OREGON OCCUPATIONAL SAFETY AND HEALTH DIVISION
DEPARTMENT OF CONSUMER AND BUSINESS SERVICES

PROGRAM DIRECTIVE

Program Directive A-278
Issued August 18, 2010

SUBJECT: National Emphasis Program: Hexavalent Chromium

REFERENCES:

A. CPL 02-02-076; EFFECTIVE DATE: February 23, 2010
SUBJECT: National Emphasis Program – Hexavalent Chromium

B. CFR 1910.1026 Chromium (VI), published 2/28/06, Federal Register, vol. 71, no. 39, p. 10100; 12/12/08, FR vol. 73, no. 240, pp. 75568-75589, 29 CFR 1926.1126, Chromium (VI).

C. Oregon OSHA FIRM
Oregon OSHA enforcement

D. Oregon OSHA Program Directive A-270, Chromium (VI) Inspection Procedures, July 24, 2008. (Contains enforcement policy for general industry and construction)

PURPOSE: This directive describes policies and procedures for implementing a national emphasis program (NEP) in Oregon to identify and reduce or eliminate the health hazards associated with occupational exposure to hexavalent chromium and other toxic substances often found in conjunction with hexavalent chromium.

SCOPE: Applies to all Oregon OSHA.

BACKGROUND: Hexavalent chromium compounds all contain the chromium (+6) ion, which is also written as chromium (VI) or Cr(VI). In 2006, Oregon OSHA issued health standards regulating exposures to hexavalent chromium compounds in general industry (1910.1026) and construction (1926.1126). The primary occupational health effect associated with hexavalent chromium compounds is an increased risk of lung cancer from inhalation exposures. In addition, health effects associated with exposure to chromium (VI) can include airway sensitizations, or asthma, skin sensitizations, e.g., allergic and irritant contact dermatitis, nasal and skin ulcerations, and eye irritation. There are many hexavalent chromium compounds in industrial use, including: chromate pigments in dyes, paints, inks, and plastics; chromates added as anticorrosive agents to paints, primers, and other surface coatings; and chromic acid used to electroplate chromium onto metal parts to provide a decorative or protective coating. Hexavalent chromium can also be formed during "hot

work," such as the welding, brazing, and cutting of stainless steel or other chromium-containing metals and the melting of chromium metal. In these situations, the chromium metal is not originally hexavalent, but the high temperatures involved in the process result in oxidations that convert the chromium to a hexavalent state. Through analysis of historical Federal OSHA sampling data, a number of toxic substances were identified that are often found in the same industrial applications where hexavalent chromium is or can be present: antimony, arsenic, cadmium, calcium oxide, cobalt, copper fume, lead, iron oxide, manganese, nickel, silver, tin, and zinc oxide. See Appendix C. These substances are regularly present in conjunction with hexavalent chromium and may be released into the work environment from the same materials and in the same manner as hexavalent chromium.

PROCEDURES:

A. Targeting.

Inspections under this NEP will generally focus on industries where overexposures to hexavalent chromium are known to occur. Establishments with fewer than 10 workers will be included in this NEP.

1. Identifying Facilities for Inspection.

Exposures to hexavalent chromium are found in many industries, but are not necessarily found in all establishments within those industries. Federal OSHA compiled extensive data on hexavalent chromium exposures in developing the Chromium (VI) standard, and has relied on that data for purposes of establishing a targeting program for this NEP.

Appendix A-1 contains a list of industries where overexposures to hexavalent chromium are known to occur, although not all firms in these industries necessarily have hexavalent chromium exposures.

Appendix A-2 describes methods that can be used to target, with greater certainty, firms that are most likely to have Cr(VI) overexposures.

a. Master List Generation.

The health inspection scheduling system targets employers in high hazard industries identified in 437-001-0057, Scheduling Inspection, Appendix B, Health Inspections for Fixed Places of Employment, Tier A. Inspections under this NEP will be scheduled within Tier A of the health scheduling system. Table A-1, (found in Appendix A-1) identifies the selected industries in which inspections under this NEP will be targeted.

b. Inspection Scheduling.

Inspections may be scheduled in any order to make efficient use of resources. Upon adoption of this emphasis program, inspections will be scheduled beginning with the FFY2011 scheduling list. (Some of the industries targeted by this NEP are also targeted by other NEPs, e.g., combustible dust, lead, and silica.) Whenever possible, inspections under this NEP should be conducted concurrently with other programmed inspections.

2. Complaints and Referrals.

a. General Industry.

Complaint(s) or referral(s) for any general industry operation alleging potential overexposures to Cr(VI) must be handled in accordance with the procedures outlined in Oregon OSHA Program Directive A-219, Inspection Criteria: Complaint Policies and Procedures. Appendix B-1 of this Cr(VI) NEP provides information on general industry operations particularly likely to lead to worker overexposures to Cr(VI). Complaints and referrals alleging worker overexposures to Cr(VI) or involving workers with elevated biomarkers of Cr(VI) exposure (e.g., in blood, urine, or hair) or symptoms of exposure to Cr(VI) have priority and require an inspection.

b. Construction.

Appendix B-2 of this Cr(VI) NEP provides information on construction processes most likely to result in overexposures to hexavalent chromium. Whenever Oregon OSHA receives a complaint or referral for any construction operation where the potential exists for worker overexposure to Cr(VI), or a compliance safety/health officer (CSHO) observes a potential worker overexposure to Cr(VI), or Oregon OSHA receives information through any other source regarding construction operations where there is a potential for overexposure to Cr(VI), Oregon OSHA will:

- Document the status and condition of the work operation as far as they are known, noting any potentially serious hazards. Where possible this should include process information (such as type of process, substrates for welding, or conditions of exposure) that is indicative of the likelihood of overexposure to hexavalent chromium. Documentation of the events leading up to the observation must be maintained in the file.

- Note the location of the workplace and name/address of the employer(s) performing the operation; and,

- Handle the complaint or referral in accordance with the procedures outlined in Oregon OSHA's Field Inspection Reference Manual (FIRM).

- When a safety compliance officer (SCO) is inspecting a construction site and observes an activity where potential Cr(VI) overexposures are suspected, appropriate health referrals will be made.

B. Inspection Procedures.

Inspections initiated under this NEP will be scheduled and conducted in accordance with provisions of the FIRM, except as noted.

1. Once an inspection has been scheduled for an identified establishment, review the employer's citation and fatality/accident history prior to opening the inspection. Inspections under this NEP are to be conducted by a health compliance officer (HCO) who has received training. This training will be accomplished at the local level and cover the hazards of hexavalent chromium, the contents of this directive, and the Chromium (VI) Inspection Procedures, PD A-270.

2. Inspections for this NEP will be done in conjunction with the comprehensive scheduled inspections from Health Inspections for Fixed Places of Employment, Tier A. The HCO must also determine if the identified establishment is scheduled for any other programmed inspection (e.g., national emphasis program (NEP) or local emphasis program LEP).

3. At the opening conference, the HCO will verify with the employer the correct Standard Industrial Classification (SIC) or NAICS code for the establishment. The HCO must then verify with the employer whether processes that may produce worker exposures to Cr(VI) or any of the toxic substances listed in Appendix C of this Cr(VI) NEP are conducted at the facility. For health inspections not tied to Health Inspections for Fixed Places of Employment, Tier A if it is determined that no such processes are present, the HCO must exit the facility with no inspection being conducted. However, if the establishment is targeted under another NEP or LEP, the HCO will proceed with an inspection under the other program.

   If any processes are present that may produce worker exposures to Cr(VI) or any of the toxic substances listed in Appendix C, the HCO will proceed with the inspection following the procedures of this NEP. The HCO will consider and evaluate worker exposures and compliance in regard to activities including, but not limited to: regular operations; setup and preparation for regular operations; making adjustments during operations;

cleaning of the process area; scheduled and unscheduled maintenance; implementation of engineering controls; use of personal protective equipment (PPE); medical surveillance programs; and worker training and education.

In conducting inspections under this NEP, the HCO must also follow the inspection procedures contained in the Oregon OSHA FIRM or PD A-270, Chromium (VI) Inspection, Section I.

4. All inspections conducted under this NEP where workers are exposed to Cr(VI) or any of the toxic substances listed in Appendix C of this Cr(VI) NEP are expected to include personal exposure monitoring. HCOs assigned inspections under this NEP will normally take calibrated instruments and sampling media with them on the first day of the inspection in order to take advantage of any worker sampling opportunities that may be present, including short duration screening samples. This should include adequate materials to immediately ship Cr(VI) sampling media to the lab. If exposure monitoring is not conducted as part of the inspection, include a thorough explanation for why monitoring was not conducted in the inspection file. HCOs should not rely solely on employer sampling data in making the decision not to conduct monitoring.

5. If safety hazards are noted that cannot be appropriately dealt with by the HCO, an appropriate safety referral will be made.

6. The protection of CSHOs during any inspection is important. In order to ensure adequate protections, CSHOs must conduct a hazard determination to establish the presence of Cr(VI) (or other toxic substances) prior to initiating the walk-around. This hazard determination will rely on information such as previous inspection history, material safety data sheets, professional judgment, and/or previous exposure monitoring surveys. Appendix D of this Cr(VI) NEP contains a sample hazard determination table for CSHOs performing inspections for hexavalent chromium.

