Ontario

Background and Rationale Report for the: Metal Finishers – Industry Standard

Ontario Ministry of the Environment and Climate Change
Environmental Sciences and Standards Division
Standards Development Branch

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Cette publication hautement spécialisée ‘Modifications de la norme sectorielle relative au traitement des surfaces métalliques en vertu du Règlement sur la qualité de l'air à l'échelle locale (Règlement de l'Ontario 419/05)’ n'est disponible qu'en anglais conformément au Règlement 671/92, selon lequel il n’est pas obligatoire de la traduire en vertu de la *Loi sur les services en français*. Pour obtenir des renseignements en français, veuillez communiquer avec le ministère de l’Environnement et au (416) 327-5519 ou par courriel à SDBTechStd@ontario.ca.

Translation: This highly specialized publication ‘Metal Finishers - Industry Standard under the Local Air Quality Regulation (O. Reg. 419/05)’ is available in English only in accordance with Regulation 671/92, which exempts it from translation under the French Language Services Act. To obtain information in French, please contact the Ministry of the Environment and Climate Change at (416) 327-5519 or SDBTechStd@ontario.ca.

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Executive Summary

The Canadian Association for Surface Finishing (CASF) requested that the Ministry of the Environment and Climate Change (the ministry) develop a technical standard to address challenges in meeting the new air standards for chromium compounds (hexavalent) and nickel and nickel compounds that come into effect July 1, 2016. The ministry has been working with the sector on developing the Metal Finishers – Industry Standard.

CASF requested the development of a technical standard for metal finishers based on the basis that many metal finishers would exceed the new air standard for chromium compounds (hexavalent) that will come into effect July 1, 2016. Having met this criteria, the technical standard could also include additional contaminants for consideration. CASF later requested the addition of nickel and nickel compounds to the technical standard as some members may exceed this new air standard that also comes into effect July 1, 2016.

An external technical committee was formed in 2011 consisting of CASF members and ministry staff from a variety of branches as well as representatives of Environment Canada which met regularly between 2011 to 2015.

The “Technical Standard Publication” has now been updated to include the Metal Finishers – Industry Standard (MFIS). The proposal was posted for a 60 day public comment period from May 19, 2015 to July 18, 2015 (see EBR # 012-3610). The rationale for MFIS is included in this document.

The metal finishing sector includes a set of activities related to creating a specific surface on an item, such as electroplating a thin layer of chromium on a steel object like a bumper. Metal finishing can include a large number of different operations generally starting with surface preparation such as mechanical grinding and cleaning then a core process such as electroplating followed by post treatment processes like mechanical polishing.

The processes can be physical such as abrasive blasting; or chemical such as a solvent degreasing; or electrolytic such as anodizing. Depending on the end product, different combinations are often used so each metal finishing facility can be unique.

The North American Industry Classification System (NAICS) code that best describes the activities or key sources of chromium compounds (hexavalent) and nickel and nickel compounds in the metal finishing sector is 332810: Coating, engraving, cold and heat treating and allied activities.

The metal finishing sector is unique in that approximately 50% of facilities are commonly referred to as “job shops” that focus on metal finishing operations and typically take in “jobs” or work and perform metal finishing then return it to the customer. The other 50% are referred to as “captive” shops in which only a portion of the facility is dedicated to metal finishing and the other parts of the facility may do assembly or other activities. The result is that companies that perform metal finishing may identify themselves as NAICS code 332810 or one of many other NAICS codes such as machinery manufacturing, printing, computer, electrical, furniture or transportation equipment manufacturing and can be related to hundreds of possible products.

In Ontario, the sector is predominantly made up of small and medium sized enterprises and only a few large companies. They tend to be located in mainly urban areas with approximately 60% are located in the Toronto, Barrie, Halton-Peel and York-Durham regions. It is estimated that most facilities operate in buildings dedicated to the one company on that property. However, for this sector it is estimated that up to 25% of facilities may be located in industrial malls or multi-tenant buildings.

Dominant Sources

The ministry assessed different types of sources of chromium compounds (hexavalent) and nickel and nickel compounds from metal finishing facilities to determine the sources that contribute the most to the maximum point of impingement concentrations using a sampling of facilities. The plating efficiency of nickel electroplating is significantly higher at approximately 97% than electroplating with chromium compounds (hexavalent) at approximately 10-20%. Historically air emissions from nickel electroplating tanks were not controlled but would be released into the building air which would be emitted outside through general ventilation above or near the nickel electroplating operations.

The assessment found the dominant sources of chromium compound (hexavalent) emission to be the exhausts from the decorative chromium electroplating and the hard electroplating processes, general ventilation, and atmospheric evaporators.

The dominant source of nickel and nickel compounds was identified as general ventilation. The key processes that emit nickel and nickel compounds in the context of this sector are typically various types of nickel electroplating and electroless nickel plating.

A typical decorative chromium electroplating facility has more nickel electroplating tanks than tanks electroplating with chromium compounds (hexavalent).

General Overview of Metal Finishers – Industry Standard

The Metal Finishers – Industry Standard will apply to NAICS code 332810 activities, namely chromium electroplating, chromium anodizing, chromium reverse etching, nickel electroplating and electroless nickel plating and general ventilation for chromium compounds (hexavalent) and nickel and nickel compounds.

A review of North American and European jurisdictional requirements related to chromium compounds (hexavalent) and nickel and nickel compounds electroplating was conducted. This included a review of the federal Environment Canada regulation for “Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations” (Federal Regulation). Similar to the United States Environmental Protection Agency (US EPA), the Federal Regulation has rules for limiting surface tension to 45 dynes/cm measured by a stalagmometer and 35 dynes/cm measured by a tensiometer and emission limits that are equivalent to packed bed scrubbers or the use of tank covers. Like the US EPA rules, it includes other requirements for operating, monitoring, inspection and maintenance, stack testing, recordkeeping and notifications.

The ministry has made an effort to harmonize chromium electroplating, requirements for chromium anodizing and reverse etching requirements with the Federal Regulation. Both the chromium anodizing and reverse etching processes produce hydrogen and oxygen bubbles at an electrode similar to chromium electroplating.

In order to prevent, reduce or minimize emissions of chromium compounds (hexavalent) and nickel and nickel compounds, the Metal Finishers – Industry Standard compliance approach includes specified technologies that must be used, as well as operational, monitoring, recordkeeping and reporting requirements.

The technical standard requirements are organized into the following parts:

- Part I: General
- Part II: Technology Specification
- Part III: Operation and Maintenance
- Part IV: Industrial Ventilation
- Part V: Requirement to Continue use of Ventilation Systems and Methods to Manage Emissions
- Part VI: Complaints, Annual Summary Reports and Records

The proposed Metal Finishers – Industry Standard was re-organized for improved clarity and two new parts were added Industrial Ventilation and Requirement to Continue use of Ventilation Systems and Methods to Manage Emissions. Parts III and VI were re-named to be more specific regarding their content.

The requirements related to the use of specific technologies for chromium compounds (hexavalent) are listed in Part II including:

- Use of local exhaust ventilation and an air pollution control device;
- Use of fume suppressants; or
- Use of a tank cover.

The requirements for specified technologies for nickel and nickel compounds are also listed in Part II including:

- Use of local exhaust ventilation and an air pollution control device; or
- Use of wetting agents.

Specified technologies are more stringent for new processes that result in increased production capacity than for existing processes.

The ministry found that facilities located in multi-tenant buildings can have a higher exposure than those with a single tenant. The final technical standard includes a new option to use both local exhaust ventilation and an air pollution control device and a fume suppressant or wetting agent for facilities located in multi-tenant buildings.

It also includes a new option for facilities to measure building differential pressure or to prepare and maintain a table of volumetric air flows entering and exiting the facility.

There are also requirements that apply to both chromium compounds (hexavalent) and nickel and nickel compounds listed in Parts II, III, IV and V:

- Vertical and unimpeded exhaust stacks for new sources;
- Keeping a negative pressure in building areas that contain certain processes;
- Ventilation program that includes current drawings of ventilations systems;
- Ventilation assessments when certain criteria are met;

- Additional requirements for metal finishers located in multi-tenant buildings; and
- A general requirement for facilities to maintain existing air pollution control devices and ventilation systems to ensure “no backsliding” or a requirement to continue air pollution controls or ventilation systems that are in place at the time of registration.

Part VI requirements are related to records, internal reports to be provided to the Highest Ranking Individual, external notifications to the ministry and the availability of certain information to the public.

The technical standard was prepared based on the approach to focus on improving the management of dominant sources. The report also highlights particular requirements in the Metal Finishers – Industry Standard where the ministry had specifically invited feedback and comments received. For more information, please refer to the Environmental Registry posting (EBR # 012-3610).

1. Introduction

1.1. Background

Ontario's local air quality regulation (O. Reg. 419/05: Air Pollution – Local Air Quality)(the regulation) made under the Environmental Protection Act (EPA) works within the province's air management framework by regulating air contaminants released into communities by various sources including local industrial and commercial facilities. The regulation aims to limit exposure to substances released into air that can affect human health and the environment while allowing industry to operate responsibly under a set of rules that are publicly transparent.

The regulation includes three compliance approaches for industry to demonstrate environmental performance and make improvements when required. Industry can meet the air standard, request and meet a site-specific standard or register and meet the requirements of a sector-based technical standard (if available). All three approaches are allowable under the regulation.

Provincial air standards are set based solely on science and therefore, may not be achievable by a facility or a sector due to unique technical or economic limitations. Instead of making the air standard less stringent, the regulation allows facilities or sectors to exceed the air standard as long as they are working to reduce their air emissions as much as possible with technology-based solutions and best practices. The Ministry of the Environment and Climate Change (the ministry) closely oversees their progress using a framework to manage risk that was developed in cooperation with Public Health Units in Ontario and other stakeholders. Some facilities may never meet the air standard and instead will be regulated under one of the other compliance approaches. There are two types of technical standards:

- Industry Standards regulate all sources of a specified contaminant(s) within an industry sector.
- Equipment Standards address a source of contaminant, but may apply to one or multiple industry sectors.

Facilities in a sector that are operating under a technical standard may not meet one or more air standards; however, the focus is on best practices and lower emissions that reduce risks to local communities. In developing this Metal Finishers - Industry Standard, key sources of contaminants were identified and prescribed steps and timelines are included to address them. Some facilities may also choose to register under the technical standard for contaminants that meet the air standards. This allows them to be excluded from the modelling requirements of the regulation and reduce regulatory burden.

A technical standard is a technology-based solution designed for two or more facilities in a sector that may not be able to meet an air standard due to technical or economic limitations. This approach can include technology, operation, monitoring and reporting requirements. Once the technical standard is published, any facility in the sector (that may or may not meet the air standard) may apply to be registered under this compliance approach. Such registration would involve a posting on the Environmental Registry and may involve other forms of public outreach. The goal is to have a more efficient tool to better manage air emissions in the sector and reduce overall exposure from various industrial and commercial facilities.

The Technical Standards are published under the authority of section 38 of the regulation. The Technical Standards publication specifies the classes of facilities and the contaminants the technical standard applies to and the steps and time periods for compliance. A facility may be registered for an industry standard, an equipment standard or a combination of industry standards and equipment standards.

If the technical standards published address all sources of a contaminant from a facility, then the registered facility is exempt from the relevant air standard – and instead must abide by the requirements of the technical standard. If the published technical standards do not address all sources of a contaminant from a facility, then only certain sources of the contaminant may be excluded from the Emission Summary and Dispersion Modelling (ESDM) report. A facility can also choose which contaminants it registers for. The Director must consider whether or not the technical standard compliance approach is appropriate for a specific facility.

In the development of a technical standard, the ministry assesses all sources of a contaminant related to a North American Industry Classification System (NAICS) code, and makes a decision as to whether or not that source needs to be better controlled, monitored or managed. Development of a technical standard includes a better understanding of sources of the contaminant for that sector, benchmarking technology to address the sources of a contaminant, and consideration of economic issues. Specific requirements are included in the technical standard for those major sources that are determined to need better management or control. Timeframes are specified for implementation of the requirements.

In the regulation, the impact of the facility's point of impingement (POI) concentration on the local community and environment is the driver to reduce emissions: the driver is not necessarily the mass rate of emission of a contaminant. For development of a technical standard, the dominant sources contributing to the exceedance of the POI are identified, and technical solutions are determined that are appropriate for those sources.

Table 1-1: New or Updated Air Standards that take effect in 2016

Contaminant Name	**Air Standard (1)**
Benzene	0.45 µg/m^3, annual average
Benzo-a-pyrene (as a surogate of total PAHs)	0.00001 µg/m^3, annual average
1,3-Butadiene	2 µg/m^3, annual average
Chromium and Chromium Compounds (Metallic, Divalent & Trivalent)	0.5 µg/m^3, 24-hour average
Chromium Compounds (Hexavalent)	0.00014 µg/m^3, annual average
Dioxins, Furans and Dioxin-like PCBs	0.0000001 µg/m^3, 24-hour average

Contaminant Name	**Air Standard [1]**
Manganese and Manganese Compounds	0.4 µg/m^3, 24-hour average
Nickel and Nickel Compounds	0.04 µg/m^3, annual average
Uranium and Uranium Compound (in the PM_{10} fraction)	0.03 µg/m^3, annual average

(1) For those facilities that are not yet using new air dispersion models, the ministry has also expressed the new standards as half hour average in Schedule 2 of the regulation.

The Canadian Association for Surface Finishing (CASF) requested the development of a technical standard for surface finishers based on the prediction that many surface finishers would exceed the new air standard for chromium compounds (hexavalent) that will come into effect July 1, 2016. Having met this criteria, the technical standard could also include additional contaminants for consideration. CASF later requested the addition of nickel and nickel compounds to the technical standard as some members may also exceed this new air standard that also comes into effect July 1, 2016. They foresee that the additional compliance approach of a technical standard would be beneficial to the sector.

In Canada, the metal finishing sector is primarily represented by CASF. CASF provides a unified voice for surface finishers and suppliers across Canada; and provide a vital link between industry and government, businesses and suppliers. CASF plays an advocacy role by working with all levels of government on issues related to the sector and provides opportunities for networking and learning, and helping ensure the sector continues to succeed.

1.2. Purpose of the Rationale Report

The purpose of this report is to set out the background and rationale for the development of a technical standard for the metal finishing sector. It includes:

- Consideration of appropriate Canadian and other jurisdictional methods and technologies to assess, reduce and control emissions from relevant processes and equipment;
- Consultation and consideration of input from industry regarding the technical aspects and potential impacts of a technical standard for the metal finishing sector;
- Consultation and consideration of input from public and other stakeholders located in the communities surrounding Ontario's metal finishing facilities; and
- Development of a technical standard that fosters continuous improvement in reducing emissions from Ontario's metal finishing facilities.

1.3. Organization of Report

Chapter 1.0 provides background to Ontario's local air quality regulation including the three compliance pathways available to facilities along with the underpinning authority through which the ministry administers technical standards. The overall purpose and organization of the report is also presented in this chapter.

Chapter 2.0 provides an overview of the metal finishing sector in Ontario and scope of the Metal Finishers – Industry Standard.

Chapter 3.0 summarizes the processes and equipment utilized in the metal finishing sector, identifies key contaminants associated with these processes/equipment and identifies the dominant sources of air emissions.

Chapter 4.0 examines current practices being used at Ontario facilities to minimize air emissions.

Chapter 5.0 summarizes the technical requirements associated with metal finishing operations across a number of jurisdictions including Environment Canada, the United States of America and the European Union. The focus will be on the technical requirements rather than on how these other jurisdiction regulate metal finishing operations.

Chapter 6.0 defines the types of technically feasible methods available to address air emissions from metal finishing operations, and concludes by providing a summary table of the recommended air pollution control strategy taking into consideration cost effectiveness.

Chapter 7.0 discusses the public consultation efforts which were carried out in support of a technical standard for this sector, how stakeholder comments were addressed and the path forward.

Taking into consideration the first seven chapters of this report, Chapter 8.0 presents the structure for a technical standard for the metal finishing sector. The rationale for the requirements is discussed and the means of assessing continuous improvement are explored. More information is also available on the Environmental Registry (EBR# 012-3610).

1.4. **Authority for this proposal**

Technical Standards are published under the authority of section 38 of the Regulation. Under Section 38 of the Regulation - Technical Standards publication:

“38. (1) The Minister shall ensure that, with respect to the Technical Standards publication, all of the following criteria are met:

1. *Every technical standard set out in the Technical Standards publication is specifically identified in the publication as an industry standard or an equipment standard.*
2. *For each industry standard that is set out in the Technical Standards publication,*
    - *i. the Technical Standards publication specifies which classes of facilities the industry standard applies to, and those classes are identified with reference to NAICS codes,*
    - *ii. the Technical Standards publication specifies which contaminants the industry standard applies to,*
    - *iii. the Technical Standards publication sets out the steps that shall be taken to comply with the industry standard, and*

iv. the Technical Standards publication sets out the time periods, if any, within which the steps specified under subparagraph iii shall be taken.

3. The Technical Standards publication indicates that, with respect to each class specified under subparagraph 2 i to which an industry standard applies, and with respect to at least one contaminant to which that standard applies, the Minister is of the opinion that,

i. with respect to at least two facilities in the class that are located in Ontario,

A. it is not technically feasible to comply with section 19 or 20, whichever is applicable, or

B. it is not economically feasible to comply with section 19 or 20, whichever is applicable,

ii. compliance, in accordance with subsection 42 (5), with the industry standard that applies to the class and the contaminant,

A. is technically and economically feasible with respect to at least one facility in the class that is located in Ontario, and

B. will permit efforts that would otherwise be made to comply with section 19 or 20 to be put to better use to protect the natural environment, having regard to subparagraph i,

iii. including the industry standard that applies to the class and the contaminant in the Technical Standards publication is more efficient than having the Director consider separate requests under section 32 to set site-specific standards for the contaminant that would otherwise apply to facilities in the class.

4. For each equipment standard that is set out in the Technical Standards publication,

i. the Technical Standards publication specifies which classes of facilities the equipment standard applies to, and those classes are identified with reference to NAICS codes,

ii. the Technical Standards publication specifies which contaminants the equipment standard applies to,

iii. the Technical Standards publication specifies which sources of contaminant the equipment standard applies to,

iv. the Technical Standards publication sets out the steps that shall be taken to comply with the equipment standard, and

v. the Technical Standards publication sets out the time periods, if any, within which the steps specified under subparagraph iv shall be taken.

5. The Technical Standards publication indicates that, with respect to each class specified under subparagraph 4 i to which a equipment standard applies and with respect to at least one contaminant and source of contaminant to which that standard applies, the Minister is of the opinion that,

i. at least two facilities in the class that are located in Ontario have the source of contaminant, and

ii. compliance, in accordance with subsection 43 (4), with the equipment standard that applies to the class, the contaminant and the source of contaminant is *technically and economically feasible with respect to at least one facility in the class that is located in Ontario.*

(2) Before a technical standard is set out in the Technical Standards publication, the Minister shall consider whether provisions dealing with the following matters should be included in the technical standard:

1. Notification of and consultation with affected persons before making an application for registration in respect of the technical standard.

2. The making and retention of records.

3. Circumstances in which notice is required to be given to the Ministry.

4. Progress reports relating to implementation of the technical standard.

(3) Before an industry standard that applies to a class of facilities is set out in the Technical Standards publication, the Minister shall consider whether compliance, in accordance with subsection 42 (5), with the industry standard may reduce the regulatory burden applicable to facilities in that class for which compliance with section 19 or 20 would otherwise be required.

(4) Before an equipment standard that applies to a class of facilities and a source of contaminant is set out in the Technical Standards publication, the Minister shall consider whether compliance, in accordance with subsection 43 (4), with the equipment standard may reduce the regulatory burden applicable to facilities in that class for which consideration of the source of contaminant would otherwise be necessary when using an approved dispersion model for the purposes of this Part."

The technical standards publication specifies the classes of facilities and the contaminants the technical standard applies to and the steps and time periods for compliance. Industry standards and equipment standards are published in the document "Technical Standards to Manage Air Pollution". This technical standards publication may be updated from time to time, based upon public consultation consistent with the Ontario Environmental Bill of Rights legislation.

Although industries participating in the technical standards may not meet certain air standards in the Regulation, they are still expected to manage continual improvements to reduce air emissions to the extent that the technology and methods make this possible.

In the development of a technical standard, the ministry assesses all sources of a contaminant related to a North American Industry Classification System (NAICS) code, and makes a decision as to whether or not that source needs to be better controlled, monitored or managed. Development of a technical standard includes a better understanding of sources of the contaminant for that sector, benchmarking technology to address the sources of a contaminant, and consideration of economic issues. Specific requirements are included in the technical standard for those major sources that are determined to need better management or control. Timeframes are specified for implementation of the requirements.

2. Sector Overview

Metal finishing as defined by the Institute of Metal Finishing is "the deposition of a coating (metallic or non-metallic) on to a substrate (metallic or non-metallic), or a surface treatment yielding a thin film, to enhance the appearance, function or performance of a product and to give added-value and increased marketability". This process enhances corrosion resistance, wear resistance, hardness, electrical conductivity, and aesthetics as examples. It is a key process in many manufacturing industries since it has a profound effect on the appearance and/or functioning of the final product. It allows the use of different metals underneath a very thin coating of different, sometimes more expensive metals such as gold plated earrings for it's decorative properties or a chromium plated steel bumper for rust inhibiting properties.

Typical metal finishing operations include electroplating, electro-less plating, etching, chemical conversion coating and acid anodizing. These processes are often preceded by cleaning operations which may involve solvents and followed by rinsing operations. The most common metals electroplated on a commercial scale are cadmium, chromium, copper, gold, nickel, silver, tin and zinc. A more detailed description of the various operations can be found in Chapter 3.0 of this report.

In Ontario, there are approximately 200 metal finishing facilities mostly located in urban areas. Of the estimated 200 Ontario facilities, approximately 70 Ontario facilities carry out chromium electroplating, chromium anodizing, and/or reverse etching operations and are subject to the federal chromium regulations called the Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations. Facilities across Canada are subject to the federal chromium regulations with approximately 35% of those facilities located in Ontario.

Approximately 50% of the metal finishing operations in Ontario are found in job shops which perform electroplating (and services/process associated with electroplating) on demand or as specified by different clients and according to the capabilities of the shops themselves. The remaining 50% of the metal finishing operations in Ontario are found in captive shops which perform electroplating as part of the overall manufacturing process of a company and the electroplating that is performed is specific to the products the company manufactures.

A few large operations are owned by major companies, however, the vast majority are considered to be small to medium enterprises (SMEs). These SMEs employ from a single employee to more than several hundred employees. Job shops tend to be smaller than captive shops with an average of only 25 employees.

Metal finishing operations are found across a broad range of sectors including:

- printing and related support activities (NAICS code 323);
- plastics and rubber products manufacturing (NAICS code 326);
- abrasive product manufacturing (NAICS code 327910);
- primary metal manufacturing (NAICS code 331);
- fabricated metal product manufacturing (NAICS code 332);
- machinery manufacturing (NAICS code 333);
- computer and electronic product manufacturing (NAICS code 334);
- electrical equipment, appliance and component manufacturing (NAICS code 335);

- transportation equipment manufacturing (NAICS code 336);
- furniture and related product manufacturing (NAICS code 337);
- miscellaneous manufacturing including jewelry, silverware, sporting/athletic goods and signs (NAICS code 339);
- research and development in the physical, engineering and life sciences (NAICS code 541710); and
- appliance repair and maintenance (NAICS code 811412).

A large number of surface finishers identify themselves as NAICS code 332810 - Coating, engraving, cold and heat treating and allied activities or 332999 - All Other Miscellaneous Fabricated Metal Product Manufacturing. Activities can include plating, polishing, brazing, heat treating and other surface finishing activities. Often job shops are considered NAICS code 332810. Captive shops may have a different primary NAICS code than 332810 but may conduct activities associated with NAICS code 332810.The MFIS is for NAICS code 332810.

