

Appendix F

Worker Training Manual for Managing Contaminated Soils and Groundwater

**WORKER TRAINING MANUAL
FOR MANAGING CONTAMINATED
SOILS AND GROUNDWATER**

**HONEYWELL SITES
JERSEY CITY, NEW JERSEY**

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This Worker Training Manual is hereby approved by the following parties.



Honeywell - Global Remediation Director

4/5/17

Date



Jersey City Municipal Utilities Authority - Senior Engineer

3/28/17

Date

1.0 INTRODUCTION

This document presents a Worker Training Manual (Manual) for sewer sites located in Jersey City, New Jersey, for which Honeywell has responsibility for remediation of chromium-impacted fill (referred to herein as “sewer sites” or “sites”). Portions of the sites may contain chromium ore processing residue (COPR) historically used as fill material.

This Manual was prepared by Honeywell to assist the Jersey City Municipal Utilities Authority (JCMUA) with protection and training of workers who potentially may be exposed to COPR, chromium-impacted soils or groundwater in conjunction with utility or other subsurface work performed at the sites, and provides steps for the identification and coordination of work with Honeywell.

This Manual:

- Identifies health and safety requirements for workers who maintain, repair or replace utilities or conduct other ground intrusive activities (e.g., digging, drilling, excavation) in areas of COPR and/or chromium contaminated fill.
- Provides a basis for worker awareness and training to inform workers of potential hazards associated with chromium-impacted media.
- Addresses identification and coordination of work with Honeywell.

This Manual supplements a Standard Operating Procedure (SOP) for coordinating work within chromium soils, which has been developed by Honeywell in cooperation with the JCMUA. The SOP addresses coordination of work between the JCMUA and Honeywell at the sites. The coordination covers notification, response, and handling and disposal of chromium soils in conjunction with sewer work at the sites. Site information and maps are provided with the SOP.

This Manual is organized into the following sections:

Section 1 – Introduction: identifies the purpose and scope of the Manual.

Section 2 – Site Background: includes site information including regulatory background, remediation phase, engineering and institutional controls

Section 3 – Hazard Evaluation: provides general information on potential health hazards associated with chromium.

Section 4 – Health and Safety Requirements: identifies applicable health and safety requirements for workers.

Section 5 – Coordination of Work: addresses coordination of work between the JCMUA and Honeywell including management and disposal of chromium-impacted materials in connection with utility work.

JCMUA employees may perform sewer maintenance and repair work for projects up to depths of approximately 20 feet below grade. For emergency sewer work and excavation to depths greater than 20 feet below grade, work is typically performed by JCMUA contractors. Additionally, the JCMUA has entered into a long-term agreement with United Water for operation and maintenance of its water systems. Accordingly, any reference to the JCMUA in terms of operation and maintenance of its water system shall be interpreted as including United Water, its contractors and employees. Similarly, any mention of Honeywell in this document includes its contractors and consultants.

This Worker Training Manual focuses on work performed by JCMUA and their contractors; however, it may also be used by other parties as a guide for other workers who may be doing utility or other subsurface work on the sites. Other potential users of the manual may include the following utilities and their contractors: Public Service Electric and Gas Company (PSE&G), Comcast, Verizon, and SUEZ North America (formerly United Water).

It is essential that all existing and future remedial measures and engineering controls (e.g. capping systems) are not compromised by utility or other subsurface work. Deed notice documents contain specific requirements pertaining to notification, disturbance and repair of engineering controls.

2.0 SITE BACKGROUND

Pursuant to a Consent Judgment between the NJDEP et al. and Honeywell et al., dated September 7, 2011 (Consent Judgment), Honeywell has responsibility for the investigation and remediation of designated sewer sites in accordance with a NJDEP approved Sewer Protocol, which includes requirements for developing procedures to identify when sewer sites are scheduled for repair, emergency utility repair procedures, training for utility workers on recognition of chromium materials and appropriate steps for worker protection.

The SOP for Coordinating Utility Work within Chromium Soils identifies Honeywell-assigned sewer sites and contains site maps and a summary table with information on ownership, address, and tax parcel information. The majority of sites are currently in the remedial investigation phase. Additional remedial investigation work to assess chromium impacts in soils and groundwater will be conducted and documented in Remedial Investigation Reports pursuant to Honeywell's Master Schedule for chromium sites approved by the NJDEP. Refer to the SOP for site maps and further information about the sites.

Chromium-contaminated fill (also referred to as chromite ore processing residue or COPR) was historically used as construction fill at various sites in Hudson County, New Jersey, including portions of sewer pipelines in Jersey City. The presence of chromium impacts or fill may be indicated as gray-black granular material, yellow-green colored staining, reddish-brown nodules in soils, green-gray mud, or extremely hard layers of dark brown soil. Chromium-impacted groundwater may be indicated by yellow-green colored water. Fill soils may also contain other contaminants that are commonly associated with historic fill and unrelated to chromium fill, such as polycyclic aromatic hydrocarbons (PAHs) and metals.

3.0 HAZARD EVALUATION

This section provides information on chromium, including health and safety information and general assessment of potential hazards and health and safety concerns for work on sites where COPR fill or chromium-impacted media such as soils or groundwater are present.

Chromite ore processing residue (COPR) is a by-product of the extraction process of chromium from its ore. COPR is typically a grayish-black colored granular material and may also be indicated by the presence of yellow to green colored staining, reddish-brown nodules, or hard layers of reddish-brown material. COPR contains both hexavalent and trivalent chromium in a complex mineral matrix and may be caustic, i.e., highly alkaline with pH values typically greater than 11.

