

www.environment-agency.gov.uk

Consultation Draft - Guidance for the Surface Treatment of Metals and Plastics by Electrolytic and Chemical Processes



Commissioning Organisation

Environment Agency
Rio House
Waterside Drive
Aztec West
Almondsbury
Bristol BS32 4UD
Tel 01454 624400 Fax 01454 624409

© Environment Agency
First Published February 2004
ISBN 0

This document is Environment Agency copyright . We specifically allow the following:

- Internal business or personal use. You may use this document for your own private use or for use within your business without restriction.
- Giving copies to others. You may do this without restriction provided that you make no charge.

If you wish to use this document in any way other than as set out above including in particular for commercial gain, for example by way of rental, licence, sale or providing services you should contact:

Liz Greenland
Environment Agency
Scientific and Technical Information Service
2440 The Quadrant
Aztec West
Almondsbury
Bristol
BS32 4AQ

This is an uncontrolled document. To ensure you are using the latest version please check on any of the websites listed within the references.

Table 0.1: Record of changes

Version	Date	Change	Template Version
Draft 2.1	9 November 2001	Initial draft supplied to Trade Associations, Operators, Agency staff etc.	V1
Consultation Draft	February 2004	Updated template, amendments to regulations, emissions to air	V1

Note: Queries about the content of the document should be made to Aidan Whitfield (01733 464161) or any member of the PIR Process Management Team.

Written comments or suggested improvements should be sent to surface.treatment@environment-agency.gov.uk or to:

PIR Process Management
Environment Agency
Block 1, Government Buildings
Burghill Rd
Westbury-on-Trym
Bristol.
BS10 6BF
Telephone 0117-914 2871

Executive summary

This guidance has been produced by the Environment Agency for England and Wales with the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment and Heritage Service (EHS). Together these are referred to as “the Regulator” throughout this document. Its publication follows consultation with industry, government departments and non-governmental organisations.

What is IPPC?

Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single Permitting process. To gain a Permit, Operators will have to show that they have systematically developed proposals to apply the Best Available Techniques (BAT) and meet certain other requirements, taking account of relevant local factors.

This Guidance and the BREF

This UK Guidance is interim guidance for delivering the requirements of the PPC Regulations in those sectors with chemical or electrochemical Surface Treatment, and it sets out the techniques and standards that need to be addressed to satisfy those regulatory requirements. A BAT Reference document (BREF) resulting from an interchange of information between Member States and industry responsible for Plating, Anodising and other final Surface Treatments, is in the early stages of preparation by the European Commission. (See Ref 1) When that document is published this Guidance will be reviewed against the information contained in that BREF, and a new Guidance Note, cross-referenced to the Surface Treatment BREF, will be published.

Guidance on chemical or electrolytic surface treatment in other industries is also provided. For example, BAT for pickling in preparation for galvanising or cold rolling is based on the BREF prepared by the EC for the Ferrous Metals Processing Industry. (See Ref 2) The usefulness of that BREF is acknowledged and this guidance is cross-referenced to it so the reader is advised to have access to it.

The aims of this Guidance

The aims of this Guidance are to:

- provide a clear structure and methodology for Operators to follow to ensure they address all aspects of the PPC Regulations and other relevant Regulations
- minimise the effort by both Operator and Regulator in the permitting of an installation by expressing the BAT techniques as clear indicative standards
- improve the consistency of applications by ensuring that all relevant issues are addressed
- increase the transparency and consistency of regulation by having a structure in which the Operator's response to each issue, and any departures from the standards, can be seen clearly and which enables applications to be compared

To assist Operators in making applications, separate, horizontal guidance is available on a range of topics such as waste minimisation, monitoring, calculating stack heights and so on. Most of this guidance is available free through the Environment Agency, SEPA or EHS (Northern Ireland) websites (see [References](#)).

Contents

1 Introduction	1
1.1 Understanding IPPC	1
1.2 Making an application	3
1.3 Installations covered	4
1.4 Timescales	6
1.4.1 Permit review periods	6
1.4.2 Upgrading timescales for existing plant	6
1.5 Key issues	7
1.6 Summary of releases	8
1.7 Technical overview	9
1.8 Economics	11
2 Techniques for pollution control	13
2.1 In-process controls	14
2.1.1 Environmental performance indicators	14
2.1.2 Storage of Input Chemicals and Anode Materials	15
2.1.3 Water Treatment	18
2.1.4 Mechanical Preparation	19
2.1.5 Organic Solvent Cleaning	20
2.1.6 Chemical Preparation	21
2.1.7 Surface Treatment Processes	24
2.1.8 Rinsing	34
2.1.9 Drying	37
2.2 Emissions control	38
2.2.1 Point source emissions to air	38
2.2.2 Point source emissions to surface water and sewer	40
2.2.3 Point source emissions to groundwater	44
2.2.4 Control of fugitive emissions to air	47
2.2.5 Fugitive emissions to surface water, sewer and groundwater	49
2.2.6 Odour	51
2.3 Management	53
2.4 Raw Materials	56
2.4.1 Raw materials selection	56
2.4.2 Waste minimisation audit (minimising the use of raw materials)	59
2.4.3 Water use	61
2.5 Waste handling	64
2.6 Waste recovery or disposal	65
2.7 Energy	66
2.7.1 Basic energy requirements (1)	66
2.7.2 Basic energy requirements (2)	68
2.7.3 Further energy-efficiency requirements	70
2.8 Accidents	71
2.9 Noise	74
2.10 Monitoring	76
2.11 Closure	81
2.12 Installation issues	83

3 Emission benchmarks	84
3.1 Emissions inventory	84
3.2 Emission benchmarks	86
3.2.1 Emissions to air associated with the use of BAT	86
3.2.2 Emissions to water associated with the use of BAT	87
3.2.3 Waste releases associated with the use of BAT	88
3.2.4 Standards and obligations	89
3.2.5 Units for benchmarks and setting limits in permits	90
3.2.6 Statistical basis for benchmarks and limits in permits	91
3.2.7 Reference conditions for releases to air	91
4 Impact	92
4.1 Impact assessment	92
4.2 Waste Management Licensing Regulations	94
4.3 The Habitats Regulations	95
References	96
Abbreviations	99
Glossary	100
Appendix 1:Some common monitoring and sampling methods	101
Appendix 2:Equivalent legislation in Scotland & Northern Ireland	103

List of Figures

Typical Pre-treatment Schematic Flow Diagram	10
Typical Surface Finishing and Post Treatment Stages	10
Work Flow Direction	36
Typical Effluent Treatment Facility	40

List of Tables

Table 1.1: Summary of Releases	8
Table 1.2: Distrribution of Electroplating Processes	9
Table 1.3: Distribution of Employees	9
Table 1.4: Distribution of Employees by Plant Size	9
Table 1.5: Anode Metal Consumption Data	11
Table 1.6: Capital Investment Costs	11
Table 1.7: Examples of Cost Saving Technigues	12
Table 2.1: Processes Covered by this Sector	24
Table 2.2: Typical Process Sequences	25
Table 2.3: Rinsing Ratios	35
Table 2.4: Cascade Rinsing	35
Table 2.5: Raw Material Substitutions	58
Table 2.6: Example breakdown of delivered and primary energy consumption	67
Table 2.7: Example format for energy efficiency plan	69
Table 2.8: Monitoring of process elements released to controlled waters:	80
Table 3.1: Emissions to air associated with the use of BAT	87
Table 3.2: Benchmark values for releases to Sewer	88
Table 3.3: Process Efficiencies	88
Table 4.1: Measurement methods for common substances to water	101
Table 4.2: Measurement methods for air emissions	102
Table 4.3: Equivalent legislation	103

1 Introduction

1.1 Understanding IPPC

IPPC and the Regulations

Integrated Pollution Prevention and Control (IPPC) is a regulatory system that employs an integrated approach to control the environmental impacts of certain industrial activities. It involves determining the appropriate controls for industry to protect the environment through a single permitting process. To gain a Permit, Operators will have to show that they have systematically developed proposals to apply the Best Available Techniques (BAT) and meet certain other requirements, taking account of relevant local factors.

The essence of BAT is that the selection of techniques to protect the environment should achieve an appropriate balance between the environmental benefits and the costs incurred by Operators.

IPPC operates under the Pollution Prevention and Control Regulations, (see [The Pollution Prevention and Control Regulations](#) and [Appendix 2](#)). These Regulations have been made under the Pollution Prevention and Control (PPC) Act 1999 and implement the EC Directive 96/61 on IPPC. Further information on the overall system of IPPC, together with Government policy and more detailed advice on the interpretation of the Regulations, can be found in the Department of the Environment, Food and Rural Affairs (DEFRA) document [IPPC: A Practical Guide](#).

Installation based, NOT national emission limits

The BAT approach of IPPC differs from regulatory approaches based on fixed national emission limits (except where General Binding Rules or standard Permits are issued). The legal instrument that ultimately defines BAT is the Permit, and this can only be issued at the installation level.

Indicative BAT Standards

Indicative BAT standards (essentially for BAT, but also covering other aspects) are laid out in national guidance (such as this) and should be applied unless there is strong justification for another course of action. BAT includes both the technical components of the installation given in Section 2 and the benchmark levels identified in Section 3. Departures from those standards, in either direction, can be justified at the local level taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. If there are any applicable mandatory EU emission limits, these must be met, although BAT may go further.

BAT and EQS

The BAT approach also differs from, but complements, regulatory approaches based on Environmental Quality Standards (EQS). Essentially, BAT requires measures to be taken to prevent or, where this is not practicable, to reduce emissions. That is, if emissions can be reduced further, or prevented altogether, at reasonable cost, then this should be done irrespective of whether any environmental quality standards are already being met. It requires us not to consider the environment as a recipient of pollutants and waste, which can be filled up to a given level, but to do all that is practicable to minimise the impact of industrial activities. The BAT process considers what can be reasonably achieved within the installation first (covered by Sections 2 and 3 of this Guidance) and only then checks to ensure that the local environmental conditions are secure (see [Section 4](#) on page 92 of this Guidance and [IPPC Environmental Assessments for BAT](#)). So the BAT approach is a more precautionary one, which may go beyond the requirements of Environmental Quality Standards.

Conversely, it is possible that the application of BAT may lead to a situation in which an EQS is still threatened. The Regulations therefore allow for expenditure beyond indicative BAT where necessary. This situation should arise very rarely assuming that the EQS is soundly based on an assessment of harm. The BAT assessment, which balances cost against benefit (or prevention of harm) should, in most cases, have come to the same conclusion about the expenditure which is appropriate to protect the environment.

Advice on the relationship of environmental quality standards and other standards and obligations is given in [IPPC: A Practical Guide](#) and in Section 3.

Assessing BAT at the sector level

The assessment of BAT takes place at a number of levels. At the European level, the EC issues a BAT reference document (BREF) for each sector. The BREF is the result of an exchange of information which member states should take into account when determining BAT, but which gives them flexibility in its application. This UK Sector Guidance Note takes into account the information contained in the BREF and lays down the indicative standards and expectations in the UK. At this national level, techniques that are considered to be BAT should represent an appropriate balance of costs and benefits for a typical, well-performing installation in that sector and be affordable without making the sector as a whole uncompetitive, either within Europe or world-wide.

Assessing BAT at the installation level

When assessing which sectoral, indicative BAT standards apply at the installation level, departures may be justified in either direction as described above. The most appropriate technique may depend on local factors and, where the answer is not self-evident, a local assessment of the costs and benefits of the available options may be needed. Individual company profitability is not considered. Further information on this can be found in [IPPC: A Practical Guide](#) and [IPPC Part A\(1\) Installations: Guide for Applicants](#).

Costs may only be taken into account at the local level where:

- the local technical characteristics or environmental conditions can be shown to be different from those assumed in the national/European assessment of BAT described in this guidance; in such cases a local cost benefit assessment may be appropriate
- where the BAT cost/benefit balance of an improvement only becomes favourable when the relevant item of plant is due for renewal/renovation. In effect, these are cases where BAT for the sector can be expressed in terms of local investment cycles
- a number of expensive improvements are needed. Then a phasing programme may be appropriate as long as it is not so drawn out that it appears to be rewarding a poorly performing installation, (see [IPPC Environmental Assessments for BAT](#) for more details).

Innovation

The Regulators encourage the development and introduction of innovative techniques that meet the BAT criteria. They are looking for continuous improvement in the overall environmental performance of the installation as a part of progressive sustainable development. This Sector Guidance Note describes the indicative standards at the time of writing. However, Operators should keep up-to-date with the relevant BATs. This note may not be cited in an attempt to delay introducing improved techniques. The technical characteristics of a particular installation may also allow for opportunities not foreseen in the Guidance; as BAT is determined at the installation level, except in the case of General Binding Rules (GBRs), it is valid to consider these even where they go beyond the Indicative Standards.

New installations

The Indicative Requirements apply to both new and existing activities, but it will be more difficult to justify departures from them in the case of new installations. For new activities the Indicative Requirements should normally be in place before operations start. In some cases, such as where an audit of ongoing operations is required, this is not possible and indicative upgrading timescales are given for such cases.

Existing installation standards

For upgrading timescales for existing plant, see [Section 1.4.2](#) on page 6.

1.2 Making an application

A satisfactory Application is made by:

- addressing the issues in Sections 2 and 3 of this guidance;
- assessing the environmental impact described in Section 4 (and in England and Wales [Environmental Assessment and Appraisal of BAT \(IPPC H1\)](#));
- demonstrating that the proposed techniques are BAT for the installation.

In practice, some Applicants have submitted far more information than was needed, yet without addressing the areas that are most important - and this has led to extensive requests for further information. In an attempt to focus application responses to the areas of concern to the Regulator, Application forms (templates) have been produced by the Environment Agency, by SEPA and by EHS in N Ireland. In addition, as the dates for application have approached, the operators in most industrial sectors in England and Wales have been provided with Compact Discs (CDs) which contain all relevant Application Forms, technical and administrative guidance, BREFs and Assessment tools, hyper-linked together for ease of use.

For Applicants with existing IPC Authorisations or Waste Management Licences, the previous applications may provide much of the information for the PPC application. However, where the submitted Application refers to information supplied with a previous application the Operator will need to send fresh copies - though for many issues where there is a tendency for frequent changes of detail (for example, information about the management systems), it will be more appropriate simply to refer to the information in the Application and keep available for inspection on site, up-to-date versions of the documents.

For further advice see [IPPC Part A\(1\) Installations: Guide for Applicants \(for England and Wales\)](#) or [PPC Part A Installations: Guide for Applicants \(for Scotland\)](#) or the equivalent Northern Ireland guide for Applicants.

1.3 Installations covered

This Guidance relates to installations containing the activities listed below, as described in Part A(1) of Schedule 1 to the [Pollution Prevention and Control Regulations \(England & Wales\)](#). The schedules of listed activities are slightly different in Scotland and Northern Ireland so for their equivalent Regulations see [Appendix 2](#)

- (a) those containing activities described in Section 2.3 Part A(1) (a) of Schedule 1 to the PPC Regulations (see [Ref 3](#)), "listed activities", as follows:

Unless falling within Part A (2) of this section* surface treating metals and plastic materials using an electrolytic or chemical process where the aggregated volume of the treatment vats is more than 30m³.

- (b) those involving surface treatment with cadmium-containing solutions which are covered by Section 4.2, Part A(1) (f), thus:

Unless falling within another Section of this Schedule, any manufacturing activity involving the use of mercury or cadmium or any compound of either element, or which may result in the release into air of either of those elements or their compounds.

* - In July 2003, the PPC Regulations were amended by SI 2003 No 1699, which inserted a new Section 2.3 A (2) (a), thus:

Surface treating metals and plastic materials using an electrolytic or chemical process where the aggregated volume of the treatment vats is more than 30m³ and where the activity is carried out at the same installation as one or more activities falling within -

- (i) Part A(2) or B of Section 2.1 (Ferrous Metals);
- (ii) Part A(2) or B of Section 2.2 (Non-Ferrous Metals); or
- (iii) Part A(2) or B of Section 6.4 (Coating Activities, Printing and Textile Treatments).

The amendment has the effect of moving some activities from Environment Agency to Local Authority regulation, e.g. where pickling is carried out prior to galvanising, phosphating prior to painting and anodising prior to powder coating. This guidance note only covers those A (1) activities which will be regulated by the Agency.

(THIS PARAGRAPH TO BE REMOVED FROM THE FINAL VERSION OF THIS GUIDANCE NOTE).
On 10 December 2003 Defra issued a consultation paper setting out a series of proposals to amend the PPC regulations. The amendments may affect the regulation of some installations in this sector of industry. As the consultation paper does not currently have any draft regulations it is difficult to know any specific details. Any operators potentially affected by this should respond to Defra. The closing date for responses is 12 March 2004.

There is no volume threshold for cadmium processes. For all others, overall treatment volume is calculated as the total volume of all vats or tanks used for immersion operations which involve chemical or electrochemical alteration of the surface of the work.

Tanks or vats used for static or running rinsing, for degreasing or physical cleaning of the surface, for reagent storage or for effluent treatment are not included in the assessment of the treatment volume in relation to the 30 m³ threshold, - nor are trays or enclosures used to contain treatment liquors during spraying operations (even when the latter activities involve chemical change of the surface being treated). Similarly, tanks or vats used for chemical or electrochemical milling or used for electrophoretic coating are considered to be outside the scope of the treatment volume assessment because milling involves dissolution of the body of a work-piece rather than just treatment of its surface, and electrophoretic techniques do not involve any chemical change to the surface of the work.

The following list summarises the types of immersion activity which do meet the description of "treatment" (ie. cause chemical change to the surface) and so contribute to the aggregation total for comparison with the 30m³ threshold : Electroplating, electroless (autocatalytic) plating, anodising, passivation, electropolishing, pickling, activation, chromating, phosphating, bright dipping, chemical blacking, decorative oxidation, stripping (removal of plated metal), post-anodising sealing (both hot water and cold, eg. with nickel acetate solutions), and surface etching (but not "chemical milling"). Electrolytic cleaning may meet the description if voltage conditions are changed such that metal is removed as ions instead of scale being eroded by hydrogen liberation.

The following do not meet the description of "treatment " : Rinsing, subsequent weak acid or alkaline dips to remove residual alkalinity or acidity, respectively, from previous treatment stages, alkaline soak cleaning of steel (and other metals that are unreactive under alkaline conditions), electrolytic alkaline soak (except where the polarity is reversible and/or conditions favour metal corrosion), bacterial cleaning, colour dyeing, and electrophoretic lacquering or painting.

Although not counting towards the qualifying treatment volume these activities may still be included in the installation that is to be regulated. The installation includes not only the chemical and electrolytic surface treatment activities but also directly associated activities which have a technical connection with the "listed" activities and which may have an effect on emissions and pollution. These include:

- storage and handling of input chemicals and anode metals
- water treatment
- mechanical preparation of the work to be treated
- liquid or vapour degreasing of the work to be treated
- chemical preparation of the work to be treated
- rinsing of the work being treated
- drying of the treated work
- post-treatment of the work (where necessary to complete the surface treatment)
- fume extraction and fume abatement system
- effluent treatment
- handling of spent process fluids
- handling of wastes
- onsite energy generation
- onsite waste disposal (e.g. incineration or possibly landfill)

Advice on the extent of the activities which are contained within an installation and how they may be connected (e.g. split sites), is given in IPPC Part A(1) Installations: Guide for Applicants (see [IPPC Part A\(1\) Installations: Guide for \(Applicants England and Wales\)](#)), or in the Environment Agency's Regulatory Guidance Note No.5 - Interpretation of "Installation" in the PPC Regulations (see [PPC Part A Installations: Guide for Applicants \(Scotland\)](#)). Operators are advised to discuss this issue with the Regulator prior to preparing their application.

Examples relevant to installations with surface treatment activities might be:

- A site has a number of separate surface treatment lines undertaking different types of process, none of which exceeds 30m³ of treatment volume on its own. If the total volume of all the tanks making chemical changes to work-piece surfaces exceeds 30m³ then there will be an IPPC installation (and only one IPPC installation) which includes all associated activities on site which are technically connected with any of the surface treatment lines
- A site includes two >30 m³ surface treatment shops operated by separate companies, but they share a common effluent treatment facility. The installation will therefore include both main surface treatment activities plus some or all of the associated activities listed above. However, although there is only one installation, both operators are required to be separately permitted (with linked permits) for operation of that installation and BAT must apply to the whole installation."

1.4 Timescales

1.4.1 Permit review periods

Permits are likely to be reviewed as follows:

- for individual activities not previously subject to regulation under IPC or Waste Management Licensing, a review should be carried out within four years of the issue of the IPPC Permit
- for individual activities previously subject to regulation under IPC or Waste Management Licensing, a review should be carried out within six years of the issue of the IPPC Permit

So activities/installations not currently in IPC or Waste Management Licensing will be initially reviewed within four years and thereafter within six years.

An exception to this is where discharges of List I or List II substances have been permitted, or where there is disposal or tipping for the purposes of disposal of any matter that might lead to an indirect discharge of any substance on List I or II. In such cases the review must be carried out within four years.

This period will be kept under review and, if any of the above factors change significantly, may be shortened or extended.

1.4.2 Upgrading timescales for existing plant

Existing installation timescales

For an existing activity, a less strict proposal (or an extended timescale) may be acceptable, for example, where the activity already operates to a standard that is very close to an indicative requirement. Equally, local environmental impacts may require action to be taken more quickly than the indicative timescales given in this Guidance. Furthermore, where IPC upgrading programmes are already in place, it is not expected that the indicative timescales given in this Guidance would extend to these.

Upgrading timescales will be set in the improvement programme of the Permit, along the following lines. Improvements fall into a number of categories:

- The many good-practice requirements in Section 2, such as management systems, waste, water and energy audits, bunding, good housekeeping measures to prevent fugitive or accidental emissions, energy baseline measures, waste-handling facilities, monitoring equipment, or installation of some secondary techniques. Also, longer-term studies required for control, environmental impacts and the like – at the latest within 2 years of the issue of the Permit.
- The larger, usually more capital-intensive improvements such as abatement equipment.
- All improvements should be carried out at the earliest opportunity and to a programme approved by the Regulator. Any longer timescales will need to be justified by the Operator

The Applicant should include a proposed timetable covering all improvements

Groundwater Regulations List 1 includes cadmium, mercury and cyanides, and List II includes zinc, copper, chromium, silver, titanium, tin, lead and some other less common metals, so this means that for most installations containing surface treatment activities. Permits will have to be initially reviewed within four years and thereafter at intervals not exceeding 4 years - regardless of whether or not the main activity is currently in IPC or Waste Management Licensing.

1.5 Key issues

Overall Requirement

The “BAT” approach of preventing or, where that is not practicable, of minimising emissions has specific implications for this sector. It means that treatments should use the least harmful metals and chemicals as is practicable, and employ techniques which aim for near-zero emissions to water and minimal creation of waste. These latter two can be achieved by techniques such as cascade rinsing, evaporation, recovery and recycling within the activity, but where particularly toxic metals such as cadmium have to be used special techniques are required to prevent their release.

Management Systems

The sector has a significant number of small to medium enterprises (SMEs), with limited technical resources. Hence, management systems are a critical issue, particularly written procedures and training. Although only the cadmium platers have been subject to IPC regulation, all Operators should be familiar with waste regulation systems and obligations on discharges to sewer. Operators should have an Environmental Management System (EMS) in place, preferably with external accreditation. A useful starting point should be the Surface Engineering Association Health, Safety and Environment Code of Practice for the Surface Finishing Industry 2001.

Emissions to Sewer and Controlled Waters

Normally discharges to water in this sector are to foul sewer. Any process discharges directly to surface water should be discussed with the regulator at the Preapplication stage, as they will require special attention.

BAT for rinsing and metal recovery systems should be in place (or plans provided) such that emissions of metals to water will be very low. Any capital improvements can be phased but must be within three years. In addition, the use of proprietary additives or other chemical inputs can result in release of some persistent organic substances - and it is a requirement of BAT that BOD and COD in discharges to sewer must be minimised.

Minimising Hazardous wastes

The bulk of the chemicals used in the processes are lost through drag-out, and final discharge of spent process fluids. The metals are usually removed in an effluent treatment plant resulting in the production of hazardous wastes comprising metal hydroxide sludge and filter cake. In some electroplating processes a significant proportion of the input anode materials is lost as sludge, generally ending up as hazardous waste but this depends on the process - some like copper plating leave no sludge and some use inert anodes.

Minimising the use of Water and other raw materials

Water consumption should be minimised. Much of the water input is used for rinsing purposes and is discharged after treatment as trade effluent. Where rinsing techniques are poor, not only is water use per unit of output high but metal can be wasted as it is carried out into the effluent treatment.

In order to minimise water and metal use, rinsing systems should be optimised and recirculatory or low flow systems such as counter current or spray rinse systems should be considered. If rinse waters are recycled to replace water lost to evaporation from process tanks then zero liquid discharge can be achieved.

Accident Prevention and Control

Procedures for emptying vats, transferring and storing liquors and chemicals must be in place. In addition to the potential for spillage or leakage of treatment fluids, some sites may have leaky drainage systems that will need attention. Secure storage arrangements for raw materials and chemicals must be provided.