The range of products treated by metal finishing operations varies significantly and includes (but is not limited to):

- agricultural implements (plows, spades, hoes)
- aircraft landing gear
- armature shafts for motors
- automotive shock absorbers and struts
- automotive parts (bumpers, door handles, interior trim, wheel rims)
- ball valves
- bathroom/kitchen fixtures
- building door and window frames
- coins
- crankshafts
- cutting saw blades
- cutting, milling, turning tools
- engine cylinders and piston rings
- engine valve stems
- fastenings (bolts, nails, nuts, screws)
- gauges and pins
- gun barrels
- hydraulic pistons and cylinders
- jet engine components
- jewellery
- machine parts
- moulds and dies
- printed circuit boards
- railroad wheel bearings
- rolls for the steel, paper, aluminum and plastic industries
- rotogravure cylinders for the printing industry
- seals
- textile guides

The annual direct cost of corrosion worldwide is over 3% of the world's Gross Domestic Product (GDP). Corrosion experts have concluded that a net 20 to 25% of that annual cost can be saved by applying currently available corrosion technologies. Metal finishing enhances corrosion protection and plays a vital role in the lives of consumers and in the province/ nations economic future.

The metal finishing sector is faced with ongoing federal, provincial and municipal regulatory requirements such as;

- Canadian Environmental Protection Act, 1999 - Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations
- Canadian Environmental Protection Act, 1999 – Environmental Emergency Regulations
- Canadian Environmental Protection Act, 1999 - Chemical Management Plan Requirements
- Ontario Regulation 419/05 – Local Air Quality
- Toxic Reductions Act, 2009
- Ontario Regulation 455/19 – Toxic Reductions
- Sewer Use By Laws (specific to facility location), and ChemTRAC (Toronto only)

These regulatory requirements have been put in place to regulate various environmental issues associated with this sector including: air contaminates, reducing usage of prescribed toxic substances, annual reports for pollutants to air, water and land develop, and test emergency plans.

CASF has stated that in the past 2-5 years, the metal finishing sector has been faced with new compliance requirements that have significantly increased cost to maintain compliance, and have also increased costs for resources, operations, and energy. Furthermore, the industry claims that the onset of some of these new regulatory requirements have resulted in some facility closures. In the next 2-5 years, new regulatory requirements will be taking effect under O. Regulation 419/05 – Local Air Quality that will impact the metal finishing sector, and may increase their compliance costs again. Our goal is to protect the environment and to allow industry to operate both competitively and responsibly under a set of rules that are publicly transparent.

A review of Ontario data from this sector reported to the National Pollutant Release Inventory (NPRI) found that air emissions of chromium and chromium compounds (hexavalent) has been generally decreasing since 2003. See Figures 2-1 and 2-3.

A review of Ontario data from this sector reported to the NPRI found that the emissions of nickel and nickel compounds has also generally decreased since 2003. See Figures 2-2 and 2-4.

Figure 2-1: NPRI Reported Air Emissions of Chromium Compounds (hexavalent) from Ontario NAICS 332810

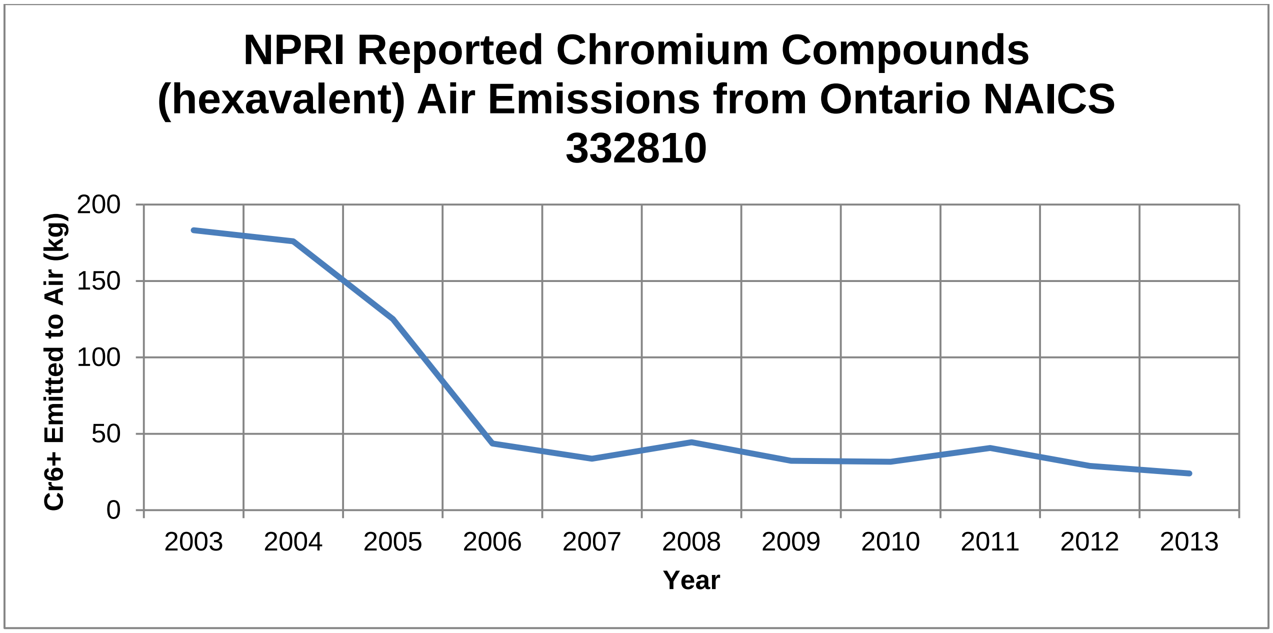


Figure 2-2: NPRI Reported Air Emissions of Nickel and Nickel Compounds from Ontario NAICS 332810

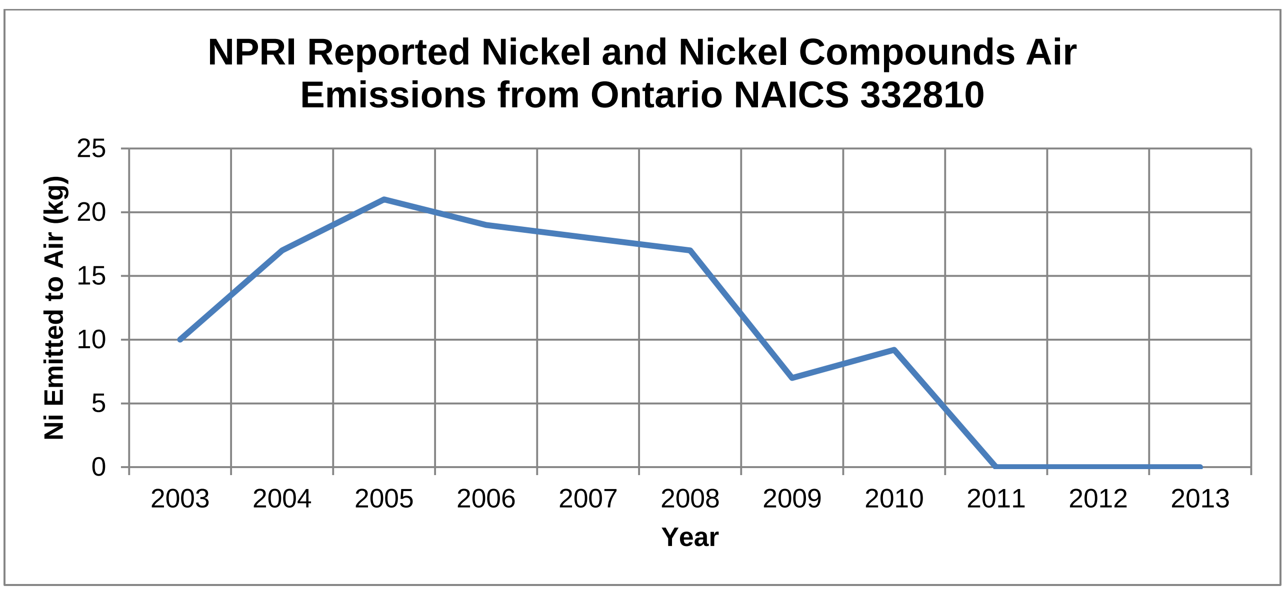


Figure 2-3: NPRI Reported Air Emissions of Chromium Compounds (hexavalent) in Ontario

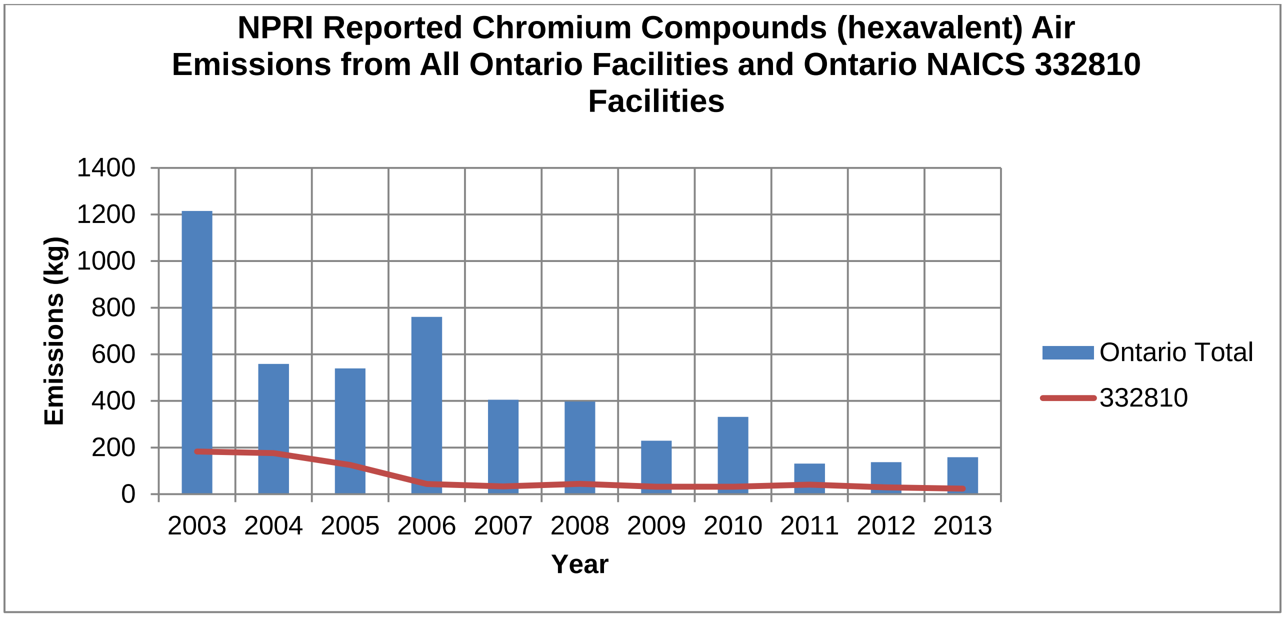
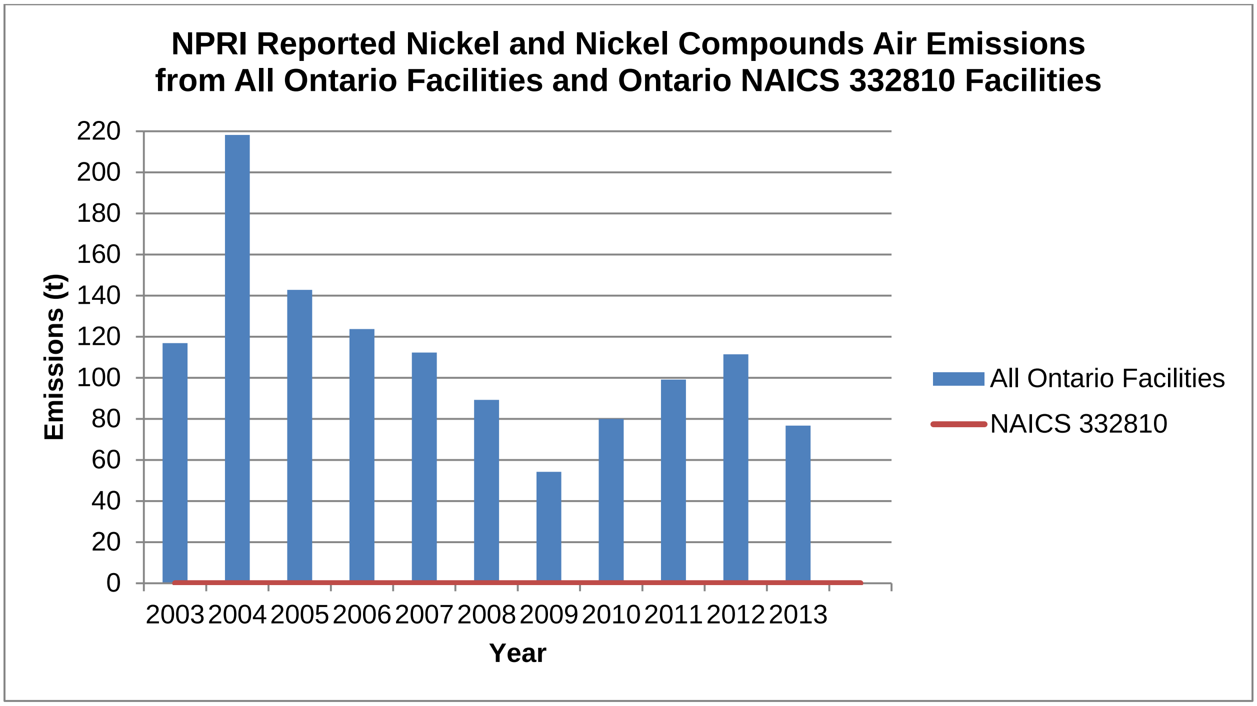


Figure 2-4: NPRI Reported Air Emissions of Nickel and Nickel Compounds in Ontario



2.1. Scope of the Metal Finishers – Industry Standard

The scope of the technical standard for the metal finishing sector is currently for chromium compounds (hexavalent) and nickel and nickel compounds. The type of technical standard is an industry standard. The scope of industry standards is defined in Ontario Regulation 419/05 (Section 38(1) paragraph 2, clauses (i) and (ii), for each industry standard that is set out in the technical standards publication,

i. the Technical Standards publication specifies which classes of facilities the industry standard applies to, and those classes are identified with reference to NAICS codes;
ii. the Technical Standards publication specifies which contaminants the industry standard applies to.

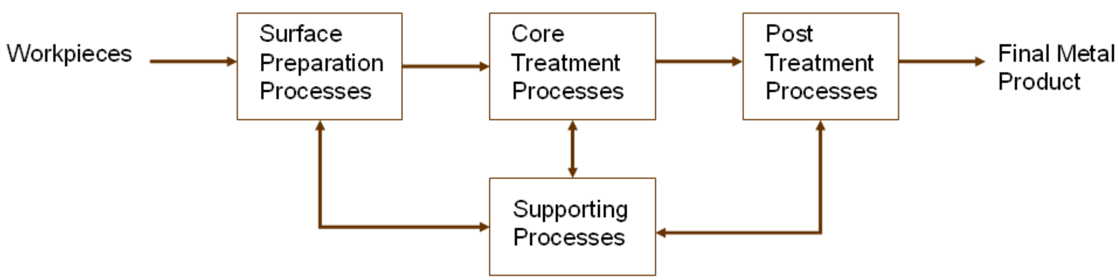
For the development of an industry standard, the dominant sources contributing to the exceedence of the point of impingement are identified and the technical solutions are determined that are appropriate for controlling emissions from those sources. A single NAICS code is included in the Metal Finishers – Industry Standard, 332810. The ministry acknowledges that approximately 50% of the metal finishing sector may not list the 332810 as their primary NAICS code but may still conduct activities associated with 332810 which could still be acceptable and registration could be allowed if all criteria are met. This will be evaluated on a case-by-case basis in the registration process.

3. General Description of Metal Finishing Processes

3.1. Description of Processes

Metal finishing operations typically involve surface preparation processes followed by core treatment processes and then potentially followed by some form of post treatment. Figure 3-1 provides a simplified process flow diagram for the processes associated with metal finishing. There are a variety of surface preparation, core treatment and post treatment processes that may be incorporated into any given metal finishing operation. The condition of the incoming work pieces along with the desired finished metal products will drive which processes are included in any given metal finishing operation. There are also a number of supporting processes associated with a metal finishing operation. The sub processes associated with metal finishing operations are described in the subsections below. More detailed descriptions of metal finishing processes are provided in Appendix B. Example process flow diagrams for hard chromium plating, decorative chromium plating and chromium anodizing are also included in the subsections below.

Figure 3-1 Simplified Metal Finishing Operation



3.1.1. Handling Techniques

Many of the metal finishing operations are batch operations where work pieces are dipped into a series of baths containing various reagents/solutions for achieving the required surface characteristics. Work pieces can either be mounted on jigs or racks or loaded inside barrels. Jigs or racks are frames that carry the work pieces individually or in groups. Barrels are typically plastic cylinders that rotate in the bath solution and hold many smaller work pieces. Coils or reels of substrate can also be processed on a continuous basis.

3.1.2. Surface Preparation Processes

Surface preparation is a critical step in metal finishing operations to ensure uniform application and permanent adhesion of the surface treatment. These pretreatment steps not only remove oils and greases from the work pieces but also remove oxides, blemishes or imperfections and provide chemically active surfaces for the subsequent treatments.

Essentially all metal finishing operations include cleaning or degreasing where work pieces are heavily soiled. Surface soils include the following:

- residues such as oil, fingerprints, drawing compounds and soils driven into surface porosity or applied under pressure. Generally these soils are not removed by conventional emulsification, wetting and displacement soak cleaners;

- finely divided particles, such as polishing compound abrasives, metallic fines from grinding or metalworking operations, carbon and other alloying elements. Often this fine particulate matter (generally referred to as smut) may be held to the surface by simple mechanical forces, electrostatically or in a thin oil or grease matrix; and
- metal oxidation products, the result of exposure to the atmosphere or a thermal process such as heat treatment, forging, welding, etc.

There are three common types of surface preparation processes: physical, chemical and electrolytic.

Physical surface preparation processes include the following sub processes that involve mechanically treating the surface such as:

- grinding:
- abrasive blasting
- buffing
- deburring/tumbling
- grinding/sanding
- polishing (mechanical)

Chemical surface preparation processes often involve the use of acids or solvents to clean or otherwise prepare the surface of a work piece including:

- aqueous cleaning
- degreasing
- deoxidizing/de smutting
- etching
- pickling & acid dipping
- chemical polishing

The third common type of surface preparation is conducted with electrolytic processes with the aid of electricity including:

- pickling, activation & degreasing (electrolytically assisted)
- polishing (electrolytic & chemical)

The basic considerations for selecting the right cleaning and activation solutions include:

- identifying the base metal (type, alloy, surface characteristics);
- limitations (process line, chemistry, temperature, time);
- rinsing characteristics (work pieces, equipment, process line);
- type and quantity of soils; and
- existing finishes (chromates, electroplated coatings, phosphates, rust inhibitors)

3.1.3. Core Treatment Processes

Similar to surface pretreatment processes, core treatment processes can also be grouped into different types of sub processes. Some finishes involve the electroplating of a very thin layer of metal onto a metallic or non-metallic (e.g. plastic) work piece. There are other treatments that only alter the surface of the work piece such as anodizing. And still others where coatings added to the surface of a work piece such as dipping or spraying a paint (liquid or powder).

Some examples include the following sub processes:

- anodizing
- brightening
- chemical blackening
- chemical conversion coatings
- dip spin coating
- dying/colouring
- electroless plating
- electrophoretic coating (E-coating)
- electroplating
- heat treatment
- hot dip galvanizing
- mechanical plating
- paint dipping
- paint spraying
- passivation
- phosphating
- powder coating
- reverse etching
- rinsing

3.1.4.Post Treatment Processes

Post treatment processes include the following sub processes:

- drying/curing
- metal stripping
- paint stripping
- polishing (mechanical)
- sealing

3.1.5.Supporting Processes

Common processes supporting the metal finishing operations include the following:

- boilers, heaters and cooling towers to heat or cool the building or processes
- emergency generators for emergency power
- general ventilation historically used to release excess heat from buildings
- laboratories often used for quality control testing
- roadways (onsite)

- storage tanks
- resource recovery
- welding/soldering often used for general maintenance of equipment

3.1.6. Electrolytic Processes

An electrolytic process consists of the following:

- A solution of electrolytes
- At least two electron conductors (electrodes) and the ability to form a circuit
- A current (usually direct current although the voltage can be AC or reversing DC in specific cases)

When the work piece is connected to the circuit in the electrolytic cell, the cations (M+ and H+) move towards the cathode (which is negatively charged). The metal is deposited while the hydrogen is generated as a secondary cathodic reaction. The anions (X-) move towards the anode (which is positively charged).

Electrolytic processes do not operate with 100 percent efficiency. Some of the current decomposes water in the bath resulting in hydrogen and oxygen gases. In fact the main advantage of electrocleaning is the mechanical action produced by the vigorous emission of hydrogen at the cathode which tends to lift off films of oil, grease, paint and dirt. The rate of gassing varies widely with the individual process. When the gassing rate is high, entrained mists of acids, alkaline materials or other bath constituents are discharged into the atmosphere.

An electroplating system consists of two electrodes (an anode and a cathode) immersed in an electrolyte and connected to an external source of direct current electricity. The work piece upon which the plating is to be deposited makes up the cathode. In most electroplating systems, a bar of the metal to be deposited is used as the anode. The electrolyte is a solution containing ions of the metal to be deposited and additional dissolved materials to aid in electrical conductivity and produce desirable characteristics in the plated metal.

When an electric current is passed through the electrolyte, ions from the electrolyte are reduced (or deposited) at the cathode and an equivalent amount of either the same or a different element is oxidized (or dissolved) at the anode. In some systems, such as chrome plating, the deposited metal does not dissolve at the anode therefore insoluble anodes are used. The source of the deposited metal being ions formed from salts of that metal previously dissolved in the electrolyte.

Mists are generated during the electroplating process as hydrogen and oxygen gasses evolve. The gas bubbles rise to the surface of the tank and as the bubbles burst at the surface they release the bath solution as a fine mist. Approximately 80% of particles of the mist from hard chromium electroplating have particle diameter less than 8 micrometers (um) and 70% less than 3um and 7% less than 0.5um.

The degree of severity of air emissions from these electroplating processes may vary from being insignificant to a potentially serious hazard depending the processes, chemicals being employed, the range of operating conditions being used and the air pollution controls and measures that are in place.

Factors affecting air emissions from electroplating operations:

- current density applied
- surface area of work piece plated
- plate thickness
- plating time
- type of work piece to be plated
- type of metal being plated onto the work piece
- orientation of work piece in tank
- bath temperature
- surface tension of plating bath
- plating bath solution
- agitation (eg. mechanical or air sparging)

Electrolytic processes include:

Chromium Electroplating
Chromium anodizing
Reverse Etching
Nickel electroplating

Decorative chromium electroplating

In decorative plating, the base material (e.g., brass, steel, aluminum, or plastic) is generally plated with a layer or layers of nickel followed by a relatively thin layer of chromium to provide a bright surface with wear and tarnish resistance. When plating hexavalent chromium, a chromic acid bath is generally used. The evolution of hydrogen gas from chemical reactions at the cathode consumes 80 to 90 percent of the power supplied to the plating bath, leaving the remaining 10 to 20 percent for the deposition reaction. When the hydrogen gas develops, it entrains chromic acid and causes misting at the surface of the plating bath.

Electroplating tanks are typically equipped with some type of heat exchanger. Bath temperatures often range from 40-45 or 50-65 degrees Celsius. Mechanical agitators or compressed air supplied through pipes on the bottom of tanks are sometimes used to provide uniformity of bath temperature and composition.