Potential chemical hazards associated with sewer repair and/or replacement work or disturbance of remedial measures and engineering controls at the sites may include the presence of chromium and hexavalent chromium in fill soils and groundwater. Chromium-impacted soil (also referred to as “chromium soils”) refers to soils containing hexavalent chromium above the NJDEP soil criteria, currently 20 milligrams per kilogram (mg/kg or parts per million [ppm]). Chromium-impacted groundwater refers to groundwater containing chromium above the NJDEP groundwater quality standards, currently 70 micrograms per liter ($\mu\text{g/L}$ or parts per billion [ppb] based on total chromium).

Potential chemical exposure pathways include:

- Inhalation of airborne dusts and mists that may contain contaminated particulates
- Skin and eye contact and absorption due to direct contact with contaminated soil sediment, and/or liquids
- Incidental ingestion of contaminated soils, liquids, and/or particulates

Potential exposure to chromium contamination could occur by construction or utility workers performing ground intrusive activities (e.g., drilling, digging, excavation). Only properly trained and equipped personnel should be allowed to perform tasks

that may involve the handling of known or suspected contaminated media. Worker training requirements are included in Section 4.

In the event of any inadvertent disturbance to any existing engineering controls or underlying chromium soils by workers who are not properly trained, workers are advised to stop work, cover and secure the area using appropriate measures (e.g., plastic sheeting, traffic cones or barrier) and notify appropriate site management personnel (JCMUA or other applicable party). On-going work would then be coordinated with Honeywell with respect to the management of chromium-contaminated materials and restoration of any engineering controls (see Section 5 for coordination of work).

The following fact sheets with information on chromium, potential health hazards, and precautions to prevent exposure are provided in **Appendix A**:

- Agency for Toxic Substance and Disease Registry (ATSDR) Fact Sheet on Chromium
- Occupational Safety and Health Administration (OSHA) Fact Sheet on Health Effects of Hexavalent Chromium
- New Jersey Department of Health and Senior Services (DHSS) Right to Know Hazardous Substance Fact Sheet

Representative photographs of COPR fill are provided for reference in **Appendix B**.

4.0 HEALTH AND SAFETY REQUIREMENTS

This section presents health and safety requirements and programs for workers who may be potentially exposed to hazardous substances including hexavalent chromium. These programs include worker training, medical monitoring, respiratory protection, and hazard communication. Applicable regulations include OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) requirements at 29 Code of Federal Regulations (CFR) Section 1926.65 and the Hexavalent Chromium Standard (29 CFR 1926.1126; Construction Industry Standard). A summary of worker training requirements for hazardous waste sites and hexavalent chromium is presented on **Table 1**.

The training requirements in this section are applicable to workers who could be exposed to chromium-contaminated materials and are to be addressed by the employer of the person performing the work. These requirements do not apply to work that does not involve potential exposure to contaminants, such as non-intrusive work or work limited to clean cover soils above any existing engineering controls (cap).

Prior to work at the sites in areas of known or suspected chromium soils, Honeywell must be notified as indicated in Section 5 to confirm requirements and coordinate removal and/or disposal of chromium soils and restoration of engineering controls, if required in connection with the work. Contractors for JCMUA should incorporate the worker protection requirements of this section into their Health and Safety Plan, which would be prepared and implemented by the site contractors performing the work under OSHA HAZWOPER requirements.

In most cases, JCMUA personnel are not expected to conduct ground intrusive activities (e.g., excavation, digging, drilling) that would involve potential for exposure to chromium soils. It is expected that such activities (if required) would be implemented by contractors for JCMUA who need to be knowledgeable about potential hazards and procedures to be followed when work is conducted in areas of engineering controls. Therefore, the JCMUA and/or other applicable party responsible for conducting work at the sites are obligated to confirm that their personnel and contractors have appropriate training.

Honeywell Training

Honeywell will provide the following training (refer to Section 5 for details):

- Initial and periodic training for JCMUA on this Worker Training Manual including chromium awareness, remedial measures and engineering controls, and procedures for coordination of work with Honeywell

JCMUA and Contractors

The following sections include, but are not necessarily limited to, current OSHA requirements expected to be applicable to work involving potential for exposure to chromium-contaminated soils or groundwater. All parties conducting work at the sites are responsible for complying with current OSHA requirements.

Personnel Training

- OSHA HAZWOPER training is required for field personnel whose job responsibilities cause them to be exposed or have the potential to be exposed to hazardous substances/wastes, in this case, hexavalent chromium. This applies to work involving disturbance of any existing engineering controls and potential exposure to hexavalent chromium at the sites or work within the exclusion zone or regulated area for field work as defined in the site-specific HASP.
- Management and Supervisory Training is required for individuals who manage or supervise personnel engaged in hazardous waste operations.
- Training documentation is required to be maintained by the party conducting the field work. Field work supervisory personnel (i.e., health and safety officer) are responsible for checking training documentation to verify that workers have complete and current documentation.

Preparation of Site Health and Safety Plan

- Potential exposure to contaminants in the soil or groundwater would be addressed as part of a site-specific HASP, which would be prepared and implemented by contractors performing field work under OSHA HAZWOPER requirements.