7. Personal protective equipment (PPE) to be used during the inspection, such as respirators, gloves and/or protective clothing, is to be made available to the CSHO prior to the inspection and will be worn based on the CSHO's determination of expected hazardous exposures. Appendix E of this Cr(VI) NEP contains tables of suggested PPE for CSHOs conducting inspections under this NEP in the following industries:

   a. Electroplating, Plating, Polishing, Anodizing and Coloring Industry

   b. Gray and Ductile Iron Foundries

c. Metal Fabrication Shops

d. Scrap Metal Industry

The health enforcement managers will ensure that CSHOs understand how their own PPE is to be handled after an inspection, including provisions for laundering or disposal of protective clothing and decontamination of equipment. Generally, equipment decontamination may be aided with the use of soap and water, but where material safety data sheets are available they should be consulted for cleaning methods within the sections for first aid and/or spill control.

8. Expanding Scope of Inspection.

The CSHO may expand the scope of an inspection if other workplace hazards or violative conditions are observed and/or brought to their attention. The CSHO will follow the guidelines in the FIRM when expanding the scope of the inspection (Oregon OSHA's FIRM Chapter 3)

C. Follow-Up Inspections and Monitoring.

Follow-up inspections will be conducted for case(s) in which the employer was cited for violations tied to documented exposure(s) above the applicable (permissible exposure limit (PEL) for hexavalent chromium or any of the toxic substances listed in Appendix C of this Cr(VI) NEP. Health Enforcement Managers will work with HCOs where the employer has requested abatement assistance in determining if controls reduce exposure(s) below the PEL. Follow-up inspections could also be conducted for cases with documented exposures above the action level (AL) where the employer was cited for failure to comply with requirements triggered by those exposures. Resources allowing, the follow-up inspection will be conducted within 30 days after the final abatement date for the cited violations. During the follow-up visit the HCO must verify the employer's abatement documentation/verification by carefully evaluating any and all air monitoring results, implemented engineering controls, PPE (including respiratory protection), housekeeping and worker information and training programs. Procedures for follow-up inspections will be in accordance with the Oregon OSHA FIRM.

It is expected that personal air sampling will be conducted by HCOs during follow-up inspections, unless the job task or job site is no longer active. If exposure monitoring is not conducted, a thorough explanation for not monitoring is required.

OSHA-1 CODING: All enforcement activities (inspections, complaints, and referrals) and compliance assistance conducted under this NEP must be coded with the NEP code, "CHROME6," entered in the appropriate NEP field/item

number on the respective form. All inspections conducted under this NEP will be "Health" inspections and should be coded as such.

The OSHA-1 for all inspections will be coded as follows:

1. The Inspection Classification (box 25d) will be National Emphasis Program **"CHROME6"**

2. Inspection Category, (box 21) must be recorded as "H."

OUTREACH: Outreach efforts will be made to employers, industry groups, trade associations, labor unions, and safety and health organizations that may be affected by this national emphasis program.

TRAINING: Oregon OSHA will assure that HCOs receive training on this national emphasis program and other appropriate policies and procedures prior to conducting health inspections under this directive.

EVALUATION: Oregon OSHA will review the targeted industry processes/operations and update them on a periodic basis.

EFFECTIVE DATE: This directive is effective immediately and will remain in effect until canceled or superseded.

History: Issued 8-18-2010

APPENDIX A

TARGETING FACILITIES WITH HEXAVALENT CHROMIUM EXPOSURES

This Appendix describes the procedures that will be used to identify facilities for inspection under this Cr(VI) NEP. This Appendix is divided into two parts:

- APPENDIX A-1. Industries for the Cr(VI) NEP.

  Contains Table A-1, listing industry sectors where overexposures to hexavalent chromium are known to occur (though not all firms in these industries necessarily have hexavalent chromium exposures). These industries were selected by federal OSHA based on a review of (1) data about hexavalent chromium exposures presented in the preamble to the 2006 Final Rule for the Chromium (VI) Standards (71 FR 10100, 10225-63); (2) inspection sampling data showing where federal OSHA has identified overexposures for Cr(VI); and (3) local and regional emphasis programs already addressing Cr(VI); and (4) Oregon OSHA sampling data where exposures to hexavalent chromium were at or above 5 $\mu g/m^3$.

APPENDIX A-1
Industries for the Cr(VI) NEP.

The table below lists industry sectors where overexposures to hexavalent chromium are known to occur, though not all firms in these industries necessarily have hexavalent chromium exposures. The selected industries are based on the review of federal and state (Oregon OSHA) industrial hygiene sampling data as indicated in the table.

Table A-1. Selected Industries for the Cr(VI) NEP.

Industry Sector	SIC	SIC Code Title	NAICS	NAICS Code Title	Comments
Sawmills and Wood Preservation	2421	Sawmills & Planing Mills, General	321113	Sawmills	State data
Converted Paper Products Misc	2657	Folding Paperboard Boxes	322299	All Other Converted Paper Products Manufacturing	State data
Chromate Pigment Producers	2816	Inorganic Pigments	325131	Inorganic Dye and Pigment Manufacturing	Federal data;
Chromium Dye Producers	2819	Industrial Inorganic Chemicals, NEC	325131	Chrome Colors and Other Inorganic Pigments	Federal data;
Chromium Catalyst Producers	2819	Industrial Inorganic Chemicals, NEC	325188	Industrial Inorganic Chemicals Not Otherwise Classified, which includes catalyst production	Federal data; See Appendix A-2, Sect. A
Plastic Colorant Producers	2821	Plastics Materials and Resins	325211	Plastics Materials and Resin Manufacturing	Federal data
Steel Mills	3312	Iron and Steel Mills	331111	Iron and Steel Mills	Federal data
Superalloy Producers	3341	Secondary Smelting, and Refining of Nonferrous Metals	331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except copper and aluminum)	Federal data; See Appendix A-2, Sect. A
Iron and Steel Foundries	332	Iron and Steel Foundries	331512	Steel Investment Foundries	State data
Foundries	3366	Copper Foundries	331525	Copper Foundries (except die casting)	State data

Industry Sector	SIC	SIC Code Title	NAICS	NAICS Code Title	Comments
Cutlery & Tool Manufacturing	3425	Saw Blades & Hand Saws	332213	Saw Blade & Hand Saw Manufacturing	State data
Boiler, Tank & Shipping Container Manufacturing	3443	Fabricated Plate Work (Boiler Shops)	332410	Power Boiler & Heat Exchanger Manufacturing	State data
Machine Shops	3599	Industrial & Commercial Machinery & Equipment, NEC	332710	Machine Shops	State data
Electroplating	3471	Metal Plating and Finishing	332813	Electroplating, Plating, Polishing, Anodizing, and Coloring	Federal data
Other Fabricated Metal Products Manufacturing	3291	Abrasive Products	332999	All Other Miscellaneous Fabricated Metal Products Manufacturing	State data
Agriculture, Construction & Mining Machinery Manufacturing	3523	Farm Machinery & Equipment	333111	Farm Machinery & Equipment Manufacturing	State data
Other General Purpose Machinery, Misc	3561	Pumps & Pumping Equipment	333911	Pumps & Pumping Equipment Manufacturing	State data

APPENDIX A-2
Screening Tools for Targeting the Cr(VI) NEP.

Screening Methods.

Facilities targeted solely by NAICS codes will frequently not have hexavalent chromium exposures, even in those NAICS codes most likely to have hexavalent chromium. For example, in a pilot examination, federal OSHA looked at 40 randomly selected establishments in the NAICS code for electroplating and found that almost 50 percent did not do any chromium plating.

To help assure that OSHA is not doing a large number of inspections at facilities that are unlikely to have Cr(VI) overexposures, the Internet may be used to search for firms' Web sites; many firms' Websites provide specific information about what they make and what services they offer. Such information can be used to identify and eliminate from the list of targeted sites facilities that are not likely to have hexavalent chromium overexposures, e.g., plating establishments that do not do chromium plating and specialty steel producers who do not produce high-chromium or stainless steel.

APPENDIX B

ACTIVITIES MOST LIKELY TO INVOLVE OVEREXPOSURE TO HEXAVALENT CHROMIUM—SUGGESTIONS FOR MAKING REFERRALS

This appendix provides information on the types of activities most likely to result in overexposures to hexavalent chromium.[1] This guide is intended to provide CSHOs with the tools and information needed to make observations and ask questions necessary to identify exposures. The use of referrals is particularly important for hexavalent chromium because the most common activities leading to overexposures - welding, plating, and painting - are found in hundreds of industries, but are common in only a few.

This Appendix is divided into two parts:

- APPENDIX B-1: Work Activities in General Industry that are Likely to Result in Elevated Exposures to Hexavalent Chromium
- APPENDIX B-2: Work Activities in Construction that are Likely to Result in Elevated Exposures to Hexavalent Chromium

[1] Source: "Industrial Profile, Exposure Profile, Technological Feasibility Evaluation, and Environmental Impact for Industries Affected by a Proposed OSHA Standard for Hexavalent Chromium," Shaw Environmental, Inc., February 21, 2006, OSHA Docket H054A, Ex. 50-1.

