follow GoM SWP formatting and added key responsibilities to specific titles. Also linked job roles to Control of Work titles to align with operations. Section 3: Added a General Requirements section and removed written compliance SWP requirements and replaced with include heavy metal exposure in HITRA process. Section 4: Changed title to "Procedures" and reorganized section to include section 4.1 to Testing a Paint/Coating or Metal and removed the use of an XRF, section 4.2 to Monitoring and Exposure Assessment, section 4.3 to Hot Work on Heavy Metal Containing Materials, sections 4.4-4.6 are regarding hot work, abrasive blasting, and corroded cadmium bolts, section 4.7 new housekeeping section and that the use of dry sweeping and compressed air is restricted, and section 4.9 added medical surveillance requirements.
29-Aug-12	3		Revised title to be called Safe Work Practice.

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03-Apr-12	2		Revised Header and Footer information and updated Authority and Custodian. Added that manual conforms with OSHA, EPA, and OMS framework; Added additional work activities involving lead or lead containing materials described by OSHA; Added additional detail language to Lead Maintenance Program, Minimum Requirements for Testing Coating or Metal for Lead, Welding Galvanized Metals Indoor, Welding Galvanized Metals Outdoor, and Abrasive Blasting Dry.
25-Aug-08	1		Updated review date. Updated authority and custodian.
20-May-04	0	JK	Initial Issue as controlled document.

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1 Purpose / Scope

This Safe Work Practice (SWP) provides information on identifying work activities with potential for heavy metal exposures, associated hazards, and measures to eliminate or reduce exposures. It covers maintenance, construction, or demolition work at BP GoM operated facilities involving materials that contain heavy metals. Heavy metals covered in this SWP include: lead, cadmium, chromium as Cr, Cr III and Cr VI, manganese and beryllium. As health concerns for heavy metals, in addition to those listed are identified, direct these to the Health and Industrial Hygiene Team.

Specific maintenance, construction, and demolition tasks covered as part of this SWP include:

- A. Removal or application of heavy metal-based paints
- B. Performing hot work (i.e., welding) on heavy metal surfaces
- C. Handling heavy metal contaminated materials and waste
- D. Machining (i.e., cutting, grinding) heavy metals
- E. Other maintenance or construction tasks having potential to generate metal fumes or dusts.

This SWP complies with the Occupational Safety and Health Administration (OSHA) substance-specific standards for lead, cadmium, and hexavalent chromium as well as the ventilation and welding standards referenced in Section 7 and conforms to 3.4 Health and Industrial Hygiene in BP's Operating Management System (OMS) framework.

2 Key Responsibilities

2.1 Offshore Installation Manager (OIM), Person In Charge (PIC) or designate

The person having overall responsibility for the implementation of the Control of Work Policy at the installation.

- Verifies that risk assessments are conducted to identify potential activities that may be associated with heavy metal exposure.

2.2 Issuing Authority (IA)

Issuing authorities are responsible for management of the permit to work process within their defined area and skill set.

- A. Ensure the team understands the assessment process, with emphasis on the recognition and reduction of risks associated with heavy metals for the task to be completed safely or, if risks cannot be controlled, to prevent the task from taking place.
- B. Ensure members of the risk assessment team have a full opportunity to contribute and the details of the assessment are agreed by team members.

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- C. Ensure the assessment team includes personnel with the necessary knowledge and competence for the task involved.
- D. Ensure the risk assessment includes a worksite visit.
- E. Ensure the details of the assessment are accurately recorded.

2.3 Performing Authority (PA)

The Performing Authority is the responsible person for the activity being carried out under the Work Control Certificate (WCC). The Performing Authority may be the person carrying out the task or may be supervising a group of people conducting the job.

- A. Inspection of the worksite, either alone or preferably with the IA to identify the hazards associated with heavy metals and planned controls prior to completion of the risk assessment for the task being planned.
- B. Documenting the task hazards associated with heavy metals, risks and controls, jobsite and process safety hazards on the WCC-Permit with input from the IA.
- C. Select work crew members who:
 - o are competent to execute the task detailed on the WCC-Permit and
 - o have not been previously sensitized to beryllium, if there is potential exposure to beryllium or alloys containing beryllium, or
 - o have not experienced cumulative trauma disorders (CTDs), if the task involves the use of needle guns or other percussive tools.
- D. Conduct a pre-job toolbox talk with the work crew to communicate the WCC-permit content and requirements and verify their understanding before the Work Crew sign the work party declaration section of the WCC-permit.
- E. Ensuring that the work site is kept in a clean and safe condition including maintaining controls specified on the WCC-permit both during and on completion of the task
- F. Communicate with the IA when the task is completed, suspended (e.g., stop the job event) or if worksite conditions change.
- G. Worksite inspection following job interruption (e.g., a shift change, stop the job event or an emergency event) once the IA has authorized reissuing a WCC-permit.

2.4 Health and Safety (H&S) Site Lead

- A. Act as a competent person during heavy metal jobs in order to identify and predict heavy metal hazards and take prompt corrective actions or measures to eliminate/reduce hazards.
- B. Assist management, supervisors, and workforce with requests regarding training and personal protective equipment (PPE) use/supply when working with heavy metals.
- C. Consult with Health and Industrial Hygiene Team on training, work practices, and protective measures for activities with potential for heavy metal exposure.