The baths contain a chromic acid solution that acts as an electrolyte. Many facilities that perform decorative chromium electroplating also conduct nickel electroplating and electroplating of other metals. Often there are more nickel tanks than hexavalent chromium tanks due to the fact that there are a number of different metallic layers under the chromium.

Hard Chromium Electroplating

Hard chromium electroplating is a slightly different electroplating process than decorative chromium electroplating. The process can be slightly warmer than decorative chromium electroplating with a higher current density or amount of electricity needed in the process. It results in a thicker layer of chromium to give greater hardness or wear resistance to a part. The chromium compounds (hexavalent) emissions are slightly higher than decorative chromium electroplating.

Chromium Anodizing

Chromium anodizing is also an electrolytic process that uses a chromic acid bath to form an oxide layer for its electrical insulation or corrosion resistance properties.

Reverse Etching

Although reverse etching is not an electroplating process, it is also an electrolytic process in a chromic acid bath. It is often the step prior to hard chromium plating to prepare the surface of the part or workpiece.

Nickel Electroplating

Nickel plating baths have high cathode efficiencies therefore the generation of mist is minimal. Only about 3% of the electrical current releases hydrogen at the cathode and practically no oxygen is emitted at the anodes during the electroplating process. Based on these high cathode efficiencies and due to the fact that these tanks are typically operated at moderate temperatures of 20-30 or 20-65 degrees Celsius and low to moderate current densities, gassing is minimal, particularly when compared to electroplating with hexavalent chromium.

There are many different types of nickel plating processes. Common processes include Watts or bright, semi-bright, Wood’s Nickel Strike, particle and electroless nickel plating.

The Watts process bath contains nickel sulfate, nickel chloride and boric acid with other chemical additives depending on the chemical supplier. The bright nickel process produces a layer that does not require buffing and is usually applied just under the chromium in decorative chromium applications. It may be thicker than the layer of chromium and thinner than underlying semi-bright nickel layers.

The semi-bright nickel process is used to help level or smooth out the surface and to improve corrosion resistance and does not contain sulphur.

Woods nickel strike is not as commonly used but is typically used for hard to plate materials as surface preparation for additional layers. Wood’s Nickel Strike process is intentionally very inefficient which causes significant gassing.

Electroless nickel plating is a non-electrolytic process with significantly lower nickel concentration in the bath, (e.g. typically less than 10% of the nickel concentration in an electrolytic nickel plating process). The electroless nickel plating process is usually operated at higher temperatures, has a very high air agitation rate and produces a significant amount of hydrogen gas as a by-product.

A 2007 US EPA study indicated nickel emissions from uncontrolled and vented Electroless Nickel, Barrel Nickel and Wood’s Nickel Strike plating (with no wetting agents, eductor system or mesh pads) are more significant (varying from 0.1 mg/dscm to 1.13 mg/dscm). None of these solutions require a wetting agent for quality purposes which is why these processes typically operate without one. In some cases, it is not technically feasible to use wetting agents for certain nickel processes because wetting agent can cause quality issues.

The barrel nickel plating process has many mechanical/physical effects (such as splashing during entry of the barrel into the tank, the large amounts of liquid leaving the barrel during removal from the tank, splashing from filter pumps) that increase nickel emissions. Electrolysis from plating operation had minimal emissions.

Supporting Processes

Most manufacturing facilities have a number of processes and activities that are not directly related to the manufacture of a product but are nevertheless needed and can emit contaminants. Some examples are described below.

General Ventilation

Historically, older facilities typically used roof vents to release excess heat from a facility. Most baths are heated and this heat needs to be emitted for the comfort of workers particularly in the summer. Indoor air that can contain fugitive emissions from various production processes can be discharged from the general ventilation such as roof vents which may simply be a “window” with fan in roof or in a side wall.

Laboratories

Most metal finishing facilities that have plating operations also have quality control labs to test and monitor chemical baths. Lab testing may be conducted and chemicals may be stored under hoods that capture any chemicals used in the lab.

Roadways

Short onsite roadways and parking lots were common in the facilities assessed. They were used predominantly for shipping and receiving products and materials and for employee parking.

Resource Recovery Processes

Many metal finishing facilities had some processes dedicated to resource recovery. Facilities approached resource recovery differently but generally a facility would try to reuse metals used in plating process or to concentrate waste streams for more efficient resource recovery. Some facilities use atmospheric evaporators or vacuum evaporators to help reduce the water content in material going for resource recovery.

General Maintenance Activities

Most manufacturing facilities have general maintenance activities that often involve a small on-site maintenance shop for equipment and building maintenance such as periodic equipment cleaning, welding, paint, grinding. Welding is very common and the metals emitted depend on the metals that are being welded. Nickel and chromium as well as chromium compounds (hexavalent) are commonly emitted from welding activities. Maintenance welding is typically done from time to time on an as needed basis in small quantities.

3.2. Identification of Key Sources

3.2.1. Dominant Source Analysis

The purpose of this analysis was to identify the sources that contribute most to the overall Point of Impingement (POI) concentration of chromium compounds (hexavalent) and nickel and nickel compounds. The analysis was performed on a sampling of facilities that conduct electroplating with chromium compounds (hexavalent) or nickel and nickel compounds. A range of facilities included stand-alone facilities where there was only a single facility on a property as well as situations of a single facility located in one unit of a multi-tenant building. The key objectives of this analysis included identifying commonality between facilities on the dominant sources of the contaminants and identifying, as necessary, the need for better management or control of these sources.

General Methodology

NAICS Codes 332810 and 332999 are Schedule 5 facilities and must use an approved model such as the AERMOD dispersion model or the ASHRAE model for facilities located in multi-tenant buildings. Both stand-alone facilities and multi-tenant facilities were assessed therefore both the AERMOD dispersion model and the ASHRAE model was used.

Typical metal finishing facilities have a limited number of sources of chromium compounds (hexavalent) or nickel and nickel compounds therefore there was no grouping of sources. The contribution of each source to the maximum overall POI concentration was determined. This was done for a number of different scenarios based on different operating assumptions and emission estimating assumptions in order to test the sensitivity of the dominant sources to different possible situations.

Using the AERMOD dispersion model dominant sources were identified based on the contribution to the maximum POI concentration. Generally sources that contributed greater than 10% to the POI were considered dominant sources but other factors were also considered including the data quality of the emission estimation technique and the source’s dispersion factor.

Many facilities located in multi-tenant buildings are small in size and often have only a few or a single stack associated with a contaminant. This was helpful because the ASHRAE model only allows for a single source to be evaluated at once. The ASHRAE model was generally used to anticipate possible maximum POI concentrations rather than contribution to a maximum POI concentration.

3.2.2. Dominant Sources of Chromium Compounds (hexavalent)

There were ten facilities that were assessed for chromium compounds (hexavalent) including seven decorative chromium electroplating, two hard chromium electroplating and one chromium anodizing facility. These included single and multi-tenant facilities.

The dominant sources included decorative chromium electroplating, hard chromium electroplating, chromium anodizing, general ventilation (e.g. general building roof exhausts) and atmospheric evaporators.

3.2.3. Dominant Source of Nickel and Nickel Compounds

A review of ESDM and NPRI data from a sampling of facilities found very limited information on nickel emissions from metal finishing facilities. Detailed information was available for one facility therefore one in-depth assessment was conducted for nickel and nickel compounds using an ESDM that included emission rates based on source testing.

None of the processes that use nickel and nickel compounds such as nickel electroplating tanks had local exhaust ventilation that led to a stack or air pollution control devices. The facility has conducted source testing on general ventilation exhausts located on the roof near the nickel processes which were determined to be dominant sources of nickel and nickel compounds.

3.2.4. Conclusions and Recommendations

It is concluded that for chromium compounds (hexavalent) the dominant sources that contribute to the maximum POI concentration are not only the key processes of decorative and hard chromium electroplating and chromium anodizing but it also includes fugitive emissions from those sources that are being emitted from general ventilation and atmospheric evaporators.

It is concluded for nickel and nickel compounds fugitive emissions from nickel electroplating which are being emitted from general ventilation are a key source.

4. Existing Methods and Controls to Reduce Emissions

4.1. Current Practices for Chromium Compounds (hexavalent)

In Ontario, there are two common methods for reducing emissions of chromium compounds (hexavalent) from decorative and hard chromium electroplating, chromium anodizing and chromium reverse etching. Both are compliance options under the Federal Regulation which includes:

- use of an air pollution control device and emission collection system (e.g. local exhaust ventilation) from a point source; or
- limiting the surface tension of the solution within the tank.

Based on information submitted to Environment Canada, approximately 50% of facilities use a control device and emission collection system from a point source and the other 50% limit surface tension of the solution in their tanks. CASF has indicated that some facilities use multiple methods to reduce emissions.

The ministry is not aware of any facilities in Ontario that have selected the third option in the Federal Regulation to use a tank cover. There are other methods of reducing the emissions that have been used in the past or may be used together with one of the Federal Regulation's options and are described below.

4.1.1. Air Pollution Control Devices and Local Exhaust Ventilation

There are different types of air pollution control devices being used in metal finishing facilities. The metal finishing sector commonly uses mist eliminators or variety of types of wet scrubbers and sometimes uses them in series as air pollution control devices.

Mist eliminators often contain mesh pads like an industrial sized scouring pad or use blades. They remove mist from the air stream. Mist eliminators can achieve better than 99% removal efficiency and can be less expensive than wet scrubbers to purchase and to operate. Pads can be designed to provide specific removal efficiencies. However, they are often not as effective for droplets less than 3 millimeters in diameter. The removal efficiency can also decrease as droplet size increases and a common problem can be clogging.

Wet scrubbers are more commonly used on their own or with a mist eliminator prior to the wet scrubber to remove larger droplets or particles. There three common types of wet scrubbers in use at metal finishing facilities in Ontario: venturi scrubbers, packed bed scrubbers and composite mesh pad scrubbers.

Venturi Scrubbers

Venturi scrubbers are a type of wet scrubber primarily used to remove particulate matter but are also effective for mists. A venturi scrubber atomizes the scrubbing liquid to increase contact of waste gas to the scrubbing liquid. Their removal efficiencies are typically higher for particulate matter with diameters ranging from 0.5 um to 5 um and can range from 70-99% removal efficiency. They are relatively simple in design, installation and maintenance. They also allow corrosive gasses to be neutralized. The US EPA estimated capital costs can be less than half of a packed bed scrubber when compared on dollars per standard cubic meter per second.

Packed Bed Scrubbers

Packed bed scrubbers are another type of wet scrubber but it uses a container filled with different shaped packing material to increase the surface area of the waste gas and scrubbing liquid. The US EPA has stated equipment vendors estimate packed bed scrubber removal efficiencies range from 95-99%. US EPA estimates a 99% removal efficiency for hard chromium electroplating operations based on higher inlet concentrations and 97% removal efficiency for chromium electroplating and chromium anodizing operations that have lower inlet concentrations. The US EPA estimated capital costs can be double the capital cost of venturi scrubbers when compared on dollars per standard cubic meter per second. Maintenance costs for packed bed scrubbers are also considered relatively high when compared to venturi scrubbers.

Composite Mesh Pad Scrubbers

The third common wet scrubbers are composite mesh pad scrubbers. They consist of layers of densely packed fibers in a series of mesh pads. The first layer generally removes larger particles and subsequent layers remove smaller particles. The US EPA reported that composite mesh pad scrubbers were developed to removal small particles in the range of 5um. The US EPA estimated composite mesh pad scrubber removal efficiency up to 99.8% based on source testing for chromium electroplating operations.

Wet Scrubber Followed by HEPA Filters

The ministry is aware of only one metal finishing facility in Ontario with wet scrubbers followed by HEPA filters. This level of control could be consistent with requirements in California and is likely the best available control technology. California Environmental Protection Agency (Cal EPA) defines a HEPA filter as a filter rated at 99.97% or more efficient in collecting particle sizes 0.3 microns or larger. Cal EPA has set requirements for the use of HEPA filters following wet scrubbers.

Local Exhaust Ventilation

Emission collection systems otherwise known as local exhaust ventilation is a common method used to capture mists from electroplating and other metal finishing tanks and convey them to an air pollution control device or stack. Access to the tanks requires the use of equipment that does not restrict the finishing activity. Canopy hoods and enclosures are generally not used for this reason. Lateral (slot) and push-pull exhaust hoods are more common for the capture of emissions from the tanks and require more space around the tanks but allow access to the tanks by overhead systems.

Where no draft exist, the recommended capture air velocity across the liquid surface of the plating tank is 46 m/min (150 ft/min) for contaminants with high hazard potential and a high rate of mist evolution, such as chromic acid (USEPA, 1993)

4.1.2. Fume Suppressants

It is estimated by Environment Canada that approximately 50% of the facilities reporting to the Federal Regulation are using fume suppressants to meet surface tension limits instead of meeting emissions limits and performing stack testing. Fume suppressants are technologies that prevent or reduce fume or mist generation or reduces fume or mist at the surface of the tank. There are two common types of fume suppressants; chemical and mechanical. Chemical fume suppressants appear to be the most common fume suppressant used in Ontario. Chemical suppliers have told us that fume suppressants for chromium compounds (hexavalent) are specifically designed to reduce fume or mists. They are typically a chemical that is added to the bath for that particular purpose and reduce the surface tension of the bath.

The US EPA has conducted studies that indicated fume suppressants with Perfluorooctane Sulfonate (PFOS), can perform up to an equivalent to 99.5% removal efficiency with surface tension limits of 45 dynes/cm or 35 dynes/cm. In Canada, the federal government began phasing out the use of PFOS in fume suppressants due to environmental concerns with the chemical. Ontario facilities that chose to limit surface tension had to use PFOS free fume suppressants since May 2013. The metal finishing sector had raised initial concerns with the potential effectiveness of PFOS free fume suppressants in what the chemical suppliers called “first generation” PFOS free fume suppressants. Environment Canada is in the process of conducting a study to determine the effectiveness of PFOS free fume suppressants. Chemical suppliers have indicated that they believe “second generation” PFOS free fume suppressants are equally effective or better then PFOS containing fume suppressants but no published data was available to support this.

Chemical suppliers indicated that other countries have already moved to eliminate PFOS from fume suppressants. The most recent US EPA MACT rule (2012) phases out the use of PFOS containing fume suppressants in September 2015.

Foam Blanket

There are some other chemical fume suppressants that create a foam blanket when there is an electrical current applied to the bath but does not lower the surface tension of the bath. The foam blanket creates a barrier to reduce fume or mist at the surface of the tank as long as a minimum blanket thickness is maintained over the entire tank but can have some disadvantages. If not properly managed, the foam can stick to parts can cause quality control problems. It can also create a hydrogen explosion hazard if the foam blanket is too thick and builds up hydrogen gas. Chemical suppliers have also informed us that there are low foaming fume suppressants whose main purpose is to lower the surface tension of the bath but generates a small amount of foam at the anodes which helps to lower fume at surface of the tank around the anodes. The use of solely a foam blanket is not currently an option of the Federal Regulation and the ministry is not aware of any chromium electroplating, chromium anodizing or reverse etching operations that rely on foam blankets without a reduction in surface tension.

In the past, facilities have used mechanical fume suppressants to reduce fume or mist at the surface of the tank. Cal EPA defines mechanical fume suppressants as any device that reduces fume or mist at the surface of an electroplating or anodizing bath by direct contact with the surface of the bath. A common example is the use of polyballs.

Polyballs

Polyballs are small balls that float on the surface of the tank covering the entire surface of the tank reducing fume or mist at the surface of the bath. A US EPA Study (1998) indicates a control efficiency of approximately 75% in a test with a two to three inch layer of 1.5 inch diameter spheres. Industry has informed the ministry that this form of control can be difficult to maintain due to accidental dragout of the balls as parts are dipped in and removed from the bath and is not widely used.

Tank Covers

Currently, the ministry is not aware of any facility in Ontario that uses a tank cover for chromium electroplating, anodizing or reverse etching. CASF indicated that due to the restriction it places on access to operating tanks as well as concerns with the potential accumulation of hydrogen gas tank covers are not generally used or may not be considered feasible.

4.1.3. Current Practices for Nickel and Nickel Compounds

Generally, nickel electroplating tanks have no air pollution control devices to manage air emissions. The rationale for this is that many nickel electroplating operations have higher electrode efficiency than decorative and hard chromium electroplating. A 2007 US EPA study on nickel electroplating operations indicated that emissions of nickel from Rack Watts Nickel and Rack Nickel Sulfamate tanks (under typical operating conditions with wetting agents, no mesh pad, air agitation) may not be very significant (<0.05 mg/dscm). However, there are typically more nickel electroplating tanks than chromium electroplating tanks in a metal finishing facility with decorative chromium electroplating operations.

Simple Mesh Pads

A US EPA study indicated that the use of simple mesh pads could result in up to a 92% removal efficiency of nickel emissions and appears to be preferable technology because it does not interfere with the bath chemistry.

Local Exhaust Ventilation

Emission collection systems otherwise known as local exhaust ventilation is a common method used to capture mists from electroplating and other metal finishing tanks and convey them to an air pollution control device or stack. Access to the tanks requires the use of equipment that does not restrict the finishing activity. Canopy hoods and enclosures are generally not used for this reason. Lateral (slot) and push-pull exhaust hoods are more common for the capture of emissions from the tanks and require more space around the tanks but allow access to the tanks by overhead systems.

Eductors

Metal finishers try to keep the solution in the plating baths uniform within the tank. This can be achieved with different methods including air agitation, air sparging or flow of the solution. Eductors are specially designed nozzles for pumps that essentially speed up the flow of the solution entering the tank to create a stirring motion. A US EPA report indicated nickel emissions were reduced an average of 15% by using eductors instead of air agitation in nickel plating processes.

Wetting Agents

Chemical suppliers indicated that there are no similar fume suppressants commercially available for nickel electroplating operations. However, certain nickel electroplating operations use wetting agents that often lower the surface tension of the baths and therefore reduce fume or mist generation. However, the primary purpose of the wetting agents is for improved quality control not for fume reduction or suppression and they are not specifically designed to reduce fumes or mists like the fume suppressants for chromium electroplating, chromium anodizing and reverse etching. The wetting agents work by reducing surface tension of the bath which can reduce the amount and size of bubbles generated in the bath and that adhere to the parts. The bursting bubbles emit the bath chemical including nickel and nickel compounds in a mist form. Bubbles that burst on the parts causes a quality control issue known as pitting and therefore the use of wetting agents are considered a critical part of the bath chemistry. Wetting agents are used based on specifications by the chemical supplier for it's particular use. Different tanks may have had different specifications from a chemical supplier even within a single facility.

CASF has indicated that deviations from proper use of wetting agents are not likely due to the sensitivity of nickel baths. Improper use would lead to higher economic costs due to higher reject rates of parts. Any potential reduction of fume or mist is inadvertent. However, a US EPA study (2007) indicated that the use wetting agents can reduce nickel emissions an average of approximately 70% versus not using a wetting agent. However, only certain types of nickel electroplating operations can use wetting agents. These include bright and semi-bright nickel electroplating. CASF informed the ministry that the use of wetting agents in other types of nickel electroplating operations can cause quality control problems.

Tank Covers

Currently, the ministry is not aware of any facility in Ontario that uses a tank cover for nickel electroplating or electroless nickel plating. CASF indicated that due to the restriction it places on access to operating tanks as well as concerns with the potential accumulation of hydrogen gas tank covers are not generally used or may not be considered feasible.

4.2. Facility Level Practices

CASF indicated that many Ontario metal finishers have other best practices that they use to reduce emissions of both chromium compounds (hexavalent) and nickel and nickel compounds but that they vary from facility to facility. Best practices can include housekeeping practices as well as operational and deliberate design. Some examples include:

- Proper storage of chromium and nickel chemicals and wastes
- Installation and use of splash guards and drip trays between tanks
- Separating mechanical polishing, buffing and grinding operations from electroplating and anodizing operations
- Prompt clean-up of overflow of baths or drips trays

5. Jurisdictional Review

This chapter provides a summary of the current and proposed air pollution regulations, associated methods and guidance utilized by the regulators in different jurisdictions specifically with regard to metal finishing operations. The jurisdictions that are discussed in this Chapter are:

- Canada;
- United States of America;
- European Union

5.1. Canada

5.1.1. Canadian Federal Government

The *Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations* (referred to as the "Federal Regulation") under the *Canadian Environmental Protection Act* (CEPA) control emissions of hexavalent chromium and its compounds within the metal finishing sector. The Federal Regulation applies to any person using a solution of hexavalent chromium compounds in a tank associated with chromium electroplating, chromium anodizing or reverse etching operations within a facility that uses more than 50 kilograms of chromium trioxide annually. The Federal Regulation came into effect on July 4th, 2009. The Federal Regulation describes three options to reduce hexavalent chromium emissions:

- stack emission limit through the use of a control device and emission collection system and verification with periodic stack testing;
- limiting the surface tension of the solution within the tank; or
- use of a tank cover.

The selected option used for each tank within the facility must be submitted to the federal Minister of Environment (via the national chromium coordinator) within 30 days of the Federal Regulation coming into force for existing tanks and 30 days prior to the beginning of operations for new tanks.

The Federal Regulation also contains general operational, inspection and maintenance requirements as well as recordkeeping and reporting requirements. There are some specific inspection and maintenance requirements required.

The first compliance option is basically a stack limit for tanks that emit chromium compounds (hexavalent) emissions from electroplating, anodizing and reverse etching. The emissions must be captured and directed to a control device (such as a composite mesh pad or packed bed scrubbers) before being released by a point source (e.g. a stack). Emissions of hexavalent chromium compounds at the stack can be no greater than 0.03 milligrams per dry standard cubic meter (mg/dscm). Facilities must be in compliance with the release limit within 30 months of the Federal Regulation being enacted (i.e. by January 4th, 2012). Release tests must be performed every five years to ensure compliance with The Federal Regulation. A release test must be performed within 24 months of the Federal Regulation coming into force. Release tests performed up to 2 years prior to the Federal Regulation coming into effect are also deemed acceptable as long as they are in compliance with release limits. The average of three, two hour, sampling runs must be below the 0.03 mg/dscm release limit delineated by the Federal

Regulation. Environment Canada must be notified 30 days before release testing is set to occur. This is required in order to provide the option for release testing to be witnessed. A report detailing the results of the release test must be submitted to the minister within 60 days of its undertaking. The requirements of the report and technical parameters of the release tests can be found in Federal Regulation. A brief summary is described in Appendix C.1. Furthermore, new release tests are required within 75 days of a modification to a facility that includes:

- replacing a control device;
- >25% increase in surface area of a tank connected to a control device;
- installation of a new tank that increases the surface area of solution connected to a control device by >25%; and
- changes to ventilation system connected to a tank affecting velocity and flow rate.

An inspection and maintenance plan must also be in place within 30 months of the Federal Regulation coming into force. Inspections should occur every 3 months to ensure that there are no defects with the control device, ventilation equipment, and no visible signs of hexavalent chromium exiting the control device. If a composite mesh pad system is used as the control device, verification that there is no build up on the pads must be obtained, as well as ensuring that the pads are washed for at least 20 minutes twice during each 8 hour operation period (at least 3 hours between washes). If a problem is identified, the defect must be remediated before resuming operations. A report detailing the date/time, nature of the defect, and mitigation measures taken should be kept on site.

