

Calgary



# Metal plating industry

## Wastewater compliance information



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## Glossary of terms

**Dragout** - A film of contaminants that are carried from the process/cleaning solution into the rinse tank

**Hazardous substance** – means a substance that is either a hazardous substance or a hazardous waste or has the properties of hazardous waste as described in the Environmental Protection and Enhancement Act.

**Pre-treatment system**- means a treatment system or device that is designed to remove substances or contaminants from wastewater produced on site before that wastewater passes into the wastewater system, and includes interceptors, separators and sumps.

**Standard methods**- means the analytical and examination procedures set out in the current edition of “Standard methods for the Examination of Water and Wastewater” published jointly by the American Public Health Association, the American Water Works Association and the Water Environment Federation

**Wastewater**- means the composite of water and water-carried substances released from premises or from any other source

**Wastewater treatment facility**- means a facility that stores, treats and disposes of wastewater, but which is not part of the wastewater system

## 1.0 Introduction

The term metal finishing can refer to several different types of industrial processes. In general, they all work to improve the surface of a metal. Facilities receive all types of metal or plastic parts that require varying degrees of surface finishing. A wide range of manufacturing processes make use of metal finishing services including automotive, electronics, aerospace, hardware, jewelry, heavy equipment, appliances, and telecommunications. Metal finishing can provide many beneficial properties to the item of interest, commonly referred to as the “workpiece”. Such benefits can include wear and corrosion resistance, enhanced electrical conductivity and resistance, improved appearance and many other desired physical and chemical properties.

This information document focuses on the plating aspect of the metal finishing industry.

It is important to note that the purpose of this document is to provide general information to metal plating customers that may aid them in identifying ways to achieve compliance with the City of Calgary Wastewater Bylaw 14M2012 and reduce their environmental impact. This document also contains some general federal, provincial and municipal regulations that may be applicable to this type of industry. It is the responsibility of each business to know and comply with all applicable federal, provincial and municipal regulations.

This document aligns with the pollution prevention principles outlined in the Canadian Environmental Protection Act. These principles place priority on reducing, eliminating or preventing pollution at its source. In general, the options for minimizing waste production and potential pollution should take priority as follows:

1. **Elimination** – Where feasible, eliminate generation of waste in the first place (i.e. substitution for environmentally friendly products, adjust process design)
2. **Reduction** - Reduce waste at the source by making changes to materials and procedures
3. **Re-use/recycle** - Recycle or treat waste generated and recover material that has value from the waste
4. **Proper disposal** - Dispose of generated waste through the appropriate waste streams

## 2.0 Regulations

The objective of applicable federal, provincial and municipal pieces of legislation is to protect people and the environment from substances of concern used in the metal plating industry. Common substances of concern may include heavy and precious metals, caustic and acidic solutions, chelating agents, oils and solvents.

The regulations listed below are a summary of some, but not all, guidelines and requirements that may apply. This regulation list is for information purposes only and reference to the actual legislation document is recommended.

### 2.1 The City of Calgary regulations

**Wastewater Bylaw Number 14M2012** (from now on referred to as Wastewater Bylaw) is a City of Calgary bylaw that allows the municipality to regulate wastewater. This bylaw sets concentration limits for contaminants found within metal plating wastewater. There are multiple sections addressing contamination limits within this bylaw. These sections include but are not limited to:

#### Schedule A

- This section lists substances that should not be released into the wastewater system in any concentration. An example of prohibited substances relevant to metal plating operations includes:
  - (a) a substance that will cause an adverse effect
  - (k) wastewater having a pH of less than 5.5 or greater than 10
  - (n) corrosive or toxic wastewater that will cause an adverse effect
  - (r) hazardous substances
- **Schedule B**
  - This section states concentration limits for inorganic, metals and organic contaminants.
- **Schedule C**
  - This section outlines concentration limits for substances for which a surcharge fee may be applied if limits are exceeded.
- **Section 35: Release Reporting**
  - This section outlines the notification requirements that must be followed following a release of a substance into the wastewater system in contravention of the wastewater bylaw.