Medical Monitoring

- Under the OSHA HAZWOPER standard, medical monitoring is required for workers performing field work onsite for more than 30 days per year and exposed to hazardous substances including hexavalent chromium above applicable exposure limits. Medical monitoring requirements would apply to most work situations involving disturbance of engineering controls and potential for exposure to chromium-contaminated soils, to be determined on a case by case basis by the entity performing field work. If required, medical monitoring is provided by the employer of the person performing field work.

Hazard Communication

- OSHA hazard communication requirements govern “hazardous substances” and exclude “hazardous waste.” For hazardous waste site work, the OSHA Hazard Communication standard only applies to hazardous chemicals brought to the site (e.g., decontamination fluids), not to the contaminants in the soil or groundwater.
- The hazard communication program is required to be part of the Health and Safety Policy and Procedures Manual and be made available to employees for review. A model hazard communication program can be found at the following OSHA website:
<http://www.osha.gov/dsg/hazcom/oshacomplianceassistance.html>.
- Containers of hazardous substances are required to be labeled as to the contents, appropriate hazard warning, and the name and address of the manufacturer. The name on the label must match the name on Material Safety Data Sheets/Globally Harmonized System. Material Safety Data Sheets are obtained from the manufacturer when hazardous substances are purchased to conduct field work, and maintained at the work site for all hazardous substances to be used.

In addition to the above requirements to address work at the sites involving potential exposure to hexavalent chromium, there may be other applicable OSHA training requirements for contractors performing field work. Compliance with such requirements, as for example those pertaining to excavation activities under OSHA 29 CFR 1926.650, is the result of the type of activity undertaken rather than the presence of chromium, thus the JCMUA and their respective contractors must independently evaluate the need to comply with such requirements. All parties

conducting work at the subject sites must check applicability and comply with current OSHA requirements.

5.0 COORDINATION OF WORK

Details regarding coordination of utility work at the sites are contained in the SOP for Coordinating Utility Work within Chromium Soils, which has been developed by Honeywell in cooperation with the JCMUA. Prior to performing any utility maintenance or repair work at the chromium sewer sites, the JCMUA and/or their contractors or other parties conducting work must notify Honeywell and provide information regarding the work location and nature of disturbance (i.e., area and depth of disturbance, timing of work). This information will enable coordination of work, establishing requirements for worker protection, handling and disposal of chromium-impacted media, and repair and restoration of the engineering controls. A summary of worker training requirements for hazardous waste sites and hexavalent chromium is provided for reference on **Table 1**.

As indicated in the SOP, JCMUA is required to notify Honeywell prior to any planned maintenance or emergency repair of sewer pipelines on any of the chromium sewer sites. Deed Notice requirements also specify notification to Honeywell and the NJDEP prior to any activities that will involve the disturbance of engineering controls or remedial measures.

Honeywell has established a telephone notification and response system for use by the JCMUA and/or other parties to notify Honeywell of any activities planned or required on an emergency basis at the sites. The notification and response system facilitates coordination of activities between Honeywell, JCMUA and/or other parties with respect to handling and disposal of contaminated media that may be generated during sewer work at the sites. The notification and response system is an element of the JCMUA work process for sewer work.

The notification system includes a telephone answering service (referred to as the Chromium Response Hotline: **855-727-2658**); this number will also be included in Deed Notice documents for providing notification to Honeywell prior to disturbance of engineering controls. All parties who plan to perform any work that may have the potential to disturb any existing engineering controls and/or cause exposure to chromium-impacted media must notify Honeywell and determine what level of

worker protection is appropriate and if the proposed work activities comply with or are applicable to any existing deed notice requirements.

Standard Operating Procedure for Coordination of Work

Honeywell in cooperation with the JCMUA has developed a Standard Operating Procedure (SOP) for identifying and coordinating work at the chromium sewer sites. The SOP addresses repair or replacement performed as part of planned maintenance work or required as a result of an emergency situation. Prior to performing sewer work, JCMUA will contact the Chromium Response Hotline, which will prompt Honeywell to coordinate field work activities including proper handling and disposal of chromium-contaminated materials with the JCMUA. Refer to the SOP document for further details regarding coordination of work between Honeywell and the JCMUA.

Coordination of Work Between Honeywell, JCMUA and Other Parties

The following steps summarize procedures for coordination of work between Honeywell, JCMUA or other parties performing subsurface work at the sites:

1. JCMUA or other party identifies work project (e.g., sewer/utility repair or replacement) at the chromium sewer sites.
2. JCMUA or other party notifies Honeywell of the planned work location and the estimated schedule/timing for completion of work.
3. For emergency situations where work needs to be done before a determination can be made on whether the work location is in an area of chromium soils, JCMUA's contractor will proceed with work using properly trained workers (i.e., OSHA 40-hour HAZWOPER training) and Honeywell will provide technical assistant and field support (to be determined in cooperation with JCMUA). For non-emergency situations, Honeywell determines whether or not the proposed work location is within an area of chromium soils and provides confirmation to the JCMUA and/or other applicable party. If the work location is confirmed to be in an area of chromium soils, then Honeywell coordinates with the JCMUA or other party regarding response and field work activities. If Honeywell determines that the proposed work is not in an area of chromium soils, then JCMUA or other party would proceed with its work without further coordination with Honeywell.

