Sector Guidance Note IPPC SG5
December 2003

Integrated Pollution Prevention and Control (IPPC)

Secretary of State's Guidance for the A2 Galvanizing Sector
Defra would like to acknowledge the work of the Environment Agency's Local Authority Unit in the drafting of this guidance note.
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1 Introduction

Background

1.1 This sector guidance note is issued by the Secretary of State and the Welsh Assembly Government (WAG), following consultation with relevant trade bodies, representatives of regulators including members of the Industrial Pollution Liaison Committee, and other interested organisations.

1.2 The note constitutes statutory guidance under regulation 37 of the Pollution Prevention and Control (England and Wales) Regulations 2000, SI 1973 (Ref 1) on the integrated pollution control standards appropriate for the generality of new and existing A2 installations in the galvanizing sector.

These installations require a permit to operate in accordance with the 2000 Regulations under what is known as the Local Authority-Integrated Pollution Prevention and Control (LA-IPPC) regime. Local authority regulators are required by regulation 37 to have regard to this guidance. The Secretary of State / WAG will also treat this guidance as one of the material considerations when determining any appeals made under the Regulations against a local enforcing authority decision.

1.3 The guidance also (where appropriate) gives details of any mandatory requirements affecting emissions and impacts from these installations, which are in force at the time of publication. These include requirements contained in directions from the Secretary of State / WAG.

1.4 This is one of a series of such guidance notes aimed at providing a strong framework for consistent and transparent regulation of LA-IPPC installations.

1.5 General guidance explaining LA-IPPC and setting out the policy and procedures, is contained in the “General Guidance Manual on Policy and Procedures for A2 and B Installations” (Ref 2) available from www.defra.gov.uk/environment/ppc/index.htm, to be referred to in this document as the “General Guidance Manual.” This is designed for operators and members of the public, as well as for local authority regulators.

Best Available Techniques (BAT)

1.6 BAT is the main basis for determining standards in LA-IPPC. This sector guidance note addresses what is considered by the Secretary of State/WAG to constitute BAT for the galvanizing sector.

This sector guidance note takes into account information contained in the BREF (Ref 3)

As made clear in chapter 12 of the General Guidance Manual, BAT for each installation should be assessed by reference to the appropriate sector guidance note, and these notes should be regarded by local authorities as their primary reference document for determining BAT in drawing up permits. In general terms what is BAT for one installation is likely to be BAT for a comparable installation. However, determination of what is BAT is ultimately a matter for case-by-case decision taking into account that individual circumstances may affect BAT judgements and what are the appropriate permit conditions.

Thus, for each galvanizing installation, local authorities (subject to appeal to the Secretary of State / WAG) should regard this guidance note as a baseline, but ensure they take into account any relevant case-specific factors such as the individual process configuration and other characteristics, its size, location, and any other relevant features of the particular installation. Further guidance on this, including the issue of taking account of operators’ individual financial position, is contained in chapter 12 of the General Guidance Manual.

1.7 If there are any applicable mandatory EU emission limits, these must be met, although BAT may go further. The same applies to UK regulations, such as The Control of Pollution (Oil Storage) (England) Regulations 2001, SI 2954.

Who is this guidance for?

1.8 This guidance is for:
- local authority regulators: who must have regard to the guidance when determining applica-
tions and when regulating installations which have a permit
- operators: who are best advised also to have regard to it when making applications and in the
subsequent operation of their activities
- members of the public: who may be interested to know what standards are envisaged for the
generality of installations in this sector.

1.9 The guidance is based on the state of knowledge and understanding of installations in this
sector, their potential impact on the environment, and the available control techniques at the
time of writing. The guidance may be amended from time to time in order to keep abreast with
developments, including improvements or changes in techniques and new understanding of
environmental impacts and risks. Any such amendments may be issued in a complete revision
of this note, or in separate additional guidance notes which address specific issues. (N.B. It may
not always be possible to issue amending guidance quickly enough to keep in absolute step with
rapid changes, which might be another justification in particular cases for diverging from this
note.) Steps will be taken to ensure that those who need to know about changes are informed of
any amendments. Operators (and their advisers) are, however, strongly advised to check with
the relevant local authority whether there have been any amendments before relying on this
note for the purposes of applying for a permit or making any other decisions where BAT and
related matters may be a consideration.

Terminology

1.10 In addition to the General Guidance Manual referred to above, explanation or clarification of
certain terms used in this sector guidance note may be found in a general guidance note issued
under Part I of the Environmental Protection Act 1991: 'Interpretation of terms used in process
Where there is any conflict between GG4 and the guidance issued in this note or in the General
Guidance Manual, the latter two documents should prevail, as should any subsequent guidance
issued in relation to LA-IPPC.

Installations covered

1.11 The installation includes the main activities above plus the directly associated activities which
have a technical connection with the main activities and which may have an effect on emissions
and pollution.

1.12 This note covers installations, described in Section 2.1 Part A2 of Schedule 1 to the PPC
Regulations (as amended) (Ref 1), Section 2.2 Part A2 or Section 2.3 Part A2 as follows:

Section 2.1 - Ferrous Metals

Part A2

Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per
hour.

Section 2.2 - Non Ferrous Metals

Part A2

(a) Melting, including making alloys, of non-ferrous metals, including recovered products (refin-
ing, foundry casting, etc.) where -

(i) the plant has a melting capacity of more than 4 tonnes a day for lead or cadmium or 20
 tonnes per day for all other metals; and

(b) no furnace, bath or other holding vessel used in the plant for the melting has a design hold-
ing capacity of 5 tonnes or more.
Section 2.3 - Surface Treating Metals and Plastic Materials

Part A2

(a) 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 A2 or B of Section 2.1 (Ferrous Metals);
(ii) Part A2 or B of Section 2.2 (Non Ferrous Metals); or
(iii) Part A2 or B of Section 6.4 (Coating Activities, Printing and Textile Treatments);

Review and Upgrading Periods

Existing installations or activities

1.13 The previous guidance (PG 2/2 (96)) relating to emissions to air advised that upgrading to that standard should have been completed, other than in exceptional circumstances, by 1 October 1996. Requirements still outstanding from any existing upgrading programme should be completed.

1.14 The new provisions of this note and the dates by which compliance with these provisions is expected, are listed in Table 1 below, together with the paragraph number where the relevant guidance is to be found. Compliance with the new provisions should normally be achieved by the dates shown. Permits should be drafted having regard to this compliance timetable.

1.15 A programme for upgrading within the specified timescales to those new / additional provisions in this guidance which involve significant improvement work, should be submitted to the relevant local authority regulator within 6 months of the date of issue of the permit.
1.16 Replacement plant should normally be designed to meet the appropriate standards specified for new installations or activities.

Where requirements in the preceding guidance note have been deleted or relaxed, permits should be varied as necessary as soon as reasonably practicable.

New installations or activities

1.17 For new installations or activities - from the first day of operation the permit should have regard to the full standards of this guidance.

Substantially changed installations or activities

1.18 For substantially changed installations or activities - as from the first day of operation, the permit should normally have regard to the full standards of this guidance with respect to the parts of the installation that have been substantially changed and any part of the installation affected by the change.

Permit reviews

1.19 Permits should be reviewed in accordance with the guidance in chapter 26 of the General Guidance Manual. The review frequencies given in that chapter are considered appropriate for activities and installations covered by this sector guidance note.

Table 1: Compliance timetable

<table>
<thead>
<tr>
<th>Guidance</th>
<th>Reference</th>
<th>Compliance Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermostatic control and insulation for newly installed heated tanks</td>
<td>BAT 9</td>
<td>Immediately for any tanks installed after the date of publication of this note.</td>
</tr>
<tr>
<td>Emission limit for lead (for wire galvanizers) of 0.25 mg/m³.</td>
<td>Table 3 and BAT 26</td>
<td>Within 12 months of issue of the permit.</td>
</tr>
<tr>
<td>Groundwater Contamination Risk Audit</td>
<td>3.75, BAT 42 and BAT 47</td>
<td>1 April 2006.</td>
</tr>
<tr>
<td>Raw Materials / Waste Minimisation Audit</td>
<td>3.92 and BAT 58 and 59</td>
<td>Within 18 months of issue of the permit.</td>
</tr>
<tr>
<td>Water Audit</td>
<td>BAT 62</td>
<td>1 April 2005.</td>
</tr>
<tr>
<td>Energy Audit</td>
<td>3.102 and BAT 73</td>
<td>Within 12 months of issue of the permit.</td>
</tr>
<tr>
<td>Noise &amp; Vibration</td>
<td>BAT 83</td>
<td>1 August 2004.</td>
</tr>
<tr>
<td>All Other Provisions</td>
<td>-</td>
<td>To be complied with as soon as practicable, which in most cases should be within 12 months of the publication of this note.</td>
</tr>
</tbody>
</table>
### Summary of releases

**Table 2: Summary of direct releases**

<table>
<thead>
<tr>
<th>Source</th>
<th>Material storage and handling, general operations and maintenance</th>
<th>Shotblasting</th>
<th>Degreasing</th>
<th>Pickling</th>
<th>Rinsing</th>
<th>Stripping</th>
<th>Fluxing</th>
<th>Hot dipping</th>
<th>Post treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxides of nitrogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Oxides of carbon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>W</td>
<td>L</td>
<td>W</td>
<td>A</td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>W</td>
<td>L</td>
<td>A</td>
<td>W</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hydrogen chloride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc chloride</td>
<td>W</td>
<td></td>
<td>A</td>
<td>W</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ammonium chloride</td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>W</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iron oxide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Metallic iron particulates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Phosphoric acid</td>
<td></td>
<td></td>
<td>W</td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sodium hydroxide</td>
<td>W</td>
<td></td>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zinc, lead and their oxides</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Chromates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>W</td>
<td>L</td>
</tr>
<tr>
<td>Liquid fuel oils and greases</td>
<td>L</td>
<td>W</td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td></td>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>Sludge waste</td>
<td></td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td>L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refractory waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

**KEY**

A - Release to Air, W - Release to Water, L - Release to Land, *** - High, ** - Medium * - Low

Substances include their compounds, except where separate reference to the compound is made.