The second compliance option focuses on limiting surface tension of the solution within the tank. Surface tension is typically reduced through the use of a fume suppressant. A fume suppressant is typically a chemical added to the chromium plating bath solution in order to reduce the surface tension of the solution therein. A reduction in surface tension will limit the energy of the bursting of gas bubbles at the solution’s surface that release a chromic acid mist and size of gas bubbles. Smaller, less energetic bursting will decrease the amount of mist and hexavalent chromium emitted. PFOS was a commonly used surfactant in the metal finishing industry prior to a ban on its use in 2008. The decision to ban PFOS substances was due to the potential persistence, bioaccumulation, and general toxicity to organisms. The metal finishing industry is exempt from the regulation banning the use of PFOS for 5 years after the initial promulgation of the *Perfluorooctane Sulfonate and its Salts and Certain Other Compounds Regulations*. Substances containing PFOS are only allowed to be used until May 28th, 2013 at which time alternative methods for reducing surface tension will be required to be used. As part of the Federal Regulation, the surface tension of the plating solution must be measured daily (at least 16 hours apart) and must not exceed 35 dynes per centimetre (dynes/cm) if the measurement is taken with a tensiometer or 45 dynes/cm if taken with a stalagmometer. These limits became active three months after the Federal Regulations were enacted. A report for surface tension data recorded between Jan 1st - June 30th must be submitted to the minister by July 31st and data taken July 1st – Dec 31st must be submitted by Jan 31st of the following year.

Early anecdotal evidence suggested that first generation of PFOS free fume suppressants were not as effective as PFOS containing fume suppressants. Some reported that newer second generation PFOS free fume suppressants may perform more similarly to PFOS containing fume suppressants. Chemical suppliers that we contacted were not able to provide any data that indicated a numerical level of performance of PFOS free fume suppressants. However, Environment Canada is currently undertaking it's own study of the effectiveness of PFOS free fume suppressants.

The third compliance option allows a tank cover to be used to contain emissions associated with the electroplating process. The cover must be installed within 6 months of the Federal Regulation coming into force. The cover must be closed during the electroplating process and include a seal joining the cover to the tank as well as a membrane inset with a minimum surface area of 0.28 m^2/kA with pore openings no greater than 1µm. The cover must also include an evacuation device designed to remove any hexavalent chromium compounds from the air inside the tank, prior to removing the cover, following the completion of chromium electroplating, anodizing, or reverse etching operations. This evacuation device must be attached to the outside of the tank and include a HEPA filter with pore openings no greater than 0.1µm. An inspection and maintenance plan must be in place within 6 months of the Federal Regulation coming into force to ensure that the cover's seal remains tight and there are no leaks. The evacuation device must be drained and the access doors/membrane must be inspected weekly, clamps inspected monthly, piping to and from the evacuation device inspected every 3 months, and the HEPA filter replaced annually. If a problem is identified the defect must be remediated before resuming operations. A report detailing the date/time, nature of the defect, and mitigation measures taken should be kept on site. Prior to the first use of the tank cover, and every three months afterwards, a smoke test must be conducted in order to ensure that there are no leaks. 15-30 m^3 of smoke must be generated for every 2 m^3 of tank surface. Dates, results, manufacturer name of the smoke test device, and a description of the steps taken during the test must be recorded for each instance.

If an unexpected release or likelihood of a release of hexavalent chromium compounds occurs a report must be provided to the Regional Director of the Environmental Enforcement Division in the region the facility is located in. This report must include the contact information of the facility where the release occurred and the person submitting the report, the time and location of the release, estimated quantity of hexavalent chromium compound released, and a description of the circumstances that led to the release and the mitigation measures taken to resolve it.

A comparison of Environment Canada's regulatory requirements to the other jurisdictions reviewed in this report is included in Appendix C.2.

5.1.2. Quebec

The *Clean Air Regulation* under the *Environmental Quality Act* came into force on June 30, 2011 and replaced the *Regulation Respecting the Quality of the Atmosphere*. It updated ambient air quality standards for conventional contaminants (e.g., particulate matter, nitrogen oxides, sulphur dioxide) and introduced new ambient air quality standards and stricter emission standards.

The province of Quebec established emission standards for metallic surface treatment processes through the *Clean Air Regulation*. The regulation defines the treatment of metallic surfaces to mean the "preparation of metallic surfaces by pickling, other than abrasive blast cleaning, or etching, and the treatment of the surfaces by chemical or electrochemical methods".

Any facility with a metallic surface treatment process must limit emissions of hexavalent chromium to 0.9 milligrams per dry cubic meter (mg/dscm) and inorganic acid other than chromic acid to 10 mg/dscm by the 30th of June 2011. By January 4, 2012 hexavalent chromium emissions must be limited to 0.03 mg/dscm. This more stringent limit conforms to the Federal regulation.

The metallic surface treatment operations that use a chromic acid process must also undertake source emission testing every 5 years at a minimum to ensure compliance with the regulation limits. The first sampling event must occur within 1 year of the date of application. In order for a test to be considered complete, a number of different stipulations need to be met. Firstly, testing must include a minimum of three sampling runs and the average of those runs must be less or equal than the emission limit. Secondly, only one of the three sampling runs is allowed to exceed the standard. Finally, none of the sampling runs can exceed the standard by more than 20%. The analysis of emission data must be carried out at a laboratory accredited by the Minister of Sustainable Development, Environment and Parks.

As with Environment Canada, the Quebec regulation allows for alternative compliance through the limitation of surface tension. When measurements are taken with a tensiometer the limit is 35 dynes per centimetre. When the measurements are taken with a stalagmometer the limit is 45 dynes per centimetre. Surface tension measurements must be taken every day for each tank and measurements must be at least 16 hours apart.

A comparison of Quebec's regulatory requirements to the other jurisdictions reviewed in this report is included in Appendix C.2.

5.1.3. Other Canadian Jurisdictions

A review of other Canadian jurisdictions found no other technology based requirements for this sector.

5.2. European Union

<u>Integrated Pollution Prevention and Control Directive 2001/80/EC:</u>

The Integrated Pollution Prevention and Control (IPPC) Directive (2001/80/EC and amendments) set the framework for the control of industrial pollution in the EU, and established the system of Best Available Techniques (BAT) Reference Documents (known as BREFs). In the setting of emission limits, regulators should take account of the BAT conclusions which are contained within the BREFs. The requirements in this Directive have been incorporated into and expanded upon in the Industrial Emissions Directive.

<u>Industrial Emissions Directive 2010/75/EU:</u>

The main piece of EU legislation controlling emissions from stationary sources is the Industrial Emissions Directive (IED) (2010/75/EU) which must be transposed into national law by January 7th, 2013. This new Directive combines and updates seven earlier Directives covering industrial pollution: Integrated Pollution Prevention and Control (IPPC); waste incineration, large combustion plants, solvents, and waste from the titanium dioxide industry.

One of the reasons for the IED was that regulators in the member states were not consistently requiring the use of BAT to control emissions, and its wording in this respect is stronger than in the previous Directive. For example, it requires regulators to provide the public with the justification when BAT has not been required.

Generic and industry specific BAT Reference Documents (known as BREFs) are available from the European IPPC Bureau. Currently, there are 35 BREFs which provide guidance on the control of emissions, including, where appropriate, fugitive emissions, and emission levels achievable with different techniques. These documents cover emissions to air, water and land.

In August 2006, the European Commission published, as part of the IPPC, the Reference Document on Best Available Techniques in the Surface Treatment of Metals and Plastics.

This document covers installations for the surface treatment of metals and plastics using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 cubic metres. The interpretation of 'where the volume of the treatment vats exceeds 30 cubic metres' plays an important role in deciding whether a specific installation requires an IPPC permit. This document does not deal with:

- hardening (with the exception of hydrogen de-embrittlement)
- other physical surface treatments such as vapour deposition of metals
- hot-dip galvanising and the bulk pickling of iron and steels: these are discussed in the BREF for the ferrous metals processing industry
- surface treatment processes that are discussed the BREF for surface treatment using solvents, although solvent degreasing is referred to in this document as a degreasing option
- electropainting (electrophoretic painting), which is also discussed in the BREF for surface treatment using organic solvents.

The document summarizes that the main environmental impacts relate to energy and water consumption, the consumption of raw materials, discharges to surface and groundwaters, solid and liquid wastes and the site condition on cessation of activities. Emissions to air were not identified as a major source, however, the following emissions were identified as being important from a local perspective:

- nitrogen oxides, hydrogen chloride, hydrogen fluoride and acid particulates from pickling operations;
- hexavalent chromium mist released from hexavalent chromium plating;
- ammonia from copper etching in PCB manufacturing and electroless plating;
- dust (combination of abrasives and abraded substrate) from mechanical preparation of parts; and
- solvents used in some degreasing operations.

Generic and specific BAT relating to the most relevant environmental issues (which goes beyond simply air emissions) are outlined in the document. The generic best available techniques for the surface treatment of metals and plastics include:

- implement and adhere to environmental and other management systems. These include benchmarking consumptions and emissions (over time against internal and external data), optimizing processes and minimizing reworking;
- protect the environment, particularly soil and groundwater, by using simple risk management to design, construct and operate an installation;
- minimize electrical losses in the supply system as well as to reduce heat losses from heated processes;
- minimize water usage for cooling by using evaporation and/or closed loop systems, and to design and operate systems to prevent the formation and transmission of legionella;
- minimize material losses by retaining raw materials in process vats and at the same time minimize water use by controlling the drag-in and drag-out of process solutions, as well as rinsing stages. This can be achieved by jigging and barrelling workpieces to enable rapid draining, preventing overdosing of process solutions and using eco rinse tanks and multiple rinsing with countercurrent flows, especially with the return of rinse-water to the process vat; and
- aid recycling and recovery, identify potential waste streams for segregation and treatment, re-use materials such as aluminium hydroxide suspension externally, and recover externally certain acids and metals.

The specific best available techniques for the surface treatment of metals and plastics include:

- use less hazardous substances;
- substitute for ethylenediaminetetraacetic acid (EDTA) by biodegradable alternatives or to use alternative techniques. Where EDTA has to be used, it is BAT to minimize its loss and treat any remaining in waste waters;
- minimize the use of PFOS by controlling additions, minimizing fumes to be controlled by techniques including floating surface insulation sections: however, occupational health may be an important factor. PFOS can be phased out in anodizing and there are alternative processes to hexavalent chromium and alkali cyanide-free zinc plating;
- replacement of cyanide in all applications in not possible, but cyanide degreasing is not BAT. BAT substitutes for zinc cyanide are acid or alkali cyanide free zinc, and for cyanide copper are acid or pyrophosphate options (with some exceptions);
- hexavalent chromium cannot be replaced in hard chromium plating;
- for decorative plating, BAT is trivalent chromium or alternative processes such as tin-cobalt, however, at an installation level there may be specification reasons such as wear resistance or colour that require hexavalent chromium processing;
- for hexavalent chromium plating reduce air emissions by techniques including covering the solution or vat and achieving closed loop for hexavalent chromium, and in new or rebuilt lines (in certain situations) by enclosing the line;
- no BAT identified for chromium passivation;
- replace hexavalent chromium systems in phospho-chromium finishes with non-hexavalent chromium systems;

- for degreasing, liaise with customers to minimize the grease or oil applied and/or remove excess oil by physical techniques;
- replace solvent degreasing by other techniques, usually water-based, except where these techniques can damage the substrate;
- reduce amount of chemicals and energy used in aqueous degreasing systems by using long-life systems with solution maintenance or regeneration;
- increase process solution life and preserve quality by monitoring and maintaining solutions within established limits;
- for pickling on a large scale, extend the life of the acid by techniques including electrolysis; acids may also be recovered externally;
- recover heat from sealing baths when anodizing in certain circumstances; and
- recover caustic etch where there is high consumption, there are no interfering additives and the surface can meet specifications;
- closing rinse-water cycles using deionized water is not considered BAT because of the cross-media impacts of the regenerations;
- for large scale continuous steel coil:
    - use real time process controls to optimize processes;
    - replace worn motors by energy efficient motors;
    - use squeeze rollers to prevent process solution drag-in and drag-out;
    - switch the polarity of the electrodes at regular intervals in electrolytic degreasing and electrolytic pickling;
    - minimize oil use by using covered electrostatic oilers;
    - optimize the anode-cathode gap for electrolytic processes;
    - optimize conductor roll performance by polishing;
    - use edge polishers to remove metal build-up on the edge of the strip; and
    - use edge masks to prevent excess metal build-up, and to prevent overthrow when plating one side only.

Additional Initiatives:

The European Union (EU) has established a number of initiatives that indirectly affect the metal finishing industry through the reduction and limitation of products containing hazardous substances (such as hexavalent chromium). These additional initiatives include: End of Life Vehicle (ELV) Directive, Waste Electrical and Electronic Equipment (WEEE) Directive, Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (RoHS).

REACH Regulation:

REACH stands for Registration, Evaluation, Authorisation and Restriction of Chemicals. REACH is the European Community Regulation on chemicals and their safe use (EC 1907/2006) which came into force on June 1, 2007 and provisions are being phased-in over 11 years. The goal of the REACH regulation is to improve the protection of human health and the environment through improved and earlier identification of the intrinsic properties of chemical substances. The REACH regulation placed greater responsibility on industry to manage the risks from chemicals and to provide safety information on the substances. Manufacturers and importers are required to gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database run by the European Chemicals Agency (ECHA) in Helsinki. ECHA manages the databases necessary to operate the REACH system, co-ordinates the in-depth analysis of suspicious chemicals and is building up a public database where consumers and professionals are able to find hazard information. The regulation also calls for the progressive substitution of the most dangerous chemicals when suitable alternatives have been identified.

At present, EU regulations exert a primarily indirect effect on finishing firms located in Canada. Products destined for export to European market may require new materials or technologies to comply with European requirements. For example, the EU has placed restrictions on products containing cadmium and hexavalent chromium, both commonly used in finishing processes. As more and more materials become affected (especially by the REACH framework that imposes significant burdens on virtually all materials, existing as well as new, commonly used in manufacturing products), Canadian firms' customers that export to Europe will begin demanding alternative coatings.

5.3. United States of America

5.3.1. US EPA

The Clean Air Act (CAA) requires the United States Environmental Protection Agency (US EPA) to regulate emissions of hazardous air pollutants (HAPs) from a published list of industrial source categories. These standards are authorized by Section 112 of the CAA and the regulations are published in 40 CFR Parts 61 and 63. Section 112d of the CAA states that the US EPA must promulgate regulations establishing national emission standards for hazardous air pollutants (NESHAPs) for each category or subcategory of major sources and area sources of HAPs (Section 112c). Major sources are generally any stationary source or group of stationary sources that emits or has the potential to emit, in the aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants while considering controls. Area sources are any stationary source of hazardous air pollutants that is not a major source. Area sources do not include motor vehicles or non-road vehicles.

NESHAPs are found in two different sections of the Federal Code of Regulations: 40 CFR 61 and 40 CFR 63. Part 61 NESHAPs regulate seven hazardous air pollutants: Asbestos; Beryllium; Mercury; Vinyl Chloride; Benzene; Arsenic; and Radon/ radionuclides. Part 63 includes the NESHAPs promulgated after the 1990 Amendments to the CAA which target the current list of 188 hazardous air pollutants and are generally standards based on control technology. For these post-1990 standards, the US EPA determines an emission rate (or emission intensity), concentration or level of control determined to be the Maximum Achievable Control Technology (MACT). The implementation of MACT standards by the US EPA is undertaken in two main steps:

1. Defining MACT based on top-performing sources within a category; and
2. Completing Risk Assessments and Technology Reviews for each category.

In determining MACT, the US EPA selects the level of control achieved by the top-performing 12% of sources within the category or the average of the best-performing 5 sources, for categories with fewer than 30 sources. This first step constitutes a "follow-the-leader" approach, whereby the poorer performing sources are essentially required to catch up to the level of control being regularly achieved in practice within a category.

As a second step, the CAA requires the US EPA to undertake two different analyses. First the US EPA is required to review technology-based standards and revise them "as necessary (taking into account developments in practices, processes and control technologies)" no less frequently than every 8 years as set out by section 112(d)(6) of the CAA. Secondly and within 8 years after promulgation, section 112(f) requires the US EPA to evaluate the risk to the public remaining (residual risk) after the application of the technology-based standard and to revise the standards if necessary to "provide an ample margin of safety to protect public health or to prevent, taking into consideration costs, energy, safety, and other relevant factors, an adverse environmental effect". Recent efforts by the US EPA have been to combine these assessments into a single risk and technology review document. The methodology for conducting these reviews is described in: "Risk and Technology Review (RTR) Risk Assessment Methodologies: For Review by the EPA's Science Advisory Board with Case Studies – MACT I Petroleum Refining Sources and Portland Cement Manufacturing (EPA-452/R-09-006)".

There are two NESHAP rules that apply to the metal finishing sector, which are:

- National Emission Standards for Hazardous Air Pollutant Emissions: Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks, Subpart N, originally passed on January 1995 and recently amended on September 19, 2012.
- National Emission Standards for Hazardous Air Pollutants for Area Sources: Plating and Polishing, Subpart WWWWWW, originally passed on June 12, 2008 and recently amended on June 20, 2011.

<u>NESHAP for Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks:</u>

The US EPA initially promulgated the NESHAP for Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks, a national rule for the control of hexavalent chromium emissions associated with chromium electroplating and anodizing tanks in January 1995. A key amendment to the original rule was published in July 2004. The current version of the rule is represented by updates that were approved for publication of the final rule on August 15, 2012 following a 6 month comment period from the initial proposal in February 2012. The final rules were published on September 19, 2012.

The rule applies to all facilities undertaking chromium electroplating or anodizing operations regardless of the size or production rate of the facility. The size, type of operation and date of initial operation of the tank affects the emission limit that must be adhered to. There are three types of electroplating operations covered by the rule: hard chromium electroplating, decorative chromium electroplating, and chromium anodizing. Facilities undertaking hard chromium electroplating operations have separate emission limits depending on whether they are classified as "large" or "small" facilities. The large and small classification depends on the annual ampere hours associated with their metal finishing operations. The rule defines large hard chromium electroplating facilities use more than 60 million ampere-hours annually in their plating operations; small hard chromium electroplating facilities use less than 60 million ampere-hours annually. Facilities with chromium anodizing or decorative chromium electroplating operations are all held to the same emission standard and are not partitioned by size. Facilities that have been undertaking metal finishing operations prior to the promulgation of the rule are subject to different emission limits compared to facilities that have been constructed or reconstructed after the rule came into force.

The 1995 rule set emission limits for new and existing large hard chromium plating tanks and new small hard chromium plating tanks at 0.015 milligrams per dry standard cubic meter (mg/dscm), based on the use of composite mesh pad system. Existing small hard chromium plating tanks had an emission limit of 0.03 mg/dscm, based on the use of packed bed scrubbers. All new and existing decorative chromium plating and chromium anodizing tanks had an emission limit of 0.01mg/dscm based on the use of fume suppressants. Facilities had the choice of using total chromium or hexavalent chromium to demonstrate compliance with the emission limits. Alternatively, tanks could be controlled with the use of the fume suppressants and surface tension must not exceed 45 dynes/cm.

Key 2004 amendments to the NESHAP for Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks resulted in the addition that 1995 emission limits also applied to reconstructed tanks and specified two different surface tension limits depending on the manner of measurement. If surface tension measurements were taken with a stalagmometer measurements cannot exceed 45 dynes/cm; if surface tension were measured with a tensiometer the measurement cannot exceed 35 dynes/cm.

The most up to date version of the chromium electroplating emission regulations was published for comments by the EPA in February 2012 before being approved for publication on August 15, 2012. Facilities are separated into large and small hard chromium electroplating facilities (with same classification divides as the previous regulations), decorative chromium electroplating facilities, and chromium anodizing facilities. Facilities constructed or reconstructed prior to February 8, 2012 are considered to be existing facilities; otherwise they are classified as new. Generally, the updates reduce the allowable emission limits of hexavalent chromium. Existing large hard chromium facilities must limit emissions of hexavalent chromium to 0.011mg/ dscm and new facilities must stay below a 0.006 mg/dscm limit. Existing small hard chromium plating facilities must meet an emission limit of 0.015 mg/dscm and new facilities must maintain levels below 0.006 mg/dscm. Decorative chromium plating and chromium anodizing have the same applicable limits; existing facilities at or below 0.007mg/dscm and new locations limited to 0.006 mg/dscm. Proponents still have the option of alternative compliance through controlling surface tension values. The surface tension values have also been slightly lowered from the previous regulation. If measured with a stalagmometer the surface tension of the plating solution must be at or below 40 dynes/cm and at or below 33 dynes/cm if measured with a tensiometer. Facilities had to show compliance with the updated regulation within 2 years of the publishing of the final rule (date published was September 19, 2012). In order to demonstrate compliance, existing facilities were to provide a stack emissions test report delineating the concentration of emissions resulting from electroplating, reverse etching and anodizing operations. A previously conducted stack emission test report was acceptable provided operating conditions at the time of the test were representative of the current control situation at the facility. New facilities must demonstrate compliance with the regulation upon initiation of operations.

An influence on the recent decision to further reduce allowable chromium emissions is the role of add-on control technology that can be used to minimize hexavalent chromium emissions associated with the metal finishing industry. The US EPA regulation gives examples of common add-on control devices that are used to reduce chromium emissions. Packed bed scrubbers, composite mesh pads, fume suppressants (e.g. wetting agent, foam blanket), mesh pad mist eliminators, and High Efficiency Particulate Air (HEPA) filters are all described in the 2012 regulation amendments as typical emission control devices. The US EPA regulation does not limit control devices to the previous list. As long as compliance with emission limits can be maintained, other control devices are acceptable. The decision to reduce allowable emission levels of hexavalent chromium was specifically influenced by the US EPA's access to revised data. This information showed that the majority of facilities were already in compliance with the updated regulations due to the general effectiveness of current control options. The subsequent reduced economic burden for facilities and general benefits (health, environmental, etc.) of reducing atmospheric hexavalent chromium represent positive aspects of reduced emission limits. The US EPA is phasing out any wetting agent fume suppressant that contains perfluorooctyl sulfonates (PFOS) due to associated cancer risks. The US EPA believes that wetting agent fume suppressants that do not contain PFOS are readily available and show comparable results.

The US EPA estimated that it would cost a total of $1.8 million for all facilities to comply with the revised emission limits which includes conducting the relevant testing and monitoring. A further $2.2 million for the sector would be required for annual operation and maintenance. The increased cost per facility was estimated to be $8,300. It is important to note that this is not a representative number of the actual costs for facilities that will need to take steps to ensure compliance, as the average is taken based on the total number of facilities and not only the facilities that would require alterations. The US EPA estimated that the majority (~88%) of hard chromium electroplating facilities in the United States would already be in compliance with the new emission limit reduction. Therefore, the total capital costs mentioned above would be borne by a relatively small percentage (~11%) of the industry. Furthermore, ~6% of facilities in the United States would likely also have to reduce emissions to ensure continuous compliance as their current emissions of ~0.009 mg/dscm are still within but towards the upper level of the 0.0011 mg/ dscm limit and are therefore at risk of a violation. As a result of this information the US EPA decided that it is economically feasible, citing the carcinogenic nature of hexavalent chromium emissions as a contributing factor for the requirement of regulation.

An operation and maintenance plan must be in place at each facility. The operation and maintenance plan must include a description of the control devices and monitoring equipment used at the facility, a checklist to document operation and maintenance conditions of equipment, follow work practice standards (see Appendix C.3), procedures to limit malfunction, and procedures to mitigate the effects of any possible malfunction. Initial performance testing must be carried out by facilities to demonstrate compliance with updated standards. Initial performance testing reports must include a description of the process and sampling locations, test results, quality assurance procedures and results, records of operating conditions for the duration of testing, data sheets used during testing and documentation of any calculations performed. If a facility has recently undertaken a performance test the results of that test are acceptable providing that an appropriate test method was used, the test was performed under operating conditions that are characteristic of the current state of the facility, and all of the criteria for initial performance testing listed above are followed.