4. Honeywell or other applicable party provides notification to the NJDEP, as may be required in accordance with Deed Notice requirements for disturbance of engineering controls or other regulatory requirements.
5. Honeywell coordinates with JCMUA or other party as needed for performance of field work including the use of qualified contractors for excavation and disposal of chromium-contaminated materials at a facility licensed to accept such materials, backfilling, and site restoration including replacement of any engineering controls. JCMUA's contractor will take the lead in performing field work (with the exception of possibly longer term, planned sewer work). Honeywell will provide technical assistance and field support as needed for documentation and reporting requirements. In some cases, Honeywell's contractor may take the lead in performing field work or a portion of field work (e.g., removal and disposal of chromium contaminated materials, restoration of engineering controls), to be determined on a case by case basis in consultation and cooperation with the JCMUA or other party performing site work.
6. Honeywell prepares an updated chromium soils map and provides a copy to the JCMUA following completion of the work, as applicable.
7. Honeywell or other applicable party prepares and submits a summary report of field work to the NJDEP (with copies provided to the JCMUA) in accordance with Deed Notice or other regulatory requirements.

Training - JCMUA

With respect to training of JCMUA employees, Honeywell will provide training support to the JCMUA as deemed appropriate, and JCMUA will develop and implement a worker training plan based on the requirements outlined in this Worker Training Manual. Honeywell in consultation with the JCMUA has identified the following training needs for JCMUA employees that would be provided by Honeywell (or its designated contractor):

- Chromium Awareness Training - initial and periodic training (every 3 years estimated): estimated 1 to 2 hours and include JCMUA staff with responsibility for performing field work.

- HAZWOPER 40-hour training and annual 8-hour refresher training: estimated to include two JCMUA supervisory employees.

Honeywell will pay for the cost of the training program and the JCMUA would cover the cost for the time for its employees to attend the training.

JCMUA's contractors performing field work on the sites will be required to have applicable health and safety training as indicated in the Worker Training Manual. It is expected that health and safety training requirements for JCMUA contractors will be specified as part of JCMUA's bidding process for sewer work and that contractors will be required to demonstrate appropriate training documentation to the JCMUA prior to performing field work at the sites.

The timing for training will be coordinated in consultation with JCMUA.

TABLE 1

SUMMARY OF WORKER TRAINING REQUIREMENTS

**TABLE 1: Summary of Worker Training Requirements
Hazardous Waste Sites and Hexavalent Chromium Standard**

| Type of Workers | Hexavalent Chromium Standard Awareness Training | 40-Hour OSHA Hazwoper Training | 24-Hour OSHA Hazwoper Training ⁽¹⁾ | On The Job Training | 8-hour refresher | 8-hour Supervisory | Respiratory Protection | Medical Monitoring ⁽²⁾ | Hazard Communication ⁽³⁾ |
|--|--|--|--|---------------------|-------------------|---|---|---|--|
| Hands On Site Workers (JCMUA, Contractors or Other Parties) | Required for those working in exclusion zone/regulated area who maybe exposed to COPR | Required on hazardous waste sites for site workers. Site workers may potentially be required to wear respirators. This training is recommended for workers who may be directly exposed (direct contact) to COPR or hexavalent chromium. While the use of respiratory protection isn't expected to be required, this would allow the use of respiratory protection should site conditions warrant | Not applicable - superseded by 40-hour training | 3 Days | Required annually | Required if directly supervises other workers | Respiratory protection program is required for workers who work on hazardous waste sites | Medical monitoring is required for workers who work on hazardous waste sites. Typically, HAZWOPER physicals also cover medical monitoring requirements under the Hexavalent Chromium Standard (verify with examining physician) | Hazard Communication Program is applicable for chemical usage including any chemicals brought onsite for use during site work. |
| Supervisory Type Personnel (JCMUA, Contractors or Other Parties) | Required for those working in exclusion zone/regulated area who maybe exposed to COPR or hexavalent chromium | Not required | Minimum Training allowable for working on hazardous waste sites and typically does not include in-depth coverage of respiratory protection and level C and B personal protection equipment. Cannot be used if respiratory protection will be required. | 1 Day | Required annually | Required if directly supervises other workers | These types of workers are unlikely to be exposed to levels above the PEL/TLV therefore, the need for respiratory protection is not likely to be required | Workers are not expected to be exposed to elevated levels above the PEL/TLV, medical monitoring is not likely required under the OSHA Standard | Hazard Communication Program is applicable for chemical usage including any chemicals brought onsite for use during site work. |

This table is provided for reference purposes; all parties conducting work at the subject sites are responsible to verify applicability and comply with current OSHA requirements, as applicable.

⁽¹⁾ Workers who have only received 24-hour of initial training who then need to wear a respirator will first be required to complete an additional 16 hour of classroom training and two additional days of on the job training and be enrolled in a medical monitoring program. If use of respirator is likely, then worker should receive 40-hours of initial training.

