# UK Best Available Techniques

# Formal Draft:
# BAT Conclusions for the Ferrous Metals Processing (Forming) Sector



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# Preface

## Status of the document

This document is the formal draft of the UK Best Available Techniques (BAT) and BAT Associated Emission Limits (BAT-AELs) and Environmental Performance Levels (BAT-AEPLs) for the Ferrous Metals Processing (Forming) sector.

It has been developed based on the outputs from the EU BREF process, which UK representatives participated in up to 31 January 2020, along with comments and evidence provided by the UK BAT Ferrous Metals Processing (Forming) Technical Working Group (TWG). It uses evidence available from current industry practice, sector activities and regulatory submissions within a UK context.

The formal draft documents the consensus reached at the formal meeting of the TWG held 28 February, 1, 2 March, 11 May and 7 June 2023. No alternative positions have been presented.

## UK BAT process

The UK BAT process was established in 2022 to organise an information exchange between UK Government, Devolved Administrations, Regulators, industry and interested third parties, e.g. environmental non-governmental organisations (NGOs) on BAT used to control industrial pollution. Technical Working Groups (TWGs) will be formed for each sector under review. They will work in a collaborative forum to discuss and develop BATC for the United Kingdom.

The UK BAT Conclusions (BATC) comprise a short description of each Best Available Technique identified, its applicability and where applicable associated emission or consumption levels.

This draft UK BATC will be published for comment and public consultation. When the BATC are approved it will be published as a statutory instrument and used as a basis for environmental permit conditions.

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# Scope of review

## Scope of the review under UK legislation

### In **England and Wales** under UK SI 2016 no.1154 The Environmental Permitting (England and Wales) Regulations 2016:

Schedule 1 Part 2, Chapter 2 Production and processing of metals, Section 2.1 Ferrous Metals, Part A(1) (c) "Processing ferrous metals and their alloys by using hot-rolling mills with a production capacity of more than 20 tonnes of crude steel per hour."

Schedule 1 Part 2, Chapter 2 Production and processing of metals, Section 2.1 Ferrous Metals, Part A(2) (c) "Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per hour" (when it is carried out in hot dip coating).

Schedule 1, Part 2, Chapter 2 Production and processing of metals, Section 2.3 Surface treating metals and plastic materials, Part A(1) (a) "Unless falling within Part A(2) of this Section, surface treating metals and plastic materials using an electrolytic or chemical process where the aggregated volume of the treatment vats is more than $30m^3$" (where this is carried out in cold rolling or wire drawing).

Schedule 1, Part 2, Chapter 2 Production and processing of metals, Section 2.3 Surface treating of metals and plastics materials, Part A(2) (a) "Surface treating metals and plastic materials using an electrolytic or chemical process where the aggregated volume of the treatment vats is more than $30m^3$ and where the activity is carried on at the same installation as one or more activities falling within (i) Part A(2) or Part B of Section 2.1, (ii) Part A(2) or Part B of Section 2.2, or (iii) Part A(2) or Part B of Section 6.4" (when it is carried out in hot dip coating).

Schedule 1, Part 2, Chapter 5 Waste management, Section 5.7 Treatment of waste water as amended by The Environmental Permitting (England and Wales) (Amendment) (EU Exit) Regulations 2019 (S.I. 2019/39), regs. 1, 2(7)(a)(ii); 2020 c. 1, Sch. 5 para. 1(1), Part A(1) (a) "Independently operated treatment of waste water not covered by the Urban Waste Water Treatment (England and Wales) Regulations 1994 and discharged by an installation carrying out any other Part A(1) or A(2) activity" (provided that the main pollutant load originates from the activities covered by these BAT conclusions).

### In **Scotland** under SSI 2012 no.360 The Pollution Prevention and Control (Scotland) Regulations 2012:

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals, PART A (c) "Processing ferrous metals and their alloys by using hot-rolling mills with a production capacity of more than 20 tonnes of crude steel per hour."

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals, PART A (g) "Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per hour" (when it is carried out in hot dip coating).

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Schedule 1, Part 1, Chapter 2, Section 2.3 Surface treating metals and plastic materials, PART A (a) "Surface treating metals and plastic materials using an electrolytic or chemical activity where the aggregated volume of the treatment vats exceeds 30m$^3$" (when it is carried out in cold rolling or wire drawing).

Schedule 1, Part 1, Chapter 5 Waste management, Section 5.7: Treatment of waste water as amended by The Environment (EU Exit) (Scotland) (Amendment etc.) Regulations 2019 (S.S.I. 2019/26), regs. 1, 13(20); 2020 c. 1, Sch. 5 para. 1(1), PART A "Independently operated treatment of waste water not covered by the Urban Waste Water Treatment (Scotland) Regulations 1994 and discharged by an installation carrying out any other Part A activity" (provided that the main pollutant load originates from the activities covered by these BAT conclusions).

In **Northern Ireland** under The Northern Ireland Statutory Rules 2013 No. 160 The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals, Part A (c) "Processing ferrous metals and their alloys by using hot-rolling mills with a production capacity of more than 20 tonnes of crude steel per hour."

Schedule 1, Part 2, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals, Part A (g) "Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per hour" (when it is carried out in hot dip coating).

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.3 Surface treating metals and plastic materials, Part A(a) "Surface treating metals and plastic materials using an electrolytic or chemical process where the aggregated volume of the treatment vats is more than 30m$^3$ "(when it is carried out in cold rolling or wire drawing).

Schedule 1, Part 1, Chapter 6 Waste management, Section 6.11 Waste water treatment, Part A (a) "Independently operated treatment of waste water not covered by Directive 91/271/EEC and discharged by a Part A installation or Part A mobile plant" (provided that the main pollutant load originates from the activities covered by these BAT conclusions).

Note: a current version of the above-mentioned Regulations should be consulted as they may have been amended since these BAT Conclusions were published.

## Associated activities included in the UK BAT scope, but which are not listed in UK legislation:

a. Cold rolling and wire drawing if directly associated with hot rolling and/or hot dip coating.
b. Acid recovery, if directly associated with the activities covered by these BAT conclusions.
c. The combined treatment of wastewater from different origins, provided that the waste water treatment is not covered by Directive

91/271/EEC and that the main pollutant load originates from the activities covered by these BAT conclusions.

d. Combustion processes directly associated with the activities covered by these BAT conclusions provided that (i) the gaseous products of combustion are put into direct contact with material (such as direct feedstock heating or direct feedstock drying), or (ii) the radiant and/or conductive heat is transferred through a solid wall (indirect heating):(a) without using an intermediary heat transfer fluid, or (b) when a gas (e.g. $H_2$) acts as the intermediary heat transfer fluid in the case of batch annealing.

## Activities excluded from the UK BAT Ferrous Metals Processing (Forming) scope under UK legislation

In **England and Wales** under The Environmental Permitting (England and Wales) Regulations 2016 UK SI 2016 no.1154:

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals,

Part A(2) (c) "Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per hour" (where this activity is batch galvanizing).

In **Scotland** under SSI 2012 no.360 The Pollution Prevention and Control (Scotland) Regulations 2012:

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals,

PART A (g) "Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per hour" (where this activity is batch galvanizing).

In **Northern Ireland** under The Northern Ireland Statutory Rules 2013 No. 160 The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013:

Schedule 1, Part 1, Chapter 2 Production and processing of metals, Section 2.1 Ferrous metals,

PART A (g) "Applying protective fused metal coatings with an input of more than 2 tonnes of crude steel per hour" (where this activity is batch galvanizing).

Across the UK also excluded are:

a. Metal coating by thermal spraying.
b. Electroplating and electroless plating; this may be covered by the BAT conclusions for Surface Treatment of Metals and Plastics (STM).

## Other relevant BATC

Other BAT conclusions and reference documents which could be relevant for the activities covered by these BAT conclusions include the following:

a. Iron and Steel Production (IS);
b. Large Combustion Plants (LCP);
c. Surface Treatment of Metals and Plastics (STM);
d. Surface Treatment using Organic Solvents (STS);

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e. Waste Treatment (WT);
f. EU BAT Reference Document (BREF) for the Ferrous Metals Processing Industry 2022;
g. Ferrous Metals Processing (Galvanizing) UK BAT.

These BAT conclusions apply without prejudice to other relevant legislation, e.g. on the registration, evaluation, authorisation and restriction of chemicals (REACH), and on classification, labelling and packaging (CLP).

## Links between UK legislation and EU directives

These draft BATC cover the above activities as defined in UK legislation based on Annex I of the Industrial Emissions Directive (2010/75/EU) facilitated through the European Union (Withdrawal) Act 2018 (2018 c. 16).

As they are based on the draft outputs from a process in which the UK was included up to 31 January 2020, the references to Directives and associated sections of the final draft EU BATC in the draft EU BREF for the ferrous metals processing sector have been retained. This is to ensure a clear line of sight to the technical background developed from UK evidence. The EU BAT conclusions, published on the 11 October 2022, have no legal basis in UK law.

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# Definitions

For the purposes of these BAT conclusion, the following general definitions apply:

## General terms

Table 1: Definition of general terms

| Term Used | Definition |
|---|---|
| Batch galvanizing | Discontinuous immersion of steel workpieces in a bath containing molten zinc to coat their surface with zinc. This also includes any directly associated pre- and post-treatment processes (e.g. degreasing and passivation). |
| Bottom dross | A reaction product of molten zinc with iron or with iron salts carried over from pickling or fluxing. This reaction product sinks to the bottom of the zinc bath. |
| Channelled emissions | Emissions of pollutants into the environment through any kind of duct, pipe, stack, etc. |
| Cold rolling | Compression of steel by rollers at ambient temperatures to change its characteristics (e.g. size, shape and/or metallurgical properties). This also includes any directly associated pre- and post-treatment processes (e.g. pickling, annealing and oiling). |
| Continuous measurement | Measurement using an automated measuring system permanently installed on site. |
| Direct discharge | Discharge to a receiving water body without further downstream wastewater treatment. |
| Existing plant | A plant that is not a new plant. |
| Feedstock | Any steel input (unprocessed or partly processed) or workpieces entering a production process step. |
| Feedstock heating | Any process step where feedstock is heated. This does not include feedstock drying or the heating of the galvanizing kettle. |
| Ferrochromium | An alloy of chromium and iron typically containing between 50 wt-% and 70 wt-% of chromium. |
| Flue-gas | The exhaust gas exiting a combustion unit. |
| High-alloy steel | Steel in which the content of one or more alloy elements is 5 wt-% or more. |
| Hot dip coating | Continuous immersion of steel sheets or wires through a bath containing molten metal(s), e.g. zinc and/or aluminium, to coat the surface with metal(s). This also includes any directly associated pre- and post-treatment processes (e.g. pickling and phosphating). |

| Term Used | Definition |
|---|---|
| Hot rolling | Compression of heated steel by rollers at temperatures typically ranging from 1,050 °C to 1,300 °C to change its characteristics (e.g. size, shape and/or metallurgical properties). This includes also hot ring rolling and hot rolling of seamless tubes as well as any directly associated pre- and post-treatment processes (e.g. scarfing, finishing, pickling and oiling). |
| Indirect discharge | A discharge to a receiving water body that is not a direct discharge. |
| Installation | A stationary technical unit where one or more activities listed in Schedule 1 of the Environmental Permitting (England and Wales) Regulation 2016, or Schedule 1 of The Pollution Prevention and Control (Scotland) Regulations 2012, or Schedule 1 of The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013 are carried on, and any other location on the same site where any other directly associated activities are carried on.<br>A directly associated activity means an operation which—<br>(a)has a technical connection with the activity,<br>(b)is carried on the same site as the activity, and<br>(c)could have an effect on pollution. |
| Intermediate heating | Heating of the feedstock between the hot rolling stages. |
| Iron and steel process gases | Blast furnace gas, basic oxygen furnace gas, coke oven gas or mixtures of these originating from iron and steel production. |
| Leaded steel | Steel grades in which the content of lead added is typically between 0.15 wt-% and 0.35 wt-%. |
| Low fume flux | A low fume flux is one where most of the ammonium chloride content has been replaced with potassium chloride so that it releases far less fume during the dipping operation. The composition of a low fume flux is typically in the range of 60 % zinc chloride, 30 % potassium chloride and 10 % ammonium chloride. |
| Major plant upgrade | A major change in the design or technology of a plant with major adjustments or replacements of the process and/or abatement technique(s) and associated equipment. |
| Mass flow | The mass of a given substance or parameter which is emitted over a defined period of time. |
| Mechanical processing | Includes slitting, descaling, grinding, roughing, rolling, finishing and levelling. |
| Mill scale | Iron oxides formed on the surface of steel when oxygen reacts with hot metal. This occurs immediately after casting, during reheating and hot rolling. |

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| **Term Used** | **Definition** |
|---|---|
| Mixed acid | A mixture of hydrofluoric acid and nitric acid. |
| New plant | A plant first permitted at the site of the installation following the publication of these BAT conclusions or a complete replacement of a plant following the publication of these BAT conclusions. |
| Other than normal operating conditions | Such as start-up and shut-down operations, leaks, malfunctions, momentary stoppages and definitive cessation of operations; |
| Periodic measurement | Measurement at specified time intervals using manual or automated methods. |
| Plant | All parts of an installation covered by the scope of these BAT conclusions and any other directly associated activities which have an effect on consumption and/or emissions. Plants may be new plants or existing plants. |
| Post-heating | Heating of the feedstock after hot rolling. |
| Process chemicals | Substances and/or mixtures as defined in Article 3 of Regulation EC/1907/2006 and used in the process(es). |
| Recovery | Recovery as defined in Article 3(15) of Directive 2008/98/EC.<br>The recovery of spent acids includes their regeneration, reclamation and recycling. |
| Reheating | Heating of the feedstock before hot rolling. |
| Residue | Substance or object generated by the activities covered by the scope of these BAT conclusions as waste or by-product. |
| Sensitive receptor | Areas which need special protection, such as:<br>- residential areas;<br>- areas where human activities are carried out (e.g. neighbouring workplaces, schools, day-care centres, recreational areas, hospitals or nursing homes). |
| Stainless steel | High-alloy steel which contains chromium typically within the range 10-23 wt-%. It includes austenitic steel, which also contains nickel typically within the range 8-10 wt-% |
| Top dross | In hot dipping, the oxides formed on the surface of the molten zinc bath by reaction of iron and aluminium. |
| Valid hourly (or half-hourly) average | An hourly (or half-hourly) average is considered valid when there is no maintenance or malfunction of the automated measuring system. |
| Volatile substance | A substance capable of readily changing from a solid or liquid form to a vapour, having a high vapour pressure and a low boiling point (e.g. HCl). This includes volatile organic compounds as defined in Article 3(45) of Directive 2010/75/EU. |

| Term Used | Definition |
|---|---|
| Wire drawing | Drawing of steel rods or wires through dies to reduce their diameter. This also includes any directly associated pre- and post-treatment processes (e.g. wire rod pickling and feedstock heating after drawing). |
| Zinc ash | A mixture comprising zinc metal, zinc oxide and zinc chloride that is formed on the surface of the molten zinc bath. |

## Pollutants and parameters:

Table 2: Pollutants and parameters

| Term | Definition |
|---|---|
| B | The sum of boron and its compounds, dissolved or bound to particles, expressed as B. |
| Cd | The sum of cadmium and its compounds, dissolved or bound to particles, expressed as Cd. |
| CO | Carbon monoxide. |
| COD | Chemical oxygen demand. Amount of oxygen needed for the total chemical oxidation of the organic matter to carbon dioxide using dichromate. COD is an indicator for the mass concentration of organic compounds. |
| Cr | The sum of chromium and its compounds, dissolved or bound to particles, expressed as Cr. |
| Cr(VI) | Hexavalent chromium, expressed as Cr(VI), includes all chromium compounds where the chromium is in the oxidation state +6. |
| Dust | Total particulate matter (in air). |
| Fe | The sum of iron and its compounds, dissolved or bound to particles, expressed as Fe. |
| $F^-$ | Dissolved fluoride, expressed as $F^-$. |
| HCl | Hydrogen chloride. |
| HF | Hydrogen fluoride. |
| Hg | The sum of mercury and its compounds, dissolved or bound to particles, expressed as Hg. |
| HOI | Hydrocarbon oil index. The sum of compounds extractable with a hydrocarbon solvent (including long-chain or branched aliphatic, alicyclic, aromatic or alkyl-substituted aromatic hydrocarbons). |
| $H_2SO_4$ | Sulphuric acid. |
| $NH_3$ | Ammonia. |
| Ni | The sum of nickel and its compounds, dissolved or bound to particles, expressed as Ni. |

| Term | Definition |
|---|---|
| $NO_X$ | The sum of nitrogen monoxide (NO) and nitrogen dioxide ($NO_2$), expressed as $NO_2$. |
| Pb | The sum of lead and its compounds, dissolved or bound to particles, expressed as Pb. |
| Sn | The sum of tin and its compounds, dissolved or bound to particles, expressed as Sn. |
| $SO_2$ | Sulphur dioxide. |
| $SO_X$ | The sum of sulphur dioxide ($SO_2$), sulphur trioxide ($SO_3$) and sulphuric acid aerosols, expressed as $SO_2$. |
| TOC | Total organic carbon, expressed as C (in water); includes all organic compounds. |
| Total P | Total phosphorus, expressed as P, includes all inorganic and organic phosphorus compounds. |
| TSS | Total suspended solids. Mass concentration of all suspended solids (in water), measured via filtration through glass fibre filters and gravimetry. |
| TVOC | Total volatile organic carbon, expressed as C (in air). |
| Zn | The sum of zinc and its compounds, dissolved or bound to particles, expressed as Zn. |