1.6 Summary of releases

Table 1.1: Summary of Releases

SOURCE	RELEASES													
	Input chemicals and anode materials	Water treatment	Mechanical preparation	Organic solvent cleaning	Chemical Preparation	Surface treatment processes	Rinsing	Post treatment	Drying	Fume extraction/abatement	Effluent treatment plant/trade effluent (Note1)	Spent process fluids	Special waste	Stripping chemicals
Hydrochloric acid	AW	W	-	-	AW	A	W	-	-	AW	W	W	L	AW
Sulphuric acid	W	-	-	-	AW	W	W	-	-	AW	-	W	L	AW
Nitric acid	AW	-	-	-	AW	AW	W	W	-	AW	-	W	L	AW
Chromic acid	W	-	-	-	AW	W	W	-	-	AW	-	W	L	-
Sodium hydroxide	W	W	-	-	W	W	W	-	-	W	W	W	L	-
Sodium hypochlorite	AW									AW				
Cadmium	W	-	-	-	-	W	W	W	-	-	W	W	L	W
Mercury	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other heavy metals & zinc	-	-	A	-	-	W	W	W	W	AW	W	W	L	W
Oxides of sulphur	A	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxides of nitrogen	A	-	-	-	A	A	-	-	-	A	-	-	-	A
Particulates	-	-	A	-	A	A	-	-	-	AW	W	-	L	-
Cyanides	W	-	-	-	-	W	W	-	-	AW	W	W	L	-
Sulphates	W	-	-	-	-	W	W	-	-	AW	W	W	L	-
Nitrates	W	-	-	-	-	-	W	-	-	AW	W	W	L	W
Phosphates	W	-	-	-	W	W	W	-	-	AW	W	W	L	-
Chromates	W	-	-	-	-	-	W	W	W	AW	W	W	L	-
Dispersants/Surfactants	W	-	-	-	W	W	W	W	W	AW	W	W	L	-
Defoamers	W	-	-	-	W	W	W	W	W	AW	W	W	L	-
Proprietary organic additives	W	-	-	-	-	W	W	W	W	AW	W	W	L	-
Abrasives/polishing compounds	-	-	A	-	-	-	-	-	-	-	-	-	-	-
Organic solvents	A	---		A	-	-	-	-	-	-	-	-	-	-
KEY	A - Release to Air, W - Release to Water, L - Release to Land													

Most of the releases in water have passed through an effluent treatment plant, and on most installations in these sectors "release to water" means release to sewer.

Releases to air usually result in a subsequent indirect emission to land and can therefore affect human health, soil and terrestrial ecosystems.

1.7 Technical overview

The metal finishing surface treatment industry employs a wide range of processes (see Section 2.3.6) of which electroplating is the largest in terms of economic size and the number of installations. Whilst many manufacturing companies carry out surface treatment operations in-house, there is a large sub-contract surface treatment sector comprising many small companies located close to areas of manufacturing activity - with around a half of these companies employ ten people or less.

A recent Surface Engineering Association (SEA) Statistical Report indicated a UK sector comprising 200-300 anodising sites and 800-1,000 electroplating sites (of which 35-40 have cadmium plating facilities) - with several sites carrying out both types of treatment. A Yellow Pages survey in 1995 listed 69 sites which recorded anodising as the main activity. Another SEA survey indicated around 650 sub-contract plating companies.

In addition to these there is a sub-sector of around 150 printed circuit board manufacturing and related companies which carry out surface treatment operations as part of their PCB manufacturing process.

In summary:

Table 1.2: Distribution of Electroplating Processes

	No of Co's
General metal finishing	350
- in house	650
- sub-contract	150
Electronics	
TOTAL	1,150

The general metal finishing sector consists predominantly of small- to medium-sized enterprises, and a half of the sites employ 10 people or less, thus:

Table 1.3: Distribution of Employees

Employees	Sites %
1 - 10	52
11 - 20	29
21 - 30	11
31 - 50	5
51 - 75	2
76 - 100	1
101 - 200	-

An SEA analysis relating to the 30m³ threshold, suggests that there are just over 300 sites with 30m³ or more of installed chemical or electrochemical treatment volume in the general metal finishing sector. In terms of plant size these are distributed as follows:

Table 1.4: Distribution of Employees by Plant Size

Employees	Metal finishing sites	Sites > 30m ³
1 - 10	525	42
11 - 20	286	144
20 - 30	108	63
Over 30	81	62
TOTAL	1000	311

Summary of the Activities

Usages and Emissions

The industry is a significant user of water, energy and anode metals, as well as a wide range of inorganic and organic chemicals. There are substantial disposals to landfill of metals-containing sludge and filter cake and there is the potential for significant releases to water, generally to sewer. There is potential for air pollution but it is generally of lesser concern than that to the other media.

Process plant and equipment

Most surface treatment operations are carried out in a series of sequential tanks which contain the various treatment solutions. These are interspersed with water rinsing to minimise cross-contamination of the treatment solutions, and to ensure that clean, chemical-free work is delivered to the user or for onward processing. In small treatment shops the work is often moved manually from tank to tank, but larger plants use robots (transporters) which sequence the operations automatically.

Hot air or centrifugal drying is used to remove surface water from the treated work.

Fume extraction facilities (local ventilation) are often installed - in order to maintain a satisfactory workplace environment.

Figure 1.1: Typical Pre-treatment Schematic Flow Diagram

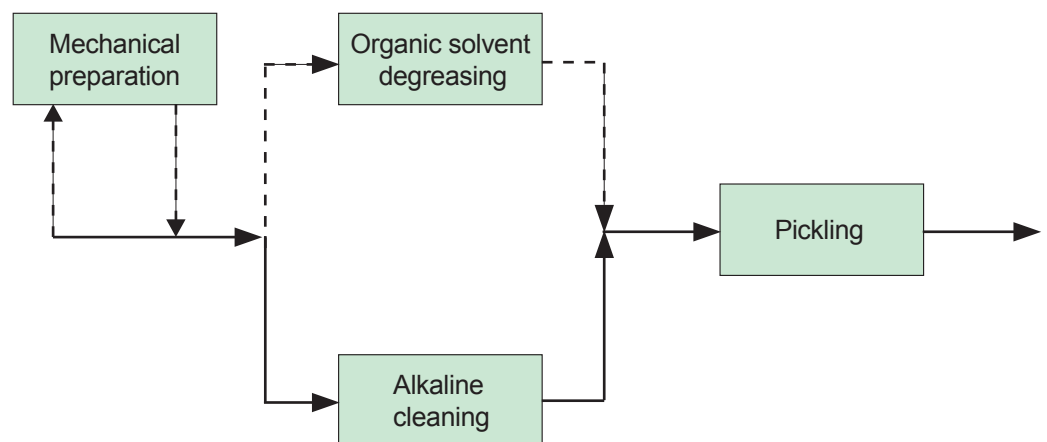
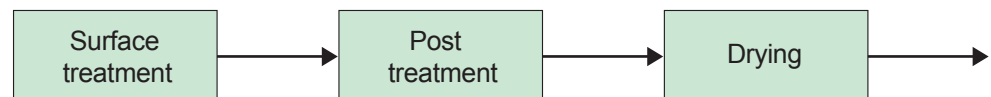


Figure 1.2: Typical Surface Finishing and Post Treatment Stages



Notes

- 1 Water rinsing is used between each stage and after the final treatment.
- 2 Some surface treatment activities require intermediate stages such as pre- and post-dips, additional cleaning etc.

1.8 Economics

As far as the metal finishing sector is concerned, there has been a decline in output from the UK (and European) aqueous surface treatment industry over the past three decades. In addition to fragile growth in manufacturing output requiring surface treatment, there has been a move away from (electro) chemical finishing into other coatings, eg; paints and powder coating. All this has resulted in consolidation of process technology supply companies, decline in the sub-contract surface treatment business sector, and the closure of many in-house surface treatment shops.

Anodising output has been generally maintained, but plating has tended to contract as the electrophoretic coating and powder coating sectors have grown. Chrome plating output, for example, is now less than 25% of the 1975 output.

The range and scope of zinc plating as a corrosion-protection surface for a wide range of automotive, wire work, ironmongery and fastener applications has expanded, but the tonnage of zinc actually plated has still declined slightly as a result of substitution by powder coatings in some applications. Zinc plating however is the largest sub-sector within the plating sector in terms of metal tonnage and capital investment. Smaller, but technically important, plating processes are autocatalytic nickel for engineering applications, and silver, tin, tin-lead, copper and gold for electrical and electronics applications.

Anode metal consumption data are shown below (in tonnes used per annum):

Table 1.5: Anode Metal Consumption Data

	1975	2000
Nickel	6000	1300
Zinc	5000	4500
Silver	70	40
Manufacturing output index	100	115

1.8.1 Cost information

Surface treatment is a capital intensive industry. Capital investment for typical automated surface treatment plants are:

Table 1.6: Capital Investment Costs

Plant	Size	Investment
Rack zinc	4000 mm wide	£500k
Barrel zinc	1200 mm long	£400k
Rack chrome (Ni and Cr)	1800 mm wide	£350k
Rack chromic acid anodising	1250 mm wide	£150k
Rack autocatalytic nickel	2000 mm wide	£250k
Continuous silver strip line		£350k

There are several techniques described in section 2 that can be adopted for new plant at relatively low cost and under the appropriate circumstances can provide a reasonable payback period. There are also more substantial improvements which require a more rigorous cost-benefit analysis. Some examples are shown below

Table 1.7: Examples of Cost Saving Techniques

Activity	Size	Capital	Annual Operation	Comment
Electrochemical reactor	500A	£25k	£2k	Recovery of metals
Evaporator -atmospheric -vacuum	0.1m ³ /h 0.1m ³ /h	£15k £35k	£6k £5k	Drag-out recovery
Electrodialysis	0.1m ³ /h	£10k	£2k	Oxidation of Cr III
Membrane filtration	0.3m ³ /h	£5k	£1k	Oil recovery from cleaners
Reverse osmosis	10m ³ /h	£25k	£2k	Water purification
Chelating ion-exchanger	1m ³ /h	£15k	£2k	Polishing of effluent
Permanent media filter	5m ³ /h	£20k	£0.5k	Polishing of effluent

2 Techniques for pollution control

This section summarises, in the outlined BAT boxes: the indicative BAT requirements (i.e., what is BAT in most circumstances) against which the application will be judged.

At the top of each BAT box is the issue which is being addressed. These reflect the requirements or information laid down in the Regulations.

Although referred to as BAT, the requirements also cover the other requirements of the PPC Regulations and those of other Regulations such as the Waste Management Licensing Regulations (see Appendix 2 for equivalent legislation in Scotland and Northern Ireland) and the Groundwater Regulations insofar as they are relevant to an IPPC Permit).

For further information on the status of the Indicative BAT standards, see [Guidance for applicants](#).

In responding to the requirements the Operator should keep the following general principles in mind.

- There should be evidence in the application you have considered the possibility of preventing the release of harmful substances by substituting materials or processes (see [Section 2.2.1](#) on page 38), preventing releases of water altogether (see [Section 2.2.2](#) on page 40), or by preventing waste emissions by reuse or recovery. For example, scope for this would be the replacement of organic solvent cleaning by aqueous alkaline or biological cleaner systems, or the replacement of decorative hexavalent chromium plating electrolytes by less harmful trivalent chromium electrolytes or by chromium free alloy electrolytes.
- Where that is not practicable you should reduce emissions that may cause harm.

All of the requirements identified in the BAT boxes should be identified in the application. Where information is not available, the reason should be explained and discussed with the Regulator before finalising the application. The Regulator may require, by formal notice, information that is missing.

The Regulations require Applicants to describe the proposed installation activities and the proposed techniques and measures to prevent and reduce waste arisings and emissions of substances and heat (including during periods of start-up or shut-down, momentary stoppage, leak or malfunction).

2.1 In-process controls

2.1.1 Environmental performance indicators

Benchmark values in this guidance are typically presented as concentrations (e.g. mg/l, mg/Nm³). Concentrations are the traditional basis for setting emission limits in permits as they are good indicators of unit operation performance but they have limitations. Thus, for England and Wales, the Environment Agency is developing complementary “Environmental Performance Indicators” that could help to target regulatory effort on the most important environmental issues.

Environmental Performance Indicators involve using emission data to:

- Normalise for the scale of process operation - to benchmark the emissions from installations that have different sizes and product mixes (e.g. quantity of emitted pollutant per unit of production).
- Calculate “Environmental Burdens” - using equivalency factors to determine the significance of emissions in terms of recognised environmental impacts.

Consideration is being given to a range of Environmental Performance Indicators, including:

For Air:

Stratospheric Ozone Depletion,
Global Warming (both from the installation and from imported power),
Photochemical Ozone Creation,
Airborne Acidification.

For Water:

Acidification,
Oxygen Demand,
Eutrophication.

For Waste:

Waste Hazard Score (from H1),
Waste Disposal Score (from H1).

For raw materials:

Water use (potable and non-potable).

For hazardous substances:

Environmental Health,
Human Health.

In the absence of any guidelines for the calculation of Environmental Performance Indicators, there are no indicative BAT requirements. However, Operators in England or Wales should demonstrate to the Environment Agency that they have their own methods of monitoring and benchmarking their environmental performance and show how these are used to drive environmental improvements.

The choice of Environmental Performance Indicators is left to Operators but they should give consideration to the issues that are listed above. The H1 database tool is advocated as providing a simple solution.

In future the Environment Agency may recommend specific methodologies for calculating Environmental Burden and/or normalising for scale. Research projects are currently under way to develop these systems.

2.1.2 Storage of Input Chemicals and Anode Materials

2.1.2.1 Strong Acids

Storage

Storage: Small quantities are usually stored in 25l, 30l, 50l and/or 205l special plastic containers supplied by chemicals distributors, often on a returnable basis. High consumption acids, eg; 32% hydrochloric acid or concentrated sulphuric acid, are stored in the larger installations in dedicated bulk stock tanks or in 1000l returnable Intermediate Bulk Containers (IBCs).

Dilution of strong acid to the operational concentration is usually carried out at the process tanks.

Releases

Water

Small amounts from spillage and drainage

Air

Dedicated tonnage storage vessels are vented to atmosphere to relieve pressure changes. Concentrated hydrochloric acid has a significant vapour pressure and fume can be released during filling. Concentrated nitric acid also fumes during handling.

Waste

Empty non-returnable plastic containers.

Energy

None

Accidents

Accidental leakages can occur during filling operations. Storage vessels may develop leaks, or be overfilled. Similarly pumps, pipework, valves and fittings transferring acids to the point of use may leak through damage or deterioration

Noise

None

2.1.2.2 Sodium Hydroxide Solution

Storage	<p>Small quantities are usually stored in 25l and 205l plastic containers supplied by chemicals distributors, often on a returnable basis.</p> <p>Bulk storage of 25% or 50% solution is usually in 1000l returnable IBCs or in dedicated mild steel or lined storage vessels</p>
Releases	<p>Water</p> <p>Small amounts from spillage and drainage</p> <p>Air</p> <p>None.</p> <p>Waste</p> <p>Empty non-returnable plastic containers.</p> <p>Energy</p> <p>None</p> <p>Accidents</p> <p>Accidental leakages can occur during filling operations . Storage vessels may develop leaks, or be overfilled. Similarly pumps, pipework, valves and fittings transferring acids to the point of use may leak through damage or deterioration</p> <p>Noise</p> <p>None</p>

2.1.2.3 Sodium Hydrochlorite Solution

Storage	<p>Small quantities are usually stored in 25l and 205l plastic containers supplied by chemicals distributors, often on a returnable basis. Bulk storage of 13-15% (chlorine) solution is usually in 1000l IBCs or in dedicated lined mild steel or GRP storage vessels.</p>
Releases	<p>Water</p> <p>Small amounts from spillage and drainage.</p> <p>Air</p> <p>Chlorine can be released by reaction or when solutions are heated and agitated.</p> <p>Waste</p> <p>Empty non-returnable plastic containers.</p> <p>Energy</p> <p>None</p> <p>Accidents</p> <p>Accidental leakages can occur during filling operations . Storage vessels may develop leaks, or be overfilled. Similarly pumps, pipework, valves and fittings transferring acids to the point of use may leak through damage or deterioration.</p> <p>Noise</p> <p>None</p>

2.1.2.4 Solid Raw Materials

Storage

Small quantities from floor spillage.

Releases

Water

None.

Air

None.

Waste

Small amounts from floor spillage.

Energy

None

Accidents

Floor spillage from opened, or broken bags. Spillage during transfer of the bagged material for dissolution in the process tanks.

Noise

None

2.1.2.5 Vapour Degreasing Solvents

Storage

Small quantities are contained in mild steel drums supplied by the distributor on a returnable basis. On-site bulk storage is in dedicated mild steel stocktanks.

Releases

Water

None except in the event of an accidental spillage in a wastewater catchment area.

Air

Small losses during transfer and from fume extraction, dependent upon the volatility of the solvent.

Waste

None.

Energy

None

Accidents

Leakage of solvent from transfer piping to the degreaser. Loss of solvent to ground and air during manual transfer operations.

Noise

None

Indicative BAT requirements for Storage of input chemicals

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 The main control issue is the containment of fugitive emissions to water - see [Section 3.2.7](#) on page 91

2.1.3 Water Treatment

2.1.3.1 Fresh Water (Town's Water)

Process

Most surface treatment processes use fresh water for the make-up and maintenance of process fluids, and for the subsequent rinsing operations. Where the input water is of insufficient quality (eg. for the surface treatment of electronic components) filtration, deionisation, and/or other forms of pre-treatment may be required. The use of untreated hard water for make-up and maintenance may result in the shortening of process fluid life through the build-up of calcium and magnesium salts and other substances.

Deionised water is essential for the prolongation of process fluid life where the return of drag-out upstream (ie: closed loop operation) is practised.

Releases

Water

The main release from water deionisation is the discharge from ion-exchange regeneration, ie; degraded hydrochloric acid and sodium hydroxide solutions. Water purification by reverse osmosis also provides a waste water stream. In both cases the waste streams are normally discharged to the effluent treatment facility.

Air

None.

Waste

None.

Energy

Not significant (pumping duty only)

Accidents

Pumping and piping system leakages of HCl or NaOH.

Noise

Slight noise from high pressure pumps used in reverse osmosis equipment.

Indicative BAT requirements for Water Treatment

- 1 With the Application, the operator should:
 - Supply information on water consumption and comparison with any available benchmarks.
 - Supply a diagram of the water circuits with indicative flows.
 - Demonstrate that the proposals are BAT, by confirming compliance with the indicative requirements, by justifying departures (as described in [Section 3.2.7 on page 91](#) and in the Guide to Applicants), or alternative measures.
 - Describe, in particular, any water audits already conducted and the improvements made or planned.
- 2 The main control issue is the containment of fugitive emissions to water - see section [Section 3.2.7 on page 91](#)

2.1.4 Mechanical Preparation

Mechanical preparation includes grinding, linishing, blast cleaning, vibratory mass finishing polishing.

2.1.4.1 Linishing and Mechanical Polishing

Process

Prior to surface treatment, some types of work may require linishing to remove rust or heatscale before chemical preparation - which is a manual labour intensive operation - but modern manufacturing techniques have greatly reduced the need for linishing on mass produced components. Similarly, progress in the development of bright high-levelling plating electrolytes has obviated the need for mechanical polishing except where the highest degree of reflectivity is required.

Releases

Water

None.

Air

Linishing and polishing equipment require local ventilation for operator protection and dry dust filtration facilities to avoid the emission of abrasive materials eg; aluminium oxide, proprietary polishing compound and abraded metal particles to atmosphere.

Waste

Worn linishing belts and other abrasive materials. Abrasives containing residues.

Energy

Not significant.

Accidents

Emission to the atmosphere through faulty dust extraction equipment.

Noise

Significant.

Indicative BAT requirements for Mechanical Preparation

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 The main control issues are:
 - the containment of fugitive emissions - see Section
 - replacement of silica and silicate containing abrasives/polishing compounds by synthetic aluminium oxide based products
 - acoustic screen for automated polishing equipment

2.1.5 Organic Solvent Cleaning

2.1.5.1 Vapour Phase Degreasing

Process

The use of vapour phase degreasing has significantly diminished. It is not a process that can easily be integrated into an automated surface treatment plant. It is used only for low-volume high-value components that require a high level of cleanliness, eg. in the aerospace and specialist electronics industries.

Releases

Water

Water is required for cooling purposes. Small degreasing units often use it on a once through basis. Larger units may use closed-loop refrigerated water.

Air

There may be a significant loss of solvent to the atmosphere with many existing units.

Waste

Sludge residue.

Energy

Not significant.

Accidents

Solvent leakage from equipment.

Noise

None.

Indicative BAT requirements for Mechanical Preparation

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
 - Demonstrate how the requirements of the Solvents Emissions Directive ([Ref 22](#)) are complied with. If consumption is in excess of 1 tpa, of chlorinated solvent or 2 tpa of other organic solvent, a Solvent Management plan, inter alia, will be required. Point source releases must comply with specific ELVs, and fugitive releases must not exceed fixed percentages of total use.
- 2 The main control issues are:
 - Control of point source emissions to air (from the degreaser vents system).
 - Control of fugitive emissions to air.
 - Solvent in spent solvent waste should be recovered – See [Section 2.6](#) on page 65.
- 3 In addition, the following techniques will minimise emissions to air, (and also operator exposure):
 - Disciplined use of properly positioned and closed lids, except when loading and unloading conventional degreasers.
 - The use of top-loading multiple door facilities.
 - The use of totally sealed end-loading degreasers with solvent vapour condensation and condensate recycle.

2.1.6 Chemical Preparation

A clean surface is essential for satisfactory surface treatment operations. The first preparation stage is the removal of soils eg; fine metallic particles, swarf and dirt, and oils and grease resulting from the manufacturing processes of machining, stamping, pressing, polishing etc. For this operation hot alkaline soak and electrolytic cleaners are usually used. A further step - to remove oxides and heat scale - known as pickling - is also required

2.1.6.1 Aqueous Alkaline Cleaning

Process

Process :Alkaline cleaning is the most common first step. It is usually carried out as an immersion (in-tank) operation, but spray cleaning is sometimes used. The cleaning process usually comprises two consecutive operations:.

- A hot alkaline oil emulsifying soak cleaner at 60-90°C
- A hot electrolytic alkaline cleaner at 50-70°C which utilises the 'scrubbing' effect of liberated hydrogen or oxygen at the work's surface to remove strongly adherent soils and surface smut.

It is not now usual to provide a water rinse between the two alkaline cleaning stages. Alkaline cleaners become spent after a period of time and require partial or total replenishment, but many plants use flotation oil separation equipment on the alkaline soak cleaner as a means of prolonging the life of the cleaning fluid

Releases

Water

Water rinsing is required after alkaline cleaning. The contaminated water is discharged to the effluent treatment facility.

Air

There is a significant loss of water from hot, cleaner tanks through evaporation. In modern plants, the evaporated water is removed by the fume extraction system. There are no volatile process chemicals but losses of alkaline cleaner can occur through droplet entrainment resulting from splashing, over-high tank levels or too high a fume extraction velocity.

Waste

Spent alkaline cleaners containing oils, greases, soils, swarf etc are discharged to the effluent treatment facility or are removed by a licensed waste disposal contractor. Sludge that has collected at the bottom of the cleaner tank is also removed from time to time and dealt with as for the spent cleaner.

Energy

Significant energy is required for process heating mainly due to the evaporative loss at 60°C and above. This loss is aggravated by the fume extraction system drawing air across the tank's surface.

Accidents

Overfilling of tanks after make-up for evaporative loss, leading to floor spillage and/or entrainment in the fume extraction system and thence release to atmosphere. Leakage from the tank drainage and oil separation equipment.

Noise

None.

Indicative BAT requirements for Chemical Preparation (Alkaline Clean)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - Rinse water economy
 - Energy consumption
 - Cleaning fluid lifetime
 - Disposal of spent cleaners
 - Prevention of fugitive emissions to air - See Section
- 3 The following techniques will minimise waste and energy consumption, minimise the load on the effluent treatment facility and minimise emissions to air:
 - Use of proprietary cleaners that allow a lower operating temperature.
 - Use of a low temperature biological cleaner system in place of the traditional alkaline soak cleaner for a long production life, low waste and low energy consumption.
 - Use of a minimum of two, preferably three, stages of cascade rinsing with air agitation.
 - Use of closed loop operation with three to four stage cascade rinsing, so that drag-out can be returned upstream to balance the evaporative loss and minimise waste.
 - Generation of turbulence by means of an eductor to provide improved cleaning, and maintain particulates in suspension so that they can be removed continuously by external filtration.
 - Use of membrane filtration to remove oil and grease, emulsions and dispersants
 - Use of automatic dosing of proprietary concentrated cleaner for a consistent cleaning standard, by maintaining optimum conditions of temperature, and cleaner concentration, etc
 - Maintenance of adequate freeboard above the cleaner level (minimum of 125mm) to minimise entrainment of liquid and subsequent emissions to air, with extraction lip ducts mounted at least 50mm above the top of the tank lip angle, and minimum air flow consistent with satisfactory extraction.
 - Use of “hexagons” or “croffles” on the tank surface to reduce evaporative loss, and consequent energy consumption by up to 50%. The use of automated lids on larger cleaner tanks will reduce fume extraction energy costs by up to 80%, as well as reducing consumption for process heating

2.1.6.2 Pickling

Larger ferrous processing industries

Process

The ferrous metal processing, wire drawing and hot-dip coatings industries, comprise the larger sub-sector employing acid pickling as a pre-treatment to subsequent processing steps. Specifically the sub-sector includes. .

- Continuous cold-rolling of hot-rolled coils where thickness and other technological characteristics are changed solely by compression
- Wire-drawing of hot-rolled coils of rod or wire for diameter reduction
- Continuous hot-dip coating of wire or sheet steel
- Batch hot-dip galvanising of iron or steel fabrications
- Lead-tin (terne) coating of steel sheet
- Continuous electroplating of steel sheet
- Batch pickling

These are Part A(2) activities describe in the Secretary of State's Guidance for the A2 Galvanising Sector IPPC SG5. ([Ref 21](#))

Smaller-scale surface treatment and plating industries

In the surface treatment sub-sector, 15-30% hydrochloric acid at ambient temperature is the most common pickling agent. 10% sulphuric acid at up to 70 degrees C is also used, as is mixtures of hydrochloric and sulphuric acids. Corrosion of the work is likely with acid pickling unless an inhibitor is incorporated.

A mixture of nitric and hydrofluoric acids at elevated temperature is used for the descaling of high alloy steels prior to electropolishing

Proprietary dry acid salts are available for small-scale work where the use and storage and handling concentrated acids is undesirable.

