Welding Health Hazards

1910 Subpart Q & 1926 Subpart J

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Welding Shield Gas

- Carbon Dioxide
- Argon
- Take care to provide general ventilation
- Provide general ventilation in confined spaces

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Welding Carbon Steel

- Iron Oxide Fume is Generated
- PEL: 5 mg/m3 TWA
- PEL Not normally exceeded in open welding
- Can exceed the PEL in Confined Space
- Manganese Fume is Generated
- PEL: 5 mg/m3 Ceiling
- Sampled on a .8 Micron MCEF Filter

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Welding Galvanized

- Should Actually not Weld Galvanized
- Zinc Oxide PEL: 15 mg/m3
- Zinc Oxide TLV: 10 mg/m3
- Metal Fume Fever
- Drink Milk at Night if You Do Weld Galvanized

- Sampled on a .8 Micron MCEF Filter

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Welding Stainless

- Typical Fumes Generated Include:
- Cadmium, AL: 2.5ug/m3, PEL: 5ug/m3
- Nickel, PEL: 1 mg/m3
- Manganese, PEL: 5 mg/m3
- Chrome, PEL: 0.5 mg/m3

- Sampled on a .8 Micron MCEF Filter

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1910.1026 & 1926.1126

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Why is It An Issue Now?

- It was released on February 28th, 2006 Under Court Order, 2006 with a PEL of 5µg/m3
- State Plans Adopted the Standard
- Four Years after the effective date of the standard, all provisions were in effect including engineering controls

What is Hexavalent Chrome?

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What is Chrome?

- Chromium Occurs in the Environment predominately in:
  - Trivalent State: Occurs Naturally
  - Hexavalent State: Metallic Chromium positive-6 valence (hexavalent) state.

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Why is It a Problem?

Why is it a Health Hazard?

- NIOSH considers all Cr(VI) compounds to be potential occupational carcinogens
- An increased risk of lung cancer has been demonstrated in workers exposed to Cr(VI) compound… there's more…

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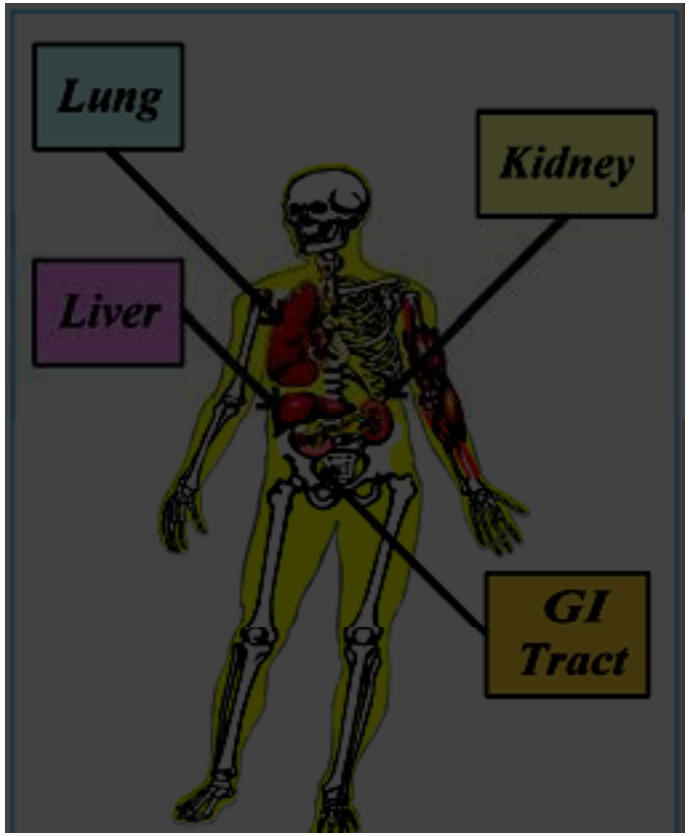
Why is It a Problem?

