

MANAGEMENT OF SUBSTANCES HAZARDOUS TO HEALTH

Guidelines for the  
**Safe use of chemicals in  
Electroplating**

and related industries

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# 1. Introduction

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## 1.1 Purpose

The purpose of these guidelines is to identify the chemical hazards associated with the various processes in electroplating and related industries and the precautions that should be adopted for the safety and health of all personnel involved in these processes. It will establish safe work practices that will reduce the potential for exposure of workers.

A summary of the Health and Safety in Employment Act 1992 as it affects these workplaces is included as appendix 1.

A copy of these guidelines should be readily available to all employees so that they are able to follow the recommended work practices and are aware of the dangers and related safety procedures.

## 1.2 Definitions

### *Electroplating methods*

**Electroplating** When a metallic salt is dissolved in water it dissociates to form electrically charged ions. By passing a DC electric current through the solution, positive ions migrate to, and are deposited on, the negative electrode, causing the article to be plated. Such a process is known as electroplating.

**Anodising** This process is related to electroplating. It uses similar plant and equipment and gives rise to similar hazards. The process involves the anodic oxidation of metals, usually aluminium. In this instance, the metal concerned is the anode and undergoes surface oxidation by the oxygen liberated there. Two methods are employed: one uses sulphuric acid as the electrolyte, the other chromic acid.

**Electroforming** The electrode position of a metallic coating within a mould.

**Electroless plating** The deposition of a metal from a solution of its salts by a reduction/oxidation reaction rather than by electrical power.

**Barrel plating** The electroplating of small components by rotating in a submerged or partially submerged barrel. Electrical contact is provided by a dangling contact in the barrel covered by the parts to be plated.

### *Pre-treatment processes*

The purpose of these processes is to ensure that grease, dirt, oxides, other solutions and scales are removed from the surface of the base metal before the coating stage.

**Solvent degreasing** Generally, this process involves the use of the chlorinated hydrocarbons (usually trichloroethylene or perchloroethylene) in either heated liquid or hot vapour form (vapour degreasing).

**Alkali cleaning** Electrolytic cleaning with alkalis may be used instead of vapour degreasing. The common electrolyte used is sodium carbonate.



**Acid dipping** This process involves the use of mineral acids, mainly hydrochloric and sulphuric acids.

***Some commonly used terms***

**AC** Abbreviation for alternating current. This is electric current which reverses direction periodically, usually many times a second.

**Anode** The anode is the positive electrode in an electroplating or anodising solution.

**Cathode** The cathode is the negative electrode in an electroplating or anodising solution.

**Cell** Vessel containing electrodes for current generation or electrolysis.

**Current density** The current density is the amount of electricity measured in amps per unit area of work to be processed and is expressed as amps per square decimetre.

**DC** Abbreviation for direct current. This is electric current which flows in one direction only, as opposed to alternating current.

**Electrode** Conductor through which electricity enters or leaves an electrolyte, gas, vacuum or other medium.

**Electrolyte** Solution able to conduct electric current, especially in an electric cell or battery.

## 2 Related legislation

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These guidelines cover the approach to be taken to reduce the risk associated with the use of chemicals in the electroplating and associated industries. They are not comprehensive and should be read in conjunction with more general legislation, codes and guidelines that are relevant to the industry. A summary of the Health and Safety in Employment Act 1992 is given as appendix 1 with other relevant legislation and references set out in appendix 2.



## 3 Plant design

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All new plant should be designed to provide the safest working conditions possible. With existing plant, steps must be taken to identify, assess and then take the appropriate steps to control hazards. Where an assessment indicates that there is an immediate threat to health or safety, action to control the hazard should be taken without delay.

All employees should have the opportunity to be involved in hazard identification and assessment. The person ultimately responsible for the assessment and control of hazards should be a competent person with knowledge of the electroplating industry and an understanding of the principles of occupational health and safety.

### 3.1 Managing hazardous substances

In deciding on the control needed for the management of hazardous substances, the following steps should be undertaken:

(a) Identify all substances that may be hazardous to health.

Note: where an electroplating product contains several substances, all of the major constituents should be identified.

(b) Compile information on the health hazards associated with each of the substances identified. In many cases this can be obtained from a material safety data sheet (MSDS) for the product, but where this is not available further information should be sought from the supplier.

(c) Look at how the substances are used in the workplace.

(d) With knowledge of the health hazards associated with the substances, and information on how they are used in the workplace, assess the adequacy of the control measures that are in place. In some instances it may be necessary to measure the actual exposure experienced by the workers before this step can be completed.

(e) Where necessary, modify or put controls in place bearing in mind that the HSE Act requires that elimination and then isolation be considered before controls that minimise a hazard. An expanded hierarchy of control applicable to hazardous substances is: elimination, substitution, engineering control (including isolation), administrative control and finally personal protective equipment.

#### 3.1.1 Elimination/substitution

It is not envisaged that completely eliminating hazardous substances from a process would often be possible. However, consideration must be given to the substitution of a hazardous substance or process with a less hazardous one — e.g, the replacement of a degreasing process that uses solvents by a water-based pre-treatment process. When considering possible substitutions, care must be taken to ensure that the replacement does not simply result in swapping of one hazardous substance for another.

#### 3.1.2 Isolation/ minimisation

Completely isolating a plating process from the workers is unlikely to be practicable, therefore minimisation in the form of efficient local exhaust ventilation is normally considered to be the preferred control option. Emission control for plating operations has generally been developed



with chromium plating in mind. While this section follows that trend, the principles can be equally applied to other potentially hazardous plating processes.

## 3.2 Engineering controls for plating tanks

In a chromic acid tank, the electrical efficiency of the chromium plating process is relatively low, resulting in the formation and release of hydrogen in the form of small bubbles from the cathode. The breaking of these bubbles at the surface is responsible for the generation of chromic acid mist. A range of control systems are available to limit the release of the chromic acid mist into the workplace air. These include exhaust ventilation, mist suppressants that modify the surface tension of the solution, and small plastic balls referred to as chroffles.

The use of mist suppressants or chroffles on their own is not encouraged and exhaust ventilation would normally be considered necessary for chromium plating. The humidity and the corrosive nature of the atmosphere in a plating room makes it desirable to apply exhaust ventilation to other plating processes — even if this is only to protect the structure of the building.

### 3.2.1 Exhaust ventilation

Exhaust ventilation should be established in accordance with the following principles:

- Extraction points should be located as close to the potential hazard as practicable.
- Random air draughts around the tank should be prevented or shielded but adequate make-up air should be supplied so that the ventilation plant operates at its required capacity and clean air is drawn past the operator.
- Air intakes should not draw contaminated air from an air outlet. No recirculation of exhaust air should be permitted.
- Ducting should be constructed of corrosion-resistant, crack-resistant material damped from excessive vibration and should avoid sharp changes in direction.
  - Extraction fan components, such as fan blades and bearings, should be constructed from corrosion resistant materials.
- An effective inspection and maintenance schedule should be set up for all ventilation plant.
- The ventilation system should be sufficient to ensure that the recommended capture velocity (0.5 metres/second) is maintained at the point of emission.
- Exhaust ventilation requirements differ according to the type of plant. The best practicable system that will minimise the contaminant concentration without interfering with the operator's access to the solution should be used.
- Exhaust ventilation systems should be designed using the latest available technology. Lip extraction, push-pull systems, or partially enclosed hood systems are all suitable and choice will be dictated by the plant design. The system should be designed so that fresh air is supplied to and contaminated air is drawn away from the operator.
- Diagrams showing some of the principles of exhaust ventilation for open surface tanks and preferred designs of ventilation systems are given in appendix 4.
- Air emissions from electroplating plants must conform with regional council requirements.