There are also proprietary alkaline derusting salts which enable iron and steel work to be rapidly descaled without the danger of attack on the basis metal, and are especially suitable for precision components where etching of the surface must be avoided. Alkaline derusting is also employed for the treatment of high tensile and hardened steels which are susceptible to hydrogen embrittlement under acid conditions.

The performance of pickling solutions deteriorates as the level of dissolved iron and other metals increases. Partial or total replenishment then becomes necessary

Releases

Water

Water rinsing is required after pickling to remove the pickle agent, iron salts, any other dissolved metals and organic inhibitor. Part or all of the contaminated rinse-water may be recycled; the remainder passes to the effluent treatment facility and, after pH adjustment to precipitate metals, is usually discharged as trade effluent.

Air

There is potential for significant release of HCl gas or fume from hydrochloric acid pickling, especially where the acid is more concentrated and/or at elevated temperature. Emissions are generally at their highest during entry and exit of work at the pickle tank(s), and high fume extraction rates may also lead to excessive mass release of HCl.

Sulphuric acid pickling tends to release a fine aerosol of the acid, particularly at temperatures above 60°C.

Pickling with mixtures of nitric and hydrofluoric acids release HF and nitric acid vapour and also NO_x which results from chemical reactions taking place on the surface of the metal. Fume extraction and abatement is always necessary with mixed acid pickling.

Waste

Spent pickle liquors contain dissolved iron (present as ferrous chloride and typically up to 75 g/l in HCl pickles) together with other metals eg. zinc from the dissolution of plated metal on jig tips, jig stripping, and the use of pickle tanks for the recovery of poor quality plated or galvanised work. A significant level of free acid remains and this may be recovered by filtration for reuse in lower grade pickling operations. Spent acid from continuous pickling operations (eg. removal of scale from hot-rolled products) is usually treated by an acid regeneration process to recover the HCl, whereas that from batch-galvanising and aqueous surface treatment shops is generally tankered off-site. Many plating shops bleed the spent liquor into the site effluent treatment plant where the free acid is neutralised with alkali, and the iron and other metals are precipitated as hydroxides for separation and removal off-site

Energy

Sulphuric acid is heated to at least 60°C for effective pickling. Because of the increasing need to controlling fume above 25°C, heating is not normally used for hydrochloric acid pickling - except in continuous processing lines where it is usual to provide closed pickling tanks with fume extraction facilities.

Mixed HF/HNO₃ acid for the continuous pickling of high alloy steels is at temperatures up to 70°C.

Energy consumption in fume extraction and abatement scrubbers may be significant.

Accidents

Overfilling of pickle tanks during batch replenishment, leading to floor spillage and/or entrainment in the fume extraction system and thence release to atmosphere. Leakage from the feed supply and tank drainage systems.

Noise

None.

Indicative BAT requirements for Chemical Preparation (Acid Pickling)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - Rinse water economy
 - Pickle efficiency
 - Acid regeneration
 - Acid recycling
 - Prevention and control of point source and fugitive emissions to air
 - Use of inhibitors which are readily biodegradable
- 3 The following techniques will minimise waste , reduce the load on the effluent treatment facility and minimise emissions to air.
- 4 For pickling ahead of electroplating or similar activities:
 - Minimum two, preferably three stages, of cascade rinsing with air agitation.
 - Three stage cascade pickling with continuous pickle acid feed and continuous discharge to the effluent treatment facility.
 - Fugitive emissions to air – see Section 2.3.11 .
 - Use of spent pickle acid for pH control in the effluent treatment facility.
- 5 For pickling in the galvanising and related ferrous industries:
 - (Details from the BREF to be inserted here)

2.1.7 Surface Treatment Processes

There are several diverse processes covered by this Sector. All however are based on aqueous technology. The most important are:

Table 2.1: Processes Covered by this Sector

Electrolytic Processes	Chemical Processes
Electroplating	Autocatalytic (electroless) plating
Anodising	Phosphating
Plating on plastics	Direct chromating of zinc, magnesium
Electropolishing	Decorative oxidation, bright dips
	Pickling

Electroplating, anodising, autocatalytic plating and electropolishing represent the bulk of the sub-contract surface treatment industry's business that is covered by the activity description in the PPC Regulations. Phosphating, and plating on plastics are mainly carried out by manufacturing companies with in-house treatment shops. Chromating, decorative oxidation and bright dip facilities, whether in-house or in sub-contract shops are numerous but small. Surface treatment operations for printed circuit board and certain other electronics component manufacture are integrated into the overall manufacturing process and are therefore always carried out in-house.

Notwithstanding the wide range of surface treatment processes and their application in manufacturing industry, most plants follow a common process sequence, whether the work to be treated is carried out in rotating barrels (small components eg; fasteners) or on jigs (large work, eg; point of sale goods)

Typical process sequences for electroplating and other electrolytic processes are:

Table 2.2: Typical Process Sequences

Electroplating	Anodising	Electropolishing
Zinc on steel	Sulphuric acid-aluminium	Stainless steel
Alkaline soak clean	Alkaline soak clean	Alkaline soak clean
Electrolytic clean	Etch	Cascade rinse
Cascade rinse	Desmut	Descale (welded and heat treated work only)
Hydrochloric acid pickle	Cascade rinse	Cascade rinse
Cascade rinse	Anodise	Electropolish
Electroclean	Cascade rinse	Acid soak
Cascade rinse	Seal	Cascade rinse
Zinc plate	Cascade rinse	Dry
Cascade rinse	Hot rinse	
Passivate	Dry	
Cascade rinse		
Hot-air dry		

2.1.7.1 Electroplating

Most plating electrolytes incorporate proprietary additives, usually of organic formulation which assist in the deposition process and provide desirable surface properties such as grain refinement, ductility levelling, brightness. Certain additives are consumed in the electrochemical reaction, others act as "carriers" and are lost from the electrolyte by drag-out. Similarly the salts, alkalies and/or acids that comprise the basic electrolyte are lost by drag-out. The drag-out losses are balanced by regular additions of the appropriate proprietary and commodity chemicals. Mass drag-out is minimised by operation at the lowest acceptable dissolved solids concentration.

Cadmium plating is carried out in an alkaline cyanide-based electrolyte. Release of cadmium to sewer has effectively to be prevented (not just minimised and rendered harmless) and BAT for drag-out minimisation and cadmium recovery have special significance in minimising cadmium release to landfill.

The operational temperature is dependent on the nature of the electrolyte, the metal being plated, and the volatility of the organic additives. There is a substantial energy input from the DC plating supply, necessitating a similar energy demand for cooling in the case of ambient temperature processes. In other processes the plating current energy needs to be augmented to achieve operating temperatures in the order of 50-65°C (eg; nickel plating). Thermally stable processes that do not require the intervention of continuous process heating or cooling are desirable but not yet common place.

Releases

Fume extraction is often used for plating electrolytes. It is essential for hexavalent chromium; with plating tanks requiring fume extraction backed by efficient de-misting equipment to minimise the release of chromic acid aerosols to the atmosphere.

Water

Water rinsing is required after plating, and this contaminated water is discharged to the effluent treatment facility.

Air

There is loss of volatile (sometimes malodorous) organic additives at above-ambient operational temperatures. There can be loss of the bulk plating electrolyte by entrainment when low pressure air is used to generate turbulence;

Hydrogen gas is produced in processes operating with a low cathode efficiency (such as chromium plating) and the liberated hydrogen gas carries microdroplets of the plating electrolyte into the fume extraction system, and thence to atmosphere;

Water vapour is a significant component at operational temperatures over 60°C

Waste

Plating electrolytes usually have a life of some years, with disposal only occurring as a result of a change to a product from a different supplier. In the end, an electrolyte cannot usually be economically recovered due to the high contaminant level, so it is discharged to the effluent treatment facility or consigned to a licensed waste disposal contractor.

Energy

The DC plating supply represents a significant energy usage, as does process cooling or heating.

Accidents

Overfilling of tanks during replenishment/topping-up leading to floor spillage and possibly also to significant loss to the fume extraction (if installed) and thence to atmosphere. Leakage from local pumping systems and the filtration system (if installed). Loss of electrolyte when changing filter media.

Noise

None.

Indicative BAT requirements for Treatment Techniques (Electroplating)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - Rinse water economy
 - Mass drag-out reduction
 - Return of drag-out
 - Recovery of higher value metals from drag-out which cannot be returned
 - Energy consumption
 - Prevention of fugitive emissions to air
 - Substitution of chromium VI with less toxic plating chemicals
- 3 The following techniques will minimise waste and energy consumption, minimise the load on the effluent treatment facility and minimise emission to air:
 - Use of a minimum of three stages of cascade rinsing, and air agitation.
 - Use of proprietary plating electrolytes that have a low concentration of dissolved solids and operate with minimum energy requirements for heating or cooling.
 - Minimisation of drag-out by maximising the drainage time of the work over the plating tank or in a separate drainage tank. Drainage times should not be less than 20 seconds for rack plant and 30 seconds for barrel plant.
 - Use of an ECO-rinse tank(s) to reduce mass drag-out and subsequent rinse-water consumption by 40%. (See Section 2.3.7).
 - Use of electrochemical metals recovery technology for unreturned drag-out.
 - Use of air-swept evaporation technology in conjunction with 3-5 stage cascade rinsing to allow closed loop operation for hot (35×C plus) plating processes, ie; 100% return of drag-out.
 - Generation of turbulence by hydraulic power and eductors.
 - Fugitive emissions to air – see Section 2.3.11

2.1.7.2 Anodising

Aluminium, and to a lesser extent, magnesium and titanium, are anodised to provide surface properties which include improved corrosion protection, hardness, and decorative appeal. The three main processes used for aluminium work are:

- Sulphuric acid anodising at 18 to 22×C for decorative work
- Sulphuric acid anodising at -5 to 5× C for hard, thick films
- Chromic acid anodising at 38 to 42×C for corrosion protection

Following the preparation stages described in Section 2.3.2 to 2.3.5, the work is then etched in a sodium hydroxide-based etchant or chemically/electrolytically polished, depending on the finish required. The removal of smut with dilute nitric acid generally follows. The work is then anodised in the appropriate electrolyte. Post-anodising, the anodic film requires sealing in hot water, or in a proprietary metal salt solution prior to hot water sealing, though for decorative applications, the work may be immersed in dye solution prior to sealing.

The issues relating to drag-out, anodising current, process heating/cooling are similar to electroplating. Close temperature control of the anodising electrolyte is important, and it is necessary to provide vigorous turbulence through air agitation or, preferably, through the use of hydraulic eductor systems. Fume extraction is usual for the hot processes and for the sulphuric acid anodising electrolytes. It is essential for chromic acid electrolytes

Releases

Water

Water rinsing is required after the etch, desmut, anodising, drying and sealing steps. The contaminated water is discharged to the effluent treatment facility.

Air

The entrainment of sulphuric or chromic acid spray from the anodising electrolyte is of concern, especially when air is used for agitation

Waste

The concentration of aluminium in the anodising electrolyte increases to a point where the solution becomes spent. It then requires partial or complete discharge to the effluent treatment facility or removal by a licensed waste disposal contractor. The pre-anodisation solutions like the sodium hydroxide and chromic acid based etchants also become spent and require similar treatment.

Energy

The DC anodising supply represents a significant energy usage, as does process cooling or heating.

Accidents

Overfilling of tanks during replenishment/topping-up leading to floor spillage and possibly also to significant loss to the fume extraction (if installed) and thence to atmosphere. Leakage from local pumping systems and the filtration systems.

Noise

None.

Indicative BAT requirements for Treatment Techniques (Anodising)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - Rinse water economy
 - Mass drag-out reduction
 - Removal of dissolved aluminium for the anodising electrolyte
 - Energy consumption
 - Prevention of fugitive emissions to air
 - Substitution of chromium VI with less toxic plating chemicals
- 3 The following techniques will minimise waste and energy consumption, minimise the load on the effluent treatment facility and minimise emission to air:
 - Use of a minimum of 2, preferably, 3 stages of cascade rinsing, and air agitation.
 - Minimisation of drag-out by maximising the drainage time of the work over the anodising tank, or use of a separate drainage tank.
 - Use of an ECO-rinse tank(s) to reduce mass drag-out and subsequent rinse water consumption by 40%.
 - Use of atmospheric evaporation in conjunction with 3-5 stage cascade rinsing to allow closed loop operation for chromic acid anodising processes, and achieve 100% return of drag-out.
 - Use of electro dialysis technology for the re-oxidation of chromium VI degraded to chromium III in chromic acid anodising electrolytes.
 - Generation of turbulence by hydraulic power and eductors.
 - Fugitive emissions to air – see Section 2.3.11

2.1.7.3 Electropolishing

Stainless steels and related alloys are electropolished on a considerable scale as a means of improving corrosion resistance, as well as enhancing appearance. Following conventional aqueous alkaline cleaning, there is usually a descaling process based on a mixture of hydrofluoric and nitric acids. The work is then anodically electropolished in a concentrated phosphoric/sulphuric acid mixture at a temperature of 60-90°C. Following rinsing, the work is treated in 20% nitric acid at 50°C to remove phosphate smut.

The issues relating to drag-out, rinsing. DC supply, process heating etc are similar to electroplating. Fume extraction is necessary with NOx abatement.

Releases

Water

Water rinsing is required after the descale,(if required), electropolishing and passivation steps. The contaminated water with dissolved metals from the work (eg nickel, chromium, iron) is discharged to the effluent treatment facility.

Air

Phosphoric/sulphuric acid spray from newly made-up electrolytes is of concern, as is the possibility of NOx evolution from the descaling and nitric acid treatment processes.

Waste

The concentration of iron and other metals in the descaling and electropolishing steps increases to a point where the process fluids become spent. Partial or complete discharge to the effluent treatment facility or removal by a licensed waste contractor is then necessary.

Energy

The DC electropolishing supply represents a significant energy usage, as does process heating.

Accidents

Overfilling of tanks during replenishment/topping-up leading to floor spillage and possibly also to significant loss to the fume extraction (if installed) and thence to atmosphere. Leakage from local pumping systems.

Noise

None.

Indicative BAT requirements for Treatment Techniques (Electropolishing)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - Rinse water economy
 - Mass drag-out reduction
 - Prolongation of the descaling and electropolishing process fluids by basis metal removal
 - NOx control
 - Energy consumption
 - Prevention of fugitive emissions
- 3 The following techniques will minimise waste and energy consumption, minimise the load on the effluent treatment facility and minimise emission to air:
 - Use of a minimum of 2, preferably 3 stages of cascade rinsing and air agitation.
 - Minimisation of drag-out by employing a drainage time over the process tanks of at least 20 seconds.
 - Use of an ECO-rinse tank(s) to reduce mass drag-out and subsequent rinse water consumption by 40%.
 - The use of hydrogen peroxide in the pickling tank can reduce NOx emission by up to 70%, and reduce acid consumption by 20-25%.
 - The use of lids on process tanks operating at 60½C and above, and hexagons or croffles should be considered for all manually operated tanks.
 - Fugitive emissions to air – see Section 2.3.11

2.1.7.4 Plating on Plastics

Plating on ABS and a few other plastic materials is generally carried out in large automated plants. There are two stages in the overall process. In the first (pre-treatment) stage, the work is etched in chromic/sulphuric acid (400g/l CrO₃) at 60C, and then autocatalytically plated with a thin layer of nickel which provides a conductive surface for the second stage conventional electroplating treatment. This will generally comprise copper and nickel substrates (bright or satin) followed by a decorative chromium finish. The first stage comprising etching, activation, acceleration and autocatalytic nickel requires a high level of process control. Generally, the issues relating to drag-out, rinsing, DC supply, process heating, fume extraction, etc are similar to electroplating.

Releases

Water

Water rinsing is required after each process step, and the contaminated water is discharged to the effluent treatment facility. Unrecovered drag-out from the chromic/sulphuric acid etch rinse stages is likely to be significant.

Air

Chromic/sulphuric acid mist from the etch process tank, and chromic acid mist from the decorative chromium plating process tank require fume extraction and mist elimination. Fume extraction may be required for the conventional electroplating stages, as appropriate.

Waste

The chromic/sulphuric acid etch and other processes in the pre-treatment stage have a finite life and require disposal on a routine basis.

Energy

There is a significant consumption of energy for the hot chromic acid/sulphuric acid etch stage, for the DC plating supply, and for process heating.

Accidents

As for electroplating, see [Section 2.1.7.1](#) on page 25.

Noise

None.

Indicative BAT requirements for Treatment Techniques (Plating on Plastics)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - rinse water economy
 - mass drag-out reduction
 - return of drag-out
 - prolongation of the life of process fluids in the pre-treatment stage
 - energy consumption
 - prevention of fugitive emissions
- 3 The following techniques will minimise waste and energy consumption, minimise the load on the effluent treatment facility and minimise fugitive emission to air:
 - Use a minimum 2 stages of cascade rinsing with air agitation for each pre-treatment process. A minimum of 4 and preferably 5 stages of cascade rinsing after the chromic/sulphuric acid etch, with techniques for minimising drag-out - (see electroplating [Section 2.1.7.1](#) on page 25).
 - Employment of electro dialysis (porous pot) technology for the continuous oxidation of chromium III to chromium VI at the etch stage.
 - Use of evaporation technology to enable total return of etch drag-out.
 - Consideration of alternatives to chromic/sulphuric acid as an etchant.
 - Reduction of process heating requirement by using a removable lid and/or hexagons or crof-fles for the each process tank.
 - Minimisation of fugitive emissions to air – see Section 2.3.11

2.1.7.5 Autocatalytic Plating

Autocatalytic (electroless) plating of nickel is used for complex shaped engineering components where an even coating is required. The process (usually based on the supply of proprietary chemicals) depends upon an autocatalytic effect whereby the nickel ions in solution are reduced to the metal only on the surface of the component. The deposit is an alloy of nickel and phosphorus (or occasionally of boron). The phosphorus content is typically 8%. Autocatalytic nickel is also used to provide an electrically conductive surface in the plating of plastics.

Autocatalytic copper plating is used in the printed circuit board industry. It provides the electrically conductive surface for drilled holes in copper clad laminate prior to electroplating.

Autocatalytic nickel-plating systems generally operate at a temperature of 85-95½C so fume extraction is essential. The process fluid has a relatively short life due to the build-up of decomposition products, with 6-8 turnovers typically being achieved before replacement is necessary. The spent fluid requires considerable treatment before it can be discharged as trade effluent due to the presence of complexing

agents and, in some proprietary formulations, a trace quantity of a brightener based on a cadmium salt. If this cannot be accomplished in-house it has to be consigned to a licensed waste disposal contractor for treatment and disposal off-site.

Autocatalytic copper systems are based on QUADROL or EDTA and formaldehyde, and generally operate at 45°C.

Releases

Water

Water rinsing is required after the plating stage, and the contaminated water (which may contain a trace quantity of cadmium) is discharged to the effluent treatment facility.

Air

There is a significant evaporation of water from the process tank through evaporation together with an odorous process fluid mist associated with liberated hydrogen. All are removed by the fume extraction system.

Waste

Build-up of decomposition products in the autocatalytic solutions necessitates frequent dumping. Treatment in a conventional effluent treatment facility is difficult so removal by a licensed waste disposal contractor is the usual route. EDTA however may be precipitated out at low pH and at a temperature below 10°C.

Energy

Significant energy is required for autocatalytic nickel-plating in maintaining the process tank at 85-95°C.

Accidents

Overfilling of tanks during replenishment/topping-up leading to floor spillage and possibly also to significant loss to the fume extraction and thence to atmosphere. Leakage from local pumping systems.

Noise

None.

Indicative BAT requirements for Treatment Techniques (Autocatalytic Plating)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - rinse water economy
 - mass drag-out reduction
 - prolongation of process fluid life
 - avoidance of the use of cadmium salt as a brightener in autocatalytic nickel systems
 - disposal of spent process fluid
 - energy consumption
 - prevention of fugitive emissions
 - avoidance of the use of EDTA in autocatalytic copper systems
- 3 The following techniques will minimise waste and energy consumption and minimise fugitive emission to air:
 - Minimisation of drag-out by maximising drainage time over the process tanks.
 - Use of a minimum of 3, preferably 4 stages of cascade rinsing, enabling partial return of drag-out upstream to balance evaporated water loss.
 - Use of proprietary systems which provide a long process fluid life, which do not contain cadmium, and which require relatively simple effluent treatment. Replace EDTA by QUADROL in autocatalytic copper systems.
 - Use of low temperature process technology consistent with an economically viable metal deposition rate, including the use of lidded tanks and the use of hexagons or croffles on manually operated tanks.
 - Generation of turbulence by hydraulic power and eductors.
 - Minimisation of fugitive emissions to air – see Section 2.3.11

2.1.7.6 Dip Treatments

There are several surface treatments that do not involve electrolytic or autocatalytic processes. These include (but not necessarily limited to):

- Bright dipping
- Chemical blacking
- Chromating
- Stripping (removal of plated metal)
- Etching
- Oxidation (decorative)
- Phosphating

All the above require post treatment rinsing, and drying unless followed by another process.

Releases

Water

Water rinsing is required in each case, and the contaminated water, generally containing dissolved metals, is discharged to the effluent treatment facility.

Air

Humid air is emitted by processes operating at 60°C and above, and bright dipping, etching and oxidation process may generate acid mists, eg nitric acid.

Waste

The process fluids have a finite life. Partial or complete discharge to the effluent treatment facility or removal by a licensed waste disposal contractor is then necessary.

Energy

Some processes eg phosphating require significant energy for process heating.

Accidents

Overfilling of tanks during replenishment/topping-up leading to floor spillage and possibly also to significant loss to the fume extraction system and thence to atmosphere. Leakage from local pumping.

Noise

None.

Indicative BAT requirements for Treatment Techniques (Dip Treatments)

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - rinse water economy
 - mass drag-out reduction
 - prolongation of process fluid life
 - energy consumption
 - prevention of fugitive emissions
- 3 The following techniques will minimise waste and energy consumption, minimise the loading on the effluent treatment facility, and minimise fugitive emission to air:
 - Use of a minimum of 2, preferably 3 stages of cascade rinsing with air agitation.
 - Minimisation of drag-out by maximising drainage time over the process tank, or use a separate drainage tank.
 - Provision of jig or barrel supports whilst draining for manually operated process tanks.
 - Use of continuous filtration and removal of sludge from phosphating process tanks.
 - Reduce of process heating requirement by using a removable lid on the tank and/or hexagons or croffles on the process fluid surface
 - Minimisation of fugitive emissions to air – see Section 2.3.11.

2.1.8 Rinsing

The proper design of rinsing systems is essential for water conservation and for the prolongation of process fluids life. Adequate rinsing is necessary to ensure that the finished work is chemically clean, especially when the final treatment is a hexavalent chromium plated finish or a chromium VI based passivate.

Single rinse tanks whether used for interstage rinsing or as a final rinse are ineffective unless a very large volume of water is used. Cascade (counterflow) rinsing in two or more stages reduces the water requirement to a low level whilst improving the quality of rinsing. Rinsing quality is defined as the ratio of the concentration of a metal or other ion in the preceding process tank to its concentration in the final rinse tank. Effective rinsing ratios depend on the process concentration, eg decorative chromium plating electrolyte with a 250g/l CrO_3 concentration will require a rinsing ratio of at least 15,000:1, equivalent to a final rinse concentration of 17mg/l.

Recommended rinsing ratios for a range of processes are:

Table 2.3: Rinsing Ratios

Process	Ratio	
Post alkaline cleaner rinse	2,000	
Post acid pickle rinse	pre cyanide plating process	5,000
	pre non-cyanide plating process	2,000
Post plating rinse	cadmium, silver, zinc (alkaline)	2,000
	zinc (acid)	3,000
	electronic nickel	5,000
	autocatalytic nickel	10,000
	chromium VI	15,000
Post passivate rinse	5,000	

Cascade Rinsing

Rinse water flows in litre/hr per litre of drag-out (perfect mixing) - for a range of rinse stages and rinsing ratios.

Table 2.4: Cascade Rinsing

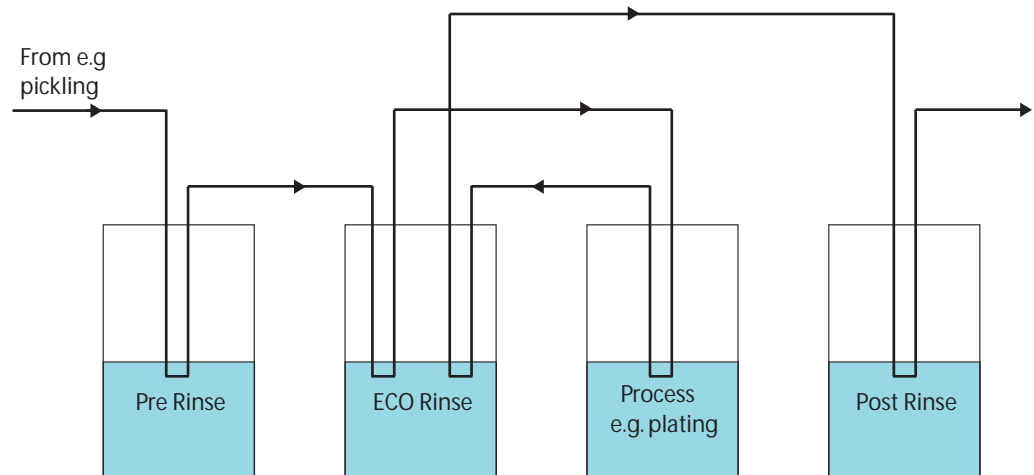
1	2	3	4	5	Rinsing Ratio
1,000	32	10	6	4	1,000
2,000	45	13	7	5	2,000
3,000	55	15	8	5	3,000
5,000	71	17	8	6	5,000
10,000	100	22	10	7	10,000
15,000	122	25	11	7	15,000

It can be seen that a triple stage rinse will save 90% or more of the water needed for a single rinse, and at least 70% of that needed for a twin stage rinse. Three to five stages reduce the water requirement to a level whereby the rinse flow can be fed forward to the preceding process tank and used as make-up for natural or assisted evaporation. Drag-out recovery may be close to 100%, and trade effluent flow from plants incorporating multistage rinsing and evaporative recovery can be very low. The additional capital investment for extra rinse tanks, evaporation equipment, etc is off-set by capital savings on a smaller effluent treatment facility. In addition, there will be operational savings on effluent treatment chemicals and on trade effluent discharge or disposal charges.

