1.0 INTRODUCTION

Hexavalent Chromium (Hex. Chrome) is a toxic, carcinogenic form of elemental chromium that is formed through industrial processes. Exposure to Hex. Chrome can occur by disturbing or interacting with chrome containing metal alloys (See the Welding Corporate Standard for expectations on managing hex. Chrome exposures from welding).

This standard addresses a unique presentation of Hex. Chrome, called residues. Residues form as surface contaminant on chrome metal components under specific conditions and can easily impact uninformed workers performing routine tasks such as removing insulation and cleaning bolts.

This document outlines expectations and requirements to identify, plan and safely manage work where Hex. Chrome residues could be formed.

2.0 SCOPE

Hexavalent Chromium residues can form in very specific conditions. All components or systems that meet the 3 criteria below have potential for Hex. Chrome residue to be generated and will assume to contain Hex. Chrome residue until proven otherwise:

1. **Chrome:** the metal component or system must contain some chrome alloy (>1%), and
   Examples: this includes stainless steel(s) and most specialty alloys. Carbon steel can also contain chrome if it comes from a recycled source.
2. **Temperature:** the metal component or system must be exposed to temperatures above or 250C (480F), and
3. **Silicates:** the metal component or system must have contact or proximity with substances that contain silicates, such as calcium, barium, magnesium (and possibly other silicates).
   Examples: Anti-seize compounds and/or Calcium Silicate Insulation

Hex. Chrome residues can appear as white or yellow residue although, a physical residue may not always be visible. All white or yellow residue on components or systems meeting the criteria above will be assumed to contain Hex. Chrome unless tested for confirmation (see Appendix A for visual examples).

Hex. Chrome residues are a relatively new hazard, and our understanding is evolving alongside our industry peers. However, industry experience helps us understand that we can anticipate finding them on hot chrome containing metals:

- Underneath calcium silicate insulation (and possibly others)
- On nuts, bolts valves where calcium based anti-seize compounds have been used

However, as this is a new, evolving risk - Chrome containing components heated above 250C should be considered to have Hex. Chrome residues, until an assessment or testing has been completed.

3.0 REFERENCES

Environmental Abatement Council of Canada – Performance Leak Testing Guideline for HEPA Filtered Equipment	https://www.eaccanada.ca/wp-content/uploads/2021/06/EACC-Performance-Leak-Testing-Guideline-for-HEPA-Filtered-Equipment-June-2021.pdf
HSEE-03-18	Respiratory Protective Equipment

4.0 TERMS AND DEFINITIONS

Anti-seize	A compound or lubricant designed to prevent metal parts from binding or seizing at high temperatures or in harsh conditions
Biological Monitoring	Testing of biological components to assess internal exposure or health affects from exposure to hazardous agents.
Competent	qualified, because of such factors as knowledge, training and experience, to do assigned work in a manner that will ensure the health and safety of persons, (b) knowledgeable about the provisions of the Act and the regulations that apply to the assigned work, and (c) knowledgeable about potential or actual danger to health or safety connected with the assigned work
Doffing Station	A segregated area equipped with the necessary resources to safely remove and dispose of potentially contaminated PPE without contaminating the worker.
Donning Station	An area with the required resources to equip workers with the necessary PPE before entering a potentially contaminated work area.
Elemental Chrome	An element found in the earth's crust that is added to metals, such as stainless steel, due to its corrosion and heat resistant properties
DOP	DOP or dioctyl phthalate is an organic compound used as a poly-dispersed test aerosol, to generate sub-micron particles, to challenge (evaluate integrity of) of HEPA filters. PAO and DOP can be used interchangeably.
PAO	PAO or Poly Alfa Olefin is a monoor poly-dispersed test aerosol of submicron particles, generated to challenge (evaluate integrity of) of HEPA filters. PAO and DOP can be used interchangeably.
DOP Test	Challenging a HEPA filter or installed HEPA filter system by a test aerosol.
HEPA	High Efficiency Particulate Arresting filter that is at least 99.97% efficient at collecting a 0.3 micrometer aerosol.
HEPA Filtered Equipment	Any equipment or device equipped with a 99.97% (0.3 micrometer) high efficiency particulate air filter removal system
HEPA Vacuum –	A specialized industrial vacuum capable of safely cleaning hazardous materials while filtering 99.97% of particles 0.3 microns and larger. A HEPA vacuum must have a valid DOP Test certificate
Neutralized	A cleaning method that uses a chemical reaction to alter the Hex. Chrome to a less toxic state. Hex. Chrome can only be considered neutralized when testing confirms it is no longer present.
Negative Air Unit	Exhaust fan in sealed cabinet equipped with HEPA filtration used to exhaust filtered air out of an enclosed hazardous materials work area for the purpose of establishing and maintaining a Negative Pressure in the hazardous materials work area with respect to

	surrounding areas, and also to provide general ventilation of the abatement area and also provide general ventilation to the abatement work area
Residue(s)	a substance that remains behind after a process such as combustion or evaporation.
Wet Methods	Cleaning methods where moisture is used (directly or indirectly) to minimize aerosolizing a particulate hazard