APPENDIX B-1
Work Activities in General Industry and Maritime Likely to Result in Elevated Exposures to Hexavalent Chromium.

The following general industry and maritime operations may be associated with elevated exposures to hexavalent chromium.

A. Electroplating Operations.

Electroplating operations are found in many industries. These processes apply a chromium coating to a metal or plastic surface for decorative or corrosion control purposes. Workplace exposures to Cr(VI) in electroplating operations are dependent upon the type of plating being performed:

- Hard chrome plating is a process by which a thick layer of Cr metal is applied to a base material to improve wear or corrosion resistance. Exposures commonly exceed the permissible exposure limit (PEL) for Cr(VI) of 5 $\mu g/m^3$.
- Decorative (bright) chrome plating is a process by which a thin layer of Cr is applied to a base material to provide a bright surface with wear resistance. Exposures could potentially exceed 5 $\mu g/m^3$.
- Anodized chrome plating is a process by which an oxide layer is produced on a base material using chromic acid. Exposures are typically less than 5 $\mu g/m^3$.

Tasks involving the highest potential for exposure include placing and removing products into and from the bath, rinsing plated products with water, and replenishing the bath with chromate solution or powder.

B. Welding.

Welding is found in nearly all NAICS codes in general industry, with some of the largest reported numbers of welders in the following industries: NAICS 332, Fabricated Metal Product Manufacturing; NAICS 3366, Ship and Boat Building; and NAICS 562, Waste Management and Remediation Services.

Workplace exposures to Cr(VI) in welding are dependent upon a variety of conditions including the type of material used, the type of welding performed, and the welding environment. Welding activities with the greatest potential for exposure to Cr(VI) include welding stainless steel (e.g., maintenance welding in food manufacturing, NAICS 311) and welding in confined spaces or indoor conditions, on both stainless steel and carbon (mild) steel. Indoor welding without engineering controls results in greater exposures than outdoor welding. Conditions unlikely to result in overexposure to Cr(VI) include carbon steel welding in ventilated areas and welding of stainless or carbon steel in outdoor environments.

Welding fumes may generate from the base metal and applied coatings, electrode coatings, or from the filler metal or flux. High-chromium nickel alloy electrodes and chromium-containing filler metals produce significant hexavalent chromium fume. Similarly, certain types of base metals contain greater percentages of chromium than others and will result in more Cr(VI) in the welding fume. For a list of the most common types of welding metals and their chromium composition, refer to Table B-2.

The following types of welding may result in Cr(VI) exposures exceeding the PEL, in order from highest to lowest likely exposures: thermal cutting (plasma cutting); shielded metal arc welding (SMAW); gas metal arc welding (GMAW); flux-cored arc welding (FCAW); air cutting, arc gouging; plasma welding; and oxy-fuel welding. SMAW, GMAW, and FCAW welding use an electrode and filler metal that may contain Cr(VI); therefore, exposures are possible during those operations even when welding on a non-stainless steel base material.

C. Painting.

Painting operations with the greatest potential for overexposures to Cr(VI) are spray painting, abrasive blasting for the removal of Cr(VI)-containing paint or primer, sanding, and grinding on Cr(VI)-coated materials. The primary hexavalent chromium compounds found in paints and primers are strontium chromate and zinc chromate. Chrome yellow paints and primers are potential sources of hexavalent chromium exposure; however, chrome green paints and primers are not. Blasting grit will contain paint waste; therefore, cleanup and maintenance activities are also potential sources of exposure.

Aircraft spray painting operations have the potential to generate overexposures to hexavalent chromium. Although please note the unique provisions of the chromium standard governing these activities. For large parts or whole craft, engineering and work practice controls must be sufficient to reduce airborne concentrations to 25 $\mu g/m^3$. Respirators must then be used to achieve the PEL of 5 $\mu g/m^3$.

D. Maritime/Shipyard Operations.

In Oregon, Maritime/Shipyard Operations are under the jurisdiction of Federal OSHA. All occupational activities at Maritime/Shipyard Operations will be referred to Federal OSHA.

E. Foundry, Steel Mill, and Other Molten Metal Handling Operations.

Operations with the greatest potential for overexposures to Cr(VI) are furnace and crane operations, molten metal pouring and transfer, tapping, surface conditioning, hot rolling, torch cutting and gouging, and welding (see welding section, above).

APPENDIX B-2
Work Activities in Construction Likely to Result in Elevated Exposures to Hexavalent Chromium.

The following construction industry operations may be associated with elevated exposures to hexavalent chromium.

A. Painting and Surface Preparation (Abrasive Blasting).

Operations with the greatest potential for overexposures to Cr(VI) include the removal of chromate-containing paint and primer for surface preparation of existing steel structures, such as bridges, water towers, and industrial buildings. Use of chromate-containing paint and primer for resurfacing industrial structures is rare and, therefore, not a significant potential source of exposure.

Abrasive blasting is the most common method for preparing steel structures prior to resurfacing, and is often performed inside a temporary enclosure surrounding the structure. Compressed air blow-downs, sweeping, shoveling, and wiping of surfaces following abrasive blasting are also performed inside the enclosure and are potential sources of Cr(VI) overexposures. Equipment maintenance for and site cleanup following abrasive blasting of chromate-containing paint and primer are also potential sources of Cr(VI) overexposures.

B. Welding and Thermal Cutting.

Workplace exposures to Cr(VI) in welding are dependent upon a variety of conditions including the type of material used, the type of welding performed, and the welding environment. Welding operations with the greatest potential for exposure to Cr(VI) include welding stainless steel and welding in confined spaces or indoor conditions, for both stainless steel and carbon (mild) steel. Indoor welding without engineering controls results in greater exposures than outdoor welding. Conditions unlikely to result in overexposure to Cr(VI) include carbon steel welding in ventilated areas and welding of stainless or carbon steel in outdoor environments. Boilermakers perform the majority of confined space work on construction sites.

Welding fumes may generate from the base metal and applied coatings, electrode coatings, or from the filler metal or flux. High-chromium nickel alloy electrodes and chromium-containing filler metals produce significant hexavalent chromium fume. Similarly, certain types of base metals contain greater percentages of chromium than others and will result in more Cr(VI) in the welding fume. For a list of the most common types of welding metals and their chromium composition, refer to Table B-2, below. Types of structures that commonly use stainless steel in construction include: industrial piping and vessels; architectural facades; constructional structures; boilers; indoor architecture; petrochemical structures; and turbine blades.

The following types of welding may result in Cr(VI) exposures exceeding the PEL, in order from highest to lowest likely exposures: brazing, metalizing; thermal cutting (plasma cutting); shielded metal arc welding (SMAW); gas metal arc welding (GMAW); flux-cored arc welding (FCAW); air cutting, arc gouging; plasma welding; and oxy-fuel welding. SMAW, GMAW, and FCAW welding use an electrode and filler metal that may contain Cr(VI); therefore, exposures are possible during these operations even when welding on a non-stainless steel base material.

The table below lists the chromium content of metal alloys commonly found in welding operations. Carbon steels contain less than 10.5 percent chromium. Stainless steels are iron alloys with a minimum chromium composition of 10.5 percent.

Table B-2. Chromium Content of Metal Alloys in Typical Welding Operations.

Metal	Percent Chromium	Extent of Use (Volume)
A 36	0.0	High
AH36	0.03	Low
DH36	0.25 max	Low
EH36	0.04	Low
P91	8–9.5	Low
HY-80	1.0-1.8	Medium
(High tensile strength) HTS	<1	Low
(High strength low alloy) HSLA 80	0.6-0.9	Medium
HSLA 100	0.45-0.75	Medium
HS	0.25	Low
(High yield) HY-100	1.0-1.8	Medium
Inconel	10-20	Low
304 Stainless Steel	17-19	High
308 Stainless Steel	19.5-22	Low
309 Stainless Steel	22-24	Low
310 Stainless Steel	24-26	Medium
316 Stainless Steel	16-18.5	High
321 Stainless Steel	17-19	Low
409 Stainless Steel	10.5-11.75	Medium
410 Stainless Steel	11.5-12.5	Medium
430 Stainless Steel	16-18	Medium
904 Stainless Steel	20	Medium

C. Miscellaneous Construction Activities with Limited Potential for Cr(VI) Exposures.

Woodworking operations involving chromated copper arsenate (CCA) treated lumber may result in Cr(VI) exposures. However, the use of CCA-treated lumber has declined in the construction industry, and the use of this lumber in non-industrial structures, such as playground equipment, decks, picnic tables, landscaping timbers, patios, walkways, boardwalks, residential fencing, and related residential uses has been curtailed.

Industrial rehabilitation and maintenance may result in Cr(VI) exposures. Construction workers may come into contact with Cr(VI) when performing maintenance work on facilities that manufacture or process Cr(VI)-containing compounds, or where Cr(VI)-containing byproducts or wastes are generated.