Multistage cascade rinsing may extend the length of a traditional surface treatment line by around 20%, and its capital investment by 5-10%. The construction of such a plant on a new site should not pose technical challenges, but the adaptation of an existing unit in an already cramped building will be less easy, unless there are redundant or spare tanks available in the line. Where this type of upgrading is physically impossible or extremely difficult, multistage spray rinsing carried out in a single tank should be considered. For warm processes, a spray rinse as the work is withdrawn from the process tank may be effective and constitute the first stage of cascade rinsing.

ECO-rinsing is a technique in which drag-out is recovered in a single static rinse tank in which the work is dipped both before and after being processed. As can be seen from the diagram below, the ECO-rinse tank operates in an equilibrium condition and is only drained for routine cleaning or maintenance. The technique recovers at least 40% of drag-out.

Figure 2.1: Work Flow Direction



Another technique is the use of ion exchange technology to clean and recycle contaminated rinse water. Again, it is possible to achieve a low water discharge to the external environment. In this case, drag-out recovery is effected with the use of one or more drag-out tanks prior to the running rinse system. Drag-out may be partially or completely returned upstream, depending on the extent of natural or forced evaporation from the process tank.

Cost-benefit analysis will generally indicate the most favourable route, depending on such factors as the nature of the process, whether the installation is existing or proposed, available building space etc.

Indicative BAT requirements for Rinsing

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - water economy
 - mass drag-out reduction
- 3 The following techniques will minimise waste and energy consumption and minimise the loading on the effluent treatment facility.
 - Use of multistage cascade rinsing – see [Section 2.1.6](#) on page 21 to [Section 2.1.7.6](#) on page 33.
 - Minimisation of drag-out by employing a drainage time over the process tanks of at least 20 seconds for rack work and 30 seconds for barrelled work.
 - Use of a drag-in – drag-out tank (ECO rinse system) to reduce mass drag-out and subsequent rinse water consumption by 40% [Ref 7](#) and [Ref 8](#)).
 - Use of continuous filtration and removal of sludge from phosphating process tanks.
 - Recycle of trade effluent to less critical rinsing stages
 - Recycle of rinse water through ion-exchange equipment.

2.1.9 Drying

Surface treated work generally requires drying to prevent possible tarnishing and corrosion of the coating in storage. Rack work is usually dried on-line in a hot air recirculated oven. For low output plants the work may be manually transferred to an oven. The drying temperature is generally 60-80½C, but a maximum of 60½C for passivated zinc-plated work. Small work which is treated in barrel plants is usually dried in batch centrifugal driers. Manually operated lines frequently use a final static water rinse at 60-90½C to heat the work so that it will flash dry after withdrawal.

Releases

Water

Hot water drying tanks need to be regularly drained and refilled to prevent a build-up of contaminants (but can be used as make-up water for rinsing)

Air

There is a significant loss of water vapour from tanks at operational temperatures above 60°C., as well as from the drying operations.

Waste

None.

Energy

Significant, depending on the amount of water to be evaporated eg hollow and complex shaped work will have a high drag-out. of water.

Accidents

None.

Noise

None.

Indicative BAT requirements for Drying

- 1 With the Application, the operator should:
 - Supply the general Application requirements for [Section 2.1](#) on page 14 for each of the materials used in the activity.
- 2 Indicative BAT requirements control issues are:
 - reduction of energy
- 3 The following techniques will minimise energy consumption:
 - The use of centrifugal drying consumes less energy than a hot air drier, but is only suitable for small work. It is not suitable for work that needs careful physical handling to prevent scratching or deformation
 - Provision of lids for hot water tank driers.
 - Provision of a continuous bleed-off from hot-water driers as supply for the preceding cascade rinsing system, with equivalent water feed to hot water tank driers to make-up for evaporative loss and the bleed to the rinsing tanks. This ensures clean drying conditions without the need regularly to drain the tank.

2.2 Emissions control

2.2.1 Point source emissions to air

The nature and source of the emissions expected from each activity is given in previous sections and will be confirmed in detail in the Operator's response to the emissions inventory.

The nature and source of the emissions expected from each activity is given in previous sections and will be confirmed in detail in the operator's response to Section 3.1. In general they comprise:

- particulates from mechanical preparation equipment
- VOCs from vapour degreasing equipment
- humid air from hot aqueous alkaline cleaning tanks
- humid air containing hydrochloric acid gas from hydrochloric acid pickle tanks
- humid air containing sulphuric mist from hot sulphuric acid pickle tanks
- humid air containing process fluid mists from surface treatment process tanks. Volatile organics may also be present from electroplating tanks
- humid air containing process fluid mists from post treatment tanks
- humid air containing NO_x from nitric acid oxidation and stripping processes

Material losses and pollution are negligible from well-designed extraction systems. However, where there is a need, cross-sectoral guidance on abatement techniques for point source emissions to air can be found in [Ref 7](#)

It is usual for there to be a common fume extraction manifold, fan and stack for the chemical preparation, surface treatment process and post treatment tanks.

Where the surface treatment process tanks contain cyanide substances, the overall extraction system is divided for safety purposes into two parts: an alkaline system to which the alkaline and cyanide tanks are extracted, and an acid system to which the acidic process fluids are extracted.

Many plants, and always those in which there is a hexavalent chromium plating tank, employ a wet mist eliminator down upstream of the extraction fan(s) and stack(s).

Wet abatement scrubbers are not generally necessary unless there are significant levels of gases present which are soluble in water or aqueous solutions eg NO_x. Scrubbers are generally placed after the extraction fan and there is then no need for a wet mist eliminator prior to the extraction fan.

Indicative BAT requirements for the control of point-source emissions to air

- 1 The benchmark values in [Section 3](#) on page 84 should be achieved unless alternative values are justified and agreed with the Regulator in the Permit.
- 2 The Operator should identify the main chemical constituents of the emissions (this includes, in particular, the speciation of VOCs to understand the potential harm of the releases) and assess of the fate of these chemicals in the environment.
- 3 Vent and chimney heights should be sufficient to ensure that there is adequate dispersion of the emission(s) to prevent exceedances of local ground level pollution thresholds (EALs) based on the most sensitive receptor, be it human health, soil or terrestrial ecosystems. The installation should only contribute a small proportion of the threshold (see [IPPC Environmental Assessments for BAT](#)), and may need to be supported by more detailed dispersion modelling as described in [Section 4](#) on page 92.
- 4 Where appropriate, the chimney or vent should be recognised as an emergency emission point. Process upsets or equipment failure giving rise to abnormally high emission levels over short periods should be assessed. Even if the Applicant can demonstrate a very low probability of occurrence, the height of the chimney or vent should nevertheless be set to avoid any significant risk to health. The impact of fugitive emissions can also be assessed in many cases.
- 5 Steam plume elimination. Releases from wet scrubber vents should be hot enough to avoid visible plume formation in the vicinity of the vent. This is to prevent the condensation or adsorption of environmentally harmful substances by the condensing water vapour. Exhaust gases from a wet scrubber can be heated by the use of waste heat to raise the temperature of the exhaust gases and prevent immediate condensation on the exit from the vent. This procedure also aids the thermal buoyancy of the plume. Where there is no available waste heat and the vent contains no significant environmentally harmful substances, the Applicant may be able to demonstrate that the BAT criteria have nonetheless been met.
- 6 The Operator should complete any detailed studies required into abatement or control options as an improvement condition.
- 7 Indicative BAT requirements are:
 - The operator should complete any detailed studies required into abatement or control options see item 3 in Section 2.3\)) as an improvement condition to a timescale to be agreed with the Regulator but in any case within the timescale given in [Section 1.1](#) on page 1.
 - Steam plume elimination. Releases from wet scrubber vents should be hot enough to avoid visible plume formation in the vicinity of the vent. This is to prevent the condensation or absorption of environmentally harmful substances by the condensing water vapour. Exhaust gases from a wet scrubber can be heated by the use of waste heat to raise the temperature of the exhaust gases and prevent immediate condensation on the exit from the vent. This procedure also aids the thermal buoyancy of the plume. Where there is no available waste heat and the vent contains no significant environmentally harmful substances, the applicant may be able to demonstrate that the BAT criteria have nonetheless been met..
 - Process tank operating freeboard should be at least 125mm (preferably 150mm), and not less than 150mm for hexavalent chromium plating, chromic acid anodising, and chromic/sulphuric acid etch tanks.
 - Local extraction rates should be capable of regulation by local dampers.
 - Process tank lip ducts should be located with at least a 50mm gap between the top of the tank and the bottom of the lip duct.
 - Fume extraction through the upper sides of process tanks is not recommended.
 - A mist eliminator should be installed in the suction side of the extraction fan, with mist-eliminator drainage and washings being discharged to the effluent treatment facility.

2.2.2 Point source emissions to surface water and sewer

The nature and source of the emissions expected from each activity is given in previous sections and will be confirmed in detail in the Operator's response to the emissions inventory.

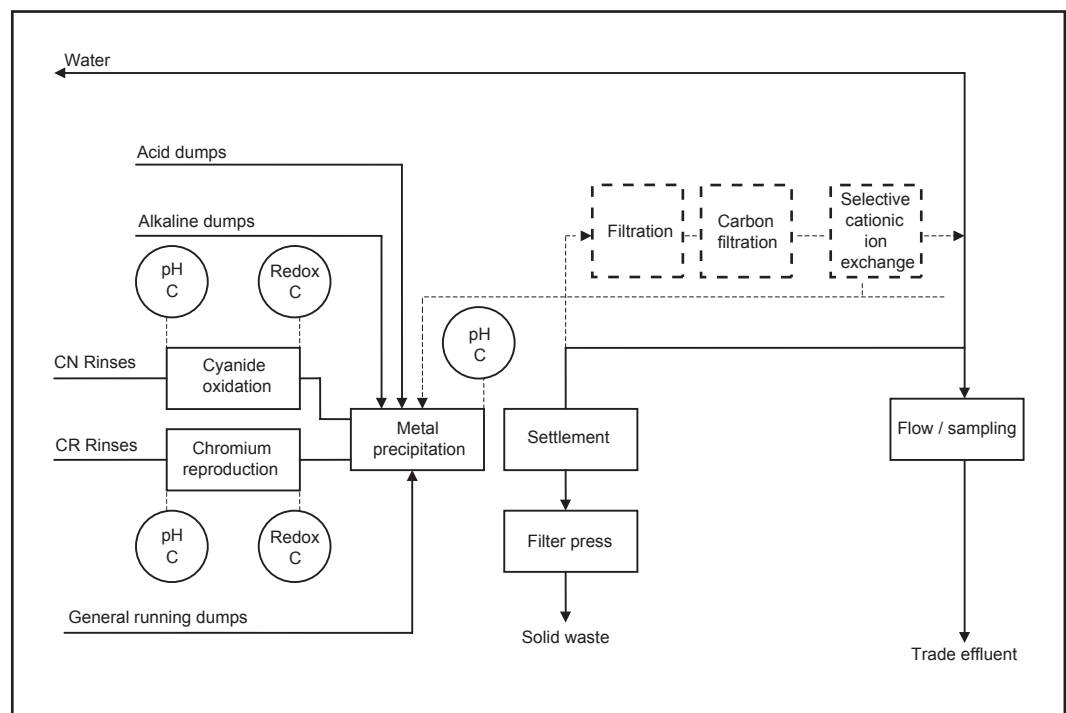
The nature and source of the emissions expected from each activity is given in previous sections and will be confirmed in detail in the operator's response to [Section 3.1](#) on page 84. In general, wastewater can arise from any of the process activities, from storm water, from cooling water, from accidental release of raw materials, products or waste materials, and from fire-fighting. In addition to the techniques given below, guidance on cost-effective effluent treatment techniques can be found in ETBPP Guides ([Ref 7](#)), and in the Handbook of Effluent treatment and Recycling for the Metal Finishing Industry ([Ref 30](#)).

A wide range of inorganic and organic chemicals is used in surface treatment activities but the effluent is of a predominantly inorganic nature. The largest contribution to the organic content of trade effluent from general metal finishing activities is the oil and grease from alkaline cleaning, but trace quantities of substances such as emulsifying agents, surfactants, defoamers and other organic additives may also be present, (for example, certain alkaline zinc-nickel electrolytes contain an amine complexing agent).

Surface treatment activities in the printed circuit industry may involve the release of complexing agents and formaldehyde used in autocatalytic copper plating and water soluble resists. The effluents can be complex mixture of substances and the impact of these, both individually and synergistically, needs to be assessed. Thus whole sampling monitoring techniques can be appropriate – see [Section 2.10](#) on page 76.

Most surface treatment operations employ a dedicated effluent treatment facility, but there are a few operations that currently still rely on a high rinse water flow and high dilution to achieve the Sewage Undertaker's consent to discharge limits. A typical effluent treatment facility is shown below.

Figure 2.2: Typical Effluent Treatment Facility



Indicative BAT requirements for the control of effluent treatment (Sheet 1 of 3)

- 1 The primary consideration should be to prevent releases of harmful substances to the aquatic environment, whether releases are direct or via a sewage treatment works.
- 2 The following general principles should be applied in sequence to control emissions to water:
 - water use should be minimised and wastewater reused or recycled (see [Section 2.4.2](#) on page 59)
 - contamination risk of process or surface water should be minimised (see [Section 2.2.5](#) on page 49)
 - wherever possible, closed loop cooling systems should be used and procedures in place to ensure blow down is minimised
 - where any potentially harmful materials are used measures should be taken to prevent them entering the water circuit
- 3 Consideration should be given to the use of filtration/osmosis or other techniques. such techniques allow the water to be cleaned to the above level for release or, preferably, be returned to the process. Particular consideration should be given to the fate of the concentrated residues of such techniques. These can often be returned to furnaces, evaporated, solidified, sent for incineration etc. that tankering of such residues off site as waste, simply transfers the problem to another place unless they are sent to a facility with the genuine ability to recycle the materials.
- 4 If the wastewater is all readily biodegradable or contains only materials which are naturally occurring in much larger quantities in the receiving water the Operator can offer justification as to why filtration/osmosis or other techniques are not appropriate.
- 5 Where prevention is not possible, the emissions benchmarks given in [Section 3](#) on page 84, are achievable.
- 6 Where effluent is treated off-site at a sewage treatment works, the above factors apply in particular demonstrating that:
 - the treatment provided at the sewage treatment works is as good as would be achieved if the emission was treated on-site, based on reduction of load (not concentration) of each substance to the receiving water (using the [IPPC Environmental Assessments for BAT](#) software tool will assist in making this assessment).
 - whether action plans are appropriate in the event of sewer bypass, (via storm/emergency overflows or at intermediate sewage pumping stations) to prevent direct discharge of the waste waters during these periods, e.g. knowing when bypass is occurring, rescheduling activities such as cleaning or even shutting down when bypass is occurring.
 - a suitable monitoring programme is in place for emissions to sewer. This may be that specified by the sewerage undertaker to protect the treatment plant, or it may be more extensive if further controls are required to minimise the load released.
- 7 The Operator should maintain an understanding of the main chemical constituents of the treated effluent (including the make-up of the COD) and assessment of the fate of these chemicals in the environment.
- 8 All emissions should be controlled, as a minimum, to avoid a breach of water quality standards (see [Section 3.2](#) on page 86 and [Section 4.1](#) on page 92), but noting that where BAT can deliver further reduction at reasonable cost it should do so (see [Section 1.1](#) on page 1). Calculations and/or modelling to demonstrate this will be carried out in response to [Section 4.1](#).

Handling

- 9 Buffer storage tanks should normally be provided to contain process fluid dumps eg spent alkaline cleaners, pickles, passivates, which are preferably treated in the effluent treatment facility rather than removed by a licensed waste disposal contractor. Usually, there will be a dedicated storage tank for alkaline, acidic, and hexavalent chromium dumps. In such cases the Operator should demonstrate that the spent materials can be released to the effluent treatment facility at a slow controlled rate.
- 10 For larger surface treatment operations where there are several process lines, the effluent flow will vary in accord with the number of lines in operation. The Operator should show how peak loads are handled without overloading the capacity of the effluent treatment facility.
- 11 Small effluent treatment facilities are preferably operated on a batch basis which only release trade effluent to the sewer after confirmation that it is within the Sewerage Undertaker's consent limits. Larger facilities may be operated on a continuous basis provided that adequate monitoring is in place.

Treatment Objectives

- 12 The Operator should justify the choice and performance of the effluent treatment facility against the following:
- the objectives include the removal of dissolved metals (these include basis metals, eg iron, aluminium, copper, and zinc, and plating metals eg chromium, copper, nickel, lead, tin, silver, and zinc) and the control of the trade effluent pH within the Sewerage Undertaker's consent limits. Formal consent limits may also be set for suspended solids, oil and grease, sulphate, detergents, COD, and cyanide.

Primary Treatment

- 13 Whether multistage cascade or rinse water recirculation with ion-exchange is used for water conservation, the primary stage of effluent treatment is the precipitation of the dissolved metals from the rinse water effluent, or from the recirculating rinse water ion-exchange regenerate. Where hexavalent chromium is present, it is first necessary to carry out a reduction to the trivalent state in a turbulent tank reactor. Any cyanide containing stream requires a cyanide oxidation step, again in a turbulent tank reactor. The dissolved metals in the combined effluent stream are then precipitated in a turbulent tank reactor at a pH in the range 6-10 depending on the metals present using acid or alkali, as appropriate. Mixing in circular tank reactors is, preferably promoted by slow speed propellor or turbine agitation and wall baffles. pH stability may be improved by using PID control in place of on-off control systems for dosing chemicals. The next step is the separation of the precipitate in a void tank settler or a lamellar clarifier, often with chemical pre-treatment (eg polyelectrolytes, inorganic coagulants and bentonite) to enhance the removal of colloidal solids, and/or to reduce the settlement time. Settling equipment works best with a steady continuous flow. Pumping tanks should preferably be fitted with a level sensing device with a proportional output that is used to control the flow either by a proportional action flow control valve or by varying the shaft speed of a centrifugal pump. The settled sludge containing 2-3% solids is periodically discharged to a secondary settlement tank where the solids level is allowed to attain a level of around 8%. The sludge is then filtered in a high pressure batch filter press for further water removal. The discharged filter cake containing 20-30% solids is removed by a licensed waste disposal contractor to landfill. Filter press pumps providing an operational pressure of 10-15 bar will increase the solids content of the filter cake to 35-40%. The filtrate is recycled to the precipitation reactor. The clean water flow from the settler/clarifier is usually discharged directly to the foul sewer as trade effluent
- 14 The effluent system should be designed so as to prevent process effluent by-passing the effluent treatment plant.

Secondary/Tertiary Treatment

- 15 Filtration to remove fine suspended solids to achieve trade effluent consent limits for metals. of 1-3mg/l is common, Trade effluent, whether filtered or not, may be recycled to the less critical rinsing steps and thus reduce input water usage by up to 30%. Where multistage cascade rinsing is in place, the effluent flow may be very low and “end of pipe” treatment with such techniques as activated carbon, bone charcoal, selective cationic ion-exchange, membrane filtration technology, and reverse osmosis may then be considered - thus enabling a further reduction in water usage.

2.2.3 Point source emissions to groundwater

Groundwater protection legislation

The Groundwater Regulations for the UK came into force on 1 April 1999. An IPPC Permit will be subject to the following requirements under these Regulations.

- i. It shall not be granted at all if it would permit the *direct discharge* of a List I substance (Regulation 4(1)) except in limited circumstances – see note 1, below.
- ii. If the Permit allows the disposal of a List I substance or any other activity that might lead to an *indirect discharge* (see note 2, below) of a List I substance then *prior investigation* (as defined in Regulation 7) is required and the Permit shall not be granted if this reveals that indirect discharges of List I substances would occur; in any event, conditions to secure the prevention of such discharges must be imposed (Regulation 4(2) and (3)).
- iii. In the case of List II substances, Permits allowing direct discharges or possible indirect discharges, cannot be granted unless there has been a prior investigation and conditions must be imposed to prevent groundwater pollution (Regulation 5).
- iv. The Regulations contain further detailed provisions covering *surveillance* of groundwater (Regulation 8); conditions required when direct discharges are permitted (Regulation 9); when indirect discharges are permitted (Regulation 10); and review periods and compliance (Regulation 11).

The principles, powers and responsibilities for groundwater protection in England and Wales, together with the Agency's policies on this, are outlined in the Environment Agency's document [Policy and Practice for the Protection of Groundwater](#). This outlines the concepts of vulnerability and risk and the likely acceptability from the Agency's viewpoint of certain activities within groundwater protection zones. These are categorised as:

A Prior investigation of the potential effect on groundwater of on-site disposal activities discharges to groundwater. Such investigations will vary from case to case, but the Regulator is likely to require a map of the proposed disposal area; a description of the underlying geology, hydrogeology and soil type, including the depth of saturated zone and quality of groundwater the proximity of the site to any surface waters and abstraction points, and the relationship between ground and surface waters; the composition and volume of waste to be disposed of; and the rate of planned disposal.

The Environment Agency has produced a series of maps of England and Wales, which provide a guide to potential groundwater vulnerability. Source Protection Zones are intended to aid protection by defining annular zones around each major potable source, including springs, boreholes and wells, based on travel times.

B Surveillance - This will also vary from case to case, but will include monitoring of groundwater quality and ensuring the necessary precautions to prevent groundwater pollution are being undertaken.

Note 1 The Regulations state that, subject to certain conditions, the discharges of List I substances to groundwater may be authorised if the groundwater is "permanently unsuitable for other uses". Advice must be sought from the Regulator where this is being considered as a justification for such discharges.

Note 2 List I and List II refer to the list in the Groundwater Regulations and should not be confused with the similar lists in the Dangerous Substances Directive

Indicative BAT requirements for point source emissions to groundwater

Identify if there may be a discharge of any List I or List II substances and if any are identified, explain how the requirements of the Groundwater Regulations 1998 have been addressed.

- 1 In general, there should be no permitted releases to groundwater of either a direct or indirect nature.
- 2 If such releases are to continue the requirements of the Regulations, as summarised above, must be complied with.

List I

- 1.-(1) Subject to the sub paragraph below, a substance is in List I if it belongs to one of the following families or groups of substances:
 - (a) organohalogen compounds and substances that may form such compounds in the aquatic environment
 - (b) organotin compounds
 - (c) substances that possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (including substances that have those properties that would otherwise be in List II)
 - (d) mercury and its compounds
 - (e) cadmium and its compounds
 - (f) mineral oils and hydrocarbons
 - (g) cyanides.
- 1.-(2) A substance is not in List I if it has been determined by the Regulator to be inappropriate to List I on the basis of a low risk of toxicity, persistence and bioaccumulation.

List II

- 2.-(1) A substance is in List II if it could have a harmful effect on groundwater and it belongs to one of these families or groups of substances:
 - (a) the following metalloids and metals and their compounds:

zinc	tin	copper
barium	nickel	beryllium
chromium	boron	lead
uranium	selenium	vanadium
arsenic	cobalt	antimony
thallium	molybdenum	tellurium
titanium	silver	
 - (b) biocides and their derivatives not appearing in List I
 - (c) substances that have a harmful effect on the taste or odour of groundwater, and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption
 - (d) toxic or persistent organic compounds of silicon, and substances that may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances
 - (e) inorganic compounds of phosphorus and elemental phosphorus
 - (f) fluorides
 - (g) ammonia and nitrates.

- 2.-(2) A substance is also in List 2 if:
- (a) it belongs to one of the families or groups of substances set out in paragraph 1(1) above
 - (b) it has been determined by the Regulator to be inappropriate to List I under paragraph 1(2); and
 - (c) it has been determined by the Regulator to be inappropriate to List II having regard to toxicity, persistence and bioaccumulation.
- 3.-(1) The Secretary of State or Scottish Ministers may review any decision of the Regulator in relation to the exercise of its powers under the paragraphs above.
- 3.-(2) The Secretary of State or Scottish Minister shall notify the Regulator of his decision following a review under List 1 sub paragraph 1 above and it shall be the duty of the Regulator to give effect to that decision.
- 4.- The Regulator shall from time to time publish a summary of the effect of its determinations under this Schedule in such manner as it considers appropriate and shall make copies of any such summary available to the public free of charge.

2.2.4 Control of fugitive emissions to air

On many installations fugitive, or diffuse, emissions may be more significant than point-source emissions. Common examples of the sources of fugitive emissions are:

Fugitive emissions to air are unlikely to be of major significance, however attention should be given to the following:

- fume from strong acid tonnage storage vessels especially during filling
- the loading and unloading of bulk transport containers
- transferring materials from one vessel to another
- excessive air extraction velocity over process tanks causing entrainment of process fluids to air
- overfilled process tanks causing entrainment of process fluids to air
- storage and handling of VOCs
- poor building containment and extraction
- bypassing of abatement equipment
- accidental loss of containment from failed plant and equipment.

As part of the Application the Operator will have identified and, where possible quantified, significant fugitive emissions to air from all relevant sources, estimating the proportion of total emissions that are attributable to fugitive releases for each substance. Where there are opportunities for reductions, the Permit may require the updated inventory of fugitive emissions to be submitted.