Releases to air may also be released to land or water, depending upon the abatement technology employed, e.g. via collected dusts, sludges or liquors.

**N.B.** It should be noted that this is not necessarily an exhaustive list. Equally not all installations will necessarily have all these releases.
2 Emission limits and other provisions

2.1 This section contains emission limits, mass release rates and other provisions that are judged for the generality of the activities within the sector to represent BAT.

Emissions to air associated with the use of BAT

Table 3: Emissions to air associated with the use of BAT

<table>
<thead>
<tr>
<th>Determinand</th>
<th>Source</th>
<th>Limit</th>
<th>Type of monitoring</th>
<th>Frequency of monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulate matter</td>
<td>All galvanizing baths.</td>
<td>15 mg/m³</td>
<td>Manual extractive test to comply with BS ISO 12141:2002 or BS EN 13284:Part 1</td>
<td>At least once a year and quarterly for low fuming flux operations where continuous indicative monitoring is not being used.</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>Galvanizing baths not using low fuming flux but using abatement plant.</td>
<td>15 mg/m³</td>
<td>Indicative monitoring.</td>
<td>Continuous</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>All authorised emission points from low fuming flux operations without abatement prior to discharge.</td>
<td>No persistent visible emission.</td>
<td>Operator observations.</td>
<td>At least daily.</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>Stack or duct emissions from contained sources other than galvanizing e.g. shot blasting plant, ash reclamation.</td>
<td>20 mg/m³</td>
<td>Continuous indicative monitoring plus manual extractive testing to comply with BS ISO 12141:2002 or BS EN 13284:Part 1</td>
<td>Continuous</td>
</tr>
<tr>
<td>Particulate matter</td>
<td>Fugitive emissions from galvanizing baths</td>
<td>No persistent visible emission.</td>
<td>Operator observations.</td>
<td>At least daily.</td>
</tr>
<tr>
<td>Total chloride (expressed as HCl)</td>
<td>Hydrochloric acid pickling plant, where emissions are contained and extracted.</td>
<td>30 mg/m³</td>
<td>EN 1911</td>
<td>Annual</td>
</tr>
<tr>
<td>Lead and its compounds (as lead)</td>
<td>Lead annealing baths (wire galvanizing)</td>
<td>0.25 mg/m³</td>
<td>Manual extractive testing (BS EN 14385 expected to be published 2004)</td>
<td>Annual</td>
</tr>
</tbody>
</table>
Benchmark emissions to water associated with the use of BAT

2.2 Limit values for water discharges will be specified in individual cases taking account of the receiving environment. Wastewater treatment systems can maximise the removal of metals using precipitation, 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. The following table provides information regarding achievable levels associated with the use of wastewater treatment systems.

2.3 In all cases the effluent discharged from the installation must not give rise to a potential breach of an EQS or an EAL for the final receiving water, when taken with compliance with any water company permit.

Table 4: Emissions to water associated with BAT

<table>
<thead>
<tr>
<th>Determinand</th>
<th>Benchmark release concentration, mg/litre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hydrocarbon oil</td>
<td>5</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>20</td>
</tr>
<tr>
<td>Zinc</td>
<td>2</td>
</tr>
</tbody>
</table>

The appropriateness of the above release concentrations will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations.
3 Techniques for pollution control

3.1 This section summarises, in the outlined BAT boxes, what BAT should be in most circumstances. The boxes should not be taken as the only source of permit conditions; compliance with emission limits and other provisions contained in this guidance note together with any relevant case-specific considerations will also need to be taken into account.

3.2 The standards cover the techniques and measures which, in combination with those in the relevant previous (LAPC/IPC/Waste) guidance, have been identified as representing BAT in a general sense. They also cover the other requirements of the Pollution Prevention and Control (England and Wales) Regulations 2000 and requirements of other regulations, such as the Waste Management Licensing Regulations and the Groundwater Regulations insofar as they are relevant to an IPPC permit. For the sake of brevity these boxes simply use the term "BAT".

3.3 Where techniques or operating conditions are referred to in the BAT boxes below, provided that it is demonstrated to the satisfaction of the regulator that an equivalent or better level of control of environmental impacts will be achieved, then other techniques or operating conditions may be used.

Process description and in-process controls

Summary of activities

3.4 The meaning of “installation” and “directly associated activity” is addressed in chapter 2 of the General Guidance Manual.

Delivery, storage and handling of raw materials

3.5 Raw materials including zinc, refractories and fluxes in solid form may be stored under cover. Following delivery, handling should be kept to a minimum. Powdered materials can be stored in sealed bags or containers. Zinc is received in bulk and should be stored under cover.

3.6 Chemicals, principally 28% hydrochloric acid, an input to the pickling process, are received by road tanker or in plastic containers. They are stored in their delivery containers or, in the case of road tankers, discharged directly into dedicated storage or process tanks. Other agents, such as mist suppressants and degreasing fluids, are received in drums and stored according to manufacturers’ directions.

3.7 Good practice when taking delivery of acid directly into an acid bath or when re-making acid baths is to secure the discharge hose to a rigid filling pipe, mounted at the tank, which terminates below the surface of the liquid. Delivery of acid from the tanker is usually air pressure assisted, and where this method is used there may be an air surge caused by the release of pressure towards the end of a delivery. Good control of the delivery rate and pressure release is required. This is managed by the tanker driver. There has been some experimentation with vehicle mounted or ground mounted pump delivery, which would avoid this problem and reduce fuming, but at the time of publication of this note, this has not been sufficiently developed to represent BAT. The CIRIA document (Ref 4) provides guidance for acid storage and fume minimisation, which may be useful where acid is stored on site prior to use.

3.8 Materials for processing, consisting of a wide variety of iron and steel applications, are received on site, usually by road haulage, and are unloaded by forklift truck or crane.

3.9 Iron and steel parts are inspected to ensure that they are suitable for galvanizing. Shot blasting removes contamination such as paint, sand or grease. Work put through the galvanizing process is typically attached to jigs by means of hooks or steel wire. Fasteners and other small components are loaded into perforated baskets.

3.10 Other minor deliveries are stored indoors.

3.11 The main control issues relate to the potential for fugitive emissions.
Environmental impact

**Water:** Spillage during delivery of liquids followed by run-off.

**Land:** Spillage, overfilling of containers.

**Air:** Not significant.

**Waste:** Not significant.

**Energy:** Not significant.

**Accidents:** Overfilling of acid tanks. Drums containing liquids need to be kept in good condition to avoid leakage.

**Noise:** Vehicles and delivery operations may cause noise disturbance, especially if close to the site boundary.

<table>
<thead>
<tr>
<th>BAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

Pre treatment

**Summary of activities**

3.12 The requirement for successful galvanizing is that the item to be dipped must be free from contaminants prior to dipping. Pretreatment to achieve the surface required for galvanizing may include cleaning, pickling and fluxing. (It is conceivable that some items, e.g. structural steel, may arrive on site in a clean state and not require any cleaning). Although it is not normal practice, vapour degreasing with organic solvents may be undertaken.

Degreasing

**Summary of activities**

3.13 Degreasing removes surface oils, grease and traces of coolants and lubricants from fabricated steel using proprietary solutions which may be alkaline, neutral or acidic. Some galvanizers use surfactant additives in the acid pickling bath which remove oil and grease from the metal surface by emulsifying. The resulting unstable emulsions float on the surface of the bath and can be removed.

3.14 Concentration, bath temperature and immersion time of the workpieces determine the efficiency of the degreasing step. The normal temperature range for indirectly heated degreasing baths is 30 - 70 °C, although in some cases hot degreasing is applied at a temperature of about 85 °C.

3.15 Alkaline degreasing baths consist of a sodium or potassium hydroxide solution plus other alkaline reagents, such as soda, sodium silicate, condensed alkaline phosphates and borax, and specific surfactants.
3.16 Acid degreasing baths consist of diluted, strong inorganic acids, like hydrochloric acid and/or phosphoric acids with additives.

3.17 Degreasing may only be omitted if the input material is oil free. After alkaline degreasing, rinsing may be necessary to prevent carry over of degreasing agents which would shorten the life of the pickling bath and reduce the usability of the bath.

Environmental impact

- **Water**: Raw material consumption, used as make up.
- **Land**: Not significant.
- **Air**: Not significant.
- **Waste**: Sludge disposed of to special waste contractors.
- **Energy**: May be required to heat the degreasing solution.
- **Accidents**: Spillage.
- **Noise**: Not significant.

### Pickling

3.18 Process: pickling is a process whereby the surface of the items are prepared for galvanizing. It involves removal of surface oxidation products (e.g. rust) and millscale (arising from the steel rolling process). Generally hydrochloric acid (28% or sometimes other grades such as 36%) is bought in bulk and diluted on site for use in pickling baths at ambient temperature. The acid used is co-product acid, which means it is derived from a commercial process involving chlorination of an organic compound, (if the co-product acid meets BS 3993 (1996) then the organic content is controlled. It is not a necessary requirement however.) It is possible on occasion that co-product acid may have an odour associated with its organic content. Sometimes sulphuric acid (delivered as 77%) is diluted on site to circa 15% and used for pickling at 40°C. In combination with a pickling inhibitor, emissions from use of sulphuric acid do not create a significant impact). A galvanizing plant usually operates with a series of pickling baths with different acid concentrations that range in strength of pickling liquor from fresh acid (normally 12 to 18%) to spent acid. (2%). To prevent excessive pickling of steel items, especially in pickling high tensile steels, and to protect the steel pickling vats, pickling inhibitors are added to the bath. Fume suppressants may also be used.

3.19 Pickling in plants with open pre-treatment is usually done at ambient air temperature; the reaction in the pickling bath is slightly exothermic. Use of heated pickling solutions reduces pickling times. Stronger acids or heated acids may generate more fume and may require arrestment and control under COSHH regulations. The acid needs to be at about 10°C to start the pickling process. If the temperature falls below this it is acceptable to apply indirect heating to raise the temperature. (Direct injection of steam may give rise to unacceptable fuming and should not be used). Plants with an enclosed pre-treatment sometimes operate with higher acid temperatures. Gaseous emissions of pickling agent can arise from the pickling bath, depending on concentration and temperature of the bath, and from the pickled items.

