BAT Guidance Note on Best Available Techniques for the Surface Treatment of Metals and Plastic Materials

(1st Edition)

ENVIRONMENTAL PROTECTION AGENCY

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1. INTRODUCTION

1.1 GENERAL

This Guidance Note is one of a series issued by the Environmental Protection Agency (EPA), which provides guidance on the determination of Best Available Techniques (BAT) in relation to:

- applicants seeking Integrated Pollution Prevention and Control (IPPC) licenses under Part IV of the Environmental Protection Agency Acts 1992 to 2007,
- existing Integrated Pollution Prevention and Control (IPPC) Licensees, whose licence is to be reviewed under the Environmental Protection Agency Acts 1992 to 2007,
- applicants seeking Waste Licenses under Part V of the Waste Management Acts 1996 to 2008,
- existing Waste Licensees, whose licence is to be reviewed under Waste Management Acts 1996 to 2008.

This Guidance Note shall not be construed as negating the installation/facility statutory obligations or requirements under any other enactments or regulations

1.2 BAT GUIDANCE NOTE STRUCTURE

This Guidance Note has been structured as follows:

Section	Details
1	Introduction
2	Interpretation of BAT
3	Sector(s) Covered by this Guidance Note
4	Process Description, Risk to the Environment and Control Techniques
5	Best Available Techniques
6	BAT Associated Emission Levels
7	Compliance Monitoring

Where relevant, references are made to other detailed guidance; such as the reference documents (BREF) published by the European Commission, Agency Guidance Notes for *Noise in Relation to Scheduled Activities*, and the determination of BAT should be made giving regard to these.

The information contained in this Guidance Note is intended for use as a tool to assist in determining BAT for the specified activities.

2. INTERPRETATION OF BAT

2.1 STATUS OF THIS GUIDANCE NOTE

This Guidance Note will be periodically reviewed and updated as required to reflect any changes in legislation and in order to incorporate advances as they arise.

Techniques identified in these Guidance Notes are considered to be current best practice at the time of writing. The EPA encourages the development and introduction of new and innovative technologies and techniques, which meet BAT criteria and look for continuous improvement in the overall environmental performance of the sectors activities as part of sustainable development. Operators should therefore continue to keep up to date with the best available techniques relevant to the activity and discuss appropriate innovations with the EPA.

2.2 INTERPRETATION OF BAT

BAT was introduced as a key principle in the IPPC Directive, 96/61/EC. This Directive has been incorporated into Irish law by the Protection of the Environment Act 2003. To meet the requirements of this Directive, relevant Sections of the Environmental Protection Agency Act 1992 and the Waste Management Act 1996 have been amended to replace BATNEEC (Best Available Technology Not Entailing Excessive Costs) with BAT.

Best available techniques (BAT) is defined in Section 5 of the Environmental Protection Agency Acts 1992 to 2007 and Section 5(2) of the Waste Management Acts 1996 to 2008 as the "most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission values designed to prevent or eliminate or where that is not practicable, generally to reduce an emission and its impacts on the environment as a whole" where:

B ***'best'*** in relation to techniques means the most effective in achieving a high general level of protection of the environment as a whole.

A ***'available techniques'*** means those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying on the activity.

T ***'techniques'*** includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

The range of BAT associated emission level values specified in Section 6 indicate those that are achievable through the use of a combination of the process techniques and abatement technologies specified as BAT in Section 5. The licensee must demonstrate to the satisfaction of the Agency, during the licensing process, that the installation/facility will be operated in such a way that all the appropriate preventative measures are taken against pollution through the application of BAT and justify the application of other than the most stringent ELV in the range.

At the installation/facility level the most appropriate techniques will depend on local factors. A local assessment of the costs and benefits of available options may be needed to establish the best option. The choice may be justified on:

- technical characteristics of the installation/facility;
- its geographical location;
- local environmental considerations;
- the economic and technical viability of upgrading existing installation/facility.

The overall objective of ensuring a high level of protection for the environment as a whole will often involve making a judgment between different types of environmental impact, and these judgements will often be influenced by local considerations. On the

other hand, the obligation to ensure a high level of environmental protection including the minimisation of long-distance or transboundary pollution implies that the most appropriate techniques cannot be set on the basis of purely local considerations.

The guidance issued in this Note in respect of the use of any technology, technique or standard does not preclude the use of any other similar technology, technique or standard that may achieve the required emission standards and is demonstrated to the Agency to satisfy the requirement of BAT.

2.3 BAT HIERARCHY

In the identification of BAT, emphasis is placed on pollution prevention techniques rather than end-of-pipe treatment.

The IPPC Directive 96/61/EC and the Environmental Protection Agency Acts 1992 to 2007 (section 5(3)), require the determination of BAT to consider in particular the following, giving regard to the likely costs and advantages of measures and to the principles of precaution and prevention:

(i) the use of low-waste technology,

(ii) the use of less hazardous substances,

(iii) the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate,

(iv) comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale,

(v) technological advances and changes in scientific knowledge and understanding,

(vi) the nature, effects and volume of the emissions concerned,

(vii) the commissioning dates for new or existing activities,

(viii) the length of time needed to introduce the best available techniques,

(ix) the consumption and nature of raw materials (including water) used in the process and their energy efficiency,

(x) the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it,

(xi) the need to prevent accidents and to minimise the consequences for the environment, and

(xii) the information published by the Commission of the European Communities pursuant to any exchange of information between Member States and the industries concerned on best available techniques, associated monitoring, and developments in them, or by international organisations, and such other matters as may be prescribed.

3. SECTOR COVERED BY THIS GUIDANCE NOTE

This Guidance Note covers the following activities under the First Schedule of the Environmental Protection Agency Acts 1992 to 2007:

12.3 The surface treatment of metals and plastic materials using an electrolytic or chemical process where the volume of the treatment vats exceeds 30 m^3.

4. PROCESS DESCRIPTION, RISK TO THE ENVIRONMENT AND CONTROL TECHNIQUES

(Note: any reference to BREF in this document means the reference document on *Best Available Techniques for the Surface Treatment of Metals and Plastics*, published by the European Commission, September 2005).

4.1 DESCRIPTION OF PROCESS

This document covers the surface treatment of metals and plastics at the levels specified in Section 3 of this document.

These activities cover a diverse range of sectors including aerospace, automotive, electrical and electronic goods and their components, engineering, packaging, etc. (see BREF Section 1.1).