Indicative BAT requirements for fugitive emissions to air (Sheet 1 of 2)

- 1 **Dust** - The following general techniques should be employed where appropriate:
 - Covering of skips and vessels
 - Avoidance of outdoor or uncovered stockpiles (where possible)
 - Where unavoidable, use of sprays, binders, stockpile management techniques, windbreaks and so on
 - Regular wheel and road cleaning (avoiding transfer of pollution to water and wind blow)
 - Closed conveyors, pneumatic or screw conveying (noting the higher energy needs), minimising drops. Filters on the conveyors to clean the transport air prior to release
 - Regular housekeeping
 - Enclosed silos (for storage of bulk powder materials) vented to fabric filters with the collected material returned to the silo or recycled to the furnace
 - Enclosed containers or sealed bags used for smaller quantities of fine materials
- 2 identify, and quantify where possible quantify, significant fugitive emissions to air from all relevant sources, including those below, estimating the proportion of total emissions which are attributable to fugitive releases for each substance; these steps will be carried out as in response to [Section 3.1](#) on page 84 but need to be understood here in order to demonstrate that the controls are adequate. Three examples are:
 - hydrochloric acid storage vessels
 - unloading of hydrochloric acid road tankers to storage
 - entrained process fluids from ventilated process tanks

3 VOCs

- When transferring volatile liquids, the following techniques should be employed – subsurface filling via filling pipes extended to the bottom of the container, the use of vapour balance lines that transfer the vapour from the container being filled to the one being emptied, or an enclosed system with extraction to suitable abatement plant.
- Vent systems should be chosen to minimise breathing emissions (for example pressure/ vacuum valves) and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment.
- Maintenance of bulk storage temperatures as low as practicable, taking into account changes due to solar heating etc.
- The following techniques should be used (together or in any combination) to reduce losses from storage tanks at atmospheric pressure:
 - Tank paint with low solar absorbency
 - Temperature control
 - Tank insulation
 - Inventory management
 - Floating roof tanks
 - Bladder roof tanks
 - Pressure/vacuum valves, where tanks are designed to withstand pressure fluctuations
 - Specific release treatment (such as adsorption condensation)

4 For Information on Odour, see [Section 2.2.6](#) on page 51.

5 Indicative BAT requirements are:

- the operator should complete any detailed studies required into abatement or control options as an improvement condition to a timescale to be agreed with the Regulator, but in any case within the timescale given in [Section 1.1](#) on page 1
- where there are opportunities for reductions, the Permit may require the updated inventory of fugitive submissions to be submitted on a regular basis
- a simple water scrubber should be fitted to the vent outlet of hydrochloric acid tonnage storage vessels (for use during filling operations)
- process tank freeboard should be not less than 125mm, (150mm for hexavalent chromium plating tanks) and preferably 150mm. The tank lip ducts should be positioned 50mm above the top of the tank lip angle. There should be local flow control damper for every lip duct.
- regular cleaning of fume extraction ducting and mist eliminators

2.2.5 Fugitive emissions to surface water, sewer and groundwater

As part of the Application the Operator will have identified and, where possible quantified, significant fugitive emissions to water from all relevant sources, estimating the proportion of total emissions that is attributable to fugitive releases for each substance. Where there are opportunities for reductions, the Permit may require regular updated inventory of fugitive emissions to be submitted.

Indicative BAT requirements for fugitive emissions to water (Sheet 1 of 2)

- 1 With regard to **subsurface structure**, the Operator should:
 - establish and record the routing of all installation drains and subsurface pipework
 - identify all subsurface sumps and storage vessels
 - engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where hazardous (i.e. listed) substances are involved
 - provide, in particular, secondary containment and/or leakage detection for such subsurface pipework, sumps and storage vessels
 - establish an inspection and maintenance programme for all subsurface structures, e.g. pressure tests, leak tests, material thickness checks or CCTV

- 2 For **surfacing**, the Operator should:
 - describe the design and condition of the surfacing of all operational areas (*Relevant information may include as appropriate: capacities; thicknesses; falls; material; permeability; strength/reinforcement; resistance to chemical attack; inspection and maintenance procedures; and quality assurance procedures.*)
 - have an inspection and maintenance programme of impervious surfaces and containment kerbs
 - justify where operational areas have not been equipped with:
 - an impervious surface
 - spill containment kerbs
 - sealed construction joints
 - connection to a sealed drainage system

- 3 All tanks containing liquids whose spillage could be harmful to the environment should be bunded. For further information on bund sizing and design, see the [Releases to water references](#). Bunds should:
 - be impermeable and resistant to the stored materials
 - have no outlet (that is, no drains or taps) and drain to a blind collection point
 - have pipework routed within bunded areas with no penetration of contained surfaces
 - be designed to catch leaks from tanks or fittings
 - have a capacity greater than 110 percent of the largest tank or 25 percent of the total tankage
 - be subject to regular visual inspection and any contents pumped out or otherwise removed under manual control after checking for contamination
 - where not frequently inspected, be fitted with a high-level probe and an alarm as appropriate

Indicative BAT requirements for fugitive emissions to water (Sheet 2 of 2)

- have fill points within the bund where possible or otherwise provide adequate containment
 - have a routine programmed inspection of bunds (normally visual, but extending to water testing where structural integrity is in doubt)
- 4 All sumps should:
- be impermeable and resistant to stored materials
 - be subject to regular visual inspection and any contents pumped out or otherwise removed after checking for contamination
 - where not frequently inspected, be fitted with a high level probe and alarm as appropriate
 - have a routine programmed inspection (normally visual but extending to water testing where structural integrity is in doubt)
- 5 Storage areas and containers should be designed and operated to minimise the risk of releases to the environment. In particular:
- Storage areas should be located away from watercourses and sensitive boundaries, for example, adjacent to areas of public use, and should be protected against vandalism.
 - Storage areas should be clearly marked and signed plus containers should be clearly labelled.
 - The maximum storage capacity of storage areas should be stated and not exceeded. The maximum storage period for containers should be specified.
 - Appropriate storage facilities should be provided for special requirements such as for substances that are flammable, sensitive to heat or light and the like; also incompatible waste types should be kept separate.
 - Containers should be stored with lids, caps and valves secured and in place. This also applies to emptied containers.
 - Storage containers, drums and the like should be regularly inspected.
 - Procedures should be in place to deal with damaged or leaking containers.

2.2.6 Odour

The level of detail supplied should be in keeping with the risk of causing odour-related annoyance at sensitive receptors.

Where an installation poses no risk of odour-related environmental impact because the activities undertaken are inherently non-odorous, this should be justified and no further information relating to odour need normally be supplied.

Where odour could be a problem, the Operator will be required in the Application to supply the information as indicated below:

- Information relating to sensitive receptors, in particular the type of receptor, location relative to the odour sources and an assessment of the impact of odorous emissions on the receptors. Where detailed information is required the Operator may be able to secure an agreement to supply this as part of an Improvement Programme.
- An overview of any complaints received, what they relate to (source/operation) and remedial action taken.
- The types and source of odorous substances used or generated, intentional and fugitive (unintentional) release points and monitoring undertaken.
- Actions taken to prevent or minimise
 - A description of the actions taken to prevent and/or minimise odour annoyance for each odour source.
 - A demonstration that the indicative BAT requirements are being complied with.
 - Identification of any circumstances or conditions which might compromise the ability to prevent or minimise odour annoyance, and a description of the actions that will be taken to minimise the impact.

There may be a requirement placed upon the Operator to provide some or all of this information in the form of an odour management statement. See the [Odour management statement](#) for a typical log book.

Indicative BAT requirements for odour control

- 1 The requirements for odour control will be installation-specific and depend on the sources and nature of the potential odour. In general:
- 2 Where odour can be contained, for example within buildings, the Operator should maintain the containment and manage the operations to prevent its release at all times.
- 3 Where odour releases are expected to be acknowledged in the Permit, (i.e. contained and treated prior to discharge or discharged for atmospheric dispersion):
 - *For existing installations*, the releases should be modelled to demonstrate the odour impact at sensitive receptors. The target should be to minimise the frequency of exposure to ground level concentrations that are likely to cause annoyance.
 - *For new installations, or for significant changes*, the releases should be modelled and it is expected that the Operator will achieve the highest level of protection that is achievable with BAT from the outset.
 - Where there is no history of odour problems then modelling may not be required although it should be remembered that there can still be an underlying level of annoyance without complaints being made.
 - Where, despite all reasonable steps in the design of the plant, extreme weather or other incidents are liable, in the view of the Regulator, to increase the odour impact at receptors, the Operator should take appropriate and timely action, as agreed with the Regulator, to prevent further annoyance (these agreed actions will be defined either in the Permit or in an odour management statement).
- 4 Where odour generating activities take place in the open, (or potentially odorous materials are stored outside) a high level of management control and use of best practice will be expected.
- 5 Where an installation releases odours but has a low environmental impact by virtue of its remoteness from sensitive receptors, it is expected that the Operator will work towards achieving the standards described in this Note, but the timescales allowed to achieve this might be adjusted according to the perceived risk.

2.3 Management

Within IPPC, an effective system of management is a key technique for ensuring that all appropriate pollution prevention and control techniques are delivered reliably and on an integrated basis.

The Regulators strongly support the operation of environmental management systems (EMSs). An Operator with such a system will find it easier to complete not only this section but also the technical/regulatory requirements in the following sections

The Regulators recommend either certification to the ISO 14001 standard or registration under EMAS (EC Eco Management and Audit Scheme) (OJ L114, 24/04/01). Both certification and registration provide independent verification that the EMS conforms to an assessable standard. EMAS now incorporates ISO 14001 as the specification for the EMS element. We believe that EMAS has a number of benefits over ISO14001 including a greater focus on environmental performance; a greater emphasis on legal compliance; and a public environmental statement. For further details about ISO 14001 and EMAS contact British Standards Institute (BSI) and the Institute of Environmental Management and Assessment (IEMA) respectively.

An effective EMS will help the Operator to maintain compliance with regulatory requirements and to manage other significant environmental impacts. This section identifies only those EMS requirements that are not specifically covered elsewhere in other sections of the document. It should not, therefore, be taken to describe all of the elements of an effective environmental management system. While the requirements below are considered to be BAT for IPPC, they are the same techniques as required in a formal EMS and are also capable of delivering wider environmental benefits. However, it is information on their applicability to IPPC which is primarily required in this application.

In 2001 the Environment Agency together with the Surface Engineering Association compiled a Health, Safety and Environment Code of Best Practice for the Surface Finishing Industry. Although relevant for the whole industry sector it should be of particular interest to smaller companies (typically with < 20 staff) who find that resources are stretched in terms of being able to fully certify their EMS. Companies who have adopted this voluntary code of practice should give an overview of this in their application with brief details of how it has been implemented and reviewed.

For the Surface Finishing sector, the management systems implemented to prevent accidents are of particular importance, and also systems for logging those which have taken place and the measures implemented to prevent any recurrence. This is dealt with more specifically in [Section 3.2.7](#) on page 91.

Indicative BAT requirements for management techniques (Sheet 1 of 3)

Operations and maintenance

- 1 Effective operational and maintenance systems should be employed on all aspects of the process whose failure could impact on the environment, in particular there should be:
 - documented procedures to control operations that may have an adverse impact on the environment
 - a defined procedure for identifying, reviewing and prioritising items of plant for which a preventative maintenance regime is appropriate
 - documented procedures for monitoring emissions or impacts
 - a preventative maintenance programme covering all plant, whose failure could lead to impact on the environment, including regular inspection of major 'non productive' items such as tanks, pipework, retaining walls, bunds ducts and filters
- 2 The maintenance system should include auditing of performance against requirements arising from the above and reporting the result of audits to top management.

Indicative BAT requirements for management techniques (Sheet 2 of 3)

Competence and training

- 3 Training systems, covering the following items, should be in place for all relevant staff which cover
 - awareness of the regulatory implications of the Permit for the activity and their work activities;
 - awareness of all potential environmental effects from operation under normal and abnormal circumstances
 - awareness of the need to report deviation from the Permit
 - prevention of accidental emissions and action to be taken when accidental emissions occur
- 4 The skills and competencies necessary for key posts should be documented and records of training needs and training received for these post maintained.
- 5 The key posts should include contractors and those purchasing equipment and materials;
- 6 The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.
- 7 Where industry standards or codes of practice for training exist (e.g. WAMITAB) they should be complied with.

Accidents/incidents/non conformance

- 8 There should be an accident plan as described in [Section 2.8](#) on page 71 which:
 - identifies the likelihood and consequence of accidents
 - identifies actions to prevent accidents and mitigate any consequences
- 9 There should be written procedures for handling, investigating, communicating and reporting actual or potential non-compliance with operating procedures or emission limits.
- 10 There should be written procedures for handling, investigating, communicating and reporting environmental complaints and implementation of appropriate actions.
- 11 There should be written procedures for investigating incidents, (and near misses) including identifying suitable corrective action and following up

Indicative BAT requirements for management techniques (Sheet 3 of 3)

Organisation

- 12 The following are indicators of good performance which will impact on Agency resources, but upon which we will not normally insist as Permit conditions
- 13 The company should preferably adopt an environmental policy and programme which:
 - includes a commitment to continual improvement and prevention of pollution
 - includes a commitment to comply with relevant legislation, and with other requirements to which the organisation subscribes
 - identifies, sets, monitors and reviews environmental objectives and key performance indicators independently of the Permit
- 14 The company should preferably have procedures which incorporate environmental issues into the following areas (as supported by demonstrable evidence e.g. written procedures):
 - the control of process change on the installation
 - design and review of new facilities (including provision for their decommissioning), engineering and other capital projects
 - capital approval
 - purchasing policy
- 15 The company should preferably have audits, at least annually, to check that all activities are being carried out in conformity with the above requirements. These should preferably be independent.
- 16 The company should preferably report annually on environmental performance, objectives and targets, and future planned improvements. This should preferably be a public environmental statement.
- 17 The company should preferably have a registered or certified EMAS/ISO 14001 system (by an accredited certification body)
- 18 The company should preferably have a clear, logical and recorded system for keeping records of:
 - Policies
 - roles and responsibilities
 - targets
 - procedures
 - results of audits
 - results of reviews

2.4 Raw Materials

This section covers the use of raw materials and water and the techniques for both minimising their use and minimising their impact by selection. (The choice of fuels is covered under [Section 2.7.3](#) on page 70, Energy).

As a general principle, the Operator will need to demonstrate the measures taken to:

- reduce the use of chemicals and other materials ([Section 2.4.2](#) on page 59)
- substitute less harmful materials, or those which can be more readily abated and when abated lead to substances that are more readily dealt with
- understand the fate of by-products and contaminants and their environmental impact ([Section 2.4.2](#) on page 59)

2.4.1 Raw materials selection

This section looks at the selection and substitution of raw materials and [Section 2.4.2](#) on page 59 describes the techniques to minimise their use.

It should be recognised that the process of selecting raw materials can present an opportunity to control emissions at source. In this regard it is suggested that Operators closely examine the range of possible raw material options available to them.

The Application requires the Operator to supply a list of the materials used, which have the potential for significant environmental impact, including:

- the chemical composition of the materials where relevant
- the quantities used
- the fate of the material (i.e. approximate percentages to each media and to the product)
- environmental impact where known (for example. degradability, bioaccumulation potential, toxicity to relevant species)
- any reasonably practicable alternative raw materials that may have a lower environmental impact including, but not limited to any alternatives described in the BAT requirements below (the substitution principle)
- and to justify (for example, on the basis of impact on product quality) the continued use of any substance for which there is a less hazardous alternative to show that the proposed raw materials are therefore BAT.

The bulk of the input chemicals and a smaller proportion of the input anode materials will end up as solid (special) waste and to a much lesser extent the trade effluent. In the aquatic environment even where evidence suggests little acute toxicity to man or other species there is usually little knowledge regarding chronic or synergistic effects. Because of the wide variety of chemicals used there will always be a risk of harmful effects which may not be expected or immediately apparent.

Raw materials used in mechanical preparation

- Aluminium oxide and silica abrasive materials
- Solid and liquid polishing compounds

Raw Materials used in vapour degreasing

- Organic solvents
- Trichloroethylene
- Methylene chloride
- Proprietary solvents (eg. n-propyl bromide-based materials)

Raw materials used in chemical preparation

Alkaline soak and electrolytic cleaners

- Blended proprietary products in concentrated solid or liquid form for dissolution/dilution with water to the working concentration containing, depending on the type, sodium hydroxide, silicates, phosphates, detergents, chelating and emulsifying agents

Biological cleaners

- Proprietary aqueous alkaline products containing emulsifying agents and bacterial micro-organisms.

Pickling and activation chemicals

- Hydrochloric, sulphuric, nitric, phosphoric, chromic, and hydrofluoric acids separately or in admixture.
- Proprietary dry (powder) acid and alkaline salts

Raw Materials used in surface treatment

- plating metal salts, alkali metal salts, alkali metal hydroxides
- buffering agents, proprietary organic additives
- Autocatalytic plating solutions
- nickel- nickel sulphate, sodium hypophosphite, proprietary inorganic and organic additives
- copper- copper sulphate, sulphuric acid, proprietary organic additives
- Anodising electrolytes- sulphuric and chromic acids
- Phosphating solutions- iron, manganese and zinc phosphates in phosphoric acid solutions

Raw materials used in post treatment

- Proprietary chromium VI and chromium III for passivates (conversion coatings) used after zinc plating and some other surface treatment processes
- Water removal agents
- Proprietary corrosion inhibitors, sealing agents
- Lacquers
- Dyes used for decorative aluminium and titanium anodised work

Indicative BAT requirements for raw materials selection

- 1 The Operator should maintain the list of materials referred to above.
- 2 The Operator should have procedures for the regular review of new developments in raw materials and the implementation of any suitable ones that are less hazardous.
- 3 The Operator should have quality-assurance procedures for controlling the content of raw materials.
- 4 The Operator should complete any longer-term studies needed into the less polluting options and should make any material substitutes identified, in particular:
- 5 The raw material substitutions in the table below should be applied where appropriate

Table 2.5: Raw Material Substitutions

Raw material	Selection techniques
Mechanical preparation	Replacement of silica and silicate materials by synthetic aluminium oxide-based materials
Alkaline soak cleaners	Biological cleaners operating on a closed loop basis at a lower temperature than traditional alkaline soak cleaners destroy oils and greases and reduce sludge formation. They should be used wherever the cleaning efficacy is adequate for the purpose.
Pickling and Activation chemicals	Replacement of chromic acid as an etchant in certain anodising treatments, and plating on plastics. Acid mixtures with oxidising agents eg persulphates should be considered for aluminium etching. Permanganate-phosphoric acid, sulphur dioxide and other novel processes should be reviewed for the etching of plastic materials.
Decorative chromium plating	The use of trivalent processes based on the less toxic trivalent form of chromium is to be preferred to the traditional hexavalent processes (ref 27).
Passivation processes	Chromium-free or trivalent chromium passivates and other conversion coatings are preferred to the traditional hexavalent proprietary products.
Cyanide based processes	Non-cyanide processes should be used wherever possible, eg acid or alkaline non-cyanide processes for zinc plating.
Tin – lead processes	Lead-free tin or tin-alloy processes should be used.
Cadmium plating	Alternatives to cadmium plating should be considered, eg zinc-nickel and tin-zinc alloy processes.
Fuels	See Section 2.7.3 on page 70
Dispersants/ surfactants	Only chemicals with high biodegradability and known degradation products should be used. Alkylphenol ethoxylates should be avoided.
Dyes and auxiliary chemicals formulations	Dyes and auxiliary chemicals that are not either biodegradable or inorganic should be identified and their use justified.
Chelants	Where chelating agents are required ones which are biodegradable should be used in preference to EDTA or NTA.
Defoamers	Only fully biodegradable products with known, safe degradation products should be used.
Solvents	Wherever possible, organic solvents should be replaced by aqueous cleaning chemicals.
Sodium Hydroxide and sodium hypochlorite	Only mercury-free or “low mercury” NaOH should be used.

2.4.2 Waste minimisation audit (minimising the use of raw materials)

The options for waste recovery and recycling are covered in [Section 2.6](#) on page 65. Waste avoidance/minimisation, and the use of clean technologies, is a theme which runs throughout [Section 2.1](#) on page 14 and [Section 2.2](#) on page 38. This section deals with the systematic approach to look for other opportunities.

Waste minimisation can be defined simply as: “a systematic approach to the reduction of waste at source, by understanding and changing processes and activities to prevent and reduce waste”.

A variety of techniques can be classified under the term waste minimisation, from basic housekeeping through statistical measurement to applying of clean technologies.

In the context of waste minimisation and this Guidance, waste relates to the inefficient use of raw materials and other substances at an installation. A consequence of waste minimisation will be the reduction of gaseous, liquid and solid emissions.

Key operational features of waste minimisation will be:

- the ongoing identification and implementation of waste prevention opportunities
- the active participation and commitment of staff at all levels including, for example staff suggestion schemes
- monitoring of materials' usage and reporting against key performance measures

For the primary inputs to waste activities e.g. incineration, the requirements of this section may have been met “upstream” of the installation. However, there may still be arisings that are relevant.

See the [Waste minimisation support references](#) for detailed information, guides and case studies on waste minimisation techniques.

Indicative BAT requirements for waste minimisation audits
Identify the raw and auxiliary materials, other substances and water that they propose to use.

1 The Operator should carry out a waste minimisation audit at least every 4 years. If an audit has not been carried out in the 2 years prior to submission of the application and the details made known at the time of the application, then the first audit shall take place within 2 years of the issue of the Permit. The methodology used and an action plan for reducing the use of raw materials should be submitted to the Regulator within 2 months of completion of the audit. The audit should be carried out as follows:

The Operator should analyse the use of raw materials, assess the opportunities for reductions and provide an action plan for improvements using the following three essential steps

- process mapping
- materials mass balance
- action plan

The use and fate of raw materials and other materials, including reactants, intermediates, by-products, solvents and other support materials, such as inerting agents, fuels, catalysts and abatement agents, should be mapped onto a process flow diagram (see the [Waste minimisation support references](#)). This should be achieved by using data from the raw materials inventory and other company data as appropriate. Data should be incorporated for each principal stage of the operation in order to construct a mass balance for the installation.

- 2 Using this information, opportunities for improved efficiency, changes in process and waste reduction should be generated and assessed. An action plan should then be prepared for implementing improvements to a timescale approved by the Regulator.
- 3 The principal cause of waste in this sector is drag-out loss in transferring the work being surface treated from one process fluid to another or from process fluid to water-rinse prior to further processing. Other causes are mechanical loss from filtration systems, and leakage or overfilling of process tanks. Spent or contaminated treatment solutions together with spillage and leakage are removed by a licensed waste disposal contractor either directly or after treatment in an on-site effluent treatment facility.
- 4 Opportunities for waste minimisation include:
- designing racks for maximum drainage, and encouraging clients to provide drainage holes in hollow or tubular work
 - using lower concentration process fluids
 - using process fluids of lower viscosity
 - allowing longer drip/draining times in the transfer of work from one tank to the next
 - using drag-out minimisation techniques
 - using multistage cascade rinsing
 - mechanical recovery and return of drag-out upstream
 - recovery of anode metals from drag-out that cannot be returned upstream
 - extending the life of process fluids
 - in situ electrochemical oxidation of chromium III to chromium VI for chromic acid etchants in aluminium anodising and in the plating of plastics

2.4.3 Water use

Reasons for reducing water use

Water use should be minimised within the BAT criteria for the prevention or reduction of emissions and be commensurate with the prudent use of water as a natural resource.

Reducing water use may be a valid environmental (or economic) aim in itself, perhaps because of local supply constraints. Also, from the point of view of reducing polluting emissions, any water passing through an industrial process is degraded by the addition of pollutants, and there are distinct benefits to be gained from reducing the water used. These include:

- reducing the size of (a new) treatment plant, thereby supporting the cost benefit BAT justification of better treatment
- cost savings where water is purchased or disposed of to another party
- associated benefits within the process such as reduced energy requirements for heating and pumping, and reduced dissolution of pollutants into the water leading to reduced sludge generation in the effluent treatment plant

The use of a simple mass balance for water use may help to reveal where reductions can be made.

Advice on cost-effective measures for minimising water can be found in the [Water efficiency references](#):

Advice on cost-effective measures for minimising water can be found in Environmental Technology Best Practice Programme (ETBPP) publications (see [Ref 8](#)).

In the Surface Treatment sector water is mainly used for rinsing purposes. However, water is also used for making-up new process fluids, topping-up tanks as a result of evaporative loss, and balancing drag-in/ drag-out volumes. Water is also used for fume extraction systems where mist eliminators or abatement scrubbers are employed.

In some older plant (eg; a plant with single-stage rinsing) rinse-water usage may be high, though this inefficiency is often offset by first using the water for once-through indirect process cooling of certain anodising and alkaline plating electrolytes. In modern plant with multistage cascade rinsing, water use is normally so low that it cannot provide more than a small part of the overall cooling duty.

A plating plant employing three to four stage cascade rinsing has a very low water consumption and results in a proportionate reduction in the mass loss of dissolved heavy metals in the trade effluent. The recycling of rinse-water treated in a conventional effluent treatment facility for use in less critical rinsing duties is increasingly practised, and another technique for the reduction of water consumption is the use of ion-exchange technology.

Cost-benefit analysis should always be carried out to determine which technique is most appropriate for specific cases in terms of water reduction and the extent of drag-out recovery.

Indicative BAT requirements for minimisation of water use (Sheet 1 of 2)
Identify the raw and auxiliary materials, other substances and water that they propose to use.

- 1 The Operator should carry out a regular review of water use (water efficiency audit) at least every 4 years. If an audit has not been carried out in the 2 years prior to submission of the application and the details made known at the time of the application, then the first audit shall take place within 2 years of the issue of the Permit. The methodology used and an action plan for reducing the use of raw materials should be submitted to the Regulator within 2 months of completion of the audit.
- The Operator should produce flow diagrams and water mass balances for the activities.
 - Water-efficiency objectives should be established by comparison with the benchmarks above. In justifying any departures from these, or where benchmarks are not appropriate, the techniques described below should be taken into account. The constraints on reducing water use beyond a certain level should be identified by each Operator, as this is usually installation-specific.
 - Water pinch techniques should be used in the more complex situations, particularly on chemical plant, to identify the opportunities for maximising reuse and minimising use of water (see the [Water efficiency references](#)).