Chromium refractory restoration and maintenance may result in Cr(VI) exposures. However, only approximately five percent of refractories contain chromium, such as those used in the fiber glass manufacturing industry.

D. Construction Health Enforcement Policy

For complete guidance on health enforcement policy for hexavalent chromium in construction (1926.1126), refer to Program Directive A-270, Chromium (VI) Inspection Procedures. In general, OR-OSHA does not expect construction employers to perform air sampling on every jobsite where mild steel is being used, provided exposure determination(s) ensure adequate worker protection consistent with the use of hierarchy of controls. For welding operations, the type of welding being performed, control of fume generation rates (e.g., voltage, current, electrode size), types of filler metals, and shielding (flux and gas) are key components in planning hazard control and worker protection strategies.

APPENDIX C

TOXIC SUBSTANCES OFTEN FOUND
IN CONJUNCTION WITH HEXAVALENT CHROMIUM

The table below was developed from historical sampling data analyzed by OSHA's Salt Lake Technical Center (SLTC).

Table C. Toxic Substances Commonly Sampled with Cr or Cr(VI).

Antimony	Iron Oxide
Arsenic	Manganese
Cadmium	Nickel
Calcium Oxide	Silver
Cobalt	Tin
Copper Fume	Zinc Oxide
Lead	

APPENDIX D

SAMPLE HAZARD DETERMINATION TABLE FOR CSHOs
INSPECTING FOR HEXAVALENT CHROMIUM

The table below was originally developed by the Eau Claire, Wisconsin, Federal OSHA Area Office, and the content was subsequently adapted by Oregon OSHA for this Cr(VI) NEP.

Table D. Field Hazard Bulletin – CSHO Inspections with Exposures to Cr(VI).

Typical Industries/Operations: Welding, cutting, brazing, abrasive blasting and grinding in general industry, construction, and shipyards (spray painting in maritime operations). Plating, metal fabrication, pigment and dye manufacturing in general industry.

Job Steps		*Hazards Identified*	Preventive or Corrective Measures
1	Anticipating and recognizing the presence of hexavalent chromium	Exposure to Cr(VI)	CSHOs are to be trained in hazard anticipation and recognition, reference Chromium (VI) Inspection Procedures, PD A-270. See Appendix C for other toxic substances.
2	Evaluate exposure of workers	Exposure to Cr(VI)	Review the employer's records to see if they have sampled for Cr(VI). See Appendix C.
3	Donning PPE	Numerous (also see Appendix E)	Wear safety toed shoes, and ANSI-certified safety glasses, wear hard hat on construction sites and all general industry sites where overhead hazards exist. Reference: Personal Protective Equipment (PPE) Policy for OR-OSHA Staff, #28.
4	Evaluate your own exposure to Cr(VI)	Exposure to Cr(VI)	Self-sample for Cr(VI); if medical surveillance required, reference. OR-OSHA Respiratory Protection Policy, #44
5	Hanging and checking pumps	Exposure to Cr(VI)	Normally hang and check pumps by having worker come out of regulated area.
6	Evaluating local exhaust ventilation used to control exposure to Cr(VI)	Exposure to Cr(VI), if controls are inadequate	Have the worker stop the operation; wear PPE including gloves with a long cuff if contact with surface contamination is likely; wear shoe/boot covers and/or full body protection, as well as proper respiratory protection.
7	Evaluating ventilation used to control exposure to Cr(VI) from welding fume	Heat, spark, intense light from welding operation	Assure that welder is off and have worker remove any objects that could burn while doing the evaluation.
8	Evaluating glove boxes used for abrasive blasting	Exposure to Cr(VI) (and silica if sand blasting; also see Appendix C)	If possible, have worker demonstrate the operation of the glove box without substrate in the box.
9	Taking wipe samples for Cr(VI)	Exposure to Cr(VI); wipes pre-treated with caustic 1% NaOH solution	Use PVC or nitrile gloves when taking the wipe sample; remove gloves only after sample(s) sealed, reference Personal Protective Equipment (PPE) Policy for OR-OSHA Staff, #28.
10	Entering regulated area	Exposure to Cr(VI)	Don elastomeric respirator, reference OR-OSHA Respiratory Protection Policy, #44. Also see Appendix C and Appendix E.
11	Decontamination of PPE	Exposure to Cr(VI)	Dispose in compliance with host employer procedures, if procedures are adequate, otherwise remove contaminated PPE and bag in plastic bag provided; contact supervisor for guidance on final disposal.

APPENDIX E

PERSONAL PROTECTIVE EQUIPMENT SUGGESTION TABLES FOR CSHO**s**
EXPOSED TO HEXAVALENT CHROMIUM

The CSHO PPE Suggestion Tables in this appendix were originally developed by the Columbus, Ohio, OSHA Area Office, and were subsequently adapted for this Cr(VI) NEP. There are four tables applicable to operations which may have exposures to hexavalent chromium. Each table is presented in a sub-appendix as follows:

- APPENDIX E-1: CSHO PPE Suggestion Tables for the Electroplating, Plating, Polishing, Anodizing and Coloring Industry
- APPENDIX E-2: CSHO PPE Suggestion Tables for Gray and Ductile Iron Foundries
- APPENDIX E-3: CSHO PPE Suggestion Tables for Metal Fabrication Shops
- APPENDIX E-4: CSHO PPE Suggestion Tables for the Scrap Metal Industry

APPENDIX E-1

CSHO PPE Suggestion Tables for the Electroplating, Plating, Polishing, Anodizing and Coloring Industry.

SIC Code 3471
Establishments primarily engaged in all types of electroplating, plating, anodizing, coloring, and finishing of metals and formed products. This includes, but is not limited to, buffing, cleaning, de-scaling, grinding, polishing/de-polishing, pickling and laminating of metal and formed products; electrolyzing steel; tumbling of machine parts; shot peening; sandblasting of metal parts; chromium, gold, silver, or decorative plating of metals and formed products; and re-chroming auto bumpers.

NAICS Code 332813
This industry comprises establishments primarily engaged in electroplating, plating, anodizing, coloring, buffing, polishing, cleaning, and sandblasting metals and metal products for the trade.

Hazards
The electroplating industry involves the coating of a metal object with another metal by using an electrical current passed through a chemical solution. The process includes a multitude of potential chemical hazards, which may cause poisoning, chemical burns, damage to the respiratory system, cancer and allergic reactions. Process fluids leaking, splashing, spilling or draining across floors can cause slip and fall hazards, as well as the unintentional mixing of reactive chemicals leading to dermal damage, compromise of clothing, buildup of humidity, deterioration in machines harming vulnerable parts and electrical wiring, and the premature and often undetected rotting or eroding of structural surfaces such as floorboards, stairways and roofing systems. The industry has many small shops where lighting is poor, heating/cooling is nonexistent and work areas are tight, leading to increased material handling accidents. Potential injuries, such as cut, puncture and abrasion hazards, exist due to the use of machines such as grinders, polishers, jigs and other sharp tools. The industry uses chemicals, such as gasoline as a cleaning agent, and stores large amounts of volatile chemicals making explosion hazards a consideration. Other common hazards include electrical shock, fire, eye damage due to flying particles, entanglement in moving machinery, noise, and burns from hot liquids.

PPE
Below is Table E-1-A listing recommended personal protective equipment to be worn by the compliance officer while investigating within this industry. It is not intended to replace CSHO assessment of the hazards, and their required actions. Additionally, the below-listed PPE is specific to the industry but general in nature. Tasks within the industry that require specific PPE are listed in Table E-1-B. Note, any brand names that may be listed are for example only; OSHA does not recommend or endorse any manufacturer or product.

Table E-1-A. CSHO PPE for Electroplating, Plating, Polishing, Anodizing, and Coloring.

Head Protection: **Hard Hat**	Cap Style Hard Hat, Type I, Class E. Specific Requirements: Made from polycarbonate, polycarbonate glass fiber, phenol textile, or polyester glass fiber.	
Application:	**Reasoning:**	**Care and Life Expectancy:**
The hard hat may be a cap style, with a bill in the front, or full brim. Type I, for reducing impacts to the top of the head, is appropriate, but Type II, with added protection against side impact, is preferred. Hard hat resists up to 20,000 volts.	Electroplating industry uses small cranes and hoists, so there are overhead hazards. Electroplating is mostly indoors, so a full-brimmed hard hat may be used but is not required. Cranes also create swinging hazards, but such hazards are predictable and can normally be avoided. Where exposure cannot be predicted and avoided, a Type II hard hat must be worn to provide protection against both side and overhead impacts, otherwise a Type I hard hat will suffice.	Replace per manufacturer's specifications. Typical life expectancy is five years. Replace regardless of age if cracks appear in the shell, the shiny surface appears dull or chalky, and/or the shell becomes brittle.