## Acronyms

For the purposes of these BAT Conclusions, the following acronyms apply:

Table 3: Acronyms

| Term | Definition |
|---|---|
| CMS | Chemicals management system |
| CR | Cold rolling |
| EMS | Environmental management system |
| HDC | Hot dip coating |
| HR | Hot rolling |
| OTNOC | Other than normal operating conditions |
| SCR | Selective catalytic reduction |
| SNCR | Selective non-catalytic reduction |
| WD | Wire drawing |

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# Descriptions of techniques

## Techniques to increase energy efficiency

Table 4: Techniques to increase energy efficiency

| Technique | Description |
|---|---|
| Coil boxes | Insulated boxes are installed between the roughing mill and the finishing mill to minimise temperature losses from feedstock during coiling/uncoiling processes and allow for lower rolling forces in hot strip mills. |
| Combustion optimisation | Measures taken to maximise the efficiency of energy conversion in the furnace while minimising emissions (in particular of CO). This is achieved by a combination of techniques including good design of the furnace, optimisation of the temperature (e.g. efficient mixing of the fuel and combustion air) and residence time in the combustion zone, and use of furnace automation and control. |
| Flameless combustion | Flameless combustion is achieved by injecting fuel and combustion air separately into the combustion chamber of the furnace at high velocity to suppress flame formation and reduce the formation of thermal $NO_X$ while creating a more uniform heat distribution throughout the chamber. Flameless combustion can be used in combination with oxy-fuel combustion. |
| Furnace automation and control | The heating process is optimised by using a computer system controlling in real time key parameters such as furnace and feedstock temperature, the air to fuel ratio and the furnace pressure. |
| Near-net-shape casting for thin slabs and beam blanks followed by rolling | Thin slabs and beam blanks are produced by combining casting and rolling in one process step. The need to reheat the feedstock before rolling and the number of rolling passes are reduced. |
| Optimisation of the SNCR/SCR design and operation | Optimisation of the reagent to $NO_X$ ratio over the cross-section of the furnace or duct, of the size of the reagent drops and of the temperature window in which the reagent is injected. |
| Oxy-fuel combustion | Combustion air is replaced fully or partially with pure oxygen. Oxy-fuel combustion can be used in combination with flameless combustion. |
| Preheating of combustion air | Reuse of part of the heat recovered from the combustion flue-gas to preheat the air used in combustion. |
| Process gas management system | A system that enables iron and steel process gases to be directed to the feedstock heating furnaces, depending on their availability. |

| Technique | Description |
|---|---|
| Recuperative burner | Recuperative burners employ different types of recuperators (e.g. heat exchangers with radiation, convection, compact or radiant tube designs) to directly recover heat from the flue-gases, which are then used to preheat the combustion air. |
| Reduction of the rolling friction | Rolling oils are carefully selected. Pure oil and/or emulsion systems are used to reduce the friction between the working rolls and the feedstock and to ensure minimal oil consumption. In hot rolling, this is usually carried out in the first stands of the finishing mill. |
| Regenerative burner | Regenerative burners consist of two burners which are operated alternately, and which contain beds of refractory or ceramic materials. While one burner is in operation, the heat of the flue-gas is absorbed by the refractory or ceramic materials of the other burner and then used to preheat the combustion air. |
| Waste heat recovery boiler | Heat from hot flue-gases is used to generate steam using a waste heat recovery boiler. The generated steam is used in other processes of the plant, for supplying a steam network or for generating electricity in a power plant. |

## Techniques to reduce emissions to air

Table 5: Techniques to reduce emissions to air

| Technique | Description |
|---|---|
| Combustion optimisation | See table 4 |
| Demister | Demisters are filter devices that remove entrained liquid droplets from a gas stream. They consist of a woven structure of metal or plastic wires, with a high specific surface area. Through their momentum, small droplets present in the gas stream impinge against the wires and coalesce into bigger drops. |
| Electrostatic precipitator | Electrostatic precipitators (ESPs) operate such that particles are charged and separated under the influence of an electrical field. Electrostatic precipitators are capable of operating under a wide range of conditions. Abatement efficiency may depend on the number of fields, residence time (size), and upstream particle removal devices. They generally include between two and five fields. Electrostatic precipitators can be of the dry or of the wet type depending on the technique used to collect the dust from the electrodes. Wet ESPs are typically used at the polishing stage to remove residual dust and droplets after wet scrubbing. |

| Technique | Description |
|---|---|
| Fabric filter | Fabric filters, often referred to as bag filters, are constructed from porous woven or felted fabric through which gases are passed to remove particles. The use of a fabric filter requires the selection of a fabric suitable for the characteristics of the waste gas and the maximum operating temperature. |
| Flameless combustion | See table 4 |
| Furnace automation and control | See table 4 |
| Low-$NO_X$ burner | The technique (including ultra-low-$NO_X$ burners) is based on the principles of reducing peak flame temperatures. The air/fuel mixing reduces the availability of oxygen and reduces the peak flame temperature, thus retarding the conversion of fuel-bound nitrogen to $NO_X$ and the formation of thermal $NO_X$, while maintaining high combustion efficiency. |
| Optimisation of the SNCR/SCR design and operation | See table 4 |
| Oxy-fuel combustion | See table 4 |
| Selective catalytic reduction (SCR) | The SCR technique is based on the reduction of $NO_X$ to nitrogen in a catalytic bed by reaction with urea or ammonia at an optimum operating temperature of around 300–450°C. Several layers of catalyst may be applied. A higher $NO_X$ reduction is achieved with the use of several catalyst layers. |
| Selective non-catalytic reduction (SNCR) | SNCR is based on the reduction of $NO_X$ to nitrogen by reaction with ammonia or urea at a high temperature. The operating temperature window is maintained between 800°C and 1,000°C for optimal reaction. |
| Wet scrubbing | The removal of gaseous or particulate pollutants from a gas stream via mass transfer to a liquid solvent, often water or an aqueous solution. It may involve a chemical reaction (e.g. in an acid or alkaline scrubber). In some cases, the compounds may be recovered from the solvent. |

## Techniques to reduce emissions to water

Table 6: Techniques to reduce emissions to water

| **Technique** | **Description** |
|---|---|
| Adsorption | The removal of soluble substances (solutes) from the wastewater by transferring them to the surface of solid, highly porous particles (typically activated carbon). |
| Aerobic treatment | The biological oxidation of dissolved organic pollutants with oxygen using the metabolism of microorganisms. In the presence of dissolved oxygen, injected as air or pure oxygen, the organic components are mineralised into carbon dioxide and water or are transformed into other metabolites and biomass. |
| Chemical precipitation | The conversion of dissolved pollutants into an insoluble compound by adding chemical precipitants. The solid precipitates formed are subsequently separated by sedimentation, air flotation or filtration. If necessary, this may be followed by microfiltration or ultrafiltration. Multivalent metal ions (e.g. calcium, aluminium, iron) are used for phosphorus precipitation. |
| Chemical reduction | The conversion of pollutants by chemical reducing agents into similar but less harmful or hazardous compounds. |
| Coagulation and flocculation | Coagulation and flocculation are used to separate suspended solids from wastewater and are often carried out in successive steps. Coagulation is carried out by adding coagulants with charges opposite to those of the suspended solids. Flocculation is carried out by adding polymers, so that collisions of microfloc particles cause them to bond to produce larger flocs. |
| Equalisation | Balancing of flows and pollutant loads at the inlet of the final wastewater treatment by using central tanks. Equalisation may be decentralised or carried out using other management techniques. |
| Filtration | The separation of solids from wastewater by passing them through a porous medium, e.g. sand filtration, microfiltration and ultrafiltration. |
| Flotation | The separation of solid or liquid particles from wastewater by attaching them to fine gas bubbles, usually air. The buoyant particles accumulate at the water surface and are collected with skimmers. |
| Nanofiltration | A filtration process in which membranes with pore sizes of approximately 1 nm are used. |

| Technique | Description |
|---|---|
| Neutralisation | The adjustment of the pH of wastewater to a neutral level (approximately pH 7) by the addition of chemicals. Sodium hydroxide (NaOH) or calcium hydroxide ($Ca(OH)_2$) is generally used to increase the pH, whereas sulphuric acid ($H_2SO_4$), hydrochloric acid (HCl) or carbon dioxide ($CO_2$) is generally used to decrease the pH. The precipitation of some substances may occur during neutralisation. |
| Physical separation | The separation of gross solids, suspended solids, metal particles from the wastewater using for example screens, sieves, grit separators, grease separators, hydrocyclones, oil-water separation or primary settlement tanks. |
| Reverse osmosis | A membrane process in which a pressure difference applied between the compartments separated by the membrane causes water to flow from the more concentrated solution to the less concentrated one. |
| Sedimentation | The separation of suspended particles and suspended material by gravitational settling. |

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# General considerations

The techniques listed and described in these BAT conclusions are neither prescriptive nor exhaustive. Other techniques may be used that ensure at least an equivalent level of environmental protection.

Unless otherwise stated, the BAT conclusions are generally applicable.

# Emission levels associated with the best available techniques (BAT-AELs) and indicative emission levels for emissions to air

It is important to ensure that any BAT-AEL and indicative emission level is expressed in a manner that allows consistent measurement and comparisons. This is achieved by defining the reference conditions under which monitoring should be reported. Emission levels associated with the best available techniques (BAT-AELs) and indicative emission levels for emissions to air given in these BAT conclusions refer to concentrations (mass of emitted substances per volume of waste gas) under the following standard conditions: dry gas at a temperature of 273.15 K and a pressure of 101.3 kPa and expressed in mg/Nm$^3$.

The reference oxygen levels used to express BAT-AELs and indicative emission levels in these BAT conclusions are shown in the table below.

Table 7: Reference oxygen levels

| **Source of emissions** | **Reference oxygen level ($O_R$)** |
|---|---|
| Combustion processes associated with:<br>- feedstock heating and drying | 3 dry vol-% |
| All other sources | No correction for the oxygen level |

For the cases where a reference oxygen level is given, the equation for calculating the emission concentration at the reference oxygen level is:

$$E_R = \frac{(21 - O_R)}{(21 - O_M)} \times E_M$$

where:

$E_R$: emission concentration at the reference oxygen level $O_R$;

$O_R$: reference oxygen level in vol-%;

$E_M$: measured emission concentration;

$O_M$: measured oxygen level in vol-%.

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The equation above does not apply if the combustion process(es) use oxygen-enriched air or pure oxygen or when additional air intake for safety reasons brings the oxygen level in the waste gas very close to 21 vol-%. In this case, the emission concentration at the reference oxygen level of 3 dry vol-% is calculated differently, e.g. by normalising on the basis of the carbon dioxide generated by the combustion.

For averaging periods of BAT-AELs for emissions to air, the following definitions apply.

Table 8: Averaging periods of BAT-AELs for emissions to air

| Type of measurement | Averaging period | Definition |
|---|---|---|
| Continuous | Daily average | Average over a period of one day based on valid hourly or half-hourly averages. |
| Periodic | Average over the sampling period | Average value of three consecutive measurements of at least 30 minutes each ([1]). |

[1] For any parameter where, due to sampling or analytical limitations and/or due to operational conditions, a 30-minute sampling/measurement and/or an average of three consecutive measurements is inappropriate, a more representative sampling/measurement procedure may be employed.

When the waste gases of two or more sources (e.g. furnaces) are discharged through a common stack, the BAT-AELs apply to the combined discharge from the stack.

For the purpose of calculating the mass flows in relation to BAT 6 and BAT 35, where waste gases from one type of source (e.g. furnaces) discharged through two or more separate stacks could, in the judgement of the competent authority, taking technical and economic factors into account, be discharged through a common stack, these stacks shall be considered as a single stack.

## Emission levels associated with the best available techniques (BAT-AELs) for emissions to water

Emission levels associated with the best available techniques (BAT-AELs) for emissions to water given in these BAT conclusions refer to concentrations (mass of emitted substances per volume of water), expressed in mg/l or µg/l.

Averaging periods associated with the BAT-AELs refer to either of the following two cases:

a. In the case of continuous discharge, daily average values, i.e. 24-hour flow-proportional composite samples. Time-proportional composite samples can be used provided that sufficient flow stability is demonstrated. Spot samples can be used when the emission levels are proven to be sufficiently stable.
b. In the case of batch discharge, average values over the release duration taken as flow proportional composite samples, or, provided that the effluent is appropriately mixed and homogeneous, a spot sample taken before discharge.

The BAT-AELs apply at the point where the emission leaves the plant.

# Other environmental performance levels associated with the best available techniques (BAT-AEPLs)

## BAT-AEPLs for specific energy consumption (energy efficiency)

The BAT-AEPLs for specific energy consumption refer to yearly averages calculated using the following equation:

$$\text{specific energy consumption} = \frac{\text{energy consumption}}{\text{input}}$$

where:

energy consumption: total amount of heat (generated from primary energy sources) and electricity consumed by the relevant process(es), expressed in MJ/year or kWh/year; and

input: total amount of feedstock processed, expressed in tonnes/year.

In the case of feedstock heating, the energy consumption corresponds to the total amount of heat (generated from primary energy sources) and electricity consumed by all furnaces in the relevant process(es).

## BAT-AEPLs for specific water consumption

The BAT-AEPLs for specific water consumption refer to yearly averages calculated using the following equation:

$$\text{specific water consumption} = \frac{\text{water consumption}}{\text{production rate}}$$

where:

water consumption: total amount of water consumed by the plant excluding recycled and reused water; cooling water used in once-through cooling systems; water for domestic-type usage expressed in $m^3$/year; and

| | |
|---|---|
| production rate: | total amount of products manufactured by the plant, expressed in tonnes/year. |

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

# BAT conclusions - general

This section captures those overarching BATC which are associated with best practice and good environmental leadership for industrial processes, but which do not directly lead to the setting of BAT-AELs.

## BAT 1: Environmental management system

To improve and maintain overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features:

a. management commitment, leadership, and accountability, including senior management, for the implementation of an effective EMS;
b. an analysis that includes the organisation's context, the needs and expectations of interested parties, and the characteristics of the installation that are associated with possible risks for the environment including human health; as well as the applicable legal requirements relating to the environment;
c. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;
d. establishing objectives and performance indicators in relation to the significant environmental aspects, including safeguarding compliance with applicable legal requirements;
e. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;
f. determination of structures, roles and responsibilities in relation to the environmental aspects and objectives including the provision of the financial and human resources needed;
g. ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training);
h. internal and external communication;
i. fostering employee involvement in good environmental management practices;
j. establishing and maintaining a management manual, written procedures to control activities with significant environmental impact, and records that demonstrate compliance and record non-compliances;
k. effective operational planning and process control;
l. implementation of appropriate maintenance programmes;
m. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;
n. when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning.
o. implementation of a monitoring and measurement programme;
p. application of sectoral benchmarking on a regular basis;

q. periodic internal auditing and independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;
r. evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur;
s. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;
t. following and taking into account the development of cleaner techniques.

Specifically for the ferrous metals processing forming sector, BAT is to also incorporate the following features in the EMS:

u. an inventory of process chemicals used and of wastewater and waste gas streams (see BAT 2);
v. a chemicals management system (see BAT 3);
w. a plan for the prevention and control of leaks and spillages (see BAT 55 (a));
x. an OTNOC management plan (see BAT 4);
y. an energy efficiency plan (see BAT 9 (a));
z. a water management plan (see BAT 18 (a));
aa. a noise and vibration management plan (see BAT 56);
bb. a residues management plan (see BAT 29 (a)).

Note: Certification to ISO 14001 is an example of an EMS consistent with this BAT.

### Applicability

The level of detail and the degree of formalisation of the EMS will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

## BAT 2: Inventory

To facilitate the reduction of emissions to water and air, BAT is to establish, maintain and regularly review (including when a significant change occurs) an inventory of process chemicals used, wastewater and waste gas streams, as part of the EMS (see BAT 1), that incorporates all of the following features:

a. Information about the production processes, including:
    i. simplified process flow sheets that show the origin of the emissions;
    ii. descriptions of process-integrated techniques and wastewater/waste gas treatment at source including their performances;

b. Information about the characteristics of the wastewater streams, such as:
   i. average values and variability of flow, pH, temperature and conductivity;
   ii. average concentration and mass flow values of relevant substances (e.g. total suspended solids, TOC or COD, hydrocarbon oil index, phosphorus, metals, fluoride) and their variability;
c. Information about the quantity and characteristics of the process chemicals used:
   i. the identity and the characteristics of process chemicals, including properties with adverse effects on the environment and/or human health;
   ii. the quantities of process chemicals used and the location of their use;
d. Information about the characteristics of the waste gas streams, such as:
   i. average values and variability of flow and temperature;
   ii. average concentration and mass flow values of relevant substances (e.g. dust, $NO_X$, $SO_2$, CO, metals, acids) and their variability;
   iii. presence of other substances that may affect the waste gas treatment system (e.g. oxygen, nitrogen, water vapour) or plant safety (e.g. hydrogen).