Some installations act as so-called jobbing shops that offer finishing processes as a service whereas in other sites the treatment step will form one part of the production process of a particular product. The introductory part of BREF Section 2 gives a description of a typical process line. The process steps for the surface treatment of metals and plastics can be generically described as follows:

- **Delivery and storage** of workpieces and consumable raw materials (see BREF Section 2.1)
- **Workpiece loading** for processing (see BREF Section 2.2). Main types are jig or rack processing and barrel processing. Other activities associated with barrel processing are also described in BREF Section 2.8
- **Pretreatment** such as cleaning or degreasing (mechanical, aqueous, solvent), polishing (mechanical, chemical, or electrochemical), abrasive blasting, deburring, tumbling, pickling (including of plastics), and stripping. There may be more than one pretreatment step (see BREF Section 2.3)
- **Rinsing and drag-out.** Rinsing is usually carried out between nearly all process steps. Drag-out is the liquid, which remains, adhered to the workpiece surface when removed from a process bath (see BREF Section 2.4)
- **Core activity** of the process. The introductory part of BREF Section 2 gives a generic description of electrolytic processes. The core activities can include:
  - plating - the different types of metal plating are described as follows:
    - copper & its alloys (see BREF Section 2.5.1)
    - nickel (see BREF Section 2.5.2)
    - chromium (see BREF Section 2.5.3 & 4.9.8)
    - zinc & its alloys (see BREF Section 2.5.4 & 4.9.4)
    - cadmium (see BREF Section 2.5.5)
    - tin and its alloys (see BREF Section 2.5.6)
    - precious metals (see BREF Section 2.5.7)
  - autocatalytic plating, also known as electroless plating (see BREF Section 2.5.8)
  - non-catalytic chemically reduced coatings, also known as immersion or displacement coatings (see BREF Section 2.5.9)
  - electrocoating (see BREF Section 2.5.10 but mainly dealt with by the BREF for surface treatment using organic solvents)
  - lacquering (see BREF Section 2.5.11)
  - oiling – an electrostatic oiling method used in coil coating (see BREF Section 2.5.12)

- anodising (see BREF Section 2.5.13)
- colour anodising of aluminium (see BREF Section 2.5.14)
- sealing after anodising (see BREF Section 2.5.15)
- phosphating conversion coatings (see BREF Section 2.5.16)
- chromium conversion coatings (see BREF Sections 2.5.17 & 4.9.10)
- metal colouring (see BREF Section 2.5.18)
- bright dipping or brightening (see BREF Sections 2.5.19 & 2.5.21)
- chemical blacking or oxidation coating (see BREF Section 2.5.20)
- etching (see BREF Sections 2.5.22 & 2.11.2.9)
- chemical milling (see BREF Section 2.5.23)

▪ After treatment activities usually drying - by hot air, hot water or air knives. Heat treatment can also be used in some cases (see BREF Section 2.6).

The steps of specific processes that are described in the BREF include printed circuit board manufacture (see BREF Section 2.11), sheet processing for aluminium lithographic plates (see BREF Section 2.10), and large scale, continuous coil electroplating of steel (see BREF Section 2.9).

Utility supplies are described in BREF Section 2.12.1 for energy, and in BREF Sections 2.12.2 & 4.4.5.1 for water supply and its pre-treatment.

4.2 RISK TO THE ENVIRONMENT

The bulk of the emissions to the environment from metals and plastics surface treatment processes are to water. The key environmental issues for these activities are water consumption, energy use, raw material consumption, emissions to waters, and waste and site remediation after cessation.

4.2.1 Emissions to Waters

Emissions to waters from this sector can pose a risk where on-site wastewater treatment plant management or maintenance is poor or investment lacking. Such emissions can also pose a risk for the operation of any downstream municipal wastewater treatment plant. There is also the potential for accidental emissions of concentrated solutions during handling or storage affecting surface waters, ground waters, or soils (see BREF Sections 1.4.2 & 3.3.1). For information in relation to emissions to waters from printed circuit board manufacture see BREF Section 3.4.3.3.

4.2.2 Water Consumption

Water is used in the process itself and for cooling requirements where necessary. The largest use of water within the process is rinsing between process steps. Water is also the medium used in process baths but accounts for much lower usage (see BREF Sections 1.4.2 & 2.12.2). Some sectoral benchmarks for water use in terms of litres per m^2 of treated surface area are detailed in BREF Section 3.2.2. Information on the range of water usage in printed circuit board manufacture is given in BREF Section 3.4.3.1.

4.2.3 Energy Use

The main areas of these processes where energy is consumed are the electrolytic and electrochemical reactions themselves, heating (or cooling) of process solutions, drying of products, and operation of plant and machinery (see BREF Sections 1.4.3 & 2.12.1). The methods used for heating process solutions are described in BREF Section 4.4.2.

4.2.4 Raw Material Consumption

A diversity of raw materials are consumed in these processes including metals, acids and bases, cyanides, hypochlorite, peroxides, surfactants, and complexing agents. The particular materials that are used at a particular installation are dependent on the types of processes in operation (see BREF Section 1.4.4). Solvents may also be in use but this is covered under the BAT Guidance Note on *Best Available Techniques for Solvent use in Coating, Cleaning and Degreasing*. Some ranges for material efficiencies are detailed for the main plating processes (see BREF Section 3.2.3), for aqueous degreasing (see BREF Section 3.2.3.1), for pickling (see BREF Section 3.2.3.2), and for electrolytic coating (see BREF Section 3.2.3.4). Information on the types of material usage in printed circuit board manufacture is given in BREF Section 3.4.3.2.

4.2.5 Waste

Wastes consist of solids; mainly sludges from on-site wastewater treatment, and spent solutions. The majority of process wastes would be classified as hazardous. Processes such as finishing and polishing would give rise to dust waste (see BREF Sections 1.4.4.9, 1.4.4.10, 2.13.2, 3.3.2 & 4.17).

4.2.6 Site Remediation

The condition of the site when activities cease and the need for remediation is a potential environmental issue (see BREF Section 1.4.1).

4.2.7 Emissions to Air

Air emissions are usually not significant for the sector but can be a local issue. General information on the various types of emissions to air and their sources for the surface treatment of metals and plastics is given in BREF Sections 2.13.3.1 & 3.3.3. Information on the types of emissions to air and their sources for printed circuit board manufacture is given in BREF Sections 3.4.3.2 & 3.4.3.5.

4.2.8 Other Emissions

Other sources of emissions can include noise and odour but in general these are usually not significant for the processes involved (see BREF Section 1.4.5).

This Guidance Note does not cover noise emission sources. For guidance on measures in relation to noise, have regard to the *Guidance Note for Noise in Relation to Scheduled Activities*.

4.3 CONTROL TECHNIQUES

The existing or possible measures for eliminating, reducing and controlling emissions from the surface treatment of metals and plastics are described in this Section. References to more detailed descriptions in the BREF document are given.

4.3.1 General Preventive Techniques

- The following general techniques can be applied to all activities involving the surface treatment of metals and plastics:
  - environmental management (see BREF Section 4.1.1 for general considerations and BREF Section 4.1.1.1 for specific EMS issues for surface treatment activities)

- monitoring of energy and raw material consumption, and wastewater and waste generation, together with appropriate production indicators (e.g. m^2 of surface treated or tonnage treated) (see BREF Section 4.1.3.1 for water, BREF Section 4.4.5.2 for information on monitoring water, and BREF Section 4.4 for information on monitoring electricity)
- reduction in reworking through process specification and quality control (see BREF Section 4.1.2 for specific areas, which can be addressed in relation to this)
- process line optimisation, for example through the use of software tools (see BREF Section 4.1.4)
- real time process control (see BREF Section 4.1.5)
- pollution prevention measures through planning, design, construction and other systems (see BREF Section 4.2.1). Specific measures detailed include choice of the type of process line and type of construction (see BREF Section 4.2.3)
- agitation of process solutions by one of the appropriate methods described to keep consistent concentrations throughout the bath (see BREF Section 4.3.4)
- maintenance of all plant and equipment (see BREF Section 4.3.5 and part (c) vii of Section 4.1.1 on EMS) including process solution maintenance (see BREF Section 4.11).