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- D. Inform laundry personnel in writing of the potential harmful effects of heavy metals when asked to launder clothing potentially contaminated with heavy metal materials/dusts (refer to Appendix 8.2).
- E. Deliver awareness overviews (using Appendices 8.3-8.6) to educate and inform workforce of risks associated with heavy metal exposure and the protective practices available.
- F. Review third-party contract risk/hazard assessments for maintenance and construction activities with potential for heavy metal exposure exists, consult with Health and Industrial Hygiene Team as needed.

2.5 Health and Industrial Hygiene Team

- A. Review and update this SWP and training materials per the document management control system review process and cycle.
- B. Provide technical support on heavy metal work practices and protective measures.
- C. Conduct and/or support personal, bulk, and area heavy metal surveys/sampling, as requested.
- D. Assist with awareness training delivery (using Appendices 8.3-8.6) to educate and inform workforce of risks associated with heavy metal exposure and the protective practices available.
- E. Assess the results of assessments and audits to identify trends, emerging risks, and opportunities to improve risk reduction measures.

2.6 Occupational Health Nurse

Provide guidance and technical support regarding medical surveillance and biological monitoring requirements for potential heavy metal exposures, as appropriate.

2.7 Environmental Advisor

- A. Provide technical support on heavy metal waste characterization and disposal.
- B. Conduct and/or support heavy metal environmental surveys/sampling, as requested.

3 General Requirements

- A. Discuss and include the potential for heavy metal exposure in the hazard identification and task risk assessment (HITRA) and work planning process.
- B. Test sample coatings and metals or review the safety data sheets (SDS), if applicable, for heavy metal content prior to starting work.
- C. Verify personnel have been trained on the heavy metals identified through the hazard/risk assessment. There shall be a competent person that is capable of identifying heavy

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metal hazards, the methods to control them, and taking corrective action or measures to eliminate hazards.

- D. If the work involves using beryllium or alloys containing beryllium, ensure no one in the work crew has a sensitization to beryllium.
- E. As required per specific job procedure, verify personnel who are required to wear a respirator are medically approved, fit-tested, and trained on use of the respirator. Respirator use is required if industrial hygiene monitoring has not been completed, when monitoring results are greater than the action limit of the applicable heavy metal, or if personnel request one. Consult with Industrial Hygiene Team regarding monitoring and PPE requirements during work activities (Section 4.0).
- F. Define and communicate heavy metal work area(s) to other personnel in/near the regulated area. Before start of job, post a sign on barrier tape that follows verbiage outlined below. Signs are required in work areas when exposure is expected or known to be at or above the applicable occupational exposure limit. There are specific signage requirements for lead and cadmium.

<p>DANGER LEAD MAY DAMAGE FERTILITY OR THE UNBORN CHILD CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM DO NOT EAT, DRINK OR SMOKE IN THIS AREA</p>	<p>DANGER CADMIUM MAY CAUSE CANCER CAUSES DAMAGE TO LUNCS AND KIDNEYS WEAR RESPIRATORY PROTECTION IN THIS AREA AUTHORIZED PERSONNEL ONLY</p>
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- F. Tyvek disposable coveralls, boot covers, goggles, gloves shall be worn during heavy metal jobs, as appropriate. Clean change areas, hand/face wash facilities, and/or showers shall be provided when heavy metal exposures are greater than the occupational exposure limit or contamination of clothing is possible. During heavy metal jobs, personnel shall not leave work area with contaminated PPE. Verify that prior to eating, drinking, or smoking; personnel have washed their hands and face.
- G. Verify individuals who will be working in “heavy metal regulated work areas” have appropriate medical surveillance including biological monitoring, if applicable. Consult with the Health and Industrial Hygiene Team regarding medical surveillance.
- H. Heavy metal contamination shall be vacuumed with a high-efficiency particulate air (HEPA) filter equipped vacuum or wet wiped. Tyvek disposable coveralls, boot covers, goggles, and gloves shall be worn during clean-up activities, as appropriate. Respiratory protection is recommended. Dry sweeping may be used if the methods above will not work or present a safety hazard. When dry sweeping, personnel shall wear an air-purifying respirator with HEPA P100 cartridge. Do not use compressed air to decontaminate work areas.
- I. Contact the Area Environmental Advisor or Environmental Waste Advisor for waste

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testing and storage. Contaminated personal protective equipment (PPE) and heavy metal containing wastes shall be placed in a labeled and airtight container.

4 Procedures

This section outlines specific protective procedures according to the work to be conducted with heavy metal containing materials. Additional protective measures may be required in certain instances, particularly those involving confined spaces.

4.1 Testing a Paint / Coating or Metal

Before maintenance, construction, abatement, or demolition work is to begin, the materials involved with the job task shall be tested for the presence or absence of heavy metal containing materials using the process below. Testing paints/coatings or metals should be included as part of the work planning process. Paint/Coating SDSs can also be used to determine the presence of heavy metals, if available.

- A. Identify the area or material to be worked on, including items such as welding rods/flux and paint/coatings.
- B. Verify that the person collecting the sample has knowledge of heavy metal hazards and has completed the required training.
- C. Non-destructive testing, using handheld X-ray fluorescence instrumentation, may be performed for cadmium, chromium, as Cr, lead, and manganese. Consult GoM Industrial Hygienist for assistance.
- D. If using destructive testing, collect a bulk sample of the heavy metal material; include all layers of paints/coatings. Consult with GoM Industrial Hygiene Team or Environmental Waste Advisor for PPE to be used during bulk sample collection and sampling protocol. If a bulk sample is collected lab analysis will be required as quantitative documentation.
- E. Identify waste streams to be generated (e.g., metal, sand blast/paint chips, PPE) and determine waste management plan.

Wipe kits and color indicator swabs are not accurate test methods for heavy metals.