⁽²⁾ Medical monitoring is required under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard (29 CFR 1926.65) and the Hexavalent Chromium Standard (29 CFR 1926.1126) if on site more than 30 days per year and exposed to hazardous waste or hexavalent chromium above applicable exposure limits (PEL/TLVs). In addition, medical clearance is required prior to wearing a respirator (29 CFR 1910.134). *If required, medical exams include baseline physicals, periodic exams (typically annually), and exit physicals. The content and frequency of medical exams must be determined in consultation with the JCMUA's medical consultant/physician; typical medical exam requirements include: occupational/medical history, physical exam, blood/urine test, ability to wear PPE (e.g., pulmonary function testing, EKG), and baseline monitoring based on potential onsite exposure to particular contaminants (e.g., hexavalent chromium). For further information, refer to OSHA Guidance Manual for Hazardous Waste Site Activities at <http://www.cdc.gov/niosh/85-115.html>*

⁽³⁾ Hazard Communication is applicable to hazardous substances such as any chemical brought onsite for use during site work. For work on hazardous waste sites, a Site Health and Safety Plan would be required to be prepared and implemented by the site remediation contractor to address potential exposure to contaminated soils and/or groundwater. *For more information, refer to the OSHA Hazard Communication Standard at <http://www.osha.gov/dsg/hazcom/oshacomplianceassistance.html>*

APPENDIX A

**FACT SHEETS: CHROMIUM INFORMATION AND
POTENTIAL HEALTH HAZARDS**

This fact sheet answers the most frequently asked health questions (FAQs) about chromium. For more information, call the ATSDR Information Center at 1-800-232-4636. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Exposure to chromium occurs from ingesting contaminated food or drinking water or breathing contaminated workplace air. Chromium(VI) at high levels can damage the nose and cause cancer. Ingesting high levels of chromium(VI) may result in anemia or damage to the stomach or intestines. Chromium(III) is an essential nutrient. Chromium has been found in at least 1,127 of the 1,669 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What is chromium?

Chromium is a naturally occurring element found in rocks, animals, plants, and soil. It can exist in several different forms. Depending on the form it takes, it can be a liquid, solid, or gas. The most common forms are chromium(0), chromium(III), and chromium(VI). No taste or odor is associated with chromium compounds.

The metal chromium, which is the chromium(0) form, is used for making steel. Chromium(VI) and chromium(III) are used for chrome plating, dyes and pigments, leather tanning, and wood preserving.

What happens to chromium when it enters the environment?

- Chromium can be found in air, soil, and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process.
- Chromium does not usually remain in the atmosphere, but is deposited into the soil and water.
- Chromium can easily change from one form to another in water and soil, depending on the conditions present.
- Fish do not accumulate much chromium in their bodies from water.

How might I be exposed to chromium?

- Eating food containing chromium(III).

- Breathing contaminated workplace air or skin contact during use in the workplace.
- Drinking contaminated well water.
- Living near uncontrolled hazardous waste sites containing chromium or industries that use chromium.

How can chromium affect my health?

Chromium(III) is an essential nutrient that helps the body use sugar, protein, and fat.

Breathing high levels of chromium(VI) can cause irritation to the lining of the nose, nose ulcers, runny nose, and breathing problems, such as asthma, cough, shortness of breath, or wheezing. The concentrations of chromium in air that can cause these effects may be different for different types of chromium compounds, with effects occurring at much lower concentrations for chromium(VI) compared to chromium(III).

The main health problems seen in animals following ingestion of chromium(VI) compounds are irritation and ulcers in the stomach and small intestine and anemia. Chromium(III) compounds are much less toxic and do not appear to cause these problems.

Sperm damage and damage to the male reproductive system have also been seen in laboratory animals exposed to chromium(VI).

ToxFAQs™ Internet address is <http://www.atsdr.cdc.gov/toxfaq.html>

Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted.

How likely is chromium to cause cancer?

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that chromium(VI) compounds are known human carcinogens. In workers, inhalation of chromium(VI) has been shown to cause lung cancer. Chromium(VI) also causes lung cancer in animals. An increase in stomach tumors was observed in humans and animals exposed to chromium(VI) in drinking water.

How can chromium affect children?

It is likely that health effects seen in children exposed to high amounts of chromium will be similar to the effects seen in adults.

We do not know if exposure to chromium will result in birth defects or other developmental effects in people. Some developmental effects have been observed in animals exposed to chromium(VI).

How can families reduce the risks of exposure to chromium?

- Children should avoid playing in soils near uncontrolled hazardous waste sites where chromium may have been discarded.
- Chromium is a component of tobacco smoke. Avoid smoking in enclosed spaces like inside the home or car in order to limit exposure to children and other family members.
- Although chromium(III) is an essential nutrient, you should avoid excessive use of dietary supplements containing chromium.

Is there a medical test to determine whether I've been exposed to chromium?

Since chromium(III) is an essential element and naturally occurs in food, there will always be some level of chromium in your body. Chromium can be measured in hair, urine, and blood.

Higher than normal levels of chromium in blood or urine may indicate that a person has been exposed to chromium. However, increases in blood and urine chromium levels cannot be used to predict the kind of health effects that might develop from that exposure.

Has the federal government made recommendations to protect human health?

The EPA has determined that exposure to chromium in drinking water at concentrations of 1 mg/L for up to 10 days is not expected to cause any adverse effects in a child.

The FDA has determined that the chromium concentration in bottled drinking water should not exceed 1 mg/L.

The Occupational Health and Safety Administration (OSHA) has limited workers' exposure to an average of 0.005 mg/m³ chromium(VI), 0.5 mg/m³ chromium(III), and 1.0 mg/m³ chromium(0) for an 8-hour workday, 40-hour workweek.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological Profile for Chromium (Draft for Public Comment). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.



Health Effects of Hexavalent Chromium

Hexavalent chromium is a toxic form of the element chromium. Hexavalent chromium compounds are man-made and widely used in many different industries.