4.3.1.1 Reduction in Drag-out

- Reduction in drag-out through choice of withdrawal and drainage dwell times (see BREF Sections 4.6.3, 4.6.4, 5.2.2 and 5.2.3 which give recommended times for jig and barrel processing) which can be used where process reaction does not have to be stopped; drain boards (see BREF Section 4.6.6); air blowing (see BREF Sections 4.6.3 & 4.6.6); spray rinses (see BREF Sections 4.6.3, 4.6.6, 4.6.4 & 4.7.5); changing the properties of the process solution (BREF Section 4.6.5); use of compatible materials in subsequent process baths (see BREF Section 4.6.2); and the following measures for specific processes:
  - jig or rack processing – orientation, positioning and arrangement of pieces on the jig; drain pans; orientation of jig arms; and inspection and maintenance of jig insulation (see BREF Section 4.6.3), and use of a static rack for manually operated lines (see BREF Section 4.7.6)
  - barrel processing – intermittent barrel rotation while draining; inclined lifting of the barrel; mesh plugs instead of holes (see BREF Section 4.6.4)
  - PCB manufacture – use of squeeze or wiper rollers (see BREF Sections 4.6 & 4.14.5).

4.3.1.2 Drag-out Recovery Techniques

- Drag-out recovery techniques including:
  - use of rinse water as process make-up (see BREF Section 4.7.2 in general, and BREF Section 4.15.6 for rinse water make-up in the etching process in printed circuit board manufacture)
  - use of an ‘eco’-rinse or predipping (see BREF Section 4.7.4)
  - use of in-process or separate equipment for evaporation where applicable (see BREF Sections 4.7.2, 4.7.11.2, & 4.7.11.3)
  - use of electrodialysis where applicable (see BREF Section 4.7.11.4)
  - use of reverse osmosis where applicable (see BREF Section 4.7.11.5).

4.3.1.3 Improved Rinsing Techniques

- Improved rinsing techniques including:

- use of an 'eco'-rinse or predipping (see BREF Sections 4.7.4 & 4.7.11.1)
- spray rinsing (see BREF Section 4.7.5)
- static rinses, multiple-stage rinses, and counter-flow rinses (see BREF Section 4.7.10)
- chemical rinses (see BREF Section 4.7.7).

Some recommended rinse ratios are outlined in BREF Section 4.7.1.

4.3.1.4 Use of Alternative Materials or Processes

- Use of alternative raw materials, processes, chemistries, methods, or alternative surface treatments:
  - general considerations (see BREF Section 4.9)
  - substitutes for EDTA and other strong complexing agents (see BREF Section 4.9.1)
  - toxic surfactants substitutes and use reduction measures (see BREF Section 4.9.2)
  - substitutes for cyanide (see BREF Section 4.9.3 (overview)), BREF Section 4.9.4.3 (acid zinc), and BREF Section 4.9.4.2 (alkaline cyanide-free zinc))
  - substitutes for hexavalent chromium in plating (see BREF Section 4.9.6 (overview), BREF Section 4.9.9 (other coating processes), BREF Section 4.9.8.3 (trivalent chromium), and BREF Section 4.9.8.2 (cold chromium hexavalent process))
  - substitutes for hexavalent chromium in chromium conversion coatings (see BREF Section 4.9.6 (overview), BREF Section 4.9.10.2 (trivalent chromium conversion process), and BREF Section 4.9.10.3 (chromium-free conversion process – this process may be as toxic and there are some corrosion limitations reported)
  - substitutes for hexavalent chromium in phospho-chromating (see BREF Section 4.9.12 (overview))
  - substitution by alternative processes (see BREF Section 4.9.16).

4.3.1.5 Minimisation of Raw Material Consumption

- Optimisation of raw material usage by controlling the concentration of process chemicals through regular process monitoring, frequent small additions, and automated dosing, where possible (see BREF Section 4.8.1).

4.3.1.6 Minimisation of Water Consumption

- The following techniques can minimise water use in all activities involving the surface treatment of metals and plastics.
  - for measures to optimise water usage, such as flow valves and process control measurements (see BREF Section 4.4.5.2).

4.3.1.7 Minimisation of Energy Consumption

- Overall considerations for reducing electrical consumption by the activities involved are outlined in the BREF introductory section 4.4. The following specific techniques can minimise energy use in all activities involving the surface treatment of metals and plastics:
  - management of incoming high voltage supply to match phases, to minimise losses on step down or rectification, and to supply large current demand (see BREF Section 4.4.1.1)
  - a number of improvements that can be made for energy savings with a DC supply (see BREF Section 4.4.1.2)

- use of energy efficient motors (see BREF Sections 4.4.1.3 & 4.14.3.1)
- improve solution conductivity through the addition of conducting chemical compounds (see BREF Section 4.4.1.4)
- reduce heat loss from process solutions using the techniques as appropriate to the prevailing conditions (see BREF Section 4.4.3)
- For process solutions, which require cooling, and the associated measures, which can reduce energy use (see BREF Section 4.4.4.1 and the Reference Document on the application of Best Available Techniques to Industrial Cooling Systems (December 2001))
- Minimise the amount of extraction air from process areas by calculating required amounts, reducing free surface areas above tanks, enclosing treatment baths (see BREF Sections 4.4.3 & 4.14.18.2), and using controls/timers on the extraction system (see BREF Section 4.18.5). Parameters, which have an influence in the amount of extraction air, are outlined in BREF Sections 2.13.3.3 and 4.18.2.

4.3.1.8 Minimisation of Waste Water

- Wastewater streams should be considered individually before mixing with other effluent streams in order to identify, where possible, preventive options (see BREF Section 4.16.1).

4.3.1.9 Minimisation of Waste

- For an overview of waste prevention for the activities covered by this document see BREF Section 4.17.2.

4.3.1.10 Minimisation of Air Emissions

- Minimise air emissions through the use of lids (see BREF Section 4.18.2), which are utilised when the line is not running, or where jig/barrel time in a bath is extended.
- Minimise air emissions for certain processes through the use of additives, which retain compounds in the solution rather than emit them to waste gases (see BREF Section 4.18.1).

4.3.2 Preventive Techniques for Specific Processes or Unit Operations

The following preventive techniques can be applied to the stated surface treatment activities or unit operations.

4.3.2.1 Metal Products/Surfaces

- Corrosion prevention of metal workpieces/surfaces:
  - through protection before and after treatment (see BREF Section 4.3.1)
  - through reducing storage time (see BREF Section 4.3.1.1)
  - through use of a ventilated storage environment with low humidity and a temperature similar to plant conditions (see BREF Section 4.3.1.2)
  - through use of protective packaging (including reusable packaging), moisture absorbents or corrosion preventing materials and use of sealed containers for small products (see BREF Section 4.3.1.3)
  - through coating with oil/grease (see BREF Section 4.3.1.4) which must be balanced with considerations for subsequent oil/grease removal (see BREF Section 4.3.2).
- Minimise the amount and type of oil and grease on the incoming workpiece/substrate through working in conjunction with product manufacture (in-

house or suppliers) giving consideration to the specific measures outlined in BREF Section 4.3.2.