NOTE: any detectable presence of heavy metals in paint or coatings, or other materials, is considered heavy metal-containing and has the potential to present an exposure risk unless a negative exposure assessment has been completed.

4.2 Monitoring and Exposure Assessment

An initial exposure assessment must be conducted to evaluate personnel exposures and whether they are at or above the Occupational Safety and Health Administration (OSHA) action levels. Monitoring must be conducted such that it is representative of the work shift and include each job category (i.e., similar exposure group) involved in the work activity/task. During the initial exposure determination, personnel exposures should be treated as unknown. Exposure monitoring data may also be used from previous jobs/tasks if conducted within the last 12 months and are of a similar operation/process where workplace conditions closely resemble the

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processes, materials, control methods, work practices, and environmental conditions used in the current job/task.

Where exposures are determined to be below the action level, a written record of this determination shall be documented. Where exposures are determined to equal or exceed the action level, personnel exposure monitoring shall be conducted that is representative of the exposure for each person in the work area. Monitoring frequency shall be conducted according to the applicable OSHA regulations.

4.3 Hot Work on Heavy Metal Containing Materials

Hot work includes: welding, torch cutting, brazing, or soldering. Heavy metal material surfaces include: galvanized metals, stainless steel, brass, bronze, or heavy metal containing metals, paints, and coatings.

4.3.1 Engineering and Administrative Controls

Respirators may not be required when using local exhaust ventilation (LEV) per OSHA 29 CFR 1910.252, OSHA 29 CFR 1910.94, or the OSHA substance-specific standards and exposure monitoring data has been reviewed and does not exceed occupational exposure limits. In Appendix 8.1 - General Guidance for Local Exhaust Ventilation, there is guidance for LEV during hot work activities.

4.3.2 PPE Requirements

PPE required for hot work on heavy metal based materials shall at a minimum utilize:

- A. Respiratory protection decisions shall be based on exposure monitoring data, work area/enclosure, and ventilation system used. Half-face respirators with HEPA filters may be used when the decision is supported with exposure data.
- B. Disposable protective clothing, boot covers, and gloves, as appropriate.
- C. Other safety equipment required in the area or used with welding, torch cutting, or power tool cleaning tasks such as: welding hoods/helmets, goggles, and protective clothing.

4.4 Abrasive Blasting on Heavy Metal Materials

4.4.1 Abrasive Blasting (Dry) - Engineering & Administrative Controls

The following engineering or administrative controls are potential replacements for dry abrasive blasting:

- A. Power tool cleaning
- B. Specialized abrasive blasting ([Section 4.4.3 Abrasive Blasting - Specialized](#))

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4.4.2 Abrasive Blasting (Dry) - PPE Requirements

PPE required for blasting on heavy metal containing paint shall at a minimum utilize:

A. Blaster

1. Minimum required safety equipment for the unit
2. Sandblasting hood with supplied air source
3. Double hearing protection
4. Tyvek disposable coveralls, boot covers and gloves, as appropriate

B. Helper inside the work enclosure area

1. Minimum required safety equipment for the unit
2. Minimum respiratory protection with full-face respirator (or half-face respirator + safety goggles) with HEPA filters. Supplied air respirator may be used when the decision is supported with exposure monitoring data.
3. Double hearing protection
4. Tyvek disposable coveralls, boot covers and gloves, as appropriate

4.4.3 Abrasive Blasting - Specialized

Specialized abrasive blasting includes but not limited to the following. It is reasonable to believe that these types of blasting can reduce potential dust and heavy metal exposures.

- A. Wet abrasive blasting
- B. Vacuum blast cleaning
- C. Sponge blasting
- D. Carbon dioxide (dry ice) blasting
- E. High pressure water jetting
- F. High pressure water jetting with abrasive injection
- G. Ultra high pressure water blasting

PPE required for wet blasting on heavy metal containing paint shall at a minimum utilize:

A. Blaster

1. Minimum required safety equipment for the unit
2. Sandblasting hood with supplied air source
3. Double hearing protection
4. Slicker suits, boot covers and gloves, as appropriate

B. Helper inside the work enclosure area

1. Minimum required safety equipment for the unit
2. Respiratory protection with full-face respirator (or half-face respirator + safety goggles) with HEPA filters.
3. Double hearing protection
4. Tyvek disposable coveralls with hood, boot covers and gloves, as appropriate

If any of the other specialized types of blasting is performed on heavy metal containing materials, please contact the Industrial Hygiene Team for further information and to arrange for exposure monitoring.

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4.5 Sanding, Grinding, Buffing, Needle Gunning on Heavy Metal Materials

4.5.1 Engineering and Administrative Controls

Respirators may not be required when using LEV per OSHA 29 CFR 1910.94 or the OSHA substance-specific standards and exposure monitoring data has been reviewed and does not exceed occupational exposure limits. In Appendix 8.1 - General Guidance for Local Exhaust Ventilation, there is guidance for LEV during grinding, sanding, or blasting activities.

Task time for needle-gunning should be limited based on the acceleration of the tool (m/s²).

$$time_{exposure} = 8h \left(\frac{5ms^{-2}}{a_{measured}} \right)^2$$

Consult GoM Industrial Hygienist for calculation of ACGIH exposure time.

4.5.2 PPE Requirements

PPE required for sanding, buffing, needle gunning, and grinding on heavy metal based materials shall at a minimum utilize:

- A. When engineering and administrative controls are not feasible or not sufficient to reduce the exposures to below the applicable exposure limits, wear air-purifying respirator with HEPA filters.
- B. Tyvek disposable coveralls, boot covers, goggles and gloves, as appropriate.
- C. For tasks with needle guns or other percussive tools, use anti-vibration gloves and anti-vibration tools to reduce the vibration coupling between the worker and the tool.