5.0 ROLES AND RESPONSIBILITIES

5.1 Executive Director

- Ensure NB Power sites have a documented initial assessment to identify if and where Hex. Chrome residue conditions could form
- Where Hex. Chrome residue conditions are possible, or confirmed present, ensure the sites create and maintain a documented management plan meeting the expectations of this standard
- Ensure resources and time are available to comply with this standard

5.2 Station/Division Manager

- Assign a Hex. Chrome management plan owner
- Ensure resources and time are available to comply with this procedure
- Ensures a management plan is developed and implemented with site specific roles and responsibilities
- Ensure personnel filling all roles are competent and have adequate training on Hexavalent Chromium.
- Ensure the management plan and inventory are accessible and provided to workers and contractors as needed
- Ensure supervisors, workers and contractors are aware of hex. Chrome site requirements

5.3 Management Plan Owner

- Ensure the management plan aligns with the expectations of this standard
- Ensure the management plan is up to date and readily available.
- Ensure an assessment is documented to identify if and where hex. Chrome residue forming conditions could exist (6.3)
- Manage the inventory and track updates as new sources are found or existing ones are eliminated.
- Serve as subject matter expert for hex. Chrome residue information for the site/division.

5.4 Supervisors

- Ensure workers receive adequate instruction on the hazards of hex. chrome exposure.
- Assume all chrome components contain hex. Chrome residue unless past testing has indicated it is not present.
- Use the inventory to identify if hex. Chrome residue could be present prior to starting work
- Ensure a Job Hazard Analysis outlining the steps of the work, the hazards and the required controls is prepared and reviewed by workers prior to starting work.
- Select and use the appropriate control measures as outlined for the appropriate level of hex. Chrome work (see Section 6.9).
- Report exposure incidents to WorkSafeNB after consultation with TH&S

- Ensure that workers that are wearing respirators are properly trained and fit-tested as per HSEE-03-18-Respiratory Protection.
- Ensure that workers use engineering controls and appropriate PPE as required for the work
- Ensure workers use donning/doffing areas when required
- Ensure workers use proper doffing techniques (Appendix C)
- Where work requires the establishment of a hex. chrome regulated area
  - Ensure other workers in the area are aware of the regulated area and its hazards
- Report any hex. Chrome residue related incident in the145 e-form for learning.

5.5 Industrial Hygienist

- Serve as subject matter expert for Hexavalent Chromium and this standard
- Perform or prescribe, and interpret, air sampling as required
- Determine when bioloigical monitoring is required

5.6 Workers / Contractors

- Respect all hex. chrome warnings and precautions.
- Assume all chrome components contain hex. Chrome residue, unless indicated otherwise.
- Abstain from handling hex. Chrome residues unless authorized to do so.
- Obtain proper clearance and don appropriate PPE before performing work on materials with hex. chrome residues
- Have respiratory protection training and fit-testing as per HSEE-03-18 Respiratory Protection prior to using a respirator
- Use donning/doffing stations when required
- Practice safe doffing techniques as per Appendix C.
- Wash hands before eating, drinking and smoking when working with hex. Chrome
- Report any concerns about hex. Chrome residues to your supervisor

6.0 STANDARD

- All sites and divisions must have a documented assessment indicating if hex. Chrome residue conditions are present or not.
- If Hex. Chrome residue forming conditions are not possible; the documented assessment is the only aspect of this standard that applies (Section 6.3)
- If hex. Chrome residue forming conditions are present, each site or division must develop and comply with a Hex. Chrome Residue Management Plan consisting of the following elements:
  1. Hex. Chrome General Awareness
  2. An Inventory of Potential Hex Chrome Locations
  3. Site Specific Roles and Responsibilities
  4. Testing Protocols
  5. Work Methods for Handling Hex Chrome
  6. Hex Chrome Disposal

6.1 Health Information:

- Inhalation and skin contact are the most important routes of exposure
- Ingestion can occur when workers eat, drink, or smoke with contaminated hands due to poor hygiene practices
- Acute health effects associated with Hex. Chrome exposures are generally caused by the corrosive nature of the hazard and include:
  - Eye and skin irritation and damage, perforated eardrums, respiratory irritation, pulmonary congestion and edema
- Chronic health effects associated with Hex. Chrome exposures include:
  - occupational asthma, kidney damage, liver damageupper abdominal pain, nose damage, respiratory cancer, and erosion and discoloration of the teeth