- Other adverse health affects include:
  - Dermal irritation
  - Skin ulceration
  - Contact dermatitis
  - Occupational asthma
  - Nasal irritation & ulceration



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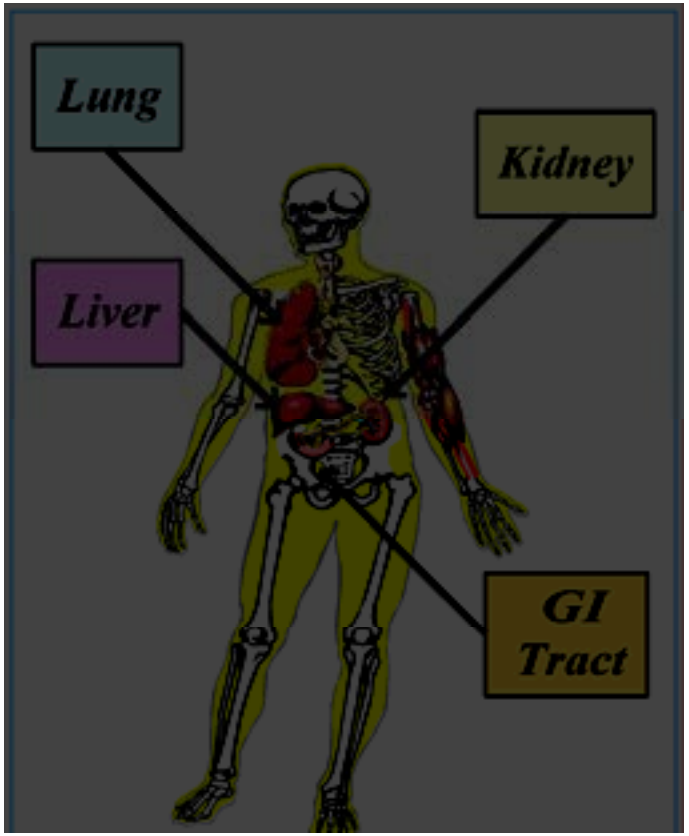
Why is It a Problem?

- Continuing:
  - Perforated nasal septum
  - Nasal cancer
  - Sinus cancer
  - Kidney damage
  - Liver damage



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How Does It Enter the Body?

- By being inhaled or…
- By being swallowed
- Can enter the body through contaminated cigarettes through inhaling
- Particles of chromium can be swallowed if the dust gets on hands, clothing, or beard, or in food or beverages

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Where Does It Occur?

- Where Does It Come From:
  - Production of Stainless Steel

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Where Does It Occur?

- Why an Exposure with Stainless Steel?

  Stainless steel is an alloy (304,2205,2550) consisting of:
  - carbon (0.03% to .45%)
  - chromium (11% to 32%)
  - nickel (.60% to 37%)
  - molybdenum (.35% to 4.0%)
  - smaller amounts of manganese, phosphorous, silicon, sulfur, and copper.

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Where Does It Occur?

- Where Does It Come From:
  - Chrome Plating
    - » chromic trioxide (chromic acid)
    - » zinc chromate
    - » barium chromate
    - » calcium chromate
    - » sodium chromate
    - » strontium chromate

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Where Does It Occur?

- Where Does It Come From:
  - Production of Chromate Pigments
    - » lead chromate (chrome yellow)
    - » chrome green
    - » molybdenum orange
    - » zinc chromate
    - » barium chromate
    - » calcium chromate
    - » potassium dichromate
    - » sodium chromate

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Where Does It Occur?

- Where Does It Come From?
  - Textile Dyes:
    - » ammonium dichromate
    - » potassium chromate
    - » potassium dichromate
    - » sodium chromate

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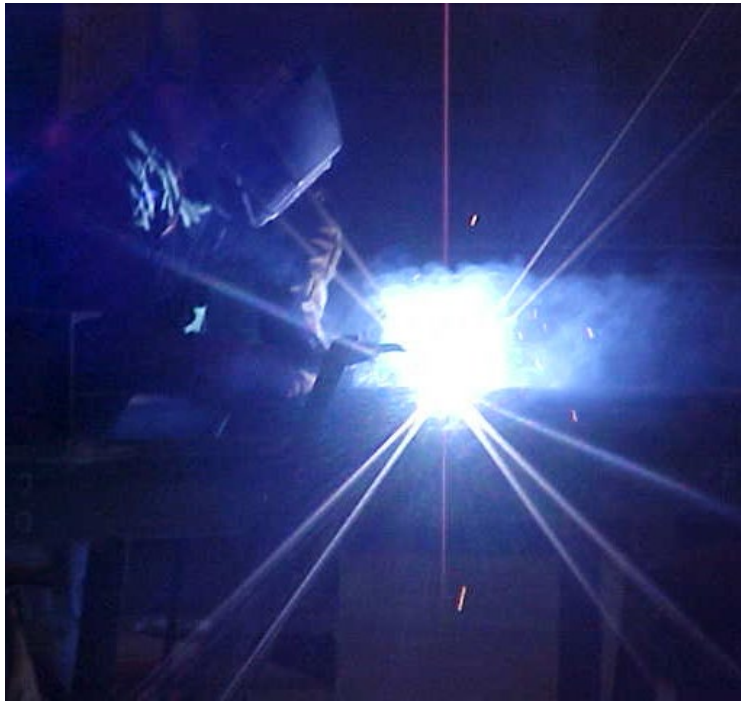
Where Does It Occur?