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<table>
<thead>
<tr>
<th>BAT</th>
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<tbody>
<tr>
<td>7 The operator should ensure that degreasing operations are carried out using the highest degree of control to minimise spillage and carryover of degreasing agents.</td>
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<tr>
<td>8 The degreasing tank should be covered when items are not being transferred to reduce evaporation and therefore increase energy efficiency.</td>
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<td>9 Newly installed heated tanks should be thermostatically controlled and insulated.</td>
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3.20 During operation the iron content of the pickling bath increases, while the amount of free acid decreases. When the bath reaches a composition of approximately 5% acid and 150 g/l of iron it is no longer effective as a pickling solution and is described as “spent” and fresh acid is added to the bath. Raising the temperature of the pickling bath can enable its use at relatively high concentrations of iron chloride with some increase in emissions.

3.21 Operators sometimes degrease articles with less heavy deposits of oil in the pickle tank. There are proprietary formulations that may be added to the pickling tank that allow degreasing to take place.

3.22 Waste acid is currently tankered off site for treatment. At the time of publication of this note, work was in hand to investigate techniques which would allow recovery and re-use of waste acid. Where there is adequate space to operate separate pickling and stripping tanks, the substantially zinc free pickle liquor arising may be used as a raw material in the manufacture of water treatment chemicals. Zinc chloride solution, substantially free of iron, may be used for flux make-up or in the manufacture of zinc ammonium chloride fluxes.

### Environmental impact

**Water:** Not significant.

**Land:** Not significant.

**Air:** Hydrochloric acid or sulphuric acid fumes (depending on pickling agent).

**Waste:** Spent liquor to waste treatment facility.

**Energy:** Where heated pickle liquor is used.

**Accidents:** Spillage.

**Noise:** Not significant.

### Summary of activities

3.23 Process: sometimes it is necessary to clean the zinc coatings from the jigs, to remove faulty coatings from steel fabrications or to de-zinc fabrications whose coatings have to be renewed. This is commonly done by dipping in diluted pickling acid. When the liquor is spent and can no longer be used for pickling it may be used for stripping.

3.24 When pickling and stripping are carried out in the same treatment vat, pickle liquors are created which contain iron and zinc chloride. Some operators have a dedicated acid bath for zinc stripping. Keeping pickling and stripping separate prevents zinc (from stripping) entering the pickling baths which enables the acidic iron chloride from spent pickling baths to be used as a raw material in the production of water treatment chemicals.

3.25 Spent stripping liquor is sent for neutralisation and disposal by external contractors.

### BAT

10 The operator should optimise the pickle liquor parameters. The Kleingarn pickling system described in Appendix 1 should be referred to determine optimum pickle rate.

11 Pickling baths should be bunded, in accordance with BAT 44, and sumps inspected and pumped to clear when necessary.

12 Direct injection of steam into the pickling bath should not be undertaken.

### Stripping
Environmental impact

**Water:** Not significant.

**Land:** Not significant.

**Air:** Hydrochloric acid or sulphuric acid fumes (depending on the acid used) are not significant apart from visibility.

**Waste:** Spent liquor to waste treatment facility.

**Energy:** Where heated pickle liquor is used.

**Accidents:** Spillage.

**Noise:** Not significant.

### BAT

| 13 | Stripping should be carried out in separate baths to pickling, to keep zinc out of the pickle liquor which enables the spent pickle liquor to be recycled off-site. |

### Rinsing

#### Summary of activities

3.26 Process: rinsing after pickling washes off acid and prevents carryover of iron salts on the surface of the workpiece. Such carryover would cause additional dross to be formed in the zinc bath. Water is used for rinsing. Two rinse tanks may sometimes be used. It is a very important step in the galvanizing process as it prolongs the life of subsequent treatment baths, reduces the generation of waste and increases the re-usability of by-products. After degreasing and pickling the fabricated steel is therefore rinsed/dipped in water baths, which are sometimes heated. Site constraints may mean that there are not enough rinse steps - this means acidic carry over may require alkaline solution additions to maintain the desired operating parameters of the flux tank, unless buffered fluxes are used. It may also lead to more dross in the dipping tank.

3.27 Carry over of solution between baths depends on the type of work (i.e. its capacity for fluid retention) and the way in which it is handled, especially the drainage time allowed before the work is transferred. The quantity of liquid carried over can vary between 5 and 20 litres per tonne of steel. Carry over of degreasing solution into the picking baths eventually leads to neutralisation of the bath; carry over of acids and iron salts from pickling into the flux baths and further to the galvanizing kettle would increase the generation of dross and the consumption of zinc.

### Environmental impact

**Water:** Not significant.

**Land:** Not significant.

**Air:** Not significant.

**Waste:** Not significant.

**Energy:** Not significant.

**Accidents:** Not significant.

**Noise:** Not significant.

### BAT

| 14 | Water from rinse tank(s) should be used to make up fresh pickling baths or as top up to replace evaporative losses from pickling tanks. |
3.28 Process: a flux is usually applied to the work surface in order to prevent any oxidation of the work piece before it is dipped. It covers the whole surface and enhances the zinc "wetting" of the steel allowing a uniform coating to be achieved on galvanizing.

3.29 Zinc chloride can be used as a flux but most fluxes consist of zinc ammonium chloride (ZAC). This is a mixture of zinc chloride and ammonium chloride salts. The proportions of each may vary. They are sometimes described as double or triple salts, where double salt is made of 55% zinc chloride 45% ammonium chloride and triple salt is made of 45% zinc chloride 55% ammonium chloride. (These salts comprise a molecular mix which is crystallised out during manufacture - "double salt" has 1 molecule of zinc chloride to 2 molecules of ammonium chloride, "triple salt" has 1 molecule of zinc chloride to 3 molecules of ammonium chloride - they store much better than a mixture of zinc chloride and ammonium chloride which goes very hard as zinc chloride is deliquescent). Ammonium chloride from the flux is one of the main components of the fume when the workpiece is dipped in the galvanizing bath.

3.30 There are now different types of flux available. Fluxes described as "low fuming" have been developed. These are proprietary mixtures where the ammonium chloride constituent of traditional fluxes has been reduced and partially replaced with other salts. These fluxes require technical management and may not be acceptable to all operators or applicable to all types of work. Due to the technicalities of the use of low fuming flux more frequent emission monitoring may be considered if a galvanizer chooses it as a new technique. Once use of the flux has become established and it has been demonstrated that the emission limit can be consistently achieved then any increased monitoring requirement may be relaxed. At the time of publication of this note, low fuming fluxes do not represent generic BAT for the whole sector.

3.31 There are two methods of fluxing. They may be used independently or in conjunction with each other.

3.32 Dry fluxing is where the work is dipped into an aqueous flux solution (sometimes referred to as preflux) after rinsing and before immersion into the galvanizing bath. The properties of ZAC fluxes can be improved by adding a wetting agent which reduces the surface tension of the flux solution. After dry fluxing the work may be placed into a drying chamber prior to dipping to remove as much water from the aqueous preflux as possible. Water carryover into the zinc bath can cause spattering of molten zinc during immersion. A drying chamber is not essential. Exhaust gases from the galvanising kettle can sometimes be a useful indirect source of heat to a drying unit although ancillary burners are often also used. Heating the flux solution to 70°C helps to speed up the fluxing action as well as the drying process.

3.33 The iron content of flux is extremely important for process control, economy and environment. A high concentration of iron in the flux (originating from drag-out from the pickling bath) will also influence the quality of the zinc coating. Iron salts carried over from the flux bath can contribute to dross made in the galvanizing bath.

3.34 Wet fluxing is where the dried work is immersed through a flux blanket which lies on the molten zinc surface. The flux agents flow as a layer of molten salt. The molten salt layer is drawn back from the surface by means of a rake to allow the steel parts to be withdrawn from the galvanizing bath without further contact with the flux. This technique is now less commonly used than dry fluxing as it is a slow process and usage rate of flux is high. Wet fluxing systems are more commonly used for specialist processes such as spin galvanizing and hand dipping. When zinc chloride flux is used it is common to pre-heat the work pieces in a furnace.

3.35 The prepared items are then ready to be galvanized.
Environmental impact

Water: Not significant.

Land: Not significant.

Air: Ammonium chloride and zinc chloride and steam.

Waste: Sludge taken off-site for disposal.

Energy: Required for heating flux solution.

Accidents: Spillage.

Noise: Not significant.

Galvanizing

Summary of activities

3.36 Process: the fluxed steel fabrications are slowly lowered into the galvanising bath which contains molten zinc or zinc alloy at about 440 - 460°C. High temperature plants operate at about 555°C. Alloy formation is different at this temperature. (98.5% zinc is the lowest grade of zinc that is usually used). Additions of other metals may be made to the molten zinc to enhance the galvanizing process and finished product. Such techniques are continually being developed world-wide within the industry. Aluminium and lead are added because of their influence on the thickness and the appearance of the coating. The addition of lead up to 1.4% has an influence on the physical properties of zinc, especially viscosity and surface tension. It helps to wet the steel before galvanizing and the zinc to flow from the surface after galvanizing. Lead can also be used to protect the base of the kettle. The thickness of the kettle's steel walls can be measured periodically (typically every 3 to 5 years) the results from which can be used to assist management procedures minimising the potential for kettle leakage through excessive kettle wall deterioration. The manufacturers guidance should be referenced when operators assess the potential for kettles to suffer leakage. Methods may include wall thickness measurement during zinc pump-outs and/or in situ measurements. Reference should also be made to the Galvanizers Association publication General Galvanizing Practice Guide (Ref 5).

3.37 The galvanizing process is a metallurgical reaction between the steel workpiece and the molten zinc which creates zinc/iron alloy layers. The composition of the alloy layers changes. The layers closest to the base metal are iron rich with the percentage of zinc increasing through the layers towards the surface. The quality of the final product can be affected by the make up of the steel article. The period of immersion varies from several minutes for relatively light steel work up to 30 minutes for the heaviest structural parts.