4.6 Removal of Corroded Heavy Metal Plated Bolts / Fasteners

Removal of corroded heavy metal plated bolts/fasteners by grinding, chipping, blasting, needle gunning, hammering, use of bolt splitters, or any other method may damage, disturb or deteriorate the bolt. Dust generated from the removal of corroded heavy metals plated bolts/fasteners has the potential for personnel exposure. Typically, bolts/fasteners that are intact do not pose a health risk unless they are disturbed such as welded on or cut via torch.

4.6.1 Engineering and Administrative Controls

- A. Follow the administrative controls below when removing such bolts/fasteners. When removing corroded heavy metal plated bolts/fasteners via pneumatic saw, bolt splitter, hammer, and wrench, wet methods shall be used. Wet methods can include utilizing a spray bottle with water and lightly spraying the bolts/fasteners with moisture before and during dust generation. The wetting task shall be assigned to one person to verify that wet methods are utilized during the bolt/fastener removal work.

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- B. When heavy metal plated bolts/fasteners are removed intact and can be removed using wrenches without generating dust, then wet methods are not required.

4.6.2 PPE Requirements

Personnel removing corroded heavy metal plated bolts/fasteners shall at a minimum utilize:

- A. Respiratory protection decisions shall be based on exposure monitoring data, work area/enclosure, and ventilation system used. Half-face respirators with HEPA filters may be used when the decision is supported with exposure data. If exposure data is not available for the task, any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive-pressure mode, or any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus may be used.
- B. Tyvek disposable coveralls, boot covers, goggles, and gloves, as appropriate.

4.7 Housekeeping and Personal Hygiene

- A. At the end of each work shift, floors and other surfaces where heavy metal dust accumulates should be vacuumed (equipped with a HEPA filter) to minimize the likelihood of heavy metal dust becoming airborne. Alternative methods to vacuuming at the end of the shift can include:
 - 1. Wet sweeping, damp mopping, and wet wiping or
 - 2. Covering dust contaminated surfaces with secured or taped down heavy duty plastic.
- B. Floors and surfaces where heavy metal dust accumulates shall be cleaned at the end of the job or when the work permit is permanently closed.
- C. Dry sweeping should be avoided to clean contaminated materials from work and floor surfaces.
- D. Compressed air shall never be used to clean contaminated materials from any work surface.
- E. Personnel who clean up or transfer heavy metal contaminated wastes/dusts should wear air-purifying respirator with HEPA filters, Tyvek disposable coveralls, goggles, gloves and boot covers, as appropriate.
- F. There shall be no food or beverage present or consumed in the heavy metal work area.
- G. Living quarters (including galley and conference rooms) shall be kept as free from heavy metal contamination as practical.
- H. Personnel shall not leave a heavy metal “regulated area” while wearing protective clothing.
- I. Do not enter break rooms, lunchrooms, or eating areas in protective clothing or equipment used for heavy metal jobs unless potential contamination has been removed by HEPA vacuuming or other means of decontamination.

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- J. A HEPA vacuum is more effective for decontaminating clothing. Surfaces of rubber boots, leather boots, and goggles may need to be wet wiped.
- K. Prior to eating, drinking, smoking, or applying cosmetics, personnel shall wash their hands and face.
- L. Shower facilities or change rooms shall be provided when personnel exposures are above the PEL.
- M. Showering shall be done at the end of the job/shift as applicable.
- N. Change rooms shall have separate storage areas for protective clothing and non-contaminated clothing as applicable. Where disposable protective clothing is used, change rooms are not required.
- O. For heavy metal jobs, non-disposable clothing that is potentially contaminated with heavy metal dusts shall be placed in labeled bags. There are specific label requirements for lead and cadmium.

<p>DANGER CLOTHING AND EQUIPMENT CONTAMINATED WITH LEAD. MAY DAMAGE FERTILITY OR THE UNBORN CHILD. CAUSES DAMAGE TO THE CENTRAL NERVOUS SYSTEM. DO NOT EAT, DRINK OR SMOKE WHEN HANDLING. DO NOT REMOVE DUST BY BLOWING OR SHAKING. DISPOSE OF LEAD CONTAMINATED WASH WATER IN ACCORDANCE WITH APPLICABLE LOCAL, STATE, OR FEDERAL REGULATIONS.</p>	<p>DANGER CONTAINS CADMIUM MAY CAUSE CANCER CAUSES DAMAGE TO LUNGS AND KIDNEYS AVOID CREATING DUST</p>
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- P. Laundry personnel shall be informed in writing of the potential harmful effects of heavy metals. Clothing should be segregated and laundered separately.
- Q. Clothing can be decontaminated by HEPA vacuum or wet wiping and then handled as non-contaminated laundry.