- Some Hex. Chrome compounds, such as sodium chromate and potassium chromate, are caustic and can cause burns upon skin contact
- Workers can develop an allergic skin reaction to Hex. Chrome that can be long lasting. Contact with open wounds or non-intact skin can lead to the formation of ulcers.
- Workers can become sensitized to chrome compounds following initial exposure. This means subsequent exposures have the potential to cause health effects at significantly lower levels of exposure.
- New Brunswick Occupational Exposure Limits (OELs) for chromium metal and inorganic compounds are:

	8-hour TWA	10-hour TWA	12-hour TWA
Metal and CRIII compounds	0.5 mg/m3	0.35mg/m3	0.25mg/m3
Water soluble Cr VI compounds	0.05 mg/m3	0.035mg/m3	0.0025mg/m3
Insoluble Cr VI compounds	0.01 mg/m3	0.007mg/m3	0.005mg/m3

6.2 Prerequisites:

Chrome containing (>1%) components, heated to 250C or above, will assume to have Hex. Chrome residues until proven otherwise. The absence of hex. Chrome residue can be proven through documented assessment, clearly showing the residue can't form and/or testing of the component.

At the time of the assessment, if the temperature of the system is not known, the assumption will be that hex. Chrome residues are present.

Due to the hazards associated with Hex. Chrome, prior to entering a regulated area or working on components or systems where Hex. Chrome residue may be present, all workers must:

- Understand the hazards and health effects associated with exposure to Hex. Chrome
- Be familiar with site specific hex. Chrome management plan and expectations to work in the regulated area
- Be trained in the proper use of all applicable PPE and Respiratory Protection Equipment.
  - This includes respiratory protection training; a valid fit-test for the make, model and size of respirator to be used; and doffing techniques
- Reviewed work scope specific JHA's, tailboards and other documents to understand all requirements of performing the work safely.

6.3 Assessment and Inventory

- Each site/division must have a documented assessment determining if hex. Chrome residue conditions could potentially exist. The assessment must address at least the two primary criteria in Section required to form hex. Chrome residues.
  - Chrome metal (>1%), and
- High Temperatures (>250C), a
- The presence or absence of silicate containing substances should be noted as well.
- If Chrome metal components (>1%) are present, they will be assumed to contain residue until the assessment can determine they are not exposed to temperatures >250C, or testing is performed that demonstrates residues are not present..
- If the assessment and/or testing determine the site/division does not have any Hex. Chrome residue or conditions, the assessment must be retained as evidence that the hazard is not present.
- The assessment must be repeated every 5 years, or as systems, assets and conditions are changed that could impact the ability to form hex. Chrome residues
- If the assessment determines that Hex. Chrome residue could be present, an inventory must be established.
- The inventory must identify locations that are assumed to contain hex. Chrome (Meeting the criteria in Section 2.2) and those where tests have confirmed the presence or absence of hex. chrome
- The inventory must be kept current and updated as new sources are found and/or hex. Chrome residues are eliminated (typically by taking away one of the required conditions).
- The inventory must be readily available to all site/division personnel and contractors
- The inventory must only be modified by the Management Plan Owner

6.4 Testing for Hex. Chrome Residue

6.4.1 Surface Testing

- Suspected components will either be treated as though they have Hex. Chrome residue, or they will be tested with a valid test method.
- Surface testing be used to determine if Hex. Chrome residues are present and to validate that cleaning and neutralization have been properly removed the hazard.
- Colorimetric test kits must have documented ability to differentiate between Hex. Chrome and Trivalent Chrome; and a detection threshold of 1 ug/m3
  - Stores Part# **00088098 and 00088101**
- Quantitative wipe tests collected and analyzed at an accredited lab following approved sample method: OSHA ID-215
- At the time of publishing this standard, X-ray Fluoresence Guns are not validated as a reliable method for measuring hex. Chrome residue as the device cannot differentiate different valences of chrome.
- Testing must be performed by a competent individual
- Due to the variability in residue formation, a minimum number of tests must be taken from separate locations on the component:
  - <2 square feet – 1 test
  - 2 to 10 square feet – 2 tests
  - 10 to 100 square feet – 3 tests
  - >100 square feet – 5 tests
- The following information must be recorded for each test:

- the exact test location,
- date and time
- name of the tester
- type of test performed

6.4.2 Air Sampling:

- Air sampling can be arranged through Industrial Hygiene.
- Air sampling can be used to:
  - validate whether controls for tasks are effective and whether exposures are being adequately controlled.
  - Asses if controls are effective at preventing inadvertent exposure to other workgroups or bystanders
- Air sampling must be performed by a competent person as per OSHA ID-215.
- The number of tests will depend on the nature of the concern and can be determine by Industrial Hygiene
- Air Sampling requires obtaining samples over a number of hours, sending the sample to a laboratory in the US and waiting for analysis. The typical turnaround time is 5-10 business days, which can be expedited to 3-5 business days if required.