3.38 Where ammonium chloride or zinc ammonium chloride type of fluxes are used, fume is created instantaneously at the point of dipping, as the sublimation temperature of ammonium chloride is lower than the temperature of the zinc bath. The fume content includes ammonium chloride, zinc oxide, zinc chloride and steam.

3.39 Containment of the fume from dipping is usually effected by the use of enclosures which may be fixed or mobile. During dipping the enclosure should be in place and the extractor fans switched on. It should be noted that full fume enclosures will not achieve 100% fume capture but when used correctly provide adequate capture. In the event that full fume enclosures are not able to be used, for example some spin galvanizing or hand dipping processes, lip extraction may achieve sufficient fume capture provided the work is handled appropriately. Lip extraction is not adequate where galvanizing leads to fume being generated outside of the zone of influence of the extraction and such a situation would require supplementary extraction.
3.40 Double dipping is a technique which is sometimes used for extremely large work pieces. Where the length of the item is such that one door of the enclosure can not be closed during dipping, then fugitive fume emissions should be contained in the building. (Note: items may be double dipped for reasons other than that the work is too large for the bath. In these cases the issue of doors being left open does not arise).

3.41 When semi-automatic tube galvanizing, full enclosure is impractical and a canopy is considered BAT in these circumstances, provided that there is sufficient extraction so that there is not significant escape of fume into the workplace. Tube blowing is carried out to remove surplus zinc buildup on the inner surface of the tube.

3.42 Dusting (also described as hand salting) - ammonium chloride salt is occasionally sprayed as a powder or a solution, or hand applied to work as it is withdrawn from the bath, in order to remove excess zinc or impurities that may have adhered to the work surface. This gives rise to fumes and should be avoided wherever possible. The use of a spray gun allows more control over the process and is to be preferred to hand application. The extraction should be operational during dusting.

3.43 The ash, which is mainly zinc oxide, forms on the surface of the molten zinc and is skimmed back before the work is withdrawn from the bath to avoid it contaminating the coating.

3.44 The dross is a solid consisting of about 95% zinc / 5% iron alloy. It is heavier than zinc and sinks to the bottom of the zinc bath. It is removed periodically with perforated grabs or spoons. Excess dross may interfere with galvanizing and may cause overheating of an externally heated kettle. The material removed is returned to the secondary zinc industry for recovery of the zinc content or to the zinc chemicals industry for the manufacture of zinc oxide.

3.45 Surplus zinc may be recovered from ash and dross prior to further processing by the zinc chemicals industry.

3.46 The terms spin galvanizing or centrifuge galvanizing are used to describe the process for hot dipping threaded components and other small parts. They are immersed into the molten zinc in a perforated basket. After the coating has formed the basket is removed from the melt and is centrifuged at high speed to throw off the surplus zinc and ensure a clean profile. The work is normally quenched after the centrifuging operation. Flux blankets are occasionally used for this process.

3.47 Certain pieces of work due to their intricate shape cannot be wired or jig mounted. Others due to their potential to trap air give rise to quality and/or safety issues. Such pieces may be galvanized by hand dipping. Hand dipping usually takes place through a flux blanket.

3.48 Continuous sheet or strip galvanizing processes are normally undertaken using an oven with a reducing atmosphere for pretreatment prior to direct immersion into a zinc bath not involving the use of fluxes.

3.49 Wire galvanizing is normally a continuous process and can involve some or all of the following pre-treatment processes - annealing, degreasing, pickling, rinsing and fluxing before the actual galvanizing.

3.50 A similar process is used for galvanizing fabricated welded wire mesh and for hexagonal wire netting.

3.51 Up to 60 individual wire strands (normally 20 - 40) pass through the galvanizing process in parallel. Lines stretch for up to 500m, of which the galvanizing bath is likely to be no more than about 8m, with a zinc capacity of up to 100 tonnes. A lead emission limit applies to processes using lead annealing or quenching baths.

3.52 Galvanized wire can be divided into two types, mild steel and high carbon steel. Mild steel galvanized wire is used for the manufacture of barbed wire, hexagonal netting, field fencing etc. High carbon steel galvanized wire is used for the manufacture of springs, ropes, cables etc (items requiring its high tensile strength). The mild steel galvanizing process generally requires a soft wire, which is achieved by annealing through molten lead baths or furnaces of several different types. The high carbon steel galvanizing process requires a re-crystallised structure which is achieved by heating through a furnace and quenching in a lead bath or other medium (can be specially designed water quench) in order to freeze the re-crystallised structure and provide a ductile and workable finished product, this process is known as “patenting”. Any of the above wires may be galvanized hard in which process the wire will pass through a low temperature lead bath or furnace in order to stress relieve the wire and degrease.

3.53 The galvanizing process itself is achieved by passing the wires through the zinc bath under a sinker. The sinker may be a roller which rotates with the wire or a solid block of ceramic or refractory concrete under which the wire skids. The wire exits the zinc normally vertically as this gives the simplest conditions for a concentric coating. It is then wiped by a range of techniques in order to achieve the required coating weight. The most common today are “jet wiping” which uses nitrogen gas to achieve heavier coating weights and “pad wiping” which uses mineral fibre pads to achieve light coating weights. The zinc bath itself will be run at about 450°C.

3.54 An alternative coating can be achieved by a double dip process with the first bath containing a conventional zinc coating and the second containing an alloy of zinc and 5% aluminium (known as Galfan) which gives enhanced corrosion protection.

3.55 The main control issue is containing the emissions of fume.

Environmental impact

Water: Scrubbing liquor where wet scrubbing is used.

Land: Localised deposition around filtration plant.

Air: Potential emissions include combustion emissions, fume and steam. (Hygroscopic materials would not be expected to give rise to a dusty emission)

Waste: Dross, ash, bag / cartridge filter dust.


Accidents: Abatement plant failure.

Noise: Steam blowing, extraction fans, steam pressure pulse for tube blowing.
Post treatment

Summary of activities

3.56 Process: the work may be left to air cool to room temperature but often it is quenched in water (boshed) after galvanizing.

3.57 "Passivation" is an optional step in the process whereby the reactivity of the surface is reduced. The choice of passivation techniques will depend upon any further process requirements or particular end uses of the product. Chromic acids or chromate salts may be added to the quench water to prevent "wet storage stain" appearing subsequently. Phosphate treatments and complex oxide treatments are also sometimes used.

3.58 The application of other coatings, for example paint, liable to emit volatile organic compounds or particulate matter where the process uses more than 5 tonnes of organic solvents in any 12 month period is the subject of separate guidance, PG 6/23 (97) Secretary of State's Guidance Coating of Metal and Plastic [PG 6/23 (97) is under review at the time of publication of this note - see LAU/Defra website]

3.59 The recovery of zinc from dross or ash removed from the galvanizing bath by separate heat or chemical treatment methods is a refining operation and subject to control under the provisions of the PPC Regulations, section 2.2 Part A1 (c), Part A2 (a) or Part B (a) (depending upon the melting capacity of the plant, the design holding capacity of the plant and the daily throughput of the operation) and is not considered further in this note.

3.60 However, the removal of metallic zinc from ash produced by the galvanizing process, achieved by physical separation techniques is within the scope of this note.

3.61 The majority of galvanizers "rework" their ash carefully on the zinc bath surface in order to reduce zinc losses into the ash. The residual ash is then taken off-site for zinc recovery. Some galvanizers may prefer to remove the ash more quickly from the surface of the bath and later "rework" their ash. Typically the ash may either be melted in a small furnace or transferred back into the galvanizing bath below the zinc surface via a screw feed. Any zinc left in the ash will melt and the ash that remains on the surface will contain less zinc. This process is likely to give rise to substantial amounts of fume. Adequate provisions must be made to ensure compliance with the emission limits.
3.62 Finishing operations such as grinding and fettling may take place.

### Environmental impact

**Water:** Used for quenching, lost as steam.

**Land:** Sludge from post treatment tanks.

**Air:** Steam from quenching.

**Waste:** Not significant.

**Energy:** Zinc re-melt furnace.

**Accidents:** Spillage.

**Noise:** Not significant.

### BAT

| 23 | All skimmings off the top of the galvanizing bath (ash) should be subject to zinc recovery. |
| 24 | Care should be taken when lowering work into the post treatment tank in order to avoid spillage and splashing. |
| 25 | Post treatment areas should be bunded, in accordance with BAT 44. |

### Emissions control

#### Point source emissions to air

3.63 The nature and source of the emissions to air expected from each activity are given in previous sections. In general they comprise:

- particulates from shotblasting
- combustion gases from burners (most burners are small and gas fired and are unlikely to warrant emission limits. If the burner rating is greater than 20 MW the regulator may wish to refer to Secretary of State’s guidance note PG 1/3).
- acid fumes (including possibly some organic material) from pickling
- the galvanizing operation may give rise to particulates, fume and steam
- steam blowing of tube may give rise to zinc (in particulate form) and zinc oxide
- ash handling may give rise to particulate matter in the form of dust. (Being hygroscopic, zinc ammonium chloride is not considered to be a dusty material)
- visible steam emissions may arise from degreasing, prefluxing and post-galvanizing treatments due to the temperature of the operations
- lead baths used in wire galvanizing have the potential to give rise to lead emissions

#### Dispersion and dilution of stack emissions

3.64 The basis upon which stack heights are calculated using HMIP Technical Guidance Note D1 (D1) ([Ref 6](#)) is that pollutants are dispersed and diluted in the atmosphere to ensure that they ground at concentrations that are harmless under the theoretical conditions of the D1 model. The emission limits in this sector note should be used as the basis for stack height calculation. The stack height so obtained is adjusted to take into account local meteorological data, local topography, nearby emissions and the influence of plant structure. It is necessary that the assessment also takes into account the relevant air quality standards that apply for the emitted pollutants.
The calculation procedure of D1 is usually used to calculate the required stack height but alternative dispersion models may be used in agreement with the regulator. D1 relies upon the unimpeded vertical emission of the pollutant. A cap or other restriction over the stack impedes the vertical emission and hinders dispersion. For this reason where dispersion is required such flow impeders should not be used. A cone may sometimes be useful to increase the efflux velocity and achieve greater dispersion.