Primary Garment: **Cotton or Cotton/Poly Blend or like Materials – Shirt and Pants or Coveralls**	Electroplating has many chemical processes. Cotton-poly blend coveralls or pants and shirt combinations are appropriate for exposures to metal fumes/dust, as well as for mild exposures to chemicals. Street clothes can be worn without risk, but are not recommended, as they could easily be ruined. Long sleeves and long pants are appropriate to protect against dust, debris, chemical exposures, and jagged or sharp edges. Jewelry may not be worn. Brand Name: Not Applicable.		
Proper Wear Instructions:	**Description of Use:**	**Care Instructions:**	**Limitations:**
Worn as a uniform or coverall to protect clothes from soiling and deterioration due to mild chemical exposures.	Used as a coverall to protect from dust, dirt, and sensitization of the skin from mild chemical exposures.	Launder and maintain per manufacturer's instructions and applicable OSHA standards.	Cotton-poly blend garments will provide only mild chemical protection.

Foot Protection: **Grade 1 Boots/Shoes**	Grade 1 boots or shoes will have reinforced toes and are resistant to impact, punctures, and have a mild chemical resistance.	
Marking:	**Acceptable Sole Types:**	**Unacceptable Sole Types:**
ASTM F2413-05 F or M, I/75 C/75 EH PR	Vibram, Chemigum/Ambergum, Neoprene, rubber/vulcanized rubber, nitrile/Nitrilegum, Dynatread, Sur-Sport Rubber, crepe rubber	Blown rubber, vulcanized PVC, leather, Vinyl Flexible, Kraton, neo crepe, polyurethane, Vylyt

Table E-1-A (Continued). CSHO PPE for Electroplating, Plating, Polishing, Anodizing, and Coloring.

Hand Protection: **Not Applicable**	No general requirement to wear hand protection while performing inspections in the electroplating industry as inspectors should not handle metal or metal products, so abrasion- or cut-resistant gloves are not normally needed unless near sharp or jagged edges. Where there is potential exposure to chemicals, oil mists, and cutting fluids, wear nitrile or Neoprene gloves; latex gloves should not be worn in this industry.

Hearing Protection: **Earplugs/Earmuffs**	Hearing protection may be worn as needed based on noise level, frequency and duration. It must be used when sound level exceeds 85 dBA.	
Application:	**Care:**	**Fit:**
May be intermittent noise exposures depending on the processes. CSHOs must screen for noise and wear protection for any exposure noted over 85 dBA.	Store in sterile container. Clean reusable hearing protection after each wearing, per manufacturer's instructions.	Follow the manufacturer's directions for the hearing protection used. When properly fitted, must be able to cup hands over ears with very little deviation in sound level.

Eye Protection: **Goggles**	Impact- and chemical-resistant goggles are appropriate for this industry. Safety glasses with side shields are not recommended due to the presence and potential exposure to caustics, corrosives, dusts, mists, and acid gases present in a majority of the operations within the electroplating industry. Impact resistance is required since the industry has the potential for flying and falling debris.		
Specific Requirements:	**Care:**	**Color of Lens:**	**Tint:**
Impact and chemical resistant.	Keep wrapped in nonabrasive fabric to avoid scratching viewing surfaces. Use a case or rigid box to avoid crushing the frames. Clean and maintain, per manufacturer's instructions.	Clear.	No tint.

Table E-1-A (Continued). CSHO PPE for Electroplating, Plating, Polishing, Anodizing, and Coloring.

<table>
<tr><td>Respiratory Protection:
Negative Pressure Respirator or PAPR</td><td colspan="2">The use of a half-mask respirator, full-face respirator, or PAPR is typically required for electroplating industry inspections. N95 respirators are not approved for this industry. High exposure levels may require SAR or SCBA. The need for respirator use is to be determined by the inspector who will establish the presence of hazardous substances prior to initiating the walkaround portion of the inspection by using information such as previous inspection history, material safety data sheets, and/or previous exposure monitoring surveys.</td></tr>
<tr><td>Air Contaminants:</td><td>Cartridges Information (if air purifying respirators allowed):</td><td>Respirator Care:</td></tr>
<tr><td rowspan="3">Potential airborne contaminants include paints, solvent-based cleaners and thinners containing volatile organic compounds, dust from blasting and mechanical cleaning operations, heavy metals and cyanide from plating operations, metalworking fluids, metal fumes, coolants, lubricants, acid gases, corrosives and caustics. Also, depending on the type of electroplating operation being performed there is a potential for exposure to toxic gases and metal fumes/dust from metals such as chromium, cadmium, lead, silver, copper, brass, nickel, gold, and zinc. The anodizing and etching processes use reactive and metal-bearing acids.</td><td>Organic vapor/formaldehyde and HEPA combination.</td><td rowspan="3">Clean and maintain in accordance with manufacturer’s instructions and the OSHA standard for respiratory protection.</td></tr>
<tr><td>Organic vapor, ammonia, methylamine, chlorine, hydrogen chloride, sulfur dioxide, formaldehyde and dust, fumes, mists, radionuclide, hexavalent chromium and (HEPA) filter.</td></tr>
<tr><td>Olive/magenta.</td></tr>
</table>

Table E-1-B. Tasks and Hazards Associated with the Electroplating Industry that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Wood dust.	The electroplating industry uses wood dust to dry newly plated and processed articles after they have been cleaned. Wood dust such as, but not limited to, beech, oak, birch, mahogany, teak, and walnut are known carcinogens.	Goggles/Respiratory protection N95, half-mask or full-face respirator or PAPR, HEPA cartridge (magenta).	A HEPA cartridge on a half mask, full face or N95 respirator or PAPR will be worn if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge.
Cyanide vapors.	Cyanide compounds are used in the plating baths. Typically they are complexed with plating metals, or as sodium cyanide or potassium cyanide. Cyanide can be absorbed through the skin, ingested and inhaled, causing interference to the metabolic system and rapid death at lower concentrations.	Respiratory protection is exposure-dependent.	For typical plating tasks, inspectors will wear half-mask or full-face respirator or PAPR equipped with multi-gas vapor/HEPA cartridges (olive/ magenta) when there is potential exposure to cyanide. If other respiratory hazards exist, wear the appropriate combination cartridge. Due to the fact that cyanide can be absorbed through the skin, Neoprene or nitrile gloves are recommended. Inspectors will discuss the need for further PPE such as SCBA, disposable coveralls, head covers, and shoe covers with their supervisor.
Paints and solvents.	Exposure to paints and solvents.	Unvented goggles/Respiratory protection typically half-mask or full-face respirator or PAPR, HEPA and organic cartridges (magenta and black) or organic cartridge with a pre-filter.	Inspectors who will be within ten feet of a painting/ finishing operation will wear unvented goggles. HEPA/organic cartridges on a half-mask or full-face respirator or PAPR is typically worn, if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge.

Table E-1-B (Continued). Tasks and Hazards Associated with the Electroplating Industry that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Metal fumes/dusts, acids, caustics, solvents and vapors associated with buffing, cleaning, de-scaling, grinding, polishing, de-polishing, pickling, laminating, tumbling, sandblasting, dipping, anodizing, etching, coating and plating operations.	Expected exposures would be to acids, caustics, solvents, vapors and metal fumes/dusts including lead, cadmium, chromium, silver, gold, brass, copper, zinc, and nickel. Cadmium, chromium and nickel are known human carcinogens. Heavy metal exposures can also lead to anemia, kidney disease, emphysema, liver problems, neurological disorders and bone diseases.	Half-mask or full-face respirator or PAPR, multi-gas vapor and HEPA cartridges (olive/ magenta).	Inspectors typically wear half-mask or full-face respirator or PAPR equipped with multi-gas vapor/HEPA cartridges (olive/magenta) when there is potential exposure to heavy metals, acids, caustics, solvents and vapors. If other respiratory hazards exist, wear the appropriate combination cartridge. Inspectors will discuss the need for further PPE such as disposable coveralls, head covers, and shoe covers with their supervisor.
Oil mists and cutting fluids.	Exposure to oil mists and cutting fluids.	Half-mask or full-face respirator or PAPR, HEPA cartridge (magenta)/Unvented goggles/Neoprene or nitrile gloves.	A HEPA cartridge on a half-mask or full-face respirator or PAPR is typically worn, if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge. Where there is exposure to heavy to moderate oil mists or cutting fluids, unvented goggles must be worn. Moderate to large amounts of airborne and residual oil mists and cutting fluids can cause mild dermal discomfort. Neoprene or nitrile gloves may be worn. Latex gloves are not appropriate for this industry. Additionally, inspectors should wear long sleeves for added protection.

APPENDIX E-2. CSHO PPE Suggestion Tables for Gray and Ductile Iron Foundries.

SIC Code 3321. Establishments primarily engaged in manufacturing gray and ductile iron castings, including cast iron pressure and soil pipes and fittings.

NAICS Code 331511. Establishments primarily engaged in pouring molten pig iron or iron alloys into molds to manufacture castings, (e.g., cast iron manhole covers, cast iron pipe, cast iron skillets). Establishments in this industry purchase iron made in other establishments.

Hazards. The grey and ductile iron foundry industry has one of the highest LWDI rates in the nation. The foundry industry leads manufacturing facilities in the number of fatalities. Hazards associated with the industry may include, but are not limited to, falls, vehicular traffic, overhead swinging and sliding objects, heat, explosion, burns from melting and pouring operations, and extreme noise.