4.8 Storage and Waste Disposal of Heavy Metal Materials

Contaminated debris, disposable clothing, spent abrasives, contaminated soil, and other waste materials shall be tested using toxicity characteristic leaching procedure (TCLP). Results exceeding the permitted limits will be treated as hazardous waste. When storing or disposing of heavy metal contaminated waste to include paint chips, spent abrasive blast media, metal shavings, protective clothing, HEPA vacuum contents, etc., the following requirements apply:

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- A. Contact the Area Environmental Advisor or Environmental Waste Advisor to make arrangements for testing and storage.
- B. Heavy metal contaminated clothing, gloves, and other PPE shall be sealed in an air tight container which is labeled as follows:

**Caution: Clothing contaminated with heavy metals.
Do not remove dust by blowing or shaking. Dispose of heavy metal contaminated wastewater in accordance with applicable local, state, and federal regulations.**

- C. Before heavy metal contaminated waste, including paint chips, spent abrasive blast media, metal shavings, protective clothing, HEPA vacuum contents, etc., is disposed of, it must be tested for heavy metal content to determine if it is classified as Resources Conservation and Recovery Act (RCRA) hazardous waste.
- D. Heavy metal contaminated waste which will be disposed of, shall be sealed in an air tight container and labeled according to the Environmental Waste Advisor instructions (GoM Waste Management Procedures can be consulted online for additional information).
- E. Water from hand and face washing facilities is considered non-contaminated.
- F. Water from large-scale clean-up or workplace decontamination such as water from wet mopping or water from wet blasting operations shall be tested to determine disposal.

4.9 Medical Surveillance

Medical surveillance is required per the applicable OSHA substance-specific standards (i.e. cadmium, lead, hexavalent chromium) and is based on exposure monitoring data and whether it exceeds the OSHA action level. The Health and Industrial Hygiene Team shall determine medical surveillance requirements based on exposure monitoring data.

5 Training

Personnel who are potentially exposed to heavy metals (i.e. cadmium, lead, hexavalent chromium, manganese or beryllium) at or above the substance-specific action level or potentially exposed to airborne lead at any level including possibility of skin or eye irritation shall complete awareness training prior to beginning work on the project or job. This training can be completed via computer-based or face-to-face training by the H&S Site Lead or Health & Industrial Hygiene Team. Initial and refresher training will follow requirements set by the applicable OSHA substance-specific standards. Where there is potential for exposure to heavy metals, personnel shall be informed of the hazards/risks of heavy metals.

6 Definitions

Term	Definition
Abatement	Any set of measures designed to permanently eliminate heavy metal containing materials.
Action Level (AL)	A term used by OSHA for a level of exposure at which the employer must initiate actions such as medical surveillance and training. The

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Term	Definition
	action level is generally set at 50% of the PEL.
Change Room	A room equipped with storage facilities for street clothes and separate storage facilities for the protective clothing to prevent cross contamination and dispersion of heavy metal dust.
Confined Space	A space that has the following criteria: 1. Large enough and so configured that an employee can physically enter; 2. Limited or restricted means for entry or exit; 3. Not designed for continuous employee occupancy.
Construction Work	Initial installation or building, alteration, and/or repair, including painting and decorating.
Demolition	The destruction or partial destruction of process equipment, structure or buildings.
Heavy Metals	Sometimes called "Toxic Metals", refers to a loosely defined subset of elements that exhibit metallic properties. For the purposes of this practice, lead, cadmium, hexavalent chromium, and manganese are considered heavy metals.
HEPA	High efficiency particulate air filter, collects 99.97% of all particles of 0.3 microns in diameter or larger.
Hexavalent Chromium [Chromium (VI) or Cr(VI)]	Chromium with a valence of positive six, in any form in any compound.
Hot Work	Welding, cutting, grinding, hot tapping, or working with an open flame or any device that may create a source of ignition by generating a spark.
Intact	Without any damage, corrosion, disturbance or deterioration so that cadmium (or other metals) is still likely to bind to its matrix.
Lead-Containing Material	Any detectable presence of lead in paint or coatings is considered lead-containing by OSHA.
Local Exhaust Ventilation (LEV)	An industrial ventilation system that captures and removes emitted air contaminants at the source before dilution into the work place.
Mechanical Ventilation	The removal of air contaminants, but not capture, by the practice of moving a large volume of air across the workplace (i.e., fans).
Occupational Exposure Limit (OEL)	A health-based workplace standard to protect workers from adverse exposures (e.g., OSHA Permissible Exposure Limits (PELs), ACGIH Threshold Limit Values (TLVs), NIOSH Recommended Exposure Limits (RELs), Immediately Dangerous to Life and Health (IDLH), Workplace Environmental Exposure Level (WEEL), Minimum Risk Levels (MRLs), Respirable (R), etc.).
Permissible Exposure Limit (PEL)	The highest concentration deemed acceptable for workplace exposure by OSHA calculated as an 8 hour time weighted average (TWA).
Personnel Exposure	The occupational exposure to heavy metals that would occur if the employee were not using a respirator.
Power Tool Cleaning	i.e. sanding, grinding, needle gun, wire wheel buffer
Regulated Area	Is a demarcated area where an employee's exposure to airborne concentrations of heavy metals exceeds or can reasonably be expected

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Term	Definition
	to exceed, the respective PEL. An area of appropriate distance from the work location based on the type of work being conducted that is barricaded and has limited entry with the appropriate signage.
Time Weighted Average (TWA)	The individuals average airborne exposure in any 8-hour work shift of a 40-hour workweek, which shall not be exceeded. The 8-hour TWA permissible exposure limit is the level of exposure established as the highest level of exposure an employee may be exposed to without incurring the risk of adverse health effects. Note: For GoM Region, personnel work 12-hour days for a 14-day period, the occupational exposure limits and action levels (AL) are adjusted to account for this unusual work schedule. Refer to Health Risk and Exposure Assessment SWP for details on adjusting OELs for unusual work schedules.