**Stormwater Bylaw Number 37M2005** (from now on referred to as Stormwater Bylaw) is a City of Calgary bylaw that allows the municipality to regulate storm drainage, including discharges to the storm water collection system. Sections include but are not limited to:

- **Section 2 (t)**
  - “Prohibited Material” means any substance that may, directly or indirectly, obstruct the flow of water within the storm drainage system or may have an adverse effect and includes, but is not limited to:
    - Hazardous substances
    - Industrial waste
- **Section 4**
  - No Person shall Release, or allow to be Released, any Prohibited Material into the Storm Drainage System unless permitted in Subsection (3)
- **Section 5**
  - This section outlines the notification requirements that must be followed following a release of a substance into the storm drainage system in contravention of the Stormwater Bylaw.

## 2.2 Provincial regulations

**Environmental Protection and Enhancement Act** supports and promotes the protection, enhancement and wise use of the environment while recognizing the need for economic growth and sustainable development as well as other factors.

**Wastewater and Storm Drainage Regulation** is an Alberta regulation under the Environmental Protection and Enhancement Act that addresses wastewater discharge and storm drainage.

- **Section 7**
  - Owners of wastewater or storm drainage systems are not permitted to use or dispose of substances into the wastewater or storm drainage system in an amount, concentration, level or rate of release that may hinder the integrity, operation or quality of the treated materials within these systems.

## 2.3 Federal regulations

**Fisheries Act** is a Canadian regulation that focuses on protecting the productivity of commercial, recreational and Aboriginal fisheries through regulating construction, impact and wastewater discharge.

**Canadian Environmental Protection Act** is one of the most important environmental laws in Canada as it protects the environment as well as the health and well being of Canadians. A major part of this Act is to sustainably prevent pollution by addressing wastewater discharge and dangerous chemical substance exposure.

Specifically related to the metal finishing industry, Environment Canada regulation SOR/2009-162 requires limiting surface tension of the plating solution by using a tensiometer or stalagmometer. This regulation also includes specific regulations pertaining to air emissions.

## 3.0 Industry overview

### 3.1 Metal plating process

Prior to actual plating, the workpiece will typically require some level of surface preparation and treatment. This may include grinding, polishing and degreasing (usually a solvent). Other types of surface treatments may require the parts undergo heating, cooling, alkaline or acid cleaning.

Following surface preparation, parts may need to go through anodic treatment to further clean the surface and promote adhesion of coatings. The last step of the process is plating the object with the desired metal. Electroplating uses electrodeposition to apply a thin metal coating. This process is done by passing an electric current through a solution containing dissolved metal ions and then placing the workpiece into the solution. The workpiece is typically placed on racks or in barrels then moves through the process tanks. Each individual process tank is usually followed by a rinse tank that acts to remove the solution from the workpiece and prevent solution carryover into the next process tank.

During metal plating, materials are commonly coated with copper, nickel, chromium, brass, zinc and cadmium. Common processes within the metal finishing industry and their associated pollutants of concern are presented below in Table 1.

Process	Common contaminants
Machining	Spillage of oil or cooling water, metal fragments
Cleaning and Surface Preparation <ul style="list-style-type: none"><li>Alkaline/Acid Cleaning</li><li>Paint Stripping</li><li>Solvent Degreasing</li></ul>	Rinse water with high/low pH, heavy metals
Plating and coating <ul style="list-style-type: none"><li>Electroplating</li><li>Electroless Plating</li><li>Mechanical Plating</li><li>Chemical Coating</li><li>Hot Dip Coating</li></ul>	Rinse water containing high/low pH, heavy metals, precious metals, acids, chelating agents
Anodizing	Rinse water with high/low pH, heavy metals, caustic and acidic solutions
Etching and Chemical milling	Rinse water with high/low pH, heavy metals, caustic/acidic solutions

*Table 1. Sources of Contaminants*



## 3.2 Wastewater treatment

The metal finishing process can produce several undesirable by-products including air emissions, wastewater, and hazardous solid wastes. Treatment of wastewater in this industry typically involves chemical processes as the contaminants of concern are generally toxic and highly resistant to biological treatment.