The most common exposure in General Industry & Construction comes from stainless welding & cutting of painted surfaces (Lead Chromate Paint)



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Where Does It Occur?

- Stainless Welding Processes Yield:
  - Welding Fume Exposures

    Including elements of:
    - » Chromium
    - » Nickel
    - » Cadmium
    - » Manganese
    - » Hexavalent Chrome

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Typical Historical Exposure Levels

- Production (Rolling Mills): 3 – 22 µg/m3
- Chrome Plating: 6 – 28 µg/m3
- Chromate Pigment: 2 – 8 µg/m3
- Textile Dying: 1 – 4 µg/m3
- Stainless MIG Welding: 1.2 – 256 µg/m3
- Stainless TIG Welding: 0.5 – 5 µg/m3

Again, stainless welding and cutting of zinc chromate & lead chromate painted surfaces are the Greatest Exposures In Construction

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Some Understanding of the Science

- When created by welding, hexavalent chrome remains in the hexavalent state for only 72 hours.
- After 72 hours, it reverts back to Chrome III.

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The Requirements of the Standard

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Key Compliance Steps

- Perform a risk assessment of CrVI exposures
  - Review MSDS to determine presence of Cr VI
  - Review past IH samples
  - Assess processes
  - Assess current engineering and administrative controls
  - Quantify CrVI exposure….
  - Based on results - Implement Program

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Basics of The Standard

- Monitor employee exposure in General Industry

- Establish regulated areas in General Industry when exposures may be expected to exceed the PEL (Regulated Areas not Required in Construction, but may be mandated on Industrial Construction Sites

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Basics of The Standard

- Implement engineering and work practice controls to reduce exposures
- Provide respiratory protection in emergencies or when engineering and work practice controls are not feasible or are insufficient
- Provide other protective clothing and equipment as necessary for eye and dermal protection if hazard assessment indicates exposure

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Basics of The Standard

- Provide hygiene facilities and housekeeping activities in some situations
- Provide medical surveillance for employees experiencing signs or symptoms of CrVI exposure or who are exposed in an emergency
- Train workers about hexavalent chromium hazards
- Use signs and labels to communicate hazards to workers
- Keep records on everything

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Basics of The Standard

Exceptions:

- Tasks or operations that do not result in exposures above the PEL for 30 or more days per year

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Basics of The Standard

- How do we address the “Potential for Skin & Eye Exposure”? Do we need it?
  - Welding of stainless creates airborne hexavalent chrome
  - Cutting of lead chromate coated steel creates airborne hexavalent chrome
  - NIOSH stated in a 2003 Study that airborne concentrations of hexavalent chrome over 1 µg/m3 is considered a contaminated area.

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Basics of The Standard

- How do we address the “Potential for Skin & Eye Exposure”? Do we need it?
  - If IH sampling results are over 1 µg/m3 - protection for eye & skin contact may be necessary - research is ongoing.
  - OSHA has stated that employer must perform “Hazard Assessment”
  - OSHA has also stated “Exposure must be reduced or eliminated”

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Basics of The Standard

How do We Start Complying

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Quantify the Exposure

- IH sampling must be performed.
- Use the correct sampling procedure
- CrIII and CrVI cannot be sampled on the same media
- Consult with your laboratory for sampling method and analyzing method

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Implement Respiratory Protection

- Select respirators based on IH sample data
- Implement all elements of Respiratory Program

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Evaluate Potential for Skin & Eye Exposure

Perform Hazard Assessment

- Determine potential for skin and eye contact

- Implement program and procedures for protective clothing & eye protection

If Assessment Indicates Exposure…

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Change Rooms & Hygiene Facilities

- Change rooms
  - separate storage facilities for PPE and street clothes

- Washing facilities
  - Wash hands and face:
    - » at the end of the work shift
    - » prior to eating, drinking, smoking, chewing tobacco or gum, applying cosmetics, or using the toilet

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Medical Screening

- Must be provided by or under the supervision of a physician or other licensed health care professional (PLHCP)
- Must be performed within 30 days of the initial exposure to hexavalent chrome
- Must be performed annually thereafter

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Explore Engineering Controls

- Enclosing the process if possible
- Change weld chemistry or process
- Local exhaust ventilation (LEC)
  (Lincoln makes a portable HEPA local exhaust system - other mfgs. also supply)
- Gun mounted local exhaust systems
- LEC does not work on MIG welding (Shield Gas)
- LEC can work on stick welding

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Sampling for Hexavalent Chrome

Let's Use Welding Fume Sampling as an Example

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How do We Sample for Hexavalent Chrome?