### 3.2.2 Free-board on tanks

Losses from plating tanks can be limited by maintaining a reasonable free-board, i.e. the distance between the surface of the plating solution and the top of the tank. A free-board of 350 mm is recommended.

### 3.2.3 Mist suppression

Where a mist suppressant is used it is important to ensure that the concentration is maintained at an effective level. This requires regular additions of the suppressant to the tank.

### 3.2.4 Temperature control

The temperature of all tanks requiring control should be kept within the limits set down by the product manufacturer or supplier.

## 3.3 Vapour degreasing tanks

With degreasing tanks, the correct operation of the condensing coils and the amount of free-board are important considerations for minimising vapour release. However, the siting of the tanks within the plant to achieve adequate ventilation, but avoiding drafts, must also be considered. For further information on vapour degreasing, refer to the *Code of Practice for Vapour Degreasing Operations*, Department of Labour 1984.

## 3.4 Floor drainage and waste disposal

The floor of every electroplating room should be made of an impervious material e.g. concrete or asphalt, and be uniformly sloped to floor drains, which lead to the disposal system.

Tanks should drain, as far as practicable, directly into floor outlets. The effluents from electroplating plants must conform with local authority requirements.

## 3.5 Walkways

The danger of employees slipping on wet floors near tank operations is very real. This can be reduced by using non-slip surfaces.

Where the floor in plating shops has to be kept wet, elevated board platforms should be installed. These should be well maintained and low enough so that workers are not at risk of falling into tanks. Prompt attention should be paid to faults as soon as they occur.

## 3.6 Tanks

If the edge of a tank containing a liquid is less than 1 metre above the floor or platform, the tank must be either securely covered, or fenced to a height of at least 1 metre.

### 3.7 Electrical safety

Electrical installations should meet the requirements for wet situations as required by the current Electrical Wiring Regulations. Unless properly controlled, the combination of electricity, water, damp and corrosive conditions can be lethal.

A regular survey of the electrical system and the equipment which is or may be connected to it should be carried out. This will entail the physical inspection of the system and its equipment, and appropriate testing to determine its condition and suitability for use, carried out by a competent person. An adequate survey will identify problem areas of the system and equipment/conditions needing attention. It will also enable a programme of remedial work to be prepared and prioritised.

With hard anodising and other processes where voltages of 50 - 200V may be used, equipment must be protected against accidental contact. This must include covering and/or guarding all electrical contacts and connections which are within reach and are not covered with insulating materials.

### 3.8 Lighting

Lighting should be by natural light so far as is reasonably practical. Good lighting is important, particularly when vision is restricted by the use of protective equipment such as visors, full-face respirators or safety glasses. Lighting should be appropriately selected, properly maintained and replaced where appropriate. Specific requirements for lighting in plating shops are set out in table B1 of NZS 6703:1984 *Code of practice for interior lighting design*.



## 4 Safe plant operation

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A large variety of substances are used in electroplating and other industries. They are all potentially hazardous, so to avoid problems, safe working procedures are essential. No drums of chemicals should be handled until suppliers' and/or manufacturers' instructions have been issued to, and understood by, those going to do the work.

Appendix 5 lists substances commonly used in electroplating, along with the possible biological effects associated with exposure to these substances.

### 4.1 Material safety data sheets

Every chemical manufacturer or importer should produce and make freely available an up-to-date material safety data sheet (MSDS) for each of the products it supplies.

A properly completed MSDS will provide essential information about hazardous substances and how to use them safely without harmful effects to workers or the environment. It should provide easily understood advice, in a standard format, about the hazards of the material, precautions for use, emergency procedures, and safe handling practices.

Employers should make the MSDSs readily available to all workers and ensure that information relevant to the safe use of hazardous substances is conveyed in a way that can be readily understood. In some cases this will require the information from an MSDS or other source being interpreted and put into context of its use in the plant. One recommended format for this is the product safety card outlined in the *Guidelines for the Preparation of Material Safety Data Sheets* in this series. An example of a product safety card is given in appendix 6.

### 4.2 Labelling

All containers should be clearly labelled at all times with sufficient information to allow the safe use of the product they contain.

### 4.3 Storage of chemicals

Chemicals must be stored in a cool, dry, well-ventilated place. All containers should be clearly labeled and stored off the floor. Regard must be given to the provisions of dangerous goods legislation.

The basic principle that should be applied to the storage of plating chemicals is to segregate incompatible substances. In particular, separate:

- Cyanides from acids; and
- Oxidising agents (e.g. chromium trioxide) from combustibles.

Highly toxic materials such as cyanides should be locked away. Eating, drinking and smoking should not be permitted in areas where chemicals are stored or used. The access to hazardous substances should be limited to as few people as practical.

## 4.4 Handling hazardous substances

An inventory of substances and the amounts held should be kept in a readily accessible location. It may be advisable to keep minimum stocks of various substances depending on the supply. The safest practicable procedure should be used to handle or transfer hazardous substances. For example:

- Wherever possible, use a suitable drum pump to transfer liquids from containers to tanks. Where substances have to be mixed, additions should be made slowly and with constant mixing.
- ALWAYS add acids to water and NOT the reverse.
- When handling solid substances, local exhaust ventilation should be used. This is particularly important when toxic substances such as cadmium salts are being handled. Use a scoop to transfer solid materials.

Before moving containers, check that the lid or bung is firmly fixed and that there are no leaks. Transfer the contents of damaged drums to clean, sound containers, suitably labeled and sealed. It is particularly important to ensure that cyanide and acid containers are well identified (inadvertent mixing of cyanide and acid can have fatal consequences). Further information on corrosive chemicals can be obtained from the booklet *Safety with Corrosive Chemicals*, Department of Labour 1988.

## 4.5 Drum handling

When handling corrosive chemicals the weight of the container and the distance to be transported should be taken into consideration. The risk of spilling corrosive liquids is reduced by ensuring that the employee is working within his physical capabilities.

If drums are moved manually, there is a risk of back injury because of the weight. Use machinery such as forklifts, chain hoists and trolleys to move drums wherever possible.

Slipping on wet surfaces is another hazard. Extreme care must therefore be taken: drums should be held in suitable clamping frameworks where possible, and protective clothing such as safety footwear (with metal toecaps), gloves, and overalls should be worn.