### Neutralization

The production of acidic and/or basic wastewaters in the metal plating process may be due to cleaning, manufacturing or waste treatment processes. Neutralization can be done either as batch or continuous process depending on the amount of wastewater generated. The mixing of highly acidic and basic solutions must be done with caution due to the potential generation of heat and toxic gases.

Wastewater with high pH can be neutralized by the addition of acids such as sulfuric or hydrochloric acid. Gaseous forms of carbon dioxide or sulfur dioxide can also be introduced into the water to reduce pH. Low pH wastewater can be neutralized by calcium or magnesium oxide, calcium or magnesium hydroxide, sodium hydroxide or soda ash.

### Common metal removal

Common metals (cadmium, chromium copper, lead, nickel and zinc) generated from electroplating and metal finishing can be removed by hydroxide precipitation. Optimal pH for precipitating the common metals will be dependent on which specific metal you are targeting. If the waste stream contains two or more metals that require significantly different optimal pH levels, then a two-stage operation may be required. A mixing unit of some kind paired with a coagulating chemical or polymer will also encourage coagulation, flocculation and sedimentation. A final pH adjustment may also be required to mitigate the high pH created by the treatment chemicals.

Once precipitated the metals can be removed through settling. Some type of filtration using sand or mixed media filter can also be used to dewater sludges. It is important to note that these metal sludges would classify as hazardous waste and thus require appropriate handling and disposal.

### Complex metal removal

Complex metals are generally found in waste streams from electroless plating and immersion plating. Complex metals have a lower tendency than common metals to form precipitates and settle out. They may have reacted with ammonia or citrates, tartrates, quadrol and EDTA. Since these metals will not be effectively removed by hydroxide precipitation, complexed metals should be kept separate from other metal waste streams. Some treatment processes to deal with complex metals include; treatment through high pH precipitation, chemical reduction or sulfide precipitation.

## 4.0 Education materials

### 4.1 Employee education

Investing in staff can provide many benefits such as improved motivation and productivity, improved health and safety and reduced material losses. It can also provide an important awareness of relevant and/or changing regulatory requirements.

### 4.2 Materials storage and disposal

Chemical storage containers should be impermeable, resistant to stored materials and be subject to regular visual inspection. Secondary containment for storage of hazardous chemicals provides added protection for both your employees' safety and the environment. Documented procedures should be in place to control processes within the operation that have the potential to impact the environment. A preventative maintenance program should encompass all related facility processes.

All spent plating baths, solvents and chemicals should be contained appropriately and disposed at an [Alberta Environment and Parks approved facility](#).

### 4.3 Spill response

It is important to train all staff in the correct steps and procedures to follow when dealing with a spill. Instructions should be posted in the workplace and appropriate spill response equipment should be made available. The contents of a spill kit will depend on the requirements of each individual operation. Some examples of items that may be found in spill kits includes:

- Protective clothing and equipment
- Absorbent materials such as sand, sawdust, absorbent pads, kitty litter, mops, brooms and rags
- Brooms, shovels and dustpans to clean up the absorbent materials
- Portable barriers or storm drain covers to prevent spills from entering the storm drainage system

During a spill it is important to act quickly to prevent wastewater from entering any nearby storm drain. Spills entering the storm drainage system could have adverse effects on the local environment. The City of Calgary Wastewater Bylaw section 35 requires the person who released or allowed the release of wastewater to notify:

- The 9-1-1 emergency telephone number
- The City by calling 311 and emailing the Industrial Monitoring Group at [IMG@calgary.ca](mailto:IMG@calgary.ca)
- The owner of the premise where the release occurred
- Any other person that may be affected by the release

### 4.4 Records

As required in section 26 (4) of the wastewater bylaw, a written record of all maintenance, cleaning and inspections of your pre-treatment system must be kept on file for a minimum of

two years. An [example of a pre-treatment record form](#), shown in Appendix A, can be downloaded from [calgary.ca/IMG](http://calgary.ca/IMG).