- First, talk with your AIHA accredited laboratory

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How do We Sample for Hexavalent Chrome

- Welding Sample:
  - 25mm PVC sample media
  - Under the hood
  - Sample rate is typically 2 LPM
  - Separate morning & afternoon samples are recommended

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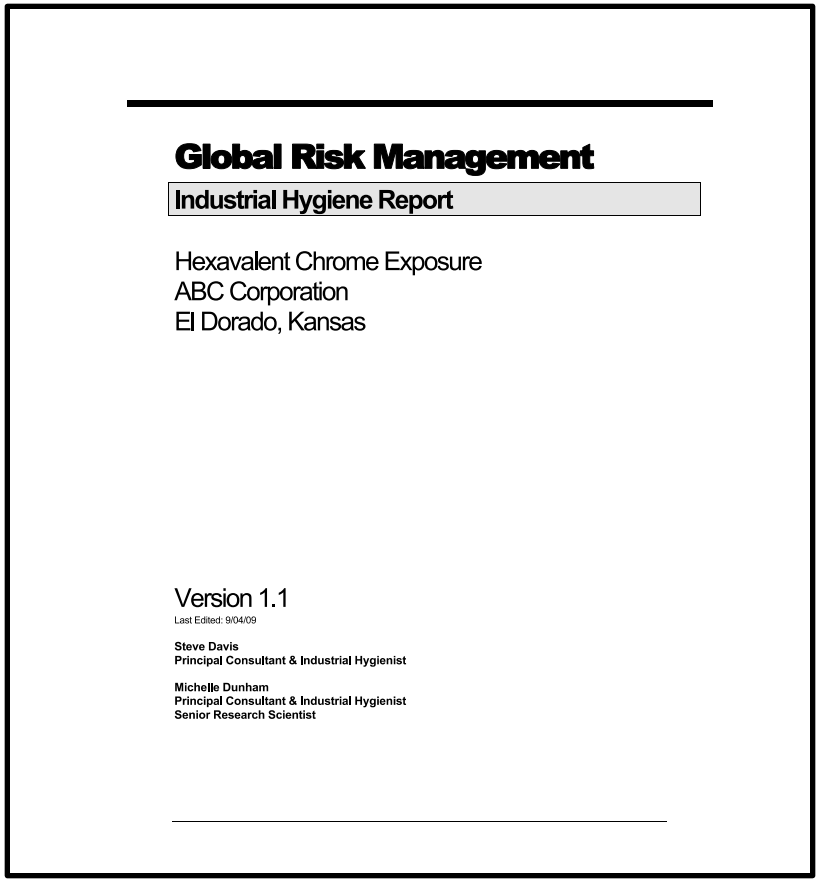
How do We Sample for Hexavalent Chrome

- Sample on Monday-Thursday (not on Friday)
- Must process and overnight samples to lab (72 hour rule)
- Ask for Results to be emailed

Once the Sample Results are Received

- Evaluate and develop your analysis and report
- Communicate the sample results to the workers in writing within 5 days or receipt



Global Risk Management

Industrial Hygiene Report

Hexavalent Chrome Exposure
ABC Corporation
El Dorado, Kansas

Version 1.1

Last Edited: 9/04/09

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Results, Analysis & Report

- Determine worker exposure
- Determine engineering controls/options
- Determine sample program
- Determine respiratory protection

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Evaluate IH Results

If initial Cr(VI) concentration is:

– Below the AL	Discontinue monitoring
– At or above the AL	Monitor every 6 months Can discontinue monitoring if exposures are below AL and confirmed
– Above the PEL	Monitor every 3 months Can discontinue monitoring if exposures are below AL and confirmed

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Key Fact

- You must sample for different worker exposures, i.e..
  - Different Weld Procedures
    - Stick, MIG, TIG, Submerged Arc, plasma cutting, arc gouging
  - Different Base Metals
    - 304
    - 2201
    - 2205
  - Different Weld Chemistry
    - 2209 wire
    - High nickel chrome moly wire