## 4.6 Tanks

Chemical levels should be at least 100 mm below the lip of the tank to reduce spillage over the sides. (Note: for plating and degreasing tanks the free-board recommended to reduce mist or vapour losses is greater than 100 mm — see section 3.2.2.) Tanks containing any strong acid, strong alkali, degreasing fluid, chromium or cyanide solution should be clearly labeled and covered when not in use.

## 4.7 Confined spaces

In working inside tanks and other containers, the hazards associated with confined spaces must be considered. This is particularly important during operations such as cleaning sludge from tanks that have contained cyanide. Procedures for working in confined spaces are outlined in the OSH publication *Safety in Confined Spaces*.



## 4.8 Administrative control measures

Administrative control offers a way to reduce the duration or intensity of an individual's exposure to a hazardous substance through such measures as:

- Workplace organisation that limits the time a worker spends in a contaminated area;
- Job rotation to reduce the period of exposure for employees;
- Prohibiting eating, drinking and smoking in contaminated areas; and
- Ensuring all unnecessary contact with hazardous substances is minimised.

To ensure the safety of visitors to the plant, entry to processing areas should be strictly controlled.

## 4.9 Personal protection

### 4.9.1 Employer and employee responsibilities

Employers have a responsibility to provide and maintain protective clothing and equipment, and to ensure that it is used in the appropriate manner.

Employees have a responsibility to use the protective equipment and clothing provided.

### 4.9.2 Protective equipment

#### ***Gloves***

The gloves provided must be appropriate for the operation e.g, manual platers' gloves should be elbow-length, and should be made of an impervious material such as PVC. They should be personally issued to each worker whenever possible, and the correct size, to ensure that they do not reduce dexterity.

Cotton linings can prevent heat discomfort from perspiration, and should be changed and washed daily for maximum comfort.

A suitable place to store gloves when not in use should be provided. However, some should be permanently sited near hazardous operations e.g, degreasers and bright dips.

#### ***Clothing and face protection***

Overalls must be provided and changed regularly to prevent skin contact with hazardous substances.

Impervious aprons should be worn over overalls to protect workers from splashes of tank solutions.

Suitable acid-resistant footwear with hard toe-caps should be provided.

A visor, face shield or well-fitting goggles must be worn if there is a risk of splashes on the face. Protective equipment should be washed at least daily.

Separate storage should be available for dirty and clean clothes.

Maintenance and cleaning of protective clothing should be carried out weekly, or more frequently if necessary.

#### ***Respirators***

Respirators should be available to all workers for use in:

- Spillages;
- Mixing hazardous substances;
- Handling cyanide salts for mixing; and
- Tank operations.

Respirators should not be used to replace controls that reduce the contaminant concentration at the source. Generally, they should only be used for short operations that occur infrequently; employees should not be expected to use them daily or for long periods.

Personal issue of fit-tested respirators will ensure that respirators are efficient and comfortable. It also eliminates the possibility of infection being transferred from person to person through the face piece.

Employees should be adequately trained in the safe use of respirators.

Respirators should be kept in an uncontaminated area as close as practicable to the work area where they may be needed. Emergency equipment should be stored close to the danger area in clearly marked locations, so that any rescuer can immediately find it.

The OSH booklet *Respirators and Breathing Apparatus* (1992) gives advice on the selection, use and care of respiratory protective equipment (see also AS/NZS 1715:1994).

#### 4.9.2 Personal hygiene

Even though the employer should meet the requirements of this guideline and provide a safe working environment for employees, there remains the possibility that an employee's protective clothing, skin, and hair will become contaminated with traces of highly toxic substances. To meet their obligations not to endanger themselves or others, employees should:

- Leave all protective clothing in the lockers provided; and
- Use the washing or showering facilities before eating, smoking, or leaving the site.

It is very important that employees maintain high standards of personal hygiene. Full use should be made of washing facilities to minimise the hazard caused by contact with hazardous substances.

#### *Skin*

Water alone is an effective means of washing chemicals off the skin.

To remove dirt and grease, formulated skin cleansers (germicidal and antiseptic soaps, detergents, cleansing creams) should be used rather than solvents, as they are less likely to damage the skin. Soap and water must then be used to get rid of all traces of the cleanser.

When it is not practical to wear gloves, hand washing should be routine after contact with cleaning agents and other potentially hazardous substances. At no time is it sufficient just to dry the hands without washing. This is a harmful practice which leads to the chemicals becoming more concentrated on the skin, inflicting damage more readily.

Hands should be washed thoroughly at each major work break.

Barrier creams alone are not a substitute for protective clothing, as they are the least effective way of protecting skin. The cream must be applied on clean skin at the beginning of the workshift, and removed and reapplied at breaks.

#### *Nose*

Creams, such as petroleum jelly or lanoline-based creams, may be applied to the nose as an additional protective measure against ulcers.



## 4.10 Emergency procedures for spillages

All significant spillages should be cleaned up immediately. A spill kit should be maintained for this purpose.

Employers and employees in each work place should formulate their own emergency procedures for dealing with spillages, and these should be known and understood by everyone. The procedures should cover:

- Clearing everyone from the area;
- NO SMOKING;
- NO FLAMES;
- Arranging first aid;
- Appointing someone to keep all people and traffic away;
- Alerting management;
- Alerting emergency services in the case of large spillages; and
- Requesting advice from qualified personnel on cleaning up the spillage. No attempt to wash it away or treat it should be made until this has been done. The person to contact should be listed as part of the procedure.

## 4.11 Maintenance

Maintenance procedures should be arranged to suit individual work situations.

Areas which require regular attention are:

- Exhaust ventilation equipment;
- Storage, handling and labeling of hazardous substances;
- Critical plant and process control equipment;
- Safety equipment;
- Washroom and lunchroom facilities; and
- First aid equipment.

All items should be inspected by staff as part of their daily routine, and by supervisors at least weekly.

Respiratory protective equipment should also be checked regularly before and immediately after use, so that the equipment is ready for an emergency situation.

Exhaust ventilation equipment should be fully examined and performance tested at least once a year.

Repairs or adjustments to process control on safety equipment should be carried out by qualified personnel only. The repair or adjustment of any safety-related equipment must be attended to as soon as it is found to be faulty.



## 4.12 Information and training

The training of employees is an important safety measure that must be undertaken by every employer. Training in the safe use of plant and the measures required for the employee's protection must be completed before the employee undertakes any work. Supervision by an experienced person is required until the employee gains adequate knowledge and experience to be able to do the job safely.

The initial training should include the following aspects:

- Safe work procedures, methods, and practices making reference to MSDSs and relevant publications where applicable;
- The correct procedures to be followed if a spillage occurs;
- The adverse health effects of the substances they are exposed to. This should cover the possibility of contact with the skin and eyes, and inhalation of dusts, aerosol mists or fumes;
- The use and care of personal protective clothing and equipment;
- Emergency and first aid procedures, and the location of emergency showers and eye wash facilities;
- The importance of good hygiene practices;
- The reporting of any defects in safety devices and equipment;
- The reasons for the medical and environmental monitoring which is carried out;
- The purpose and use of exhaust ventilation equipment;
- It is important to make sure employees fully understand the information given. Retraining should be carried out periodically and whenever significant changes are made to the plant operation; and
- Instruction should be given by a supervisor or a suitably qualified person familiar with the industry.