6.4.3 Clearance Sampling:

- Clearance sampling is performed for 2 purposes.
  - To validate that surfaces are hex. Chrome free
  - To validate that airborne hex chrome are low enough to remove any protective measures in place such as enclosures and negative air.
- Clearance sampling must be performed by a competent individual. Air clearance tests must be performed by Industrial Hygiene or a 3rd party Consultant
- The minimum number of clearance samples taken are established below:
  - Air Testing: At least two clearance samples are collected in work areas up to 1235 square feet (115 m2) and one clearance sample for every additional 1235 square feet (115 m2 or part thereof; and
  - Surface Testing:
    - <2 square feet – 1 test
    - 2 to 10 square feet – 2 tests
    - 10 to 100 square feet – 3 tests
    - >100 square feet – 5 tests
- A value for clearance sampling is 0.001 mg/m3
- All tests must be below their respective thresholds to deem an area safe.
- Clearance thresholds are:
  - Air Tests: 0.001mg/m3
  - Surface testing: Any detectable amount or color change indicates Hex. Chrome is still present and needs additional cleaning.
- Guidance for combined clearance testing:
  - Surfaces that could be touched by workers must be found to be hex. Chrome free.
  - Air test results must be below the threshold to remove enclosures and negative air.

6.4.4 Hex. Chrome Residue Neutralization

- Industry experience has demonstrated that neutralization agents exist and can be effective at reducing the risks associated with hex. Chrome residues.
- There are multiple variants, but neutralization agents typically work by lowering the pH and stabilizing Hex. Chome to a less toxic version of chromium – Trivalent Chromium.
- Neutralization can be validated by performing surface testing. If the test kit/swab does not indicate the presence of hex. Chrome, it is considered neutralized and the risk level of work can be reduced.
- If clearance testing confirms the components being worked on are neutralized, then normal work procedures will apply within reason.
- If the component is inside a regulated area with other components, hex. Chrome residue precautions may still apply.

6.5 Hex. Chrome Residue Prevention

Where Hex. Chrome residue could be found, sites/divisions should consider procurement steps to eliminate future or reoccurring formation of hex. Chrome residues.

Hex. Chrome residues form when all three conditions in Section 2.2. exist at the same time. Strategies to eliminate one of the 3 criteria should be able to eliminate the formation of additional hex. Chrome.

- Chrome is an essential component of metallurgy and is often required in high temperature and/or high corrosion circumstances. Chrome is unlikely to be a candidate for replacement, however, its need should be assessed in new builds and component replacements.
- High temperatures are a necessity of processes required to produce electricity. Where appropriate explore opportunities to temperatures below the threshold in Section 2.2
- The most likely opportunity to prevent hex. Chrome residue formation is by eliminated the presence of silicates such as calcium. This can be done by identifying systems where silicate containing substances such as calcium silicate and calcium based anti-seize can be replaced by equivalent alternatives.

6.6 Accidental Hex. Chrome Residue Exposure

In the event that a worker suspects they have discovered, or been exposed to, hex. Chrome residue , follow these steps:

- Immediately stop work and contact your supervisor if you suspect you have discovered or have been exposed to hex. Chrome residue. Do not leave the worksite until given permission from your supervisor.
- The supervisor will make arrangements to secure the work area, and have the material tested.
- The supervisor shall notify Total Health and Safety who may request worker decontamination and or biological monitoring.

6.7 Hazard Communication to Employees

- Each Station/Division is responsible for making workers and contractors aware of where hex. Chrome residues could be present.
- Persons controlling building, equipment or work areas are responsible for
  - notifying employees and contractors who may work in or adjacent to areas where hex. Chrome work is being performed. This can take place as clear boundaries, labels and signs, etc to prevent inadvertent exposure to hex. Chrome.
- The Site/Division is responsible for notifying prospective employers bidding on work if hex. Chrome residues may be present.

6.8 Prohibited Activities

The following activities are known to significantly increase the risk of exposure to hex. Chrome residue and are hereby prohibited:

- Eating or drinking in a hex. chrome contaminated or restricted area.
- Entering hex chrome contaminated or restricted areas without permission and the appropriate PPE.
- Performing hex. chrome work without the appropriate training, education and permission.
- Using compressed air for any cleaning of hex. Chrome residue

6.9 Classification of Hex. Chrome Work

6.9.1 Low Risk – tasks or activities where hex. Chrome residue is not disturbed enough to result in exposures above the Occupational Exposure Limit (OEL), but skin exposure and or clothing contamination is possible.