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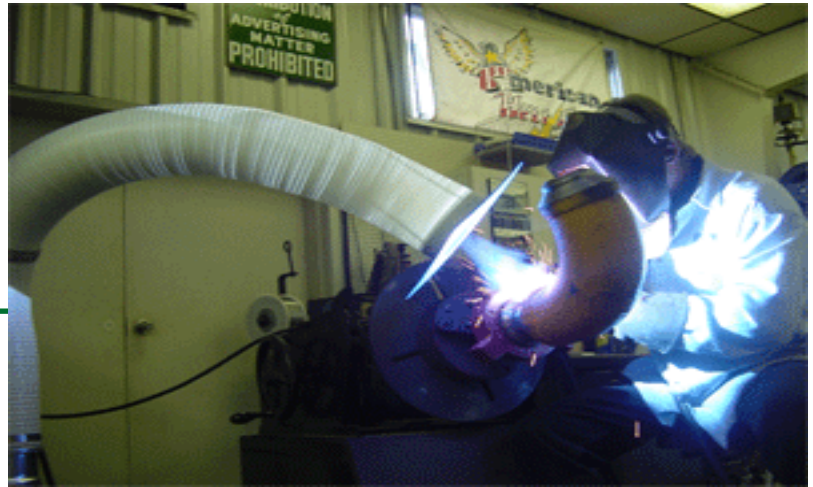
How Do We Control Exposure?

Under the Current Standard, Typical Control Measures Include:

- ***Local Exhaust Ventilation (Fume Extractors)***



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Hex Chome Engineering Controls

- Key Fact:
- It's very difficult to use local exhaust ventilation on shielded gas welding (MIG)
- Will remove the shield gas – resulting in poor weld quality

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How Do We Control Exposure?

Under the Current Standard, Typical Control Measures Include:

- ***Respirators***
  - ***Air Purifying***
  - ***HEPA***
  - ***PAPR***
  - ***Supplied Air***
  - ***Welding Hood PAPR***

Cannot Select without IH

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How Do Control Exposure?

Respirator Use in Hexavalent Chrome Exposures:

One Thing to Remember: Respirators with PF of 10 Will Not Work @ Exposures above 50ug/m3. Otherwise, Air Supplied

Respirators or Full Face Air Purifying Respirators must be used.

We Must Attempt to Engineer Out the Exposure…How?

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Case Study

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Example of Implemented Program

Project

- ***AEP Cardinal 3 JBR Vessel Erection***
- ***Base Metal: 2205 & 2550 Stainless***
- ***Weld Procedures: MIG and Pulse Arc Welding with 2209 & High NiCrM Wire***

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Example of Implemented Program

- ***Assessment with IH sampling for Welding - sampling under the hood (25mm PVC Cassette)***
- ***Low Profile 3M P100 with 2097 Cartridge***
- ***3M 8515***
- ***Protective Clothing & Eye Protection***