Some major industrial sources of hexavalent chromium are:

- chromate pigments in dyes, paints, inks, and plastics
- chromates added as anti-corrosive agents to paints, primers and other surface coatings
- chrome plating by depositing chromium metal onto an item's surface using a solution of chromic acid
- particles released during smelting of ferro-chromium ore
- fume from welding stainless steel or nonferrous chromium alloys
- impurity present in portland cement.

How hexavalent chromium can harm employees

Workplace exposure to hexavalent chromium may cause the following health effects:

- lung cancer in workers who breathe airborne hexavalent chromium
- irritation or damage to the nose, throat, and lung (respiratory tract) if hexavalent chromium is breathed at high levels
- irritation or damage to the eyes and skin if hexavalent chromium contacts these organs in high concentrations.

How hexavalent chromium affects the nose, throat and lungs

Breathing in high levels of hexavalent chromium can cause irritation to the nose and throat.

Symptoms may include runny nose, sneezing, coughing, itching and a burning sensation.

Repeated or prolonged exposure can cause sores to develop in the nose and result in nosebleeds. If the damage is severe, the nasal septum (wall separating the nasal passages) develops a hole in it (perforation).

Breathing small amounts of hexavalent chromium even for long periods does not cause respiratory tract irritation in most people.

Some employees become allergic to hexavalent chromium so that inhaling chromate compounds can cause asthma symptoms such as wheezing and shortness of breath.

How hexavalent chromium affects the skin

Some employees can also develop an allergic skin reaction, called allergic contact dermatitis. This occurs from handling liquids or solids containing hexavalent chromium. Once an employee becomes allergic, brief skin contact causes swelling and a red, itchy rash that becomes crusty and thickened with prolonged exposure. Allergic contact dermatitis is long-lasting and more severe with repeated skin contact.

Direct skin contact with hexavalent chromium can cause a non-allergic skin irritation. Contact with non-intact skin can also lead to chrome ulcers. These are small crusted skin sores with a rounded border. They heal slowly and leave scars.

How employees can be exposed to hexavalent chromium

Employees can inhale airborne hexavalent chromium as a dust, fume or mist while:

- producing chromate pigments and powders; chromic acid; chromium catalysts, dyes, and coatings
- working near chrome electroplating
- welding and hotworking stainless steel, high chrome alloys and chrome-coated metal
- applying and removing chromate-containing paints and other surface coatings.

Skin exposure can occur during direct handling of hexavalent chromium-containing solutions, coatings, and cements.

Steps OSHA has taken to protect employees from health hazards caused by hexavalent chromium

The new OSHA workplace standard requires employers to:

- limit eight-hour time-weighted average hexavalent chromium exposure in the workplace to 5 micrograms or less per cubic meter of air.
 - perform periodic monitoring at least every 6 months if initial monitoring shows employee exposure at or above the action level (2.5 micrograms per cubic meter of air calculated as an 8-hour time-weighted average).
 - provide appropriate personal protective clothing and equipment when there is likely to be a hazard present from skin or eye contact.
- implement good personal hygiene and house-keeping practices to prevent hexavalent chromium exposure.
 - prohibit employee rotation as a method to achieve compliance with the exposure limit (PEL).
 - provide respiratory protection as specified in the standard.
 - make available medical examinations to employees within 30 days of initial assignment, annually, to those exposed in an emergency situation, to those who experience signs or symptoms of adverse health effects associated with hexavalent chromium exposure, to those who are or may be exposed at or above the action level for 30 or more days a year, and at termination of employment.

For more complete information:



U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

DSG 7/2006



Right to Know Hazardous Substance Fact Sheet

Common Name: **CHROMIUM**

Synonyms: Chrome; Metallic Chromium

Chemical Name: Chromium

Date: January 2000 Revision: March 2009

CAS Number: 7440-47-3

RTK Substance Number: 0432

DOT Number: UN 3089

Description and Use

Chromium is a hard, gray, odorless solid with a metallic luster. It is used in stainless and alloy steels, in making alloys, and as an isotope in medicine and research.

Reasons for Citation

- ▶ **Chromium** is on the Right to Know Hazardous Substance List because it is cited by OSHA, ACGIH, DOT, NIOSH, DEP, IARC and EPA.
- ▶ This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- ▶ Immediately flush with large amounts of water for at least 30 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention.

Skin Contact

- ▶ Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

Inhalation

- ▶ Remove the person from exposure
- ▶ Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- ▶ Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE LAST PAGE

Hazard Summary

| Hazard Rating | NJDHSS | NFPA |
|---------------|--------|------|
| HEALTH | 2 | - |
| FLAMMABILITY | 3 | - |
| REACTIVITY | 0 | - |

FLAMMABLE POWDER
POISONOUS GASES ARE PRODUCED IN FIRE
CONTAINERS MAY EXPLODE IN FIRE

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- ▶ **Chromium** can affect you when inhaled.
- ▶ Contact can irritate and burn the skin and eyes with possible eye damage.
- ▶ Inhaling **Chromium** can irritate the nose and throat.
- ▶ Exposure to **Chromium fumes** can cause a flu-like illness called *metal fume fever*.
- ▶ **Chromium** may cause a skin allergy and an asthma-like allergy
- ▶ Inhaling **Chromium** can cause a sore and/or a hole in the "bone" (septum) dividing the inner nose.
- ▶ **Chromium** may affect the liver and kidneys.
- ▶ **Chromium** in *powder* form is FLAMMABLE and a DANGEROUS FIRE HAZARD. It may also spontaneously explode in air.

Workplace Exposure Limits

OSHA: The legal airborne permissible exposure limit (PEL) is **1 mg/m³** averaged over an 8-hour workshift.