A number of indicators must be measured to show ongoing compliance. This includes daily measurements of pressure drops across a system using a composite mesh pad system, a packed bed scrubber or fibre bed mist eliminator. If a foam blanket control device is used, blanket thickness must be measured every hour for 40 hours of operation. If no violations occur in that time, the monitoring frequency can be reduced to once every 8 hours. If a violation occurs, the monitoring frequency reverts to every hour. Surface tension measurements are initially required to be taken every 4 hours of operation. Following 40 hours of operation where there have been no exceedances of the surface tension limit, monitoring frequency can be reduced to once every 8 hours. Following a further 40 hours of continuous compliance, the monitoring frequency can again be reduced to once every 40 hours. At any time if the surface tension measurements show a violation of the limit the monitoring frequency reverts back to every 4 hours and the process begins again with measurements taken every 4 hours.

Facilities are required to keep a record of inspection and maintenance activities, malfunction records, performance test results, monitoring data records, instances of excess emissions, process records, and miscellaneous records. Initial notification of start-up must be provided to the regulating authority 180 days after the promulgation of the final rule for existing facilities and within 30 days of initial operations for new facilities. Notification must also be given prior to construction or reconstruction of a facility. Notification of intent to perform an initial performance test must be given at least 60 days prior to the planned test date in order to allow the regulating authority the option to observe testing. Compliance status must be reported within 90 days of the successful completion of a performance test or 30 days after the compliance date if no testing is required. Ongoing compliance status reports must be submitted to the regulating authority every 6 months: if the reports show an exceedance, the reporting frequency is increased to every 3 months. Following a full year of reports showing compliance, the reporting frequency will revert to every 6 months per the approval of the regulating authority.

A comparison of the US EPA's regulatory requirements for chromium electroplating and anodizing to the other jurisdictions reviewed in this report is included in Appendix C.2.

It should be noted that there is a case in the US courts regarding this most recent amendment of the NESHAP. The National Association for Surface Finishing (NASF) and Sierra Club have taken the US EPA to the US Court of Appeals regarding the NESHAP in December 2014. NASF argued that based on the US EPA's determination that any leftover residual risk to public health was acceptable meaning that the increased risk was no worse than 1 in 10,000 they should not have set more stringent emission limits and surface tension limits and that there is a lack of data on the effectiveness of non-PFOS fume suppressants to reduce chromium emissions. The Sierra Club argued that the US EPA should have set a new MACT floor based on the Clean Air Act requirements even though an earlier court ruling did not agree with this interpretation of the Clean Air Act. And finally the US EPA argued that they included data from NASF but it didn't affect the outcome of the residual risk and that the non-PFOS fume suppressants were able to reduce surface tension as well as PFOS containing fume suppressants. Ministry research indicated that a reduction in surface tension may not always result in a similar reduction in fume generation therefore it is monitoring the Environment Canada study for data on the effectiveness of non-PFOS fume suppressants to reduce hexavalent chromium emissions.

NESHAP for Plating and Polishing Area Sources:

The US EPA initially promulgated national regulations for the control of cadmium, chromium, lead, manganese and nickel emissions associated with the plating and polishing industry in July 2008. Amendments to the original regulation were published in June 2011. The regulations apply to all facilities (both new and existing) that are area sources of the specified hazardous air pollutants (ie. cadmium, chromium, lead, manganese and nickel) and that are undertaking:

- non-chromium electroplating;
- electroforming (pH<12);

- electropolishing;
- electroless plating;
- other non-electrolytic metal coating (eg. chromium conversion coating, nickel acetate sealing, sodium dichromate sealing, manganese phosphate coating);
- thermal spraying; and
- dry mechanical polishing of finished metals and formed products after plating or thermal spraying.

Area sources are those that do not emit or have the potential to emit more than 9.07 megagrams per year (10 tons per year) of a single toxic air pollutant or more than 22.68 megagrams per year (25 tons per year) of any combination of toxic air pollutants.

The regulated sources do not include chromium electroplating and chromium anodizing sources, as these sources are subject to 40 CFR part 63, subpart N, “Chromium Emissions From Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks”.

These final emission standards reflect the US EPA’s determination regarding the generally achievable control technology (GACT) and/or management practices for this area source category. GACTs are methods, practices and techniques which are commercially available and appropriate for application by the sources in the category considering economic impacts and the technical capabilities of the firms to operate and maintain the emissions control systems. Consideration of costs and economic impact during the development of GACT is particularly important for source categories that have many small businesses.

Non-cyanide electroplating, electroforming and electropolishing tanks are required to meet one of the following three compliance options:

- use wetting agent/fume suppressant (WAFS);
- capture and control metal HAP emissions using an emission control device, such as a composite mesh pad (CMP), packed bed scrubber (PBS) or mesh pad mist eliminator (MPME); or
- use a tank cover:
  - for batch process tanks – cover must enclose the entire surface area of the tank and must be in place during at least 95 percent of the process operating time; or
  - for continuous process tanks – tank surface area must be covered at least 75 percent during all periods of process operation.

Affected cyanide electroplating tanks require that a one-time measurement of pH in the tank bath(s) be performed and recorded.

Short-term or flash electroplating tanks are required to limit plating time to no more than 1 cumulative hour per day or 3 cumulative minutes per hour of plating time or to use a tank cover during a least 95 percent of the plating time.

In addition to the above requirements, all affected electroplating, other coating, temporary thermal spraying and all above electrolytic processes are required to implement, as practicable, the following applicable management practices:

- minimize bath agitation when removing any parts processed in tank(s);
- maximize draining of bath solution back into tank(s) by extending drip time when removing parts from tank(s);
- optimize design of barrels, racks and parts to minimize dragout of bath solution;
- minimize or reduce heating of process tank(s), except when doing so would interrupt production or adversely affect part quality;
- perform regular repair, maintenance, and preventive maintenance of racks, barrels, and other equipment;
- minimize bath contamination by the prevention or quick recovery of dropped parts, using distilled/de-ionized water, water filtration, pre-cleaning of parts to be plated and thorough rinsing of pre-treated parts before plating;
- maintain quality control of chemicals and other bath ingredient concentrations in tank(s);
- perform general good housekeeping, such as regular sweeping or vacuuming (if needed), and periodic washdowns;
- minimize spills and overflow of tanks;
- use squeegee rolls in continuous or reel-to-reel plating tanks; and
- perform regular inspections to identify leaks and other opportunities to prevent pollution.

Existing affected permanent thermal spraying processes require a control system that is designed to provide capture of the metal HAP emissions and transport to a water curtain, fabric filter, cartridge or high efficiency particulate air (HEPA) filter. New affected permanent thermal spraying operations are required to install a control system that is designed to provide capture and control of the metal HAP emissions and transport to a fabric filter, cartridge or HEPA filter. Temporary thermal spraying operations are required to document the length of time and location of the temporary thermal spraying and to meet applicable management practices mentioned above.

New and existing affected dry mechanical polishing operations are required to have a control system that is designed to capture the metal HAP emissions and transport them to a cartridge, fabric or HEPA filter.

The following summarizes the record keeping requirements under this NESHAP:

- records that demonstrate compliance with management practices;
- for cyanide tanks the one-time pH measurement;
- for non-cyanide tanks, amount and frequency of WAFS additions, if applicable;
- for short-term or flash electroplating tanks, the daily plating times;
- for batch electroplating tanks using covers as a control option (as opposed to a management practice), the time the tanks is operated with cover in place;

- for continuous electroplating tanks using covers as a control option (as opposed to a management practice), amount of tank surface covered and time tank is operated with cover in place;
- operating manuals for all required control systems;
- all required notifications and report, with supporting documentation;
- record should be kept in a form suitable and readily available for review; and
- records must be kept for a period of 5 years.

Each affected facility is required to submit an initial notification and a notification of compliance status. Initial notifications for existing sources were due October 29, 2008 and upon start-up for new sources. Notifications of compliance status for existing sources were due July 1, 2010 and upon start-up for new sources. The facility is also required to prepare and keep on-site an annual compliance certification. The first certification of compliance reports for existing sources were due January 31, 2011 and for new sources were due January 31 of year following startup. If any deviations occurred during the reporting year, the facility is required to submit the compliance certification along with a report that describes the deviations and the corrective action taken.

A comparison of the US EPA's regulatory requirements for non-chromium electroplating and polishing to the other jurisdictions reviewed in this report is included in Appendix C.2.

The following is a list of other NESHAPs that may also be applicable to metal finishing operations but not necessarily for chromium compounds (hexavalent) or nickel and nickel compounds:

Cleaning/Degreasing

- National Emissions Standards for Cleaning with Halogenated Solvents
- National Emission Standards for Aerospace Manufacturing and Rework Facilities

Surface Coating/Painting

- Standards of Performance for Surface Coating of Metal Furniture
- Standards of Performance for Automobile and Light-Duty Truck Surface Coating Operations
- Standards of Performance for Metal Coil Surface Coating
- Standards of Performance for Industrial Surface Coating: Surface Coating of Plastic Parts for Business Machines
- Miscellaneous Metal Parts and Products Surface Coating

5.3.2. California EPA

The state of California regulates the airborne emission of hexavalent chromium from metal finishing operations through the Airborne Toxic Control Measure (ATCM) for *Chromium Plating and Chromic Acid Anodizing Facilities Regulation* under title 17, *California Code of Regulations* sections 93102-93102.16. The ATCM was amended in October 2007 and applies to any facilities undergoing chromium electroplating, chromic acid anodizing or any business selling chromium plating kits to non-permitted facilities. The Californian regulation is similar to those set out by the US EPA however is generally more stringent. The ATCM includes differences in classification, allowable emission limits, and reporting/monitoring requirements from the US

EPA. Unlike the US EPA emission regulation the ATCM typically controls allowable emissions based on number of ampere hours during operation compared to concentration per dry standard cubic meter.

For existing facilities, the regulation requires the use of best available control technology (BACT) for all facilities. BACT for most hexavalent chromium facilities is meeting an emission rate equivalent to HEPA level of control. The emission rate for all but small facilities is limited to 0.0015 milligrams per ampere-hour (mg/amp-hr). Most facilities must meet this emission rate as measured after add-on control equipment. Small facilities located 330 feet or less from a sensitive receptor and operating 20,000 ampere-hours or less per year, or greater than 330 feet from a sensitive receptor and operating 50,000 ampere-hours or less per year are required to use specific chemical fume suppressants. The largest facilities with annual emissions exceeding 15 grams per year must also conduct a site specific risk analysis. Trivalent chromium plating facilities are required to limit emissions of total chromium; this is generally accomplished by using chemical fume suppressants.

For those facilities relying on the use of chemical fume suppressants as an alternative to emission limits, surface tension values can be measured using a stalagmometer or a tensiometer. When taking measurements with a stalagmometer the surface tension cannot exceed 40 dynes/cm when using the Benchbrite CR 1800, Clepo Chrome or Fumetrol 140 fume suppressants and cannot exceed 28 dynes/cm when using HCA-6.2, HCA-4. When surface tension measurements are taken with a tensiometer values cannot exceed 35 dynes/cm when using the Benchbrite CR 1800, Clepo Chrome or Fumetrol 140 fume suppressants and cannot exceed 32 dynes/cm when using HCA-6.2, HCA-4. Alternative chemical fume suppressants may be used upon approval by the Executive Officer.

All new facilities that began operations after October 24th, 2007 must comply with an emission limit of 0.0011 mg/amp-hr. These newer facilities are also required to perform various other actions to ensure compliance with the regulation. New facilities must be at least 1000 feet away from any school or area designated as a residential or mixed use. Proof of the nearest sensitive receptor must be provided within 30 days of the regulation coming into force. A HEPA filter must be installed as an add-on control device (or a viable alternative that maintains compliance with the emission limit). A site specific risk analysis must be undertaken and submitted to the permitting agency prior to the initiation of operations. New facilities must demonstrate to the permitting agency that emissions and actions are in compliance with the regulation through initial compliance reporting and ongoing performance testing.

The updated regulation also enforced certain changes to all new or existing chromium electroplating facilities. Add on control devices cannot be removed without adequate replacement that would ensure compliance if the device was installed before October 24th, 2007. Employees involved with chromium plating or chromic acid anodizing are required to complete the Air Resources Board environmental compliance training every two years. Various steps must also be taken to limit fugitive emissions associated with facility operations which include:

- chromic acid powder and flakes must be stored and transported in a closed container;
- spills that may contain hexavalent chromium must be remediated within an hour of the event occurring;
- dripping should be minimized during drag out by installing splash guards;

- areas around the plating tanks that may potentially accumulate hexavalent chromium or dust must be cleaned every 7 days;
- a physical barrier between plating, buffing, grinding, and polishing areas should be maintained; and
- chromium or chromium containing waste must be stored, handled, and disposed of in a manner that will not lead to the release of any fugitive emissions.

In order to ensure ongoing compliance facilities must maintain various testing and monitoring requirements. Performance tests also need to be carried out at any facility that must demonstrate compliance after regulations have been updated, modifies their operations after Oct 24th, 2007, or moves to an alternative compliance method. Furthermore, performance tests need to be undertaken to ensure compliance with regulations at any new facility within 60 days of the initiation of operations. Performance tests must be performed with a minimum of three iterations using one of the following methods: the California Air Resources Board Test Method 425, U.S. EPA Method 306, or South Coast Air Quality Management District Method 205.1. Previous performance that have been performed before January 1st, 2000 are acceptable as long as the test demonstrates compliance with the current standard, test conditions were representative of the current control method in use, the test was conducted using an approved testing method, and the performance test was approved by the permitting agency. A smoke test should also be performed in conjunction with the performance testing for tanks with a tank cover installed in order to test the seal and integrity of the control device. Any facility that is undertaking performance testing must submit a Pre-Test Protocol (PTP) to the permitting agency at least 60 days prior to the planned performance testing. The PTP should include performance test criteria, required data and calculated targets for chromium concentration, preliminary chromium analytical data, sampling parameters, and information on equipment/ personnel that will be involved with the test. All points of emission must be sampled during the performance test in order for the results to be comprehensive.

In order to ensure ongoing compliance with the regulation various parameters must be monitored. Emission limits are based on the number of ampere hours of operation at a facility. Therefore, it is important to have an accurate measurement of the ampere hours for each electroplating or anodizing tank by installing a continuous recording monitoring device. The pressure drop of each control device (e.g. composite mesh pad, packed bed scrubber, HEPA filter) and the inlet velocity of a packed bed scrubber should be continuously monitored with a mechanical gauge to ensure that levels are consistent with the values recorded during performance testing. Surface tension also has certain monitoring requirements that must be adhered to. Surface tension measurements must initially be taken daily for twenty days of operation. After twenty days with no exceedances tension measurements can be taken weekly. If a violation occurs tension measurements must revert to the beginning of the cycle and be taken daily for a further period of twenty days. Foam blanket thickness shall be monitored hourly for 15 operating days and daily afterwards if no violation occurs. A visual inspection of the electroplating or anodizing bath(s) shall occur daily to ensure comparable conditions during the performance tests.

An operation and maintenance plan must be maintained and followed by each facility. The operation and maintenance plan must include all of the inspection and maintenance requirements for control devices and other aspects of the facility as outlined in Appendix C.2. The operation and maintenance plan must include a checklist to document the operating conditions and maintenance conditions of control devices and overall facility performance. Procedures should be included within this plan to facilitate maintenance of equipment. The operation and maintenance plan should be kept on record and any amendments or alterations to the original plan should be documented in an addendum.

Facilities are obligated to report a number of different documents to the permitting agency throughout the course of normal operations. Performance test documentation must be submitted within 90 days after the completion of the test. Initial compliance status reports must be submitted within 6 months of the regulation coming into force for existing facilities (April 24th, 2008) or at the date of initial start-up for new facilities. Ongoing compliance status reports must be submitted to the permitting agency annually by February 1st for the previous calendar year. Any breakdowns at the facility should be reported to the permitting agency in accordance with their policy.

The California Air Resources Board announced on December 14, 2012 their proposal to amend the Airborne Toxic Control Measure for Chromium Plating and Chromic Acid Anodizing Facilities to align with the recent US EPA amendments to the National Emission Standards for Hazardous Air Pollutants – Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks. The primary changes proposed were to revise the surface tension limits and phase out the use of PFOS in fume suppressants.

Some of the Air Quality Management Districts in California also have their own rules for chromium electroplating and anodizing that either pre-date the CalEPA ATCM for Chromium Plating and Chromic Acid Anodizing Facilities, such as the Bay Area Air Quality Management District Regulation 11 Rule 8 Hexavalent Chromium (1988) or the South Coast Air Quality Management District Rule 1469 Hexavalent Chromium Emissions from Chrome Plating and Chromic Acid Anodizing Operations (1998).

A comparison of California’s regulatory requirements for chromium electroplating and anodizing to the other jurisdictions reviewed in this report is included in Appendix C.2.

6. Technical Methods to Reduce Emissions from Process/Equipment

6.1. Identification of Technically Feasible Methods

6.1.1. Material Substitution

CASF has indicated no metals other than chromium compounds (hexavalent) are able to replace all it's properties for hard chrome electroplating.

It is potentially technically feasible to use trivalent chromium as a substitution for chromium compounds (hexavalent) for some applications but CASF has indicated that the use of chromium compounds (hexavalent) is often driven by customer demands.

No readily technically feasible material substitutions were found for chromium anodizing. Anodizing acids other than chromic acid corrode metal under stress.

6.1.2. Process Changes

Chemical additives (fume suppressants) can be used in plating tanks to suppress aerosol formation. The fume suppressants reduce the surface tension of the solution in the plating tank which in turn reduces the size of the hydrogen bubbles. Their rates of rise and the energy of their evolution are greatly reduced and therefore the amount of mist is also greatly reduced. Some fume suppressants also create a partial foam blanket or are low foaming so that a small foam blanket is created when a current is applied. This can add greater pollution control with trapping of fume or mist in the blanket. However, the addition of fume suppressants to the bath could affect the bath chemistry. Some facilities could choose to use air pollution control devices in order to avoid possible impacts of fume suppressants on the bath chemistry.

Foaming agents (e.g. foam blankets) can also be used where a thick foam layer (e.g. 2.5 cm) is formed over the plating tank and this foam layer entraps any mist generated by the electroplating process. Technical feasibility is limited if the foam blanket is not properly managed since the foam can stick to parts and can cause quality control problems. It can also create a hydrogen explosion hazard if the foam blanket is too thick and builds up hydrogen gas. Also, careful management and monitoring may be needed to ensure a minimum blanket thickness and proper coverage over the tank surface.

CASF indicated that the use of polyballs has reduced over time due to operational difficulty in keeping polyballs in the tanks and covering the entire surface of the tanks. The dipping action of parts into tanks can result in polyballs being "dragged out" of the tank accidently. They also tend to be pushed away from the anodes and cathodes where the surface of the bath is agitated by gassing, thereby limiting their usefulness. Also, the lower estimated removal efficiency of polyballs of 68-82% (US EPA 1993) when compared to fume suppressants estimated at 99.5% (with PFOS) resulted in the US EPA not selecting this technology in the MACT standard.

Air agitation of the bath can be replaced with other methods such as circulating the process solution by pumping under surface and using eductors and/or mechanisms to move the jigs or racks. However, the use of eductors may only reduce emissions by up to 15%.

6.1.3. Add-on Controls

Chromium electroplating processes have been studied for many years. As described in chapter 4, a number of different air pollution control devices have been used over the years. Some controls can be simple in design and use such as a chevron blade mist eliminator which consists of a series of blades in a narrow duct or passage that repeatedly changes the direction of air flow by approximately 30%. Other far more sophisticated add-on controls included air pollution control devices such as composite mesh pad scrubbers or HEPA filters that are all technically feasible for different applications.

Common technical challenges for many air pollution control devices include:

- management of used scrubber water;
- corrosive nature of many electroplating bath chemistries;
- available floor space for local exhaust ventilation and the air pollution control device;
- insufficient make up comfort heating air to “make up” for air that is discharged from the building through air pollution control devices
- the installation and on-going operational costs that do not improve the product or manufacturing processes.

However, the use of air pollution control devices instead of fume suppressants is sometimes preferred because it doesn’t interfere with the bath chemistry and potential quality of the metal finish.

Scrubber Water Management

The scrubber water becomes contaminated with the acid discharged from the plating tank, therefore, efficient mist eliminators must be used in the scrubber to prevent a contaminated water mist from discharging to the atmosphere.

The scrubber water is commonly used for plating tank makeup. This procedure not only removes the acid from the scrubber but also reduces the amount of makeup acid needed for the plating solution. In some scrubbers, a very small quantity of fresh water is used to collect the acid mist. The resulting solution is continuously drained from the scrubber either into the plating tank or into a holding tank, from which it can be taken for plating solution makeup.

Corrosivity

The mists collected by the air pollution control systems are corrosive to iron or steel therefore hoods, ducts and scrubbers of these materials must be lined with, or replace by corrosion-resistant materials. Steel ducts and scrubbers lined with materials such as polyvinyl chloride have been found to resist adequately the corrosive action of the mists. Hoods, ducts and scrubbers made entirely of polyester resins reinforced with glass fibers have been used in air pollution control systems handling acid or alkaline solutions. These systems have been found to be very resistant to the corrosive effects of plating solutions but may have higher associated costs.

Availability of Floor Space

Due to the operational nature of electroplating, parts are generally dipped into tanks from above therefore overhead local exhaust ventilation such as canopy hoods cannot be used as they would limit access to tanks. Local exhaust ventilation such as side mounted slotted hoods or push-pull systems are typically used but these take up more floor space and therefore a larger building foot print is required costing more money and making retro-fitting local exhaust ventilation on tanks without existing side ventilation technically difficult. There can literally be not enough space. Local exhaust ventilation ideally must be designed in from the beginning to ensure adequate floor space requirements.

Insufficient Make Up Air

The addition of air pollution control devices that discharge from a building without the careful design and installation of corresponding make up air can cause ventilation problems such as severe negative pressure in a building or area. Severe negative pressure can create unwanted drafts and interfere with the proper operation of local exhaust ventilation to capture emissions from a process.

6.2. Consideration of Cost Effectiveness

6.2.1.General Economics of the Metal Finishing Sector

A 2008 report called the “The Future of Finishing” by the National Metal Finishing Resource Center, an American organization funded by the US EPA, showed the profitability for the finishing industry overall is down from historic patterns. Profitability trends in finishing appear to correspond to general profitability swings in U.S. manufacturing this decade.

Some analysts expect that the decline in profits and manufacturing growth may continue. While finishing firms have been faring better recently, they will continue to face some challenges on the profitability front.

Even with anecdotal reports of U.S. finishing business moving to Canada and Mexico, both countries appear to be experiencing losses as well, although perhaps not of the same magnitude. The largest finishing industry chemical and equipment suppliers recently reported that capacity utilization in the three NAFTA countries fell off dramatically over four years beginning in 2000. The largest decline was for the U.S., which was estimated as dropping off by more than a third during this period.

Based on 15 years of data starting in 1990, larger plating firms, in terms of revenues, assets, or employment, have been more profitable than smaller ones. Although some small shops have shown outstanding performance – particularly those with expertise and experience in niche markets – larger finishing operations face comparatively fewer hurdles in innovation and productivity improvements. Larger operations also frequently, but not always, find it easier to manage the burden and complexity of the many environmental, health and safety requirements and challenges facing the typical operation.

While profitability has tended to be higher for larger operations, anecdotal evidence and knowledge of recent industry developments indicates that even the largest operations are not immune from significant financial pressures associated with the recent manufacturing downturn. Some of the largest, well known U.S. finishing firms have ceased operations in the past several years due to foreign competitive pressures and related factors.

In general, small job shops have seemed to “hold their own” within the industry in terms of both employment and revenues, despite consistently lower historical reported profitability. One important factor behind this phenomenon is that the vast majority of small firms are family owned. Family capital is tied up in the business and family members are employed in the operation, and hence there are few options but to keep the shop open regardless of the business demands on the operation.