4.3.2.2 Jig Processing

- Use the correct type of jigging appropriate to the product and process concerned (see BREF Section 4.3.3).

4.3.2.3 Degreasing

- BREF Section 4.9.14 deals with choices for degreasing and possible substitutions. For more information on the measures that can be implemented in this area see the BAT Guidance Note on Best Available Techniques for solvent use in coating cleaning and degreasing.

4.3.2.4 Acid Pickling

- Multiple stage cascade rinsing which consumes a lower amount of pickling acid (see BREF Section 4.11.14.1).

4.3.2.5 Electrolytic Degreasing and Electrolytic Pickling

- Use of polarisation switching of electrodes at regular intervals to increase plating efficiency (see BREF Section 4.8.3).

4.3.2.6 Metal Plating

- Implement measures to compensate for different electrode efficiencies between the anode and the cathode (see BREF Section 4.8.2)
- Acid copper plating can reduce or eliminate the need for polishing and buffing due to its levelling properties (see BREF Section 4.9.13).

4.3.2.7 Printed Circuit Board Manufacture

- The use of the brown oxide process instead of the black oxide process for oxide coating in the manufacture of inner coating layers in printed circuit board manufacture reduces hazardous chemical usage, operates at lower temperatures and produces less waste water (see BREF Section 4.15.1)
- Enhancement of the electroplating process in printed circuit board manufacture through the use of direct air injection, vibration of the boards, and positioning of the boards in the lower part of the bath to optimise exchange of electrolytes (see BREF Section 4.15.4)
- Use of conductivity control, laboratory analysis and regular additions to the sodium carbonate developer solution in the development of dry resist (see BREF Section 4.15.5)
- Use of continuous monitoring, control and replenishment of etchant solutions in printed circuit board manufacture (see BREF Section 4.15.6)
- Use of aqueous solutions instead of solvent-based solder masks in printed circuit board manufacture. It should be noted aqueous solutions still contain some solvent (see BREF Section 4.15.11).

4.3.2.8 Large Scale, Continuous Coil Electroplating of Steel

- Specific preventive measures which can be implemented in large scale, continuous coil electroplating of steel are outlined in BREF Sections 4.14 to 4.14.5 and 4.14.6 to 4.14.9.

4.3.3 Techniques for Containment

- The following techniques for containment can be applied to activities involving the surface treatment of metals and plastics:

- adequate chemical storage - the key issues for the activities involved are outlined in BREF Section 4.2.2. For more detail refer to the Reference Document on Best Available Techniques on Emissions from Storage (January, 2005)
- the use of oil tight trays for hydraulic systems (see BREF Section 4.2.1.1)
- containment of sources of waste gases – discussed in the *Reference Document on Best Available Techniques in Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector* (February 2003), in the Reference Document on Best Available Techniques in the ferrous metals processing industries (December 2001), and in the Reference Document on Best Available Techniques in the non ferrous metals processing industries (December 2001)
- minimise the release of hexavalent chromium from treated surfaces that have been subjected to hexavalent chromium conversion coatings through the use of top coatings and the optimisation of rinses (see BREF Section 4.9.7).

4.3.4 Techniques for Recovery and Recycling

The following techniques for recovery and recycling can be applied to activities involving the surface treatment of metals and plastics.

- Wastewater and waste streams should be considered individually before mixing with other effluent streams in order to identify, where possible, reuse or recycling options (see BREF Section 4.16.1).

4.3.4.1 Closed Loop Techniques

- Closed loop techniques include:
  - evaporation - BREF Section 4.4.4.2 describes how evaporation can be used to achieve closed loop systems. BREF Section 4.16.12.1.1 describes vacuum evaporators with vapour compression; infrared evaporators are detailed in BREF Section 4.16.12.2.2
  - membranes – general considerations are outlined in BREF Section 4.16.12.2 while BREF Section 4.16.12.2.1 describes ultrafiltration and BREF Section 4.16.12.2.2 describes a combination of ultrafiltration and reverse osmosis.

4.3.4.2 Process Solution Maintenance

- Process solution maintenance - see the introduction to BREF section 4.11 for an overview which also includes a table of the major contaminants for various process solutions and a reference to the BREF sections with the appropriate techniques. The specific techniques involved include:
  - filtration - general description of filtration in processes (see BREF Section 4.10.1)
  - electrolysis or electrolytic recovery - to purify process solutions by removing metallic contaminants (see BREF Section 4.11.8) and surplus metals (often called plating out - see BREF Section 4.11.9). An electrolysis and membrane combination can be used to maintain chromium/sulphuric acid pickling solutions for plastics (see BREF Section 4.11.10), to maintain chromium solutions (see BREF Section 4.11.11). Electrolysis can be used to regenerate phosphate solutions (see BREF Section 4.11.12)
  - electrodialysis - general description (see BREF Section 4.11.2). The use of electrodialysis to remove metal salts from pickling solutions (see BREF Section 4.11.14.2)
  - ion exchange (including retardation) - see BREF Section 4.11.7 for a general description of ion exchange to remove metallic contamination. See BREF

Section 4.11.3 for a general description of retardation (the use of ion exchange to regenerate ionic process solutions), and see BREF Section 4.11.3.1 for the use of retardation in sulphuric acid anodising solutions

- crystallisation - general description of crystallisation, which is used to remove salt contaminants through, cooling natural in winter shutdowns or through a dedicated cooling system (see BREF Section 4.11.4). Another crystallation process is for the regeneration of anodising caustic etch solutions through crystallisation of alumina via seeding (see BREF Section 4.11.5)
- activated carbon treatment, which is suitable for removal of organic contaminants (see BREF Section 4.11.6)
- maintenance of degreasing solutions (see BREF Section 4.11.13) (solvent or aqueous and also includes electrolytic degreasing solutions (see BREF Section 4.11.13.8). This includes:
    - cascade or multiple use of cleaning or degreasing solutions (see BREF Section 4.11.13.1)
    - simple methods such as filtration, skimming, gravity separation, or using chemicals to break emulsions (see BREF Section 4.11.13.2)
    - gravity separation via a static separator (see BREF Section 4.11.13.3)
    - centrifugation (see BREF Section 4.11.13.5)
    - membrane filtration (see BREF Section 4.11.13.6) or
    - multistage combinations of these methods (see BREF Section 4.11.13.7), also biological degreasing regeneration (see BREF Section 4.11.13.4)
- specific examples of process bath maintenance in large scale, continuous coil electroplating of steel are outlined in BREF Section 4.14.7.

4.3.4.3 Electrolytic Recovery

- Electrolysis or electrolytic recovery - to recover metals such as nickel, chromium, copper, and precious metals from solutions including drag outs (BREF Section 4.12.1). Electrolysis used to recover copper from pickling baths is described in BREF Section 4.11.14.3.