- Inspections in areas where Hex. Chrome residues may be present but have yet to be disturbed
- Inspections in moderate risk areas when work is not actively happening
- Surface testing for hex. Chrome residue

6.9.2 Moderate Risk – tasks or activities where occupational exposure is anticipated but should remain below 10x the OEL.

- Wet cleaning using manual methods (e.g. cloth, wire brush, etc)
- Wet cleaning using power tool methods
- Disassembly or assembly of components with hex. Chrome residues
  - Removing insulation

- Unbolting components
- Any work where hex. Chrome is suspected but disassembly must occur in order to visually assess or test
- Any work not described in Low or High risk will default to moderate risk.

- Dry cleaning with HEPA vacuum

6.9.3 High Risk – tasks or activities where inhalation or skin exposure is expected to be elevated and/or are unknown.

- Dry cleaning with manual methods
- Dry cleaning with mechanical tools equipped with HEPA filters
- Hot work on residues

6.10 Low Risk Work Requirements:

- Surface testing and visual inspection can occur at various stages of work. As a result the following minimum requirements should be followed in addition to any additional expectations based on the risk level of the work happening at the time of the testing or inspection.
- No person shall enter the work area without the required PPE.
- Eating, drinking, chewing or smoking are not permitted in the work area.
- Respiratory protection is not required, but can be used voluntarily.
- All workers in the work area shall have the proper protective clothing:
  - Dust tight, full body covering with snug fitting cuffs at the wrist, ankles, neck and footwear
  - Chemical resistant gloves
  - Protective clothing is repaired or replaced if torn
  - It is left inside the work area, or is decontaminated using a HEPA vacuum before leaving the work area
  - Discarded protective clothing is disposed as hazardous waste or neutralize and test to confirm it is hex. Chrome free, and dispose of normally
- Facilities for washing/ wiping hands and face are made available and are used when leaving the work area.

6.11 Moderate Risk Work Requirements

- Before beginning any work visible dust and debris in the area should be removed with wet wiping or HEPA vacuum. See Appendix B for HEPA Vacuum expectations.
- No person shall enter the regulated work area without the required PPE.
- Eating, drinking, chewing or smoking are not permitted in the work area.
- Every person who enters the work area is provided with respiratory protection with a minimum assigned protection factor of 10. See Appendix D for a list of respirators and their assigned protection factors. Consider additional respiratory protection needs if other chemicals or substances are used to perform the work.
- All workers in the work area shall have the proper protective clothing:
  - Dust tight, full body covering with snug fitting cuffs at the wrist, ankles, neck and footwear
  - Chemical resistant gloves
  - Protective clothing is repaired or replaced if torn
  - It is left inside the work area, or is decontaminated using a HEPA vacuum before leaving the work area
  - Discarded protective clothing is disposed as hazardous waste.
- Access to the work area is restricted to those wearing the proper protective equipment.

- The work area is identified by clearly visible signs warning of the Hexavalent Chromium hazard.
- The restricted work area shall have a designated area to safely remove protective clothing and respirators.
- Spread of hex. Chrome residue from the work area is prevented by,
  - Disabling the ventilation system if in close proximity to the work area.
  - Establishing a restricted access area around the immediate work area
  - Using drop sheets under the work area to capture and contain residues
  - Frequently during the work and immediately upon completion,
    - Dust and waste containing hex. Chrome residue is cleaned up and removed by wet cleaning methods or HEPA vacuum (see Appendix B)
    - Drop sheets and barriers that are to be re-used are thoroughly cleaned.
- Facilities for washing/ wiping hands and face are made available in close proximity to the restricted work area and are used by all workers leaving the work area.
- Doffing of contaminated PPE is done according to Appendix C
- Wet methods must be used. This includes neutralizing agent, WD40 or Kroil Oil. When using wetting methods consider the need for respiratory protection that is appropriate for the wetting agent(s) being used. Consider the need for face/eye protection as well.

6.12 High Risk Work Requirements

- These activities should be avoided as much as possible. Where no data has been collected to validate exposure levels for any of these activities, extremely conservative controls are required. If any of these work methods are used, contact IH to arrange for air monitoring before starting work.

6.12.1 Preparation

- Before beginning any work visible dust and debris in the area should be removed with wet wiping or HEPA vacuum. See Appendix B for HEPA vacuum expectations.
- The work area is identified by clearly visible signs warning in sufficient number and at sufficient locations to warn of the hazard:
  - There is a Hexavalent Chromium hazard.
  - No person shall enter the work area without the required PPE and respiratory protective equipment
- All workers in the work area shall have the proper protective clothing:
  - Dust tight, full body covering with snug fitting cuffs at the wrist, ankles, neck and footwear
  - Chemical resistant gloves
  - Protective clothing is repaired or replaced if torn
  - It is left inside the work area, or is decontaminated using a HEPA vacuum before leaving the work area
  - Discarded protective clothing is disposed as hazardous waste.
- Respiratory protection is worn by all workers on-site during the preparation of work areas for hex. Chrome work
- Respiratory protection includes
  - A NIOSH approved respirator with P100 filters with an assigned protection factor of 10 or better when hex. chrome is not disturbed. See Appendix D for a list of respirators and assigned protection factors.