NIOSH: The recommended airborne exposure limit (REL) is **0.5 mg/m³** averaged over a 8-hour workshift.

ACGIH: The threshold limit value (TLV) is **0.5 mg/m³** averaged over an 8-hour workshift.

Determining Your Exposure

- ▶ Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- ▶ For each individual hazardous ingredient, read the New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet, available on the RTK Program website (www.nj.gov/health/eoh/rtkweb) or in your facility's RTK Central File or Hazard Communication Standard file.
- ▶ You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- ▶ The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Chromium**:

- ▶ Contact can irritate and burn the skin and eyes with possible eye damage.
- ▶ Inhaling **Chromium** can irritate the nose and throat causing coughing and wheezing.
- ▶ Exposure to **Chromium fumes** can cause "metal fume fever." This is a flu-like illness with symptoms of metallic taste in the mouth, headache, fever and chills, aches, chest tightness and cough. The symptoms may be delayed for several hours after exposure and usually last for a day or two.

Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Chromium** and can last for months or years:

Cancer Hazard

- ▶ While **Chromium** has been tested, it is not classifiable as to its potential to cause cancer.

Reproductive Hazard

- ▶ There is no evidence that **Chromium** affects reproduction. This is based on test results presently available to the NJDHSS from published studies.

Other Effects

- ▶ Inhaling **Chromium** can cause a sore and/or a hole in the "bone" (septum) dividing the inner nose, sometimes with bleeding, discharge, and/or formation of a crust.
- ▶ **Chromium** may cause a skin allergy. If allergy develops, very low future exposure can cause itching and a skin rash.
- ▶ **Chromium** may cause an asthma-like allergy. Future exposure can cause asthma attacks with shortness of breath, wheezing, coughing, and/or chest tightness.
- ▶ Prolonged skin contact can cause burns, blisters and deep ulcers
- ▶ **Chromium** may affect the liver and kidneys.

Medical

Medical Testing

For frequent or potentially high exposure (half the TLV or greater), the following are recommended before beginning work and at regular times after that:

- ▶ Lung function tests. The results may be normal if the person is not having an attack at the time of the test.

If symptoms develop or overexposure is suspected, the following are recommended:

- ▶ Examine your skin periodically for little bumps or blisters, the first sign of "chrome ulcers." If not treated early, these can last for years after exposure.
- ▶ Evaluation by a qualified allergist can help diagnose skin allergy.
- ▶ Liver and kidney function tests

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Mixed Exposures

- ▶ Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.
- ▶ More than light alcohol consumption can cause liver damage. Drinking alcohol can increase the liver damage caused by **Chromium**.

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- ▶ Label process containers.
- ▶ Provide employees with hazard information and training.
- ▶ Monitor airborne chemical concentrations.
- ▶ Use engineering controls if concentrations exceed recommended exposure levels.
- ▶ Provide eye wash fountains and emergency showers.
- ▶ Wash or shower if skin comes in contact with a hazardous material.
- ▶ Always wash at the end of the workshift.
- ▶ Change into clean clothing if clothing becomes contaminated.
- ▶ Do not take contaminated clothing home.
- ▶ Get special training to wash contaminated clothing.
- ▶ Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- ▶ Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- ▶ Before entering a confined space where **Chromium powder** may be present, check to make sure that an explosive concentration does not exist.
- ▶ Use a vacuum or a wet method to reduce dust during clean-up. DO NOT DRY SWEEP.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- ▶ Avoid skin contact with **Chromium**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- ▶ Safety equipment manufacturers recommend Nitrile and Natural Rubber for gloves, and Tyvek®, or the equivalent, as a protective material for clothing.
- ▶ All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- ▶ Wear eye protection with side shields or goggles.
- ▶ If additional protection is needed for the entire face, use in combination with a face shield. A face shield should not be used without another type of eye protection.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- ▶ Where the potential exists for exposure over **0.5 mg/m³**, use a NIOSH approved negative pressure, air-purifying, particulate filter respirator with an N, R or P95 filter. More protection is provided by a full facepiece respirator than by a half-mask respirator, and even greater protection is provided by a powered-air purifying respirator.
- ▶ Leave the area immediately if (1) while wearing a filter or cartridge respirator you can smell, taste, or otherwise detect **Chromium**, (2) while wearing particulate filters abnormal resistance to breathing is experienced, or (3) eye irritation occurs while wearing a full facepiece respirator. Check to make sure the respirator-to-face seal is still good. If it is, replace the filter or cartridge. If the seal is no longer good, you may need a new respirator.
- ▶ Consider all potential sources of exposure in your workplace. You may need a combination of filters, prefilters or cartridges to protect against different forms of a chemical (such as vapor and mist) or against a mixture of chemicals.
- ▶ Where the potential exists for exposure over **5 mg/m³**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- ▶ Exposure to **250 mg/m³** is immediately dangerous to life and health. If the possibility of exposure above **250 mg/m³** exists, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- ▶ Extinguish fire using an agent suitable for type of surrounding fire. **Chromium** itself does not burn.
- ▶ **Chromium** in powder form is FLAMMABLE and a DANGEROUS FIRE HAZARD. It may also spontaneously explode in air.
- ▶ Use dry sand or dry chemical extinguishing agents to fight **Chromium powder** fires.
- ▶ POISONOUS GASES ARE PRODUCED IN FIRE.
- ▶ CONTAINERS MAY EXPLODE IN FIRE.
- ▶ DO NOT get water inside container.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Chromium powder** is spilled, take the following steps:

- ▶ Evacuate personnel and secure and control entrance to the area.
- ▶ Eliminate all ignition sources.
- ▶ Moisten spilled material first or use a HEPA-filter vacuum for clean-up and place into sealed containers for disposal.
- ▶ Keep **Chromium powder** out of confined spaces, such as sewers, because of the possibility of an explosion.
- ▶ Ventilate and wash area after clean-up is complete.
- ▶ DO NOT wash into sewer.
- ▶ It may be necessary to contain and dispose of **Chromium** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Chromium** you should be trained on its proper handling and storage.