4.3.4.4 Other Recovery Techniques

- Use of ion exchange to regenerate rinse water (see BREF Section 4.7.8.1) and to recover precious metals from rinses (see BREF Section 4.12.2)
- Use of reverse osmosis to regenerate rinse water (see BREF Section 4.7.8.2)
- On-site and off-site recovery for reuse options for waste streams generated in the metal and plastic surface treatment processes (see BREF Section 4.17.3)
- Recovery of energy from exhaust air, usually only suitable for new installations and for large operations (see BREF Section 4.18.6)
- In printed circuit board manufacture, spent solution from alkaline etching processes can be continuously reconditioned and reused on-site and the copper recovered for reuse. The system removes copper electrolytically and reactivates the solution through chemical addition (see BREF Section 4.15.7)
- Recovery of exhausted chromating solutions via ion exchange or membrane technology (see BREF Section 4.12.3) is noted as being an expensive process.

4.3.5 Treatment Techniques

4.3.5.1 Treatment of Air Emissions

For general considerations in relation to air emissions and their treatment for the activities covered by this document see the introductory text to BREF Section 4.18. The following techniques can be applied to treat air emissions from metal and plastic surface treatment processes.

- General techniques for treating exhaust air from metal and plastic surface treatment processes are briefly outlined in BREF Sections 4.18.2 and 2.13.3.4. These techniques are extensively detailed in the *Reference Document on Best Available Techniques in Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector* (February 2003). These include:
  - droplet separators, mist filters, cyclones, filters, electrostatic precipitators
  - acid or alkaline scrubbers (depending on process type and waste gas constituents)
  - volatile organic compound emissions (where present) are dealt with in the BAT Guidance Note on Best Available Techniques for solvent use in coating cleaning and degreasing (EPA)
  - in printed circuit board manufacture removal of acid gases from acid etching processes via a scrubber for neutralisation (see BREF Section 4.15.6)
  - specific information on air emissions treatment for large scale, continuous coil electroplating of steel is outlined in BREF Section 4.14.18.

4.3.5.2 Treatment of Waste Water

For general considerations in relation to wastewater and its treatment for the activities covered by this document see BREF Section 2.13.1 and the introductory text to BREF Section 4.16. Wastewater treatment options are described in 2.13.1.1, and batch versus continuous processing is considered in BREF Section 2.13.1. The different wastewater pollutant parameters are described in BREF Sections 2.13.1.2 through to 2.13.1.5.

Wastewater streams should be considered individually and treated separately, where possible, before mixing with other effluent streams (see BREF Section 4.16.1).

Consideration on combining various techniques is given in BREF Section 4.16.11.

The following techniques can be applied to treat wastewater from metal and plastic surface treatment processes:

- General techniques for treating wastewater from metal and plastic surface treatment processes are briefly outlined in the BREF Sections listed below. These techniques are extensively detailed in the Reference Document on Best Available Techniques in common waste water and waste gas treatment/management systems in the chemical sector (February 2003). These include:
  - separation of oils and greases (see BREF Section 4.16.3)
  - cyanide oxidation (see BREF Sections 4.16.4 & 2.13.1.10)
  - nitrite treatment (see BREF Sections 4.16.5 & 2.13.1.9)
  - chromate treatment (see BREF Sections 4.16.6 & 2.13.1.6)
  - flocculation and precipitation of metals (see BREF Sections 4.16.7 & 2.13.1.7) using:
    - hydroxide precipitation (see BREF Section 4.16.7.1)
    - sulphide precipitation (see BREF Section 4.16.7.2) or
    - other flocculating agents (see BREF Section 4.16.6.3)

- techniques to remove complexing agents (see BREF Section 4.16.8 & 2.13.1.8)
- precipitation of anions (see BREF Section 4.16.19) in particular:
  - fluoride precipitation (see BREF Sections 4.16.9.1 & 2.13.1.12)
  - phosphate precipitation (see BREF Sections 4.16.9.2 & 2.13.1.13) and
  - sulphate precipitation (this is rarely required and generates more sludge) (see BREF Section 4.16.9.3)
- techniques to remove other pollutants such as sulphide (see BREF Section 2.13.1.11), and other salts (see BREF Section 2.13.1.14)
- final effluent polishing using sedimentation, flotation and filtration (see BREF Sections 4.16.10 & 2.13.1.15).

- In printed circuit board manufacture techniques include:
  - separate treatment using ultrafiltration of spent sodium carbonate developer solution from the development of dry resist (see BREF Section 4.15.5)
  - separate treatment of spent photoresist stripping solution using centrifugation and possibly ultrafiltration to remove solids (photoresist particles) (see BREF Section 4.15.8)
  - separate treatment of spent tin stripping solution using an organosulphide compound with external recycling of the subsequent tin rich sludge (see BREF Section 4.15.9)
  - separate treatment of aqueous-based solder masks using ultrafiltration (see BREF Section 4.15.11).

Specific information on wastewater treatment for large scale, continuous coil electroplating of steel is outlined in BREF Section 4.13.19.

4.3.5.3 Treatment of Waste

For general considerations in relation to waste for the activities covered by this document see BREF Section 4.17. The following techniques can be applied to treat waste from activities involving the surface treatment of metals and plastics.

- Spent solution from acid etching processes in printed circuit board manufacture externally reconditioned and copper salts removed (see BREF Section 4.15.6).

5. BEST AVAILABLE TECHNIQUES FOR THE SURFACE TREATMENT OF METALS AND PLASTIC MATERIALS

5.1 INTRODUCTION

As explained in Section 2, this Guidance Note identifies BAT but obviously does so in the absence of site-specific information. Accordingly, it represents the requirements expected of any new activity covered by the Note, and ultimately the requirements expected of existing facilities, but exclude additional requirements, which may form part of the granting of a licence for a specific site.

The technical feasibility of the measures listed below has been demonstrated by various sources. Used singly, or in combination, the measures represent BAT solutions when implemented in the appropriate circumstances. These circumstances depend on plant scale, process type, workpiece/substrate properties, etc.

5.2 GENERIC BAT

For all activities involved in the surface treatment of metals and plastics, BAT is to do the following as relevant.

5.2.1 General Preventive Measures

- For all activities involved in the surface treatment of metals and plastics, BAT is to do the following:
  - operate an environmental management system (EMS) implementing the measures outlined in BREF 5.1 that are listed as BAT. Give consideration to the following potential features of the EMS listed in BREF Section 5.1 which are specific to the activities covered by this document:
    - consideration of the impact of operation and decommissioning at the design stage for new plants (see BREF Section 5.1.1.1)
    - consideration of the development and use of cleaner technologies (see BREF Section 5.1.1.1)
    - Where applicable the application of sector benchmarking on a regular basis (see BREF Section 5.1.1.4)
  - implement a housekeeping and maintenance programme (see BREF Section 5.1.1.2) which includes the training and preventive actions needed, as relevant, to minimise the specific environmental risks (see BREF Sections 4.1.1(c) & 4.1.1.1)
  - minimise the environmental impacts of reworking by management systems that require regular re-evaluation of process specifications and quality control jointly by the customer and the operator by using techniques listed in BREF Section 5.1.1.3
  - regular benchmarking, where practicable, for energy, water and raw materials, continuous optimisation against this benchmarking; and the taking of actions based on this benchmarking data to the extent allowable (see BREF Section 5.1.1.4)
  - annual waste minimisation report showing efforts made to reduce specific consumption together with material balance and fate of all materials (see BREF Section 5.1.5.1)