  - A NIOSH approved respirator with P100 filters with an assigned protection factor of 1000 or better when hex. Chrome is disturbed. See Appendix D for a list of respirators and assigned protection factors.
  - If using an air purifying respirator, ensure it is equipped with P100 filters for hex chrome residue. Consider additional respiratory protection needs if other chemicals or substances are used to perform the work.
- The Mechanical ventilation system serving the work area is rendered inoperative for the duration of the work to prevent contamination and hex. Chrome residue dispersal to other areas by:
  - Switching off the system where possible, and
  - Sealing the ventilation ducts to and from the work area, or
  - Where the ventilation system cannot be switched off, blanking off the main ventilation duct to the area with rigid impervious material such as metal or wood
- All moveable equipment and material is removed from the work area
- Floors, walls and any items remaining in the room are sealed with polyethylene sheeting, and that
  - The polyethylene on the floor shall extend at least 12 inches up each wall and rip-stop poly shall be placed over the polyethylene on the floor;
  - Any damage to the polyethylene sheeting that occurs as the work proceeds is repaired immediately;
  - The polyethylene sheeting has a minimum thickness of six millimeters (mil); and
  - If the enclosure is opaque, one or more transparent widow areas are installed to allow observation of the entire work area from outside the enclosure
- Drop sheets are used during outdoor removal operations
- A decontamination area is set up adjacent to the work area which consists of:
  - A clean changing room suitable for changing into clean protective clothing or street clothes, and for storing clean clothing and equipment;
  - a room suitable for donning reusable protective clothing, and for storing contaminated protective clothing and equipment;
  - Air lock doors are provided and used between the different rooms, and that
    - they consist of layers of polyethylene with at least a three foot (1 m) overlap,
    - these sheets are weighted at the bottom to keep the flaps closed,
    - they are arranged in sequence, and
    - they are constructed so as to prevent the spread of dust;
  - Washing facilities must be provided to adequately clean potentially contaminated skin prior to workers leaving the decontamination area.
- adequate toilet facilities exist in the work area, or that where such facilities do not exist in the work area, workers must go through the proper decontamination sequence before going to the toilet facilities; and
- the enclosure must be equipped with negative air that;
  - has HEPA filters on the exhaust system
  - has been DOP tested prior to use
  - where applicable, the air is exhausted to the outdoors
  - is equipped with a magnahelic gauge to monitor that negative air can be established and maintained at 0.02 inches of water column

- once the enclosure has been established, a competent person must verify the integrity of the containment and the effectiveness of the negative air system. A record of this inspection must be maintained as part of the project records.
- Eating, drinking, chewing or smoking are not permitted in the work area.

6.12.2 Executing High Risk Hex. Chrome Work

- The supervisor shall ensure:
  - Sampling for airborne hex. Chrome in the areas outside of the containment, but in its vicinity, is performed at least daily if there are unprotected employees in the area
  - Sampling for airborne hex. Chrome in the clean room is performed at least daily during removal and clean- up operations
  - Air sampling shall be performed by a competent 3rd party consultant
  - Daily inspections area performed of the integrity of the enclosure, negative air and general worker cleanliness.
  - The results of the inspection and air sampling are available to all employees involved.
- Negative air pressure is established inside the work area before any hex. Chrome residue is disturbed.
  - Negative air must operate on a 24-hour basis until the space is deemed "clear" for return to normal work
  - A minimum of 4 air changes per hour is maintained in the removal area
  - Negative air units, filters and hosing must be used, inspected, maintained and repaired according to manufacturer specifications (Appendix B)
- Personal protective clothing is provided by the employer, and worn by every employee who enters the work site,
- Personal protective equipment is
  - Dust tight, full body covering with snug fitting cuffs at the wrist, ankles, neck and footwear
  - Chemical resistant gloves
  - repaired or replaced if torn
  - is donned in the clean changing room, and street clothes are left in the clean changing room, preferably in individual lockers, and
  - is removed (doffed) when leaving the work site and is stored or discarded in the decontamination area above.
- Respiratory protection is worn by all workers inside the enclosure during hex. Chrome work
- Respiratory protection includes
  - A NIOSH approved respirator with P100 filters with an assigned protection factor of 1000 or better when hex. Chrome is disturbed.
  - Alternatively, air line respirators can be used if required.
- Only authorized personnel are permitted to enter the enclosure and work area
- Worker decontamination (Appendix C)
  - Work clothes are removed and left in the work area or in the room between the work area and the shower room
  - Respiratory protection is only removed as the worker starts the necessary washing steps.
  - After washing, the worker proceeds to the clean change room
  - Where protective clothing will be reused, it is decontaminated using a HEPA vacuum or by damp wiping. Decontamination must be validated with testing.