Note: ISO 14031 gives guidance on the design and use of environmental performance evaluation (EPE) within an organisation.

### Applicability

The level of detail of the inventory will generally be related to the nature, scale and complexity of the plant, and the range of environmental impacts it may have.

## BAT 3: Chemicals management system (CMS)

To improve the overall environmental performance, BAT is to elaborate and implement a chemicals management system (CMS) as part of the EMS (see BAT 1) that incorporates all of the following features:

a. A policy to reduce the consumption and risks of process chemicals, including a procurement policy to select less harmful process chemicals and their suppliers with the aim of minimising the use and risks of hazardous substances and avoiding the procurement of an excess amount of process chemicals. The selection of process chemicals may consider:
   i. their eliminability, their eco-toxicity and their potential to be released into the environment in order to reduce emissions to the environment;

ii. the characterisation of the risks associated with the process chemicals, based on the chemicals' hazards statement, pathways through the plant, potential release and level of exposure;
iii. the regular (e.g. annual) analysis of the potential for substitution to identify potentially new available and safer alternatives to the use of hazardous substances (e.g. use of other process chemicals with no or lower environmental impacts, see BAT 8).
iv. the anticipatory monitoring of regulatory changes related to hazardous chemicals and safeguarding compliance with applicable legal requirements.

The inventory of process chemicals (see BAT 2) may be used to support the selection of process chemicals.

b. Goals and action plans to avoid or reduce the use and risks of hazardous substances.
c. Development and implementation of procedures for the procurement, handling, storage, and use of process chemicals to prevent or reduce emissions to the environment (e.g. see BAT 55).

Note: ISO 14031 gives guidance on the design and use of environmental performance evaluation (EPE) within an organisation.

### Applicability

The level of detail of the CMS will generally be related to the nature, scale and complexity of the plant.

## BAT 4: Other than normal operating conditions (OTNOC)

To reduce the frequency and duration of the occurrence of OTNOC and to reduce emissions during OTNOC, BAT is to set up and implement a risk based OTNOC management plan (OTNOC-MP) as part of the EMS that includes all the following elements:

a. identification of potential OTNOC scenarios (i.e. failure of equipment critical to the protection of the environment ('critical equipment')), of their root causes and of their potential consequences, and regular review and update of the list of identified OTNOC scenarios following the periodic assessment below;
b. reference to consideration of appropriate design of critical equipment (e.g. compartmentalisation of fabric filters – this is expected to be contained within the permit application);
c. set-up and implementation of an inspection and preventive maintenance plan for critical equipment;
d. quantification monitoring (i.e. estimating or, where possible, measuring) and recording of emissions during OTNOC and of associated circumstances;
e. periodic assessment of the emissions occurring during OTNOC (e.g. frequency of events, duration, amount of pollutants emitted and their likely impact) and implementation of corrective actions and additional

measures to reduce the likelihood, duration and severity of future occurrence if necessary.

### Applicability

The level of detail of the OTNOC-MP will generally be related to the nature, scale and complexity of the plant.

# BAT conclusions – process

This section captures BATC appropriate to the control of environmental impacts best controlled through good process control of the unit operations being used.

## BAT 5: Monitoring

BAT is to monitor at least once per year:

a. the yearly consumption of water, energy and materials;
b. the yearly generation of wastewater;
c. the yearly amount of each type of residues generated and of each type of waste sent for recovery or disposal.

### Description

Monitoring can be performed by direct measurements, calculations or recording, e.g. using suitable meters or invoices. The monitoring is broken down to the most appropriate level (e.g. to process or plant level) and considers any significant changes in the plant.

## BAT 6: Monitoring of channelled emissions to air

BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Table 9: Monitoring frequencies and standards of channelled emissions to air

| **Substance/ Parameter** | **Specific process(es)** | **Sector** | **Standard** | **Minimum Monitoring frequency (1)** | **Monitoring associated with** |
|---|---|---|---|---|---|
| CO | Feedstock heating (2) | HR, CR, WD, HDC | BS EN 15058 (3) | Once every year | BAT 37 |
| CO | Heating of the galvanizing kettle (2) | HDC of wires | BS EN 15058 (3) | Once every year | BAT 37 |

| Substance/ Parameter | Specific process(es) | Sector | Standard | Minimum Monitoring frequency (1) | Monitoring associated with |
|---|---|---|---|---|---|
| CO | · Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors<br>· Mixed acid recovery by spray roasting | HR, CR, HDC, WD | BS EN 15058 (3) | Once every year | BAT 44 |
| Dust | Feedstock heating (4) | HR, CR, WD, HDC | BS EN 13284-1 (3) (5) | · Continuous for any stack with dust mass flows > 2 kg/h.<br>· Once every 6 months for any stack with dust mass flows between 0.1 kg/h and 2 kg/h.<br>· Once every year for any stack with dust mass flows < 0.1 kg/h. | BAT 35 |
| Dust | Hot dipping after fluxing | HDC | BS EN 13284-1 (3) (5) | Once every year (6) | BAT 41 |

| Substance/ Parameter | Specific process(es) | Sector | Standard | Minimum Monitoring frequency (1) | Monitoring associated with |
|---|---|---|---|---|---|
| Dust | · Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors<br>· Mixed acid recovery by spray roasting or by evaporation | HR, CR, HDC, WD | BS EN 13284-1 (3) (5) | Once every year | BAT 44 |
| Dust | Mechanical processing, scarfing (other than manual scarfing) and welding | HR | BS EN 13284-1 (3) (5) | Once every year | BAT 45 |
| Dust | Decoiling, mechanical predescaling, levelling and welding | CR | BS EN 13284-1 (3) (5) | Once every year | BAT 47 |
| Dust | Lead baths | WD | BS EN 13284-1 (3) (5) | Once every year | BAT 50 |
| Dust | Dry drawing | WD | BS EN 13284-1 (3) (5) | Once every year | BAT 51 |
| HCl | Pickling with hydrochloric acid | HR, CR, HDC, WD | BS EN 1911 (3) | Once every year | BAT 39 |
| HCl | Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors | HR, CR,HDC, WD | BS EN 1911 (3) | Once every year | BAT 44 |

| Substance/ Parameter | Specific process(es) | Sector | Standard | Minimum Monitoring frequency ([1]) | Monitoring associated with |
|---|---|---|---|---|---|
| HF | Pickling with acid mixtures containing hydrofluoric acid | HR, CR, HDC | BS EN/TS 17340 ([3]) | Once every year | BAT 39 |
| HF | Recovery of mixed acid by spray roasting or by evaporation | HR, CR | BS EN/TS 17340 ([3]) | Once every year | BAT 44 |
| Ni | Mechanical processing, scarfing (other than manual scarfing) and welding | HR | BS EN 14385([3]) | Once every year ([7]) | BAT 45 |
| Ni | Decoiling, mechanical predescaling, levelling and welding | CR | BS EN 14385([3]) | Once every year ([7]) | BAT 47 |
| Pb | Mechanical processing, scarfing (other than manual scarfing) and welding | HR | BS EN 14385([3]) | Once every year ([7]) | BAT 45 |
| Pb | Decoiling, mechanical predescaling, levelling and welding | CR | BS EN 14385([3]) | Once every year ([7]) | BAT 47 |
| Pb | Lead baths | WD | BS EN 14385([3]) | Once every year | BAT 50 |
| Zn | Hot dipping after fluxing | HDC | BS EN 14385([3]) | Once every year ([6]) | BAT 41 |

| Substance/ Parameter | Specific process(es) | Sector | Standard | Minimum Monitoring frequency (1) | Monitoring associated with |
|---|---|---|---|---|---|
| $NH_3$ | When SNCR and/or SCR is used | HR, CR, WD, HDC | BS EN ISO 21877 (3) | Once every year | BAT 37, BAT 40, BAT 44 |
| $NO_X$ | Feedstock heating (2) | HR, CR, WD, HDC | BS EN 14792 (3) | · Continuous for any stack with $NO_X$ mass, flows > 15 kg/h.<br>· Once every 6 months for any stack with $NO_X$ mass flows between 1 kg/h and 15 kg/h.<br>· Once every year for any stack with $NO_X$ mass flows < 1 kg/h. | BAT 37 |
| $NO_X$ | Heating of the galvanizing kettle (2) | HDC of wires | BS EN 14792 (3) | Once every year | BAT 37 |
| $NO_X$ | Pickling with nitric acid alone or in combination with other acids | HR, CR | BS EN 14792 (3) | Once every year | BAT 40 |

| Substance/ Parameter | Specific process(es) | Sector | Standard | Minimum Monitoring frequency (1) | Monitoring associated with |
|---|---|---|---|---|---|
| $NO_X$ | · Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors<br>· Mixed acid recovery by spray roasting or by evaporation | HR, CR, WD, HDC | BS EN 14792 (3) | Once every year | BAT 44 |
| $SO_2$ | Feedstock heating (8) | HR, CR, WD, coating of sheets in HDC | BS EN 14791 (3) | · Continuous for any stack with $SO_2$ mass flows > 10 kg/h.<br>· Once every 6 months for any stack with $SO_2$ mass flows between 1 kg/h and 10 kg/h.<br>· Once a year for any stack with $SO_2$ mass flows < 1 kg/h. | BAT 36 |
| $SO_2$ | Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors | HR, CR, HDC, WD | BS EN 14791 (3) | Once every year (6) | BAT 44 |

| **Substance/ Parameter** | **Specific process(es)** | **Sector** | **Standard** | **Minimum Monitoring frequency (1)** | **Monitoring associated with** |
|---|---|---|---|---|---|
| $SO_X$ | Pickling with sulphuric acid | HR, CR, HDC, WD | BS EN 14791 (3) | Once every year | BAT 39 |
| TVOC | Degreasing | CR, HDC | BS EN 12619 (3) | Once every year (6) | BAT 38 |
| TVOC | Rolling, wet tempering and finishing | CR | BS EN 12619 (3) | Once every year (6) | BAT 49 |
| TVOC | Lead baths | WD | BS EN 12619 (3) | Once every year (6) | – |
| TVOC | Oil quench baths | WD | BS EN 12619 (3) | Once every year (6) | BAT 52 |

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[1] To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions.

[2] The monitoring does not apply when only electricity is used.

[3] If measurements are continuous, the following generic EN standards apply: BS EN 15267-1, BS EN 15267-2, BS EN 15267-3, BS EN 14181 and BS EN 17255-1.

[4] The monitoring does not apply when only electricity is used and there are no channelled emissions to air.

[5] If measurements are continuous, BS EN 13284-2 also applies.

[6] If the emission levels are proven to be sufficiently stable, a lower monitoring frequency can be adopted, but in any case, at least once every 3 years.

[7] The monitoring only applies when the substance concerned is identified as relevant in the waste gas stream based on the inventory given in BAT 2.

[8] The monitoring does not apply if only natural gas is used as a fuel or when only electricity is used.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

# BAT 7: Monitoring of emissions to water

BAT is to monitor emissions to water with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Table 10: Monitoring frequencies and standards of emissions to water

| Substance/ Parameter | Specific process(es) | Standard(s) | Minimum monitoring frequency (1) | Monitoring associated with |
|---|---|---|---|---|
| Total suspended solids (TSS) (2) | All processes | BS EN 872 | Once every week (3) | BAT 54 |
| Total organic carbon (TOC) (2) (4) | All processes | BS EN 1484 | Once every month | BAT 54 |
| Chemical oxygen demand (COD) (2) (4) | All processes | BS EN 15705 | Once every month | BAT 54 |
| Hydrocarbon oil index (HOI) (5) | All processes | BS EN ISO 9377-2 | Once every month | BAT 54 |
| Boron (5) | Processes where borax is used | Various EN standards available (e.g. BS EN ISO 11885, BS EN ISO 17294-2) | Once every month | BAT 54 |
| Cadmium (5) | All processes (6) | BS EN ISO 5961 | Once every month | BAT 54 |
| Chromium (5) | All processes (6) | BS EN ISO 11885, BS EN ISO 5961 | Once every month | BAT 54 |
| Iron (5) | All processes | BS ISO/TS 15923-2 | Once every month | BAT 54 |
| Nickel (5) | All processes (6) | BS EN ISO 11885, BS EN ISO 15586 | Once every month | BAT 54 |
| Lead (5) | All processes (6) | BS EN ISO 11885, BS EN ISO 15586 | Once every month | BAT 54 |

| **Substance/ Parameter** | **Specific process(es)** | **Standard(s)** | **Minimum monitoring frequency ([1])** | **Monitoring associated with** |
|---|---|---|---|---|
| Tin ([5]) | Hot dip coating using tin | BS EN ISO 11885, BS EN ISO 15586 | Once every month | BAT 54 |
| Zinc ([5]) | All processes ([6]) | BS EN ISO 11885, BS EN ISO 15586 | Once every month | BAT 54 |
| Mercury ([5]) | All processes ([6]) | BS EN 12846, BS EN ISO 17852 | Once every month | BAT 54 |
| Hexavalent chromium ([5]) | Pickling of high alloy steel or passivation with hexavalent chromium compounds | Various EN standards available (e.g. BS ISO 11083, BS EN ISO 23913) | Once every month | BAT 54 |
| Total phosphorus (Total P) ([2]) | Phosphating | Various EN standards available (e.g. BS EN ISO 6878, BS EN ISO 11885, BS EN ISO 15681-1 and -2) | Once every month | BAT 54 |
| Fluoride ($F^-$) ([5]) | Pickling with acid mixtures containing hydrofluoric acid | BS EN ISO 10304-1 | Once every month | BAT 54 |

[1] In the case of batch discharge less frequent than the minimum monitoring frequency, monitoring is carried out once per batch.

[2] The monitoring only applies in the case of a direct discharge to a receiving water body.

[3] Monitoring frequencies may be reduced to once every month if the emission levels are proven to be sufficiently stable.

[4] Either COD or TOC is monitored. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.

[5] In the case of an indirect discharge to a receiving water body, the monitoring frequency may be reduced to once every 3 months if the downstream wastewater treatment plant is designed and equipped appropriately to abate the pollutants concerned.

[6] The monitoring only applies when the substance/parameter is identified as relevant in the wastewater stream based on the inventory mentioned in BAT 2.

## BAT 8: Hazardous substances

In order to avoid the use of hexavalent chromium compounds in passivation, BAT is to use other metal-containing solutions (e.g. containing manganese, zinc, titanium fluoride, phosphates and/or molybdates) or organic polymer solutions (e.g. containing polyurethanes or polyesters).

### Applicability

Applicability may be restricted due to product specifications (e.g. surface quality, paintability, weldability, formability, corrosion resistance).

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

# BAT conclusions – efficiency

These BATC will describe efficiency measures. These may include energy efficiency and waste management efficiency rates. This section may include values such as BAT-AEL or BAT-AEPL.

## BAT 9: Energy efficiency

To increase the overall energy efficiency of the plant, BAT is to use both of the techniques given below.

Table 11: Techniques to increase energy efficiency

| Technique | Description | Applicability |
|---|---|---|
| a. Energy efficiency plan and energy audits | · An energy efficiency plan is part of the EMS (see BAT 1) and entails defining and monitoring the specific energy consumption of the activity/processes (see BAT 5), setting key performance indicators on an annual basis (e.g. MJ/t of product) and planning the periodic improvement targets and related actions.<br>· Energy audits are carried out at least once a year to ensure that the objectives of the energy management plan are met.<br>· The energy efficiency plan and the energy audits may be integrated in the overall energy efficiency plan of a larger installation (e.g. for iron and steel production). | The level of detail of the energy efficiency plan, of the energy audits and of the energy balance record will generally be related to the nature, scale and complexity of the plant and the types of energy sources used. |
| b. Energy balance record | Drawing up on an annual basis of an energy balance record which provides a breakdown of the energy consumption and generation (including energy export) by the type of energy source (e.g. electricity, natural gas, iron and steel process gases, renewable energy, imported heat and/or cooling). This includes:<br>(i) defining the energy boundary of the processes;<br>(ii) information on energy consumption in terms of delivered energy;<br>(iii) information on energy exported from the plant;<br>(iv) energy flow information (e.g. Sankey diagrams or energy balances) showing how the energy is used throughout the processes. | The level of detail of the energy efficiency plan, of the energy audits and of the energy balance record will generally be related to the nature, scale and complexity of the plant and the types of energy sources used. |

## BAT 10: Energy efficiency in heating

To increase energy efficiency in heating (including heating and drying of feedstock as well as heating of baths), BAT is to use an appropriate combination of the techniques given below.