- for automatic lines, use real time process control and optimisation (see BREF Section 5.1.1.5),
- regular maintenance of process baths
- implement the hazard identification, ranking and plan of action as detailed in BREF Section 4.2.1 (see BREF Section 5.1.2)
- implement utilities monitoring and raw materials usage optimisation processes (see BREF Sections 5.1.4 & 5.1.6.5)
- implement the process optimisation measures set out in BREF Section 5.1.4.3
- minimise drag-in and drag-out by implementing the general measures set out in BREF Sections 5.1.5.2, 5.1.5.3 & 5.1.5.3.1, where applicable to the process
- implement those measures set out in BREF Section 5.1.5.4 to reduce rinse water that are applicable to the process
- agitate all process solutions using hydraulic turbulence or mechanical agitation of the workpieces (see BREF Section 5.1.3)
- evaluate materials recovery and closing the loop systems (see BREF Sections 5.1.6.3 & 5.1.8.4).

5.2.2 Minimisation of Water and Material Consumption, and Waste Generation

- Minimise water consumption by implementing where feasible techniques referred to in BREF Section 5.1.8.1
- Minimise material use and loss by implementing where feasible those techniques referred to in BREF Section 5.1.6
- Minimise waste generation by implementing where feasible those techniques referred to in BREF Section 5.1.9
- Reduce water consumption during rinsing using the techniques referred to in BREF Section 5.1.5.4.

5.2.3 Minimisation of Energy Consumption

5.2.3.1 Process Activities

- For 3 phase supplies minimise losses through the regular testing described in BREF Section 5.1.4.1
- Reduce voltage drop using the measures described in BREF Section 5.1.4.1, as relevant to the installation
- Use individual anode feeding and controls to optimise current setting (see BREF Section 5.1.4.1)
- Keep bus bars short (see BREF Section 5.1.4.1)
- Maintain the rectifiers and associated electrical system (see BREF Section 5.1.4.1)
- For new activities or significantly changed activities, use rectifiers with better conversion factors as per BREF Section 5.1.4.1
- Increase conductivity of process solutions by using additives as appropriate (see BREF Section 5.1.4.1)
- Use modified wave forms where process allows (BREF Section 5.1.4.1)
- Reduce exhaust air volumes through the measures outlined in BREF Sections 4.4.3 and 4.18.3, as appropriate (see BREF Section 5.1.4.3)
- Insulate heated process surfaces, unless unfeasible for the process (see BREF Section 5.1.4.3).

5.2.3.2 Cooling Activities

- For new or replacement systems, use closed refrigerated cooling systems (see BREF Section 5.1.4.4)
- Do not use once through water-cooling systems, unless local considerations allow this (see BREF Section 5.1.4.4)
- Open cooling systems must be designed, maintained and located to prevent the formation and transmission of legionella and transmission (see BREF Section 5.1.4.4)
- Use process evaporation to allow for make up chemical volumes and reuse of rinse water (see BREF Section 5.1.4.4)
- Prevent overcooling by optimising the process solution composition and working temperature range. Monitor process and control within optimised ranges (see BREF Section 5.1.1.1).

5.2.4 Process Solution Maintenance

For each of the relevant processes listed in BREF Section 5.1.7 implement those solution maintenance measures that are feasible for the installation.

5.2.5 Prevention and Reduction

- For all facilities involved in the surface treatment of metals and plastics, BAT is to do the following:
  - prevent the loss of metals and other raw materials together, through reducing and managing drag-out (see BREF Sections 4.6 & 5.1.5.3) and increasing drag out recovery (see BREF Sections 4.7 & 5.1.6.1)
  - prevent loss of materials through overdosing using techniques described in BREF Section 5.1.6.1
  - for processes with differing electrode efficiencies implement the relevant measures listed in BREF Section 4.8.2 to control metal concentration (see BREF Section 5.1.6.5).

5.2.6 Recovery and Recycling

- For all facilities involved in the surface treatment of metals and plastics following application of prevention and reduction loss techniques (see 5.2.4 above), BAT is to do the following:
  - evaluate the feasibility of recovery of metals from process solutions and drag-outs. Implement such systems where feasible (see BREF Section 5.1.6.4)
  - identify and segregate at source wastes that could be recovered and reused implement where feasible (see BREF Section 5.1.6.4)
  - for plating solutions, evaluate the feasibility of achieving closed loop or zero discharge (see BREF Section 5.1.8.4) for individual activities/process lines (see BREF Section 5.1.6.3), and in particular for the types of processes listed in BREF Section 5.1.6.3. Implement such closed loop systems where feasible.

5.2.7 Containment

- For all facilities involved in the surface treatment of metals and plastics, BAT is to do the following:
  - implement the general chemical storage requirements of the Reference Document on Best Available Techniques on Emissions from Storage

- implement the requirements listed in BREF Section 5.1.2.1, where relevant to the installation
- protect metal workpieces/surfaces before and after treatment to prevent corrosion, using one or a combination of the measures listed in BREF Section 4.3.1 & 5.1.2.1.

5.2.8 Site Decommissioning & Groundwater Protection Section

- For all facilities involved in the surface treatment of metals and plastics, BAT is to do the following:
  - use bunding and sealing (see BREF Section 5.1.12)
  - record the information referred to in BREF Section 5.1.12 on an on-going basis, and implement if/when decommissioning occurs (see BREF Section 5.1.1.2).

5.3 BAT FOR SPECIFIC PROCESSES

For all activities involved in the surface treatment of metals and plastics, in addition to the relevant measures outlined in section 5.2 of this document, BAT is to do the following, as relevant.

5.3.1 General Preventive Measures

- For all activities involved in the surface treatment of metals and plastics, BAT is to do the following for all relevant processes (see BREF Section 5.2):
  - electrolytic degreasing and electrolytic pickling processes – switch electrode polarisation at regular intervals (see BREF Section 5.2.9)
  - it is BAT to reduce material usage and energy consumption through use of one or a combination of techniques for maintenance of degreasing solutions (see BREF Section 5.2.8)
  - it is BAT to recover hexavalent chromium in concentrated and expensive solutions (see BREF Section 5.2.10).

5.3.2 Substitution and Control Measures

- For each of the relevant substances used in the processes in BREF Section 5.2.5 implement those substitution or control measures that are feasible for the installation
- Where technically possible it is BAT to use acid copper to replace mechanical polishing and buffering (see BREF Section 5.2.6)
- It is BAT to liaise with the customer on the type of oil or grease for use of the surface of workplaces (see BREF Section 4.3.2) on order to minimise oil/grease usage and chose environmentally friendly systems (see BREF Section 5.2.7)
- Where there is excessive oil remove through physical methods (see BREF Section 5.2.7)
- Replace cyanide degreasing with other methods (see BREF Section 5.2.7.1)
- Replace solvent degreasing by other methods unless local reasons exist at an installation level for using solvent based systems (see BREF Section 5.2.7.2)
- Reduce the use of chemical and energy in degreasing systems by using long life systems with solution regeneration and/or continuous maintenance (see BREF Section 5.2.7.3)

- For high performance cleaning and degreasing requirements it is BAT to use a combination of techniques or specialist techniques such as dry ice or ultrasonic cleaning (see BREF Section 5.2.7.4).