## 5 Facilities

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### 5.1 Eye-wash facilities

Hygienic eye-wash facilities should be provided near the work area. They must be clearly sign-posted and employees should know how to use them.

By far the most effective system is a specially designed eye-wash shower which sprays water into the face. Some switch on automatically when the forehead leans on a bar, thus speeding operation when sight is impaired.

If a hose, is used it should not be long enough to touch the floor. This is extremely efficient at washing out eyes or soaking the body. A helper may be needed to administer this procedure.

Eye-wash bottles are NOT recommended. They may not contain enough water and, if both eyes are affected, are not convenient. Their contents may deteriorate even if stored unopened.

### 5.2 Showers

Showers may be used both as amenities and as emergency facilities, PROVIDED they are very close to the work area and can be reached safely in haste after a spillage. However, it is probably best to have a separate shower for emergencies in or close to the work area.

In a new plant a safety shower should be installed in the plating area and clearly sign-posted. The most important requirement is that it should be easily and safely accessible in a hurry. The area about and beneath the shower must be kept clear and must not be used for storage.

An easily operated shower where water flow starts as soon as the user steps in, is best. This should be designed so that the floor is flush with the operating mechanism.

Showers operated by a chain or lever are less desirable, since there have been occasions where, in the panic of an accident, the lever or chain has been sheared off by excessive force. The chain or lever should lock in the "on" position, so that the person has both hands free to remove contaminated clothing.

The minimum requirement for an older plant is to have several sources of clean running water around the plating area which could be used for a whole-body washdown in an emergency. These should be clearly sign-posted.

### 5.3 Eating and smoking facilities

There must be suitable and sufficient facilities provided for those who eat meals at work. In electroplating shops, the likely exposure to hazardous substances with a risk of ingestion is an obvious risk which should justify these provisions. Arrangements should be made for the facilities to be kept clean and hygienic.

Smoking and the consumption of food and drink should be permitted only in an administrative or other uncontaminated area specifically set aside for that purpose.

## 6 Health surveillance and first aid

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### 6.1 Health surveillance

Health surveillance should be used alongside prevention or adequate control of exposure, not as a substitute.

An adequate health surveillance programme is required to safeguard the health of those engaged in electroplating. A health surveillance programme should be undertaken by a nurse and/or doctor who is familiar with the workplace and the potential problems.

Health surveillance procedures include:

- Collecting, maintaining and reviewing health records;
- Checks for signs of disease;
- Pre-employment enquiries e.g. past history of asthma; and
- Pre-placement medicals when an employee first begins work in an electroplating shop.

#### 6.1.1 Pre-placement health assessment

No-one should be employed in an occupation which may either aggravate their existing health problems or create a health problem because of some underlying medical condition.

Preplacement health assessment is designed to detect these points. It also acts as a baseline against which future health assessments can be compared.

An assessment should include:

- History of previous work.
- History of previous medical problems. In particular, problems relating to skin, lungs and kidneys should be recorded and evaluated.

#### 6.1.2 Periodic health assessment

Every 3 months at least, an examination of the hands, forearms and nose of every person working in any room where a chromium plating process is carried out should be undertaken. A record should be kept of the results of this examination.

#### ***Chrome ulcers***

Examination of the nose should include the recording of any symptoms reported by the employee. The first symptoms noticed by the employee normally include bleeding or blood staining when blowing the nose. Encrustation of the nose may be noticed at a later stage.

The skin of the hands, forearms and lower legs should be examined for cracks, breaks, dryness, irritation and inflammation, or the appearance of chrome ulcers. The employee should be asked to report skin itchiness or irritation if, and when, it occurs.

Where health problems are found, the examination should be carried out more often and an assessment of environmental conditions carried out.



### 6.1.3 Individual health records

As well as medical information, recorded information for each worker should include :

- The industry the worker is engaged in (electroplating, electroforming, chromic acid anodising, sulphuric acid anodising);
- Job classification (plater, jigger, detacher, polisher, degreaser);
- The metals worked with; and
- Health problems experienced, particularly those which may be work-related (dermatitis, chrome ulcers, breathing problems).

These records should include a precise job classification to ensure useful health statistics.

Health records should not be made available to other employees without having had all personal identifiers removed.

## 6.2 First aid

After an accident or incident, correct and prompt first aid measures are essential.

At least one employee on each shift should be qualified to provide first aid measures. One person should be designated as in charge of the first aid kit.

The first aid kit should be well signposted and maintained, and near to the work area.

To ensure that rescuers are not the next victims, safety equipment should be used in the danger area during a rescue, the area evacuated and the equipment closed down.

### 6.2.1 ABC of resuscitation

1. Ensure **AIRWAY** is clear.
2. Ensure **BREATHING** is adequate.
3. Ensure **CIRCULATION** is adequate (know how to do cardiopulmonary resuscitation (CPR) and how to stop bleeding).
4. Never give an unconscious person anything to drink, and do not make them vomit.

SEEK DOCTOR, NURSE OR AMBULANCE SERVICE AS QUICKLY AS POSSIBLE.

### 6.2.2 Specific emergencies

#### *Acid or alkali on the skin*

1. Wash thoroughly with water (for up to 10 minutes).
2. Remove contaminated garments (during washing).

SEEK MEDICAL HELP

#### *Acid or alkali swallowed*

1. Drink water or milk (large amounts).
2. Do not cause vomiting.

SEEK MEDICAL HELP

***Splashes in the eye***

Act promptly.

**Wash the eye with water for 15 minutes, ensuring that it is open.** (Eye-wash equipment details are given in section 5.1.) If contact lenses are involved and they are not flushed out they may be safely removed at a later time by the worker or medical staff.

The victim **must not rub the eyes**, especially with dirty hands.

Seek medical help if corrosive chemicals are splashed into the eye.

## 6.3 Cyanide poisoning

Cyanide is extremely poisonous. Inhalation of the fumes is the gravest danger. If cyanide is mixed with acid, a very poisonous gas — hydrogen cyanide — is produced. Skin contact is less dangerous than inhalation or swallowing, but this depends on the extent of the splash and the promptness of treatment.

### 6.3.1 Signs and symptoms of cyanide poisoning

#### ***Acute cyanide poisoning***

##### *Mild*

The onset of symptoms after exposure is very rapid. Symptoms of mild cyanide poisoning include headaches, giddiness, nausea, (and vomiting if cyanide has been ingested). The person has difficulty breathing, a sense of suffocation and a feeling of general weakness with heaviness of arms and legs. Cyanide also causes irritation of the nose, mouth, and throat.

##### *Severe*

Severe cyanide poisoning may be characterised by vomiting, gasping for breath and loss of consciousness. After loss of consciousness, breathing may be weak or absent and may result in cardiac arrest and possible death.