Using this information, opportunities for reducing water use should be generated and assessed. An action plan should then be prepared implementing improvements to a timescale approved by the Regulator.

- 2 The following general principles should be applied in sequence to reduce emissions to water:
- water supply pipework systems should be inspected on a regular basis. Any leaks should be repaired as soon as practicable
 - water-efficient techniques should be used at source where possible
 - water should be recycled within the process from which it issues, by treating it first if necessary. Where this is not practicable, it should be recycled to another part of the process that has a lower water-quality requirement
 - in particular, uncontaminated roof and surface water, which cannot be used, should not be mixed with contaminated water until the latter has been treated in the effluent treatment system and after final monitoring
- 3 Measures should be implemented to minimise contamination risk of process or surface water (see [Section 2.2.5](#) on page 49).
- 4 To identify the scope for substituting water from recycled sources, the water-quality requirements associated with each use should be identified. Less contaminated water streams, such as cooling waters, should be kept separate where there is scope for reuse, possibly after some form of treatment.
- 5 Ultimately wastewater will need some form of treatment (see [Section 2.2.2](#) on page 40). However in many applications, the best conventional effluent treatment produces a good water quality that may be usable in the process directly or when mixed with fresh water. While treated effluent quality can vary, it can be recycled selectively, when the quality is adequate, reverting to discharge when the quality falls below that which the system can tolerate. The Operator should identify where treated water from the effluent treatment plant could be used and justify where it is not.
- 6 In particular, the cost of membrane technology continues to reduce. They can be applied to individual process streams or to the final effluent from the effluent treatment plant. Ultimately, they could completely replace the ETP plant, leading to greatly reduced effluent volume. There remains, however, a concentrated effluent stream but, where this is sufficiently small, and particularly where waste heat is available for further treatment by evaporation a zero effluent system could be produced. Where appropriate, the Operator should assess the costs and benefits of providing such treatment.

Indicative BAT requirements for minimisation of water use (Sheet 2 of 2)
Identify the raw and auxiliary materials, other substances and water that they propose to use.

- 7 Water used in cleaning and washing down should be minimised by:
 - vacuuming, scraping or mopping in preference to hosing down
 - evaluating the scope for reusing wash water
 - trigger controls on all hoses, hand lances and washing equipment
- 8 Fresh water consumption should be directly measured and recorded regularly - ideally on a daily basis.
- 9 Fresh water should only be used for:
 - rinsing purposes (after incorporating multistage cascade rinsing, trade effluent recycle or other recycling systems);
 - the making-up of process fluids;
 - the making-up of evaporation losses from process fluids;
 - the preparation of deionised water for any of the above purposes;
 - *for the indirect cooling of electrolytes or degreasing equipment, provided that it is subsequently reused for rinsing or any of the other purposes above.*

2.5 Waste handling

The normal nature and source of the waste from each activity is given in [Section 2.1](#) on page 14 and will be confirmed in detail in the Operator's response to the emissions inventory.

In general the waste streams comprise:

- filter cake or sludge from the effluent treatment facility
- spent process fluids not able to be treated in the effluent treatment facility
- sludge routinely removed from alkaline cleaners and phosphating process tanks not able to be treated in the effluent treatment facility
- recovered oils and greases from alkaline cleaners
- waste from vapour degreasing equipment
- process chemical containers and general inert industrial waste

Indicative BAT requirements for waste handling

Characterise and quantify each waste stream and describe the proposed measures for waste management, storage and handling.

- 1 A system should be maintained to record the quantity, nature, origin and, where relevant, the destination, frequency of collection, mode of transport and treatment method of any waste that is disposed of or recovered.
- 2 Wherever practicable, waste should be segregated and the disposal route identified. This should be as close to the point of production as possible.
- 3 Records should be maintained of any waste sent off-site (Duty of Care).
- 4 All appropriate steps to prevent emissions (for example, liquids, dust, VOCs and odour) from storage or handling should be taken (see [Section 2.2.4](#) on page 47, [Section 2.2.5](#) on page 49 and [Section 2.2.6](#) on page 51).

2.6 Waste recovery or disposal

The Regulations require the Regulator, in setting Permit conditions, to take account of certain general principles, including that the installation in question should be operated in such a way that “waste production is avoided in accordance with Council Directive 75/442/EEC on waste; and where waste is produced it is recovered, or where this is technically or economically impossible it is disposed of, while avoiding or reducing the impact on the environment”. The objectives of the National Waste Strategies should also be considered. Waste avoidance (minimisation) is covered throughout [Section 2.1](#) on page 14 and [Section 2.2](#) on page 38. and by the specific requirement for a waste minimisation audit in [Section 2.4.2](#) on page 59.

To meet this requirement, the Regulator needs Operators to provide the information in point 2 below.

Indicative BAT requirements for waste recovery or disposal

Describe how each waste stream is proposed or disposed of. If you propose any disposal, explain why recovery is technically and economically impossible and describe the measures planned to avoid or reduce any impact on the environment.

- 1 Waste should be recovered, unless it is technically or economically impossible to do so.
- 2 Where waste must be disposed of, unless agreed with the Regulator to be inappropriate, the Operator should provide a detailed assessment identifying the best environmental options for waste disposal. For existing activities, this may be carried out as an improvement condition to a timescale to be approved by the Regulator.
- 3 Effluent treatment facilities should be designed to process spent process fluids and recover anode metals for reuse, eg cadmium, copper and nickel.
- 4 Spent alkaline cleaners and acid pickles should be used for pH control in the effluent treatment facility.
- 5 The use of phosphating sludge as a filler for agricultural and horticultural use should be evaluated.
- 6 Filter cake may have uses, and these should be investigated in preference to landfill disposal.
- 7 Filter cake presses should be operated at not less than 7 bar and preferably 10-15 bar to reduce its mass, volume and water content.

2.7 Energy

BAT for energy efficiency under the PPC Regulations will be satisfied provided the Operator meets the following conditions:

either

- the Operator meets the basic energy requirements in Section 2.7.1 and Section 2.7.2 below and is a participant to a Climate Change Agreement (CCA) or a Direct Participant Agreement (DPA) within the Emissions Trading Scheme.

or

- the Operator meets the basic energy requirements in Section 2.7.1 and Section 2.7.2 below and the further sector-specific energy requirements in Section 2.7.3 below.

Note that even where a Climate Change Agreement or Direct Participant Agreement is in place, this does not preclude the consideration of energy efficiency (including those identified in Section 2.7.3) as part of an integrated assessment of BAT where they impact on other emissions, e.g. where:

- the choice of fuel impacts upon emissions other than carbon, e.g. sulphur in fuel
- the minimisation of waste by waste-to-energy does not maximise energy efficiency, e.g. by Combined Heat and Power (CHP)
- the most energy-intensive abatement leads to the greatest reduction in other emissions

Further guidance is given in the guidance note [H2 Energy efficiency for IPPC](#).

2.7.1 Basic energy requirements (1)

The requirements of this section are basic, low cost, energy standards that apply whether or not a CCA or DPA is in force for the installation.

Indicative BAT requirements for basic energy requirements (1):

Provide a breakdown of the energy consumption and generation by source and the associated environmental emissions.

- 1 The Operator should provide annually the energy consumption information, shown in the table below, in terms of delivered energy and also, in the case of electricity, converted to primary energy consumption. For the public electricity supply, a conversion factor of 2.6 should be used. Where applicable, the use of factors derived from on-site heat and/or power generation, or from direct (non-grid) suppliers should be used. In the latter cases, the Operator should provide details of such factors. Where energy is exported from the installation, the Operator should also provide this information. In the application this information should be submitted in the inventory in the H1 software tool and should also supplement this with energy flow information (such as “Sankey” diagrams or energy balances) showing how the energy is used throughout the process.
- 2 The Operator should provide the following Specific Energy Consumption (SEC) information. Define and calculate the SEC of the activity (or activities) based on primary energy consumption for the products or raw material inputs that most closely match the main purpose or production capacity of the installation. Provide a comparison of SEC against any relevant benchmarks available for the sector.
- 3 The Operator should provide associated environmental emissions. This is dealt with in the Operator’s response to the emissions inventory using the H1 software tool.

Table 2.6: Example breakdown of delivered and primary energy consumption

Energy source	Energy consumption		
	Delivered, MWh	Primary, MWh	% of total
Electricity*			
Gas			
Oil			
Other (Operator to specify)			

* specify source.

2.7.2 Basic energy requirements (2)

The requirements of this section are basic, low-cost, energy standards that apply whether or not a CCA or DPA is in force for the installation.

Indicative BAT requirements for basic energy requirements (2)

Describe the proposed measures for improvement of energy efficiency.

- 1 **Operating, maintenance and housekeeping measures** should be in place in the following areas. Indicative checklists of appropriate measures are provided in Appendix 2 of the guidance note [H2 Energy efficiency for IPPC](#), where relevant:
 - air conditioning, process refrigeration and cooling systems (leaks, seals, temperature control, evaporator/condenser maintenance)
 - operation of motors and drives
 - compressed gas systems (leaks, procedures for use)
 - steam distribution systems (leaks, traps, insulation)
 - space heating and hot-water systems
 - lubrication to avoid high-friction losses
 - boiler maintenance, e.g. optimising excess air
 - other maintenance relevant to the activities within the installation
- 2 **Basic, low cost, physical techniques** should be in place to avoid gross inefficiencies. These should include insulation, containment methods, (such as seals and self-closing doors), and avoidance of unnecessary discharge of heated water or air (e.g. by fitting simple control systems such as timers and sensors).
- 3 **Energy-efficient building services** should be in place to deliver the requirements of the Building Services section of the guidance note [H2 Energy efficiency for IPPC](#). For energy-intensive industries these issues may be of minor impact and should not distract effort from the major energy issues. They should nonetheless find a place in the programme, particularly where they constitute more than 5 percent of the total energy consumption.
- 4 **Energy management techniques** should be in place, according to the requirements of Section 2.3 noting, in particular, the need for monitoring of energy flows and targeting of areas for reductions.
- 5 **An energy efficiency plan** should be provided that:
 - identifies all techniques relevant to the installation, including those listed above and in Section 2.7.3, that are applicable to the installation
 - estimates the CO₂ savings that would be achieved by each measure over its lifetime
 - and, in the case where the activities are NOT covered by a CCA or DPA; provides information on the equivalent annual costs of implementation of the technique, the costs per tonne of CO₂ saved and the priority for implementation. A procedure is given in the Energy Efficiency Guidance Note.
- 6 An example format of the energy efficiency plan is shown in [Table 2.7](#).

Table 2.7: Example format for energy efficiency plan

ALL APPLICANTS			ONLY APPLICANTS WITHOUT CCA		
Energy efficiency measure	CO ₂ savings (tonnes)		Equivalent Annual Cost (EAC) £k	EAC/CO ₂ saved £/tonne	Date for implementation
	Annual	lifetime			
<hr/>					
<hr/>					
<hr/>					

Refer to Energy Efficiency Guidance Note for appraisal methodology. Where other appraisal methodologies have been used, state the method, and provide evidence that appropriate discount rates, asset life and expenditure (£/t) criteria have been employed.

The energy efficiency plan is required to ensure that the Operator has considered all relevant techniques. However, where a CCA or DPA is in place the Regulator will only enforce implementation of those measures in categories 1-3 above.

2.7.3 Further energy-efficiency requirements

Indicative BAT requirements for further energy-efficiency requirements Climate Change Agreement for Trading Agreement.

- 1 The following techniques should be implemented where they are judged to be BAT based on a cost/ benefit appraisal according to the methodology provided in Appendix 4 of the guidance note [H2 Energy efficiency for IPPC](#).

Energy-efficiency techniques

- 2 Within IPPC it is valid to consider both the emission of direct (heat and emissions from on-site generation) and indirect (emissions from a remote power station) pollution when considering options for energy efficiency.
- 3 The techniques will be largely sector-specific but the following may be applicable in many sectors.
- heat recovery from different parts of the processes
 - high efficiency dewatering techniques to minimise drying energy
 - minimisation of water use and closed circulating water systems
 - good insulation
 - plant layout to reduce pumping distances
 - phase optimisation of electronic control motors
 - using spent cooling water (which is raised in temperature) for rinsing purposes
 - automated control
 - automated control for DC rectifiers
 - low temperature processes eg alkaline cleaners
 - electrolytic processes that operate under thermally stable conditions without the need for heating or cooling
 - minimum use of fume extraction consistent with COSHH Regulations
 - inverter speed control or flow damper for fume extraction centrifugal fans

Energy supply techniques

- 4 The following techniques should be considered:
- use of Combined Heat and Power (CHP)
 - recovery of energy from waste
 - use of less polluting fuels
- 5 The Operator should provide justification that the proposed or current situation represents BAT, irrespective of whether a CCA or Trading Agreement is in place, where there are other BAT considerations involved, such as:
- the choice of fuel impacts upon emissions other than carbon, for example, sulphur in fuel
 - where the potential minimisation of waste emissions by recovery of energy from waste conflicts with energy efficiency requirements
- 6 Where there is an on-site combustion plant other guidance is also relevant. For plants greater than 50MW, Operators should consult the IPC guidance on power generation (reference IPC S2 1.01 Combustion Processes: Large boilers and furnaces 50MW(th) and over and supplement IPC S3 1.01 Combustion Processes). Operators of plant of 20-50MW should consult the Local Authority Air Pollution Control guidance. On IPPC installations this guidance will be generally applicable to plant under 20MW also. For incineration plant S2.5.01 Waste Incineration should be consulted (available from the [EA website](#)).

2.8 Accidents

This section covers accidents and their consequences. It is not limited to major accidents but includes spills and abnormal operation.

Some installations will also be subject to the Control of Major Accident Hazards Regulations 1999 (COMAH) (see [Appendix 2](#) for equivalent legislation in Scotland and Northern Ireland). IPPC and COMAH sometimes overlap and some systems and information for both regimes may be interchangeable.

The COMAH regime applies to major hazards. For accidents covered by COMAH, refer to any reports already held by the Regulator. However, the accident provisions under IPPC may fall beneath the threshold for major accident classification under COMAH, so Operators also need to consider smaller accidents and abnormal operation as well. Guidance (see the [COMAH guides](#)), prepared in support of the COMAH Regulations may also help IPPC Operators (whether or not they are covered by the COMAH regime), in considering ways to reduce the risks and consequences of accidents.

General management requirements are covered in Section 2.1. For accident management, there are three particular components:

- identification of the hazards posed by the installation/activity
- assessment of the risks (hazard x probability) of accidents and their possible consequences
- implementation of measures to reduce the risks of accidents, and contingency plans for any accidents that do occur

Indicative BAT requirements for accidents and abnormal operations (Sheet 1 of 3)

Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

- 1 A structured accident management plan should be submitted to the Regulator that should:
- 2 Identify the hazards to the environment posed by the installation. Particular areas to consider may include, but should not be limited to, the following:
 - transfer of substances (for example, loading or unloading from or to vessels)
 - overfilling of vessels
 - failure of plant and/or equipment (for example, over-pressure of vessels and pipework, blocked drains)
 - failure of containment (such as bund and/or overfilling of drainage sumps)
 - failure to contain firewaters
 - making the wrong connections in drains or other systems
 - preventing incompatible substances coming into contact
 - unwanted reactions and/or runaway reactions
 - emission of an effluent before adequate checking of its composition has taken place
 - steam main issues
 - vandalism

Indicative BAT requirements for accidents and abnormal operations (Sheet 2 of 3)

Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

- 3 **assesses the risks.** Having identified the hazards, the process of assessing the risks should address six basic questions:
 - how likely are they to occur? (source frequency)
 - what gets out and how much? (risk evaluation of the event)
 - where does it end up? (predictions for the emission – what are the pathways and receptors?)
 - what are the consequences? (consequence assessment – the effects on the receptors)
 - what are the overall risks? (determination of the overall risk and its significance to the environment)
 - what can prevent or reduce the risk? (risk management – measures to prevent accidents and/or reduce their environmental consequences)
- 4 The depth and type of assessment will depend on the characteristics of the installation and its location. The main factors to take into account are:
 - the scale and nature of the accident hazard presented by the installation and the activities
 - the risks to areas of population and the environment (receptors)
 - the nature of the installation and complexity of the activities and the relative difficulty in deciding and justifying the adequacy of the risk-control techniques
- 5 **identify the techniques necessary to reduce the risks.** The following techniques are relevant to most installations:
 - an inventory should be maintained of substances, present or likely to be present, which could have environmental consequences if they escape. Do not forget that many apparently innocuous substances can be environmentally damaging if they escape (for example, a tanker of milk spilled into a watercourse could destroy its ecosystem). The Permit will require the Regulator to be notified of any changes to the inventory
 - the inventory of all dangerous substances should be reduced as far as practicable, to reduce the quantities that might be released in the event of an accident.
 - procedures should be in place for checking raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact
 - adequate storage arrangements for raw materials, products and wastes should be provided
 - to ensure that control is maintained in emergency situations, consideration should be given to process design alarms, trips and other control aspects, for example, automatic systems based on microprocessor control and passing valve control, tank level readings such as ultrasonic gauges, high-level warnings and process interlocks and process parameters
 - preventative techniques, such as suitable barriers to prevent damage to equipment from the movement of vehicles, should be included as appropriate
 - appropriate containment should be provided, for example, bunds and catchpots, building containment
 - techniques and procedures should be implemented to prevent overflowing of storage tanks (liquid or powder), for example, level measurement, independent high-level alarms, high-level cut-off, and batch metering
 - where the installation is situated in a floodplain, consideration should be given to techniques which will minimise the risk that flooding may either cause a pollution incident or make one worse
 - installation security systems to prevent unauthorised access should be provided as appropriate and should include maintenance arrangements where necessary
 - there should be an installation log/diary to record all incidents, near-misses, changes to procedures, abnormal events and findings of maintenance inspections

Indicative BAT requirements for accidents and abnormal operations (Sheet 3 of 3)

Describe your documented system that you propose to be used to identify, assess and minimise the environmental risks and hazards of accidents and their consequences.

- procedures should be established to identify, respond to and learn from such incidents
- roles and responsibilities of personnel involved in accident management identified
- clear guidance should be available on how each accident scenario should be managed, for example, containment or dispersion, to extinguish fires or let them burn
- procedures should be in place to avoid incidents occurring as a result of poor communication among operations staff during shift changes and maintenance or other engineering work
- safe shutdown procedures should be in place
- communication routes should be established with relevant authorities and emergency services both before and in the event of an accident. Post-accident procedures should include the assessment of harm caused and steps needed to redress this
- appropriate control techniques should be in place to limit the consequences of an accident, such as oil spillage equipment, isolation of drains, alerting of relevant authorities and evacuation procedures
- personnel training requirements should be identified and provided
- the systems for the prevention of fugitive emissions are generally relevant ([Section 2.2.4](#) on page 47 and [Section 2.2.5](#) on page 49) and in addition, for drainage systems:
 - procedures should be in place to ensure that the composition of the contents of a bund sump, or sump connected to a drainage system, are checked before treatment or disposal
 - drainage sumps should be equipped with a high-level alarm or sensor with automatic pump to storage (not to discharge)
 - there should be a system in place to ensure that sump levels are kept to a minimum at all times
 - high-level alarms and the like should not be routinely used as the primary method of level control
- adequate redundancy or standby plant should be provided with maintenance and testing to the same standards as the main plant
- process waters, site drainage waters, emergency firewater, chemically contaminated waters and spillages of chemicals should, where appropriate, be contained and, where necessary, routed to the effluent system, with provision to contain surges and storm-water flows, and treated before emission to controlled waters or sewer. Sufficient storage should be provided to ensure that this could be achieved. There should also be spill contingency procedures to minimise the risk of accidental emission of raw materials, products and waste materials and to prevent their entry into water. Any emergency firewater collection system should also take account of the additional firewater flows or fire-fighting foams. Emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters (see the [Releases to water references](#))
- consideration should be given to the possibility of containment or abatement for accidental emissions from vents and safety relief valves/bursting discs. Where this may be inadvisable on safety grounds, attention should be focused on reducing the probability of the emission

2.9 Noise

The level of detail supplied should be in keeping with the risk of causing noise-related annoyance at sensitive receptors.

Where an installation poses no risk of noise-related environmental impact because the activities undertaken are inherently quiet, this should be justified and no further information relating to noise need normally be supplied. It should, however, be remembered that there can still be an underlying level of annoyance without complaints being made.

Where noise issues are likely to be relevant, the Operator will be required, in the Application, to provide information on the following: (for more details see [H3 Part 1 Noise](#))

- the main sources of noise and vibration that will fall within the IPPC installation and also on Infrequent sources of noise and vibration
- the nearest noise-sensitive sites
- conditions/limits imposed under other regimes
- the local noise environment
- any environmental noise measurement surveys, modelling or any other noise measurements
- any specific local issues and proposals for improvements.

Within this section “noise” should be taken to refer to “noise and/or vibration” as appropriate, detectable beyond the site boundary.

The PPC Regulations require installations to be operated in such a way that “all the appropriate preventative measures are taken against pollution, in particular through the application of BAT”. The definition of pollution includes “emissions that may be harmful to human health or the quality of the environment, cause offence to human senses or impair or interfere with amenities and other legitimate uses of the environment”. BAT is therefore likely to be similar, in practice, to the requirements of the statutory nuisance legislation, which requires the use of “best practicable means” to prevent or minimise noise nuisance. It is understood that raw material handling can generate noise where glass is being recycled or broken up. It is suggested that consideration be given to the use of sonic booths or sound proofing to control the generation of noise where such activities are being carried out.

In the case of noise, “offence to any human senses” can normally be judged by the likelihood of complaints, but in some cases it may be possible to reduce noise emissions still further at reasonable costs, and this may exceptionally therefore be BAT for noise emissions.

For advice on how noise and/or vibration related limits and conditions will be determined see [Assessment and Control of Environmental Noise and Vibration from Industrial Activities](#),

Indicative BAT requirements for noise and vibration

Describe the main sources of noise and vibration (including infrequent sources); the nearest noise-sensitive locations and relevant environmental surveys which have been undertaken; and the proposed techniques and measures for the control of noise.

- 1 The Operator should employ basic good practice measures for the control of noise, including adequate maintenance of any parts of plant or equipment whose deterioration may give rise to increases in noise (for example, maintenance of bearings, air handling plant, the building fabric as well as specific noise attenuation measures associated with plant, equipment or machinery).
- 2 The Operator should also employ such other noise control techniques to ensure that the noise from the installation does not give rise to reasonable cause for annoyance, in the view of the Regulator and, in particular, should justify where either Rating Levels ($L_{Aeq,T}$) from the installation exceed the numerical value of the Background Sound Level ($L_{A90,T}$).
- 3 Further justification will be required should the resulting field rating level ($L_{AR,TR}$) exceed 50 DB by day and a facade rating level exceed 45 DB by night, with day being defined as 07:00 to 23:00 and night 23:00 to 07:00.
- 4 In some circumstances "creeping background" may be an issue. Where this has been identified in pre application discussions or in previous discussions with the local authority, the Operator should employ such noise control techniques as are considered appropriate to minimise problems to an acceptable level within the BAT criteria.
- 5 Noise surveys, measurement, investigation (which can involve detailed assessment of sound power levels for individual items of plant) or modelling may be necessary for either new or existing installations depending upon the potential for noise problems. Operators may have a noise management plan as part of their management system.

2.10 Monitoring

This section describes monitoring and reporting requirements for emissions to all environmental media. Guidance is provided for selecting the appropriate monitoring methodologies, frequency of monitoring, compliance-assessment criteria and environmental monitoring.

Indicative BAT requirements for monitoring (Sheet 1 of 5)

Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

Emissions monitoring

- 1 The following monitoring parameters and frequency are normally appropriate in this sector. Generally, monitoring should be undertaken during commissioning, start-up, normal operation and shut-down unless the Regulator agrees that it would be inappropriate to do so.
- 2 Continuous monitoring (or at least sampling in the case of water) and recording are likely to be required under the following circumstances:
 - Where the potential environmental impact is significant or the concentration of substance varies widely.
 - Where a substance is abated continuous monitoring of the substance is required to show the performance of the abatement plant. For example continuous monitoring of dust is needed after a fabric filter to show the effectiveness of the filter and indicate when maintenance is needed, or sampling BOD from an effluent treatment plant.
 - Where other control measures are required to achieve satisfactory levels of emission (e.g. material selection).
- 3 Where effective surrogates are available, they may be used to minimise monitoring costs.
- 4 Where monitoring shows that substances are not emitted in significant quantities, it may be possible to reduce monitoring frequency.
- 5 For analysis techniques and compliance criteria see [Appendix 1](#).

Monitoring and reporting of emissions to water and sewer

- 6 Monitoring of process effluents released to controlled waters and sewers should include the parameters details in [Table 2.8](#) below. **Note:** other parameters specifically limited in the permit should also be monitored. The appropriateness of the above frequencies will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations.
- 7 The Operator should also have a fuller analysis carried out covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. This should cover the substances listed in Schedule 5 of the Regulations unless it is agreed with the Regulator that they are not applicable. The need to repeat such a test will depend upon the potential variability in the process and, for example, the potential for contamination of raw materials. Where there is such potential, tests may be appropriate.
- 8 Any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact, should also be monitored more regularly. This would particularly apply to the common pesticides and heavy metals. Using composite samples is the technique most likely to be appropriate where the concentration does not vary excessively.

Indicative BAT requirements for monitoring (Sheet 2 of 5)

Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

- 9 In some sectors there may be releases of substances that are more difficult to measure and whose capacity for harm is uncertain, particularly when combined with other substances. "Whole effluent toxicity" monitoring techniques can therefore be appropriate to provide direct measurements of harm, for example, direct toxicity assessment. See [Section 2.2.2](#) on page 40.