Revised stack height calculations should not be required unless it is considered necessary because of a breach, or serious risk of breach, of an EC Directive limit value and because it is clear from the detailed review and assessment work that the Part A2 activity itself is a significant contributor to the problem.

An operator may chose to meet a tighter emission limit in order to reduce the required stack height.

3.65 Liquid condensation on internal surfaces of flues and exhaust ducts might lead to corrosion and ductwork failure or to droplet emission.
- adequate insulation should be provided to minimise the cooling of waste gases and prevent liquid condensation by keeping the temperature of the exhaust gases above the dewpoint

3.66 Unacceptable emissions of droplets could possibly occur as a result of entrainment from wet abatement plant where the linear velocity within the associated ductwork exceeds 9 m/s. The use of mist eliminators reduces the potential for droplet emissions.
- where a linear velocity of 9 m/s is exceeded in the ductwork of existing wet abatement plant, the linear velocity should be reduced, subject to health and safety considerations, to ensure that droplet fallout does not occur

3.67 The dispersion from all emission points to air can be impaired by low exit velocity at the point of discharge, or deflection of the discharge.
- flues and ductwork should be cleaned to prevent accumulation of materials, as part of the routine maintenance programme
- a minimum discharge velocity should be required in order to prevent the discharged plume being affected by aerodynamic down wash

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**BAT (Sheet 1 of 2)**

**All releases to air**

The operator should:

26 Ensure that all operations which generate emissions to air are contained and adequately extracted to suitable abatement plant, where this is necessary to meet specified emission limits.

27 Ensure that emissions from combustion processes in normal operation are free from visible smoke and in any case do not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742:1969.

28 Ensure that hot emissions take place from the minimum practicable number of stacks, in order to obtain maximum advantage from thermal buoyancy. This is particularly important when new plants are being designed or when changes are being made to existing processes. If practicable a multi-flue stack should be used.

29 Ensure that stack heights are sufficient to ensure adequate dispersion under normal conditions.

30 Ensure that the minimum stack height is 3 metres above roof ridge height of any building within a distance of 5 times the uncorrected stack height and in no circumstances should it be less than 8 metres above ground level.

31 Be able to demonstrate to the regulator that all reasonably practicable steps are taken during start-up and shut down, and changes of fuel or combustion load in order to minimise emissions.
3.68 The nature and source of the emissions expected from each activity is given in previous sections. In general, wastewater can arise from storm water, from cooling water, from accidental emissions of raw materials, products or waste materials and from fire-fighting. In addition to the techniques below, guidance on cost-effective effluent treatment techniques can be found in ETBPP/Envirowise Guides (Ref 7).

3.69 The following general principles should be applied in sequence to control emissions to water:
- water use should be optimised and wastewater re-used or recycled
- contamination risk of process or surface water should be minimised
- wastewater treatment systems can maximise the removal of pollutants, for example metals, using precipitation, sedimentation and filtration. The mix of pollutants will define the methods and reagents used. Concentrated effluents should be pretreated as necessary before discharge into the final effluent treatment system
- ultimately, surplus water is likely to need treatment to meet the requirements of BAT (and statutory and non-statutory objectives). Generally, effluent streams should be kept separate as treatment will be more efficient. However, the properties of dissimilar waste streams should be used where possible to avoid adding further chemicals, e.g. neutralising waste acid and alkaline streams. Also, biological treatment can occasionally be inhibited by concentrated streams, while dilution, by mixing streams, can assist treatment
- systems should be engineered to avoid effluent by-passing the treatment plant

3.70 The nature of the receiving water should be taken into account, with regard to any pollutant released to this media. Irrespective of the receiving water, the adequacy of the plant to minimise emissions must be considered. Guidance on treatment of persistent substances can be found in Ref 7.
Local Authority Regulation

3.71 Regulation 13 of The Pollution Prevention and Control (England and Wales) Regulations 2000 states that:
• “(1) In the case of a Part A installation or Part A mobile plant in relation to which a local authority regulator exercises functions under these Regulations, the Environment Agency may, at any time, give notice to the local authority regulator specifying the emission limit values or conditions which it considers are appropriate in relation to preventing or reducing emissions into water.”
• “(3) Where a notice under paragraph (1) specifies conditions in relation to emissions into water from an installation or mobile plant, the permit authorising the operation of that installation or mobile plant, shall include those conditions or more onerous conditions dealing with the same matters as the local authority regulator considers to be appropriate.”

Point source emissions to groundwater

Groundwater protection legislation

3.72 The Groundwater Regulations for the UK came into force on 1 April 1999. If List I or List II substances are discharged to groundwater or may be discharged to groundwater then the Environment Agency will provide advice as part of their statutory consultation duties. For further guidance see chapter 31 in the General Guidance Manual.

Control of fugitive emissions to air

3.73 Common sources of fugitive emissions are:
• poor extraction from the galvanizing bath
• poor building containment
• handling of bag filter waste
• ash handling
• accidental loss of containment from failed plant and equipment including leakage

3.74 Where there are opportunities for reductions in fugitive emissions, the Permit may require an updated inventory of fugitive emissions to be submitted on a regular basis.

BAT

40 Operations should be controlled to minimise fugitive emissions.

41 The operator should identify fugitive emissions to air from all relevant sources, and describe the controls used to minimise the emissions.
Fugitive emissions to surface water, sewer and groundwater

3.75 Operations should be controlled so as to minimise fugitive emissions. A record of fugitive emissions should be submitted on a regular basis, and normally at least once a year.

**BAT (Sheet 1 of 2)**

42 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

43 For **surfacing**, the operator should:
- ensure that all operational areas are equipped with an impervious surface, spill containment kerbs, sealed construction joints, and connection to a sealed drainage system unless the operator justifies that this is not necessary to the satisfaction of the regulator.
- keep records of the design and condition of the surfacing of all operational areas - relevant information may include, as appropriate, capacities, thicknesses, falls, material, permeability, strength/reinforcement, and resistance to chemical attack
- 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

44 The operator should ensure that all tanks containing liquids whose spillage could be harmful to the environment are contained. The operator should ensure that all bunds:
- are 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
- are designed to catch leaks from tanks or fittings
- have a capacity of at least 110% of the largest tank *
- are visually inspected weekly and any contents pumped out or otherwise removed under manual control after checking for contamination
- where not frequently inspected, are fitted with a high-level probe and an alarm as appropriate
- have an annual maintenance inspection (normally visual but extending to water testing where structural integrity is in doubt)

* A Code of Practice on the use and storage of solvents is currently being drawn up and will be published on the Defra website. [www.defra.gov.uk/environment/water/ground/solvents/index](http://www.defra.gov.uk/environment/water/ground/solvents/index)

Where the Code, when published, contains anything more stringent as regards bunding, account should be taken of it.
**Odour**

3.76 Chapter 17 of the General Guidance Manual provides guidance on controlling odour from installations and the information required in an application.

3.77 Implementation of the best available techniques and the emission limit values and provisions of this note should ensure that offensive odours are not perceived beyond the site boundary, other than where unavoidable plume grounding occurs. It may be necessary to include additional controls to avoid offensive odours, for example where local meteorological conditions frequently lead to poor dispersion conditions.

3.78 The locality will influence the assessment of the potential for odour impact, for example, where the site has a low odour impact due to its remoteness from sensitive receptors, the escape of offensive odour beyond the installation would be unlikely to cause harm. In these circumstances it is expected that the operations should be optimised to minimise odour emissions and also that effective process management is applied. Assessment of the potential for offensive odour beyond the site boundary should take account of all predicted wind directions and weather conditions, which are typical of the location in question.

3.79 It is possible on occasion that co-product acid may have an odour associated with its organic content. This should be acceptable provided it is not noticeable outside the process boundary.
Management

3.80 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.

3.81 An effective Environmental Management System (EMS) will help the operator to maintain compliance with regulatory requirements and to manage other significant environmental impacts.

Operations and maintenance

3.82 **Maintenance** - It is good practice to ensure:
- effective preventative maintenance on all aspects of the process the failure of which could impact on the environment
- clear written maintenance instructions for all relevant items are developed and maintained
- a method of reviewing maintenance needs, with demonstrable evidence that this process takes place

3.83 **Responding to problems** - The regulator needs to be notified about certain events and expects the operator to respond to problems which may have an effect on emissions to the environment. Such problems may arise within the process itself or, for example, with the abatement plant.

3.84 **Contractors on site** - It is important to be aware that in complying with their permit, operators will be responsible for work undertaken by contractors. Operators are advised to provide instructions to contractors regarding protecting the environment whilst working on site.

**BAT (Sheet 1 of 2)**

**Operations and maintenance**

48 Effective operational and maintenance systems should be employed on all aspects of the installation whose failure could impact on the environment, in particular there should be:
- documented operational control procedures
- a documented preventative maintenance schedule, covering all plant whose failure could lead to impact on the environment, including major ‘non productive’ items such as tanks, pipework, retaining walls, bunds, ducts and filters; this should be reviewed and updated annually
- documented procedures for monitoring emissions

49 The regulator should be provided with a list of key process equipment and abatement equipment. Such equipment should be provided with alarms or other warning systems which indicate equipment malfunction or breakdown. Such warning systems should be maintained and checked to ensure continued correct operation, in accordance with the manufacturer’s recommendations.

50 Essential spares and consumables should be held on site or be available at short notice from suppliers, so that plant breakdown can be rectified rapidly.

51 Records of breakdowns should be kept and analysed by the operator in order to eliminate common failure modes.

52 A competent person should be appointed to liaise with the regulator and the public with regard to complaints. The regulator should be informed of the designated individual.
Raw Materials

3.85 This section covers the use of raw materials and water and the techniques for both optimising their use and minimising their impact by selection (Energy and fuels are covered under Energy).

3.86 As a general principal, the operator will need to demonstrate the measures taken to:

- **reduce** the use of chemicals and other materials (Waste minimisation (optimising the use of raw materials))
- **substitute** with materials presenting lower risks to the environment
- **understand** the fate of by-products and contaminants and their environmental impact

Raw materials selection

3.87 Raw materials used in galvanizing processes consist of:

- zinc
- hydrochloric acid
- sulphuric acid
- acid inhibitors
- fluxes
- degreasing solutions
- post treatment chemicals
- lubricating oils, hydraulic oils and fuel oils
- wire for jiggging
Waste minimisation (optimising the use of raw materials)

3.88 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”.