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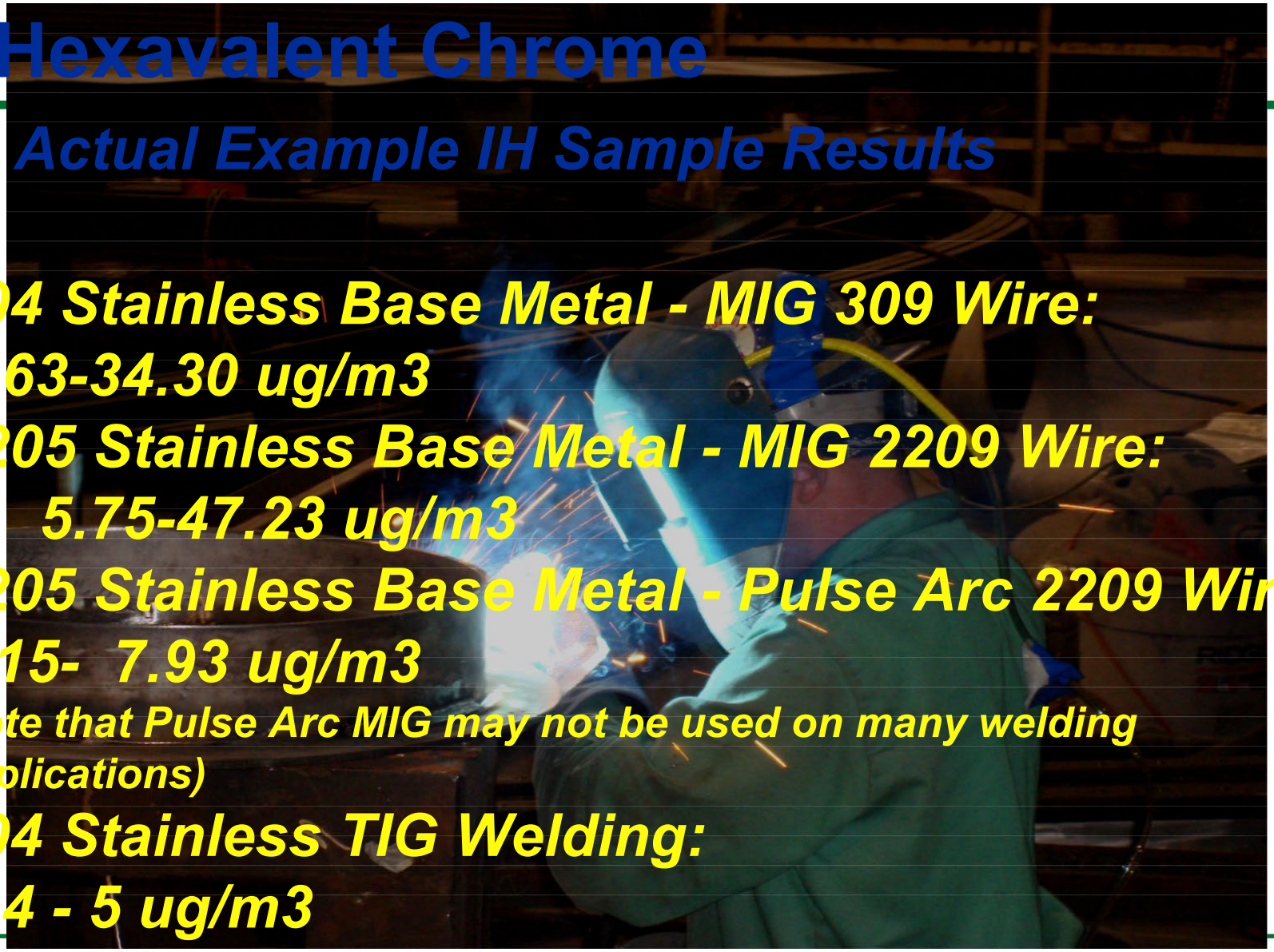
Actual Example IH Sample Results



- *304 Stainless Base Metal - MIG 309 Wire: 5.63-34.30 ug/m3*
- *2205 Stainless Base Metal - MIG 2209 Wire: 5.75-47.23 ug/m3*
- *2205 Stainless Base Metal - Pulse Arc 2209 Wire 1.15- 7.93 ug/m3*

  (Note that Pulse Arc MIG may not be used on many welding applications)
- *304 Stainless TIG Welding: 0.4 - 5 ug/m3*

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Example of Implemented Program

Change Trailer with Hygiene Facilities

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Example of Implemented Program

Barricaded Areas & Signs

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Example of Implemented Program

Laundering of Protective Clothing with Water Soluble Bags

This solution coordinated with UniFirst

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Common Citations

- **1910.1026(d)(2)(i)** Exposure Monitoring
- **1910.1026(d)(4)(i)** Worker Communication
- **1910.1026(e)(1)** Regulated Areas
- **1910.1026(f)(1)(i)**Control Measures (Engineering)
- **1910.1026(g)(1)** Respiratory Protection
- **1910.1026(h)(1)** Protective Clothing & Equipment
- **1910.1026(i)(1)** Hygiene Areas & Practices
- **1910.1026(l)(2)(i)** Employee Information & Training
- **1910.1026(m)(4)(i)** Medical Surveillance

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References To Use

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References - URL's To View

- ***OSHA Hex Chrome Website: www.osha.gov/SLTC/hexavalentchromium/recognition.html***
- ***NIOSH Topics Page http://www.cdc.gov/niosh/topics/hexchrom/***
- ***NIOSH Methods Page: http://www.cdc.gov/niosh/76-129.html***
- ***Argonne National Laboratory Paper on Chromium http://www.ead.anl.gov/pub/doc/chromium.pdf***
- ***NAM's Letter to OSHA http://www.nam.org/s_nam/doc1.asp?CID=201576&DID=232786***
- ***ASSE's Letter to OSHA http://www.asse.org/press424.htm***
- ***Public Citizen's Position Letter http://www.citizen.org/pressroom/release.cfm?ID=1800***

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Objectives

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Summary

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Thank You For Attending!

Final Questions?

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Handouts

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