Table 12: Techniques to increase energy efficiency in heating

| Technique | Description | Applicability |
|---|---|---|
| a. Design and operation: Optimum furnace design for feedstock heating | This includes techniques such as:<br>· Optimisation of key furnace characteristics (e.g. number and type of burners, air tightness and furnace insulation using suitable refractory materials).<br>· Minimisation of heat losses from furnace door openings, e.g. by using several liftable segments instead of one in continuous reheating furnaces.<br>· Minimisation of the number of feedstock-supporting structures inside the furnace (e.g. beams, skids) and use of suitable insulation to reduce the heat losses from water cooling of the supporting structures in continuous reheating furnaces. | Only applicable to new plants and major plant upgrades. |
| b. Design and operation: Optimum galvanizing kettle design | This includes techniques such as:<br>· Uniform heating of the galvanizing kettle walls (e.g. by using high-velocity burners or radiant design).<br>· Minimisation of heat losses from the furnace using insulated outer/inner walls (e.g. ceramic lining). | Only applicable to new plants and major plant upgrades. |

| Technique | Description | Applicability |
|---|---|---|
| c. Design and operation: Optimum galvanizing kettle operation | This includes techniques such as:<br>Minimisation of heat losses from the galvanizing kettle in hot dip coating of wires e.g. by using insulated covers during idle periods. | Generally applicable. |
| d. Design and operation: Combustion optimisation | See table 4. | Generally applicable. |
| e. Design and operation: Furnace automation and control | See table 4. | Generally applicable. |
| f. Design and operation: Process gas management system | See table 4.<br>The calorific value of iron and steel process gases and/or CO-rich gas from ferrochromium production is used. | Only applicable when iron and steel process gases and/or CO-rich gas from ferrochromium production are available. |
| g. Design and operation: Batch annealing with 100 % hydrogen | Batch annealing is carried out in furnaces using 100 % hydrogen as a protective gas with increased thermal conductivity. | Only applicable to new plants and major plant upgrades. |
| h. Design and operation: Oxy-fuel combustion | See table 4. | · Applicability may be restricted for furnaces processing high-alloy steel.<br>· Applicability to existing plants may be restricted by furnace design and the need for a minimum waste gas flow.<br>Not applicable to furnaces equipped with radiant tube burners. |

| Technique | Description | Applicability |
|---|---|---|
| i. Design and operation: Flameless combustion | See table 4. | · Applicability to existing plants may be limited by furnace design (i.e. furnace volume, space for burners, distance between burners) and the need for a change of the refractory lining.<br>· Applicability may be limited for processes where close control of temperature or temperature profile is required (e.g. re-crystallisation).<br>· Not applicable to furnaces operating at a temperature lower than the auto-ignition temperature required for flameless combustion or to furnaces equipped with radiant tube burners. |
| j. Design and operation: Pulse-fired burner | The heat input to the furnace is controlled by the firing duration of the burners or by the sequential start of the individual burners instead of adjusting combustion air and fuel flows. | Only applicable to new plants and major plant upgrades. |
| k. Heat recovery from flue-gases: Feedstock preheating | Feedstock is preheated by blowing hot flue-gases directly onto it. | Only applicable to continuous reheating furnaces. Not applicable to furnaces equipped with radiant tube burners. |
| l. Heat recovery from flue-gases: Preheating of combustion air | See table 4.<br>This may be achieved for example by using regenerative or recuperative burners. A balance has to be achieved between maximising heat recovery from the flue-gas and minimising $NO_X$ emissions. | Applicability to existing plants may be restricted by a lack of space for the installation of regenerative burners. |

| Technique | Description | Applicability |
| --- | --- | --- |
| m. Heat recovery from flue-gases: Waste heat recovery boiler | The heat from hot flue-gases is used to generate steam or hot water that is used in other processes (e.g. for heating pickling and fluxing baths), for district heating or for generating electricity. | Applicability to existing plants may be restricted by a lack of space and/or a suitable steam or hot water demand. |

## Further process techniques to increase energy efficiency

Further process techniques to increase energy efficiency in hot rolling, cold rolling and wire drawing are given in BAT 19, BAT 20, BAT 23 and BAT 25 of these BAT conclusions.

## BAT-associated environmental performance levels (BAT-AEPLs) for energy efficiency in hot rolling

Table 13: BAT-associated environmental performance levels (BAT-AEPLs) for specific energy consumption for feedstock heating in hot rolling

| Specific process(es) and steel products at the end of the rolling process | Unit | BAT-AEPL (yearly average) |
| --- | --- | --- |
| Feedstock reheating: Hot rolled coils (strips) | MJ/t | 1,200–1,500 ([1]) |
| Feedstock reheating: Heavy plates | MJ/t | 1,400–2,000 ([2]) |
| Feedstock reheating: Bars, rods | MJ/t | 600–1,900 ([2]) |
| Feedstock reheating: Beams, billets, rails, tubes | MJ/t | 1,400–2,200 |
| Feedstock intermediate heating: Bars, rods, tubes | MJ/t | 100–900 |
| Feedstock post-heating: Heavy plates | MJ/t | 1,000–2,000 |
| Feedstock post-heating: Bars, rods | MJ/t | 1,400–3,000 ([3]) |

[1] In the case of high-alloy steel (e.g. austenitic stainless steel), the higher end of the BAT-AEPL range may be higher and up to 2,200 MJ/t.

[2] In the case of high-alloy steel (e.g. austenitic stainless steel), the higher end of the BAT-AEPL range may be higher and up to 2,800 MJ/t.

[3] In the case of high-alloy steel (e.g. austenitic stainless steel), the higher end of the BAT-AEPL range may be higher and up to 4,000 MJ/t.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

## BAT-associated environmental performance level (BAT-AEPL) for energy efficiency in cold rolling

Table 14: BAT-associated environmental performance level (BAT-AEPL) for specific energy consumption in annealing after cold rolling

| **Specific process(es)** | **Unit** | **BAT-AEPL (Yearly average)** |
|---|---|---|
| Annealing after cold rolling (batch and continuous) | MJ/t | 600–1,200 ([1]) |

[1] The BAT-AEPL may be higher for continuous annealing lines requiring an annealing temperature above 800°C.

## BAT-associated environmental performance level (BAT-AEPL) for energy efficiency in hot dip coating

Table 15: BAT-associated environmental performance level (BAT-AEPL) for specific energy consumption of feedstock heating before hot dip coating

| **Specific process(es)** | **Unit** | **BAT-AEPL (Yearly average)** |
|---|---|---|
| Feedstock heating before hot dip coating | MJ/t | 700–1,100 ([1]) |

[1] The BAT-AEPL may be higher for continuous annealing lines requiring an annealing temperature above 800°C.

The associated monitoring is given in BAT 5.

# BAT 11: Material efficiency in degreasing

To increase material efficiency in degreasing and to reduce the generation of spent degreasing solution, BAT is to use a combination of the techniques given below.

Table 16: Techniques to increase material efficiency in degreasing

| **Technique** | **Description** | **Applicability** |
|---|---|---|
| a. Avoiding or reducing the need for degreasing: Use of feedstock with low | The use of feedstock with low oil and grease contamination prolongs the lifetime of the degreasing solution. | Applicability may be limited if the feedstock quality |

| Technique | Description | Applicability |
|---|---|---|
| oil and grease contamination | | cannot be influenced. |
| b. Avoiding or reducing the need for degreasing: Use of a direct-flame furnace in the case of hot dip coating of sheets | · The oil on the surface of the sheet is burnt in a direct-flame furnace.<br>· Degreasing before the furnace may be needed for some high-quality products or in the case of sheets with high residual oil levels. | Applicability may be limited if a very high level of surface cleanliness and zinc adhesion is required. |
| c. Degreasing optimisation: General techniques for increased degreasing efficiency | These include techniques such as:<br>· monitoring and optimising the temperature and the concentration of degreasing agents in the degreasing solution;<br>· enhancing the effect of the degreasing solution on the feedstock (e.g. by moving the feedstock, agitating the degreasing solution or by using ultrasound to create cavitation of the solution on the surface to be degreased). | Generally applicable. |
| d. Degreasing optimisation: Minimisation of drag-out of degreasing solution | This includes techniques such as:<br>· using squeeze rolls, e.g. in the case of continuous degreasing of strip;<br>· allowing for a sufficient dripping time, e.g. by slow lifting of workpieces. | Generally applicable. |
| e. Degreasing optimisation: Reverse cascade degreasing | Degreasing is carried out in two or more baths in series where the feedstock is moved from the most contaminated degreasing bath to the cleanest. | Generally applicable. |
| f. Extending the lifetime of the degreasing baths: Cleaning and reuse of the degreasing solution | Magnetic separation, oil separation (e.g. skimmers, discharge launders, weirs), micro- or ultrafiltration or biological treatment is used to clean the degreasing solution for reuse. | Generally applicable. |

## BAT 12: Material efficiency in pickling (acid heating)

To increase material efficiency in pickling and to reduce the generation of spent pickling acid when pickling acid is heated, BAT is to use one of the techniques given below and not to use direct injection of steam.

Table 17: Techniques to increase material efficiency when pickling acid is heated

| Technique | Description |
|---|---|
| a. Acid heating with heat exchangers | Corrosion-resistant heat exchangers are immersed in the pickling acid for indirect heating, e.g. with steam. |
| b. Acid heating by submerged combustion | Combustion gases pass through the pickling acid, releasing the energy via direct heat transfer. |

## BAT 13: Material efficiency in pickling

To increase material efficiency in pickling and to reduce the generation of spent pickling acid, BAT is to use an appropriate combination of the techniques given below.

Table 18: Material efficiency in pickling

| Technique | Description | Applicability |
|---|---|---|
| a. Avoiding or reducing the need for pickling: Minimisation of steel corrosion | This includes techniques such as:<br>· cooling the hot rolled steel as fast as possible depending on product specifications;<br>· storing the feedstock in roofed areas;<br>· limiting the storage duration of the feedstock. | Generally applicable. |
| b. Avoiding or reducing the need for pickling: Mechanical (pre)descaling | This includes techniques such as:<br>· shot blasting;<br>· bending;<br>· sanding;<br>· brushing;<br>· stretching and levelling. | Applicability to existing plants may be restricted by a lack of space. Applicability may be restricted due to product specifications. |

| Technique | Description | Applicability |
|---|---|---|
| c. Avoiding or reducing the need for pickling: Electrolytic pre-pickling for high-alloy steel | Use of an aqueous solution of sodium sulphate ($Na_2SO_4$) to pre-treat high-alloy steel before pickling with mixed acid, in order to speed up and improve the removal of the surface oxide scale. The wastewater containing hexavalent chromium is treated using technique BAT 54(f). | Only applicable to cold rolling.<br>Applicability to existing plants may be restricted by a lack of space. |
| d. Pickling optimisation: Rinsing after alkaline degreasing | Carry-over of alkaline degreasing solution to the pickling bath is reduced by rinsing feedstock after degreasing. | Applicability to existing plants may be restricted by a lack of space. |
| e. Pickling optimisation: General techniques for increased pickling efficiency | These include techniques such as:<br>· optimisation of the pickling temperature for maximising pickling rates while minimising emissions of acids;<br>· optimisation of the pickling bath composition (e.g. acid and iron concentrations);<br>· optimisation of the pickling time to avoid over-pickling;<br>· avoiding drastic changes in the pickling bath composition by frequently replenishing it with fresh acid. | Generally applicable. |
| f. Pickling optimisation: Cleaning of the pickling bath and reuse of free acid | A cleaning circuit, e.g. with filtration, is used to remove particles from the pickling acid followed by reclamation of the free acid via ion exchange, e.g. using resins. | · Not applicable if cascade pickling (or similar) is used, as this results in very low levels of free acid.<br>· Not applicable for $HF/H_2SO_4$ mixed acid. |
| g. Pickling optimisation: Reverse cascade pickling | Pickling is carried out in two or more baths in series where the feedstock is moved from the bath with the lowest acid concentration to the one with the highest. | Applicability to existing plants may be restricted by a lack of space. |

| Technique | Description | Applicability |
|---|---|---|
| h. Pickling optimisation: Minimisation of drag-out of pickling acid | This includes techniques such as:<br>· using squeeze rolls, e.g. in the case of continuous pickling of strip;<br>· allowing for a sufficient dripping time, e.g. by slow lifting of workpieces;<br>· using vibrating wire rod coils. | Generally applicable. |
| i. Pickling optimisation: Turbulence pickling | This includes techniques such as:<br>· injection of the pickling acid at high pressure via nozzles;<br>· agitation of the pickling acid using an immersed turbine. | Applicability to existing plants may be restricted by a lack of space. |
| j. Pickling optimisation: Use of pickling inhibitors | Pickling inhibitors are added to the pickling acid to protect metallically clean parts of the feedstock from over-pickling. | · Not applicable to high-alloy steel.<br>· Applicability may be restricted due to product specifications. |
| k. Pickling optimisation: Activated pickling in hydrochloric acid pickling | Pickling is carried out with a low hydrochloric acid concentration (i.e. around 4–6 wt-%) and a high iron concentration (i.e. around 120–180 g/l) at temperatures of 20–25°C. | Generally applicable. |

## BAT 14: Material efficiency in fluxing

To increase material efficiency in fluxing and to reduce the quantity of spent fluxing solution sent for disposal, BAT is to use techniques (a) and (b), in combination with technique (c) or in combination with technique (d) given below.

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

Table 19: Material efficiency in fluxing

| Technique | Description | Applicability |
|---|---|---|
| a. Optimised fluxing operation | The chemical composition of the fluxing solution is monitored and adjusted frequently. The amount of fluxing agent used is reduced to the minimum level required to achieve the product specifications. | Generally applicable. |
| b. Minimisation of drag-out of fluxing solutions | The drag-out of the fluxing solution is minimised by allowing enough time for it to drip off. | Generally applicable. |
| c. Iron removal and reuse of the fluxing solution | Iron is removed from the fluxing solution by one of the following techniques:<br>· electrolytic oxidation;<br>· oxidation using air or $H_2O_2$;<br>· ion exchange.<br>After iron removal, the fluxing solution is reused. | Applicability to existing plants may be restricted by a lack of space. |
| d. Recovery of salts from the spent fluxing solution for production of fluxing agents | Spent fluxing solution is used to recover the salts to produce fluxing agents. This may take place on site or off site. | Applicability may be restricted depending on the availability of a market. |

## BAT 15: Material efficiency of hot dipping in the coating of wires

To increase the material efficiency of hot dipping in the coating of wires, and to reduce the generation of waste, BAT is to use all of the techniques given below.

Table 20: Material efficiency of hot dipping in the coating of wires

| Technique | Description |
|---|---|
| a. Reduction of the generation of bottom dross | The generation of bottom dross is reduced, e.g. by sufficient rinsing after pickling, removing the iron from the fluxing solution (see BAT 14 (d)), using fluxing agents with a mild pickling effect and avoiding local overheating in the galvanizing kettle. |

| Technique | Description |
|---|---|
| b. Reduction of the generation of zinc ash | The formation of zinc ash, i.e. zinc oxidation on the bath surface, is reduced for example by:<br>· sufficient drying of the workpieces / wires before dipping;<br>· avoiding unnecessary disturbances of the bath during production, including during skimming;<br>· in continuous hot dipping of wires, reducing the bath surface that is in contact with air using a floating refractory cover. |

## BAT 16: Material efficiency in phosphating and passivation

To increase material efficiency and to reduce the quantity of waste sent for disposal from phosphating and passivation, BAT is to use technique (a) and one of the techniques (b) or (c) given below.

Table 21: Material efficiency in phosphating and passivation

| Technique | Description |
|---|---|
| a. Extending the lifetime of the treatment baths: Cleaning and reuse of the phosphating or passivation solution | A cleaning circuit, for example with filtration, is used to clean the phosphating or passivation solution for reuse. |
| b. Treatment optimisation: Use of roll coaters for strips | Roll coaters are used to apply a passivation or a phosphate-containing layer on the surface of strips. This allows better control of the layer thickness and thus the reduction of the consumption of chemicals. |
| c. Treatment optimisation: Minimisation of drag-out of chemical solution | The drag-out of chemical solution is minimised, e.g. by passing the strips through squeeze rolls or by allowing for sufficient dripping time for workpieces. |

## Further sector-specific techniques to increase material efficiency

Further process techniques to increase material efficiency in hot rolling, cold rolling, wire drawing and hot dip coating are given in BAT 21, BAT 22, BAT 24, BAT 26, BAT 27 and BAT 28 of these BAT conclusions.

## BAT 17: Recovery of pickling acids

To reduce the quantity of spent pickling acid sent for disposal, BAT is to recover spent pickling acids (i.e. hydrochloric acid, sulphuric acid and mixed acid). The neutralisation of spent pickling acids or the use of spent pickling acids for emulsion splitting is not BAT.