## 5.0 Information on minimizing waste

### 5.1 Surface preparation

The first step to begin reducing the amount of surface preparation waste (prior to plating) is to identify the degree of cleaning and surface preparation that is required. It may also be worthwhile to investigate what can be done to minimize surface contamination in the first place. Surface contamination may be introduced during manufacturing, machining or handling. Identify what actions can be taken at each stage to reduce surface contamination and thereby reduce the extent of surface cleaning and preparation needed. This will reduce the amount of cleaning agents required. If possible, consider using alternative low environmental impact cleaners with an extended life. It may be possible to completely remove the use of solvents by using water and non-toxic detergents, heating and agitation.

#### Phosphatizing

Phosphatizing is a bath solution process that helps to prevent corrosion and prepares the surface of the metal for coating. Water usage in the phosphatizing process can be reduced by monitoring and modifying the temperature, chemical concentration, pH level and rate of recirculated rinse water. High concentrations of phosphorus can be deleterious to the receiving environment. To reduce the phosphorus concentration, consider using alternative acids to phosphoric acid. The dragout reduction techniques described later in section 5.3 would also apply to this process.

### 5.2 Rinse waste

The metal coating process takes place using metal plating baths in conjunction with cleaning and rinsing baths. Rinsing and cleaning is required to remove plating solutions/cleaners from the workpiece. The primary source of wastewater is generated during the rinsing and cleaning process. Up to 90% of the wastewater discharged from a plating operation comes from rinsing workpieces. Rinses that are agitated improve the efficiency of the rinsing process and reduce the required contact time. Effective agitation methods can include:

- Air pumped into the bottom of the tank
- Ultrasonic agitation
- Mechanical agitation
- Forced water agitation

### 5.3 Dragout

A film of contaminants that are carried from the process/cleaning solution into the rinse tank is commonly referred to as “dragout”. Dragout is a significant concern due to chemical loss, water treatment requirements and the potential large amount of water required to remove this film. The dragout contaminants may end up concentrating in the rinse tank. Rinse water containing these contaminants should not be discharged into the wastewater or stormwater system.

There are several methods that can be employed to effectively reduce dragout. This can include changing viscosity, chemical concentration, surface tension, speed of removal and temperature. Some actions that can be taken to minimize dragout include:

- Slowing down workpiece withdrawal speeds;
- Adjusting workpiece position and design of racks;
- Optimizing orientation of work for drainage (especially if they contain holes, threads, etc.);
- Staggering parts so dripping from one piece to another is reduced;
- Increasing drainage time of the work over the plating tank (10 seconds minimum, optimally allow 20-30 seconds for adequate drainage);
- Mechanical recovery and return of drag-out solution;
- Using low volume atomized spray rinsing to wash films back into plating tank without adding a significant volume of rinse water to the tank;
- Air-mixing in rinse tanks: increasing turbulence in the rinse tank helps to remove the dragout solution from crevices of the workpiece; and
- Improving rinsing practices.

### **Dragout recovery**

Recovery of dragout can be achieved using a series of one or more air agitated non-flowing rinses placed between the process and rinse tanks. The goal of these air agitated recovery tanks is to reduce or eliminate dragout from entering and contaminating the rinse tank. The more recovery tanks used the lower the loading to the rinse tank. The metal concentration in the dragout recovery tanks will continue to increase over time. It may be possible to recycle this concentrated solution back to the process tank or it may need to be disposed of at an approved waste handling facility as referenced in Section 4.

Dragout recovery can reduce dragout losses by up to 50% or more. Two stage dragout can reduce losses by 70% or more and multiple drag-out tanks can eliminate dragout losses completely. Simple solutions include the use of drain boards or electrochemical metals recovery technology. In electrochemical recovery, as in electroplating, metal plates out of the dragout solution onto a cathode. Recovery units reduce the polarization of the cathode to increase metal recovery from dilute solutions. Active bath maintenance is a key component to an effective recovery system. Other more advanced recovery strategies can include ion exchange, reverse osmosis, electrodialysis and evaporation. The implementation of recovery systems can become quite involved and costly. Dragout recovery technologies are usually only considered once all low-cost water and material conservation practices have been utilized.