Monitoring and reporting of emissions to air

- 10 There are a wide variety of possible releases to air, and specific information may be found in the existing sector guidance. In general:
- Monthly monitoring would be only expected where the releases are significant and where it is needed to maintain good control; eg NO_x emissions.
 - Gas flow should be measured, or otherwise determined, to relate concentration to mass releases.
 - To relate measurements to reference conditions, the following will need to be determined and recorded:
 - Temperature and pressure.
 - Water vapour content, where the emissions are the result of a combustion process or any other wet gas stream. It would not be needed where the water vapour content is unable to exceed 3% v/v or where the measuring technique measures the other pollutants without removing the water.
 - Where appropriate, periodic visual and olfactory assessment of releases should be undertaken to ensure that all final releases to air should be essentially colourless, free from persistent trailing mist or fume and free from droplets.
- 11 Where appropriate, periodic visual and olfactory assessment of releases should be undertaken to ensure that all final releases to air should be essentially colourless, free from persistent trailing mist or fume and free from droplets.

Monitoring and reporting of waste emissions

- 12 For waste emissions, the following should be monitored and recorded:
- the physical and chemical composition of the waste
 - its hazard characteristics
 - handling precautions and substances with which it cannot be mixed
 - where waste is disposed of directly to land, for example, sludge spreading or an on-site landfill, a programme of monitoring should be established that takes into account the materials, potential contaminants and potential pathways from the land to groundwater surface water or the food chain

Environmental monitoring (beyond the installation)

- 13 The Operator should consider the need for environmental monitoring to assess the effects of emissions to controlled water, groundwater, air or land, or emissions of noise or odour.
- 14 Environmental monitoring may be required, for example, when:
- there are vulnerable receptors
 - the emissions are a significant contributor to an Environmental Quality Standard (EQS) that may be at risk
 - the Operator is looking for departures from standards based on lack of effect on the environment;
 - to validate modelling work.

Indicative BAT requirements for monitoring (Sheet 3 of 5)

Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

- 15 The need should be considered for:
- groundwater, where it should be designed to characterise both quality and flow and take into account short- and long-term variations in both. Monitoring will need to take place both up-gradient and down-gradient of the site
 - surface water, where consideration will be needed for sampling, analysis and reporting for upstream and downstream quality of the controlled water
 - air, including odour
 - land contamination, including vegetation, and agricultural products
 - assessment of health impacts
 - noise
- 16 Where environmental monitoring is needed, the following should be considered in drawing up proposals:
- determinands to be monitored, standard reference methods, sampling protocols
 - monitoring strategy, selection of monitoring points, optimisation of monitoring approach
 - determination of background levels contributed by other sources
 - uncertainty for the employed methodologies and the resultant overall uncertainty of measurement
 - quality assurance (QA) and quality control (QC) protocols, equipment calibration and maintenance, sample storage and chain of custody/audit trail
 - reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information for the Regulation
- 17 Guidance on air quality monitoring strategies and methodologies can be found in [Monitoring Guidance](#), for noise.
- Monitoring of process variables*
- 18 Some process variables may affect the environment and these should be identified and monitored as appropriate. Examples might be:
- raw materials monitoring for contaminants where contaminants are likely and there is inadequate supplier information (see [Section 2.4.1](#) on page 56)
 - plant efficiency where it has an environmental relevance
 - energy consumption across the plant and at individual points of use in accordance with the energy plan. Frequency – normally continuous and recorded
 - fresh water use across the activities and at individual points of use should be monitored as part of the water efficiency plan (see Section 0). Frequency – continuous and recorded

Indicative BAT requirements for monitoring (Sheet 4 of 5)

Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

Monitoring standards (Standard Reference Methods)

Equipment standards

- 19 The Environment Agency has introduced its Monitoring Certification Scheme (MCERTS) to improve the quality of monitoring data and to ensure that the instrumentation and methodologies employed for monitoring are fit for purpose. Performance standards have been published for continuous emissions monitoring systems (CEMs), ambient air quality monitoring systems (CAMs), chemical testing of soils and manual stack emissions monitoring. Other MCERTS standards are under development to cover portable emissions monitoring equipment, water monitoring instrumentation, data acquisition and Operators' own arrangements, such as installation, calibration and maintenance of monitoring equipment, position of sampling ports and provision of safe access for manual stack monitoring.
- 20 As far as possible, Operators should ensure their monitoring arrangements comply with the requirements of MCERTS where available, for example using certified instruments and equipment, and using a stack testing organisation accredited to MCERTS standards. Where the monitoring arrangements are not in accordance with MCERTS requirements, the Operator should provide justification and describe the monitoring provisions in detail. See [MCERTS approved equipment](#) for a listing of MCERTS equipment.
- 21 The following should be described in the application, indicating which monitoring provisions comply with MCERTS requirements or where other arrangements have been made:
- monitoring methods and procedures (selection of Standard Reference Methods)
 - justification for continuous monitoring or spot sampling
 - reference conditions and averaging periods
 - measurement uncertainty of the proposed methods and the resultant overall uncertainty
 - criteria for the assessment of non-compliance with Permit limits and details of monitoring strategy aimed at demonstration of compliance
 - reporting procedures and data storage of monitoring results, record keeping and reporting intervals for the provision of information to the Regulator
 - procedures for monitoring during start-up and shut-down and abnormal process conditions
 - drift correction calibration intervals and methods
 - the accreditation held by samplers and laboratories or details of the people used and the training/competencies

Sampling and analysis standards

- 22 The analytical methods given in [Appendix 1](#) should be used. In the event of other substances needing to be monitored, standards should be used in the following order of priority:
- Comité Européen de Normalisation (CEN)
 - British Standards Institution (BSI)
 - International Standardisation Organisation (ISO)
 - United States Environmental Protection Agency (US EPA)
 - American Society for Testing and Materials (ASTM)
 - Deutsches Institut für Normung (DIN)
 - Verein Deutscher Ingenieure (VDI)
 - Association Française de Normalisation (AFNOR)

Indicative BAT requirements for monitoring (Sheet 5 of 5)

Describe the proposed measures for monitoring emissions, including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed.

23 Further guidance on standards for monitoring gaseous releases relevant to IPC/IPPC is given in the **Monitoring Guidance**. A series of updated Guidance Notes covering this subject is being prepared. This guidance specifies manual methods of sampling and analysis that will also be suitable for calibration of continuous emission monitoring instruments. Further guidance relevant to water and waste is available from the publications of the Standing Committee of Analysts.

24 If in doubt the Operator should consult the Regulator.

Monitoring timescales

25 The Operator should complete any detailed studies required into monitoring needs as an improvement condition to a timescale to be agreed with the Regulator.

26 For existing activities, the above techniques should be programmed for implementation within the same timescale.

Table 2.8: Monitoring of process elements released to controlled waters should include at least:

Parameter	Monitoring frequency
Flow rate	Daily and preferably continuous with integrated flows
pH	Continuous
Temperature	Spot or continuous in more critical situations
COD/BOD	Weekly
Turbidity	Daily visual observation or continuous in more critical situations.
Metals	Weekly

2.11 Closure

The PPC Regulations require an Applicant to submit a site report, describing the condition of the site, as part of the application. Guidance on this is in Annex C of the Guide for Applicants (see [IPPC Part A\(1\) Installations: Guide for Applicants](#)) or Guidance for SEPA Staff On Land and Groundwater Considerations for PPC Part A Installations (Scotland) (see [PPC Part A Installations: Guide for Applicants \(Scotland\)](#)).

Indicative BAT requirements for closure (Sheet 1 of 2)

Describe the proposed measures, upon definitive cessation of activities, to avoid any pollution risk and return the site of operation to a satisfactory state (including where appropriate, measures relating to the design and construction of the installation).

1 Operations during the IPPC Permit

Operations during the life of the IPPC Permit should not lead to any deterioration of the site if the requirements of the other sections of this and the specific-sector notes are adhered to. Should any instances arise which have, or might have, impacted on the state of the site, the Operator should record them along with any further investigation or ameliorating work carried out. This will ensure that there is a coherent record of the state of the site throughout the period of the IPPC Permit. This is as important for the protection of the Operator as it is for the protection of the environment. Any changes to this record should be submitted to the Regulator.

2 Steps to be taken at the design-and-build stage of the activities

Care should be taken at the design stage to minimise risks during decommissioning. For existing installations, where potential problems are identified, a programme of improvements should be put in place to a timescale agreed with the Regulator. Designs should ensure that:

- underground tanks and pipework are avoided where possible (unless protected by secondary containment or a suitable monitoring programme)
- there is provision for the draining and clean-out of vessels and pipework prior to dismantling
- lagoons and landfills are designed with a view to their eventual clean-up or surrender
- insulation is provided that is readily dismantled without dust or hazard
- materials used are recyclable (having regard for operational or other environmental objectives)

3 The site-closure plan

A site closure plan should be maintained to demonstrate that, in its current state, the installation can be decommissioned to avoid any pollution risk and return the site of operation to a satisfactory state. The plan should be kept updated as material changes occur. Common sense should be used in the level of detail, since the circumstances at closure will affect the final plans. However, even at an early stage, the closure plan should include:

- either the removal or the flushing out of pipelines and vessels where appropriate and their complete emptying of any potentially harmful contents
- plans of all underground pipes and vessels
- the method and resource necessary for the clearing of lagoons
- the method of ensuring that any on-site landfills can meet the equivalent of surrender conditions
- the removal of asbestos or other potentially harmful materials unless agreed that it is reasonable to leave such liabilities to future owners
- methods of dismantling buildings and other structures, see [Ref 1](#) which gives guidance on the protection of surface and groundwater at construction and demolition-sites
- testing of the soil to ascertain the degree of any pollution caused by the activities and the need for any remediation to return the site to a satisfactory state as defined by the initial site report

Indicative BAT requirements for closure (Sheet 2 of 2)

Describe the proposed measures, upon definitive cessation of activities, to avoid any pollution risk and return the site of operation to a satisfactory state (including where appropriate, measures relating to the design and construction of the installation).

- 4 For existing activities, the Operator should complete any detailed studies (see Application item Error! Reference source not found. above), and submit the site-closure plan as an improvement condition to a timescale to be agreed with the Regulator but in any case within the timescale given in [Section 1.1](#) on page 1 (Note that radioactive sources are not covered by this legislation, but decommissioning plans should be co-ordinated with responsibilities under the Radioactive Substances Act 1993.)

2.12 Installation issues

In some cases it is possible that actions that benefit the environmental performance of the overall installation will increase the emissions from one Permit-holder's activities. For example, taking treated effluent as a raw water supply will probably slightly increase emissions from that activity, but could dramatically cut the total emissions from the whole installation.

Where you are not the only Operator of the installation, describe the proposed techniques and measures (including those to be taken jointly by yourself and other Operators) for ensuring the satisfactory operation of the whole installation

Indicative BAT requirements for installation wide issues

Where you are not the only Operator of the installation, describe the proposed techniques and measures (including those to be taken by yourself and other Operators) for ensuring the satisfactory operation of the whole installation.

- 1 The Operator should consider possibilities for minimising environmental impact to the environment as a whole, by operating together with other Permit holders. Possibilities include:
 - Communication procedures between the various Permit-holders; in particular those needed to ensure that the risk of environmental incidents is minimised.
 - Benefiting from the economies of scale to justify the installation of a CHP plant.
 - The combining of combustible wastes to justify a combined waste-to-energy/CHP plant.
 - The waste from one activity being a possible feedstock for another.
 - The treated effluent from one activity being of adequate quality to be the raw water feed for another activity.
 - The combining of effluent to justify a combined or upgraded effluent-treatment plant.
 - The avoidance of accidents from one activity that may have a detrimental knock-on effect on the neighbouring activity.
 - Land contamination from one activity affecting another – or the possibility that one Operator owns the land on which the other is situated.

3 Emission benchmarks

3.1 Emissions inventory

The Regulations require the Applicant to describe the nature, quantities and sources of foreseeable emissions into each medium. This will be done by completing the inventory of emission and consumption in the H1 software tool. The information required is as follows.

Provide a table of significant emissions of substances (except noise, vibration, odour and heat which are covered in their respective sections) that will result from the proposals and should include, preferably in order of significance:

- substance (where the substance is a mixture, for example, VOCs or COD, separate identification of the main constituents or inclusion of an improvement proposal to identify them)
- source, including height, location and efflux velocity
- media to which it is released
- any relevant EQS or other obligations
- benchmark
- proposed emissions normal/max expressed, as appropriate for:
 - mass/unit time
 - concentration
 - annual mass emissions
- statistical basis (average, percentile etc.)
- notes covering the Operators confidence in his ability to meet the benchmark values
- if intermittent, the appropriate frequencies
- plant loads at which the data is applicable
- whether measured or calculated (the method of calculation should be provided)

The response should clearly state whether the emissions are current emission rates or those planned following improvements, and should cover emissions under both normal and abnormal conditions for:

- point-source emissions to surface water, groundwater and sewer
- waste emissions
- point-source emissions to air
- significant fugitive emissions to all media, identifying the proportion of each substance released that is due to fugitives rather than point-source releases
- abnormal emissions from emergency relief vents, flares and the like
- indirect and direct emission of carbon dioxide associated with energy consumed or generated

Emissions of carbon dioxide associated with energy use should be broken down by energy type and, in the case of electricity, by source, for example, public supply, direct supply or on-site generation. Where energy is generated on-site, or from a direct (non-public) supplier, the Operator should specify and use the appropriate factor. Standard factors for carbon dioxide emissions are provided in the guidance note [H2 Energy efficiency for IPPC](#).

Where VOCs are released, the main chemical constituents of the emissions should be identified.

For waste, emissions relate to any wastes removed from the installation, or disposed of at the installation under the conditions of the Permit, for example, landfill. Each waste should have its composition determined and the amounts expressed in terms of cubic metres or tonnes per month. A suitable table on which to record this information is provided in the electronic version of this Guidance Note.

Indicative BAT requirements for emission benchmarks

Describe the nature, quantities and sources of foreseeable emissions into each medium (which will result from the techniques proposed in Section 2).

- 1 The Operator should compare the emissions with the benchmark values given in the remainder of this Section.
- 2 Where the benchmarks are not met, the Operator should revisit the responses made in Section 2 as appropriate and make proposals for improvements or justify not doing so as part of the BAT assessment.

3.2 Emission benchmarks

Introduction to emission benchmarks

Guidance is given below on release concentrations or mass release rates achievable for key substances using the best combination of techniques. These BAT-based benchmarks are not mandatory release limits and reference should be made to Section 1 and the Guide for Applicants regarding their use.

3.2.1 Emissions to air associated with the use of BAT

The emissions quoted below are daily averages based upon continuous monitoring during the period of operation. See [Section 3.2.7](#) on page 91 for the standard conditions that should be applied. Care should always be taken to convert benchmark and proposed releases to the same reference conditions for comparison. To convert measured values to reference conditions, see the [Monitoring Guidance](#) for more information. The benchmarks given do not take sampling, analytical errors, or uncertainties into account. These will be considered when setting an ELV for a Permit.

Limits in Permits may be set for mean or median values over long or short periods. The periods and limits selected should reflect:

- the manner in which the emission may impact upon the environment
- likely variations which will arise during operation within BAT
- possible failure modes and their consequences
- the capabilities of the monitoring and testing system employed

Where emissions are expressed in terms of concentrations and where continuous monitors are employed, it is recommended that limits are defined such that:

- not more than one calendar monthly average during any rolling twelve month period shall exceed the benchmark value by more than 10%
- not more than one half hour period during any rolling 24 hour period shall exceed the benchmark value by more than 50% (for the purpose of this limit half hourly periods commence on the hour and the half hour)

Where spot tests are employed:

- the half hour limit above shall be applied over the period of the test
- the mean of three consecutive tests taken during a calendar year shall not exceed the benchmark value by more than 10%

VOC releases from the vapour degreasing equipment, eg trichloroethylene and methylene chloride, may have to comply with the requirements of the Solvent Emissions Directive.

Table 3.1: Emissions to air associated with the use of BAT

Emission	Benchmark Level	Techniques which may be considered to be BAT	Comment
Chromium (VI) and compounds as chromium	1mg/m ³	Substitution of chromium VI with less toxic plating chemicals	IPC S2 4.04
Hydrogen Chloride	10 mg/m ³	Counter current packed tower with final alkaline scrubber	Ferrous metals BREF ref A 4.2.2.7
Hydrogen Cyanide	5 mg/m ³		IPC S2 4.04
Hydrogen Fluoride	2 mg/m ³	Scrubbers and adsorption towers	Ferrous metals BREF ref A5.2
Nickel and its compounds (as nickel)	2 mg/m ³		IPC S2 4.04
Oxides of Nitrogen (total acid forming as NO ₂)	200 mg/m ³	Scrubbers or adsorption towers	IPC S2 4.04
Particulate matter	50 mg/m ³	From the wet scrubber	Ferrous metals BREF ref A5.2
Sulphuric Acid Mist	5 mg/m ³	Mist eliminators	Ferrous metals BREF ref A 4.2.2.10
Oxides of sulphur (as SO ₂)	100 mg/m ³	Counter current packed tower with final alkaline scrubber	Ferrous metals BREF ref A 4.2.2.10

3.2.2 Emissions to water associated with the use of BAT

Wastewater treatment systems can maximise the removal of metals using sedimentation and possibly filtration. The reagents used for precipitation may be hydroxide, sulphide or a combination of both, depending on the mix of metals present. It is also practicable in many cases to re-use treated water.

Where automatic sampling systems are employed, limits may be defined such that:

- not more than 5% of samples shall exceed the benchmark value

Where spot samples are taken:

- no spot sample shall exceed the benchmark value by more than 50%

Releases to Water

Benchmark values for releases to sewer (in trade effluent) - based on chemical precipitation and permanent media filtration:

Table 3.2: Benchmark values for releases to Sewer

Substance	Level - mg/l
Aluminium	10
Cadmium	0.01
Free Cyanide	0.2
Chromium VI	0.2
Chromium, total	1.0
Copper	1.0
Lead	1.0
Nickel	1.0
Silver	0.1
Tin	2.0
Zinc	2.0
BOD	
COD	500
Hydrocarbons	0.1
Halogenated hydrocarbons	0.1

3.2.3 Waste releases associated with the use of BAT

Solid waste releases as sludge or filter cake comprise the largest source of pollution. Plating sludge and filter cake comprise hydrated hydroxide of iron (from the work) and the plating metals, together with soil, oil and greases from the chemical preparation processes. Solid waste from aluminium anodising process is largely made up of hydrated aluminium hydroxide. Phosphating process waste is mainly iron manganese or zinc phosphate. A drag-out reduction, drag-out recover and other BATS will ensure the following process efficiencies with respect to input materials:

Table 3.3: Process Efficiencies

Zinc plating (all processes)	90%
Nickel plating (closed loop)	95%
Autocatalytic nickel plating	95% (excluding losses spent solutions)
Copper plating (cyanide process)	95%
Tin and tin alloys	95%
Chromium plating (closed loop)	96%
Precious metal plating	98%
Cadmium	99%
Phosphating	90%
Anodising	90%

3.2.4 Standards and obligations

In addition to meeting the requirements of BAT, there are other national and international standards and obligations that must either be safeguarded through the IPPC Permit or, at least, taken into account in setting Permit conditions. This is particularly the case for any EC based EQSs.

EC-based EQ standards

IPPC: A Practical Guide explains how these should be taken into account and contains an annex listing the relevant standards. (See **Appendix 2** for equivalent legislation in Scotland and Northern Ireland). They can be summarised as follows.

Air quality

- Statutory Instrument 1989 No 317, Clean Air, The Air Quality Standards Regulations 1989 gives limit values in air for nitrogen dioxide (any emission from the process should not result in a breach of this standard beyond the site boundary), sulphur dioxide and suspended particulates.
- Environmental Protection, The Air Quality Regulations 1997.
- Statutory Instrument 2000 No.928, Air Quality (England) Regulations 2000 gives air quality objectives to be achieved by:
 - 2005 for nitrogen dioxide
 - 2004 for SO₂ and PM₁₀
 - 2003 for CO, 1,3 butadiene and benzene
 - in two stages for lead by 2004 and 2008 respectively

Water quality

- Directive 76/464/EEC on Pollution Caused by Dangerous Substances Discharged to Water contains two lists of substances. List I relates to the most dangerous, and standards are set out in various daughter Directives. List II substances must also be controlled. Annual mean concentration limits for receiving waters for List I substances can be found in SI 1989/2286 and SI 1992/337 the Surface Water (Dangerous Substances Classification) Regulations. Values for List II substances are contained in SI 1997/2560 and SI 1998/389. Daughter Directives cover EQS values for mercury, cadmium, hexachlorocyclohexane, DDT, carbon tetrachloride, pentachlorophenol, aldrin, dieldrin, endrin, isodrin, hexachlorobenzene, hexachlorobutadiene, chloroform, 1,2-dichloroethane, trichloroethane, perchloroethane and trichlorobenzene.
- Other waters with specific uses have water-quality concentration limits for certain substances. These are covered by the following Regulations:
 - SI 1991/1597 Bathing Waters (Classification) Regulations
 - SI 1992/1331 and Direction 1997 Surface Waters (Fishlife) (Classification) Regulations
 - SI 1997/1332 Surface Waters (Shellfish) (Classification) Regulations
 - SI 1996/3001 The Surface Waters (Abstraction and Drinking Water) (Classification) Regulations

Future likely changes include:

- Some air-quality and water-quality standards may be replaced by new ones in the near future.
- The Solvents Directive on the limitation of emissions of VOCs due to the use of organic solvents in certain activities and installations.

Other standards and obligations

Those most frequently applicable to most sectors are:

- Hazardous Waste Incineration Directive
- Waste Incineration Directive.
- Large Combustion Plant Directive.
- Reducing Emissions of VOCs and Levels of Ground Level Ozone: a UK Strategy (published by the Department of the Environment in October 1993. It sets out how the Government expects to meet its obligations under the UNECE VOCs Protocol to reduce its emissions by 30% (based on 1988 levels) by 1999, including the reductions projected for the major industrial sectors).

- Water Quality Objectives – assigned water quality objectives to inland rivers and water courses (ref. Surface (Rivers Ecosystem) Classification).
- The UNECE convention on long-range transboundary air pollution (negotiations are now underway which could lead to a requirement further to reduce emissions of NO_x and VOCs. A requirement to further reduce SO₂ emissions from all sources has been agreed. The second Sulphur protocol (Oslo, 1994) obliges the UK to reduce SO₂ emissions by 80% (based on 1980 levels) by 2010).
- The Montreal Protocol.
- The Habitats Directive (see [Section 4.3](#) on page 95).
- Sulphur Content of Certain Liquid Fuels Directive 1999/32/EC (from 1 January 2003, the sulphur content of heavy fuel oil must not exceed 1% except when it is burnt in plants fitted with SO₂ abatement equipment. Sulphur levels in gas oil must not exceed 0.2% from 1 July 2000, and 0.1% from the start of 2008.)

3.2.5 Units for benchmarks and setting limits in permits

Releases can be expressed in terms of:

- “**concentration**” (for example mg/l or mg/m³), which is a useful day-to-day measure of the effectiveness of any abatement plant and is usually measurable and enforceable. The total flow must be measured/controlled as well
- “**specific mass release**” (for example, kg/ product or input or other appropriate parameter), which is a measure of the overall environmental performance of the plant (including the abatement plant) compared with similar plants elsewhere
- “**absolute mass release**” (for example, kg/hr, t/yr), which relates directly to environmental impact

When endeavouring to reduce the environmental impact of an installation, its performance against each of these levels should be considered, as appropriate to the circumstances, in assessing where improvements can best be made.

When setting limits in Permits, the most appropriate measure will depend on the purpose of the limit. It may also be appropriate to use surrogate parameters, which reflect optimum environmental performance of plant as the routine measurement, supported by less frequent check-analyses on the final concentration. Examples of surrogate measures would be the continuous measurement of conductivity (after ion-exchange treatment) or total carbon (before a guard-column in activated carbon treatment) to indicate when regeneration or replacement is required.

The emission level figures given in this chapter are based on average figures, not on maximum, short-term peak values, which could be expected to be higher. The emission levels given are based on a typical averaging period of not less than 30 minutes and not greater than 24 hours.

3.2.6 Statistical basis for benchmarks and limits in permits

Conditions in Permits can be set with percentile, mean or median values over annual, monthly or daily periods, which reflect probable variation in performance. In addition, absolute maxima can be set.

Where there are known failure modes, which will occur even when applying BAT, limits in Permits may be specifically disapplied, but with commensurate requirements to notify the Regulator and to take specific remedial action.

For water: UK benchmarks or limits are most frequently 95 percentile concentrations or absolute concentrations, (with flow limited on a daily average or maximum basis).

For air: benchmarks or limits are most frequently expressed as daily averages or, typically 95 percent of hourly averages.

3.2.7 Reference conditions for releases to air

The reference conditions of substances in releases to air from point-sources are:

- temperature 0 °C (273K)
- pressure 101.3 kPa
- no correction for water vapour or oxygen

To convert measured values to reference conditions, see the [Monitoring Guidance](#) for more information.

4 Impact

4.1 Impact assessment

The Operator should assess that the emissions resulting from the proposals for the activities/installation will provide a high level of protection for the environment as a whole, in particular having regard to EQS etc, revisiting the techniques in Section 2 as necessary. The use of [IPPC Environmental Assessments for BAT](#), and the [IPPC Environmental Assessments for BAT software tool](#), and the other tools on the Application CD, will lead the Applicant through the process.

The depth to which the impact assessment should go should be discussed with the Regulator. For some low risk sites the requirements may be reduced.

Indicative BAT requirements for impact assessment

Provide an assessment of the potential significant environmental effects (including trans-boundary effects) of the foreseeable emissions.