7 References

- GoM Respiratory Protection SWP (UPS-US-SW-GOM-HSE-DOC-00128-2)
- GoM Region Health Risk and Exposure Assessment Plan (UPS-US-SW-GOM-HSE-DOC-00424-2)
- GoM Hazard Communication SWP (UPS-US-SW-GOM-HSE-DOC-00107-2)
- GoM Waste Management Procedures on Waste Sampling (UPS-US-SW-GOM-HSE-DOC-01091-2)
- OSHA 29 CFR 1910.252 Welding, Cutting, and Brazing
- OSHA 29 CFR 1910.94 Ventilation
- OSHA 29 CFR 1910.1025 Lead
- OSHA 29 CFR 1910.1026 Hexavalent Chromium
- OSHA 29 CFR 1910.1027 Cadmium
- OSHA 29 CFR 1910.1127 Cadmium
- OSHA 29 CFR 1926.62 Lead
- ACGIH TLV Documentation – Beryllium and Compounds, 2014

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8 Appendices

8.1 General Guidance Mechanical Ventilation

8.1.1 Welding, Cutting and Brazing

There are specific mechanical ventilation requirements per OSHA 29 CFR 1910.252, during welding, cutting, and brazing.

8.1.1.1 *General Mechanical Ventilation*

When general mechanical ventilation is used, the airflow rate shall be a minimum of 2000 cubic feet per minute (cfm) per welder and be used:

- In a space of less than 10,000 cubic feet per welder
- In a space having a ceiling height of less than sixteen feet
- In confined spaces or where the welding area contains structural barriers to the extent that they obstruct cross ventilation

Exceptions to the 2000 cfm per welder include when local exhaust hoods or airline respirators are used.

NOTE: When performing hot work on materials or base metals that contain lead, zinc, fluorine compounds, beryllium, mercury, or cadmium, general mechanical ventilation shall not be used.

8.1.1.2 *Local Exhaust Ventilation - Hoods*

Air flow to be provided must be sufficient to maintain a velocity in the direction toward the hood of 100 linear feet per minute (fpm) in the zone of heavy metal contaminant generation when the hood is at its most remote distance from the source. Hoods are intended to be placed by the employee as close as reasonably possible to the work area for the purpose of capturing and removing the air contaminant at the source.

8.1.1.3 *Local Exhaust Ventilation - Fixed Enclosures (i.e., pressurized welding enclosures)*

A fixed enclosure can be useful for welding, torch cutting, brazing, or soldering tasks. A fixed enclosure will have a top and no less than two sides surrounding the contaminant source and have sufficient airflow to maintain a velocity away from the welder of no less than 100 fpm.

8.1.2 Grinding, Sanding, and Abrasive Blasting

Calculating effective ventilation flow rates required for systems during grinding, sanding and abrasive blasting is much more difficult than with welding, torch cutting, brazing, or soldering. This is due to the fact that the particles emitted from grinding, sanding, and abrasive blast operations are larger, generally moving much quicker and in random direction, and are therefore harder to capture. Contact the Health and Industrial Hygiene Team for help setting up specific grinding, sanding, and abrasive blasting ventilation systems.

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8.2 Notification of Hazards for Laundry Personnel

DATE:

TO: Camp Boss

CC: OIM and Contractor Representative

FROM: H&S Site Lead

RE: Potential exposure to heavy metal contaminated clothing

A project involving heavy metals will soon be starting/has started on Facility Name and there is potential for clothing to contain heavy metal dusts. The clothing will be in labeled bags and should be segregated and washed separately from other laundry. The heavy metals included on this project are:

- Cadmium
- Hexavalent Chromium
- Lead
- Manganese
- Other _____

BP does not anticipate that you will experience exposure to the heavy metals listed. However, in order to reduce possible health effects, BP recommends that you avoid shaking clothes, which can disperse heavy metal particles into the air. We recommend wearing disposable gloves while handling clothing and hand washing after working and before eating or drinking. Following these recommendations will reduce the potential for exposure to the heavy metals listed.

Although we do not anticipate significant exposures, potential signs and symptoms of heavy metal exposure are:

- Difficulty Breathing
- Flu-like symptoms
- Irritability
- Myalgia (muscle pain)
- Gastrointestinal problems (i.e. upset stomach)

Contact your facility Medic if you begin to experience the symptoms above after handling/laundrying clothing potentially contaminated with heavy metals. If you have any questions or concerns, please feel free to contact the Health & Industrial Hygiene Team.

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8.3 Beryllium Overview

8.3.1 Overview

Beryllium is a heavy metal that is not hazardous as a bulk solid, but is a health hazard as a dust or fume and may cause an ignitable and/or an explosive atmosphere in the form of a powder or dust. Beryllium is both a respiratory and dermal sensitizer and a known human carcinogen (lung cancer). Prevent eye and skin contact. Beryllium has been recognized as a potential health hazard in the GoM through the use of copper nickel alloy by welding, torch cutting, grinding, chipping, blasting, and needle gunning.

Beryllium reacts with strong acids and strong bases, forming flammable or explosive gas (hydrogen). It also forms shock sensitive mixtures with some chlorinated solvents, e.g. carbon tetrachloride and trichloroethylene.

8.3.2 Occupational Exposure Limits for Beryllium

Type of OEL	OEL Concentration
IDLH	Carcinogen [4 mg/m ³ (as Be)]
ACGIH TLV	0.00005 mg/m ³ TWA
OSHA PEL	0.002 mg/m ³ TWA Ceiling 0.005 mg/m ³ (30 minutes), with a maximum peak of 0.025 mg/m ³
NIOSH REL	Carcinogen Ceiling 0.0005 mg/m ³

8.3.3 Potential Health Effects

Acute:

Inhalation	Skin	Eyes
<ul style="list-style-type: none">• Cough• Shortness of breath• Sore throat• May cause chemical pneumonitis• Effects may be delayed.	<ul style="list-style-type: none">• Redness	<ul style="list-style-type: none">• Redness• Pain

Chronic: Repeated or prolonged contact may cause skin sensitization. Lungs may be affected by repeated or prolonged exposure to dust particles, resulting in chronic beryllium disease (cough, weight loss, weakness) or lung cancer.