It is noted that the signs and symptoms of fear of poisoning are similar to that of mild cyanide poisoning. These include nausea, headache, sense of suffocation and agitation.

#### ***Chronic cyanide poisoning***

The symptoms of chronic cyanide poisoning are similar to those of mild cyanide poisoning. These include headaches, dizziness, nausea or vomiting, and visual and peripheral nervous system effects. Repeated or prolonged skin contact to low concentrations of potassium cyanide dust may lead to dermatitic effects (“cyanide rash”) characterised by itching and skin eruptions.

### 6.3.2 Emergency first aid for cyanide poisoning

All personnel where cyanide or cyanide compounds are used should be well versed in emergency first aid treatment for cyanide poisoning. Current medical opinion is that antidotes (apart from oxygen) are not useful in the first aid treatment of cyanide poisoning.

All staff on site should be aware of the hazards of cyanide poisoning and the necessary first aid measures.

The local hospital, the local medical centre and the local ambulance should be notified that the workplace is a potential source of people with possible cyanide poisoning.



There should be a hazard management policy to manage the risk posed by the cyanide solutions from the time of entry on to the premises to their final disposal.

This should include proper training in:

- Handling procedures;
- The use of personal protective equipment; and
- First aid measures.

***Recommended first aid procedures for cyanide poisoning***

**Immediately** move the patient into fresh air and remove contaminated clothing.

Summon urgent medical help.

If the patient is not breathing, do not use mouth-to-mouth or mouth-to-nose resuscitation because of the danger to the rescuer of possible contamination with cyanide around the patients' mouth. Use a resuscitation bag and mask instead.

If pulse is absent, start external cardiac massage.

Give 100% oxygen by mask. This should be:

- a) readily available from medical services nearby; or
- b) kept on the premises if there are no medical services nearby.

Arrange for urgent transfer of the patient to hospital as soon as possible for professional medical care.

The specific antidotes for cyanide are recommended to be used only under experienced medical supervision, where the cause of the collapse can be unequivocally attributed to cyanide, and when the collapse is profound.

## 7 Monitoring chromium plating tanks

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Monitoring of chromium plating tanks is required to ensure that adequate control is maintained on the release of chromic acid mist. The design and implementation of a monitoring programme should be carried out by, or in consultation with, a properly qualified person.

### 7.1 Air sampling

Air sampling (the direct measurement chromic acid mist in air concentrations) is one of the techniques that can be used but simpler and less costly checks may also be effective. These include the evaluation of the local exhaust ventilation, the mist suppressant concentration and the freeboard above the liquid in the tank.

It is suggested that, initially, air sampling is performed under conditions that are likely to produce the highest chromic acid mist concentrations (e.g. highest current, longest plating time etc.). Air samples should be taken 0.3 metres above the upper edge of and over the tank using a suitable method\*. The performance of the control measures is considered adequate if the chromic acid mist level is below 0.025 mg/m<sup>3</sup>. This means that the personal exposure levels averaged over an 8-hour period should be below the workplace exposure standard of 0.05 mg/m<sup>3</sup> for chromic acid mist.

Once it has been established that the control measures in place are capable of maintaining safe levels of chromic acid mist, then monitoring the performance of the control measures is acceptable. Air sampling would need to be repeated if changes are made to the process or there is reason to believe that the last measurement is no longer valid.

\* A method that is specific for chromic acid mist may be used e.g. MDHS 52/2, *Hexavalent Chromium in Chromium Plating Mist*, 1990, Health and Safety Executive, UK. Alternatively, it may be assumed that all of the airborne chromium is chromium (VI) and a non-specific method such as collection on a filter and analysis by AAS be used. The latter procedure would overestimate the risk if chromium metal dust or mists containing chromium (II) or (III) compounds were present in the air.



## Appendices

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### Appendix 1: A Summary of the Health and Safety in Employment Act 1992

The principal object of the Health and Safety in Employment Act 1992 (HSE Act) is to prevent harm to employees at work. To do this, it imposes duties on employers, employees, principals and others, and promotes excellent health and safety management by employers. It also provides for the making of regulations and codes of practice.

#### **Regulations**

Regulations are promulgated from time to time under the HSE Act. Regulations may impose duties on employers, employees, designers, manufacturers, and others relating to health and safety. These regulations may apply with respect to places of work, plant, processes or substances and may have been made to deal with particular problems that have arisen.

#### **Approved codes of practice**

“Approved codes of practice” are provided for in the HSE Act. They are statements of preferred work practice or arrangements, and may include procedures which could be taken into account when deciding on the practicable steps to be taken. Compliance with codes of practice is not mandatory. However, it may be used as evidence of good practice in Court.

#### **Employers' duties**

Employers have the most duties to perform to ensure the health and safety of employees.

Employers have a general duty to take all practicable steps to ensure the safety of employees at work. In particular, they are required to take all practicable steps to:

- (a) Provide and maintain a safe working environment;
- (b) Provide and maintain facilities for the safety and health of employees at work;
- (c) Ensure that machinery and equipment is safe for employees;
- (d) Ensure that working arrangements are not hazardous to employees; and
- (e) Provide procedures to deal with emergencies that may arise while employees are at work.

Taking “all practicable steps” means doing what is reasonably able to be done in the circumstances, taking into account:

- (a) The severity of any injury or harm to health that may occur;
- (b) The degree of risk or probability of that injury or harm occurring;
- (c) How much is known about the hazard and the ways of eliminating, reducing or controlling it; and
- (d) The availability, effectiveness and cost of the possible safeguards.

#### **Hazard management**

Employers must identify and regularly review hazards in the place of work (existing, new and potential), to determine whether they are significant hazards and require further action. If an



accident or harm occurs that requires particulars to be recorded, employers are required to investigate it to determine if it was caused by or arose from a significant hazard.

“Significant hazard” means a hazard that is an actual or potential cause or source of:

- (a) Serious harm; or
- (b) Harm (being more than trivial) where the severity of effects on any person depends (entirely or among other things) on the extent or frequency of the person’s exposure to the hazard; or
- (c) Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.

*Where the hazard is significant*, the HSE Act sets out the steps employers must take:

- (a) Where practicable, the hazard must be eliminated;
- (b) If elimination is not practicable, the hazard must be isolated; and
- (c) If it is impracticable to eliminate or isolate the hazard completely, then employers must minimise the hazard to employees.

*Where the hazard has not been eliminated or isolated*, employers must, where appropriate:

- (a) Ensure that protective clothing and equipment is provided, accessible and used;
- (b) Monitor employees exposure to the hazard;
- (c) Seek the consent of employees to monitor their health; and
- (d) With informed consent, monitor employees’ health.

### ***Information for employees***

Before employees begin work, they must be informed by their employer of:

- (a) Hazards employees may be exposed to while at work;
- (b) Hazards employees may create which could harm other people;
- (c) How to minimise the likelihood of these hazards becoming a source of harm to themselves and others;
- (d) The location of safety equipment; and
- (e) Emergency procedures.

Employers are also required to inform employees of the results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected.