5.3.3 Printed Circuit Boards

- For printed circuit board manufacturing, BAT is to do the following (see BREF Section 5.2.13):
  - use squeeze wiper rollers to reduce dragout
  - use the brown oxide technique, unless it is demonstrated to be unfeasible
  - dispose of direct plating solutions as waste and not via the treatment plant
  - implement measures regarding the developing step for dry resist
  - implement the measures regarding the etching process, where the relevant processes are being carried out
  - implement the technique appropriate to the scale of the installation regarding the removal of resist from the effluent from resist stripping process
  - collect rinsing waters from etch tin resist stripping process
  - use high solids low VOC resins in the solder mask step.

5.3.4 Measures for Treatment, Abatement and Disposal

5.3.4.1 Treatment of Air Emissions

- For all activities involved in the surface treatment of metals and plastics, BAT is to minimise the formation of air emissions using the measures outlined in section 5.2 of this document:
  - use air extraction for all of the processes listed in BREF Section 5.1.10 (while minimising volume as already outlined) other processes may also require extraction these are given in BREF Chapters 2 and 4
  - For VOC emissions, refer to the Guidance Note on Best Available Techniques for the Manufacture of Organic Chemicals.

5.3.4.2 Treatment of Waste Water

- For all activities involved in the surface treatment of metals and plastics, BAT is to minimise the formation of wastewater using the measures outlined in section 5.2 of this document:
  - identify wastewater flows that could be treated separately as listed in BREF Section 5.1.8.2, and implement where feasible
  - remove metals by flocculation and pH adjust (see BREF Section 5.1.8)
  - remove solids by filtration or precipitation (see BREF Section 5.1.8)
  - do not send bulk solutions to the treatment plant that can upset its operation (see BREF Section 5.1.8).

5.3.4.3 Treatment and Disposal of Waste

For all activities involved in the surface treatment of metals and plastics, BAT is to minimise the quantity and load of waste generated using the measures outlined in section 5.1.9 of this document, and then dispose of the waste using appropriately licensed recovery or disposal facilities.

Further information on a number of waste gas and wastewater treatment techniques can be found in the BREF document on *Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector*, EIPPCB, February 2003.

6. BAT ASSOCIATED EMISSION LEVELS

6.1 EMISSION LEVELS FOR DISCHARGES TO AIR

The BAT-associated emission levels for emissions to air given below in Table 6.1

All parameters will not be relevant to every installation and will depend on the type of substances and processes in use at the installation, and other site-specific factors.

Table 6.1 BAT-Associated Emission Levels for Emissions to Air

Constituent Group or Parameter Note1	**Class**	**Emission Level (mg/m^3)**	**Mass Flow Threshold (g/hr)** Note 2
Carcinogenic Substances (Note 3)	**Class I (limits set for class total)** - arsenic and its compounds (except for arsine), as As - benzo(a)pyrene - cadmium and its compounds, as Cd - water-soluble compounds of cobalt, as Co - chromium (VI) compounds (except for barium chromate and lead chromate), as Cr	0.05	0.15
	Class II (limits set for class total) - acrylamide - acrylonitrile - dinitrotoluenes - ethylene oxide - nickel and its compounds (except for nickel metal, nickel alloys, nickel carbonate, nickel hydroxide, nickel tetracarbonyl) as Ni - 4-vinyl-1,2-cyclohexane-diepoxy	0.5	1.5
	Class III (limits set for class total) - benzene - bromoethane - 1,3-butadiene - 1,2-dichloroethane - 1,2-propylene oxide (1,2-epoxy propane) - styrene oxide - o-toluidine - trichloroethane - vinyl chloride	1	2.5
Vaporous or Gaseous Inorganic Substances	**Class I (limits set on a per substance basis)** - arsine - cyanogen chloride - phosgene - phosphine	0.5	2.5

	Class II (limits set on a per substance basis) - bromine and its gaseous compounds, as HBr - chlorine - hydrocyanic acid - fluorine and its gaseous compounds, as HF - hydrogen sulphide	3	15
	Class III (limits set on a per substance basis) - ammonia - gaseous inorganic compounds of chlorine, as HCl	30	150
	Class IV (limits set on a per substance basis) - sulphur oxides (sulphur dioxide and sulphur trioxide), as SO_2 - nitrogen oxides (nitrogen monoxide and nitrogen dioxide), as NO_2 - nitrogen monoxide and nitrogen dioxide, as NO_2 (thermal or catalytic post-combustion facilities) - Carbon monoxide	350	1800
Inorganic Dust Particles (Note 3)	**Class I (limits set on a per substance basis)** - mercury and its compounds, as Hg - thallium and its compounds, as Tl	0.05	0.25
	Class II (limits set for class total) - lead and its compounds, as Pb - cobalt and its compounds, as Co - nickel and its compounds, as Ni - selenium and its compounds, as Se - tellurium and its compounds, as Te	0.5	2.5
	Class III (limits set for class total) - antimony and its compounds, as Sb - chromium and its compounds, as Cr - easily soluble cyanides (e.g. NaCN), as CN - easily soluble fluorides (e.g. NaF), as F - copper and its compounds, as Cu - manganese and its compounds, as Mn - vanadium and its compounds, as V - tin and its compounds, as Sn - Other substances with risk phrases R40, R62 or R63	1	5
Particulate Matter		5 - 20 150	>200 <200

Volatile Organic Compound (VOCs)			Refer to the BAT Guidance note on Best Available Techniques for the Manufacture of Organic Chemicals Sector
Other			Note 4

- For existing activities, BAT associated emission levels shall as a minimum, be considered TA Luft (Technical Instructions on Air Quality Control - TA Luft in accordance with Art. 48 of the Federal Immission Control Law (BImSchG) dated 15 March 1974 (BGBI. I p.721). Federal Ministry for Environment, Bonn 1986, including the amendment for Classification of Organic Substances according to section 3.1.7 TA.Luft, published in July 1997).

Note 1: Where a substance falls into more than one category in Table 6.1, the lower emission limit value applies.

Note 2: The Mass Flow Threshold is calculated in g/hr or kg/hr and is determined to be the maximum emission, which can occur over any one-hour period of plant operation. Where the Mass Flow in the raw gas exceeds the mass flow threshold given in the Table, abatement will be required to reduce the emission to below the appropriate emission level or mass flow threshold.

Note 3: Where substances of several classes are present, in addition to the above limit, the sum of Classes I & II shall not exceed the Class II limit and the sum of Classes I & III, II & III or I, II & III shall not exceed the Class III limit.

Note 4: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

6.2 EMISSION LEVELS FOR DISCHARGES TO WATER

The following table sets out emission levels that are achievable using BAT for wastewater treatment. However establishing emission limit values within a licence for direct discharges to surface water from wastewater treatment plant and stormwater discharges must ensure that the quality of the receiving water is not impaired or that the current Environmental Quality Standards (EQS) are not exceeded.