Finishers have responded to pricing and foreign competitive pressures in a range of ways such as:

- Cost reductions (reducing workforce, expanding temporary hires)
- Quality improvements (minimizing defects and waste with lean manufacturing approaches)
- Automation and technology to achieve productivity increases by minimizing labor (if capital is available)
- Eliminate permanently or temporarily shut down unprofitable processes
- Shift to new process (partly driven by environmental pressures) depending on the customer base, such as non-electrolytic coatings and non-hexavalent chromium replacement technologies for certain applications.
- Forming formal corporate alliances locally with other finishers to increase leverage in purchasing from suppliers and reduce the costs of process chemicals and other products and services from outside vendors.
- Partnering with foreign-based companies in Asia, India, Mexico or Europe to produce and sell into those markets.
- Locating new operations in lower-price locals, such as Mexico, that are relatively accessible geographically
- Focusing strategy on finishing for products and components that are more logistically difficult or costly to source globally
- Building new capabilities beyond just surface finishing that offer much higher value to the customer.

6.2.2. Estimated costing of Possible Control Technologies

CASF provided case studies of estimated costing in current Canadian dollars for the installation of composite mesh pad or packed bed scrubber system which did not include building constraints, roofing, structural drawings, structural reinforcement, permitting, cranes or electrical work.

One case study for 13 bright and semi-bright nickel tanks with a total surface area of 1217 square feet estimated the cost of local exhaust ventilation systems and required air make up units including installation but excluding ductwork (2 x 60,000 cubic feet per minute (CFM) push pull systems) at approximately $810,000. The cost for 6 particle nickel and nickel strike tanks with a total surface area of 384 square feet was estimated at approximately $305,000 for a total facility cost of approximately $1,115,000 (excluding cost of an air pollution control device and its installation).

A second case study estimated the cost of electroless nickel plating tank with a total of 40 square feet of surface area at approximately $120,000 for the push pull local exhaust ventilation system and corresponding air make up unit installed excluding ductwork.

A new facility or a facility with increased total rectifier capacity will be required to install a packed bed scrubber or composite mesh pad scrubber whose capital costs are estimated at $23,000 to $117,000 per standard cubic meter per second in 2002 US dollars, with estimated operating and maintenance costs of $32,000 to $104,000 per standard cubic meter per second, annually (2002 US dollars) based on US EPA Fact Sheets.

One metal finishing facility investigated the capital cost of tank covers which was estimated at $15,000 per tank (current Canadian dollars).

Based on these cost estimates and the potential effects associated with chromium compounds (hexavalent) and nickel and nickel compounds, the Metal Finishers – Industry Standard is reasonable.

7. Public Consultation

7.1. Summary of Public Consultation Efforts

The metal finishing sector is comprised of mostly small to medium sized businesses that are generally located in urban areas of southern Ontario. Therefore, the ministry is taking a more generalized approach to engagement and consultation on the proposal for this sector.

Similar to other technical standards, the ministry used a technical committee with members from the Canadian Association for Surface Finishing (CASF) and ministry staff from various branches to engage the sector in technical discussions and questions regarding contaminants, processes and environmental methods to better control or manage emissions. The technical committee included representatives from metal finishing facilities, chemical suppliers, consultants and Environment Canada. Meetings were held between 2011 and 2015. It is our understanding that CASF conducted outreach with its Ontario membership regarding our work with them on the Metal Finishers – Industry Standard.

The ministry also participates on the Air Standards/Local Air Quality External Working Group (EWG) which has members from various industry sectors, public health agencies, environmental non-governmental organizations and some members of First Nations. The EWG provides general feedback and recommendations to the ministry on a broad range of issues related to the Local Air Quality Regulation (O.Reg.419/05). Status updates have been given to the EWG regarding the development of the Metal Finishers – Industry Standard and more discussion was offered during the public comment period. Input from the EWG was at a general program level (as opposed to sector-specific technical issues).

The ministry requested input from stakeholders on a number of questions in the draft rationale report. Comments were received from two organizations: a public health unit and industry.

During the public comment period, the following questions were posed. Below are the responses to the question.

Public Transparency

Summaries that are made available to the public were included in the Pulp and Paper – Industry Standard based on feedback from the Local Air Quality Regulation External Working Group for the need for more public transparency.

The technical standard requires that the same two annually, updated summary tables are made available to the public; the Implementation Summary Table and the Performance Summary Table. The implementation summary table includes a list of the requirements that apply to the registered facility, when the requirements phase-in and the date the facility implemented the requirements. The Performance Summary Table for the metal finishing sector would include a listing of notifications made to the ministry, notices and orders issued by the ministry to the facility.

Public Transparency Question:

7.1 A: Are there other relevant aspects of the proposed Metal Finishers – Industry Standard that the ministry should consider including in the Public Summaries?

Both commenters were supportive of these two summary tables being made available to the public.

7.2. Consideration of Feedback from Public Consultation

The ministry posted the draft Rationale Report and the proposed draft Metal Finishers – Industry Standard on the Environmental Bill of Rights Environmental Registry (EBR) for public comment on May 19th, 2015 until July 18th, 2015. All comments received during the public consultation period were reviewed and considered by the ministry before a final decision was made.

In addition, in June 2015, the ministry hosted a stakeholder meeting which included industry, public health units and environmental non-government organizations. An overview of the proposed Metal Finishing – Industry Standard was provided with an opportunity for stakeholders to provide comments and ask questions of the ministry.

Two comments were received: one (1) from industry and one (1) from public health.

As a result of consultation on the proposal, there were two significant additions to the Metal Finishers – Industry Standard.

Multi-tenant Buildings:

Facilities that operate in multi-tenant buildings will now have the option to use both a fume suppressant or wetting agent and an air pollution control device with local exhaust ventilation to minimize emissions or to replace make-up air filters, as per the original proposal.

Maintaining Negative Building Pressure:

Maintaining a negative pressure in key areas of the building will minimize fugitive emissions and improve the capture efficiency of the fume hoods so as to improve the control of emissions from processes in the building. The original proposal required facilities to maintain a negative pressure in the metal finishing tank areas and to assess this by maintaining a table of air flows entering and exiting the facility or area. Any facility will now have the option to either maintain a table of these air flows or to measure building pressure differential in 30 minute block averages. If the building pressure differential over a 30 minute block average is positive, facilities must make operational adjustments to self-correct. If there is a second measurement of a 30 minute block average showing positive pressure in the same day, this would be considered non-compliance and the facility is required to notify the ministry at the end of the calendar day of all the positive 30 minute block averages of the calendar day.

The following is a summary of the major comments and how they were considered by the ministry in finalizing the Metal Finishers – Industry Standard.

1. Inspection and access issues with proposed requirements for Facilities in Multi-Tenant Buildings

Comment: The proposed requirements under the Metal Finishers - Industry Standard could raise issues around the inspection and access to make up air units of other building tenants.

The ministry should consider an alternative option allowing facilities to use both a fume suppressant and an air pollution control device with local exhaust ventilation or to supply make up air filters to the landlord twice per year.

Response: The Metal Finishers – Industry Standard includes two options for metal finishers registered to chromium compounds (hexavalent) located in multi-tenant buildings:

To provide the person responsible for the building new make up air filters for each make up air unit at the building every six months; or

To use both fume suppressant and an air pollution control device with local exhaust ventilation on metal finishing tanks used for decorative chromium electroplating, hard chromium electroplating, chromium anodizing or chromium reverse etching.

Similarly, for metal finishers registered to nickel and nickel compounds located in multi-tenant buildings:

To provide the person responsible for the building new make up air filters for each make up air unit at the building every six months; or

To use both a wetting agent and an air pollution control device with local exhaust ventilation on metal finishing tanks used for bright and semi-bright nickel electroplating.

The above requirements will take effect July 1, 2019.

2. Administrative Burden to require a table of air flows entering and exiting the building

Comment: The proposed requirement to maintain a table of air flows entering and exiting the building may be an administrative burden on metal finishers. An alternative that may satisfy the intent is to require regular checks of building differential pressure.

Response: The Metal Finishers – Industry Standard includes two options:

To prepare and update a table of volumetric air flows into and out of the building; or

To take and record measurements of building differential pressure in 30 minute block averages.

3. Facilities should be required to demonstrate continuous improvement over time

Comment: The ministry should include a mechanism to assess continuous improvement over time.

Response: During the development of the Metal Finishers – Industry Standard, the ministry assessed the dominant sources of chromium compounds (hexavalent) and nickel and nickel compounds. The requirements of the Metal Finishers – Industry Standard focus on the dominant sources of these contaminants. More stringent requirements are included for new facilities and facilities that undergo an expansion. This approach will ensure continuous improvements over time.

A technical standard can also be updated if new cost-effective technology becomes available in the future. The ministry is currently considering when and how to ensure technical standards in general continue to be kept up to date.

4. Use the most stringent limits

Comment: The ministry should consider the use of the more stringent surface tension limits from the US EPA rules.

Response: At the time of developing this technical standard, the ministry was unable to find any published information to confirm that a reduction in surface tension from say 35 dynes/cm to 33 dynes/cm would result in a measurable reduction in exposure or emissions. However, the science behind fume suppressants is evolving and new approaches such as PFOS-free fume suppressant continue to be reviewed. The ministry may consider a future study to determine if a reduction in surface tension would further reduce exposures or emissions.

The Technical Standards Publication (see chapter 1.4 Updating of Technical Standards) acknowledges that updates to technical standard should be considered if new technically and/or economically feasible approaches become commercially available.In addition, every application for registration to a technical standard is posted to the EBR for public comment. In some cases, enhanced public outreach may be requested such as letters to neighbours, advertisements in a local newspaper to a public meeting. The need for enhanced public outreach is considered on a case-by-case basis.

8. Metal Finishers - Industry Standard

8.1. Structure

The Metal Finishers – Industry Standard applies to NAICS code 332810 activities, namely chromium electroplating, chromium anodizing, chromium reverse etching, nickel electroplating and electroless nickel plating and general ventilation for chromium compounds (hexavalent) and nickel and nickel compounds.

In addition to chromium electroplating, requirements for chromium anodizing and reverse etching are included in order to harmonize with the Federal Regulation. Both the chromium anodizing and reverse etching processes produce hydrogen and oxygen bubbles at an electrode similar to chromium electroplating.

In order to prevent, reduce or minimize emissions of chromium compounds (hexavalent) and nickel and nickel compounds the Metal Finishers – Industry Standard compliance approach includes specified technologies that must be used, operational, monitoring, recordkeeping and reporting requirements.

The requirements are summarized as follows:

- Part I: General
- Part II: Technology Specification
- Part III: Operation and Maintenance
- Part IV: Industrial Ventilation
- Part V: Requirement to Continue the use of Ventilation Systems and Methods to Manage Emissions
- Part IV: Complaints, Annual Summary Reports and Records

Requirements related to the use of specific technologies for chromium compounds (hexavalent) are listed in Part II including:

- Use of local exhaust ventilation and an air pollution control device;
- Use of fume suppressants; or
- Use of a tank cover.

Requirements for specified technologies for nickel and nickel compounds are also listed in Part II including:

- Use of local exhaust ventilation and an air pollution control device; or
- Use of wetting agents.

Specified technologies are more stringent for new processes that result increased production capacity than existing processes and facilities located in multi-tenant buildings.

There are also requirements that apply to both chromium compounds (hexavalent) and nickel and nickel compounds listed in Parts II, III, IV and V:

- Vertical and unimpeded exhaust stacks for new sources;

- Keeping a negative pressure in building areas that contain certain processes;
- Ventilation program that includes current drawings of ventilations systems;
- Ventilation assessments when certain criteria are met;
- Additional requirements for metal finishers located in multi-tenant buildings; and
- A general requirement for facilities to maintain existing air pollution control devices to ensure “no backsliding” or degradation of air pollution controls that are in place at the time of registration.

Part IV requirements are related to records, internal reports to be provided to the Highest Ranking Individual, external notifications to the ministry and the availability of certain information to the public. This approach is similar to parts of the Pulp and Paper – Industry Standard, published March 5, 2015.

8.2. Rationale for Requirements and Timing

8.2.1. Specified Technologies for Chromium Compounds (hexavalent)

Efforts were made to harmonize the specified technologies for chromium compounds (hexavalent) with the requirements of the Federal Regulation. The three compliance options described in section 3 of the industry standard can be considered complementary:

- Use of local exhaust ventilation and an air pollution control device;
- Use of fume suppressants; or
- Use of a tank cover.

The first option is very similar to the Federal Regulation but the Federal Regulation also includes an emission limit and periodic stack testing to confirm the emission limit. It was felt the critical component was the use of local exhaust ventilation and an air pollution control device. Based on the results of the dominant source analysis and information provided by CASF facilities, it was determined that even facilities able to meet the emission limit in the Federal Regulation would not necessarily be able to meet the upcoming chromium compounds (hexavalent) Ontario air standard.

The Federal Regulation also requires stack testing once every five years. This provides a snap shot of performance but may not be reflective of day to day performance. The Ontario Metal Finishers – Industry Standards requires that daily operational parameters be monitored to ensure effective operation. Therefore, Ontario did not duplicate stack testing requirements in this Metal Finishers – Industry Standard.

The second option of using a fume suppressant is also harmonized with the Federal Regulation which sets specified surface tension limits of 45 dynes/cm and 35 dynes/cm, which are specified normal operating ranges.

The values of Federal Regulations and the normal operating ranges are consistent with the original US EPA MACT standard (1995). However, they are higher than the latest US EPA MACT standard (2012) which set surface tension limits of 40 dynes/cm and 33 dynes/cm. In general, the lower the surface tension the greater the reduction in mist generation. It is our understanding that the surface tension and emission limits were part of the appeal of 2012 US EPA MACT standard. The chemical suppliers were not able to provide any data to demonstrate the specific improvement by the drop of 45 dynes/cm to 40 dynes/cm. In fact, chemical suppliers expressed concern that reducing the surface tension too low can start to increase mist generation but did not provide any specific data to support this. The courts upheld the US EPA MACT standard despite the concern raised by the the National Association for Surface Finishing (NASF) and in particular NASF raised concerns with the updated surface tension limits of 40 dynes/cm and 33 dynes/cm in that they may have been set without adequate rationale. Without data to confirm that the reduction would result in a non-negligible reduction in exposure the surface tension values were left the same as the Federal Regulation. The ministry is considering a study to determine if there could be a measurable reduction in exposure with the use of PFOS-free fume suppressants at the lower US EPA MACT limits.

The third option of the use of a tank cover is duplicative of the Federal Regulation in order to maintain a consistent approach for the metal finishing sector in Ontario.

8.2.2. Specified Technologies for Nickel and Nickel Compounds

It is expected that some metal finishing facilities will exceed the nickel and nickel compounds air standard that will come into effect in July 2016. Based on the ministry's assessment, the key sources are general ventilation (e.g. roof vents above nickel plating tanks). The ministry has included requirements in section 5 of the industry standard that will help to reduce the generation of nickel mists from the tanks with the use of wetting agents or the use of local exhaust ventilation (e.g. hoods) connected to air pollution control devices. These requirements are consistent with US EPA GACT standard. The industry has indicated that use of tank covers is not favoured due to technical issues therefore this option was not proposed or included.

Wetting agents are commonly used in particular types of nickel electroplating, for example bright and semi-bright nickel electroplating but not technically feasible in all nickel operations.

With this in mind, the ministry requested input on the following questions relating to proposed Technologies for Nickel and Nickel compounds:

8.2.2 A: What nickel electrolytic processes use wetting agents?

8-2-2 B: Are there types of nickel electroplating or electroless nickel plating other than bright and semi-bright that also use wetting agents?

8-2-2 C: Are there other methods of managing nickel and nickel compounds that should be included and if so, what is the rationale for including them?

No comments were received regarding these questions.

8.2.3. More Stringent Requirements for New and Expanded Facilities

The requirements for more stringent air pollution control devices for new facilities and facility expansions is based on two drivers: the desire for continuous improvement and cost effectiveness. The ministry believes that more stringent requirements for new and expanded facilities will drive continuous improvement over time and do so in a more cost effective manner. CASF indicated that there would likely be both technical and economic constraints to retro-fitting existing facilities and operations with more stringent requirements. In some cases due to available floor space and accessibility to the tanks, it is not possible to install local exhaust ventilation or certain types of air pollution control devices and the cost for retrofitting systems is much greater than designing it from the beginning. See sections 3 and 6 of the industry standard for details.

Based on initial feedback with the technical committee, a three year phase-in of this requirement was included to allow the phase-in to align with typical capital planning cycle of the metal finishing sector. This is consistent with the updates to the Foundries – Industry Standard. During the public comment period, the following questions were posed. Below are responses to these questions. Capital Planning Cycle Question

8.2.3 A: What is the capital planning cycle for the metal finishing sector when planning new facilities or expansions?

8.2.3 B: Is the proposed three years a reasonable timeframe for planning to account for more stringent air pollution control devices?

8.2.3 C: Should a shorter time period be considered and if so, why?

No comments were received regarding these questions.

8.2.4. Operating, Monitoring, Inspections and Maintenance

Improving and maintaining performance of air pollution control devices on a regular basis with regular monitoring, inspections and maintenance help to ensure emissions are well controlled on an on-going basis. Monitoring these devices can help to track performance and identify potential problems early - allowing a facility to self-correct before it becomes a problem. Similarly, regular inspections and maintenance also help to keep air pollution control devices working properly and identify potential issues before they become problems. The inspection and maintenance tasks are based on recommended practices by the US EPA and other technical standards. In order to give facilities some flexibility, facilities can alter the frequency of inspections and maintenance based on a professional's recommendation but not the specified tasks. For example, a key inspection is to verify that monitoring devices are measuring accurately on an annual basis. Facilities would be given the flexibility to use a different frequency based on a professional recommendation, so based on a professional's recommendation the frequency could be once every two years but would not the flexibility to change or ignore the requirement to verify the monitoring devices are measuring accurately. Some small companies purchase second-hand air pollution control devices. In these cases, a professional's recommendation on appropriate inspections and maintenance is useful. In other cases, medium sized companies may have more sophisticated inspection and maintenance programs in place, and therefore some flexibility to use professional recommendations has been included. If there is no record of a professional's recommendation, the inspection and maintenance schedules must be followed.

During the public comment period, the following questions were posed. Below are responses to these questions.

Inspection and Maintenance Question

8.2.4 A: The ministry would like feedback on the proposed key inspection and maintenance activities listed in the Inspection and Maintenance Summary Table to section 14 as it would pertain to the metal finishing sector in Ontario.

The industry provided feedback on the activities and frequencies of the proposed inspection and maintenance activities which were included in the Metal Finishers – Industry Standard.

8.2.5. Ventilation Program

One finding of the dominant source analysis was that general ventilation (e.g. roof vents) were key sources of both chromium compounds (hexavalent) and nickel and nickel compounds. General ventilation was also a key source for the foundry sector. Environmental regulatory requirements directly related to industrial ventilation have been included to address this issue. Best practices include greater accountability for ventilation with the identification of a ventilation coordinator, current drawings and specifications and regular monitoring of the performance of ventilation systems. The US EPA rule for Secondary Lead Smelters is one of the only specific environmental regulatory requirements for negative pressure. There is a requirement for negative pressure in areas of foundries that contain certain operations in the Foundries – Industry Standard. An approach similar to the Foundries – Industry Standard has been included in the metal finishing sector including a ventilation program that has a ventilation coordinator, current ventilation records such as drawings and system specifications, regular monitoring of ventilation systems, maintaining negative pressure in areas of the building that contain operating tanks and the ability to require a ventilation study and action plan if there are problems.

Two new options were included in the ventilation program to address comments from stakeholders. One option was added to allow facilities to use an air pollution control device with local exhaust ventilation and a fume suppressant (chromium compounds (hexavalent) or wetting agent (nickel and nickel compounds) or to supply make up air filters for each make up air unit at the multi-tenant building at least every six months.

In addition, new requirements regarding the commissioning of ventilation equipment were added to be consistent with the industry best practice and the Foundries – Industry Standard.

See Part IV, sections 15-22 of the industry standard for details on industrial ventilation requirements.

During the public comment period, the following question was posed. Below is the response to the question.

Ventilation Question

8.2.5 A: The ministry is proposing to allow an exception to the requirement to evaluate the impacts of changes to a ventilation system before implementation. It is proposed that an assessment of such impacts would not be required if, (1) it is associated with natural gas or propane combustion, and (2) if the change being considered is no more than 5% of the absolute difference between the volumetric flow entering versus entering the building envelope.

Industry commented that the 5% absolute difference is acceptable.

8.2.6. Multi-tenant Buildings

It is estimated that one in four metal finishing facilities could be located in multi-tenant buildings such as industrial strip malls. This could mean shorter distances between the source and possible point of impingement receptors such as air intakes (e.g. HVAC units) resulting in potentially higher exposures levels. Therefore, the ministry included additional requirements for metal finishing facilities located in multi-tenant buildings. Industry provided preliminary feedback that the proposed concept of requiring a tenant of a multi-tenant building to check the HVAC and ductwork of another tenant could result in unintended legal issues for the tenant metal finisher and a potentially unreasonable need to replace or repair filters that may not have been impacted by the metal finisher operations. Hence, the ministry is highlighting this item and sought input during this consultation period.

During the public comment period, the following question was posed. Below is the response to the question.

Multi-Tenant Question:

8.2.6 A: The ministry is seeking input on proposed multi-tenant requirements in the proposal and other possible methods for reducing impacts from metal finishers in multi-tenant buildings.

Comments were received from industry recommended that the inspection and access challenges could be addressed by requiring the facility to supply filters at a frequency of twice per year. It was also recommended that as another option to supplying filters that both fume suppressants and air pollution control devices are required for facilities located in multi-tenant buildings. Facilities in multi-tenant buildings will have the option of supplying air filters for each make up air unit supplying other units or to use both a fume suppressant and air pollution control device for metal finishing tanks. These requirements are being phased-in and come into effect on July 1, 2019.

8.2.7. Assessment of Continuous Improvement

The requirements include a variety of approaches to performance including certain requirements that are offences including not having at least one of the specified technologies such as local exhaust ventilation connected to an air pollution control device (see sections 3-7 of the industry standard for details on this and other offences). Other approaches require regular monitoring of operating parameters such as pressure drop across a packed bed scrubber, static pressure in a duct or surface tension of a bath (see sections 8, 9, 12, 14, 15, 16, 17 of the industry standard for details). A facility must track and self-correct if the operating parameter is not in the normal operating range. It would not be an offence to deviate from a normal operating range (unless there was an adverse effect). However, it is an offence if the monitoring was not conducted or if operational adjustments were not made. In addition, if the operating range is above the notification range, such as a certain number of deviations, in a specified time period, the ministry must be notified. This could highlight a potential problem to the ministry for potential follow-up. The rationale for this approach is that some excursions from normal operating range does not necessarily result in a measurable environmental impact, but excursions can serve as a warning that a problem could arise if it is not corrected.

This type of continuous improvement cycle is common to management approaches used in industry such as the ISO (International Organization for Standardization) quality and environmental management systems and can allow for alignment with a facility’s existing systems.