### Description

Techniques to recover spent pickling acid on site or off site, include:

a. spray roasting or using fluidised bed reactors for the recovery of hydrochloric acid;
b. crystallisation of ferric sulphate for the recovery of sulphuric acid;
c. spray roasting, evaporation, ion exchange or diffusion dialysis, for the recovery of mixed acid;
d. use of spent pickling acid as a secondary raw material (e.g. for the production of iron chloride or pigments).

### Applicability

Under exceptional circumstances neutralisation of spent pickling acid may take place.

## BAT 18: Water-use and wastewater generation

To optimise water consumption, to improve water recyclability and to reduce the volume of wastewater generated, BAT is to use both techniques (a) and (b), and an appropriate combination of the techniques (c) to (h) given below.

Table 22: Water use and wastewater generation

| Technique | Description | Applicability |
|---|---|---|
| a. Water management plan and water audits | A water management plan and water audits are part of the EMS (see BAT 1) and include:<br>· flow diagrams and a water mass balance of the plant;<br>· establishment of water efficiency objectives;<br>· implementation of water optimisation techniques (e.g. control of water usage, water recycling, detection and repair of leaks).<br>· Water audits are carried out at least once every year to ensure | The level of detail of the water management plan and water audits will generally be related to the nature, scale and complexity of the plant. |

| Technique | Description | Applicability |
|---|---|---|
| | that the objectives of the water management plan are met.<br>The water management plan and the water audits may be integrated in the overall water management plan of a larger installation (e.g. for iron and steel production). | |
| b. Segregation of water streams | Each water stream (e.g. surface run-off water, process water, alkaline or acidic wastewater, spent degreasing solution) is collected separately, based on the pollutant content and on the required treatment techniques. Wastewater streams that can be recycled without treatment are segregated from wastewater streams that require treatment. | Applicability to existing plants may be limited by the layout of the water collection system. |
| c. Minimisation of hydrocarbon contamination of process water | The contamination of process water by oil and lubricant losses is minimised by using techniques such as:<br>· oil-tight bearings and bearing seals for working rolls;<br>· leakage indicators;<br>· regular inspections and preventive maintenance of pump seals, piping and working rolls. | Generally applicable. |
| d. Reuse and/or recycling of water | Water streams (e.g. process water, effluents from wet scrubbing or quench baths) are reused and/or recycled in closed or semi-closed circuits, if necessary after treatment (see BAT 53 and BAT 54). | The degree of water reuse and/or recycling is limited by the water balance of the plant, the content of impurities and/or the characteristics of the water streams. |
| e. Reverse cascade rinsing | Rinsing is carried out in two or more baths in series where the feedstock is moved from the most contaminated rinsing bath to the cleanest. | Applicability to existing plants may be restricted by a lack of space. |

| Technique | Description | Applicability |
|---|---|---|
| f. Recycling or reuse of rinsing water | Water from rinsing after pickling or degreasing is recycled/reused, if necessary after treatment, to the preceding process baths as make-up water, rinsing water or, if the acid concentration is sufficiently high, for acid recovery. | Generally applicable. |
| g. Treatment and reuse of oil- and scale-bearing process water in hot rolling | Oil- and scale-bearing wastewater from hot rolling mills is treated separately using different cleaning steps including scale pits, settling tanks, cyclones and filtration to separate oil and scale. A large proportion of the treated water is reused in the process. | Generally applicable. |
| h. Water spray descaling triggered by sensors in hot rolling | Sensors and automation are used to track the position of the feedstock and adjust the volume of the descaling water passing through the water sprays. | Generally applicable. |

## BAT-associated environmental performance levels (BAT-AEPLs) for water use and wastewater generation

Table 23: BAT-associated environmental performance levels (BAT-AEPL) for specific water consumption

| Sector | Unit | BAT-AEPL (Yearly average) |
|---|---|---|
| Hot rolling | $m^3/t$ | 0.5–5 |
| Cold rolling | $m^3/t$ | 0.5–10 |
| Wire drawing | $m^3/t$ | 0.5–5 |
| Hot dip coating | $m^3/t$ | 0.5–5 |

The associated monitoring is given in BAT 5.

# BAT conclusions for hot rolling

Additional BAT conclusions for hot rolling.

## BAT 19: Hot rolling - energy efficiency in feedstock heating

To increase energy efficiency in feedstock heating, BAT is to use a combination of the techniques given in BAT 10 together with an appropriate combination of the techniques given below.

Table 24: Techniques to increase energy efficiency for heating feedstock for the hot rolling process

| Technique | Description | Applicability |
|---|---|---|
| a. Near-net-shape casting for thin slabs and beam blanks followed by rolling | See table 4. | Only applicable to plants adjacent to continuous casting and within the limitations of the plant layout and product specifications. |
| b. Hot/direct charging | Continuous-cast steel products are directly charged hot into the reheating furnaces. | Only applicable to plants adjacent to continuous casting and within the limitations of the plant layout and product specifications. |
| c. Heat recovery from skids cooling | Steam produced when cooling the skids supporting the feedstock in the reheating furnaces is extracted and used in other processes of the plant. | Applicability to existing plants may be restricted by a lack of space and/or by a suitable steam demand. |
| d. Heat conservation during transfer of feedstock | Insulated covers are used between the continuous caster and the reheating furnace, and between the roughing mill and the finishing mill. | Generally applicable within the limitations of the plant layout. |
| e. Coil boxes | See table 4. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| f. Coil recovery furnaces | Coil recovery furnaces are used as an addition to coil boxes to restore the rolling temperature of coils and return them to a normal rolling sequence in the event of rolling mill interruptions. | Generally applicable. |
| g. Sizing press | See BAT 20 (a). Sizing press is used to increase the energy efficiency in feedstock heating because it enables the hot charging rate to be increased. | Only applicable to new plants and major plant upgrades for hot strip mills. |

## BAT 20: Hot rolling - energy efficiency in rolling

To increase energy efficiency in rolling, BAT is to use a combination of the techniques given below.

Table 25: Techniques to improve energy efficiency during rolling for the hot rolling process

| Technique | Description | Applicability |
|---|---|---|
| a. Sizing press | The use of a sizing press before the roughing mill enables the hot charging rate to be significantly increased and results in a more uniform width reduction both at the edges and centre of the product. The shape of the final slab is nearly rectangular, significantly reducing the number of rolling passes necessary to reach product specifications. | Only applicable to hot strip mills. Only applicable to new plants and major plant upgrades. |
| b. Computer-aided rolling optimisation | The thickness reduction is controlled using a computer to minimise the number of rolling passes. | Generally applicable. |
| c. Reduction of the rolling friction | See table 4. | Only applicable to hot strip mills. |
| d. Coil boxes | See table 4. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| e. Three-roll stand | A three-roll stand increases the section reduction per pass, resulting in an overall reduction of the number of rolling passes required for producing wire rods and bars. | Generally applicable. |
| f. Near-net-shape casting for thin slabs and beam blanks followed by rolling | See table 4. | Only applicable to plants adjacent to continuous casting and within the limitations of the plant layout and product specifications. |

## BAT-associated environmental performance levels (BAT-AEPLs) for specific energy consumption in rolling

Table 26: BAT-associated environmental performance levels (BAT-AEPLs) for specific energy consumption in rolling

| Steel products at the end of the rolling process | Unit | BAT-AEPL (yearly average) |
|---|---|---|
| Hot rolled coils (strips), heavy plates | MJ/t | 100–400 |
| Bars, rods | MJ/t | 100–500 ([1]) |
| Beams, billets, rails, tubes | MJ/t | 100–300 |

[1] In the case of high-alloy steel (e.g. austenitic stainless steel), the higher end of the BAT-AEPL range is 1,000 MJ/t.

The associated monitoring is given in BAT 5.

# BAT 21: Hot rolling – material efficiency

To increase material efficiency, and to reduce the quantity of waste sent for disposal from feedstock conditioning, BAT is to avoid or, where that is not practicable, to reduce the need for conditioning by applying one or a combination of the techniques given below:

Table 27: Hot rolling – Material efficiency

| Technique | Description | Applicability |
|---|---|---|
| a. Computer-aided quality control | The quality of slabs is controlled by a computer which allows the adjustment of the casting conditions to minimise surface defects and enables manual scarfing of the damaged area(s) only rather than scarfing of the entire slab. | Only applicable to plants with continuous casting. |
| b. Slab slitting | The slabs (often cast in multiple widths) are slit before hot rolling by means of slitting devices, slit rolling or torches either manually operated or mounted on a machine. | May not be applicable for slabs produced from ingots. |
| c. Edging or trimming of wedge-type slabs | Wedge-type slabs are rolled under special settings where the wedge is eliminated by edging (e.g. using automatic width control or a sizing press) or by trimming. | May not be applicable for slabs produced from ingots. Only applicable to new plants and major plant upgrades. |

## BAT 22: Hot rolling – material efficiency for flat products

To increase material efficiency in rolling for the production of flat products, BAT is to reduce the generation of metallic scrap by using both of the techniques given below.

Table 28: Techniques to improve material efficiency when hot rolling flat products

| Technique | Description |
|---|---|
| a. Crop optimisation | The cropping of the feedstock after roughing is controlled by a shape measurement system (e.g. camera) in order to minimise the amount of metal cut off. |
| b. Control of the feedstock shape during rolling | Any deformations of the feedstock during rolling are monitored and controlled in order to ensure that the rolled steel has as rectangular a shape as possible and to minimise the need for trimming. |

# BAT Conclusions for cold rolling

Additional BAT conclusions for cold rolling.

## BAT 23: Cold rolling - energy efficiency

To increase energy efficiency in rolling, BAT is to use a combination of the techniques given below.

Table 29: Cold rolling - Energy efficiency

| Technique | Description | Applicability |
|---|---|---|
| a. Continuous rolling for low-alloy and alloy steel | Continuous rolling (e.g. using tandem mills) is employed instead of conventional discontinuous rolling (e.g. using reversing mills), allowing for stable feed and less frequent start-ups and shutdowns. | Only applicable to new plants and major plant upgrades. Applicability may be restricted due to product specifications. |
| b. Reduction of the rolling friction | See table 4. | Generally applicable. |
| c. Computer aided rolling optimisation | The thickness reduction is controlled using a computer to minimise the number of rolling passes. | Generally applicable. |

## BAT-associated environmental performance levels (BAT-AEPLs) for specific energy consumption in rolling

Table 30: BAT-associated environmental performance levels (BAT-AEPLs) for specific energy consumption in rolling

| Steel products at the end of the rolling process | Unit | BAT-AEPL (Yearly average) |
|---|---|---|
| Cold rolled coils | MJ/t | 100–300 ([1]) |
| Packaging steel | MJ/t | 250–400 |

[1] In the case of high-alloy steel (e.g. austenitic stainless steel), the higher end of the BAT-AEPL range may be higher and up to 1,600 MJ/t.

The associated monitoring is given in BAT 5.

## BAT 24: Cold rolling - material efficiency

To increase material efficiency and to reduce the quantity of waste sent for disposal from rolling, BAT is to use all of the techniques given below.

Table 31: Cold rolling - Material efficiency

| Technique | Description | Applicability |
|---|---|---|
| a. Monitoring and adjustment of the rolling emulsion quality | Important characteristics of the rolling emulsion (e.g. oil concentration, pH, emulsion droplet size, saponification index, acid concentration, concentration of iron fines, concentration of bacteria) are monitored regularly or continuously to detect anomalies in the emulsion quality and take corrective action, if needed. | Generally applicable. |
| b. Prevention of contamination of the rolling emulsion | Contamination of the rolling emulsion is prevented by techniques such as:<br>· regular control and preventive maintenance of the hydraulic system and the emulsion circulation system;<br>· reducing bacterial growths in the rolling emulsion system by regular cleaning or operating at low temperatures. | Generally applicable. |
| c. Cleaning and reuse of the rolling emulsion | Particulate matter (e.g. dust, steel slivers and scale) contaminating the rolling emulsion is removed in a cleaning circuit (usually based on sedimentation combined with filtration and/or magnetic separation) in order to maintain the emulsion quality and the treated rolling emulsion is reused. The degree of reuse is limited by the content of impurities in the emulsion. | Applicability may be restricted due to product specifications. |
| d. Optimal choice of rolling oil and emulsion system | Rolling oil and emulsion systems are carefully selected to provide the optimum performance for the given process and product. Relevant characteristics to be considered are, for example:<br>· good lubrication;<br>· potential for easy separation of contaminants;<br>· stability of the emulsion and dispersion of the oil in the emulsion;<br>· non-degradation of the oil over a long idling time. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| e. Minimisation of oil/rolling emulsion consumption | The consumption of oil/rolling emulsion is minimised by using techniques such as:<br>· limiting the oil concentration to the minimum required for lubrication;<br>· limiting carry-over of emulsion from the previous stands (e.g. by separating the emulsion cellars, shielding of the mill stands);<br>· using air knives combined with edge suction to reduce the residual emulsion and oil on the strip. | Generally applicable. |

## BAT conclusions for wire drawing

Additional BAT conclusions for wire drawing.

## BAT 25: Wire drawing - energy efficiency

To increase the energy and material efficiency of lead baths, BAT is to use either a floating protective layer on the surface of the lead baths or tank covers.

### Description

Floating protective layers and tank covers minimise heat losses and lead oxidation.

## BAT 26: Wire drawing - material efficiency

To increase material efficiency and to reduce the quantity of waste sent for disposal from wet drawing, BAT is to clean and reuse the wire drawing lubricant.

### Description

A cleaning circuit, e.g. with filtration and/or centrifugation, is used to clean the wire drawing lubricant for reuse.

## BAT conclusions for hot dip coating of sheets and wires

Additional BAT conclusions for hot dip coating of sheets and wires.

## BAT 27: Hot dip coating – material efficiency

To increase material efficiency in continuous hot dipping of strips, BAT is to avoid excess coating with metals by using both techniques given below.

Table 32: Techniques for improving material efficiency during hot dip coating of metal strips

| Technique | Description |
|---|---|
| a. Air knives for coating thickness control | After leaving the molten zinc bath, air jets stretching over the width of the strip blow the surplus coating metal off the strip surface back into the galvanizing kettle. |
| b. Stabilisation of the strip | The efficiency of the excess coating removal by air knives is improved by limiting the oscillations of the strip, e.g. by increasing strip tension, using low-vibration pot bearings, using electromagnetic stabilisers. |

## BAT 28: Hot dip coating – material efficiency for wire

To increase material efficiency in continuous hot dipping of wire, BAT is to avoid excess coating with metals by using one of the techniques given below.

Table 33: Techniques for improving material efficiency during hot dip coating of wire

| Technique | Description |
|---|---|
| a. Air or nitrogen wiping | After leaving the molten zinc bath, circular air or gas jets around the wire blow the surplus coating metal off the wire surface back into the galvanizing kettle. |
| b. Mechanical wiping | After leaving the molten zinc bath, the wire is passed through wiping equipment/material (e.g. pads, nozzles, rings, charcoal granulate) which take the surplus coating metal off the wire surface back into the galvanizing kettle. |

## BAT 29: Residues

To reduce the quantity of waste sent for disposal, BAT is to avoid the disposal of metals, metal oxides and oily sludge and hydroxide sludge by using technique (a) and an appropriate combination of techniques (b) to (h) given below.

Table 34: Techniques to reduce the quantity of residues

| Technique | Description | Applicability |
|---|---|---|
| a. Residues management plan | A residues management plan is part of the EMS (see BAT 1) and is a set of measures aiming to 1) minimise the generation of residues, 2) optimise the reuse, recycling and/or recovery of residues, and 3) ensure the proper disposal of waste.<br>The residues management plan may be integrated in the overall residues management plan of a larger installation (e.g. for iron and steel production). | The level of detail and the degree of formalisation of the residues management plan will generally be related to the nature, scale and complexity of the installation. |
| b. Pre-treatment of oily mill scale for further use | This includes techniques such as:<br>· briquetting or pelletising;<br>· reducing the oil content of oily mill scale, e.g. by thermal treatment, washing, flotation. | Generally applicable. |
| c. Use of mill scale | Mill scale is collected and used on site or off site, e.g. in iron and steel production or in cement production. | Generally applicable. |
| d. Use of metallic scrap | Metallic scrap from mechanical processes (e.g. from trimming and finishing) is used in iron and steel production. This may take place on site or off site. | Generally applicable. |
| e. Recycling of metal and metal oxides from dry waste gas cleaning | The coarse fraction of metal and metal oxides originating from dry cleaning (e.g. fabric filters) of waste gases from mechanical processes (e.g. scarfing or grinding) is selectively isolated using mechanical techniques (e.g. sieves) or magnetic techniques and recycled, e.g. to iron and steel production. This may take place on site or off site. | Generally applicable. |
| f. Use of oily sludge | Residual oily sludge, e.g. from degreasing, is dewatered to recover the oil contained therein for material or energy recovery. If the water content is low, the sludge can be directly used. This may take place on site or off site. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| g. Thermal treatment of hydroxide sludge from the recovery of mixed acid | Sludge generated from the recovery of mixed acid is thermally treated in order to produce a material rich in calcium fluoride that can be used in argon oxygen decarburisation converters. | Applicability may be restricted by a lack of space. |
| h. Recovery and reuse of shot blast media | Where mechanical descaling is carried out by shot blasting, the shot blast media are separated from the scale and reused. | Generally applicable. |

## BAT 30: Residues from hot dip coating

To reduce the quantity of waste sent for disposal from hot dipping, BAT is to avoid the disposal of zinc-containing residues by using all of the techniques given below.