3.89 A variety of techniques can be classified under the term waste minimisation and they range from basic housekeeping techniques through statistical measurement techniques, to the application of clean technologies.

3.90 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

3.91 Using this information, opportunities for waste reduction, changes in process and improved efficiency should be generated and assessed, and an action plan prepared for the implementation of improvements.

3.92 The use and fate of all materials should be mapped onto a process flow diagram 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. The mass balance can then be used to identify opportunities for improvements.

BAT

58 The operator should:
- maintain an inventory covering the principal types of raw materials used
- annually review alternatives for the principal types of raw materials used with regard to their environmental impact
- have quality procedures to control the specification of raw materials used, in order to minimise any potential environmental impact
- complete any long term studies needed into the less polluting options and make any material substitutions identified within the review period

59 The operator should carry out a waste minimisation audit at least as frequently as the review period of the permit. The methodology used and an action plan for optimising the use of raw materials should be submitted to the regulator within 2 months of completion of the audit.

60 If an audit has not been carried out in the 2 years prior to submission of the application then the first audit should take place within 18 months of the issue of the permit.

61 Specific improvements resulting from the recommendations of audits should be carried out within a timescale approved by the regulator.
Water use

3.93 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.

3.94 Reducing water use may be a valid environmental and/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 use can be found in Ref 7.

3.95 The main uses for water are for degreasing, in acid baths, in flux solution and as a top up for evaporative losses in the post treatment operations. It can also be used as a scrubber medium in abatement plant.

3.96 The following general principals should be applied in sequence to reduce emissions to water:

• water-efficient techniques should be used where possible
• water should be recycled within the process from which it issues, treating it first if necessary. Where this is not practicable, it should be recycled to another part of the process which has a lower water quality requirement

Water use

<table>
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<tr>
<th>BAT</th>
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<tbody>
<tr>
<td>62 The operator should carry out a regular review of water use (water efficiency audit). Where one has not been carried out recently, an initial comprehensive audit should be carried out at the earliest opportunity. Audits should be at least as frequent as the IPPC permit reviews.</td>
</tr>
<tr>
<td>63 Using this information, opportunities for reduction in water use should be assessed and, where appropriate, should be carried out in accordance with a timescale approved by the regulator.</td>
</tr>
<tr>
<td>64 The volume of mains and abstracted water used in the activities should be directly measured normally once a day, or at a frequency agreed with the regulator, when the installation is operating all measurements should be recorded and the records held on site.</td>
</tr>
<tr>
<td>65 Rinse water should be used for topping up pickling tanks.</td>
</tr>
</tbody>
</table>

Waste handling

3.97 Good segregation of materials is essential to facilitate opportunities for recovery, recycling and re-use.

3.98 Other than spent acid which is tankered off-site, the most important wastes are:

• particulate matter collected in bag or cartridge filters
• ash and dross
• scrubber liquors and sludges, and output from the effluent treatment plant
• chemical and oil containers
• general inert industrial waste
**Environmental impact**

**Water**: Not significant.

**Land**: Scrubber sludge.

**Air**: Fugitive dust from handling and transfer.

**Waste**: Most galvanizing waste is recovered or recycled.

**Energy**: Not significant.

**Accidents**: Not significant.

**Noise**: Not significant.

<table>
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<tr>
<th>BAT</th>
<th>The operator should:</th>
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<tbody>
<tr>
<td>66</td>
<td>• record the quantity, nature, origin and where relevant, the destination, frequency of collection, mode of transport and treatment method of any waste which is disposed of or recovered</td>
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<td>• ensure that waste storage areas are clearly marked and signed, and that containers are clearly labelled</td>
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<td></td>
<td>• ensure that appropriate storage facilities are provided for substances that are flammable, sensitive to heat or light etc, and that incompatible waste types are kept separate</td>
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<td></td>
<td>• ensure that containers are stored with lids, caps and valves secured and in place (this also applies to emptied containers)</td>
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<td></td>
<td>• ensure that procedures are in place to deal with damaged or leaking containers.</td>
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<td></td>
<td>• segregate waste wherever practicable</td>
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<td></td>
<td>• identify the disposal route for all waste, which should be as close to the point of production as possible</td>
</tr>
<tr>
<td>67</td>
<td>Ash, and any other potentially dusty materials, should be stored in such a manner as to prevent wind whipping and leaching to land or surface water. All such materials should be stored in covered containers or within an enclosed area, and handled in a manner that avoids emissions of dust.</td>
</tr>
<tr>
<td>68</td>
<td>Ashes from the zinc bath should be kept dry at all times to avoid the risk of toxic arsine gas (arsenic trihydride) being formed.</td>
</tr>
<tr>
<td>69</td>
<td>The method of collection of waste from dry arrestment plant should be such that dust emissions are minimised.</td>
</tr>
<tr>
<td>70</td>
<td>A high standard of housekeeping should be maintained in areas where waste is handled.</td>
</tr>
<tr>
<td>71</td>
<td>Lorries transporting ash or other potentially dusty materials should be sheeted immediately after loading.</td>
</tr>
</tbody>
</table>
**Waste re-use, recovery, recycling or disposal**

3.99 Waste should be re-used, recovered or recycled unless the regulator has accepted a satisfactory BAT justification.

3.100 **Ash** consists mainly of zinc oxide. Most galvanizers extract as much zinc from the ash as they can. Techniques vary but include working the ash on the bath itself or using very small gas fired remelt furnaces. (emissions are extracted via abatement) The remainder of the ash is then sold off-site for recycling. It is anticipated that no ash is landfilled.

**Dross** is taken off-site and may be used as a feedstock for zinc oxide producers or may be re-processed.

**Flux skimmings** are sold onto recyclers.

**Bag filter dust** goes to landfill.

**Spent acid** is sent to licenced specialist treatment operators where it is neutralised using alkaline waste from other industries; resulting salts then go to landfill. The spent acid could possibly be re-used as a water treatment chemical. This option is currently being researched.

**Process liquids and associated sludges** including aqueous pre-flux, pickling, degreasing, rinse, and post treatment sludges are normally taken off-site as special waste. The quantity of this waste depends upon the quantity and nature of the input material. As it is directly throughput related it cannot be reduced.

| BAT | 72 | The operator should carry out an annual review to demonstrate that the best environmental options are being used for dealing with all waste from the installation. |

**Energy**

3.101 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 efficiency requirements below and is a participant to a Climate Change Agreement (CCA) or a Direct Participation Agreement (DPA) with the Government.

- **or**
  - the operator meets the basic energy efficiency requirements below and the additional energy efficiency requirements.

3.102 Energy used can be calculated from the gas bill and electricity bill and reported by tonnage throughput which might be described as either weight of galvanized product or pre-galvanized weight.
Basic energy efficiency requirements

3.103 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.

<table>
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<tr>
<td>73. The operator should produce a report annually on the energy consumption of the installation. The figures collected should be reported in terms of energy used per tonne of throughput.</td>
</tr>
<tr>
<td>74. The operator should monitor energy use and target areas for reduction which should be updated annually.</td>
</tr>
<tr>
<td>75. The operator should ensure that all plant is operated and maintained to minimise the use and loss of energy e.g. insulation of tanks and overnight covering.</td>
</tr>
<tr>
<td>76. The operator should ensure that all appropriate containment methods are employed and maintained to minimise energy loss.</td>
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<tr>
<td>77. The operator should ensure that burners are regularly maintained.</td>
</tr>
</tbody>
</table>

Additional energy efficiency requirements

3.104 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.

3.105 The techniques described in the following BAT box should be considered by the operator, discussed with the regulator and implemented as appropriate.

<table>
<thead>
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<th>BAT</th>
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<tbody>
<tr>
<td><strong>Energy efficiency techniques</strong></td>
</tr>
<tr>
<td>78. The following techniques should be considered:</td>
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<tr>
<td>• heat recovery from different parts of the processes</td>
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<td>• minimisation of water use and closed circulating water systems</td>
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<td>• good insulation</td>
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<td>• plant layout to reduce pumping distances</td>
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<td>• phase optimisation of electronic control motors</td>
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<tr>
<td>• optimised efficiency measures for combustion plant e.g. air/feedwater preheating, excess air etc.</td>
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<tr>
<td><strong>Energy supply techniques</strong></td>
</tr>
<tr>
<td>79. The following techniques should be considered:</td>
</tr>
<tr>
<td>• use of Combined Heat and Power (CHP)</td>
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<tr>
<td>• generation of energy from waste</td>
</tr>
<tr>
<td>• use of less polluting fuels</td>
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</table>
Accidents

3.106 For accident management, there are three particular components:
• identification of the hazards to the environment 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 occur

3.107 Further guidance can be found in chapter 20 of the General Guidance Manual.

Identification of the hazards

3.108 In identifying the hazards particular areas to consider may include, but should not be limited to, the following:
• transfer of substances (e.g. loading or unloading from or to containers/silos or storage tanks)
• overfilling of containers/silos or tanks
• failure of plant and/or equipment (e.g. extraction fans or pumps, over-pressure of storage silos and pipework, blocked drains)
• failure of containment (e.g. bund and/or overfilling of drainage sumps)
• fires and problems arising from fighting fires such as 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
• vehicle movements

Measures to reduce the risks (identified by risk assessment)

3.109 Risk reduction can be achieved by process management controls and preventative measures. The following techniques will be relevant to most installations, although this is not an exhaustive list.