- Where protective clothing will not be reused, it is discarded in the same manner as hex. Chrome hazardous waste.

6.12.3 Clean-up of Removal Area

The supervisor shall ensure;

- following removal of hex. Chrome, the entire area, including the decontamination area, is wet cleaned and vacuumed with HEPA filters to remove all visible residue;
- the equipment used during the removal is (i) wet wiped; (ii) washed and wrapped in polyethylene; or (iii) placed in plastic bags;
- Surfaces that are intended to be clean can be neutralized where appropriate. Neutralization must be validated with spot testing to validate it was effective.
- Areas that are intended to be returned in a "hex. Chrome free" state must be tested as per section 6.4.1 and found to be hex. Chrome free.
- Workers involved in clean up use the same PPE, respiratory protection and decontamination procedures as Section 6.12.2
- Washing facilities are dismantled and removed last, in order that they can be used by employees engaged in the clean-up procedures;
- Except for outdoor operations, the owner of a place of employment, an employer and a contractor shall ensure that clearance testing is performed as per Section 6.4.3:

Waste Management

- All components and materials suspected or known to have hex. Chrome residues, must be stored to prevent the spread of contamination
- Components or material surfaces can be tested to assess if hex. Chrome residues are present or have been effectively removed. If test results indicate hex. Chrome is not present; the components or materials are no longer considered hazardous waste.
- Small, contaminated materials (e.g. gloves, disposable coveralls, wipes, used test swabs) shall be placed in labelled plastic bags (6 mil) or barrels prior to removal from the worksite.
- Disposal must meet applicable Department of Environment and Local Government Guidelines.

7.0 TRAINING

All individuals who will be working on materials with Hex. Chrome residue will require appropriate instruction and training.

- Low Risk - Awareness Level Understanding - Review standard and applicable work procedures
- Moderate Risk – Awareness Level Understanding - Review standard, doffing procedure (appendix c) and applicable work procedures
- High Risk – Formal training:
  - Health Hazards
  - Exposure risks
  - Specific work practices
    - Building and validating enclosures
    - Validation of HEPA filters equipment according to Appendix B (where applicable)

- Worker protection
  - Proper use of required PPE
  - Work control methods
  - Doffing and worker hygiene practices (Appendix C)

- Proof of training shall be provided for each employee or contractor, upon request.

8.0 APPENDIX

Appendix A – Images of Hex. Chrome Residue
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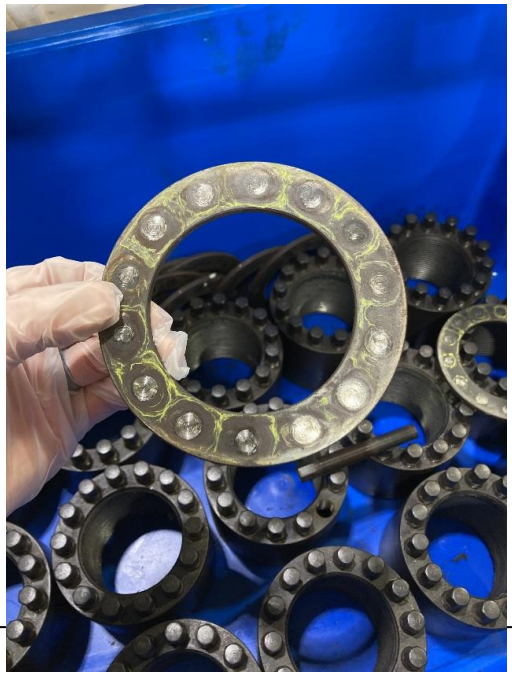
Director of Total
Health & Safety

DOCUMENT APPROVAL/REVISION RECORD

Revision #	Date	Revision Summary	Author	Reviewed By	Approved By
New		New	M. MacFarlane	H&S Team	Roland Roy