Table 35: Techniques to reduce zinc-based residues from hot dip coating

| Technique | Description | Applicability |
|---|---|---|
| a. Recycling of fabric filter dust | Dust from fabric filters containing ammonium chloride and zinc chloride is collected and reused, e.g. to produce fluxing agents. This may take place on site or off site. | Only applicable in hot dipping after fluxing. Applicability may be restricted depending on the availability of a market. |
| b. Recycling of zinc ash and top dross | Metallic zinc is recovered from zinc ash and top dross by melting in recovery furnaces. The remaining zinc-containing residue is used, e.g. for zinc oxide production. This may take place on site or off site. | Generally applicable. |
| c. Recycling of bottom dross | Bottom dross is used, e.g. in the non-ferrous metals industries to produce zinc. This may take place on site or off site. | Generally applicable. |

## BAT 31: Residues from hot dip coating (storage)

To improve the recyclability and recovery potential of the zinc-containing residues from hot dipping (i.e. zinc ash, top dross, bottom dross, zinc splashes, and fabric filter dust) as well as to prevent or reduce the environmental risk associated with their storage, BAT is to store them separately from each other and from other residues on:

a. impermeable surfaces, in enclosed areas and in closed containers/bags, for fabric filter dust;
b. impermeable surfaces and in covered areas protected from surface run-off water, for all the other residue types above.

## BAT 32: Reduction of waste from texturing of working rolls

To increase material efficiency and to reduce the quantity of waste sent for disposal from texturing of working rolls, BAT is to use all of the techniques given below.

Table 36: Reduction of waste from texturing of working rolls

| Technique | Description |
|---|---|
| a. Cleaning and reuse of grinding emulsion | Grinding emulsions are treated using lamellar or magnetic separators or using a sedimentation / clarification process in order to remove the grinding sludge and reuse the grinding emulsion. |
| b. Treatment of grinding sludge | Treatment of grinding sludge by magnetic separation for recovery of metal particles and recycling of metals, e.g. to iron and steel production. |
| c. Recycling of worn working rolls | Worn working rolls which are unsuitable for texturing are recycled to iron and steel production or returned to the manufacturer for refabrication. |

Further sector-specific techniques to reduce the quantity of waste sent for disposal are given in BAT 33 and BAT 34 of these BAT conclusions.

# BAT conclusions for wire drawing

## BAT 33: Residues from wire drawing

To reduce the quantity of waste sent for disposal, BAT is to avoid the disposal of lead-containing residues by recycling them, e.g. to the non-ferrous metals industries to produce lead.

## BAT 34: Residues from wire drawing (storage)

To prevent or reduce the environmental risk associated with the storage of lead-containing residues from lead baths (e.g. protective layer materials and lead oxides), BAT is to store lead-containing residues separately from other residues, on impermeable surfaces and in enclosed areas or in closed containers.

# BAT conclusions – emissions

This section describes BATC where there is a BAT-AEL associated. Where the descriptive flow requires, other non-BAT-AEL BATC can also be included here. It is expected that emissions to air, land and water will be included in this section. This section should cover BATC associated with noise and odour. BAT-AEL can be included.

## BAT 35: Emissions to air from heating

To prevent or reduce dust emissions to air from heating, BAT is to use either technique (a) in combination with technique (c), or technique (b) in combination with techniques (c) and /or (d) given below.

Table 37: Techniques to reduce emissions to air from heating

| Technique | Description | Applicability |
|---|---|---|
| a. Electrical heating | Preferably using electricity generated from fossil-free energy sources or from sources with low carbon intensity such as CHP from waste heat. | Generally applicable. |
| b. Use of fuels with low dust and ash content | Fuels with low dust and ash content include e.g. natural gas, liquefied petroleum gas, dedusted blast furnace gas, dedusted coke oven gas and dedusted basic oxygen furnace gas. | Generally applicable. |
| c. Limiting the entrainment of dust | Entrainment of dust is limited by for example:<br>· as far as practically possible, use of clean feedstock or cleaning the feedstock of loose scale and dust before feeding it into the furnace;<br>· minimisation of dust generation from refractory lining damage by e.g. using ceramic coatings on the refractory lining. | Generally applicable. |
| d. Limiting the entrainment of dust from heating from combustion | For heating from combustion:<br>· avoiding direct contact of the flames with the Feedstock.<br>· avoiding direct contact of the flames with the refractory lining. | Avoiding direct contact of the flames with the feedstock is not applicable in the case of direct flame furnaces. |

## BAT-associated emission levels (BAT-AELs) for channelled dust emissions to air from feedstock heating

Table 38: BAT-associated emission levels (BAT-AELs) for channelled dust emissions to air from feedstock heating

| Parameter | Sector | Unit | BAT-AEL ([1]) (Daily average or average over the sampling period) |
|---|---|---|---|
| Dust | Hot rolling | $mg/Nm^3$ | < 2–10 |
| Dust | Cold rolling | $mg/Nm^3$ | < 2–10 |
| Dust | Wire drawing | $mg/Nm^3$ | < 2–10 |
| Dust | Hot dip coating | $mg/Nm^3$ | < 2–10 |

[1] The BAT-AEL does not apply when the dust mass flow is below 100 g/h

The associated monitoring is given in BAT 6.

# BAT 36: Emissions to air of $SO_2$ from heating

To prevent or reduce $SO_2$ emissions to air from heating, BAT is to use either electricity (preferably using electricity generated from fossil-free energy sources or from sources with low carbon intensity such as CHP from waste heat), or a fuel, or a combination of fuels, with low sulphur content.

## Description

Fuels with low sulphur content include e.g. natural gas, liquefied petroleum gas, blast furnace gas, basic oxygen furnace gas and CO-rich gas from ferrochromium production.

## BAT-associated emission levels (BAT-AELs) for channelled $SO_2$ emissions to air from feedstock heating

Table 39: BAT-associated emission levels (BAT-AELs) for channelled $SO_2$ emissions to air from feedstock heating

| **Parameter** | **Sector** | **Unit** | **BAT-AEL (Daily average or average over the sampling period)** |
|---|---|---|---|
| $SO_2$ | Hot rolling | $mg/Nm^3$ | 50–200 ([1]) ([2]) |
| $SO_2$ | Cold rolling, wire drawing hot dip coating of sheets | $mg/Nm^3$ | 20–100 ([1]) |

[1] The BAT-AEL does not apply to plants using 100 % natural gas or 100 % electrical heating.

[2] The higher end of the BAT-AEL range may be higher and up to 300 $mg/Nm^3$ when using a high share of coke oven gas (> 50 % of energy input).

The associated monitoring is given in BAT 6.

## BAT 37: Emissions to air of $NO_X$ from heating

To prevent or reduce $NO_X$ emissions to air from heating while limiting CO emissions and the emissions of $NH_3$ from the use of SNCR and/or SCR, BAT is to use either electricity (preferably using electricity generated from fossil-free energy sources or from sources with low carbon intensity such as CHP from waste heat) or an appropriate combination of the techniques given below.

Table 40: Techniques to reduce emissions to air of $NO_X$ from heating

| **Technique** | **Description** | **Applicability** |
|---|---|---|
| a. Reduction of generation of emissions: Use of a fuel or a combination of fuels with low NOX formation potential. | Fuels with a low $NO_X$ formation potential, e.g. natural gas, liquefied petroleum gas, blast furnace gas and basic oxygen furnace gas. | Generally applicable. |
| b. Reduction of generation of emissions: | See table 5. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| Furnace automation and control | | |
| c. Reduction of generation of emissions: Combustion optimisation | See table 5.<br>Generally used in combination with other techniques. | Generally applicable. |
| d. Reduction of generation of emissions: Low-$NO_X$ burners | See table 5. | Applicability may be restricted at existing plants by design and/or operational constraints. |
| e. Reduction of generation of emissions: Flue-gas recirculation | Recirculation (external) of part of the flue-gas to the combustion chamber to replace part of the fresh combustion air, with the dual effect of lowering the temperature and limiting the $O_2$ content for nitrogen oxidation, thus limiting the $NO_X$ generation. It implies the supply of flue-gas from the furnace into the flame to reduce the oxygen content and therefore the temperature of the flame. | Applicability to existing plants may be restricted by a lack of space. |

| Technique | Description | Applicability |
| --- | --- | --- |
| f. Reduction of generation of emissions: Limiting the temperature of air preheating | Limiting the air preheating temperature leads to a decrease of the concentration of $NO_X$ emissions.<br><br>A balance has to be achieved between maximising heat recovery from the flue-gas and minimising $NO_X$ emissions. | May not be applicable in the case of furnaces equipped with radiant tubes burners. May not be applicable where the furnace or burner design do not incorporate practical means of reducing air preheat temperature independent of other operating conditions.<br><br>A balance must be achieved between reducing $NO_X$ emissions and the efficiency of the furnaces.<br><br>For some existing plant designs, such as first generation regenerative burners, it may not be possible to operate within the BAT AEL range while preheating. Where this is the case, it is not considered BAT to remove preheating or reduce the temperature if this increases $CO_2$ emissions. The best overall environmental benefits should be considered. |
| g. Reduction of generation of emissions: Flameless combustion | See table 5. | Applicability to existing plants may be limited by furnace design (i.e. furnace volume, space for burners, distance between burners) and the need for a change of the refractory lining.<br><br>Applicability may be limited for processes where close control of the temperature or temperature profile is required (e.g. re-crystallisation).<br><br>Not applicable to furnaces operating at a temperature lower than the auto-ignition temperature required for flameless combustion, or to furnaces equipped with radiant tube burners. |

| Technique | Description | Applicability |
|---|---|---|
| h. Reduction of generation of emissions: Oxy-fuel combustion | See table 5. | Applicability may be restricted for furnaces processing high-alloy steel.<br>Applicability to existing plants may be restricted by furnace design and the need for a minimum waste gas flow.<br>Not applicable to furnaces equipped with radiant tube burners. |
| i. Waste gas treatment: Selective catalytic reduction (SCR) | See table 5. | Applicability to existing plants may be restricted by a lack of space.<br>The variable operating conditions of many reheating furnaces mean that the point where the temperature is optimal for ammonia injection may change and $NO_X$ reduction efficiency can be significantly lower than in more stable combustion processes.<br>Applicability may be restricted in batch annealing due to the varying temperatures during the annealing cycle. |
| j. Waste gas treatment: Selective non-catalytic reduction (SNCR) | See table 5. | Applicability to existing plants may be restricted by the optimum temperature window and the residence time needed for the reaction.<br>The variable operating conditions of many reheating furnaces mean that the point where the temperature is optimal for ammonia injection may change and $NO_X$ reduction efficiency can be significantly lower than in more stable combustion processes.<br>Applicability may be restricted in batch annealing due to the varying temperatures during the annealing cycle. |

| Technique | Description | Applicability |
|---|---|---|
| k. Waste gas treatment: Optimisation of the SNCR/SCR design and operation | See table 5. | Only applicable where SNCR/SCR is used for the reduction of $NO_X$ emissions. |

## BAT-associated emission levels (BAT-AELs) for channelled $NO_X$ emissions to air and indicative emission levels for channelled CO emissions to air from feedstock heating in hot rolling

Table 41: BAT-associated emission levels (BAT-AELs) for channelled $NO_X$ emissions to air and indicative emission levels for channelled CO emissions to air from feedstock heating in hot rolling

| Parameter | Type of fuel | Specific process | Unit | BAT-AEL (Daily average or average over the sampling period) | Indicative emission level (Daily average or average over the sampling period) |
|---|---|---|---|---|---|
| $NO_X$ | 100 % natural gas | Reheating | mg/Nm$^3$ | New plants: 80–200<br>Existing plants: 100–350 | No indicative level |
| $NO_X$ | 100 % natural gas | Intermediate heating | mg/Nm$^3$ | 100–250 | No indicative level |
| $NO_X$ | 100 % natural gas | Post-heating | mg/Nm$^3$ | 100–200 | No indicative level |
| $NO_X$ | Other fuels | Reheating, intermediate heating, post-heating | mg/Nm$^3$ | 100–350 (1)(2) | No indicative level |
| CO | 100 % natural gas | Reheating | mg/Nm$^3$ | No BAT-AEL | 10–50 |
| CO | 100 % natural gas | Intermediate heating | mg/Nm$^3$ | No BAT-AEL | 10–100 |

| Parameter | Type of fuel | Specific process | Unit | BAT-AEL (Daily average or average over the sampling period) | Indicative emission level (Daily average or average over the sampling period) |
|---|---|---|---|---|---|
| CO | 100 % natural gas | Post-heating | $mg/Nm^3$ | No BAT-AEL | 10–100 |
| CO | Other fuels | Reheating, intermediate heating, post-heating | $mg/Nm^3$ | No BAT-AEL | 10–50 |

[1] The higher end of the BAT-AEL range may be exceeded when using a high share of coke oven gas or of CO-rich gas from ferrochromium production (> 50 % of energy input). In this case, the higher end of the BAT-AEL range is 550 $mg/Nm^3$.

[2] At time of publication there is insufficient data to specify an appropriate BAT-AEL, when using hydrogen or natural gas enhanced with hydrogen. Reference should be made to any subsequently published studies when setting ELVs for the use of such fuels.

## BAT-associated emission levels (BAT-AELs) for channelled $NO_X$ emissions to air and indicative emission levels for channelled CO emissions to air from feedstock heating in cold rolling

Table 42: BAT-associated emission levels (BAT-AELs) for channelled $NO_X$ emissions to air and indicative emission levels for channelled CO emissions to air from feedstock heating in cold rolling

| Parameter | Type of fuel | Unit | **BAT-AEL** (Daily average or average over the sampling period) | **Indicative emission level** (Daily average or average over the sampling period) |
|---|---|---|---|---|
| $NO_X$ | 100 % natural gas | $mg/Nm^3$ | 100–250 ([1]) | No indicative level |
| $NO_X$ | Other fuels | $mg/Nm^3$ | 100–300 ([2])([3]) | No indicative level |
| CO | 100 % natural gas | $mg/Nm^3$ | No BAT-AEL | 10–50 |

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| Parameter | Type of fuel | Unit | **BAT-AEL** (Daily average or average over the sampling period) | **Indicative emission level** (Daily average or average over the sampling period) |
|---|---|---|---|---|
| CO | Other fuels | $mg/Nm^3$ | No BAT-AEL | 10–100 |

[1] The higher end of the BAT-AEL range may be exceeded in continuous annealing. In this case, the higher end of the BAT-AEL range is 300 $mg/Nm^3$.

[2] The higher end of the BAT-AEL range may be exceeded when using a high share of coke oven gas or of CO-rich gas from ferrochromium production (> 50 % of energy input). In this case, the higher end of the BAT-AEL range is 550 $mg/Nm^3$.

[3] At time of publication there is insufficient data to specify an appropriate BAT-AEL, when using hydrogen or natural gas enhanced with hydrogen. Reference should be made to any subsequently published studies when setting ELVs for the use of such fuels.

## BAT-associated emission level (BAT-AEL) for channelled $NO_x$ emissions to air and indicative emission level for channelled CO emissions to air from feedstock heating in wire drawing

Table 43: BAT-associated emission level (BAT-AEL) for channelled $NO_X$ emissions to air and indicative emission level for channelled CO emissions to air from feedstock heating in wire drawing

| Parameter | Unit | **BAT-AEL** (Daily average or average over the sampling period) | **Indicative emission level** (Daily average or average over the sampling period) |
|---|---|---|---|
| $NO_X$ | $mg/Nm^3$ | 100–250 ([1]) | No indicative level |
| CO | $mg/Nm^3$ | No BAT-AEL | 10–50 |

[1] At time of publication there is insufficient data to specify an appropriate BAT-AEL, when using hydrogen or natural gas enhanced with hydrogen. Reference should be made to any subsequently published studies when setting ELVs for the use of such fuels.

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## BAT-associated emission level (BAT-AEL) for channelled $NO_X$ emissions to air and indicative emission level for channelled CO emissions to air from feedstock heating in hot dip coating

Table 44: BAT-associated emission level (BAT-AEL) for channelled $NO_X$ emissions to air and indicative emission level for channelled CO emissions to air from feedstock heating in hot dip coating

| **Parameter** | **Unit** | **BAT-AEL** (Daily average or average over the sampling period) | **Indicative emission level** (Daily average or average over the sampling period) |
|---|---|---|---|
| $NO_X$ | mg/Nm$^3$ | 100–300 ([1])([2]) | No indicative level |
| CO | mg/Nm$^3$ | No BAT-AEL | 10–100 |

[1] The higher end of the BAT-AEL range may be exceeded when using a high share of coke oven gas or of CO-rich gas from ferrochromium production (> 50 % of energy input). In this case, the higher end of the BAT-AEL range is 550 mg/Nm$^3$.