## **5.4 Plating bath concentration control**

Plating bath concentrations should be regularly monitored and maintained, with concentrations being kept at the minimum levels. Keeping plating bath concentrations at the minimum level possible will help to reduce chemical loss due to dragout. Measured, additional chemical should be added slowly and only as required to avoid large fluctuations in bath concentrations.

Extending the life of plating baths will reduce the amount of chemical waste produced. An important part of extending the life of the plating bath is a good understanding of what causes degradation of the baths. Some practices that may help extend plating bath life includes:

- Filtering to remove particulates;
- Skimming impurities from bath surface;
- Removing workpieces that have fallen into the bath; and
- Reducing the formation of hard water salts by using de-ionized water in the plating and process baths.

Plating baths or any process solutions should never be directly disposed of into the wastewater or storm system. These solutions may contain a variety of hazardous aqueous and solid wastes.

## 5.5 Water conservation

Water rinsing is required to ensure that the finished piece is clean and ready for final treatment. A key component to conserving water is ensuring the proper design of the rinsing set up in the plating process. Rinsing quality can be determined by comparing the concentration of metal in the proceeding process tank to its concentration in the final rinse tank. Actions that can be taken to conserve water include:

- Using a dead rinse that concentrates plating bath pollutants;
- Using countercurrent, cascaded rinses;
- Using electrolytic recovery, membranes, adsorbents to separate metal impurities from plating and rinse baths;
- Measuring and controlling the flow to prevent overuse. Use flow meters with valves to control when flow needs to be adjusted for different types of parts. Flow restrictors can be used if the parts load is consistent;
- Installing conductivity controls that adjust rinse flow dependent on the purity of the rinse water and turn rinse flow on when water purity decreases;
- Installing timers and solenoid valves when throughput parts are steady but intermittent; and
- Treating and reusing rinse water. Reverse osmosis and electro dialysis can be used when recycling water or if high rinse water purity is required.

The options listed above can also be advantageous in extending the life of process solutions which results in both a cost savings and reduction in discharge of pollutants.

## 5.6 Chemical usage

A few options that can be implemented to reduce chemical usage include:

- Using an automated electroplating system to help reduce chemical usage;
- Installation of an ultrafiltration system;
- Installation of an alkaline and steam degreasing system to reduce solvent use and waste; and
- Using a closed cooling system;

Other sources of potential chemical waste may include spillage and leakage from filtration systems and overflowing process tanks. All spent process solutions should be collected and disposed of at an approved facility

## 6.0 Inspections and enforcement

City of Calgary Industrial Compliance Inspectors carry out inspections of metal plating facilities and may request records with regards to maintenance and cleaning of wastewater pre-treatment systems. Samples may also be taken to verify compliance with wastewater bylaw 14M2012. Should any non-compliances be noted the City will work with the business to determine root causes and identify the best way to achieve compliance.

**As per the disclaimer, the intent of this document is to act as a guidance document only. All applicable federal, provincial and municipal legislation and regulations shall take precedence.**

### For more information

An educational handout sheet, included in Appendix B, can be downloaded from [calgary.ca/IMG](http://calgary.ca/IMG).

For more information regarding compliance information for metal plating operations, please contact the City of Calgary at 311.

# Appendix A: Information handout

Zoom in (Ctrl+Plus)



## Metal Plating Wastewater Information Handout

Metal plating facilities must adhere to The City of Calgary Wastewater Bylaw 14M2012 and The City of Calgary Stormwater Bylaw 37M2005. Use these tips to comply with regulatory requirements, lower fees and protect your business, the community and the environment.