### ***Employers to involve employees in the development of health and safety procedures***

Employers need to ensure that all employees have the opportunity to be fully involved in the development of procedures for the purpose of identifying hazards and dealing with significant hazards or dealing with, or reacting to, emergencies and imminent dangers.

### ***Training of employees***

Employers must ensure employees are either sufficiently experienced to do their work safely or are supervised by an experienced person. In addition, employees must be adequately trained in the safe use of equipment in the place of work, including protective clothing and equipment.



***Safety of people who are not employees***

Employers are also responsible for the health and safety of people who are not employees. Employers must take all practicable steps to ensure that employees do not harm any other person while at work, including members of the public or visitors to the place of work.

***Employees' and self-employed persons' duties***

Employees and self-employed persons are responsible for their own safety and health while at work. They must also ensure that their actions do not harm anyone else. However, these responsibilities do not detract from the employer's or principal's responsibilities.

***Accidents and serious harm (recording and notification)***

The HSE Act requires employers to keep a register of work-related accidents and serious harm. This includes every accident that harmed (or might have harmed):

- (a) Any employee at work;
- (b) Any person in a place of work under the employer's control.

Employers are also required to investigate all accidents, harm and near-misses to determine whether they were caused by a significant hazard.

Employers are required to notify serious harm that occurs to employees while at work to the Secretary of Labour (in practice, the nearest OSH office), as soon as possible. In addition, the accident must also be reported on the prescribed form within 7 days. (Forms are included in the Workplace Accident Register available from OSH offices and selected stationers.)

If a person suffers serious harm, the scene of the accident must not be disturbed unless to:

- (a) Save life or prevent suffering;
- (b) Maintain public access for essential services e.g. electricity, gas; or
- (c) Prevent serious damage or loss of property.

The OSH office will advise whether it wishes to investigate the accident and what action may be taken in the meantime.

## Appendix 2: Relevant legislation and reference material

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### Legislation

**Health and Safety in Employment Act 1992 and regulations** — Provide basic occupational safety, health and welfare requirements in factories and undertakings. These include plant environmental controls to cover such items as ventilation, atmospheric conditions, lighting, noise, and preventive measures for dust explosions.

Other matters covered include protective clothing and equipment, storage of materials, access and egress, provision of amenities such as meal rooms, toilets, and machine guarding.

**Resource Management Act 1991** — Section 15 of the Resource Management Act requires that a resource consent be obtained for emissions to air, water or land. Further information should be sought from the appropriate regional council.

**Building Act 1991** — Local councils administer the Building Act and other legislative requirements covering items such as building construction, waste disposal, siting of industries, storage of dangerous goods and fire precautions.

**Dangerous Goods Act 1974 and regulations** — These outline detailed requirements for the storage and handling of dangerous goods.

### OSH publications

*Practical Guidelines for the Safe Use of Organic Solvents*

*Danger — Eyes at Work*

*Safety with Corrosive Chemicals*

*Safe Stacking and Storage*

*A Guide to Respirators and Breathing Apparatus*

*Approved Code of Practice for Training Operators and Instructors of Powered Industrial Lift Trucks*

*Safe Use of Electricity* (1986)

*Guidelines for the Preparation of Material Safety Data Sheets*

*Guide to First Aid Training*

*Code of Practice for Vapour Degreasing Operations*

### Related Standards

AS/NZS 1715:1994 *Selection, use and maintenance of respiratory protective devices*

NZS 6703:1984 *Code of practice for interior lighting design*



## Appendix 3: Workplace checklist

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In a well-operated plant the answer “yes” will be given to the following questions:

### Daily check

- |   |                              |                             |
|---|------------------------------|-----------------------------|
| Are aisles and passageways kept clean and dry?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the floor washed?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are all spillages cleaned up immediately?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are all aisles and exit routes free of obstructions?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is protective clothing worn by employees to prevent skin contact with corrosive substances? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is hearing protection provided and worn during noisy conditions?                            | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is eye protection worn where splashing is a hazard?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is smoking actively discouraged in the work area and forbidden near plating tanks?          | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is air monitoring conducted properly when it is necessary?                                  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are the emergency washing facilities operative?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

### Weekly check

- |   |                              |                             |
|---|------------------------------|-----------------------------|
| Are floor holes, such as drains, covered?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have all employees who work near tanks been instructed about the relevant hazards and safe practices? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is appropriate personal protective equipment provided?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is the ventilation for open surface tanks working correctly?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is employee exposure to hazardous substances minimised?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Do all containers — vats, storage drums, tanks, etc. have a legible label stating their contents?     | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are cyanides stored away from any possible contact with acids?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are drum pumps used, where possible, to transfer liquids?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are the respirators in use the correct type for the hazard?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are respirators kept close to all processes where they may be required?                               | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are eating areas and washrooms clean?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Is all electrical equipment safe and protected?   | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Have exposed wires, frayed cords, and deteriorated insulation been repaired or replaced?              | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are fire extinguishers available and accessible?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
| Are gloves personalised?  | <input type="checkbox"/> Yes | <input type="checkbox"/> No |

Is storage available for each worker's gloves and respirator?  Yes  No

Are the hose connections of plating tanks secure?  Yes  No

### Annual check

Have the weekly checks been carried out?  Yes  No

Are permanent aisles appropriately marked?  Yes  No

In wet surface areas are walkways provided or non-slip materials used?  Yes  No

Is management aware of the hazards presented by the substances used in the workplace?  Yes  No

Have employees been instructed in safe work practices?  Yes  No

Are spillage procedures and emergency phone numbers pinned up on the wall or noticeboard for easy reference?  Yes  No

Have employees been instructed in emergency first aid procedures for cyanide poisoning?  Yes  No

Is there some means of instantly rinsing the eyes in areas where acid or alkali splashes may occur?  Yes  No

Are sources of water for quick drenching available where corrosive materials are used?  Yes  No

Is at least one employee per shift a qualified first aider?  Yes  No

Are first aid supplies readily available, inspected and maintained?  Yes  No

Are medical personnel readily available for advice and consultation on matters of employee health?  Yes  No

Are employees involved in electroplating given periodic medical check-ups?  Yes  No

Where there is a suspected noise problem, have noise levels been measured?  Yes  No

If engineering controls cannot reduce noise to safe levels has an attempt been made to limit employee exposure?  Yes  No

Do junction boxes, switches and electrical fittings comply with the current Electrical Regulations?  Yes  No

Are fire extinguishers fully charged and kept in well sign-posted places?  Yes  No

Is lighting sufficient to illuminate detail in the plating process, contamination on surfaces and tripping hazards on the floor?  Yes  No

Do all employees have access to MSDSs, these guidelines and any other relevant safety information?  Yes  No

Have you considered, and where appropriate actioned, all suggestions made to improve the safety of the working environment?  Yes  No