[2] At time of publication there is insufficient data to specify an appropriate BAT-AEL, when using hydrogen or natural gas enhanced with hydrogen. Reference should be made to any subsequently published studies when setting ELVs for the use of such fuels.

The associated monitoring is given in BAT 6.

# BAT 38: Emissions to air from degreasing

To reduce emissions to air of oil mist, acids and/or alkalis from degreasing in cold rolling and hot dip coating of sheets, BAT is to collect emissions by using technique (a) and to treat the waste gas by using technique (b) and/or technique (c) given below.

Table 45: Techniques to reduce emissions to air from degreasing in cold rolling and hot dip coating of sheets

| **Technique** | **Description** |
|---|---|
| a. Collection of emissions: Closed degreasing tanks combined with air extraction in the case of continuous degreasing | Degreasing is carried out in closed tanks and air is extracted. |
| b. Waste gas treatment: Wet scrubbing | See table 5. |
| c. Waste gas treatment: Demister | See table 5. |

This draft document should not be used for reference until the final version is published (expected at the end of 2025).

The associated monitoring is given in BAT 6.

## BAT 39: Emissions to air from pickling

To reduce emissions to air of dust, acids (HCl, HF, $H_2SO_4$) and $SO_X$ from pickling in hot rolling, cold rolling, and wire drawing, BAT is to use technique (a) or (b) in combination with technique (c) given below.

Table 46: Techniques to reduce emissions to air of dust, acids (HCl, HF, $H_2SO_4$) and $SO_X$ from pickling in hot rolling, cold rolling, and wire drawing

| Technique | Description |
|---|---|
| a. Collection of emissions: Continuous pickling in closed tanks combined with fume extraction | Continuous pickling is carried out in closed tanks with limited entry and exit openings for the steel strip or wire. The fumes from the pickling tanks are extracted. |
| b. Collection of emissions: Batch pickling in tanks equipped with lids or enclosing hoods combined with fume extraction | Batch pickling is carried out in tanks equipped with lids or enclosing hoods that can be opened to allow charging of the wire rod coils. The fumes from the pickling tanks are extracted. |
| c. Waste gas treatment: Wet scrubbing followed by a demister | See table 5. |

### BAT-associated emission levels (BAT-AELs) for channelled emissions of HCl, HF and $SO_X$ to air from pickling in hot rolling and cold rolling

Table 47: BAT-associated emission levels (BAT-AELs) for channelled emissions of HCl, HF and $SO_X$ to air from pickling in hot rolling and cold rolling

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| HCl | $mg/Nm^3$ | < 2–10 ([1]) |
| HF | $mg/Nm^3$ | < 1 ([2])([3]) |
| $SO_X$ | $mg/Nm^3$ | < 1–6 ([4]) |

[1] This BAT-AEL only applies to pickling with hydrochloric acid.

[2] This BAT-AEL only applies to pickling with acid mixtures containing hydrofluoric acid.

[3] For existing plant the higher end of the BAT-AEL range is 1.5 mg/m$^3$ for pickling with $H_2SO_4$/HF mixed acids.

[4] This BAT-AEL only applies to pickling with sulphuric acid.

## BAT-associated emission level (BAT-AEL) for channelled HCl and $SO_X$ emissions to air from pickling with hydrochloric acid or sulphuric acid in wire drawing

Table 48: BAT-associated emission level (BAT-AEL) for channelled HCl and $SO_X$ emissions to air from pickling with hydrochloric acid or sulphuric acid in wire drawing

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| HCl | mg/Nm$^3$ | < 2–10 (1) |
| $SO_X$ | mg/Nm$^3$ | < 1–6 (2) |

[1] This BAT-AEL only applies to pickling with hydrochloric acid.

[2] This BAT-AEL only applies to pickling with sulphuric acid.

The associated monitoring is given in BAT 6.

# BAT 40: Emissions to air from pickling

To reduce $NO_X$ emissions to air from pickling with nitric acid (alone or in combination with other acids) and the emissions of $NH_3$ from the use of SCR, in hot rolling and cold rolling, BAT is to use one or a combination of the techniques given below.

Table 49: Techniques to reduce $NO_X$ emissions to air from pickling with nitric acid (alone or in combination with other acids) and the emissions of $NH_3$ from the use of SCR, in hot rolling and cold rolling

| Technique | Description | Applicability |
|---|---|---|
| a. Reduction of generation of emissions: Nitric- | Pickling of high-alloy steel is carried out by fully substituting nitric acid with a strong oxidising agent (e.g. hydrogen peroxide). | Only applicable to new plants and major plant upgrades. |

| Technique | Description | Applicability |
|---|---|---|
| acid-free pickling of high-alloy steel | | |
| b. Reduction of generation of emissions: Addition of hydrogen peroxide or urea to the pickling acid | Hydrogen peroxide or urea is added directly to the pickling acid to reduce $NO_X$ emissions. | Generally applicable. |
| c. Collection of emissions: Continuous pickling in closed tanks combined with fume extraction | Continuous pickling is carried out in closed tanks with limited entry and exit openings for the steel strip or wire. The fumes from the pickling bath are extracted. | Generally applicable. |
| d. Collection of emissions: Batch pickling in tanks equipped with lids or enclosing hoods combined with fume extraction | Batch pickling is carried out in tanks equipped with lids or enclosing hoods that can be opened to allow charging of the wire rod coils. The fumes from the pickling tanks are extracted. | Generally applicable. |
| e. Waste gas treatment: Wet scrubbing with addition of an oxidising agent (e.g. hydrogen peroxide) | See table 5. An oxidising agent (e.g. hydrogen peroxide) is added to the scrubbing solution to reduce $NO_X$ emissions. When using hydrogen peroxide, the nitric acid formed can be recycled to the pickling tanks. | Generally applicable. |
| f. Waste gas treatment: Selective catalytic reduction (SCR) | See table 5. | Applicability to existing plants may be restricted by a lack of space. |
| g. Waste gas treatment: Optimisation of the SCR design and operation | See table 5. | Only applicable where SCR is used for the reduction of $NO_X$ emissions. |

## BAT-associated emission level (BAT-AEL) for channelled $NO_X$ emissions to air from pickling with nitric acid (alone or in combination with other acids) in hot rolling and cold rolling

Table 50: BAT-associated emission level (BAT-AEL) for channelled $NO_X$ emissions to air from pickling with nitric acid (alone or in combination with other acids) in hot rolling and cold rolling

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| $NO_X$ | mg/Nm$^3$ | 10–200 |

The associated monitoring is given in BAT 6.

## BAT 41: Emissions to air from hot dipping

To reduce emissions to air of dust and zinc from hot dipping after fluxing in hot dip coating of wires, BAT is to reduce the generation of emissions by using technique (b), or techniques (a) and (b), to collect the emissions by using technique (c) or technique (d), and to treat the waste gases by using technique (e) given below.

Table 51: Techniques to reduce emissions to air of dust and zinc from hot dipping after fluxing in hot dip coating of wires

| Technique | Description | Applicability |
|---|---|---|
| a. Reduction of generation of emissions: Low-fume flux | Ammonium chloride in fluxing agents is partly substituted with other alkali chlorides (e.g. potassium chloride) to reduce dust formation. | Applicability may be restricted due to product specifications. |
| b. Reduction of generation of emissions: Minimisation of carry-over of the fluxing solution | This includes techniques such as: allowing enough time for the fluxing solution to drip off (see BAT 14 (b)); drying before dipping. | Generally applicable. |
| c. Collection of emissions: Air extraction as close as possible to the source | Air from the kettle is extracted, for example using lateral hood or lip extraction. | Generally applicable. |
| d. Collection of emissions: Enclosed kettle combined with air extraction | Hot dipping is carried out in an enclosed kettle and air is extracted. | Generally applicable. |
| e. Waste gas treatment: Fabric filter | See table 5. | Generally applicable. |

## BAT-associated emission level (BAT-AEL) for channelled dust emissions to air from hot dipping after fluxing in hot dip coating of wires

Table 52: BAT-associated emission level (BAT-AEL) for channelled dust emissions to air from hot dipping after fluxing in hot dip coating of wires

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| Dust | mg/Nm$^3$ | < 2–5 |

The associated monitoring is given in BAT 6.

# BAT 42: Emissions to air from oiling

To prevent oil mist emissions to air and to reduce the consumption of oil from oiling of the feedstock surface, BAT is to use one of the techniques given below.

Table 53: Techniques to reduce emissions to air from oiling

| Technique | Description |
|---|---|
| a. Electrostatic oiling | Oil is sprayed on the metal surface through an electrostatic field, which ensures homogeneous oil application and optimises the quantity of oil applied. The oiling machine is enclosed and oil that does not deposit on the metal surface is recovered and reused within the machine. |
| b. Contact lubrication | Roller lubricators, e.g. felt rolls or squeeze rolls, are used in direct contact with the metal surface. |
| c. Oiling without compressed air | Oil is applied with nozzles close to the metal surface using high-frequency valves. |

# BAT 43: Emissions to air from post-treatment

To reduce emissions to air from chemical baths or tanks in post-treatment (i.e. phosphating and passivation), BAT is to collect the emissions by using technique (a) or technique (b), and in that case to treat the waste gas by using technique (c) and/or technique (d) given below.

Table 54: Techniques to reduce emissions to air from post-treatment

| Technique | Description | Applicability |
|---|---|---|
| a. Collection of emissions: Air extraction as close as possible to the source | Emissions from the chemical storage tanks and chemical baths are captured, e.g. by using one or a combination of the following techniques:<br>· lateral hood or lip extraction;<br>· tanks equipped with moveable lids;<br>· enclosing hoods;<br>· placing the baths in enclosed areas.<br>The captured emissions are then extracted. | Only applicable when the treatment is carried out by spraying or when volatile substances are used. |
| b. Collection of emissions: Closed tanks combined with air extraction in the case of continuous post-treatment | Phosphating and passivation are carried out in closed tanks and the air is extracted from the tanks. | Only applicable when the treatment is carried out by spraying or when volatile substances are used. |
| c. Waste gas treatment: Wet scrubbing | See table 5. | Generally applicable. |
| d. Waste gas treatment: Demister | See table 5. | Generally applicable. |

# BAT 44: Emissions to air from acid recovery

To reduce emissions to air from the recovery of spent acid of dust, acids (HCl, HF), $SO_2$, NOx (while limiting CO emissions) and the emissions of $NH_3$ from the use of SCR, BAT is to use a combination of the techniques given below.

Table 55: Techniques to reduce emissions to air from acid recovery

| Technique | Description | Applicability |
|---|---|---|
| a. Use of a fuel or a combination of fuels with low sulphur content and/or low $NO_X$ formation potential | See BAT 36 and BAT 37 (a). | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| b. Combustion optimisation | See table 5.<br>Generally used in combination with other techniques. | Generally applicable. |
| c. Low-$NO_X$ burners | See table 5. | Applicability may be restricted at existing plants by design and/or operational constraints. |
| d. Wet scrubbing followed by a demister | See table 5.<br>In the case of mixed acid recovery, an alkali is added to the scrubbing solution to remove traces of HF and/or an oxidising agent (e.g. hydrogen peroxide) is added to the scrubbing solution to reduce $NO_X$ emissions. When using hydrogen peroxide, the nitric acid formed can be recycled to the pickling tanks. | Generally applicable. |
| e. Selective catalytic reduction (SCR) | See table 5. | Applicability to existing plants may be restricted by a lack of space. |
| f. Optimisation of the SCR design and operation | See table 5. | Only applicable where SCR is used for the reduction of $NO_X$ emissions. |

## BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, HCl, $SO_2$ and $NO_X$ to air from the recovery of spent hydrochloric acid by spray roasting or by using fluidised bed reactors

Table 56: BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, HCl, $SO_2$ and $NO_X$ to air from the recovery of spent hydrochloric acid by spray roasting or by using fluidised bed reactors

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| Dust | $mg/Nm^3$ | < 2–15 |
| HCl | $mg/Nm^3$ | < 2–15 |

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| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
| --- | --- | --- |
| $SO_2$ | mg/Nm$^3$ | < 10 |
| $NO_X$ | mg/Nm$^3$ | 50–180 |

## BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, HF and $NO_X$ to air from the recovery of mixed acid by spray roasting or evaporation

Table 57: BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, HF and $NO_X$ to air from the recovery of mixed acid by spray roasting or evaporation

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
| --- | --- | --- |
| Dust | mg/Nm$^3$ | < 2–10 |
| HF | mg/Nm$^3$ | < 1 |
| $NO_X$ | mg/Nm$^3$ | 50–100 ([1]) |

[1] The higher end of the BAT-AEL range may be higher and up to 200 mg/Nm$^3$ in the case of recovery of mixed acid by spray roasting.

The associated monitoring is given in BAT 6.

## BAT conclusions for hot rolling

Additional BAT conclusions for hot rolling.

## BAT 45: Emissions to air – hot rolling

To reduce emissions to air of dust, nickel and lead in mechanical processing, scarfing and welding, BAT is to collect the emissions by using techniques (a) and (b) and in that case to treat the waste gas by using one or a combination of the techniques (c) to (e) given below.

Table 58: Techniques to reduce emissions to air of dust, nickel and lead from mechanical processing, scarfing and welding in hot rolling

| Technique | Description | Applicability |
|---|---|---|
| a. Collection of emissions: Enclosed scarfing and grinding combined with air extraction | Scarfing (other than manual scarfing) and grinding operations are carried out completely enclosed (e.g. under closed hoods) and air is extracted. | Generally applicable. |
| b. Collection of emissions: Air extraction as close as possible to the emission source | Emissions from slitting, descaling, roughing, rolling, finishing, levelling and welding are collected, for example using hood or lip extraction. For roughing and rolling, in the case of low levels of dust generation, e.g. below 100 g/h, water sprays can be used instead (see BAT 46). | May not be applicable for welding in the case of low levels of dust generation, e.g. below 50 g/h. |
| c. Waste gas treatment: Electrostatic precipitator | See table 5. | Generally applicable. |
| d. Waste gas treatment: Fabric filter | See table 5. | May not be applicable in the case of waste gases with a high moisture content. |
| e. Waste gas treatment: Wet scrubbing | See table 5. | Generally applicable. |

## BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, lead and nickel to air from mechanical processing, scarfing (other than manual scarfing) and welding

Table 59: BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, lead and nickel to air from mechanical processing, scarfing (other than manual scarfing) and welding

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| Dust | mg/Nm$^3$ | < 2–5 ([1]) |
| Ni | mg/Nm$^3$ | 0.01–0.1 ([2]) |
| Pb | mg/Nm$^3$ | 0.01–0.035 ([2]) |

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[1] When a fabric filter is not applicable, the higher end of the BAT-AEL range may be higher and up to 7 mg/Nm$^3$.

[2] The BAT-AEL only applies when the substance concerned is identified as relevant in the waste gas stream based on the inventory given in BAT 2

The associated monitoring is given in BAT 6.

## BAT 46: Emissions to air – hot rolling

To reduce emissions to air of dust, nickel and lead in roughing and rolling in the case of low levels of dust generation (e.g. below 100 g/h (see BAT 45(b))), BAT is to use water sprays.

### Description

Water spraying injection systems are installed at the exit side of each roughing and rolling stand to abate dust generation. The humidification of dust particles facilitates agglomeration and dust settling. The water is collected at the bottom of the stand and treated (see BAT 54).

## BAT conclusions for cold rolling

Additional BAT conclusions for cold rolling.

## BAT 47: Cold rolling - emissions to air of dust, nickel and lead from decoiling, mechanical predescaling, levelling and welding

To reduce emissions to air of dust, nickel and lead from decoiling, mechanical predescaling, levelling and welding, BAT is to collect the emissions by using technique (a) and in that case to treat the waste gas by using technique (b).

Table 60: Techniques to reduce emissions to air of dust, nickel and lead from decoiling, mechanical predescaling, levelling and welding in cold rolling

| Technique | Description | Applicability |
|---|---|---|
| a. Collection of emissions: Air extraction as close as possible to the emission source | Emissions from decoiling, mechanical predescaling, levelling and welding are collected, for example using hood or lip extraction. | May not be applicable for welding in the case of low levels of dust generation e.g. below 50 g/h. |
| b. Waste gas treatment: Fabric filter | See table 5. | Generally applicable. |

## BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, nickel and lead to air from decoiling, mechanical predescaling, levelling and welding

Table 61: BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, nickel and lead to air from decoiling, mechanical predescaling, levelling and welding

| **Parameter** | **Unit** | **BAT-AEL (Daily average or average over the sampling period)** |
|---|---|---|
| Dust | $mg/Nm^3$ | < 2–5 |
| Ni | $mg/Nm^3$ | 0.01–0.1 ([1]) |
| Pb | $mg/Nm^3$ | ≤ 0.003 ([1]) |

[1] The BAT-AEL only applies when the substance concerned is identified as relevant in the waste gas stream based on the inventory given in BAT 2

The associated monitoring is given in BAT 6.