APPENDICES

APPENDIX A: ACRONYMS, ABBREVIATIONS AND DEFINITIONS

ATCM	Airborne Toxic Control Measure
BACT	Best Available Control Technology
BAT	Best Available Techniques
BREF	Best available techniques REFerence documents
CAA	Clean Air Act
CASF	Canadian Association for Surface Finishing
CEPA	Canadian Environmental Protection Act
CMP	Composite Mesh Pad
ECHA	European CHemicals Agency
ELV directive	End of Life Vehicle directive
ESDM report	Emission Summary and Dispersion Modelling report
EU	European Union
GACT	Generally Achievable Control Technology
HAPs	Hazardous Air Pollutants
HEPA filter	High Efficiency Particulate Air filter
IED	Industrial Emissions Directive
IPPC directive	Integrated Pollution Prevention and Control directive
MACT	Maximum Achievable Control Technology
MOECC	Ontario Ministry of the Environment and Climate Change
MPME	Mesh Pad Mist Eliminator
NAICS code	North American Industry Classification System code
NESHAP	National Emission Standards for Hazardous Air Pollutants
PBS	Packed Bed Scrubber
PFOS	PerFluoroOctane Sulfonate
PTP	Pre-Test Protocol
REACH	Registration, Evaluation, Authorisation and restriction of CHemicals
RoHS directive	Restriction of the use of certain Hazardous Substances in electrical and electronic equipment directive
SME	Small to Medium Enterprises
T-BACT	Best Available Control Technology - Toxics
US EPA	United States Environmental Protection Agency

WAFS	Wetting Agent/Fume Suppressant
WEEE directive	Waste Electrical and Electronic Equipment directive
dynes/cm	dynes per centimetre
m^2/kA	square metre per kiloampere
m^3	cubic metres
mg/amp-hr	milligrams per ampere-hour
mg/dscm	milligrams per dry standard cubic metre
µg/L	micrograms per litre
µm	micrometer

APPENDIX B: DETAILED METAL FINISHING PROCESS DESCRIPTIONS

Process	Sub-process	Description
Surface Preparation	Abrasive Blasting	To finish, clean, remove coating, prepare/treat the surface of the workpiece using glass beads, coarse abrasives (eg. sand), metallic abrasives (eg. steel and iron shot/grit), fine angular abrasives (eg. aluminum oxide) or softer/finer organic abrasives (eg. ground walnut shells).
	Aqueous Cleaning	To dislodge surface soil with inorganic cleaning solutions (typically alkaline or neutral but may be acidic). May be soak (no current) or electrofied. Increased temperature along with surface impingement are the most common ways to improve the effectiveness of aqueous cleaning.
	Buffing	Mechanical technique used to prepare surface of a workpiece for plating, painting, or other surface treatment or can be used to bring a workpiece to final finish. Used to generate smooth surfaces, free of lines and other surface defects. Deep lines and other more severe surface defects should be removed before buffing by polishing. The desired finish can range from semibright to mirror bright or high luster. Buffing compounds are available in paste or solid form. There are thousands of products available. Nonferrous workpieces made of copper, nickel, chromium, zinc, brass and aluminum are frequently buffed with compounds containing silica. Steel workpieces are normally buffed with compounds containing aluminum oxide. Chromium oxide is used to attain the highest reflectivity on stainless steel, chromium, and nickel plate. Iron oxide is generally used to attain a high reflectivity on brass, gold, copper, and silver. Lime-based buffing compounds are used to generate mirror finishes on nickel workpieces. Liquid abrasive compounds are also available and are common in high production buffing.
	Burnishing/ Deburring/ Tumbling	To clean and deburr workpieces by mixing with abrasive media and tumbled or vibrated for up to several hours. Most commonly used abrasive media are either ceramic- or plastic-based. Most common abrasives used in ceramic and plastic media are: silica (sand); brown and white fused alumina (aluminum oxide); silicon carbide; and zirconium. Generally applied to smaller, mass-produced components often followed by barrel treatment.
	Vapour Degreasing	To remove surface oils, waxes, buffing compounds and other soils bu using vapour from organic solvent
	Degreasing	Removes surface oils, greases, waxes and corrosion-inhibiting compounds by dipping the part in organic solvents or by using vapour from organic solvents.
	Deoxidizing/ Desmutting	Residual metallic alloying materials (or smut) are left on an aluminum surface following the etching process. Removal is required through the use of deoxidizer/desmutters leaving the treated surface clean for subsequent finishing steps.
	Etching (metals)	To enhance adhesion prior to autocatalytic or electrolytic metal plating. Also known as chemical milling.

	Etching (plastics)	To enhance metal adhesion (applied to ABS-type plastic surfaces to oxidize and dissolve butadiene component and generate a micro-rough surface).
	Grinding/Sanding/ Polishing (Mech)	To remove fine marks using abrasive belts. Mechanical polishing removes defects from and smoothing the surface of finished metals and formed products after plating or thermal spraying. Involves the use of automatic or manually-operated machines that have hard-faced abrasive wheels or belts where no liquids or fluids are used to trap the removed metal particles.
	Pickling & Acid Dipping	Chemical metal stripping process to remove tarnish or oxide films formed in the alkaline cleaning step and to neutralize the alkaline film. Can also be used to etch an already clean surface so that any coating that is then put on the metal surface will stick better.
	Pickling (electrolytically assisted)	Cleans the metal surface using a direct or reverse current and enhance the adhesion of metal(s) during the electroplating process.
	Polishing (electrolytic)	Produces smooth bright surfaces using selective dissolution processes where high points of rough surface are dissolved faster than depressions. Surface is clean, gives better subsequent deposit adhesion and high corrosion resistance.
	Reverse Etching (hard chrome)	Sometimes a pre-plating step for hard chrome by reversing the polarity of the tank.
	Zincating	Immersion treatment where a coating of zinc or zinc alloy is deposited over cleaned and activated aluminum workpieces in preparation for electroplating process.
Core Treatment Processes	Anodizing	Electrolytic surface oxidation process to enhance the natural aptitude for the metal (often aluminum but can also be magnesium, titanium, tantalum and niobium) to oxidize. Forms a hard, corrosion-resistant and abrasion-resistant coating with excellent wear properties. This porous coating may also be coloured.
	Brightening	To make the surface of the workpiece bright and clean so that metals such as brass or copper may be lacquered or plated directly without resorting to polishing or other hand preparation.
	Chemical Blackening	Process forms magnetite on the surface of the workpiece. Typically is preceded by alkaline soak clean and followed up by a seal with oil, wax or acrylic.

Chemical Conversion Coatings - hexavalent chromium passivates	Parts are immersed in a passivation tank after electroplating with zinc or a zinc alloy.
Dip Spin Coating	Ideally suited for workpieces which are processed in bulk such as fasteners and other barrel-plated workpieces. A mesh basket (full of workpieces) is immersed in a coating tank, removed from the coating solution, spun to remove excess liquid and then dried at a specified curing temperature. Transfer efficiencies are typically 90 to 98%.
Dying/Colouring	Porous oxides which are formed when anodizing can be coloured using organic dyes, pigment impregnation or electrolytic deposition of various metals into the pores of the coating.
Electroless Plating	To deposit/plate a coating of metal upon the surface of a workpiece through autocatalytic or chemical reduction of aqueous metal ions. Electroless baths include aqueous solutions of metal ions, reducing agent(s), complexing agent(s), and bath stabilizer(s) operating in a specific metal ion concentration, temperature, and pH range. Unlike conventional electroplating, no electrical current is required for deposition. The electroless bath provides a deposit that follows all contours of the substrate exactly, without building up at the edges and corners.
Electrophoretic Coating (E-coating)	To apply a coating by immersing a workpiece into a coating bath and applying direct current electricity through the bath. The workpiece to be coated is one of the electrodes. Transfer efficiencies routinely in 95 to 99% range.
Electroplating	To deposit/plate a coating of metal upon the surface of a workpiece by electrochemical reactions. Achieved by passing an electric current through a solution containing dissolved metal ions and the metal object to be plated. The metal object serves as the cathode in an electrochemical cell, attracting ions from the solution. Ferrous and non-ferrous metal objects are plated with a variety of metals including brass, bronze, cadmium, chromium, copper, gold, indium, lead, nickel, palladium, platinum, rhodium, silver, tin, and zinc. The process is regulated by controlling a variety of parameters including voltage and amperage, temperature, residence times and purity of bath solutions.
Heat Treatment	The controlled heating and cooling of metals to improve their structural and physical properties. Basic heat treating processes include: annealing (to relieve internal stresses, soften, make more ductile, and refine grain structures), case hardening (carburizing or nitriding process for parts which require a wear-resistant surface and a tough core), hardening (increases hardness and strength but also increases brittleness), normalizing (to relieve internal stresses produced by machining, forging, or welding) and tempering (to relieve internal stresses and reduce brittleness).
Hot Dip Galvanizing	Process of coating a metal, usually iron or steel, with a protective covering of zinc by passing the metal through a molten bath of zinc.

	Mechanical Plating	A method for coating ferrous metals, copper alloys, lead, stainless steel, and certain types of castings involving the application of a malleable, metallic, corrosion-resistant coating of zinc, cadmium, tin, lead, copper, silver, and combinations of metals such as zinc-aluminum, zinc-tin, zinc-nickel, tin-cadmium, and others. Metallic coatings are produced by tumbling workpieces in a mixture of water, glass beads, metallic dust or powder, and proprietary chemicals. Inert/non-toxic glass beads provide impacting energy which hammer or “cold-weld” the metallic particles against the surface of the workpieces. Plating efficiency is 93%.
	Paint Dipping	To apply an organic coating (i.e., paint) by immersing a workpiece for protective and decorative purposes. Paints can be solvent-based formulations and water-based formulations.
	Paint Spraying	To apply an organic coating (i.e., paint) through a spray system to a workpiece for protective and decorative purposes. Paints can be solvent-based formulations and water-based formulations. Several types of spray gun technologies are used: conventional air spray, high volume low pressure (HVLP), airless, air-assisted airless and electrostatic systems. Electrostatic systems apply a negative charge to the coating as it is atomized. Transfer efficiencies for the various spray guns are: 20-40% for conventional, 40-60% for HVLP, 30-50% for airless, 45-60% for air-assisted airless and 50-85% for electrostatic.
	Passivation	The formation of a stable and relatively insoluble film (made up of chromium and nickel oxides) to enhance the corrosion resistance of primarily stainless steel.
	Phosphating	Applied by immersion or spray to steel for corrosion resistance, lubricity or as a base for subsequent coating (eg. painting).
	Powder Coating	Coatings are applied electrostatically in dry powder form to a very clean pretreated workpiece and cured through application of heat to a durable finish. Powder coatings are organic but do not contain any solvents. Each discrete powder particle contains the entire coating formulation (ie. resins, pigments, fillers and modifiers). The overspray has the potential to be reused directly onsite by recycling the powder back to the spray guns.
	Rinsing	To prevent cross-contamination of process solutions and ensures there is no deterioration of workpiece surface by residual chemicals.
Post Treatment Processes	Drying/Curing	Dries a workpiece by heating at relatively low temperatures and/or cures a workpiece by causing a chemical reaction in a product. Typically fueled by natural gas.
	Metal Stripping	To strip metal from jigs and/or jig contacts used in the electroplating process (to extend the life of the jigs and recover metal deposited) and to strip metal deposits on workpieces.
	Paint Stripping	To periodically strip dried paint from racks using thermal stripping (molten salt bath or high-temperature oven), cryogenic stripping (exposure to liquid nitrogen followed by physical removal of the embrittled paint) or blasting (sand or steel shot).

	Polishing (mechanical)	To remove defects from and smoothing the surface of finished metals and formed products after plating or thermal spraying. Involves the use of automatic or manually-operated machines that have hard-faced abrasive wheels or belts where no liquids or fluids are used to trap the removed metal particles.
	Sealing	To improve corrosion resistance and retain any surface colouring. A sealing operation usually completes the anodizing process where pores of the anodized layer are hydrated which fills the pores and provides improved corrosion resistance. Chromic acid or other chromates may be added to the solution to help improve corrosion resistance.
Supporting Processes	Boilers and Heaters	Provide comfort heating/cooling, process heating and water heating. Typically fuelled by natural gas. Fuel oil backup systems possible.
	Cooling Towers	Heat exchangers used to dissipate large heat loads to the atmosphere. Wet cooling towers provide direct contact between cooling water and air passing through the tower. Some liquid water may be entrained in the air stream and be carried out of the tower as "drift" droplets.
	Emergency Generators	Produce power to maintain operating conditions when power produced by normal sources of power is cut off or reduced. Other than this emergency type of operation, these generators are operated for testing purposes periodically. Typically fuelled by diesel.
	General Ventilation	Ventilation in a building provides a continuous supply of fresh outside air, maintains temperature and humidity at comfortable levels, reduces potential fire or explosion hazards and removes or dilutes airborne contaminants. Fugitive air emissions released inside a building generally occur due to process operations performed inside a building that are not exhausted through a dedicated ventilation system or those that are equipped with dedicated ventilation but not achieving complete capture of related emissions. Fugitive emissions released inside a building can be exhausted to the atmosphere through the general ventilation system or other building penetrations (i.e. window and door openings).
	Laboratory	Laboratory fume hoods/exhausts used for quality control and quality assurance purposes.
	Roadways (onsite) and Storage Piles	Fugitive particulate from on-site roadways and outdoor storage piles has the potential of containing metals.
	Storage Tanks	Stores raw materials for use in the metal finishing operations and holds spent chemicals prior to their removal by tanker truck.

	Water and Wastewater Management	Conventional physical and chemical treatment used on wastewater. Involves the use of chemicals to react with soluble pollutants to produce insoluble byproduct precipitants, which are removed by physical separation via clarification and/or filtration. Conventional treatment systems often include hexavalent chromium reduction, cyanide oxidation, and chemical precipitation in a neutralization tank. Sludge is stored/thickened in a sludge tank then dewatered via a filter press. Sludge dryers are also used. A small amount of trivalent chromium may be converted back to hexavalent chromium in a direct fired sludge dryer. Evaporation used to dewater various plating rinse waters to recover bath concentrate and to minimize liquid discharges from manufacturing plants by concentrating certain pretreated wastewaters for haul-away and disposal while recovering additional process water for recycle to the process. In most atmospheric evaporator designs, the vaporized rinse water is not captured. Instead, the humid air stream is vented to atmosphere. To avoid possible carryout and discharge of hazardous substances, the air stream may require additional treatment (e.g. scrubber).
	Welding/ Soldering	To unite metallic components by heating and allowing the metals to flow together used for maintenance purposes and/or as part of a larger manufacturing operation.

APPENDIX C: SUMMARY OF JURISDICTIONAL REQUIREMENTS

Appendix C.1 – Highlights of the Release Test Requirements in the Federal Regulation

The following must be provided in the report for each point source (section 11 of the Federal Regulation):

- Date and time of sampling
- Test results
- Floor plan with location of any relevant sources, tanks, or controls etc. marked
- Test method used
- Number of tanks in use during sampling and number of tanks not in use if applicable
- Description of ventilation for each tank in use and connected to the point source during sampling
- Diameters of the ducts linking each tank and connected to the point source
- Electrical output setting for each tank's rectifier
- Dimension of stack if applicable
- Diameter and location of each sampling port in relation to the point of release from the stack
- Type of extension, if applicable, as well as dimensions and location of the extension of each sampling port
- Dimension, type and name of the manufacturer for each control device
- Model and name of manufacturer for each control device fan and its rated capacity
- Concentration (mg/dscm) of hexavalent chromium, or total chromium
  - For all 3 sampling runs
  - Average calculated concentration of the three runs

Conditions applicable to all release tests (subsection 5(4) of Federal Regulation)

The Regulations specify the technical parameters to be observed when performing a release test. The test must be performed under representative operating conditions without using dilution air. The sampling must be performed in accordance with generally accepted standards and consist of three two-hour sampling runs (with a minimum sampling total volume of 1.7 dscm).

The analysis of the samples must be performed in accordance with generally accepted standards by a laboratory located in Canada that is accredited by a Canadian accrediting body under the standard ISO/IEC 17025: 2005. Moreover, the analysis must be carried out with an analytical method whose precision and accuracy are based on a minimum of seven replicate samples and that has:

- a method detection limit of at least 8 µg/L of chromium;
- a precision of 5% relative standard deviation at 10 times the method detection limit; and
- an accuracy of 100% ± 5% based on analyte recovery at least 10 times the method detection limit.

Finally, the average of three sampling runs must not exceed the chromium release limit of 0.03 mg/dscm.

Appendix C.2 – Summary of Regulatory Requirements from Various Jurisdictions

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Authority	*The Chromium Electroplating, Chromium Anodizing and Reverse Etching Regulations* under the Canadian Environmental Protection Act (CEPA)	The *Clean Air Regulation* under Quebec's Environmental Quality Act	National emission standards for chromium emissions from hard and decorative chromium electroplating and chromium anodizing tanks can be found in subpart N of *40 CFR 63 of the Federal Code of Regulations*. National emission standards for hazardous air pollutants (NESHAPs) under section 112c of the *Clean Air Act* (CAA).	National emission standards for plating and polishing can be found in subpart WWWWWW of *40 CFR 63 of the Federal Code of Regulations*. National emission standards for hazardous air pollutants (NESHAPs) under section 112c of the *Clean Air Act* (CAA).	*Airborne Toxic Control Measure (ATCM) for Chromium Plating and Chromic Acid Anodizing Facilities Regulation* under title 17 of the California Code of Regulations
Facility Classification	-	-	• large hard chromium electroplating (> 60 million ampere hrs/yr) • small hard chromium electroplating (< 60 million ampere hrs/yr)	• area sources of the specified hazardous air pollutants (ie. cadmium, chromium (excluding processes in NESHAP for Chromium Electroplating and Anodizing), lead, manganese and nickel) • area sources are those that do not emit or have the potential to emit more than 10 tons/yr of a single toxic air pollutant or more than 25 tons/yr of any combination of toxic air pollutants.	Existing facilities – operating prior to October 24, 2007 • Distance to sensitive receptor ≤ 330 feet: o ≤ 20,000 amp-hr/yr facility o > 20,000 and ≤200,000 amp-hr/yr facility o > 200,000 amp-hr/yr facility • Distance to sensitive receptor > 330 feet o ≤ 50,000 amp-hr/yr facility o > 50,000 and ≤ 500,000 amp-hr/yr facility o > 500,000 amp-hr/yr facility New facilities - began operations after October 24th, 2007
Minimum Usage	• 50 kilograms of chromium trioxide annually	-	- (all facilities involved in chromium electroplating processes regardless of size)	-	- (all facilities involved in chromium electroplating, chromic acid anodizing regardless of size)
Operations Covered by the Regulation	• chromium electroplating • chromium anodizing • reverse etching	• metallic surface treatment processes meaning the "preparation of metallic surfaces by pickling, other than abrasive blast cleaning, or etching, and the treatment of the surfaces by chemical or electrochemical methods".	• large hard chromium electroplating • small hard chromium electroplating • decorative chromium electroplating • chromium anodizing	• non-chromium electroplating • electroforming • electropolishing • electroless plating • other non-electrolytic metal coating (eg. chromium conversion coating, nickel acetate sealing, sodium dichromate sealing, manganese phosphate coating) • thermal spraying • dry mechanical polishing of finished metals and formed products after plating or thermal spraying	• hard and decorative chromium electroplating • chromic acid anodizing (Note: rinse tanks, etching tanks, electro stripping tanks, cleaning tanks and tanks that contain a chromium solution, but in which no electrolytic process occurs (eg. chromium conversion coating tank where no electrical current is applied) are <u>not</u> subject to this regulation)

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Controls	A: Control device (e.g. composite mesh pad OR packed bed scrubbers) and ultimately emitting from a point source; B: Surface tension controls; OR C: Tank cover/HEPA filter	-	• packed bed scrubber • composite mesh pad • fume suppressants (e.g. wetting agent, foam blanket) • other controls are allowed as long as the emission limit is met	• Non-cyanide electroplating, electroforming and electropolishing tanks three compliance options: o use wetting agent/fume suppressant (WAFS); o capture and control using composite mesh pad (CMP), packed bed scrubber (PBS) or mesh pad mist eliminator (MPME); OR o use a tank cover – batch process tanks: cover must enclose entire surface area of tank and must be in place during at least 95% of process operating time; OR – continuous process tanks: tank surface area must be covered at least 75% during all periods of process operation. • short-term/flash electroplating tanks required to limit plating time to no more than 1 cumulative hour/day or 3 cumulative minutes/hr of plating time or to use a tank cover during a least 95 percent of the plating time. • existing affected permanent thermal spraying require capture and control with water curtain, fabric filter, cartridge or high efficiency particulate air (HEPA) filter. • new affected permanent thermal spraying require capture and control with fabric filter, cartridge or HEPA filter. • new and existing affected dry mechanical polishing require capture and control with cartridge, fabric or HEPA filter.	• HEPA filter • composite mesh pad • fiber-bed mist eliminator • packed bed scrubber • chemical fume suppressant • mechanical fume suppressant (eg. polyballs)

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Emission Limits	By January 4th, 2012: • 0.03 mg/dscm for hexavalent chromium	By June 30th, 2011 (date regulation came into force): • 0.9 mg/dscm for hexavalent chromium • 10 mg/dscm for inorganic acids other than chromic acid By January 4th, 2012: • 0.03 mg/dscm for hexavalent chromium • 10 mg/dscm for inorganic acids other than chromic acid	Previous Limits (2004): • large hard chromium electroplating: 0.015 mg/dscm for total chromium • small hard chromium electroplating: 0.030 mg/dscm for total chromium (0.015 mg/dscm if (re)constructed after Dec 16th, 1993) • decorative chromium electroplating: 0.010 mg/dscm for total chromium • anodizing: 0.010 mg/dscm for total chromium New Limits (2012): • large hard chromium electroplating: 0.011mg/dscm for total chromium (0.006 mg/dscm if (re)constructed after Feb 8th, 2012) • small hard chromium electroplating: 0.015 mg/dscm for total chromium (0.006 mg/dscm if (re)constructed after Feb 8th, 2012) • decorative chromium electroplating: 0.007 mg/dscm for total chromium (0.006 mg/dscm if (re)constructed after Feb 8th, 2012) • anodizing: 0.007 mg/dscm for total chromium (0.006 mg/dscm if (re)constructed after Feb 8th, 2012)	-	For facilities which began operations before October 24, 2007: • Distance to sensitive receptor ≤ 330 feet: o > 20,000 and ≤200,000 amp-hr/yr facility - 0.0015 mg/amp-hr hexavalent chromium with add-on control (by October 24, 2010) o > 200,000 amp-hr/yr facility - 0.0015 mg/amp-hr hexavalent chromium with add-on control (by October 24, 2009) • Distance to sensitive receptor > 330 feet o > 50,000 and ≤ 500,000 amp-hr/yr facility - 0.0015 mg/amp-hr hexavalent chromium (by October 24, 2011) o > 500,000 amp-hr/yr facility - 0.0015 mg/amp-hr hexavalent chromium with add-on control (by October 24, 2009) For facilities that began operations on or after October 24, 2007: • all: 0.0011 mg/amp-hr hexavalent chromium

Elements	**Canada**	**Quebec**	**US EPA NESHAP for Chromium Electroplating and Anodizing**	**US EPA NESHAP for Plating and Polishing**	**California**
Surface Tension Limits (Alternative to Emission Limits)	By October 4th, 2009: • 35 dynes/cm (tensiometer) • 45 dynes/cm (stalagmometer) (Note: surface tension must be measured in accordance with method ASTM D 1331-89 if a tensiometer is used)	By June 30th, 2011: • 35 dynes/cm (tensiometer) • 45 dynes/cm (stalagmometer)	Previous Limits (2004): • 35 dynes/cm (tensiometer) • 45 dynescm (stalagmometer) New Limits (2012): • 33 dynes/cm (tensiometer) • 40 dynes/cm (stalagmometer)	-	For Benchbrite CR 1800, Clepo Chrome, Fumetrol 140 : • <35 dynes/cm (tensiometer) • <40 dynes/cm (stalagmometer) For HCA-6.2, HCA-4: • <32 dynes/cm (tensiometer) • <28 dynes/cm (stalagmometer) Alternative chemical fume suppressant may be used upon approval by the Executive Officer (Note: surface tension using a tensiometer shall be measured in accordance with U.S. EPA Method 306B (40 CFR 63 Appendix A). Surface tension using a stalagmometer shall be measured using the procedure set forth in Appendix 8, or an alternative procedure approved by the permitting agency)
Control Requirements	Under the tank cover control option (c), cover membrane (minimum surface area: 0.28 m^2/kA and pore openings ≤ 1μm) complete with an evacuation device equipped with a HEPA filter	-	-	-	• for facilities that began operations after October 24, 2007, HEPA filter must be installed as an add-on control device (or a viable alternative that maintains compliance with the emission limit) • control devices installed before October 24, 2007 cannot be removed without being adequately replaced
Control Implementation Timeframe	A: meet limit within 30 months of the regulation coming into force (i.e. January 4th, 2012) B: within 3 months of regulation coming into force (i.e. October 4th, 2009) C: installed within 6 months of regulation coming into force (i.e. January 4th, 2010)	-	• existing facilities must demonstrate compliance within 2 years of the final rule being published • newly constructed facilities must show compliance from initial start up of operations	-	-