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8.3.4 First Aid

Eye Exposure	Irrigate immediately and continue for several minutes. Remove contact lenses, if easily possible, then transport to the doctor
Skin Exposure	Remove contaminated clothing. Rinse skin with plenty of water or shower.
Ingestion	Rinse mouth. Do NOT induce vomiting. Refer for medical attention
Inhalation	Fresh air, rest and refer for medical attention.

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8.4 Cadmium Overview

8.4.1 Overview

Cadmium is a heavy metal regulated by the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1027 and 29 CFR 1926.1127. Cadmium has been recognized as a potential health hazard in the GoM through the removal of corroded cadmium plated bolts/fasteners by grinding, chipping, blasting, needle gunning, hammering, use of bolt splitters, or any other means that damage, disturb or deteriorate the bolt. Welding or torch cutting cadmium plated bolts/fasteners may also present a health hazard. Although cadmium bolts/fasteners are recognized as the primary source of exposure, other sources of exposure are possible.

8.4.2 Occupational Exposure Limits for Cadmium

Type of OEL	OEL Concentration
IDLH	9 mg/m ³
ACGIH TLV	0.01 mg/m ³ (Total) TWA 0.002 mg/m ³ (Respirable) TWA
OSHA PEL	0.005 mg/m ³ TWA
NIOSH REL	Lowest Feasible

8.4.3 Potential Health Effects

Acute:

Early Symptoms	1-10 Hours	24 Hours
<ul style="list-style-type: none">Mild irritation of upper respiratory tractSensation of constriction of the throatMetallic taste and / or cough	<ul style="list-style-type: none">Shortness of breathChest painFlu- like symptoms (weakness, fever, headache, chills, sweating and muscular pain)	<ul style="list-style-type: none">Acute pulmonary edemaIf death from asphyxia does not occur, symptoms may resolve within a week.

Chronic: Repeated long-term (chronic) exposure, even at relatively low concentrations, may result in kidney damage and an increased risk of cancer of the lung and prostate.

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8.4.4 First Aid

Eye Exposure	Direct contact may cause redness or pain. Wash eyes immediately with large amounts of water, lifting the upper and lower eyelids. Get medical attention immediately.
Skin Exposure	Direct contact may result in irritation. Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water.
Ingestion	Ingestion may result in vomiting, abdominal pain, nausea, diarrhea, headache, and sore throat. Get medical attention immediately.
Inhalation	If large amounts of cadmium are inhaled, the exposed person must be moved to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation. Administer oxygen if available. Keep the affected person warm and at rest. Get medical attention immediately.

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8.5 Hexavalent Chromium Overview

8.5.1 Overview

Hexavalent chromium is a heavy metal regulated by the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1026. Hexavalent chromium [Chromium (VI) or Cr (VI)] means chromium with a valence of positive six, in any form and in any compound. Cr (VI) is a natural occurring metal that is present in a wide variety of industrial activities which include welding on stainless steel, painting and pigment application, electroplating, surface coating processes, wood preservation and abrasive blasting materials.

Cr (VI) in Industry Products

Uses	Types of Hexavalent Chromium Chemicals
Pigments for paints, inks, and plastics	Lead chromate (chrome yellow, chrome green, molybdenum orange), zinc chromate, barium chromate, calcium chromate, potassium dichromate, sodium chromate
Anti-corrosion products (chrome plating, spray coatings, additives)	Chromic trioxide (chromic acid), zinc chromate, barium chromate, strontium chromate
Stainless Steel	Cr (VI) is given off when stainless steel is cast, welded, or torch cut
Welding	Stainless steel contains metallic chromium. High heat from welding arc causes the metallic chromium to oxidize and transmit into the air as a fume. The generation of fumes is affected by the process being done. The highest fume exposures from highest to lowest are the following: arc gouging, plasma arc cutting, shielded metal ward welding, gas metal arc, and tungsten arc.
Working with paint or chemicals containing Cr (VI) (e.g. corrosion inhibitors)	Cr (VI) emitted into the air as an aerosol.
Torch cutting on chromate or dichromate paint	Cr (VI) emitted into the air as a fume.
Abrasive blasting involving grit contaminated with Cr (VI)	Cr (VI) emitted into the air due to the blasting.
Abrasive blasting or grinding on Cr (VI)	Cr (VI) emitted into the air due to the grinding.