PPE. Below is Table E-2-A listing recommended personal protective equipment to be worn by the compliance officer while investigating within this industry. It is not intended to replace CSHO assessment of the hazards, and their required actions. Additionally, the below-listed PPE is specific to the industry but general in nature. Tasks within the industry that require specific PPE are listed in Table E-2-B. Note, any brand names that may be listed are for example only; OSHA does not recommend or endorse any manufacturer or product.

Table E-2-A. CSHO PPE for Gray and Ductile Iron Foundries.

Head Protection: **Hard Hat**	Cap Style Hard Hat, Type I, Class E . Specific Requirements: Made from polycarbonate, polycarbonate-glass fiber, phenol textile, or polyester-glass fiber for foundry and metal splash hazards.	
Application:	**Reasoning:**	**Care and Life Expectancy:**
Characterized by a bill in the front. Most hard hats use this design. The design looks very similar to a baseball cap. Intended to reduce the force of impact resulting from a blow to the top of the head. Hard hat resists up to 20,000 volts.	Gray and ductile iron foundries have both overhead falling and swinging hazards; however, such hazards are predictable and can normally be avoided, but where exposure cannot be predicted and avoided, a Type II hard hat must be worn which provides protection against both side impact and blows to the top of the head; otherwise, a Type I hard hat will suffice. Cap style is required due to molten metal pouring operations. Full brimmed hard hats not recommended for this industry.	Replace according to manufacturer's specifications. Typical life expectancy is five years. Replace regardless of age if cracks appear in the shell, the shiny surface appears dull or chalky, and/or the shell becomes brittle.

Primary Garment: **FR Cotton (100%) or Wool (100%) - Jacket and Pants or Coveralls**	Garment recommended because of its fire resistance due to torch cutting operations. Lightweight durable fabric for outdoor wear. Brand Name: INDURA - Westex, Dale Antiflame - Dale North America, PROBAN/FR 7A – Westex		
Proper Wear Instructions:	**Description of Use:**	**Care Instructions:**	**Limitations:**
Worn as a primary coverall over secondary fire-resistant garments. Should have no outside facing pockets or cuffs. Long sleeves are required. Pant legs must cover top of boot edge and should not be tucked in. If separate jacket and pants are worn, jacket must hang past pants pockets and cover secondary garments while in bent position.	Most areas involving ferrous metals such as foundries, flame cutting, welding, etc. Also used in electrical utilities and chemical, oil, and petrochemical industries. Resistant to alkalis and most solvents.	Launder and maintain in accordance with manufacturer’s instructions and applicable OSHA standards.	Not to be worn in areas with molten metal hazards (e.g., pouring operations that may require aluminized PPE), nor for use in critical static control operations. Not for chemical operations where there is a possibility of contact with strong oxidizers. Poor acid resistance.

Table E-2-A (Continued). CSHO PPE for Gray and Ductile Iron Foundries.

Foot Protection: **Grade 1 Boot with Metatarsals**	Grade 1 boots with reinforced toes, not shoes. The boots must lace up and cannot have zippers or elastic. Additionally, the boot will have either built-in metatarsal protection or have metatarsal attachments. The soles of the boot must be heat-resistant. Boot uppers will not be made from materials that could melt or ignite. Leather uppers are recommended for heat resistance, puncture resistance, and mild chemical resistance.	
Marking:	**Acceptable Sole Types:**	**Unacceptable Sole Types:**
ASTM F2413-05 F or M, I/75 C/75 MT/75 EH PR	Vibram, Chemigum/Ambergum, Neoprene, rubber/vulcanized rubber, nitrile/Nitrilegum, Dynatread, Sur-Sport Rubber, crepe rubber.	Blown rubber, vulcanized PVC, leather, Vinyl Flexible, Kraton, neo crepe, polyurethane, Vylyt.

Hand Protection: **Light Duty Leather/Leather Palm Gloves**	Leather/leather palm gloves offer good puncture and abrasion resistance, and impact absorption. They can be used when handling hot or cold objects, and offer greater thermal protection than cotton or knitted fibers. Can handle hot objects that are < 200 degrees F.	
Heat Resistance:	**Chemical Resistance:**	**Cuff Length:**
Light duty leather gloves have a heat resistance for anything less than 200 degrees F. The gloves are not intended for the handling of hot products. They are to protect against hot surfaces from peripheral objects which are metal or like substances and likely to retain uncomfortable levels of heat such as railings and doorknobs.	Compliance officers are not anticipated to be handling chemicals in foundries; however, the presence of airborne gases, fumes, and caustics, which may cause dermal irritation, require the use of gloves. Leather gloves are mildly chemical resistant and heat tolerant. Where chemical exposures are found to be higher than average, switch to treated leather or Kevlar gloves.	Sleeves must cover the cuff of the glove. Do not tuck sleeves into the cuffs of the gloves. When the arm is fully extended, the cuff of the glove and sleeve must not allow bare skin to be exposed. The cuff is to be at least three inches in length. Gauntlet length cuffs are not recommended because they allow molten metal to become trapped in the cuff.

Table E-2-A (Continued). CSHO PPE for Gray and Ductile Iron Foundries.

Hearing Protection: Earplugs/Earmuffs	As needed based on noise level, frequency and duration. Used when sound level exceeds 85 dBA.		
Application:		**Care:**	**Fit:**
In gray and ductile iron foundries, the shake out and other processes frequently operate at sound levels in excess of 85dBA, so hearing protection is necessary. Because of melting and pouring operations, inspectors should avoid use of hearing protection that may be combustible, such as some urethane foam earplugs.		Store in sterile container. Clean reusable hearing protection after each wearing, in accordance with manufacturer's instructions.	Follow the manufacturer's directions for the hearing protection used. When properly fitted, must be able to cup hands over ears with very little deviation in sound level.

Eye Protection: Goggles	Impact- and chemical-resistant goggles are appropriate for this industry. Safety glasses with side shields are not recommended due to the presence and potential exposure to caustics, corrosives, dusts, and acid gases present in a majority of the operations. Impact resistance is required since the industry has the potential for flying and falling debris. Where molten metal operations must be viewed for a significant amount of time, #3-#5 green goggles or safety glasses under goggles should be worn.		
Specific Requirements:	**Care:**	**Color of Lens:**	**Tint:**
Goggles should be impact and chemical resistant.	Keep wrapped in non-abrasive fabric to avoid scratching viewing surfaces. Use a case or rigid box to avoid crushing the frames. Clean and maintain, in accordance with manufacturer's instructions.	Green.	3 – 5

Table E-2-A (Continued). CSHO PPE for Gray and Ductile Iron Foundries.

<table>
<tr><td>Respiratory Protection:
Negative Pressure Respirator or PAPR</td><td colspan="2">The use of a half-mask respirator, full-face respirator, or PAPR is anticipated for most, if not all of gray and ductile iron foundry inspections. N95 respirators not approved for foundry operations because of the presence and potential exposure to silica and lead. The need for respirator use is to be determined by the inspector prior to initiating the walkaround by using information such as previous inspection history, material safety data sheets, and/or previous exposure monitoring surveys.</td></tr>
<tr><td>Air Contaminants:</td><td>Cartridges Information:</td><td>Respirator Care:</td></tr>
<tr><td rowspan="3">Potential airborne contaminants include formaldehyde, ammonia, amines, isocyanates, metalworking fluids, metal fumes, coolants, lubricants, excessive dust, silica, acid gases, corrosives and caustics. Potential exposure may occur during the melting and pouring operations, cleaning operations, maintenance, core making and machining operations. Also, there is potential for exposure to toxic gases and metal fumes such as arsenic, cadmium, lead and beryllium. Acids and caustics are present during scrubber operations. Resins, catalysts and parting sprays are used during mold making, core making, maintenance and other foundry operations.</td><td>Organic vapor/formaldehyde and HEPA combination</td><td rowspan="3">Clean and maintain in accordance with manufacturer’s instructions and the OSHA standard for respiratory protection.</td></tr>
<tr><td>Organic vapor, ammonia, methylamine, chlorine, hydrogen chloride, sulfur dioxide, formaldehyde and dust, fumes, mists, radionuclide, hexavalent chromium and (HEPA) filter.</td></tr>
<tr><td>Olive/magenta.</td></tr>
</table>

Table E-2-B. Tasks and Hazards Associated with Gray and Ductile Iron Foundries that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Struck-by due to vehicular traffic.	Exposure to moving equipment such as trains, trucks and powered industrial trucks.	High-visibility traffic vest.	Inspectors must wear high-visibility traffic vests while in areas where moving vehicles are a hazard.
Metal splash and glare from melting and pouring operations.	Exposure to molten metal splash and ultraviolet/infrared glare from melting and pouring operations.	Gauntlet gloves, #3-#5 green tinted acrylic face shield or acrylic face shield, #40 steel wire mesh face shield in conjunction with #3-#5 green tinted goggles or safety glasses, and aluminized cotton, Kevlar, wool or leather clothing.	Inspectors should remain at least twenty feet from melting and pouring operations. When within a twenty-foot radius, in addition to the previously recommended PPE, inspectors should wear gauntlet gloves, #3-#5 green tinted acrylic face shield or acrylic face shield, #40 steel wire mesh face shield in conjunction with #3-#5 green tinted goggles or safety glasses, and aluminized leather, wool, Kevlar or cotton spats, caster coat or jacket, and some combination of the following: chaps, leggings, or over trousers.
Dust - including silica.	Exposure to airborne dust, scrap and other flying foreign objects during core-making and cleaning operations. Exposure to silica or lead as a component of the dust is possible in many areas and operations in the foundry, such as, but not limited to, the bag house, shake -out operations, mold making/ mold master, machining operations, and cleaning and finishing operations.	Half-mask or full-face respirator or PAPR, HEPA cartridge (magenta). N95 respirators will not be used where there is potential for exposure to silica or lead.	Inspectors will typically wear half-mask or full-face respirator or PAPR equipped with HEPA cartridges where the presence of silica or lead is known or suspected. If other respiratory hazards exist, wear the appropriate combination cartridge. Inspectors will discuss the need for further PPE, such as disposable coveralls, head covers, and shoe covers, with their supervisor.