Process management controls
• process design, alarms, trips and other failsafe control techniques to ensure the safe operation of the plant
• security systems to prevent unauthorised access
• records of all incidents, near-misses, changes to procedures, abnormal events and findings of maintenance inspections and procedures to learn from such incidents
• personnel suitably trained in accident management
• guidance for specific accident scenarios
• procedures to ensure good communication among operations staff during shift changes and maintenance or other engineering work
• safe shutdown procedures
• established communication routes with relevant authorities and emergency services
3.110 **Preventative measures**

- procedures to ensure that the composition of the contents of a bund /sump is checked before treatment or disposal
- drainage sumps equipped with a high-level alarm with automatic pump to storage (not to discharge)
- high-level alarms etc. (which should not be routinely used as the primary method of level control)
- adequate redundancy or standby plant with maintenance and testing to the same standards as the main plant
- sufficient storage to contain process waters, site drainage waters, emergency firewater, chemically contaminated waters and spillages of chemicals, which should be routed where necessary, having regard to a site-specific assessment of risks, to the effluent system
- provision to contain surges and storm-water flows, which should be treated where necessary, having regard to a site-specific assessment of risks, before emission to controlled waters or sewer
- spill contingency procedures to minimise the risk of accidental emission of raw materials, products and waste materials and to prevent their entry into water
- suitable barriers to prevent damage to equipment from the movement of vehicles, as appropriate, having regard to a site-specific assessment of risks
- where indicated by the site-specific assessment of risks, containment or abatement for accidental emissions from vents and safety relief valves/bursting discs should be provided. Where this may be inadvisable on safety grounds, attention should be focused on reducing the probability of the emission

**Accidents/incidents/non conformance**

80 There should be written procedures for investigating incidents and near misses, including identifying suitable corrective action and following up.

81 The operator should maintain an accident management plan that identifies the hazards, assesses the risks and identifies the measures required to reduce the risk of potential events or failures that might lead to an environmental impact. The plan should identify:
- the actions to be taken to minimise these potential occurrences; and
- the actions to deal with such occurrences so as to limit their consequences

82 In the case of abnormal emissions arising from an accident, such as a spillage for example, the operator should:
- investigate immediately and undertake remedial action as soon as practicable
- promptly record the events and actions taken
- ensure the regulator is made aware, as soon as practicable
Noise and Vibration

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

3.112 Further guidance can be found in chapter 16 of the General Guidance Manual.

3.113 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. Where an installation poses no risk of noise related environmental impact because the activities undertaken are inherently quiet or remote from receptors, these measures would not normally be required.

3.114 Where shot blasting and / or tube blowing are taking place there is a potential for significant noise release.

3.115 Extraction fans, bag filter plant cleaning mechanisms and on-site vehicle movement (including audible alarms) are examples of noise sources that may also require consideration.

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Monitoring

3.116 This section describes general monitoring and reporting requirements for emissions to all environmental media. Guidance is provided for the selection of the appropriate monitoring methodologies, frequency of monitoring, compliance assessment criteria and environmental monitoring. The specific monitoring requirements with respect to emissions to air are described in Table 3.

Standards for monitoring equipment and procedures

3.117 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.

• operators should ensure their monitoring arrangements comply with the requirements of MCERTS where available, e.g. using certified instruments and equipment, and using a registered stack testing organisation etc.

See http://www.environment-agency.gov.uk for listing of MCERTS equipment.

Sampling and analysis standards

3.118 The analytical methods given in Table 3 and Appendix 1 should normally be used. In the event of other substances needing to be monitored, standards should normally be used in the following order of priority:

• Comité Européen de Normalisation (CEN)
• International Standardisation Organisation (ISO)
• British Standards Institution (BSI)
• 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)
3.119 Further guidance on standards for monitoring gaseous releases relevant to IPPC is given in the Technical Guidance Note M4 (Monitoring) (Ref 8). A series of updated Guidance Notes covering this subject is currently in preparation. This guidance specifies manual methods of sampling and analysis, which 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. See http://dwi.gov.uk/regs/pdf/scabb202.pdf

3.120 If in doubt the operator should consult the regulator.

**Monitoring and sampling protocols**

3.121 Where monitoring is needed the operator should address the following:
- determinands to be monitored
- monitoring strategy and selection of monitoring points
- monitoring methods and procedures (selection of Standard Reference Methods)
- reference conditions and averaging periods
- measurement uncertainty of the proposed methods and the resultant overall uncertainty
- drift correction
- 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 to the Regulator
- the accreditation held by samplers and laboratories or details of the people used and the training/competencies

**Monitoring frequency**

3.122 The frequency of testing should be increased, for example, as part of the commissioning of new or substantially changed activities, or where the emission levels are near to or approach the emission limit.

3.123 Emission flow rates must be consistent with good operating practice and meeting the requirements of the legislation relating to workplace safety.

3.124 Where non-continuous quantitative monitoring is required, the frequency may be varied. Where there is consistent compliance with emission limits, regulators may consider reducing the frequency. When determining ‘consistent compliance’ factors to consider include:
- the variability of monitoring results, for example, results which range from 15 - 45 mg/m³, against an emission limit of 50 mg/m³ might not qualify for a reduction in monitoring
- the margin between the results and the emission limit, for example, results which range from 45 - 50 mg/m³ when the limit is 50 mg/m³ might not qualify for a reduction in monitoring

3.125 Consistent compliance should be demonstrated using the results from at least three or more monitoring exercises within two years, or two or more monitoring exercises in one year supported by continuous monitoring. Any significant process changes which might have affected the results should be taken into account.

3.126 Where effective surrogates are available they may be used to minimise monitoring costs.

3.127 Where monitoring shows that substances are not emitted in significant quantities, consideration can be given to a reduced monitoring frequency.
Monitoring emissions to air

3.128 The reference conditions of substances in releases to air from point sources are: temperature 273.15 K (0°C), pressure 101.3 kPa (1 atmosphere), measured wet, no correction for water vapour. To convert measured values to reference conditions, see Technical Guidance Note M2 (Ref 8) for more information.

Monitoring emissions to water

3.129 The appropriateness of the emission benchmarks in Section 2 will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations, nature of the discharge and receiving water. For each release point the following information is required:
- the specific volume flow from the process to sewer/controlled water
- the quality of the receiving water
- the volume of discharge compared to the percentage dry river flow of the receiving water

Environmental monitoring (beyond installation)

3.130 Environmental monitoring may be required, for example, when:
- there are vulnerable receptors
- the emissions are a significant contributor to an Environmental Quality Standard (EQS) which may be at risk
- the operator is looking for departures from standards based on lack of effect on the environment
- the operator is required to validate modelling work


Monitoring of process variables

3.132 Some process variables will have potential environmental impacts and these should be identified and monitored where they have an environmental relevance, e.g. temperature control of process tanks.

<table>
<thead>
<tr>
<th>BAT (Sheet 1 of 4)</th>
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<tbody>
<tr>
<td>Monitoring and reporting</td>
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</table>
| 84 The need for and scope of testing and the frequency and time of sampling depend on local circumstances, operational practice, and the scale of operation. As part of proper supervision the operator should monitor emissions, make tests and inspections of the process and keep records, in particular the operator should keep records of audits, inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. Monitoring may include process variables and operating conditions where relevant to emissions. In such cases:
| • current records should be kept on site and be made available for the regulator to examine |
| • records should be kept by the operator for at least two years |
| 85 The regulator needs to be informed of monitoring to be carried out and the results. The results should include process conditions at the time of monitoring. |
| 86 The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used |
87 The results of non-continuous emission testing should be forwarded to the regulator within 8 weeks of the completion of the sampling.

88 Adverse results from any monitoring activity (both continuous and non-continuous) should be investigated immediately. The operator should ensure that:
   • the cause has been identified and corrective action taken
   • as much detail as possible is recorded regarding the cause and extent of the problem and the action taken to rectify the situation
   • re-testing to demonstrate compliance is carried out as soon as possible, and
   • the regulator is notified

89 The regulator needs to be notified about certain events and expects the operator to respond to problems which may have an effect on emissions to air. Such problems may arise within the process itself or with the abatement plant, for example.

90 In the case of abnormal emissions, malfunction or breakdown leading to abnormal emissions:
   • investigation and remedial action should be undertaken immediately
   • the process or activity should be adjusted to minimise those emissions; and
   • the events and actions taken should be promptly recorded
   • In the case of non-compliance causing immediate danger to human health, operation of the activity should be suspended

91 The regulator should be informed without delay:
   • if there is an emission that is likely to have an effect on the local community; or
   • in the event of the failure of key abatement plant, for example, bag filtration plant or scrubber units
   • if continuous monitoring shows an emission concentration exceeding double the limit value

92 Care is needed in the design and location of sampling systems in order to obtain representative samples for all release points.
   • sampling points on new plant should be designed to comply with the British or equivalent standards. e.g. BS ISO 9096: 2003, BS EN 13284-1 or BS ISO 12141:2002 for sampling particulate matter in stacks
   • the operator should ensure that adequate facilities for sampling are provided on stacks or ducts
   • where monitoring is not in accordance with the main procedural requirements of the relevant standard, deviations should be reported as well as an estimation of any error invoked

93 Continuous monitoring is normally expected for the main abated releases identified in Section 3. Where continuous monitoring is required by the permit it should be carried out as follows:
   • all continuous monitoring readings should be on display to appropriately trained operating staff
   • instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of arrestment plant failure or malfunction
   • the activation of alarms should be automatically recorded
   • all continuous monitors should be operated, maintained and calibrated (or referenced) in accordance with the manufacturers’ instructions, which should be made available for inspection by the regulator. The relevant maintenance and calibration (or referencing) should be recorded
   • all new continuous monitoring equipment should be designed for less than 5% downtime over any 3-month period
Continuous indicative monitoring can be used as a management tool. In conjunction with continuous recording it identifies any trends in emissions; for example, that emissions are gradually increasing, which may indicate a need for maintenance. It can also be used with or without continuous recording to trigger an alarm when there is a sudden increase in emissions; for example if arrestment plant fails. For a given concentration of particulate, the output level varies with the instrument. It should be noted that not all monitors provide a linear response to an increase in particulate matter. The monitor should be set up to provide a baseline output when the plant is known to be operating under the best possible conditions; i.e. such that emissions are fully compliant with the requirements. The instrument manufacturer should be able to set an output level which corresponds to around 75% of the emission limit, to trigger alarms. Thus the alarms are activated in response to this significant increase in particulate loading above the baseline, so that warning of the changed state is given before an unacceptable emission occurs. The regulator may wish to agree the alarm trigger level.