8.5.2 Occupational Exposure Limits for Hexavalent Chromium

Type of OEL	OEL Concentration
IDLH	15 mg/ m ³

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ACGIH TLV	0.05 mg/m ³ TWA Water Soluble 0.01 mg/m ³ TWA Insoluble
OSHA PEL	0.005 mg/m ³ TWA
NIOSH REL	0.0002 mg/m ³ TWA

8.5.3 Potential Health Effects

Acute:

- Skin ulceration (chrome holes)
- Allergic and irritant contact dermatitis
- Ulcerated nasal septa
- Rhinitis (runny nose)
- Nasal irritation

Chronic:

- Elevated risk of lung cancer
- Reproductive Disorders
- Stomach, kidney and bladder diseases
- Asthma
- Suspected to cause Leukemia and Hodgkin's Disease

8.5.4 First Aid

Eye Exposure	Immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.
Skin Exposure	Promptly flush the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly remove the clothing and flush the skin with water. If irritation persists after washing, get medical attention.
Ingestion	Get medical attention immediately.
Inhalation	If person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

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8.6 Lead Overview

8.6.1 Overview

Lead is a heavy metal regulated by the Occupational Safety and Health Administration (OSHA) 29 CFR 1910.1025 and 29 CFR 1926.62. Lead has been used for many years in industrial and commercial applications. Lead is commonly added to industrial paints because of its characteristic to resist corrosion. Industries with particularly high potential exposures include construction work involving welding, cutting, brazing, blasting, etc., on galvanized metal or lead based paint surfaces; most smelter operations either as a trace contaminant or as a major product; and secondary lead smelters where lead is recovered from batteries, etc.

Most exposures occur with inorganic lead. Organic (tetraethyl and tetra methyl) lead, which was added to gasoline up until the late 1970s, may be encountered. Organic forms may be absorbed through the skin, while inorganic forms cannot.

Employee exposure to lead can be safely managed if appropriate controls are put in place. Engineering and administrative controls coupled with good work practices and use of personal protective equipment can effectively reduce the risk of lead exposures.

8.6.2 Occupational Exposure Limits for Lead

Type of OEL	OEL Concentration
IDLH	100 mg/m ³
ACGIH TLV	0.050 mg/m ³ TWA
OSHA PEL	0.050 mg/m ³ TWA
NIOSH REL	0.050 mg/m ³ TWA

8.6.3 Potential Health Effects

A significant portion of the lead that you inhale or ingest gets into your blood stream. Once in your blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

Acute: A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic

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effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

Chronic:

- Severe damage to blood-forming, nervous, urinary and reproductive systems
- Weakness
- Insomnia
- Headache
- Nervous irritability
- Decreased sex drive
- Impotence and sterility in men
- Risk to developing fetuses (birth defects, mental retardation, behavioral disorders or death)
- Loss of appetite
- Metallic taste in mouth
- Anxiety
- Muscle and Joint pain or soreness
- Fine tremors
- Numbness
- Alter cell structure of sperm cells
- Miscarriage and stillbirth in women
- Disrupts blood-forming system resulting in decreased hemoglobin
- Constipation
- Nausea
- Pallor
- Excessive tiredness
- Dizziness
- Hyperactivity
- Colic (with potential for severe abdominal pain)
- Decreased fertility
- Abnormal menstrual cycles
- Anemia

Damage to the central nervous system in general and the brain (encephalopathy) in particular is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy.

Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible.

8.6.4 First Aid

Eye Exposure	Immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.
Skin Exposure	Promptly flush the contaminated skin with soap and water. If this chemical penetrates the clothing, promptly remove the clothing and flush the skin with water. If irritation persists after washing, get medical attention.
Ingestion	Get medical attention immediately.

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Inhalation	If person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.
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8.7 Manganese Overview

8.7.1 Overview

Manganese is an element used in steel production, welding, and as an additive to gasoline. It can be found in many chemical forms. The most common route of toxicity is through inhalation of airborne manganese dust or fumes. Exposure to very high levels of manganese can predominately cause respiratory and nervous system health effects.

Manganese is an essential nutrient in the human diet, and the adequate intake levels for manganese are age-adjusted and average 1.4 mg per day for males and 1.2 mg per day for females.

8.7.2 Occupational Exposure Limits for Manganese

Type of OEL	OEL Concentration
IDLH	500 mg/m ³ (as Mn)
ACGIH TLV	0.02 mg/m ³ (Respirable) TWA 0.1 mg/ m ³ (Inhalable) TWA
OSHA PEL	5 mg/m ³ Ceiling
NIOSH REL	1 mg/m ³ TWA 3 mg/m ³ STEL

8.7.3 Potential Health Effects

Acute:

- Irritability
- Hallucinations
- Loss of sex drive and sperm damage
- Aggressiveness
- Irritation of lungs which could lead to pneumonia

Chronic:

- Can effect coordination and balance
- Insomnia
- Forgetfulness
- Anxiety

Manganism is a neurological disorder characterized by tremors, difficulty walking, facial spasms, and psychological disturbance. It can develop slowly over a period of chronic exposure. Even after exposure to manganese ends, symptoms can continue or even worsen.

Early symptoms of manganese poisoning:

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- Sleepiness
- Weakness in legs
- Lethargy

8.7.4 First Aid

Eye Exposure	Immediately wash (irrigate) the eyes with large amounts of water, occasionally lifting the lower and upper lids. Get medical attention immediately.
Skin Exposure	Remove contaminated clothing and wash skin with soap and water. Cover irritated skin with an emollient and seek medical attention if irritation develops.
Ingestion	Do not induce vomiting. Rinse mouth with water only if person is conscious. Seek medical attention if symptoms appear.
Inhalation	If inhaling, immediately move to fresh air. Give oxygen if breathing is difficult. Give artificial respiration if not breathing.

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Document Number	UPS-US-SW-GOM-HSE-DOC-00542-2	Revision	7
Document Title	Heavy Metals Safe Work Practice		
Next Review Date	04/18/2018		
Reason for Issue: (check applicable)	<input type="checkbox"/> New <input checked="" type="checkbox"/> Revise <input type="checkbox"/> Supersede <input type="checkbox"/> Obsolete		
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Custodian	Cheryl Metzler Industrial Hygiene Advisor	<i>Cheryl Metzler</i>	04/20/2017
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