APPENDIX E-3. CSHO PPE Suggestion Tables for Metal Fabrication Shops.

SIC Code 3442
Establishments primarily engaged in manufacturing ferrous and nonferrous metal doors, sash, window and door frames and screens, molding, and trim.

NAICS Code 332321
This U.S. industry comprises establishments primarily engaged in manufacturing metal framed windows (i.e., typically using purchased glass) and metal doors. Examples of products made by these establishments are metal door frames; metal-framed window and door screens; and metal molding and trim (except automotive).

Hazards
The metal fabrication industry involves the blanking, rolling and forming, stamping, notching, slitting, shearing, press braking, and embossing of metal. These processes include, but are not limited to, machines that reciprocate, transverse, cut, punch, shear and bend creating potential electrical and caught-in hazards. Additionally, chemical hazards exist in the form of cutting fluids, metal fumes, paints and solvents, oils and lubricants. Other physical hazards include slippery floor conditions due to oils and mists, excessive noise due to machinery, sharp or jagged edges from metal and metal products, sparks from welding and cutting operations, and the use of compressed gas creating injection and particulate hazards. Material handling and storage are considerations since product is often moved via hoist, sling or by powered industrial trucks.

PPE
Below is Table E-3-A listing recommended personal protective equipment to be worn by the compliance officer while investigating within this industry. It is not intended to replace CSHO assessment of the hazards, and their required actions. Additionally, the below-listed PPE is specific to the industry but general in nature. Tasks within the industry that require specific PPE are listed in Table E-3-B. Note, any brand names that may be listed are for example only; OSHA does not recommend or endorse any manufacturer or product.

Table E-3-A. CSHO PPE for Metal Fabrication Shops.

Head Protection: **Not Applicable**	Smaller metal fabricating shops are not expected to have overhead hazards such as cranes. Inspectors are not to approach energized machinery where there are hair caught-in hazards. Inspectors should follow the company guidelines and use best judgment. Under normal conditions, hard hats and bump caps are not required unless the shop uses overhead cranes, hoists, overhead storage, etc.

Primary Garment: **Cotton or Cotton/Poly Blend or Like Materials - Shirt and Pants or Coveralls**	The metal fabricating industry includes many diverse tasks. Where welding and cutting operations are isolated or off to the side, cotton-poly blend coveralls or pants and shirt combinations are appropriate to protect inspectors from dust and metal fumes, as well as chemicals including oil mist, cutting fluids, paints, and solvents. Street clothes can be worn without risk to the inspector, but clothes could be easily ruined. Long sleeves and long pants are appropriate to protect against dust, debris, chemical exposures and jagged or sharp edges (since inspectors are expected to keep their distance from rotating parts, long sleeves are not a safety issue). Jewelry may not be worn. Brand Name: Not Applicable.		
Proper Wear Instructions:	**Description of Use:**	**Care Instructions:**	**Limitations:**
Worn as a uniform or coverall to protect clothes from soiling and deterioration due to mild chemical exposures.	Used as a coverall to protect from dust, dirt, and sensitization of the skin from mild chemical exposures.	Launder and maintain in accordance with manufacturer's instructions and applicable OSHA standards.	Cotton-poly blend garments are not for use within ten feet of welding or torch cutting operations; all-cotton or FR-rated garments should be used for these situations. Cotton-poly blend garments are not for use in critical static control operations, and provide only mild chemical protection.

Foot Protection: **Grade 1 Boots/Shoes**	Grade 1 boots or shoes will have reinforced toes and are resistant to impact, punctures, and have a mild chemical resistance.	
Marking:	**Acceptable Sole Types:**	**Unacceptable Sole Types:**
ASTM F2413-05	Vibram, Chemigum/Ambergum, Neoprene, rubber/vulcanized rubber, nitrile/Nitrilegum, Dynatread, Sur-Sport Rubber, crepe rubber.	Blown rubber, vulcanized PVC, leather, Vinyl Flexible, Kraton, neo crepe, polyurethane, Vylyt.

Table E-3-A (Continued). CSHO PPE for Metal Fabrication Shops.

Hand Protection: **Not Applicable**	There is no general requirement for inspectors to wear hand protection in the metal fabrication industry. Inspectors are not expected to be handling metal or metal products, so abrasion or cut-resistant gloves are not normally needed unless proximity to sharp or jagged edges. Airborne and residual oil mists and cutting fluids can cause dermal discomfort, so inspectors should wear nitrile or Neoprene gloves; latex gloves should not be worn in this industry.

Hearing Protection: **Earplugs/Earmuffs**	As needed based on noise level, frequency and duration. Used when sound level exceeds 85 dBA.	
Application:	**Care:**	**Fit:**
The metal fabricating industry machinery frequently operates at sound levels in excess of 85dBA, so hearing protection is necessary. Where there are welding operations, inspectors should avoid use of hearing protection that may be combustible, such as some urethane foam earplugs.	Store in sterile container. Clean reusable hearing protection after each wearing, in accordance with manufacturer's instructions.	Follow the manufacturer's directions for the hearing protection used. When properly fitted, must be able to cup hands over ears with very little deviation in sound level.

Eye Protection: **Safety Glasses/Goggles**	Safety glasses with side shields are appropriate since the metal fabricating industry has the potential for flying debris; however, in areas where dust or oil mist is high, impact-resistant unvented goggles should be worn.		
Specific Requirements:	**Care:**	**Color of Lens:**	**Tint:**
Safety glasses should have side shields. Goggles, if selected, should be impact resistant and unvented.	Keep wrapped in nonabrasive fabric to avoid scratching viewing surfaces. Use a case or rigid box to avoid crushing the frames. Clean and maintain, in accordance with manufacturer's instructions.	Clear.	No tint.

Table E-3-B. Tasks and Hazards Associated with Metal Fabrication Shops that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Flash or glare due to welding or torch cutting operations.	Exposure to infrared/ultraviolet radiation during welding and/or torch cutting operations.	Safety glasses with side shields or impact-resistant goggles, glasses or goggles worn must be #3 - #5 tinted green.	Inspectors are to make every effort to remain at least ten feet from sparking operations. When within ten feet of such operations or when observing the operations for prolonged periods, green tinted #3-#5 safety glasses w/side shields or goggles are to be worn.
Paints and solvents.	Exposure to paints and solvents.	Unvented goggles/Respiratory protection typically half-mask or full-face respirator or PAPR, HEPA and organic cartridges (magenta and black) or organic cartridge with a pre-filter.	Inspectors who will be within ten feet of a painting/finishing operation will wear unvented goggles. HEPA/organic cartridges on a half-mask or full-face respirator or PAPR is typically worn, if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge.
Noise.	Exposure to hazardous noise levels.	Earplugs, earmuffs.	The metal fabrication industry is expected to have high levels of noise. When noise levels exceed the 85 dBA threshold, hearing protection must be worn. Due to welding and torch cutting operations, inspectors should avoid use of hearing protection that may be combustible, such as some urethane foam earplugs.
Welding or metal cutting fumes.	Exposure to metal fumes including but not limited to lead, cadmium, chromium, and manganese.	Half-mask or full-face respirator or PAPR, HEPA cartridge (magenta).	A HEPA cartridge on a half-mask or full-face respirator or PAPR is typically worn, if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge.