## BAT 48: Cold rolling - oil mist emissions to air from tempering

To prevent or reduce oil mist emissions to air from tempering, BAT is to use one of the techniques given below.

Table 62: Techniques to reduce emissions to air of oil mist from tempering in cold rolling

| **Technique** | **Description** | **Applicability** |
|---|---|---|
| a. Dry tempering | No water or lubricants are used for tempering. | Not applicable to tinplate packaging products and other products with high elongation requirements. |

| Technique | Description | Applicability |
|---|---|---|
| b. Low-volume lubrication in wet tempering | Low-volume lubrication systems are employed to supply precisely the amount of lubricants needed for reducing the friction between the working rolls and the feedstock. | Applicability may be restricted due to product specifications in the case of stainless steel. |

## BAT 49: Cold rolling - oil mist emissions to air from rolling, wet tempering and finishing

To reduce oil mist emissions to air from rolling, wet tempering and finishing, BAT is to use technique (a) in combination with technique (b) or in combination with both techniques (b) and (c) given below.

Table 63: Techniques to reduce oil mist emissions to air from rolling, wet tempering and finishing in cold rolling

| Technique | Description |
|---|---|
| a. Collection of emissions: Air extraction as close as possible to the emission source | Emissions from rolling, wet tempering and finishing are collected, for example using hood or lip extraction. |
| b. Waste gas treatment: Demister | See table 5. |
| c. Waste gas treatment: Oil mist separator | Separators containing baffle packing, impingement plates or mesh pads are used to separate the oil from the extracted air. |

### BAT-associated emission level (BAT-AEL) for channelled TVOC emissions to air from rolling, wet tempering and finishing

Table 64: BAT-associated emission level (BAT-AEL) for channelled TVOC emissions to air from rolling, wet tempering and finishing

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| TVOC | $mg/Nm^3$ | < 3–8 |

The associated monitoring is given in BAT 6.

## BAT conclusions for wire drawing

Additional BAT conclusions for wire drawing.

## BAT 50: Wire drawing – emissions to air of dust and lead from lead baths

To reduce emissions to air of dust and lead from lead baths, BAT is to use all of the techniques given below.

Table 65: Techniques to reduce emissions to air of dust and lead from lead baths in wire drawing

| Technique | Description |
|---|---|
| a. Reduction of generation of emissions: Minimisation of carry-over of lead | Techniques include the use of anthracite gravel to scrape off lead and the coupling of the lead bath with in-line pickling. |
| b. Reduction of generation of emissions: Floating protective layer or tank cover | See BAT 25.<br>Floating protective layers and tank covers also reduce emissions to air. |
| c. Collection of emissions: Air extraction as close as possible to the emission source | Emissions from the lead bath are collected, for example using hood or lip extraction. |
| d. Waste gas treatment: Fabric filter | See table 5. |

### BAT-associated emission levels (BAT-AELs) for channelled emissions of dust and lead to air from lead baths

Table 66: BAT-associated emission levels (BAT-AELs) for channelled emissions of dust and lead to air from lead baths

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| Dust | $mg/Nm^3$ | < 2 – 5 |
| Pb | $mg/Nm^3$ | ≤ 0.5 |

The associated monitoring is given in BAT 6.

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# BAT 51: Wire drawing - emissions to air of dust from dry drawing

To reduce dust emissions to air from dry drawing, BAT is to collect the emissions by using technique (a) or (b), and to treat the waste gas by using technique (c) given below.

Table 67: Techniques to reduce dust emissions to air from dry drawing in wire drawing

| Technique | Description | Applicability |
|---|---|---|
| a. Collection of emissions: Enclosed drawing machine combined with air extraction | The entire drawing machine is enclosed in order to avoid dispersion of dust and air is extracted. | Applicability to existing plants may be restricted by the plant layout. |
| b. Collection of emissions: Air extraction as close as possible to the emission source | Emissions from the drawing machine are collected, for example using hood or lip extraction. | Generally applicable. |
| c. Waste gas treatment: Fabric filter | See table 5. | Generally applicable. |

## BAT-associated emission level (BAT-AEL) for channelled dust emissions to air from dry drawing

Table 68: BAT-associated emission level (BAT-AEL) for channelled dust emissions to air from dry drawing

| Parameter | Unit | BAT-AEL (Daily average or average over the sampling period) |
|---|---|---|
| Dust | $mg/Nm^3$ | < 2 – 5 |

The associated monitoring is given in BAT 6.

# BAT 52: Wire drawing – emissions to air of oil mist from oil quench baths

To reduce oil mist emissions to air from oil quench baths, BAT is to use both of the techniques given below.

Table 69: Techniques to reduce oil mist emissions to air from oil quench baths in wire drawing

| Technique | Description |
|---|---|

| | |
|---|---|
| a. Air extraction as close as possible to the emission source | Emissions from oil quench baths are collected, for example using lateral hood or lip extraction. |
| b. Demister | See table 5. |

## BAT 53: Emissions to water (separation)

To reduce the load of organic pollutants in water contaminated with oil or grease (e.g. from oil spillages or from the cleaning of rolling and tempering emulsions, degreasing solutions and wire-drawing lubricants) that is sent to further treatment (see BAT 54), BAT is to separate the organic and the aqueous phase.

### Description

The organic phase is separated from the aqueous phase, e.g. by skimming or by emulsion splitting with suitable agents, evaporation or membrane filtration. The organic phase may be used for energy or material recovery (e.g. see BAT 29 (f)).

## BAT 54: Emissions to water

To reduce emissions to water, BAT is to treat wastewater using a combination of the techniques given below.

Table 70: Techniques to reduce emissions to water

| **Technique ([1])** | **Typical pollutants targeted** |
|---|---|
| a. Preliminary, primary and general treatment: Equalisation | All pollutants. |
| b. Preliminary, primary and general treatment: Neutralisation | Acids, alkalis. |
| c. Preliminary, primary and general treatment: Physical separation, e.g. screens, sieves, grit separators, grease separators, hydrocyclones, oil-water separation or primary settlement tanks. | Gross solids, suspended solids, oil/grease. |
| d. Physico-chemical treatment: Adsorption | Adsorbable dissolved non-biodegradable or inhibitory pollutants, e.g. hydrocarbons, mercury. |
| e. Physico-chemical treatment: Chemical precipitation | Precipitable dissolved non-biodegradable or inhibitory pollutants, e.g. metals, phosphorus and fluoride. |

| Technique [1] | Typical pollutants targeted |
|---|---|
| f. Physico-chemical treatment: Chemical reduction | Reducible dissolved non-biodegradable or inhibitory pollutants, e.g. hexavalent chromium. |
| g. Physico-chemical treatment: Nanofiltration / reverse osmosis | Soluble non-biodegradable or inhibitory pollutants, e.g. salts and metals. |
| h. Biological treatment: Aerobic treatment | Biodegradable organic compounds. |
| i. Solids removal: Coagulation and flocculation | Suspended solids and particulate-bound metals. |
| j. Solids removal: Sedimentation | Suspended solids and particulate-bound metals. |
| k. Solids removal: Filtration (e.g. sand filtration, microfiltration, ultrafiltration) | Suspended solids and particulate-bound metals. |
| l. Solids removal: Flotation | Suspended solids and particulate-bound metals. |

[1] The descriptions of the techniques are given in Table 6

## BAT-associated emission levels (BAT-AELs) for direct discharges to a receiving water body

Table 71: BAT-associated emission levels (BAT-AELs) for direct discharges to a receiving water body

| Substance / Parameter | Unit | BAT-AEL [1] | Process(es) to which the BAT-AEL applies |
|---|---|---|---|
| Total suspended solids (TSS) | mg/l | 5–30 | All processes |
| Total organic carbon (TOC) [2] | mg/l | 10–30 | All processes |
| Chemical oxygen demand (COD) [2] | mg/l | 30–90 | All processes |
| Hydrocarbon oil index (HOI) | mg/l | 0.5–4 | All processes |
| Cd | µg/l | 1–5 | All processes [3] |
| Cr | mg/l | 0.01–0.1 [4] | All processes [3] |

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| Substance / Parameter | Unit | BAT-AEL (1) | Process(es) to which the BAT-AEL applies |
|---|---|---|---|
| Cr(VI) | µg/l | 10–50 | Pickling of high-alloy steel or passivation with hexavalent chromium compounds |
| Fe | mg/l | 1–5 | All processes |
| Hg | µg/l | 0.1–0.5 | All processes (3) |
| Ni | mg/l | 0.01–0.2 (5) | All processes (3) |
| Pb | µg/l | 5–20 (6) (7) | All processes (3) |
| Sn | mg/l | 0.01–0.2 | Hot dip coating using tin |
| Zn | mg/l | 0.05–1 | All processes (3) |
| Total phosphorus (P) | mg/l | 0.2–1 | Phosphating |
| Fluoride ($F^-$) | mg/l | 1–15 | Pickling with acid mixtures containing hydrofluoric acid |

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[1] The averaging periods are defined in the general considerations.

[2] Either the BAT-AEL for COD or the BAT-AEL for TOC applies. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.

[3] The BAT-AEL only applies when the substance(s)/parameter(s) concerned is identified as relevant in the wastewater stream based on the inventory mentioned in BAT 2.

[4] The higher end of the BAT-AEL range is 0.3 mg/l in the case of high-alloy steels.

[5] The higher end of the BAT-AEL range is 0.4 mg/l in the case of plants producing austenitic stainless steel or high alloy steel with a nickel content of above 10%.

[6] The higher end of the BAT-AEL range is 35 µg/l in the case of wire drawing plants using lead baths.

[7] The higher end of the BAT-AEL range may be higher and up to 50 µg/l in the case of plants processing leaded steel.

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## BAT-associated emission levels (BAT-AELs) for indirect discharges to a receiving water body

Table 72: BAT-associated emission levels (BAT-AELs) for indirect discharges to a receiving water body

| Substance / Parameter | Unit | BAT-AEL [1][2] | Process(es) to which the BAT-AEL applies |
|---|---|---|---|
| Hydrocarbon oil index (HOI) | mg/l | 0.5–4 | All processes |
| Cd | µg/l | 1–5 | All processes [3] |
| Cr | mg/l | 0.01–0.1 [4] | All processes [3] |
| Cr(VI) | µg/l | 10–50 | Pickling of high-alloy steel or passivation with hexavalent chromium compounds |
| Fe | mg/l | 1–5 | All processes |
| Hg | µg/l | 0.1–0.5 | All processes [3] |
| Ni | mg/l | 0.01–0.2 [5] | All processes [3] |
| Pb | µg/l | 5–20 [6] [7] | All processes [3] |
| Sn | mg/l | 0.01–0.2 | Hot dip coating using tin |
| Zn | mg/l | 0.05–1 | All processes [3] |
| Fluoride ($F^-$) | mg/l | 1–15 | Pickling with acid mixtures containing hydrofluoric acid |



[1] The averaging periods are defined in the general considerations.

[2] The BAT-AELs may not apply if the downstream wastewater treatment plant is designed and equipped appropriately to abate the pollutants concerned, provided this does not lead to a higher level of pollution in the environment.

[3] The BAT-AEL only applies when the substance(s)/parameter(s) concerned is identified as relevant in the wastewater stream based on the inventory mentioned in BAT 2.

[4] The higher end of the BAT-AEL range is 0.3 mg/l in the case of high-alloy steels.

[5] The higher end of the BAT-AEL range is 0.4 mg/l in the case of plants producing austenitic stainless steel or high alloy steel with a nickel content of above 10%.

[6] The higher end of the BAT-AEL range is 35 µg/l in the case of wire drawing plants using lead baths.

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[7] The higher end of the BAT-AEL range may be higher and up to 50 µg/l in the case of plants processing leaded steel.

The associated monitoring is given in BAT 7.

## BAT 55: Emissions to soil and groundwater

To prevent or reduce emissions to soil and groundwater, BAT is to use all of the techniques given below.

Table 73: Techniques to reduce emissions to soil and groundwater

| Technique | Description | Applicability |
|---|---|---|
| a. Set-up and implementation of a plan for the prevention and control of leaks and spillages | A plan for the prevention and control of leaks and spillages is part of the EMS (see BAT 1) and includes, but is not limited to:<br>· site incident plans for small and large spillages;<br>· identification of the roles and responsibilities of persons involved;<br>· ensuring staff are environmentally aware and trained to prevent and deal with spillage incidents;<br>· identification of areas at risk of spillage and/or leaks of hazardous materials and ranking them according to the risk;<br>· identification of suitable spillage containment and clean-up equipment and regularly ensuring it is available, in good working order and close to points where these incidents may occur;<br>· waste management guidelines for dealing with waste arising from spillage control;<br>· regular (at least on an annual basis) inspections of storage and handling areas, testing and calibration of leak detection equipment and prompt repair of leaks from valves, glands, flanges, etc. | The level of detail of the plan will generally be related to the nature, scale and complexity of the plant, as well as to the type and quantity of liquids used. |
| b. Use of oil-tight trays or cellars | Hydraulic stations and oil- or grease-lubricated equipment are situated in oil-tight trays or cellars. | Generally applicable. |
| c. Prevention and handling of acid spillages and leaks | Storage tanks for both fresh and spent acid are equipped with sealed secondary containment protected with an acid-resistant coating which is regularly inspected for potential damage and cracks. Loading and unloading areas for the acids | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| | are designed in such a way that any potential spillages and leaks are contained and sent to on-site treatment (see BAT 54) or off-site treatment. | |

# BAT 56: Noise and vibration

To prevent or, where that is not practicable, to minimise emissions of noise and vibration, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the EMS that includes all the following elements:

a. a protocol containing appropriate actions and timelines;
b. a protocol for conducting noise and vibration monitoring;
c. a protocol for response to identified noise and vibration events, e.g. equipment failure or complaints;
d. a noise and vibration minimisation programme designed to:
    i. emphasize the importance of a site plan annotated to identify sources and also sensitive receptors
    ii. identify the source(s) and sensitive receptors, either potential or existing
    iii. measure/estimate noise and vibration exposures
    iv. to characterise the contributions of the sources
    v. to rank order of the sources
    vi. to implement prevention and/or minimisation measures.

## Applicability:

The applicability is commonly restricted to cases where a noise or vibration impact at sensitive human receptors is expected and/or has been substantiated. However, if there is potential for an adverse noise impact on non-human receptors such as birds, bats, or other protected species or even farm animals, it may be necessary to minimise emissions of noise and vibration on those receptors.

# BAT 57: Noise and vibration abatement

To prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given below.

Table 74: Techniques to reduce noise and vibration abatement

| Technique | Description | Applicability |
|---|---|---|
| a. Use of inherently quiet processes or low-noise equipment | This includes but not limited to techniques such as direct drive motors, low-noise compressors, pumps and fans, variable speed fans, and aerodynamic pipework layout. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| | Opportunities to minimise noise at source should always be sought when equipment is reviewed/replaced. | |
| b. Appropriate site layout to maximise screening and distances | Noise levels can be minimised by orienting equipment and processes with the highest noise impact away from the sensitive receptors, relocating the exits or entrances of the buildings, using buildings as a noise screen, and increasing the distance between the emitter and the receiver. The appropriate site layout may minimise the need for reversing goods vehicles. | For existing plants, the relocation of equipment and the exits or entrances of the buildings may be more difficult due to a lack of space and/or excessive costs. |
| c. Phasing of development and operational measures | These include but not limited to techniques such as:<br>· inspection and maintenance of equipment;<br>· closing of doors and windows of enclosed areas, if possible;<br>· equipment operation by experienced staff;<br>· using sympathetic timings, e.g. avoiding noisy activities at night-time;<br>· provisions for noise control, e.g. during production and maintenance activities, transport and handling of feedstock and materials;<br>· landfill filling sequence;<br>· careful placing instead of dropping off materials. | Generally applicable. |

| Technique | Description | Applicability |
|---|---|---|
| d. Noise and vibration control equipment | This includes but not limited to techniques such as:<br>· rev engine limiters;<br>· acoustic and vibrational insulation of equipment;<br>· enclosure of noisy equipment (e.g. scarfing and grinding machines, wire drawing machines, air jets);<br>· building materials and elements with high sound insulation properties (e.g. for walls, roofs, windows, doors). | Applicability to existing plants may be more difficult due to a lack of space and/or excessive costs. |
| e. Noise abatement and maintenance | Inserting obstacles between emitters and receivers (e.g. protection walls, bunding, noise barriers, embankments and buildings).<br>Changing bearings before noise becomes excessive, maintaining relief valves to prevent chattering.<br>Carrying out monitoring and/or measurement as an operational tool to assist with abatement. | Noise abatement is applicable to existing plants, as the design of new plants should make this technique unnecessary. For existing plants, the insertion of obstacles may be more difficult due to a lack of space and/or excessive costs. |