- 1 Provide a description, including maps as appropriate, of the receiving environment to identify the receptors of pollution. The extent of the area may cover the local, national and international (for example, transboundary effects) environment as appropriate.
- 2 Identify important receptors, which may include: areas of human population including noise or odour-sensitive areas, flora and fauna (that is, Habitat Directive sites, special areas of conservation, Sites of Special Scientific Interest (SSSI) or in Northern Ireland ASSI) or other sensitive areas), soil, water, that is groundwater (water below the surface of the ground in the saturation zone and in direct contact with the ground and subsoil) and watercourses (for example, ditches, streams, brooks, rivers), air, including the upper atmosphere, landscape, material assets and the cultural heritage.
- 3 Identify the pathways by which the receptors will be exposed (where not self-evident).
- 4 Carry out an assessment of the potential impact of the total emissions from the activities on these receptors. [IPPC Environmental Assessments for BAT](#) provides a systematic method for doing this and will also identify where modelling needs to be carried out, to air or water, to improve the understanding of the dispersion of the emissions. The assessment will include comparison (see [IPPC: A Practical Guide](#)) with:
 - community EQS levels
 - other statutory obligations
 - non-statutory obligations
 - environmental action levels (EALs) and the other environmental and regulatory parameters defined in [IPPC Environmental Assessments for BAT](#)
- 5 In particular it will be necessary to demonstrate that an appropriate assessment of vent and chimney heights has been made to ensure that there is adequate dispersion of the minimised emission(s) to avoid exceeding local ground-level pollution thresholds and limit national and transboundary pollution impacts, based on the most sensitive receptor, be it human health, soil or terrestrial ecosystems.
- 6 Where appropriate, the Operator should also recognise the chimney or vent as an emergency emission point and understand the likely behaviour. Process upsets or equipment failure giving rise to abnormally high emission levels over short periods should be assessed. Even if the Applicant can demonstrate a very low probability of occurrence, the height of the chimney or vent should nevertheless be set to avoid any significant risk to health. The impact of fugitive emissions can also be assessed in many cases.
- 7 Consider whether the responses to Sections 2 and 3 and this assessment adequately demonstrate that the necessary measures have been taken against pollution, in particular by the application of BAT, and that no significant pollution will be caused. Where there is uncertainty about this, the measures in Section 2 should be revisited as appropriate to make further improvements.
- 8 Where the same pollutants are being emitted by more than one permitted activity on the installation, the Operator should assess the impact both with and without the neighbouring emissions.

4.2 Waste Management Licensing Regulations

Indicative BAT requirements for waste management licensing regulations

Explain how the information provided in other parts of the application also demonstrates that the requirements of the relevant objectives of the Waste Management Licensing Regulations 1994 have been addressed, or provide additional information in this respect.

- 1 In relation to activities involving the disposal or recovery of waste, the Regulators are required to exercise their functions for the purpose of achieving the relevant objectives as set out in Schedule 4 of the Waste Management Licensing Regulations 1994. (For the equivalent Regulations in Scotland and Northern Ireland, see [Appendix 2](#).)
- 2 The relevant objectives, contained in paragraph 4, Schedule 4 of the Waste Management Licensing Regulations 1994 (SI 1994/1056 as amended) are extensive, but will only require attention for activities that involve the recovery or disposal of waste. Paragraph 4 (1) is as follows:
 - ensuring the waste is recovered or disposed of without endangering human health and without using process or methods which could harm the environment and in particular without:
 - risk to water, air, soil, plants or animals or
 - causing nuisance through noise or odours or
 - adversely affecting the countryside or places of special interest
 - implementing, as far as material, any plan made under the plan-making provisions
- 3 The application of BAT is likely to already address risks to water, air, soil, plants or animals, odour nuisance and some aspects of effects on the countryside. It will, however, be necessary for the Operator briefly to consider each of these objectives individually and provide a comment on how they are being addressed by your proposals. It is also necessary to ensure that any places of special concern that could be affected, such as SSSIs, are identified and commented upon although, again, these may have been addressed in your assessment for BAT, in which case a cross-reference may suffice.
- 4 Operators should identify any development plans made by the local planning authority, including any waste local plan, and comment on the extent to which the proposals accord with the contents of any such plan (see [Section 2.6](#) on page 65).

4.3 The Habitats Regulations

In this sector the releases to air are usually low and only of significance in the immediate vicinity of the installation. The releases to water are normally as trade effluent discharged to a municipal sewage treatment works. Most Operators should be able to demonstrate that the installation does not have a significant effect on any European site.

Indicative BAT requirements for the habitats regulations

Provide an assessment of whether the installation is likely to have a significant effect on a European site in the UK and, if it is, provide an assessment of the implications of the installation for that site, for the purpose of the Conservation (Natural Habitats etc.) Regulations 1994 (SI 1994/2716)

- 1 An application for an IPPC Permit will be regarded as a new plan or project for the purposes of the Habitats Regulations (for the equivalent Regulations in Scotland and Northern Ireland see [Appendix 3.2.7](#)). Therefore, Operators should provide an initial assessment of whether the installation is likely to have a significant effect on any European site in the UK (either alone or in combination with other relevant plans or projects) and, if so, an initial assessment of the implications of the installation for any such site. The application of BAT is likely to have gone some way towards addressing the potential impact of the installation on European sites and putting into place techniques to avoid any significant effects. The Operator should provide a description of how the BAT assessment has specifically taken these matters into account, bearing in mind the conservation objectives of any such site.
- 2 European sites are defined in Regulation 10 of the Habitats Regulations to include Special Areas of Conservation (SACs); sites of community importance (sites that have been selected as candidate SACs by member states and adopted by the European Commission, but which are not yet formally classified); and Special Protection Areas (SPAs). It is also Government policy (set out in PPG 9 on nature conservation) that potential SPAs and candidate SACs should be considered to be European sites for the purposes of Regulation 10.
- 3 Information on the location of European sites and their conservation objectives is available from:
 - English Nature (01733 455000), <http://www.english-nature.org.uk>
 - Countryside Council for Wales (01248 385620), <http://www.ccw.gov.uk>
 - Scottish Natural Heritage (0131 447 4784), <http://www.snh.org.uk>
 - Joint Nature Conservation Committee (01733 866852), <http://www.jncc.gov.uk>
 - Environment and Heritage Service, Northern Ireland, <http://www.ehsni.gov.uk>
- 4 The Regulator will need to consider the Operator's initial assessment. If it concludes that the installation is likely to have a significant effect on a European site, then the Regulator will need to carry out an "appropriate assessment" of the implications of the installation in view of that site's conservation objectives. The Regulations impose a duty on the Regulator to carry out these assessments, so it cannot rely on the Operator's initial assessments. Therefore the Regulator must be provided with any relevant information upon which the Operator's assessment is based.
- 5 Note that in many cases the impact of the Habitats Regulations will have been considered at the planning application stage, in which case the Regulator should be advised of the details.

References

For a full list of available Technical Guidance see Appendix A of the Guide for Applicants or visit the Environment Agency Website <http://www.environment-agency.gov.uk>. Many of the references below are being made available free of charge for viewing or download on the Website. The same information can also be accessed via the SEPA web site <http://www.sepa.org.uk>, or the NIEHS web site www.ehsni.gov.uk. Most titles will also be available in hard copy from The Stationery Office (TSO). Some existing titles are not yet available on the Website but can be obtained from TSO.

- Ref 1 *IPPC Reference Document on Best Available Techniques for the Surface Treatment of Metals and Plastics (draft August 2003), Ferrous Metals (final) and ferrous metal processing (final)* Industry European Commission <http://eippcb.jrc.es>
- Ref 2 *The Pollution Prevention and Control Act (1999)* (www.hmso.gov.uk).
- Ref 3 *The Pollution Prevention and Control Regulations* (SI 2000 No. 1973) (www.hmso.gov.uk).
- Ref 4 *IPPC: A Practical Guide* (for England and Wales) (or equivalents in Scotland and Northern Ireland) www.defra.gov.uk/environment/ppc/ipccguide/index.htm
- Ref 5 Guidance for applicants
- IPPC Part A(1) Installations: Guide for (Applicants England and Wales) (includes Preparation of a Site Report in a Permit Application) ([EA website](#)).
 - PPC Part A Installations: Guide for Applicants (Scotland) (Guidance for SEPA staff on land and groundwater considerations) [Guidance for SEPA staff on land and groundwater considerations](#)
- Ref 6 Assessment methodologies:
- *E1 BPEO Assessment Methodology for IPC*
 - *IPPC Environmental Assessments for BAT*
- Ref 7 Waste minimisation support references
- = *Environment Agency web site*. Waste minimisation information accessible via: www.environment-agency.gov.uk/subjects/waste/131528
 - = *Waste Minimisation – an environmental good practice guide for industry* (helps industry to minimise waste and achieve national environmental goals). Available free to companies who intend to undertake a waste reduction programme (tel: 0345 33 77 00)
 - = *Profiting from Pollution Prevention – 3Es methodology* (emissions, efficiency, economics). Video and A4 guide aimed at process industries. Available from Environment Agency, North East region (tel: 0113 244 0191, ask for Regional PIR)
 - = *Waste Minimisation Interactive Tools (WIMIT)*. Produced in association with Envirowise and the BOC Foundation (a software tool designed for small and medium businesses.). Available free from The Environmental Helpline (tel: 0800 585794)
 - = ENVIROWISE. A joint DTI/DEFRA programme, with over 200 separate case studies, good practice guides, leaflets, flyers, software tools and videos covering 12 industry sectors, packaging, solvents and the generic areas of waste minimisation and cleaner technology. ENVIROWISE is accessible via a FREE and confidential helpline (tel: 0800 585794) or via the web site www.envirowise.gov.uk
 - = *Increased Profit Through Improved Materials Additions: Management/Technical Guide*, ENVIROWISE, GG194/195
 - = *Waste Management Information Bureau*. The UK's national referral centre for help on the full range of waste management issues. It produces a database called Waste Info, which is available for on-line searching and on CD-ROM. Short enquiries are free (tel: 01235 463162)
 - = *Waste Minimisation – Institution of Chemical Engineers Training Package E07*. Basic course which contains guide, video, slides, OHPs etc. (tel: 01788 578214)
 - BIO-WISE - profiting through industrial biotechnology. A DTI programme providing free advice and information about how biotechnology can be used within manufacturing industry. Case studies, guides website and Helpline 0800 432100. dti.gov.uk/biowise (leather guide GG237 and case study 11)
- Ref 8 Water efficiency references:
- *Simple measures restrict water costs*, ENVIROWISE, GC22
 - *Effluent costs eliminated by water treatment*, ENVIROWISE, GC24
 - *Saving money through waste minimisation: Reducing water use*, ENVIROWISE, GG26
 - *ENVIROWISE Helpline* 0800 585794

- *Optimum use of water for industry and agriculture dependent on direct abstraction: Best practice manual.* R&D technical report W157, Environment Agency (1998), WRc Dissemination Centre, Swindon (tel: 01793 865012)
 - *Cost-effective Water Saving Devices and Practices* ENVIROWISE GG067
 - *Water and Cost Savings from Improved Process Control* ENVIROWISE GC110
 - *Tracking Water Use to Cut Costs* ENVIROWISE GG152
- Ref 9 Releases to air references:
- = BREF on Waste Water and Waste Gas Treatment.
 - = A1 Guidance on effective flaring in the gas, petroleum etc. industries, 1993, ISBN 0-11-752916-8
 - = A2 Pollution abatement technology for the reduction of solvent vapour emissions, 1994, £5.00, 0-11-752925-7
 - = A3 Pollution abatement technology for particulate and trace gas removal, 1994, £5.00, 0-11-752983-4
 - = Part B PG1/3 Boilers and Furnaces 20-50 MW net thermal input (ISBN 0-11-753146-4-7)
 - Part B PG1/4 Gas Turbines 20-50 MW net thermal input (ISBN 0-11-753147-2)
- Ref 10 Releases to water references
- = BREF on Waste Water and Waste Gas Treatment
 - = *A4 Effluent Treatment Techniques*, TGN A4, Environment Agency, ISBN 0-11-310127-9 ([EA website](#))
 - = *Pollution Prevention Guidance Note – Above-ground oil storage tanks*, PPG 2, Environment Agency, gives information on tanks and bunding which have general relevance beyond just oil ([EA website](#))
 - = *Construction of bunds for oil storage tanks*, Mason, P. A, Amies, H. J, Sangarapillai, G. Rose, Construction Industry Research and Information Association (CIRIA), Report 163, 1997, CIRIA, 6 Storey's Gate, Westminster, London SW1P 3AU. Abbreviated versions are also available for masonry and concrete bunds (www.ciria.org.uk on-line purchase)
 - = *Policy and Practice for the Protection of Groundwater* (PPPG) ([EA website](#))
 - = *Choosing Cost-effective Pollution Control* ENVIROWISE GG109
 - = *Cost-effective Separation Technologies for Minimising Wastes and Effluents* ENVIROWISE GG037
 - *Cost-effective Membrane Technologies for Minimising: Wastes and Effluents* ENVIROWISE GG044
- Ref 11 Waste references
- = *Investigation of the criteria for, and guidance on, the landspreading of industrial wastes* – final report to the DEFRA, the Environment Agency and MAFF, May 1998
 - *Agency guidance on the exemption 7 activity* (proposed)
- Ref 12 Energy references:
- *H2 Energy efficiency for IPPC* (working version available on the website should be used until the final version is published)
- Ref 13 COMAH guides
- = *A Guide to the Control of Major Accident Hazards Regulations 1999*, Health and Safety Executive (HSE) Books L111, 1999, ISBN 0 07176 1604 5
 - = *Preparing Safety Reports: Control of Major Accident Hazards Regulations 1999*, HSE Books HS(G)190, 1999
 - = *Emergency Planning for Major Accidents: Control of Major Accident Hazards Regulations 1999*, HSE Books HS(G)191, 1999
 - = *Guidance on the Environmental Risk Assessment Aspects of COMAH Safety Reports*, Environment Agency, 1999 ([EA website](#))
 - *Guidance on the Interpretation of Major Accidents to the Environment for the Purposes of the COMAH Regulations*, DEFRA, 1999, ISBN 753501 X, available from the Stationery Office
- Ref 14 Monitoring Guidance
- = *MCERTS approved equipment* link via <http://www.environment-agency.gov.uk/business/mcerts>
 - = *M1 Sampling facility requirements for the monitoring of particulates in gaseous releases to atmosphere*, March 1993, £5.00, ISBN 0-11-752777-7
 - = *M3 Standards for IPC Monitoring Part 1: Standards, organisations and the measurement infrastructure*, August 1995, £11.00, ISBN 0-11-753133-2
 - = *M4 Standards for IPC Monitoring Part 2: Standards in support of IPC Monitoring*, revised 1998
 - *Direct Toxicity Assessment for Effluent Control* Technical Guidance (2000), UKWIR 00/TX/02/07
- Ref 15 Noise references:
- = *H3 Horizontal Guidance for Noise Part 1* Regulation and Permitting
 - *H3 Horizontal Guidance for Noise Part 2* Assessment and Control

- Ref 16 Closure references
- *Working at Construction and Demolition-sites* (PPG 6) ([EA website](#))
- Ref 17 Directives
- = *Hazardous waste incineration Directive* (1994/67/EC)
 - = *Waste incineration Directive* (2000/76/EC)
 - = *Large Combustion Plant Directives* (1988/609/EEC)
 - *Habitats Directive* (92/43/EC)
- Ref 18 Dispersion
- *Dispersion Methodology Guide D1* ([EA website](#) - summary only)
- Ref 19 Fire Fighting
- = *BS 5908: Code of Practice for Fire Precautions in the Chemical and Allied Industries*
 - *Pollution prevention measures for the control of spillages and fire-fighting run-off*, PPG 18, Environment Agency Pollution Prevention Guidance Note, gives information on sizing firewater containment systems ([EA website](#))
- Ref 20 Volatile Organic Compounds
- *The Categorisation of Volatile Organic Compounds*, DOE Research Report No DOE/HMIP/RR/95/009 ([EA website](#))
- Ref 21 *Secretary of State's Guidance for the A2 Galvanizing Sector IPPC SG5 - published 2003*
- Ref 22 *Council Directive 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of solvents in certain activities and installations*

Abbreviations

BAT	Best Available Techniques – see IPPC A Practical Guide or the Regulations for further definition
BAT Criteria	The criteria to be taken into account when assessing BAT, given in Schedule 2 of the PPC Regulations
BOD	Biological Oxygen Demand
BREF	BAT Reference Document
CEM	Continuous Emissions Monitoring
CHP	Combined heat and power plant
COD	Chemical Oxygen Demand
ELV	Emission Limit Value
EMS	Environmental Management System
ETP	Effluent treatment plant
ITEQ	International Toxicity Equivalents
MCERTS	Monitoring Certification Scheme
NIEHS	Northern Ireland Environment and Heritage Service
SAC	Special Areas of Conservation
SECp	Specific Energy consumption
SEPA	Scottish Environment Protection Agency
SPA	Special Protection Area
TSS	Suspended solids
TOC	Total Organic Carbon
VOC	Volatile organic compounds

Glossary

Drag-out	Process fluid carried out with the work on its withdrawal from a process tank
DTPA	Diethylenetriaminepentaacetic acid
EDTA	Ethylenediamine-tetracetic acid.
Levelling	The ability of a plating electrolyte to deposit a level coating on an irregular surface
Linishing	Mechanical linear abrasion of work by a moving abrasive belt
NTA	Nitriloacetic acid
PID	Proportional, integral and derivative control action
QUADROL	NNN'N'-tetrakis-(2-hydroxy-propyl)ethylenediamine
Smut	Fine deposit appearing on the surface of the work after a pickling operation
Work	The components, articles, material being surface treated

Appendix 1: Some common monitoring and sampling methods

Table 4.1: Measurement methods for common substances to water

Determinand	Method	Detection limit Uncertainty	Valid for range mg/l	Standard
Suspended solids	Filtration through glass fibre filters	1 mg/l 20%	10-40	ISO 11929:1997, EN872 - Determination of suspended solids
COD	Oxidation with di-chromate	12 mg/l 20%	50-400	ISO 6060: 1989, Water Quality - Determination of chemical oxygen demand
BOD5	Seeding with micro-organisms and measurement of oxygen content	2 mg/l 20%	5-30	ISO 5815: 1989, Water Quality Determination of BOD after 5 days, dilution and seeding method EN 1899 (BOD 2 Parts)
AOX	Adsorption on activated carbon and combustion	-- 20%	0.4 - 1.0	ISO 9562: 1998, EN1485 - Determination of adsorbable organically bound halogens.
Tot P				BS 6068: Section 2.28 1997, Determination of phosphorus – ammonium molybdate spectrometric method
Tot N				BS 6068: Section 2.62 1998, Determination of nitrogen Part 1 Method using oxidative digestion with peroxydisulphate, BS EN ISO 11905
pH				SCA The measurement of electric conductivity and the determination of pH, ISBN 0117514284
Turbidity				SCA Colour and turbidity of waters 1981, ISBN 0117519553 EN 27027:1999
Flow rate	Mechanical ultrasonic or electromagnetic gauges			SCA Estimation of Flow and Load, ISBN 011752364X
Temperature				
TOC				SCA The Instrumental Determination of Total Organic Carbon and Related Determinants 1995, ISBN 0117529796 EN 1484:1997
Fatty acids				Determination of Volatile Fatty Acids in Sewage Sludge 1979, ISBN 0117514624
Metals				BS 6068: Section 2.60 1998, Determination of 33 elements by inductively coupled plasma atomic emission spectroscopy
Chlorine				BS6068: Section 2.27 1990, Method for the determination of total chlorine: iodometric titration method
Chloroform Bromoform				BS 6068: Section 2.58, Determination of highly volatile halogenated hydrocarbons – Gas chromatographic methods
Dispersants Surfactants Anionic Cationic Non-ionic				SCA Analysis of Surfactants in Waters, Wastewaters and Sludges, ISBN 01176058 EN 903:1993 (Used for anionic surfactants)

Table 4.1: Measurement methods for common substances to water

Determinand	Method	Detection limit Uncertainty	Valid for range mg/l	Standard
Pentachloro-Phenol				BS5666 Part 6 1983, Wood preservative and treated timber quantitative analysis of wood preservatives containing pentachlorophenol EN 12673:1997 (used for chlorophenol and polychlorinated phenols)
Formaldehyde				SCA The determination of formaldehyde, other volatile aldehydes and alcohols in water
Phosphates and nitrates				BS 6068: Section 2.53 1997, Determination of dissolved ions by liquid chromatography
Sulphites and sulphates				BS 6068: Section 2.53 1997, Determination of dissolved ions by liquid chromatography
Ammonia				BS 6068: Section 2.11 1987, Method for the determination of ammonium: automated spectrometric method
Grease and oils	IR absorption	0.06 mg/kg		SCA The determination of hydrocarbon oils in waters by solvent extraction IR absorption and gravimetry, ISBN 011751 7283

Table 4.2: Measurement methods for air emissions

Determinand	Method	Averaging time Detection limit Uncertainty	Compliance criterion	Standard
Formaldehyde	Impingement in 2,4 dinitro-phenyl-Hydrazine HPLC	1 hour 1 mg/m ³ 30%	Two samples taken. Each result below limit after subtraction of measurement uncertainty	NIOSH
Ammonia	Ion Chromatography	1 hour 0.5mg/m ³ 25%		US EPA Method 26
VOCs speciated	Adsorption Thermal Desorption GCMS	1 hour 0.1 mg/m ³ 30%		BS EN 1076: Workplace atmospheres. Pumped sorbent tubes for the determination of gases and vapours. Requirements and test methods.
Chloroform	Absorption on activated carbon solvent extraction. GC analysis	1 hour 1 mg/m ³ 20%		MDHS 28 Chlorinated hydrocarbon solvent vapours in air (modified)
Oxides of sulphur	UV fluorescence automatic analyser	1 hour 1 ppm 10%	95% of hourly averages over a year below specified limit	ISO 7935 (BS6069 Section 4.4) Stationary source emissions -determination of mass concentrations of sulphur dioxide CEN Standard in preparation
	Wet sampling train Ion chromatography	1 hour 1 mg/m ³ 25%	Two samples taken. Each result below limit after subtraction of measurement uncertainty	ISO 7934 (BS6069 Section 4.1) Method for the determination of the mass concentration of sulphur dioxide-hydrogen peroxide/barium perchlorate method

Measurement uncertainty is defined as total expanded uncertainty at 95% confidence limit calculated in accordance with the Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, 1st Ed., Geneva, Switzerland, ISO 1993.

See also Monitoring Guidance [Monitoring Guidance](#)

Appendix 2: Equivalent legislation in Scotland & Northern Ireland

The legislation referred to in the text is that for England. The following are the equivalents for Scotland, Wales and Northern Ireland.

Table 4.3: Equivalent legislation

England	Wales	Scotland	Northern Ireland
PPC Regulations (England and Wales) 2000	As England	PPC (Scotland) Regulations 2000, SI 200/323	SR2003 no.46 The Pollution Prevention and Control Regulations (Northern Ireland) 2003
SI:1994 1056: Waste Management Licensing Regulations	As England	As England	No N.I. equivalent
The Water Resources Act 1991	As England	COPA 1974 (S30A-30E equiv to Part III WRA91): Natural Heritage (Scotland) Act 1991 (Part II equiv to Part I WRA91)	The Water (NI) Order 1999
SI 1989 No.317: Clean Air, The Air Quality Standards Regulations 1989 SI 1995 No. 3146: The Air Quality Standards (Amendments) Regulations 1995	As England	As England	SR 1990 No.145: The Air Quality Standards Regulations (Northern Ireland) 1990 SR1996 No.23: The Air Quality Standards (Amendments) Regulations (Northern Ireland) 1996
SI 2000 No.928: The Air Quality (England) Regulations 2000	SI 2000 No.1940 (W.138): The Air Quality (Wales) Regulations 2000	SSI 2000/97: The Air Quality (Scotland) Regulations	No NI equivalent
SI 2001 No.2315: The Air Quality Limit Values Regulations 2001	SI 2001 No.2683 (W.224): The Air Quality Limit Values (Wales) Regulations 2001	SSI 2001 No.224: The Air Quality Limit Values (Scotland) Regulations 2001	SI 2002 No.94: The Air Quality Limit Values (Northern Ireland) Regulations 2002
SI 1989 No 2286 and 1998 No 389: The Surface Water (Dangerous Substances Classification) Regulations. (Values for List II substances are contained in SI 1997/2560 and SI 1998/389)	As England	SI 1990/126: Surface Water (Dangerous Substances) (Classification) (Scotland) Regulations	Surface Waters (Dangerous Substances) (Classification) Regulations 1998. Statutory Rules of Northern Ireland 1998 No 397
SI 1991 No.1597: Bathing Waters (Classification) Regulations 1991	As England	SI 1991 No.1609: Bathing Waters (Classification) (Scotland) Regulations 1991	The Quality of Bathing Water Regulations (NI) 1993
SI 1997 No.1331: The Surface Waters (Fishlife) (Classification) Regulations 1997	As England	SI 1997 No.2471 (S.163): The Surface Waters (Fishlife) (Classification) (Scotland) Regulations 1997	The Surface Water (Fishlife) (Classification) Regulations (NI) 1997
SI 1997 No.1332: The Surface Waters (Shellfish) (Classification) Regulations 1997	As England	SI 1997 No.2470 (S.162): The Surface Waters (Shellfish) (Classification) (Scotland) Regulations 1997	The Surface Water (Shellfish) (Classification) Regulations (NI) 1997

Table 4.3: Equivalent legislation

England	Wales	Scotland	Northern Ireland
SI 1994 No.2716: The Conservation (Natural Habitats, etc) Regulations	As England	As England	Conservation (Natural Habitats etc) Regulations (Northern Ireland) 1995
SI 1999 No.743: Control of Major Accident Hazards Regulations (COMAH) 1999	As England	As England	SR 2000 No.93: Control of Major Accident Hazards Regulations (Northern Ireland) 2000
SI 1998 No.2746: The Groundwater Regulations 1998	As England	As England	SR 1998 No.401: The Groundwater Regulations (Northern Ireland) 1998