Appendix A – Images of Hex. Chrome Residue



RH Bypass

Appendix B – DOP Testing requirements for HEPA Filter equipment

1. DOP Testing is required for all equipment equipped with HEPA filters where hazardous materials are being used.
2. A HEPA filter or system is DOP tested when it has a sticker and/or certificate attached that displaying:
    a. a) Testing company name and contact information. b) Certificate or Test number. c) Date of testing. In a DD/MMM/YYYY format (e.g. 5-Jan-2021). d) Location of equipment testing. e) Information of Tested Equipment including, i. Manufacturer. ii. Make/Model. iii. Serial Number. f) Maximum leakage rate %. g) Test result (i.e. Pass, Fail). h) Technician name and signature
3. DOP Testing must be performed by a competent person
4. DOP Testing must be done in accordance with an industry standard such as:
    - Environmental Abatement Council of Canada – Performance Leak Testing Guideline for HEPA Filtered Equipment **https://www.eaccanada.ca/wp-content/uploads/2021/06/EACC-Performance-Leak-Testing-Guideline-for-HEPA-Filtered-Equipment-June-2021.pdf**
5. DOP Testing must be performed at the frequency below based on the type of HEPA filter equipment being used.

    5.1 HEPA Vacuums must be tested:
    - A minimum of every 12 months regardless of location of exhausting and frequency of use.
    - Whenever maintenance work is conducted such as changing or repair of HEPA filters, working on motors or any other maintenance that will affect the seal or integrity of the vacuum.
    - In the case of hazardous material (e.g. hex. Chrome residue) abatement activities where equipment is transient every 3 months.

    5.2 HEPA Negative Air units must be tested:
    - For each project on-site where the exhaust from the units is vented indoors or near exterior HVAC systems and/or intakes.
    - A minimum of every 12 months regardless of location of exhausting and frequency of use.
    - Whenever maintenance work is conducted such as changing or repair of HEPA filters, working on motors or any other maintenance that will affect the seal or integrity of the unit.
    - Whenever the unit suffers trauma which could affect the integrity of the unit.
    - In the case of hazardous material (e.g. hex. Chrome residue) abatement activities where equipment is transient every 3 months

Appendix C – Doffing Procedure: Contaminated Area (with Hard Hat, Respirator & Safety Glasses)

Important: Perform doffing in a designated area with waste containers and hand hygiene supplies. Avoid touching your face or any contaminated surfaces.

Step-by-Step Doffing Sequence

1. **Outer Gloves** (if double-gloved)
    - Remove and discard.
    - **Hand hygiene** on inner gloves.
2. **Safety Glasses**
    - Remove by touching the arms only.
    - Avoid contact with the front lenses.
    - Place in a designated container for disinfection.
3. **Hard Hat**
    - Remove by handling the inside or back adjustment strap.
    - Avoid touching the outer shell if potentially contaminated.
    - Place in a bin for cleaning or disinfection.
4. **Coverall or Gown (including attached boot covers)**
    - Untie or unzip without touching the outer surface.
    - Peel away from the body, turning inside out.
    - Roll into a bundle and dispose of appropriately.
5. **Boot Covers** (if not attached to the suit)
    - Remove carefully, touching inside surfaces only.
    - Dispose in contaminated waste bin.
6. **Respirator**
    - Remove **last**, handling **only the straps** (top strap first, then bottom).
    - If your work requires a shower for decontamination, keep your respirator on until you get to the shower, then remove.
    - Avoid touching the front.
    - Clean with a wipe and bag (if reusable) or discard.
7. **Inner Gloves**
    - Use glove-in-glove technique to remove.
    - Dispose properly.
8. **Hand Hygiene**
    - Wash hands thoroughly with soap and water or use an alcohol-based hand sanitizer.

Summary of Order

Step	PPE Item	Key Handling Tip
1	Outer gloves	Remove carefully, avoid skin contact
2	Safety glasses	Remove by arms, avoid lens area
3	Hard hat	Remove by inside or rear strap
4	Gown/coverall	Peel off slowly, turn inside out
5	Boot covers (if separate)	Avoid touching outside
6	Respirator	Handle only straps
7	Inner gloves	Use glove-in-glove method
8	Hand hygiene	Wash or sanitize thoroughly

Appendix D – Respirator Assigned Protection Factors from HSEE-03-18: Respiratory Protective Equipment

Type of Respirator	Assigned Protection Factor
Air purifying, half-facepiece	10
PAPR, loose fitting facepiece or visor	25
PAPR, helmet or hood, with no SWPF study	25
Airline, continuous flow, loose fitting facepiece or visor	25
Airline, continuous flow, helmet or hood, with no SWPF study	25
PAPR, half-facepiece	50
Air purifying, full facepiece	50
Airline, pressure demand or continuous flow, half-facepiece	50
PAPR, full-facepiece	1000
PAPR, helmet or hood, with SWPF study	1000
Airline, pressure demand or continuous flow, full-facepiece	1000
Airline, continuous flow, helmet or hood, with SWPF study	1000
SCBA, pressure demand, full-facepiece or tight fitting hood	10000
Multifunctional SCBA/airline	10000