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Other Requirements	-	-	After September 21, 2015, use of PFOS-based fume suppressants not permitted. Existing, new, or reconstructed decorative chromium electroplating tank that uses a trivalent chromium bath that incorporates a wetting agent as a bath ingredient is subject to the recordkeeping and reporting requirements but are not subject to the emission limits, work practice requirements or the continuous compliance monitoring requirements.	• all affected electroplating, other coating, temporary thermal spraying and all electrolytic processes are required to implement, as practicable, the following applicable management practices: o minimize bath agitation when removing parts processed in tank(s) o maximize draining of bath solution back into tank(s) by extending drip time when removing parts from tank(s) o optimize design of barrels, racks and parts to minimize dragout of bath solution o minimize or reduce heating of process tank(s), except when doing so would interrupt production or adversely affect part quality. o perform regular repair, maintenance, and preventive maintenance of racks, barrels, and other equipment o minimize bath contamination by the prevention or quick recovery of dropped parts, using distilled/de-ionized water, water filtration, pre-cleaning of parts to be plated and thorough rinsing of pre-treated parts before plating o maintain quality control of chemicals and other bath ingredient concentrations in tank(s) o perform general good housekeeping, such as regular sweeping or vacuuming (if needed), and periodic washdowns o minimize spills and overflow of tanks o use squeegee rolls in continuous or reel-to-reel plating tanks o perform regular inspections to identify leaks and other opportunities to prevent pollution	• owner/operator/current employee who is onsite and overseeing the operation of the chromium electroplating and/or chromic acid anodizing must complete the Air Resources Board environmental compliance training every two years • new facilities must be at least 1000 feet away from any school or area zoned for residential or mixed use • very large facilities with annual emissions of hexavalent chromium exceeding 15 grams per year and new facilities must conduct a site specific risk analysis to ensure their emissions do not cause adverse impacts • trivalent chromium plating facilities are required to limit emissions of total chromium which is generally accomplished by using chemical fume suppressants (alternatively add-on air pollution control equipment or chemical fume suppressants or mechanical fume suppressants (i.e.polyballs) can be used to meet ≤0.01 mg/dscm)

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Monitoring	• surface tension for each tank must be measured daily to ensure compliance with measurements being taken at least 16 hours apart • if a tank is not used for more than 24 consecutive hours, the surface tension must be measured before resuming any chromium electroplating, chromium anodizing or reverse etching activity	• surface tension must be measured daily to ensure compliance with measurements being taken at least 16 hours apart	• surface tension: first 40 hours measurements taken every 4 hours, following no exceedances measurements taken every 8 hours for a further 40 hours, following no exceedance measurements taken every 40 hours. Cycle begins again if an instance of non-compliance occurs. • pressure drop for a composite mesh pad system, packed bed scrubber or fibre bed mist eliminator must be measured daily. • foam blanket thickness measured every hour for 40 hours of operation, following a 40 hour period with no violations the time period reduced to once every 8 hours.	• affected cyanide electroplating tanks require a one-time measurement of pH in tank bath(s) be performed and recorded.	• surface tension measurements daily for 20 days ... taken weekly if no violations occur in initial 20 day period • ampere hours measured/recorded continuously for every tank associated with chromium plating or anodizing operations • pressure drop of each control device must also be continuously monitored with a mechanical gauge • pressure drop shall be maintained within plus or minus 2 inches of water of the value established during performance test to demonstrate compliance with emission limitation for CMP, PBS, CMP/PBS and fiber-bed mist eliminator • pressure drop shall be maintained within - ½ times to +2 times the inches of water of the value established during performance test to demonstrate compliance with emission limitation for HEPA filters • inlet velocity pressure of a packed bed scrubber must be continuously monitored with a mechanical gauge • inlet velocity pressure shall be maintained within plus or minus 10 percent of the value established during performance test to demonstrate compliance with emission limitation • foam blanket thickness measured every hour for 15 operating days and daily after 15 days of no violation

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Testing	• facilities that chose to regulate emissions through a control device and release through a point source must perform release testing to verify compliance • three distinct samples each collected over a period of two hours • samples must be analyzed by a Canadian laboratory with ISO/IEC 17025: 2005 accreditation • every five years, with the first test taking place within 24 months of regulation coming into force or up to 24 months prior to the regulation coming into effect • notification 30 days before release testing is required to allow for the testing to be witnessed • new release tests required within 75 days of certain modifications to a facility o replacing a control device o increase the surface area of solution in one or more tanks being routed to a control device by >25% o installing new tanks that increases the total surface area of solution leading to a control device by > 25% o changes to the ventilation system that affect the velocity or flow rate of emissions	• facilities that chose the emission limit approach must perform source emission testing every 5 years (at a minimum) to verify compliance • first sampling event must occur within 1 year of the date of application • testing must include a minimum of three sampling runs • average of the three runs must be equal to or less than the emission limit • only one of the three sampling runs is allowed to exceed the emission limit • none of the sampling runs can exceed the standard by more than 20% • samples must be analyzed by a laboratory accredited by the Minister of Sustainable Development, Environment and Parks	• initial performance tests are required for existing facilities within 180 days of the final rule being published, new facilities within 30 days of start up • notification of intent to test must be given at least 60 days prior to the scheduled testing date • performance testing reports must be submitted electronically through the Electronic Reporting Tool (ERT) • initial performance testing reports must include: o description of the test procedures and sampling locations o results of the test o quality assurance procedures and results • records of operating conditions during testing, preparation of standards, calibration procedures, data sheets and calculations • acceptable test methods include Method 306 or Method 306A "Determination of Chromium Emissions From Decorative and Hard Chromium Electroplating and Anodizing Operations", the California Air Resources Board Method 425, Method 306B "Surface Tension Measurement and Recordkeeping for Tanks Used at Decorative Chromium Electroplating and Anodizing Facilities" • establish site-specific operating parameter(s) (eg. pressure drop(s) across the composite mesh-pad system/packed-bed scrubber/fiber-bed mist eliminator; velocity pressure(s) at the common inlet of the packed-bed scrubber; surface tension of the bath(s); minimum thickness of the foam blanket) that corresponds to compliance with applicable emission limit	-	• performance testing for new facilities within 60 days of initial operation • performance tests must be performed following a change to the regulation, alteration in facility operations, or the utilization of an alternative compliance method • a pre-test protocol must be submitted to the regulating agency for approval at least 60 days prior to the planned testing • pre-test protocol shall include performance test criteria of end user and all assumptions, required data, and calculated targets for testing the source target chromium concentration, preliminary chromium analytical data, planned sampling parameters, as well as information on equipment, logistics, personnel, and other resources necessary for an efficient and coordinated test • performance tests must be performed with a minimum of three iterations using one of the following methods: the California Air Resources Board Test Method 425, U.S. EPA Method 306, or South Coast Air Quality Management District Method 205.1 • performance test report must be submitted to the regulating agency within 90 days of successful test completion • a smoke test should be performed in conjunction with performance testing for any tank(s) with a cover to ensure the integrity of the seal • performance test not required if the facility's annual permitted ampere-hour usage is ≤20,000 and the facility is located within 330 feet of a sensitive receptor or the facility's annual permitted ampere-hour usage is ≤50,000 and the facility is located more than 330 feet from a sensitive receptor that exists on October 24, 2007, and the facility is using chemical fume suppressants
Inspections/ Maintenance	• For those facilities relying on the control device/point source and tank cover options, must prepare and implement an inspection and maintenance plan. • Inspections are required every 3 months to ensure no defects with control device, ventilation equipment and no visible signs of hexavalent chromium emissions. • Requirements associated with specific control techniques/equipment outlined in Table B.2. • For all three control options, if a problem is identified the defect must be remediated before resuming operations.	-	• an operation and maintenance plan must be in place and incorporate the following aspects: o description of control devices and monitoring equipment o checklist documenting operation and maintenance conditions of equipment o follows operation and maintenance practices (see Table B.3) o follows housekeeping practices (see Table B.3) • includes procedures to limit and mitigate in the case of a malfunction	• perform regular repair, maintenance, and preventive maintenance of racks, barrels, and other equipment • perform general good housekeeping, such as regular sweeping or vacuuming (if needed), and periodic washdowns • perform regular inspections to identify leaks and other opportunities to prevent pollution	• an operation and maintenance plan must be in place and shall include: o standardized checklist to document the operation and maintenance of the facility, the add-on air pollution control device, and the process and control system monitoring equipment o procedures to be followed to ensure that equipment is properly maintained (see Table B.2 for more details) • housekeeping requirements must be implemented to reduce potential fugitive emissions of hexavalent chromium (see Table B.2 for more details) • plan to be revised as necessary to minimize breakdowns • visual inspection of plating and anodizing tank(s) daily to ensure normal operating conditions

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Record Keeping	• inspection information that must be recorded and kept (but not submitted) includes: o date on which the inspection and maintenance tasks were performed; o description of each inspection and maintenance task performed; o date on which each defect was identified; and o description of the measures taken to correct the defect. • all records are to be kept at the facility where the equipment is located or, on notification to the Minister, at any other place in Canada • all records are to be kept for inspection for a period of 5 years from the date of their creation		• records of inspection activities which can take the form of a checklist and should identify device inspected, date of inspection, brief description of working condition of device (eg. control device, monitoring equipment) during inspection and any actions taken to correct deficiencies found during inspection • records of maintenance performed (excludes routine housekeeping practices) • records on malfunctions (occurrence, duration, cause if known, actions taken) • records of all performance test results • records of measurements and monitoring data • records of instances of excess emissions • records of total process operating time (during operating period) • records of cumulative rectifier capacity • records of date/time fume suppressants were added to bath(s) where applicable along with fume suppressant manufacturer and product name. • records of bath components purchased with wetting agent clearly identified • records demonstrating waiver status • records of all documentation supporting notifications/reports • all records must be kept for a period of 5 years.	• records that demonstrate compliance with management practices • for cyanide tanks the one-time pH measurement • for non-cyanide tanks, amount and frequency of WAFS additions, if applicable • document length of time and location of temporary thermal spraying • for short-term or flash electroplating tanks, the daily plating times • for batch electroplating tanks using covers as a control option (as opposed to a management practice), the time the tanks is operated with cover in place • for continuous electroplating tanks using covers as a control option (as opposed to a management practice), amount of tank surface covered and time tank is operated with cover in place • operating manuals for all required control systems • all required notifications and report, with supporting documentation • record should be kept in a form suitable and readily available for review • records must be kept for a period of 5 years	• records of operation and maintenance plan(s) • inspection records shall be maintained, can take the form of a checklist and shall identify: o device inspected o date and time of inspection o brief description of the working condition of the device during inspection o maintenance activities performed on the components of the air pollution control system (i.e. duct work replacement, filter pad replacement, fan replacement, etc) o actions taken to correct deficiencies found during the inspection • records of performance tests • records of monitoring data (eg. cumulative rectifier usage, pressure drop, inlet velocity pressure, surface tension, with mechanical fume suppressant use coverage on electroplating or anodizing bath reported as a percentage of bath surface area, foam thickness) • records of breakdowns including records of the occurrence, duration, and cause (if known) and action taken on each breakdown • records of exceedances of the emission limitations, monitoring parameter values or any site-specific operating parameters established for alternative equipment ... records shall include the date of the occurrence, the duration, cause (if known), and, where possible, the magnitude of any excess emissions. • records demonstrating facility size • records of annual ampere-hour use • records of chemical fume suppressant additions • records of trivalent chromium process components • records of new/modified source review information • housekeeping records • all records shall be maintained for 5 years (at least two years on site)

Elements	Canada	Quebec	US EPA NESHAP for Chromium Electroplating and Anodizing	US EPA NESHAP for Plating and Polishing	California
Reporting	• Selected control method used for each tank within a facility must be submitted to the federal Minister of Environment (via the national chromium coordinator) within 30 days of the Federal Regulation coming into force for existing tanks and 30 days prior to the beginning of operations for new tanks. • Every person that performed a release test must, within 75 days after the last sample is taken, submit to the Minister a report for each point source. • Every person that uses surface tension limiting to control the release of HVC must submit a biannual report to the Minister: o For surface tension recorded from January 1 to June 30, report must be submitted no later than July 31 of the same calendar year. o For surface tension recorded from July 1 to December 31, report must be submitted no later than January 31 of the next calendar year. • There are no specific reporting requirements for those relying on the tank cover option.	-	• ongoing compliance reports (Inspection, Maintenance, Malfunctions etc.) are required every 6 months • if a violation occurs facilities may be required to submit reports every 3 months.	• annual compliance certifications must be prepared and kept on-site. • first certification of compliance reports for existing sources due January 31, 2011 and for new sources were due January 31 of year following startup. • if any deviations occurred during the reporting year, the facility is required to submit the compliance certification along with a report that describes the deviations and the corrective action taken.	• initial compliance status reports must be submitted within 6 months of the regulation coming into force for existing facilities and at time of initial operation for new facilities • ongoing compliance reports must be submitted annually by February 1st documenting the previous calendar year • any breakdowns must be reported in accordance with the regulating agency's policy • proof of nearest sensitive receptor within 30 days of initial operation • site specific risk analysis submitted prior to initial operation
Notifications	• In the event of an unexpected hexavalent chromium release, notification and a written report must be provided to the Regional Director of the Environmental Enforcement Division in the region in which the release or likelihood of a release took place. • The written report must include contact/facility information, date/time, location of release, estimated amount, circumstances that led to the release and mitigation measures taken. Identification of all persons and agencies notified must also be included.	-	• notification of compliance must be given within 90 days of the completion of a performance test or within 30 days of the compliance date if no testing is required.	• initial notifications for existing sources due October 29, 2008 and upon start-up for new sources • notifications of compliance status for existing sources were due July 1, 2010 and upon start-up for new sources	-

Table C.3 – Inspection and Maintenance Requirements/Standards for Various Control Techniques/Equipment in Different Jurisdictions

Control Technique/Equipment	**Canada**		**U.S. Environmental Protection Agency**		**California**	
	Inspection and Maintenance Requirements	**Frequency**	**Inspection and Maintenance Practices**	**Frequency**	**Inspection and Maintenance Requirements**	**Frequency**
Packed-bed scrubber (PBS)	Verify the control device surfaces and all its components are free from any fracture or deformation.	1/quarter	Visually inspect device to ensure there is a proper drainage, no chromic acid build-up on the packed beds, and no evidence of chemical attack on the structural integrity of the device.	1/quarter	Visually inspect device to ensure that there is proper drainage, no unusual chromic acid buildup on the pads, and/or packed beds and no evidence of chemical attack that affects the structural integrity of the device.	1/quarter
	Verify the ductwork between the control device and any tank does not leak and is not broken.		Visually inspect back portion of the chevron-blade mist eliminator to ensure that it is dry and there is no breakthrough of chromic acid mist.		Visually inspect back portion of the mesh pad closest to the fan to ensure there is no breakthrough of chromic acid mist, and/or back portion of the chevron mist eliminator to ensure it is dry and there is no breakthrough of chromic acid mist.	
	Verify the filtering media within the control device are free of any blockage and there is no buildup that would affect the operation of the device.		Visually inspect ductwork from tank(s) to the control device to ensure there are no leaks.		Visually inspect ductwork from tank to the control device to ensure there are no leaks.	
	Verify there are no visible signs of hexavalent chromium at the exit of the control device.		Add fresh makeup water to the top of the packed bed.	Whenever makeup is added	Perform washdown and/or add fresh makeup water to the packed bed when it is needed.	Per manufacturer
Composite mesh-pad (CMP) system	Verify that there is no build up on the pads.	1/quarter	Visually inspect device to ensure there is proper drainage, no chromic acid build-up on the pads, and no evidence of chemical attack on the structural integrity of the device.	1/quarter	Same as PBS above	Save as PBS above
	If not continuously washed, wash for at least 20 minutes twice during each 8 hours operation period (at least 3 hours between washes) OR in accordance with the manufacturer's recommendations.	2/8hour	Visually inspect back portion of the mesh pad closest to the fan to ensure there is no breakthrough of chromic acid mist.			
			Visually inspect ductwork from tank(s) to the control device to ensure there are no leaks.			
			Perform washdown of the composite mesh-pads in accordance with manufacturer's recommendations.	Per manufacturer		
PBS/CMP system	-	-	Same as for CMP system	Same as for CMP system	Same as PBS above	Same as PBS above
Fiber-bed mist eliminator	-	-	Visually inspect fiber-bed unit and prefiltering device to ensure there is proper drainage, no chromic acid buildup in the units, and no evidence of chemical attack on the structural integrity of the devices.	1/quarter	Visually inspect device to ensure that there is proper drainage, no unusual chromic acid buildup on the pads and no evidence of chemical attack that affects the structural integrity of the device.	1/quarter
			Visually inspect ductwork from the tank(s) to the control device to ensure there are no leaks.		Visually inspect ductwork from tank to the control device to ensure there are no leaks.	
			Perform washdown of the fiber elements in accordance with manufacturer's recommendation.	Per manufacturer	Perform washdown when it is needed.	Per manufacturer
Mechanical fume suppressant (eg. Polyballs)	-	-	-	-	Visually inspect the electroplating or anodizing bath(s) for coverage comparable to the coverage during the performance test	1/day
Other air pollution control device (APCD)	-	-	To be proposed by the source for approval by the Administrator.	Proposed by the source for approval by the Administrator	-	-

Control Technique/Equipment	Canada		U.S. Environmental Protection Agency		California	
	Inspection and Maintenance Requirements	Frequency	Inspection and Maintenance Practices	Frequency	Inspection and Maintenance Requirements	Frequency
Pitot tube	-	-	Backflush with water, or remove from the duct and rinse with fresh water. Replace in the duct and rotate 180 degrees to ensure that the same zero reading is obtained. Check pitot tube ends for damage. Replace pitot tube if cracked or fatigued.	1/quarter	Backflush with water, or remove from the duct and rinse with fresh water. Replace in the duct and rotate 180 degrees to ensure that the same zero reading is obtained. Check pitot tube ends for damage. Replace pitot tube if cracked or fatigued.	1/quarter
Stalagmometer			Follow manufacturer's recommendations.	Per manufacturer	Calibrate and maintain per manufacturer's specifications.	Per manufacturer
Tensiometer			Follow manufacturer's recommendations,	Per manufacturer	Calibrate and maintain per manufacturer's specifications.	Per manufacturer
Chromium tank covers	Confirmation of external pressure on the tank cover and drainage of the air inlet must be verified.	1/day the tank is in operation	-	-	Drain the air-inlet (purge air) valves at the end of each day that the tank is in operation.	1/day
	The evacuation device must be drained and the access doors/membrane must be inspected.	1/week			Visually inspect access door seals and membranes for integrity.	1/week
	Inspection of the membrane for perforations using a light source.	1/month			Drain the evacuation unit directly into the plating tank or into the rinse tanks (for recycle into the plating tank).	
	Inspection of the clamps used to hold the cover in place.				Visually inspect membranes for perforations using a light source that adequately illuminates the membrane (e.g., Grainger model No. 6X971 Fluorescent Hand Lamp).	1/month
	Inspection of the piping to and from the evacuation device to verify that there are no leaks and no evidence of deterioration.	1/quarter (minimum)			Visually inspect all clamps for proper operation; replace as needed.	
	A smoke test must be conducted in order to ensure that there are no leaks. Dates, results, manufacturer name, and a description of the steps taken during the test must be recorded for each instance.	Prior to the first use of the tank cover and every three months afterwards			Clean or replace filters on evacuation unit.	
					Visually inspect piping to, piping from, and body of evacuation unit to ensure there are no leaks and no evidence of chemical attack.	1/quarter
					Replace access door seals, membrane evacuation unit filter, and purge air inlet check valves in accordance with the manufacturer's recommendations.	Per manufacturer
Ampere-hour meter	-	-	-	-	Install and maintain per manufacturer's specifications.	Per manufacturer
High Efficiency Particulate Arrestor (HEPA) filter	Replacement of the HEPA filter.	1/year	-	-	Look for changes in the pressure drop.	1/week
					Replace HEPA filter.	Per manufacturer's specifications, or permitting agency's requirement
Housekeeping			Store any substance used in an affected tank in a closed container in an enclosed storage area or building and use a closed container when transporting the substance from the enclosed storage area.	At all times except when transferring the substance to and from container	Chromic acid powder and flakes (or other substances that may contain hexavalent chromium) must be stored and transported in a closed container and must be stored in an enclosed storage area.	-

Control Technique/Equipment	Canada		U.S. Environmental Protection Agency		California	
	Inspection and Maintenance Requirements	Frequency	Inspection and Maintenance Practices	Frequency	Inspection and Maintenance Requirements	Frequency
			Minimize spills of bath solution that result from dragout: • install drip trays that collect and return to tank any bath solution that drips/drains from parts; OR • contain and return to the tank any bath solution that drains/drips from parts; OR • collect and treat in an onsite wastewater treatment plant any bath solution that drains/ drips from parts.	Prior to operating and whenever removing parts from an affected tank	Dragout from tank(s) should be minimized by: • installing drip trays between tanks for automated lines to return liquid to tanks • handling parts so that chromic acid is not dripped outside electroplating tank for non-automated lines • installing splash guards to control spraying operations over electroplating and anodizing tanks for non-automated lines to return liquid to tanks	-
			Install a splash guard to minimize overspray during spraying operations for removing excess chromic acid from parts and return to affected tank any hexavalent chromium laden liquid captured.	Prior to any such spraying operation	-	-
			Begin clean up, or otherwise contain, all spills of any substances used in affected tank(s) that contain hexavalent chromium.	Within 1 hour of spill	Spills that may contain hexavalent chromium must be cleaned up or contained.	Within one hour of the event occurring
			Clean surfaces within the enclosed storage area, open floor area, walkways around the affected tanks contaminated with hexavalent chromium using one or more of the following: • HEPA vacuuming • hand-wiping with damp cloth • wet mopping • hose down or rinse with potable water which is collected in a wastewater collection system • other cleaning method approved by the permitting authority Alternatively, apply a non-toxic chemical dust suppressant to the surfaces according to manufacturer's recommendations.	1/7day OR After every 40 hours of operating time of one or more affected tank(s) (whichever timeline is later)	Areas around the plating tanks that may potentially accumulate hexavalent chromium or dust must be cleaned using one or more of the following: • HEPA vacuuming • hand-wiping with damp cloth • wet mopping • otherwise cleaned as approved by the permitting agency • maintained with the use of non-toxic chemical dust suppressants	Every 7 days
			Separate all buffing/grinding/polishing operations which are located in the same room from the affected tank(s) by installing a physical barrier (may take the form of plastic strip curtains).	Prior to beginning the buffing/ grinding/ polishing operations	A physical barrier between plating and buffing/grinding/polishing areas should be maintained. The barrier may take the form of plastic strip curtains.	-
			Store, dispose, recover or recycle all chromium containing wastes generated from housekeeping activities using practices that do not lead to fugitive dust and in accordance with hazardous waste requirements.	At all times	Chromium or chromium-containing waste generated from housekeeping activities must be stored, handled, and disposed of in a manner that will not lead to the release of any fugitive emissions and in accordance with hazardous waste requirements.	-

Appendix D: References

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