Have the standards of operation relating to safety been received?  Yes  No



## Appendix 4: Exhaust ventilation for open tanks

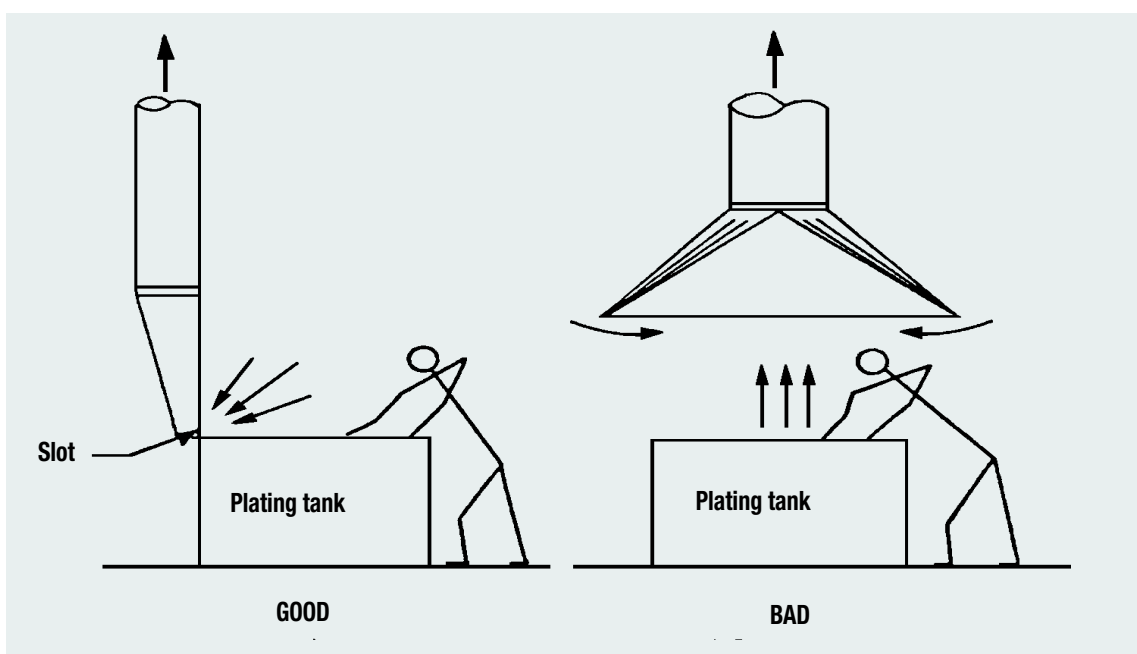
This appendix contains suggested design criteria for engineering controls to reduce emission of mists and fumes from open surface tanks.

The diagrams have been reproduced from *Industrial Ventilation* — American Conference of Governmental Industrial Hygienists (16th ed.), with their kind permission.

### Key principles of ventilation air flow

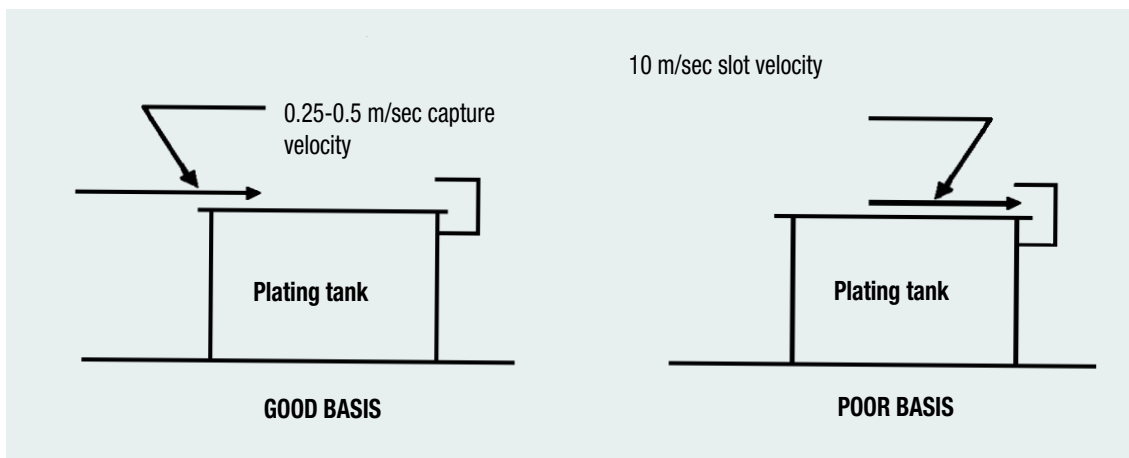
#### a) Direction of air flow

Locate the hood so the contaminant is removed away from the breathing zone of the worker.

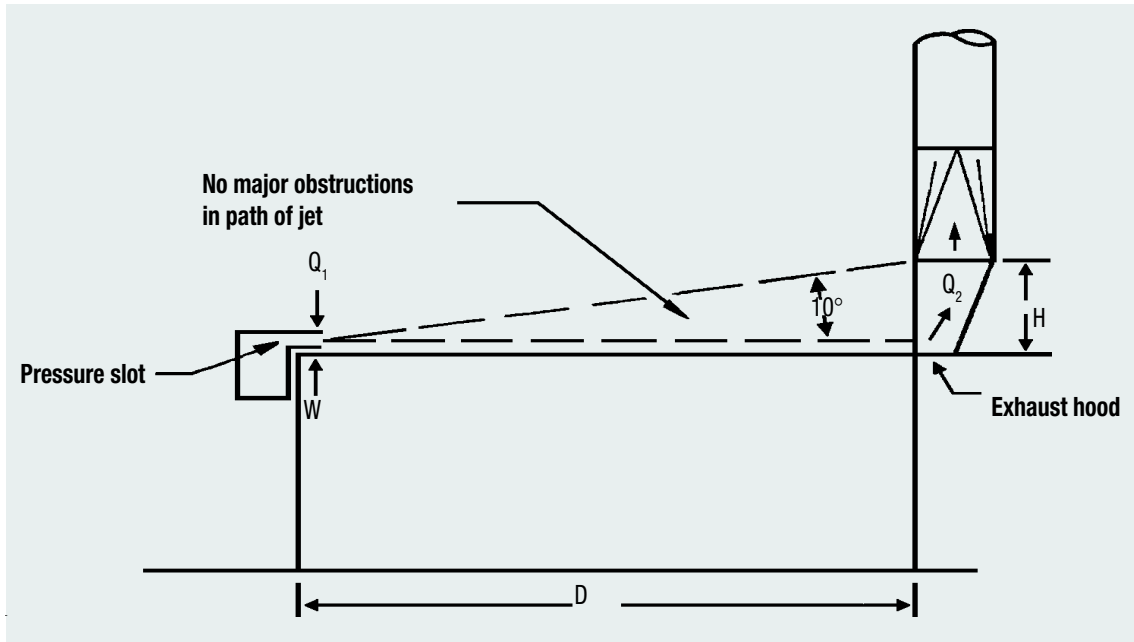


#### b) Capture velocity or proper volume

Create air flow past the source sufficient to capture the contaminant. Many arbitrary standards include this; others do not. Proper standards are usually on: m/sec capture basis at source;  $\text{m}^3/\text{second}/\text{m}^2$  of source basis.