Monitoring and reporting of emissions to air

Exhaust flow rates of waste gases should be consistent with the efficient capture of emissions, good operating practice and meeting the requirements of the legislation relating to the workplace environment.

The introduction of dilution air to achieve emission concentration limits should not be permitted.

Dilution air may be added for waste gas cooling or improved dispersion where justified, but this should not be considered when determining the mass or concentration of the pollutant in the waste gases.

Periodic visual assessment of releases should be undertaken as required by the regulator to ensure that all final releases are colourless, free from persistent visible emissions and free from droplets.

Calibration and compliance monitoring should meet the following requirements as appropriate. No result should exceed the emission concentration limits specified, except where either:

(a) data is obtained over at least 5 sampling hours in increments of 15 minutes or less; or
(b) at least 20 results are obtained where sampling time increments of more than 15 minute are involved; AND in the case of (a) or (b)
(c) no daily mean of all 15-minute mean emission concentrations should exceed the specified emission concentration limits during normal operation (excluding start-up and shut-down); and
(d) no 15-minute mean emission concentration should exceed twice the specified emission concentration limits during normal operation (excluding start-up and shut-down).

Where continuous quantitative monitoring is undertaken, compliance with (c) and (d) above should be demonstrated on a daily basis.

For particulate monitoring the provisions of BS ISO 12141:2002 or BS EN 13284:Part 1 will determine the sampling duration. It is not appropriate to specify an averaging period, however, samples should be taken during the time period of maximum emission. Inappropriate dilution should be avoided.
Monitoring of process variables

102 Pickle liquor parameters should be monitored and recorded each time a new pickling bath is made up to ensure optimum pickling rate is achieved as described in Appendix 1.

Monitoring and reporting emissions to water and sewer

103 The appropriateness of the monitoring requirements will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations, nature of the discharge and receiving water. For each release point the following information is required:
   - the specific volume flow from the process to sewer/controlled water
   - the quality of the receiving water
   - the volume of discharge compared to the percentage dry river flow of the receiving water

104 Increased monitoring should be carried out where substances to which the local environment may be susceptible could be released from the installation, e.g. where releases of common pesticides or heavy metals may occur.

105 A full analysis, to include the substances listed in Schedule 5 of the Regulations, should be carried out annually on a representative sample from each release point, unless it is agreed with the regulator that this is inappropriate.

Monitoring of process variables

106 Pickle liquor parameters should be monitored and recorded each time a new pickling bath is made up to ensure optimum pickling rate is achieved as described in Appendix 1.

Monitoring and reporting emissions to water and sewer

107 The appropriateness of the monitoring requirements will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations, nature of the discharge and receiving water. For each release point the following information is required:
   - the specific volume flow from the process to sewer/controlled water
   - the quality of the receiving water
   - the volume of discharge compared to the percentage dry river flow of the receiving water

108 Increased monitoring should be carried out where substances to which the local environment may be susceptible could be released from the installation, e.g. where releases of common pesticides or heavy metals may occur.

109 A full analysis, to include the substances listed in Schedule 5 of the Regulations, should be carried out annually on a representative sample from each release point, unless it is agreed with the regulator that this is inappropriate.

Monitoring and reporting of waste

110 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
References

Environment Agency documents referred to below are available from the Environment Agency website: [http://www.environment-agency.gov.uk](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 website [http://www.sepa.org.uk](http://www.sepa.org.uk), or the NIEHS website [www.ehsni.gov.uk](http://www.ehsni.gov.uk).


Ref 4  Chemical storage tank systems - good practice. CIRIA July 2003 ISBN 0 860 17 598 7


Ref 6  HMIP Technical Guidance Note (Dispersion) D1, 1993 The Stationery Office ISBN 0 11 752794 7

Ref 7  Water efficiency references:
   • ETBPP, Simple measures restrict water costs, GC22
   • ETBPP, Effluent costs eliminated by water treatment, GC24
   • ETBPP, Saving money through waste minimisation: Reducing water use, GG26
   • ETBPP (is now Envirowise) Helpline 0800 585794

Ref 8  Monitoring Guidance (EA website)
   • M1 Sampling requirements for monitoring stack emissions to air from industrial installations, Environment Agency July 2002
   • M2 Monitoring of stack emissions to air. Environment Agency November 2002
   • M4 Standards for IPC Monitoring Part 2: Standards in support of IPC Monitoring, HMIP Revised 1998
   • MCERTS approved equipment link via [http://www.environment-agency.gov.uk/epns](http://www.environment-agency.gov.uk/epns) "Guidance for Business and Industry"
   • Direct Toxicity Assessment for Effluent Control: Technical Guidance (2000), UKWIR 00/TX/02/07

Ref 9  "Policy and Practice for the Protection of Groundwater" (PPPG) ([EA website](http://www.environment-agency.gov.uk))


Ref 11  Environment Agency, Pollution Prevention Guidance Note - Pollution prevention measures for the control of spillages and fire-fighting run-off, PPG 18, gives information on sizing firewater containment systems ([EA website](http://www.environment-agency.gov.uk))

Ref 12  BS 5908: Code of Practice for Fire Precautions in the Chemical and Allied Industries
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>BAT</td>
<td>Best Available Techniques – see IPPC General Guidance Manual or the Regulations for further definition</td>
</tr>
<tr>
<td>BOD</td>
<td>Biochemical Oxygen Demand</td>
</tr>
<tr>
<td>BREF</td>
<td>BAT Reference Document</td>
</tr>
<tr>
<td>CEM</td>
<td>Continuous Emissions Monitoring</td>
</tr>
<tr>
<td>CHP</td>
<td>Combined Heat and Power plant</td>
</tr>
<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
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<tr>
<td>EA</td>
<td>Environment Agency</td>
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<tr>
<td>ELV</td>
<td>Emission Limit Value</td>
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<tr>
<td>EMS</td>
<td>Environmental Management System</td>
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<tr>
<td>ETP</td>
<td>Effluent Treatment Plant</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>EQS</td>
<td>Environmental Quality Standard</td>
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<tr>
<td>ITEQ</td>
<td>International Toxicity Equivalents</td>
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<tr>
<td>MCERTS</td>
<td>Monitoring Certification Scheme</td>
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<tr>
<td>NIEHS</td>
<td>Northern Ireland Environment and Heritage Service</td>
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<tr>
<td>SAC</td>
<td>Special Areas of Conservation</td>
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<tr>
<td>SEcp</td>
<td>Specific Energy Consumption</td>
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<tr>
<td>SEPA</td>
<td>Scottish Environment Protection Agency</td>
</tr>
<tr>
<td>SPA</td>
<td>Special Protection Area</td>
</tr>
<tr>
<td>TSS</td>
<td>Total Suspended Solids</td>
</tr>
<tr>
<td>TOC</td>
<td>Total Organic Carbon</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Compounds</td>
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Appendix 1: Pickling optimisation curve

Kleingarn claims that for efficient use of a pickle solution there is an optimum iron concentration (present as iron chloride) at a fixed temperature. Equally if the solubility limit of iron in HCl is exceeded then pickling will not take place. The graph below illustrates the optimum iron concentration which will give the maximum pickling rate at 20°C.

*Figure 3.1: Kleingarn pickling system*

When a fresh pickle tank is set-up it will typically have a concentration of about 16% HCl with no iron present. From the graph above it can be seen that such a composition lies well below the optimum pickle rate line. As pickling proceeds the iron concentration of the pickle solution will increase as the acid strength decreases. Kleingarn suggests that in order to prevent the need for a fresh pickle solution to be made up, the spent pickle solution may be regenerated by the removal of a quantity of the spent acid and the addition of fresh acid.
Example

A fresh acid tank which is 10.5 m x 1.5 m x 2.5 m is made up to a depth of 2.1 m to have a strength of 16% HCl and contains no iron (Point A on the graph). After a period of operation the tank contains a spent acid solution that has a concentration of 6% HCl and contains 90 g/l of iron (Point B).

The pickle solution is to be regenerated by removing a volume of the spent pickle solution (y m$^3$) and adding an equivalent volume of 32% HCl in order to produce a pickle solution with a concentration of 14% HCl.

For the example:

Volume spent pickle solution = 33 m$^3$
Volume regenerated acid = 33 m$^3$
Concentration of spent pickle solution = 6
Concentration of fresh acid = 32
Concentration of regenerated acid = 14

First calculate the volume of spent pickle solution to be removed y.

\[
y = \frac{(\text{Conc. regenerated sol.} \times \text{Vol. regenerated sol.}) - (\text{Conc. spent sol.} \times \text{Vol. spent sol.})}{(\text{Conc. fresh acid} - \text{Conc. spent sol.})}
\]

\[
y = \frac{(14 \times 33) - (6 \times 33)}{(32 - 6)}
\]

\[
y = 10.2 \text{ m}^3
\]

To achieve a regenerated solution with a concentration of 14% HCl you need to remove 10.2 m$^3$ of spent solution and top up with 10.2 m$^3$ of 32% HCl

What will the iron concentration of the regenerated solution z be?

Volume of remaining pickle solution = 33 - 10.2 = 22.8 m$^3$

\[
z = \frac{(\text{Iron conc. spent sol.} \times \text{Vol. remaining spent sol.}) + (\text{Iron conc. fresh acid} \times \text{Vol. fresh acid})}{\text{Vol. regenerated sol.}}
\]

\[
z = \frac{(90 \times 22.8) + (0 \times 10.2)}{33}
\]

\[
z = 62.2
\]

The regenerated solution contains 62.2 g/l of iron.

The new regenerated pickle solution therefore contains 14% HCl and about 62 g/l$^{-1}$ of iron (Point C on the graph).

By regenerating the pickle solution you therefore increase the acid strength and reduce the iron concentration. The result of this is that the regenerated pickle solution will be closer to the optimum pickle rate line. By following this practice and regenerating a spent acid by the addition of fresh acid several times the pickle solution will move close to the optimum pickle rate line.
Practical experience has indicated that the pickle solution will stay close to the optimum pickle rate line as long as the regeneration procedure is repeated regularly. Regeneration can continue to take place until the tank needs to be emptied for cleaning or repair. At this point a fresh solution should be made up using partly spent acid from other tanks plus fresh acid.