Table E-3-B (Continued). Tasks and Hazards Associated with Metal Fabrication Shops that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Oil mists and cutting fluids.	Exposure to oil mists and cutting fluids.	Half-mask or full-face respirator or PAPR, HEPA cartridge (magenta)/Unvented goggles/Neoprene or nitrile gloves.	A HEPA cartridge on a half-mask or full-face respirator or PAPR is typically worn, if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge. Where there is exposure to heavy to moderate oil mists or cutting fluids, unvented goggles must be worn. Moderate to large amounts of airborne and residual oil mists and cutting fluids can cause mild dermal discomfort. Neoprene or Nitrile gloves may be worn. Latex gloves are not appropriate for this industry. Additionally, inspectors should wear long sleeves for added protection.
Flying sparks from welding and torch cutting operations.	Exposure to flying sparks from welding or torch cutting operations.	FR 100% cotton coveralls, pants and shirt or jacket/Tinted safety glasses w/ side shields/Gauntlet gloves.	Inspectors are to make every effort to remain at least ten feet from sparking operations. When be within ten feet of such operations or when observing the operations for prolonged periods, green tinted #3-#5 safety glasses w/side shields are to be worn. Additionally, inspectors are to wear FR 100% cotton or wool coveralls or jackets and pants. Selected wear must have no outside facing pockets and long sleeves. The cuffs of the sleeves cannot be rolled up and must be covered by the gauntlet cuff of the gloves. Pant legs must cover top of the boot or shoe edge and may not be tucked in or rolled up. If separate jacket and pants are worn, the jacket must hang past pants pockets and cover secondary garments while in bent position. If the garment has internal pockets, no combustible or flammable items may be carried in them. No jewelry may be worn.

APPENDIX E-4

CSHO PPE Suggestion Tables for the Scrap Metal Industry.

SIC Code 5093
Establishments primarily engaged in assembling, breaking up, sorting, and wholesale distribution of scrap and waste materials.

NAICS Code 423930
Metal scrap and waste merchant wholesalers.

Hazards
Industry involves outdoor and indoor hazards including, but not limited to, flying and/or falling objects, fall hazards due to open sided platforms and pits, compressed gas equipment hazards, moving, shifting and swinging equipment, noise, sharp or irregular objects, unguarded machinery, weather elements, flying sparks from torch cutting operations, metal fumes and dust inhalation hazards, vehicular traffic, and trip hazards from irregular terrain.

PPE
Below is Table E-4-A listing recommended personal protective equipment to be worn by the compliance officer while investigating within this industry. It is not intended to replace CSHO assessment of the hazards, and their required actions. Additionally, the below-listed PPE is specific to the industry but general in nature. Tasks within the industry that require specific PPE are listed in Table E-4-B. Note, any brand names that may be listed are for example only; OSHA does not recommend or endorse any manufacturer or product.

Table E-4-A. CSHO PPE for the Scrap Metal Industry.

Head Protection: Hard Hat	Cap Style Hard Hat, Type I, Class E Specific Requirements: Not Applicable.	
Application:	**Reasoning:**	**Care and Life Expectancy:**
Characterized by a front bill, similar to a baseball cap. Reduces the force of impact resulting from a blow to the top of the head. Hard hat resists up to 2,200 volts.	Though the scrap metal industry has both overhead falling and swinging hazards, the inspector is to avoid being in the swing radius of cranes and equipment while they are operating, so Class I will suffice. Cap style is required due to torch and hot metal work. Full brimmed hard hats not recommended for this industry.	Replace per manufacturer's specifications. Typical life expectancy is five years. Replace regardless of age if cracks appear in the shell, the shiny surface appears dull or chalky, and/or the shell becomes brittle.

Primary Garment: Cotton (100%) Jacket/Shirt and Pants or Coveralls	Garment may be street clothes or professional primary wear such as jacket/shirt and pants, or coveralls consisting of 100% cotton of a medium to heavy weight. Cotton was selected for its durability against the cut/abrasion hazards that exist in the industry, its basic fire resistance (sparks from torch cutting operations), and its ability to "breathe" (environmental heat issues). The garment must have long sleeves to protect from cuts, abrasions, animal and/or insect bites and sun exposure. Brand Names: Not Applicable.		
Proper Wear Instructions:	**Description of Use:**	**Care Instructions:**	**Limitations:**
Garment(s) should fit well, but not tightly. Excessive looseness can catch on the sharp objects intrinsic to the industry.	Used for outdoor and indoor facilities where environmental heat, resistance to abrasions, and ability to be cleaned are considerations.	Launder and maintain in accordance with manufacturer's instructions and applicable OSHA standards.	Not to be worn in areas with molten metal hazards (e.g., pouring operations that may require aluminized PPE), nor for use in critical static control operations. Not for chemical operations where there is a possibility of contact with strong oxidizers. Poor acid resistance.

Foot Protection: Grade 1 Boot	Grade 1 boots will have reinforced toes and are resistant to heat, impact, sharp objects, and have the ability to function effectively on uneven terrain. With treatment, can be water resistant.	
Marking:	**Acceptable Sole Types:**	**Unacceptable Sole Types:**
ASTM F2413-05 F or M, I/75 C/75 EH, PR	Vulcanized PVC, Vibram, Chemigum/Ambergum, Neoprene, rubber/vulcanized rubber, nitrile/Nitrilegum, Dynatread, Sur-Sport Rubber, crepe rubber.	Leather, Vylyt, polyurethane, neo crepe, Kraton, Vinyl Flexible, blown rubber.

Table E-4-A (Continued). CSHO PPE for the Scrap Metal Industry.

Hand Protection: **Light Duty Leather/Leather Palm Gloves**	Leather/leather palm gloves offer good puncture and abrasion resistance, and impact absorption. They can be used when handling hot or cold objects, and offer greater thermal protection than cotton or knitted fibers. Can handle hot objects that are < 200 degrees F.	
Heat Resistance:	**Chemical Resistance:**	**Cuff Length:**
Light duty leather gloves have a heat resistance for anything less than 200 degrees F. The gloves protect against cuts and abrasions. Inspectors are to avoid working within a ten-foot radius of the torch cutting operations, but if they cannot, the gloves must be changed to heavy-duty, heat-resistant leather with gauntlet cuffs.	Not Applicable - Industry does not have significant chemical exposures.	Any length of cuff will suffice. The requirement for leather or leather palm is due to sharp objects rather than hot work, eliminating the need for gauntlet cuffs.

Hearing Protection: **Earplugs/Earmuffs**	As needed based on noise level, frequency and duration. Used when sound level exceeds 85 dBA.	
Restrictions:	**Care:**	**Fit:**
Because of the torch cutting operations, inspectors should avoid use of hearing protection that may be combustible, such as some urethane foam earplugs.	Store in sterile container. Clean reusable hearing protection after each wearing, in accordance with manufacturer’s instructions.	Follow the manufacturer's directions for the hearing protection used. When properly fitted, must be able to cup hands over ears with very little deviation in sound level.

Eye Protection: **Safety Glasses**	Safety glasses with side shields are appropriate since the industry has the potential for falling and/or flying debris.		
Specific Requirements:	**Care:**	**Color of Lens:**	**Tint:**
Side shields.	Keep wrapped in nonabrasive fabric to avoid scratching viewing surfaces. Use a case or rigid box to avoid crushing the frames. Clean and maintain, in accordance with manufacturer’s instructions.	Clear.	No tint.

Table E-4-B. Tasks and Hazards Associated with the Scrap Metal Industry that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Dust.	Exposure to airborne dust, scrap and other flying foreign objects.	Unvented goggles/HEPA cartridge (magenta), N95, half-mask or full-face respirator or PAPR.	Inspectors working in high dust locations must wear unvented goggles to protect against impact and dust rather than safety glasses w/side shields which only protect against impact. HEPA filter on a N95, half-mask or full-face respirator or PAPR are typically worn, if necessary. If other respiratory hazards exist, wear the appropriate combination cartridge.
Flying sparks from torch cutting operations.	Exposure to flying sparks from oxygen torch cutting operations.	FR 100% cotton coveralls, pants and shirt or jacket/Tinted safety glasses w/ side shields/Gauntlet gloves.	Inspectors are to make every effort to remain at least ten feet from sparking operations. When within ten feet of such operations or when observing the operations for prolonged periods, green tinted #3-#5 safety glasses w/side shields are to be worn. Additionally, inspectors are to wear FR 100% cotton or wool coveralls or jackets and pants. Selected wear must have no outside facing pockets and long sleeves. The cuffs of the sleeves cannot be rolled up and must be covered by the gauntlet cuff of the gloves. Pant legs must cover top of the boot or shoe edge and may not be tucked in or rolled up. If separate jacket and pants are worn, the jacket must hang past pants pockets and cover secondary garments while in bent position. If the garment has internal pockets, no combustible or flammable items may be carried in them.

Table E-4-B (Continued). Tasks and Hazards Associated with the Scrap Metal Industry that May Require Additional CSHO PPE.

Hazard:	**Hazard Description:**	**Specialty PPE:**	**PPE Reasoning:**
Metal fumes from torch cutting Operations.	Exposure to metal fumes including lead, cadmium, chromium, manganese, arsenic.	Half-mask or full-face respirator or PAPR, HEPA cartridge (magenta). .	Inspectors typically wear half-mask or full-face respirator or PAPR equipped with HEPA cartridges when working within vicinity of torch cutting operations where the presence of lead, cadmium, arsenic, or manganese is known or suspected. If other respiratory hazards exist, wear the appropriate combination cartridge. Inspectors will discuss the need for further PPE, such as disposable coveralls, head covers, and shoe covers, with their supervisor.
Struck-by due to vehicular traffic.	Exposure to moving equipment such as lift trucks and loaders.	High-visibility traffic vest.	Inspectors must wear high-visibility traffic vests while in “yard” areas where moving vehicles are a hazard.