All discharges to sewer are subject to approval from the Water Services Authority.

Compliance with the Water Framework Directive (2000/60/EC) is required where relevant, in particular Article 16.

Table 6.2: BAT-Associated Emission Levels for Discharges to Water*

Constituent Group or Parameter	Emission Level	Percentage Reduction[3]	Notes
pH	6 - 9	-	
Toxicity	5 TU		1
BOD_5	25mg/l	>91 - 99%	
COD	100 - 500mg/l	>75%	
Suspended Solids	10 - 35mg/l		
Total Ammonia (as N)	10mg/l		
Total Nitrogen (as N)	5 - 15mg/l	>80%	2, 4
Total Phosphorus (as P)	2mg/l	>80%	4
Oils Fats and Greases	10mg/l		
Mineral Oil (from interceptor)	20mg/l		
Mineral Oil (from biological treatment)	1.0mg/l		
Phenols			5
Metals			5, 6
Organohalogens			5
Priority Substances (as per Water Framework Directive)			5
Cyanides			5
Fluorides			5
Other			5, 7

* All values refer to daily averages based on a 24-hour flow proportional composite sample, except where stated to the contrary and for pH, which refers to continuous values. Levels apply to effluent prior to dilution by uncontaminated streams, e.g. storm water, cooling water, etc.

* Temperature measured downstream of a point of thermal discharge must not exceed the unaffected temperature by more than 1.5°C in salmonid waters and 3°C in cyprinid waters (Freshwater Fish Directive 79/659/EEC).

Note 1: The number of toxic units (TU) = 100/x hour EC/LC50 in percentage vol/vol so that higher TU values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

Note 2: Total Nitrogen means the sum of Kjeldahl Nitrogen, Nitrate N and Nitrite N.

Note 3: Reduction in relation to influent load.

Note 4: Limits will depend on the sensitivity of the receiving waterbody.

Note 5: BAT associated emissions levels are highly dependent on production process, wastewater matrix and treatment. These parameters shall be considered on a site-specific basis when setting emission limit values.

Note 6: PARCOM recommendation 92/4 applies to wastewater emissions from the electroplating industry discharging to water or public sewer. Where the sum of metals specified in combined is < 200g/day prior to treatment, their emission level values may be increased fourfold. Applies to activities other than printed circuit board manufacture. Applies to wastewater streams specially treated (PARCOM).

Note 7: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

7. COMPLIANCE MONITORING

The methods proposed for monitoring the emissions from these sectors are set out below. Licence requirements may vary from those stated below due to site location considerations, and scale of the operation.

7.1 MONITORING OF EMISSIONS TO AIR

- Stack sampling periodically, as required by licence, taking account of the nature, magnitude and variability of the emission and the reliability of the control techniques.
- Continuous monitoring on main emissions where technically feasible (e.g. HCl, Particulates, CO, SO_2, NOx).
- Monitor solvent / VOC usage by annual mass balance reports and use to determine fugitive emissions.
- Annual monitoring of boiler stack emissions for SOx, NOx, CO and particulates, as required by the licence, taking account of the nature, magnitude and variability of the emission and the reliability of the controls.
- Monitoring of boiler combustion efficiency in accordance with the manufacturer's instructions at a frequency determined by the Agency.
- Olfactory (sniff) assessment for odours should be carried out daily or as directed by the Agency at a minimum at four boundary locations and at the nearest odour sensitive locations to be agreed with the Agency.
- Periodic monitoring for other parameters as determined by the Agency.

7.2 MONITORING OF AQUEOUS EMISSIONS

- For uncontaminated cooling waters, continuous monitoring of temperature and flow.
- Establish existing conditions prior to start-up, of key emission constituents, and salient flora and fauna.
- Daily, or where deemed necessary, continuous monitoring of flow and volume. Continuous monitoring of pH. Monitoring of other relevant parameters as deemed necessary by the Agency (such as BOD, COD, metals, etc.), taking account of the nature, magnitude and variability of the emission and the reliability of the control techniques.
- Monitoring of influent and effluent from the wastewater treatment plant to establish percentage BOD reduction and an early warning of any difficulties in the waste water treatment plant, or unusual loads.
- The potential for the treated effluent to have tainting and toxic effects should be assessed and if necessary measured by established laboratory techniques.
- Periodic biodegradability checks where appropriate on effluents to municipal waste treatment plants, both prior to start-up and thereafter.

7.3 MONITORING OF EMISSIONS TO GROUNDWATER

There should be no direct emissions to groundwater, including during extraction and treatment of groundwater.

7.4 MONITORING OF SOLID WASTE

- The recording in a register of the types, quantities, date and manner of disposal/recovery of all wastes.
- Leachate testing of sludges and other material as appropriate being sent for landfilling.
- Annual waste minimisation report showing efforts made to reduce specific consumption together with material balance and fate of all waste materials.

Appendix 1

PRINCIPAL REFERENCES

1. E.C.

1.1. Council Directive 96/61/EC of 24 September 1996 concerning Integrated Pollution Prevention and Control.

1.2. Reference Document on Best Available Techniques for the Surface Treatment of Metals and Plastics (September 2005).

1.3. Council Directive 96/61/EC of 11 March 1999 on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations.

1.4. Draft Reference Document on Best Available Techniques for Surface Treatment using Organic Solvents (September 2005).

1.5. Reference Document on Best Available Techniques on Emissions from Storage (January 2005).

1.6. Reference Document on the application of Best Available Techniques to Industrial Cooling Systems (December 2001).

1.7. Reference Document on Best Available Techniques in common wastewater and waste gas treatment/management systems in the chemical sector (February 2003).

1.8. Reference Document on Best Available Techniques in the ferrous metals processing industries (December 2001).

1.9. Reference Document on Best Available Techniques in the non ferrous metals processing industries (December 2001).

2. IRELAND

2.1. Integrated Pollution Control Licensing BATNEEC Guidance Note For Electroplating Operations (EPA 1996).

2.2. Integrated Pollution Control Licensing BATNEEC Guidance Note For the Manufacture of Integrated Circuits and Printed Circuit Boards (EPA 1996).

2.3. BAT Guidance Note on Best Available Techniques for solvent use in coating cleaning and degreasing (EPA).

2.4. Integrated Pollution Control Licensing BATNEEC Guidance Note For Noise in Relation to Scheduled Activities (EPA No. LC 8 (1995)).

2.5. Guidance Note For Noise in Relation to Scheduled Activities 2ND Edition (EPA (2006)).

Appendix 2

GLOSSARY OF TERMS AND ABBREVIATIONS

BAT	Best Available Technique
BOD	Biochemical Oxygen Demand
BREF	Reference document on Best Available Techniques for the surface treatment of metals and plastics, published by the European Commission, September 2005
°C	Degree Celsius
CO	Carbon monoxide
COD	Chemical Oxygen Demand
kg	Kilogramme
m^3	Cubic metre
mg	Milligram
Nm^3	Normal cubic metre (101.3 kPa, 273 K)
NO_x	Nitrogen oxides
O_2	Oxygen
SO_x	Sulphur oxides
t	Tonne (metric)
VOC	Volatile Organic Compounds