- ▶ **Chromium** may react violently or explosively with AMMONIUM NITRATE; CARBON DIOXIDE ATMOSPHERES; BROMINE PENTAFLUORIDE; LITHIUM; NITROGEN OXIDES; and SULFUR DIOXIDE.
- ▶ **Chromium** is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); STRONG ACIDS (such as HYDROCHLORIC and SULFURIC); and ALKALI METALS (such as SODIUM and POTASSIUM).
- ▶ Store in tightly closed containers in a cool, well-ventilated area.
- ▶ Sources of ignition, such as smoking and open flames, are prohibited where **Chromium powder** is used, handled, or stored.

Occupational Health Information Resources

The New Jersey Department of Health and Senior Services, Occupational Health Service, offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health & Senior Services
Right to Know Program
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.state.nj.us
Web address: <http://www.nj.gov/health/eoh/rtkweb>

*The Right to Know Hazardous Substance Fact Sheets
are not intended to be copied and sold
for commercial purposes.*

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGs) are established by the EPA. They describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or Lower Explosive Limit, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m³ means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

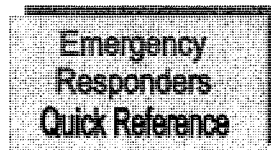
UEL or Upper Explosive Limit is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.



Right to Know Hazardous Substance Fact Sheet



Common Name: **CHROMIUM**

Synonyms: Chrome; Metallic Chromium

CAS No: 7440-47-3

Molecular Formula: Cr

RTK Substance No: 0432

Description: Hard, gray, odorless solid with a metallic luster

HAZARD DATA

| Hazard Rating | Firefighting | Reactivity |
|--|--|---|
| 2 - Health 3 - Fire 0 - Reactivity DOT#: UN 3089 ERG Guide #: 170 Hazard Class: 4.1 (Flammable Solid) | Extinguish fire using an agent suitable for type of surrounding fire. Chromium itself does not burn. Chromium in <i>powder</i> form is FLAMMABLE and a DANGEROUS FIRE HAZARD. It may also spontaneously explode in air. Use dry sand or dry chemical extinguishing agents to fight Chromium powder fires. POISONOUS GASES ARE PRODUCED IN FIRE. CONTAINERS MAY EXPLODE IN FIRE. DO NOT get water inside container. | Chromium may react violently or explosively with AMMONIUM NITRATE; CARBON DIOXIDE ATMOSPHERES; BROMINE PENTAFLUORIDE; LITHIUM; NITROGEN OXIDES; and SULFUR DIOXIDE. Chromium is not compatible with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); STRONG ACIDS (such as HYDROCHLORIC and SULFURIC); and ALKALI METALS (such as SODIUM and POTASSIUM). |

SPILL/LEAKS

Isolation Distance:

Spill: 25 meters (75 feet)

Fire: 800 meters (1/2 mile)

Moisten spilled material first or use a HEPA-filter vacuum for clean-up and place into sealed containers for disposal.

Keep **Chromium powder** out of confined spaces, such as sewers, because of the possibility of an explosion.

DO NOT wash into sewer.

PHYSICAL PROPERTIES

Odor Threshold: Odorless

Flash Point: Noncombustible solid, Flammable *powder*

Vapor Pressure: <0 mm Hg at 68°F (20°C) (approximate)

Specific Gravity: 7.2 (water = 1)

Water Solubility: Insoluble

Boiling Point: 4,788°F (2,642°C)

Melting Point: 3,452°F (1,900°C)

Molecular Weight: 52

EXPOSURE LIMITS

OSHA: 1 mg/m³, 8-hr TWA

NIOSH: 0.5 mg/m³, 8-hr TWA

ACGIH: 0.5 mg/m³, 8-hr TWA

IDLH: 250 mg/m³

The Protective Action Criteria values are:

PAC-1 = 1.5 mg/m³ PAC-3 = 250 mg/m³

PAC-2 = 2.5 mg/m³

PROTECTIVE EQUIPMENT

Gloves: Nitrile or Natural Rubber

Coveralls: Tyvek®

Respirator: >0.5 mg/m³ - full facepiece APR with High efficiency filters
>1.5 mg/m³ - SCBA

HEALTH EFFECTS

Eyes: Irritation, burns and possible eye damage

Skin: Irritation, burns, itching, rash and skin ulcers

Inhalation: Nose and throat irritation with coughing and wheezing
Headache, fever and chills

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention.

Quickly remove contaminated clothing and wash contaminated skin with large amounts of soap and water.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.

APPENDIX B

**REPRESENTATIVE PHOTOGRAPHS
CHROMIUM ORE PROCESSING RESIDUE**

**CHROMITE ORE PROCESSING RESIDUE (COPR)
EXAMPLE PHOTOS**