### Substances of concern

Plating processes can produce several undesirable by-products including air emissions, wastewater, and hazardous solid wastes. Waste reduction should be the goal in this industry as the contaminants of concern are generally toxic and highly resistant to biological treatment.

Substances of concern	Sources
Metals	Plating baths and rinse water containing heavy and precious metals
Solids	Metal shavings/particles, paint, dirt, grime
pH	Caustic and acidic chemicals from cleaning and treatment processes

### Waste reduction and pre-treatment options

Prior to surface refinishing it is important to take steps to minimize surface contamination of the object. This will reduce the need for cleaning and chemical usage during surface preparation.

### Rinse Water

It is estimated that up to 90 % of wastewater discharged from plating operations comes from the rinsing stage. Rinse tank contamination can be reduced by changing plating bath viscosity, chemical concentration, surface tension, speed of removal and temperature. Agitating rinse tanks can improve the efficiency of the rinsing process and reduce the required contact time. Recovery tanks can also be installed to reduce potential for contamination of the rinse water.

### Neutralization

Neutralization of acidic and caustic wastewater can be done either as batch or a continuous process depending on the amount of wastewater generated.

### Wastewater Treatment Options

Common metals (cadmium, chromium copper, lead, nickel and zinc) generated from electroplating and metal finishing can be removed from water by hydroxide precipitation. Complex metals treatment options may include high pH precipitation, chemical reduction or sulfide precipitation. All spent process solutions should be collected and disposed of at an approved facility.

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### What to do if you have an accidental release

In the event of an unintentional release it is important to act quickly to prevent the material from entering the wastewater or stormwater system.

The Wastewater Bylaw section 35 under "Release Reporting" requires the person who released or allowed the release to notify:

- The 9-1-1 emergency telephone number.
- The City of Calgary by contacting 311 as well as the Industrial Monitoring Group at [img@calgary.ca](mailto:img@calgary.ca)
- The owner of the premise where the release occurred.
- Any other person that may be affected by the release.

For any spills that could harm the environment you will also need to report the spill to Alberta Environment.

### Restricted substances (Wastewater Bylaw 14M2012)

The table below outlines some of the substances that may apply to metal plating operations. For a complete list of substances please refer to Schedule "B" in Wastewater Bylaw 14M2012.

Substance	Concentration Limit (mg/L)
Aluminum	50
Cadmium	0.7
Chromium	3
Cyanide	1.2
Copper	2
Iron	50
Nickel	2
Tin	5
Zinc	2
Methylene Chloride	0.09

For more information please contact 311 or the Industrial Monitoring Group at [img@calgary.ca](mailto:img@calgary.ca)

### Wastewater Bylaw 14M2012 Fines for Non-Compliance

#### Schedule "A" Prohibited Substances

The following must not be released into the wastewater system:

(k) wastewater having a pH of less than 5.5 or greater than 10;

(n) corrosive or toxic wastewater that causes or will cause an adverse effect.

#### Release of Substances

22 (1) (a) A person must not release or allow the release of any wastewater that contains a prohibited substance into the wastewater system

Specified Penalty \$3000

35 (1) Failing to immediately notify the proper authorities in accordance with subsection 35 (1) where a substance is released into the wastewater system in contravention of the Bylaw

Specified Penalty \$1000

#### Records Maintenance

26 (4) (b) Failing to maintain a maintenance schedule and record of each maintenance for the pre-treatment system installed at a premises for a period of two years, including records for disposal of waste residue

Specified Penalty \$500



## Appendix B: Example of record keeping form



### Pre-treatment Maintenance Record

A written record of all maintenance, cleaning and inspections of your pre-treatment must be kept on file for two years. The form below is available at [calgary.ca/IMG](http://calgary.ca/IMG)

Business name: \_\_\_\_\_ Business Address: \_\_\_\_\_

Date of Inspection	Cleaned Yes/No	Contractor used Yes/No	Contractor name (if applicable)	Disposal location	Condition of interceptor (good, fair, poor)	Sludge or Sediment layer (%)*

\*\*Solids should not be more than 25% in the final chamber.