**c) Push-pull hoods**



**Exhaust hood**

Quantity of air exhausted,  $Q_2 = 500$  to  $750$  l/s per square metre of tank area, depending on temperature of liquid, cross draughts, agitation etc.

Hood height should be  $H = D \times \tan 10^\circ = 0.18 D$

**Pressure slot**

Quantity of air supplied,  $Q_1 = \frac{1}{D \times E} \times Q_2$

where:  $D =$  length of throw (metres)

$E =$  entrainment factor

Throw length, $D$	Entrainment factor, $E$
0-2.4	6.7
2.4-4.9	4.7
4.9-7.3	3.3
over 7.3	2.3

Slot width  $W$  should be designed for a velocity of 5-10 m/sec.

Such systems should be designed so they can be easily modified or adjusted to obtain desired results.



## Appendix 5: Chemicals used in electroplating

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Many of the substances used in electroplating processes are toxic if ingested or if their vapours are inhaled in sufficient quantities; in addition some are corrosive to the skin and mucous membranes.

Many factors can influence the risk associated with hazardous substances in the workplace. These include the toxicity and the physical properties of the substances, work practices, the nature and the duration of the exposure, combined exposures, routes of entry and the susceptibility of workers.

It is important that everyone who could potentially come into contact with chemicals should know and understand the risks involved and the specific handling precautions required for each chemical.

A list of the chemicals commonly used in the electroplating industry is contained in the following table, along with information on their use, general storage, and possible biological effects.

For information on the specific chemicals used in each workplace, MSDSs or other relevant safety information must be obtained for each chemical.



Chemical	Physical state	Storage	Use	Possible biological effects
Acetic acid	Clear liquid	Acid store	Anodising, dyestuffs	<ul style="list-style-type: none"> <li>• Irritation of respiratory tract</li> <li>• Concentrated vapour and liquid can cause tissue damage</li> <li>• Higher doses may give rise to broncho-pneumonia and pulmonary oedema</li> </ul>
Acetone	Clear liquid	Solvent store	Degreasing	<ul style="list-style-type: none"> <li>• Irritation of respiratory tract and eyes</li> <li>• Moderate doses can cause headache, giddiness, nausea, vomiting</li> </ul>
Ammonium hydroxide	Clear liquid	Alkali store	pH control Electroplating solutions	<ul style="list-style-type: none"> <li>• Irritating to eyes and nose</li> <li>• Headache, salivation, burning of the throat, vomiting</li> <li>• Severe exposure can cause bronchitis, pneumonia, or pulmonary oedema</li> <li>• Burns following skin or eye contact with the liquid can be serious</li> </ul>
Cadmium salts • cadmium oxide • cadmium cyanide	Brown powder White powder	Dry store	Electroplating	<ul style="list-style-type: none"> <li>• Respiratory tract irritation</li> <li>• Yellow staining of the teeth</li> <li>• With higher doses, severe pulmonary irritation and pulmonary oedema.</li> <li>• Kidney damage and hypertension</li> </ul>
Chromic acid	Orange liquid	Acid store <b>CAUTION : INCOMPATIBLE WITH ORGANIC SOLVENTS</b>	Chrome plating, anodising	<ul style="list-style-type: none"> <li>• Respiratory tract irritation</li> <li>• Dermatitis, chrome ulcers on skin and nasal membrane</li> <li>• Nasal irritation, nose bleeds, ulceration and perforation of the nasal septum</li> <li>• Possible lung function decrement</li> <li>• Possible long term effects of bronchitis, lung and nasal cancers</li> </ul>
Cyanide salts, zinc, cadmium, sodium, potassium, gold, silver	White solid	Alkali store <b>CAUTION: INCOMPATIBLE WITH ACIDS</b>	Cleaning solutions Electroplating solutions	<ul style="list-style-type: none"> <li>• Respiratory tract irritation</li> <li>• Skin rash</li> <li>• Giddiness, headache, eye irritation</li> <li>• High doses may cause asphyxia, unconsciousness and death. Recovery is usually complete if dose is not lethal.</li> </ul>



Chemical	Physical state	Storage	Use	Possible biological effects
Hydrochloric acid	Pungent, fuming, yellow liquid	Acid store	Acid dips Electroplating solutions	<ul style="list-style-type: none"> <li>• May produce burns</li> <li>• Irritation to mucous membranes, skin, eye</li> <li>• Higher concentrations may cause laryngitis, bronchitis, pulmonary oedema</li> </ul>
Nickel salts chloride, sulphate	Green solid	Dry store	Nickel electroplating	<ul style="list-style-type: none"> <li>• Upper respiratory tract irritation</li> <li>• Eye irritation</li> <li>• Skin sensitisation, nickel itch resembling allergic dermatitis or irritant dermatitis.</li> </ul>
Nitric acid	Clear to yellow liquid	Acid store	Acid cleaning	<ul style="list-style-type: none"> <li>• Respiratory tract irritation</li> <li>• May produce burns</li> <li>• Irritation to mucous membranes, skin, eye</li> <li>• Higher concentrations may cause laryngitis, bronchitis, pulmonary oedema</li> </ul>
Sulphuric acid	Clear to yellow liquid	Acid store	Surface activation Pickling Chrome and copper Electroplating Anodising	<ul style="list-style-type: none"> <li>• Respiratory tract irritation</li> <li>• Eye irritation</li> <li>• Contact with the skin or eyes may produce burns</li> <li>• Long term effects of bronchitis</li> </ul>
Trichloroethylene	Clear liquid	Solvent store	Degreasing	<ul style="list-style-type: none"> <li>• Degreases skin causing irritation and dermatitis</li> <li>• Moderate concentrations produce headaches, giddiness, drowsiness</li> <li>• High concentrations may produce unconsciousness and death</li> </ul>

## Appendix 6: Product safety card

### PRODUCT SAFETY CARD

NOTE - THIS IS NOT A MATERIAL SAFETY DATA SHEET

Date of issue:

[place warning pictograms here]

## Product Name

#### IDENTIFICATION

Statement of Hazardous Nature:

Manufacturer/Importer:

UN. Number:

Dangerous Goods Class:

Hazchem Code:

Toxic Substances Schedule:

Uses:

#### Properties

Appearance:

Boiling Point:

Flash Point ( °C)

Flammability Limits (%):

#### Ingredients

Chemical name

CAS Number

Amount

#### HEALTH HAZARD INFORMATION

##### Health Effects

*Acute*

Swallowed:

Eyes:

Skin:

Inhaled:

*Chronic* :

##### First Aid

Swallowed:

Eyes:

Skin:

Inhaled:

First Aid Facilities:

#### PRECAUTIONS FOR USE

Engineering Controls:

Personal Protection:

Flammability:

#### SAFE HANDLING INFORMATION

Storage and Transport:

Spills and Disposal:

Fire/Explosion Hazard:

#### OTHER INFORMATION

Incompatible Substances:

Emergency Telephone Number:

Location of Material Safety Data Sheet:

Contact Point:

