COMMISSION IMPLEMENTING DECISION (EU) 2022/2110

of 11 October 2022

establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions, for the ferrous metals processing industry

(notified under document C(2022) 7054)

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) ([1]), and in particular Article 13(5) thereof,

Whereas:

(1) Best available techniques (BAT) conclusions are the reference for setting permit conditions for installations covered by Chapter II of Directive 2010/75/EU and competent authorities should set emission limit values which ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the BAT conclusions.

(2) In accordance with Article 13(4) of Directive 2010/75/EU, the forum composed of representatives of Member States, the industries concerned and non-governmental organisations promoting environmental protection, established by Commission Decision of 16 May 2011 ([2]), provided the Commission on 17 December 2021 with its opinion on the proposed content of the BAT reference document for the ferrous metals processing industry. That opinion is publicly available ([3]).

(3) The BAT conclusions set out in the Annex to this Decision take into account the opinion of the forum on the proposed content of the BAT reference document. They contain the key elements of the BAT reference document.

(4) The measures provided for in this Decision are in accordance with the opinion of the Committee established by Article 75(1) of Directive 2010/75/EU,

HAS ADOPTED THIS DECISION:

Article 1

The best available techniques (BAT) conclusions for the ferrous metals processing industry, as set out in the Annex, are adopted.

Article 2

This Decision is addressed to the Member States.

([1]) OJ L 334, 17.12.2010, p. 17.

([2]) Commission Decision of 16 May 2011 establishing a forum for the exchange of information pursuant to Article 13 of Directive 2010/75/EU on industrial emissions (OJ C 146, 17.5.2011, p. 3).

([3]) https://circabc.europa.eu/ui/group/06f33a94-9829-4eee-b187-21bb783a0fbf/library/b8ba39b2-77ca-488a-889b-98e13cee5141/details

Done at Brussels, 11 October 2022.

For the Commission
Virginijus SINKEVIČIUS
Member of the Commission

ANNEX

1. **BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR THE FERROUS METALS PROCESSING INDUSTRY**

SCOPE

These BAT conclusions concern the following activities specified in Annex I to Directive2010/75/EU:

2.3. Processing of ferrous metals:

(a) operation of hot rolling mills with a capacity exceeding 20 tonnes of crude steel per hour;

(c) application of protective fused metal coats with an input exceeding 2 tonnes of crude steel per hour; this includes hot dip coating and batch galvanising.

2.6. Surface treatment of ferrous metals using electrolytic or chemical processes where the volume of the treatment vats exceeds 30 m^3, when it is carried out in cold rolling, wire drawing or batch galvanising.

6.11. Independently operated treatment of waste water not covered by Directive 91/271/EEC, provided that the main pollutant load originates from the activities covered by these BAT conclusions.

These BAT conclusions also cover the following:

- Cold rolling and wire drawing if directly associated with hot rolling and/or hot dip coating.
- Acid recovery, if directly associated with the activities covered by these BAT conclusions.
- The combined treatment of waste water 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.
- Combustion processes directly associated with the activities covered by these BAT conclusions provided that:
  1. the gaseous products of combustion are put into direct contact with material (such as direct feedstock heating or direct feedstock drying); or
  2. the radiant and/or conductive heat is transferred through a solid wall (indirect heating):
     - without using an intermediary heat transfer fluid (this includes heating of the galvanising kettle), or
     - when a gas (e.g. H_2) acts as the intermediary heat transfer fluid in the case of batch annealing.

These BAT conclusions do not cover the following:

- metal coating by thermal spraying;
- electroplating and electroless plating; this may be covered by the BAT conclusions for Surface Treatment of Metals and Plastics (STM).

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

- Iron and Steel Production (IS);
- Large Combustion Plants (LCP);
- Surface Treatment of Metals and Plastics (STM);
- Surface Treatment using Organic Solvents (STS);
- Waste Treatment (WT);
- Monitoring of Emissions to Air and Water from IED Installations (ROM);
- Economics and Cross-Media Effects (ECM);

- Emissions from Storage (EFS);
- Energy Efficiency (ENE);
- Industrial Cooling Systems (ICS).

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

DEFINITIONS

For the purposes of these BAT conclusions, the following definitions apply:

General terms

Term used	Definition
Batch galvanising	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.
Carbon steel	Steel in which the content of each alloy element is less than 5 wt-%.
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 waste water 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 galvanising kettle.
Ferrochromium	An alloy of chromium and iron typically containing between 50 wt-% and 70 wt-% 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).
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 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 that is not a direct discharge.
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 thereof 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-%.
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.
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.
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.
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) No 1907/2006 of the European Parliament and of the Council (1) and used in the process(es).
Recovery	Recovery as defined in Article 3(15) of Directive 2008/98/EC of the European Parliament and of the Council (2). The recovery of spent acids includes their regeneration, reclamation and recycling.
Regalvanising	The processing of used galvanised articles (e.g. highway guard rails) that are returned to be galvanised after long service periods. Processing of these articles requires additional process steps due to the presence of partly corroded surfaces or the need to remove any residual zinc coating.
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: — residential areas; — 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.
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.

(1) Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L 396, 30.12.2006, p. 1).

(2) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3).

Pollutants and parameters

Term used	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.
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:

Acronym	Definition
BG	Batch galvanising
CMS	Chemicals management system
CR	Cold rolling
EMS	Environmental management system
FMP	Ferrous metals processing
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

GENERAL CONSIDERATIONS

Best Available Techniques

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.

BAT-AELs and indicative emission levels for emissions to air

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.

Source of emissions	Reference oxygen level (O_R)
Combustion processes associated with: — feedstock heating and drying; — heating of the galvanising kettle.	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-%.

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.

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 7 and BAT 20, 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, be discharged through a common stack, these stacks shall be considered as a single stack.

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:

— 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.

— 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:

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

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 t/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:

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

where:	water consumption:	total amount of water consumed by the plant excluding: — recycled and reused water, and — cooling water used in once-through cooling systems, and — water for domestic-type usage, expressed in m^3/year; and
	production rate:	total amount of products manufactured by the plant, expressed in t/year.

BAT-AEPLs for specific material consumption

The BAT-AEPLs for specific material consumption refer to averages over 3 years calculated using the following equation:

$$\textit{specific material consumption} = \frac{\textit{material consumption}}{\textit{input}}$$

where:	material consumption:	3-year average of total amount of material consumed by the relevant process(es), expressed in kg/year; and
	input:	3-year average of total amount of feedstock processed, expressed in t/year or m^2/year.

1.1. *General BAT conclusions for the ferrous metals processing industry*

1.1.1. General environmental performance

BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features:

i. commitment, leadership, and accountability of the management, including senior management, for the implementation of an effective EMS;

ii. an analysis that includes the determination of the organisation’s context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment;

iii. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;

iv. establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;

v. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;

vi. determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed;

vii. 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);

viii. internal and external communication;

ix. fostering employee involvement in good environmental management practices;

x. establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records;

xi. effective operational planning and process control;

xii. implementation of appropriate maintenance programmes;

xiii. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;

xiv. 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;

xv. implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations;

xvi. application of sectoral benchmarking on a regular basis;

xvii. periodic independent (as far as practicable) internal auditing and periodic 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;

xviii. 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;

xix. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;

xx. following and taking into account the development of cleaner techniques.

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

xxi. an inventory of process chemicals used and of waste water and waste gas streams (see BAT 2);

xxii. a chemicals management system (see BAT 3);

xxiii. a plan for the prevention and control of leaks and spillages (see BAT 4 (a));

xxiv. an OTNOC management plan (see BAT 5);

xxv. an energy efficiency plan (see BAT 10 (a));

xxvi. a water management plan (see BAT 19 (a));

xxvii. a noise and vibration management plan (see BAT 32);

xxviii. a residues management plan (see BAT 34 (a)).

Note

Regulation (EC) No 1221/2009 establishes the European Union eco-management and audit scheme (EMAS), which 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. In order 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 and of waste water and waste gas streams, as part of the EMS (see BAT 1), that incorporates all of the following features:

(i) information about the production processes, including:

   (a) simplified process flow sheets that show the origin of the emissions;

   (b) descriptions of process-integrated techniques and waste water/waste gas treatment at source including their performances;

(ii) information about the characteristics of the waste water streams, such as:

   (a) average values and variability of flow, pH, temperature and conductivity;

   (b) 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;

(iii) information about the quantity and characteristics of the process chemicals used:

   (a) the identity and the characteristics of process chemicals, including properties with adverse effects on the environment and/or human health;

   (b) the quantities of process chemicals used and the location of their use;

(iv) information about the characteristics of the waste gas streams, such as:

   (a) average values and variability of flow and temperature;

   (b) average concentration and mass flow values of relevant substances (e.g. dust, NO_X, SO_2, CO, metals, acids) and their variability;

   (c) presence of other substances that may affect the waste gas treatment system (e.g. oxygen, nitrogen, water vapour) or plant safety (e.g. hydrogen).

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. In order 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:

i. 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:

(a) their eliminability, their ecotoxicity and their potential to be released into the environment in order to reduce emissions to the environment;

(b) 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;

(c) 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 9).

(d) 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.

ii. Goals and action plans to avoid or reduce the use and risks of hazardous substances.

iii. 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 4).

Applicability

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

BAT 4. In order to prevent or reduce emissions to soil and groundwater, BAT is to use all of the techniques given below.

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: — site incident plans for small and large spillages; — identification of the roles and responsibilities of persons involved; — ensuring staff are environmentally aware and trained to prevent and deal with spillage incidents; — identification of areas at risk of spillage and/or leaks of hazardous materials and ranking them according to the risk; — 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;	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.

		— waste management guidelines for dealing with waste arising from spillage control; — 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.	
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 are designed in such a way that any potential spillages and leaks are contained and sent to on-site treatment (see BAT 31) or off-site treatment.	Generally applicable.

BAT 5. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions during OTNOC, BAT is to set up and implement a risk-based OTNOC management plan as part of the EMS (see BAT 1) that includes all of the following elements:

i. identification of potential OTNOC (e.g. 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 following the periodic assessment below;

ii. appropriate design of critical equipment (e.g. compartmentalisation of fabric filters);

iii. set-up and implementation of an inspection and preventive maintenance plan for critical equipment (see BAT 1 xii);

iv. monitoring (i.e. estimating or, where possible, measuring) and recording of emissions during OTNOC and of associated circumstances;

v. periodic assessment of the emissions occurring during OTNOC (e.g. frequency of events, duration, amount of pollutants emitted) and implementation of corrective actions if necessary.

1.1.2. Monitoring

BAT 6. BAT is to monitor at least once per year:

- **the yearly consumption of water, energy and materials;**
- **the yearly generation of waste water;**
- **the yearly amount of each type of residues generated and of each type of waste sent for 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 7. 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.

Substance/ Parameter	Specific process(es)	Sector	Standard(s)	Minimum monitoring frequency (1)	Monitoring associated with
CO	Feedstock heating (2)	HR, CR, WD, HDC	EN 15058 (3)	Once every year	BAT 22
	Heating of the galvanising kettle (2)	HDC of wires, BG		Once every year	
	Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors Mixed acid recovery by spray roasting	HR, CR, HDC, WD		Once every year	BAT 29
Dust	Feedstock heating	HR, CR, WD, HDC	EN 13284-1 (3) (4)	Continuous for any stack with dust mass flows > 2 kg/h Once every 6 months for any stack with dust mass flows between 0,1 kg/h and 2 kg/h Once every year for any stack with dust mass flows < 0,1 kg/h	BAT 20
	Hot dipping after fluxing	HDC, BG		Once every year (5)	BAT 26

	Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors Mixed acid recovery by spray roasting or by evaporation	HR, CR, HDC, WD		Once every year	BAT 29
	Mechanical processing (including slitting, descaling, grinding, roughing, rolling, finishing, levelling), scarfing (other than manual scarfing) and welding	HR		Once every year	BAT 42
	Decoiling, mechanical predescaling, levelling and welding	CR		Once every year	BAT 46
	Lead baths	WD		Once every year	BAT 51
	Dry drawing			Once every year	BAT 52
HCl	Pickling with hydrochloric acid	HR, CR, HDC, WD	EN 1911 (3)	Once every year	BAT 24
	Pickling and stripping with hydrochloric acid	BG		Once every year	BAT 62
	Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors	HR, CR, HDC, WD		Once every year	BAT 29
	Pickling and stripping with hydrochloric acid in open pickling baths	BG	No EN standard available	Once every year (6)	BAT 62
HF	Pickling with acid mixtures containing hydrofluoric acid	HR, CR, HDC	EN standard under development (3)	Once every year	BAT 24
	Recovery of mixed acid by spray roasting or by evaporation	HR, CR		Once every year	BAT 29

Metals	Ni	Mechanical processing (including slitting, descaling, grinding, roughing, rolling, finishing, levelling), scarfing (other than manual scarfing) and welding	HR	EN 14385	Once every year (7)	BAT 42
		Decoiling, mechanical predescaling, levelling and welding	CR		Once every year (7)	BAT 46
	Pb	Mechanical processing (including slitting, descaling, grinding, roughing, rolling, finishing, levelling), scarfing (other than manual scarfing) and welding	HR		Once every year (7)	BAT 42
		Decoiling, mechanical predescaling, levelling and welding	CR		Once every year (7)	BAT 46
		Lead baths	WD		Once every year	BAT 51
	Zn	Hot dipping after fluxing	HDC, BG		Once every year (5)	BAT 26
NH_3		When SNCR and/or SCR is used	HR, CR, WD, HDC	EN ISO 21877 (3)	Once every year	BAT 22, BAT 25, BAT 29
NO_X		Feedstock heating (2)	HR, CR, WD, HDC	EN 14792 (3)	Continuous for any stack with NO_X mass flows > 15 kg/h Once every 6 months for any stack with NO_X mass flows between 1 kg/h and 15 kg/h Once every year for any stack with NO_X mass flows < 1 kg/h	BAT 22

	Heating of the galvanising kettle (2)	HDC of wires, BG		Once every year	
	Pickling with nitric acid alone or in combination with other acids	HR, CR		Once every year	BAT 25
	Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors Mixed acid recovery by spray roasting or by evaporation	HR, CR, WD, HDC		Once every year	BAT 29
SO_2	Feedstock heating (8)	HR, CR, WD, coating of sheets in HDC	EN 14791 (3)	Continuous for any stack with SO_2 mass flows > 10 kg/h Once every 6 months for any stack with SO_2 mass flows between 1 kg/h and 10 kg/h Once a year for any stack with SO_2 mass flows < 1 kg/h	BAT 21
	Hydrochloric acid recovery by spray roasting or by using fluidised bed reactors	HR, CR, HDC, WD		Once every year (5)	BAT 29
SO_X	Pickling with sulphuric acid	HR, CR, HDC, WD		Once every year	BAT 24
		BG			

TVOC	Degreasing	CR, HDC	EN 12619 (3)	Once every year (5)	BAT 23
	Rolling, wet tempering and finishing	CR		Once every year (5)	BAT 48
	Lead baths	WD		Once every year (5)	—
	Oil quench baths	WD		Once every year (5)	BAT 53

(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: EN 15267-1, EN 15267-2, EN 15267-3 and EN 14181.

(4) If measurements are continuous, EN 13284-2 also applies.

(5) 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.

(6) In the event that techniques (a) or (b) of BAT 62 are not applicable, measurement of the HCl concentration in the gaseous phase above the pickling bath is carried out at least once every year.

(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.

BAT 8. 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.

Substance/Parameter		Specific process(es)	Standard(s)	Minimum monitoring frequency (1)	Monitoring associated with
Total suspended solids (TSS) (2)		All processes	EN 872	Once every week (3)	BAT 31
Total organic carbon (TOC) (2) (4)		All processes	EN 1484	Once every month	
Chemical oxygen demand (COD) (2) (4)		All processes	No EN standard available		
Hydrocarbon oil index (HOI) (5)		All processes	EN ISO 9377-2	Once every month	
Metals/ metalloids (5)	Boron	Processes where borax is used	Various EN standards available (e.g. EN ISO 11885, EN ISO 17294-2)	Once every month	
	Cadmium	All processes (6)	Various EN standards available (e.g. EN ISO 11885, EN ISO 15586, EN ISO 17294-2)	Once every month	
	Chromium	All processes (6)			
	Iron	All processes			

	Nickel	All processes (6)			
	Lead	All processes (6)			
	Tin	Hot dip coating using tin			
	Zinc	All processes (6)			
	Mercury	All processes (6)	Various EN standards available (e.g. EN ISO 12846, EN ISO 17852)		
	Hexavalent chromium	Pickling of high-alloy steel or passivation with hexavalent chromium compounds	Various EN standards available (e.g. EN ISO 10304-3, EN ISO 23913)		
Total phosphorus (Total P) (2)		Phosphating	Various EN standards available (e.g. EN ISO 6878, EN ISO 11885, EN ISO 15681-1 and -2)	Once every month	
Fluoride (F^-) (5)		Pickling with acid mixtures containing hydrofluoric acid	EN ISO 10304-1	Once every month	

(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 waste water 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 waste water stream based on the inventory mentioned in BAT 2.

1.1.3. Hazardous substances

BAT 9. 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).

1.1.4. Energy efficiency

BAT 10. In order to increase the overall energy efficiency of the plant, BAT is to use both of the techniques given below.

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 6), setting key performance indicators on an annual basis (e.g. MJ/t of product) and planning the periodic improvement targets and related actions. Energy audits are carried out at least once a year to ensure that the objectives of the energy management plan are met. 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: — defining the energy boundary of the processes; — information on energy consumption in terms of delivered energy; — information on energy exported from the plant; — energy flow information (e.g. Sankey diagrams or energy balances) showing how the energy is used throughout the processes.	

BAT 11. In order to increase energy efficiency in heating (including heating and drying of feedstock as well as heating of baths and galvanising kettles), BAT is to use an appropriate combination of the techniques given below.

Technique		Description	Applicability
Design and operation			
a.	Optimum furnace design for feedstock heating	This includes techniques such as: — optimisation of key furnace characteristics (e.g. number and type of burners, air tightness and furnace insulation using suitable refractory materials); — minimisation of heat losses from furnace door openings, e.g. by using several liftable segments instead of one in continuous reheating furnaces;	Only applicable to new plants and major plant upgrades.

		— 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.	
b.	Optimum galvanising kettle design	This includes techniques such as: — uniform heating of the galvanising kettle walls (e.g. by using high-velocity burners or radiant design); — 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.
c.	Optimum galvanising kettle operation	This includes techniques such as: minimisation of heat losses from the galvanising kettle in hot dip coating of wires or in batch galvanising, e.g. by using insulated covers during idle periods.	Generally applicable.
d.	Combustion optimisation	See Section 1.7.1.	Generally applicable.
e.	Furnace automation and control	See Section 1.7.1.	Generally applicable.
f.	Process gas management system	See Section 1.7.1. 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.	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.	Oxy-fuel combustion	See Section 1.7.1.	Applicability may be restricted for furnaces processing high-alloy steel. Applicability to existing plants may be restricted by furnace design and the need for a minimum waste gas flow. Not applicable to furnaces equipped with radiant tube burners.

i.	Flameless combustion	See Section 1.7.1.	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. Applicability may be limited for processes where close control of temperature or temperature profile is required (e.g. recrystallisation). 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.	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.
Heat recovery from flue-gases			
k.	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.	Drying of workpieces	In batch galvanising, the heat from flue-gases is used to dry the workpieces.	Generally applicable.

m.	Preheating of combustion air	See Section 1.7.1. 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.
n.	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 sector-specific techniques to increase energy efficiency are given in Sections 1.2.1, 1.3.1 and 1.4.1 of these BAT conclusions.

Table 1.1

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

Specific process(es) 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)
Heavy plates	MJ/t	1 400–2 000 (²)
Bars, rods	MJ/t	600–1 900 (²)
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
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.

Table 1.2

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) (²)

(¹) For batch annealing, the lower end of the BAT-AEPL range can be achieved by using BAT 11 (g).

(²) The BAT-AEPL may be higher for continuous annealing lines requiring an annealing temperature above 800 °C.

Table 1.3

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.

Table 1.4

BAT-associated environmental performance level (BAT-AEPL) for specific energy consumption in batch galvanising

Specific process(es)	Unit	BAT-AEPL (Yearly average)
Batch galvanising	kWh/t	300–800 (¹) (²) (³)

(¹) The higher end of the BAT-AEPL range may be higher when centrifugation is used to remove the excess zinc and/or when the galvanising bath temperature is higher than 500 °C.

(²) The higher end of the BAT-AEPL may be higher and up to 1 200 kWh/t for batch galvanising plants operating at an average yearly production throughput below 150 t/m³ of kettle volume.

(³) In the case of batch galvanising plants producing mainly thin products (e.g. < 1,5 mm), the higher end of the BAT-AEPL range may be higher and up to 1 000 kWh/t.

The associated monitoring is given in BAT 6.

1.1.5. Material efficiency

BAT 12. In order 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.

	Technique	Description	Applicability
Avoiding or reducing the need for degreasing			
a.	Use of feedstock with low oil and grease contamination	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 cannot be influenced.
b.	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. 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.

Degreasing optimisation			
c.	General techniques for increased degreasing efficiency	These include techniques such as: — monitoring and optimising the temperature and the concentration of degreasing agents in the degreasing solution; — 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.	Minimisation of drag-out of degreasing solution	This includes techniques such as: — using squeeze rolls, e.g. in the case of continuous degreasing of strip; — allowing for a sufficient dripping time, e.g. by slow lifting of workpieces.	Generally applicable.
e.	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.
Extending the lifetime of the degreasing baths			
f.	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 13. In order 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.

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 14. In order 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.

	Technique	Description	Applicability
Avoiding or reducing the need for pickling			
a.	Minimisation of steel corrosion	This includes techniques such as: — cooling the hot rolled steel as fast as possible depending on product specifications; — storing the feedstock in roofed areas; — limiting the storage duration of the feedstock.	Generally applicable.
b.	Mechanical (pre)descaling	This includes techniques such as: — shot blasting; — bending; — sanding; — brushing; — stretching and levelling.	Applicability to existing plants may be restricted by a lack of space. Applicability may be restricted due to product specifications.
c.	Electrolytic prepickling of high-alloy steel	Use of an aqueous solution of sodium sulphate (Na_2SO_4) to pretreat high-alloy steel before pickling with mixed acid, in order to speed up and improve the removal of the surface oxide scale. The waste water containing hexavalent chromium is treated using technique BAT 31 (f).	Only applicable to cold rolling. Applicability to existing plants may be restricted by a lack of space.
Pickling optimisation			
d.	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.	General techniques for increased pickling efficiency	These include techniques such as: — optimisation of the pickling temperature for maximising pickling rates while minimising emissions of acids; — optimisation of the pickling bath composition (e.g. acid and iron concentrations); — optimisation of the pickling time to avoid over-pickling; — avoiding drastic changes in the pickling bath composition by frequently replenishing it with fresh acid.	Generally applicable.
f.	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.
g.	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.
h.	Minimisation of drag-out of pickling acid	This includes techniques such as: — using squeeze rolls, e.g. in the case of continuous pickling of strip; — allowing for a sufficient dripping time, e.g. by slow lifting of workpieces; — using vibrating wire rod coils.	Generally applicable.
i.	Turbulence pickling	This includes techniques such as: — injection of the pickling acid at high pressure via nozzles; — agitation of the pickling acid using an immersed turbine.	Applicability to existing plants may be restricted by a lack of space.

j.	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. Applicability may be restricted due to product specifications.
k.	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.

Table 1.5

BAT-associated environmental performance level (BAT-AEPL) for specific pickling acid consumption in batch galvanising

Pickling acid	Unit	BAT-AEPL (3-year average)
Hydrochloric acid, 28 wt-%	kg/t	13–30 (1)

(1) The higher end of the BAT-AEPL range may be higher and up to 50 kg/t when galvanising mainly workpieces with a high specific surface area (e.g. thin products < 1,5 mm, tubes with a wall thickness < 3 mm) or when regalvanising is carried out.

The associated monitoring is given in BAT 6.

BAT 15. In order to increase material efficiency in fluxing and to reduce the quantity of spent fluxing solution sent for disposal, BAT is use all of the techniques (a), (b) and (c), in combination with technique (d) or in combination with technique (e) given below.

Technique		Description	Applicability
a.	Rinsing of workpieces after pickling	In batch galvanising, carry-over of iron to the fluxing solution is reduced by rinsing workpieces after pickling.	Applicability to existing plants may be restricted by a lack of space.
b.	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.
c.	Minimisation of drag-out of fluxing solution	The drag-out of the fluxing solution is minimised by allowing enough time for it to drip off.	Generally applicable.
d.	Iron removal and reuse of the fluxing solution	Iron is removed from the fluxing solution by one of the following techniques: — electrolytic oxidation; — oxidation using air or H_2O_2; — ion exchange. After iron removal, the fluxing solution is reused.	Applicability to existing batch galvanising plants may be restricted by a lack of space.

e.	Recovery of salts from the spent fluxing solution for production of fluxing agents	Spent fluxing solution is used to recover the salts contained therein 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 16. In order to increase the material efficiency of hot dipping in the coating of wires and in batch galvanising, and to reduce the generation of waste, BAT is to use all of the techniques given below.

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 15 (d)), using fluxing agents with a mild pickling effect and avoiding local overheating in the galvanising kettle.
b.	Prevention, collection and reuse of zinc splashes in batch galvanising	The generation of zinc splashes from the galvanising kettle is reduced by minimising carry-over of the fluxing solution (see BAT 26 (b)). Zinc splashes out of the kettle are collected and reused. The area surrounding the kettle is kept clean to reduce contamination of the splashes.
c.	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: — sufficient drying of the workpieces/wires before dipping; — avoiding unnecessary disturbances of the bath during production, including during skimming; — in continuous hot dipping of wires, reducing the bath surface that is in contact with air using a floating refractory cover.

BAT 17. In order 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.

Technique		Description
Extending the lifetime of the treatment baths		
a.	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.
Treatment optimisation		
b.	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.	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.

BAT 18. In order 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:

i. spray roasting or using fluidised bed reactors for the recovery of hydrochloric acid;

ii. crystallisation of ferric sulphate for the recovery of sulphuric acid;

iii. spray roasting, evaporation, ion exchange or diffusion dialysis, for the recovery of mixed acid;

iv. use of spent pickling acid as a secondary raw material (e.g. for the production of iron chloride or pigments).

Applicability

In batch galvanising, if the use of spent pickling acid as a secondary raw material is restricted by market unavailability, neutralisation of spent pickling acid may exceptionally take place.

Further sector-specific techniques to increase material efficiency are given in Sections 1.2.2, 1.3.2, 1.4.2, 1.5.1 and 1.6.1 of these BAT conclusions.

1.1.6. Water use and waste water generation

BAT 19. In order to optimise water consumption, to improve water recyclability and to reduce the volume of waste water generated, BAT is to use both techniques (a) and (b) and an appropriate combination of the techniques (c) to (h) given below.

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: — flow diagrams and a water mass balance of the plant; — establishment of water efficiency objectives; — implementation of water optimisation techniques (e.g. control of water usage, water recycling, detection and repair of leaks). Water audits are carried out at least once every year to ensure that the objectives of the water management plan are met. 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).	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.

b.	Segregation of water streams	Each water stream (e.g. surface run-off water, process water, alkaline or acidic waste water, spent degreasing solution) is collected separately, based on the pollutant content and on the required treatment techniques. Waste water streams that can be recycled without treatment are segregated from waste water 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: — oil-tight bearings and bearing seals for working rolls; — leakage indicators; — 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 30 and BAT 31).	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.
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 waste water 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.

Table 1.6

BAT-associated environmental performance levels (BAT-AEPLs) 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 6.

1.1.7. Emissions to air

1.1.7.1. *Emissions to air from heating*

BAT 20. In order to prevent or reduce dust emissions to air from heating, BAT is to use either electricity generated from fossil-free energy sources or technique (a), in combination with technique (b) given below.

Technique		Description	Applicability
a.	Use of fuels with low dust and ash content	Fuels with low dust and ash content include for example natural gas, liquefied petroleum gas, dedusted blast furnace gas and dedusted basic oxygen furnace gas.	Generally applicable.
b.	Limiting the entrainment of dust	Entrainment of dust is limited by for example: — as far as practically possible, use of clean feedstock or cleaning the feedstock of loose scale and dust before feeding it into the furnace; — minimisation of dust generation from refractory lining damage, e. g. by avoiding direct contact of the flames with the refractory lining, using ceramic coatings on the refractory lining; — avoiding direct contact of the flames with the feedstock.	Avoiding direct contact of the flames with the feedstock is not applicable in the case of direct flame furnaces.

Table 1.7

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
	Cold rolling		< 2–10
	Wire drawing		< 2–10
	Hot dip coating		< 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 7.

BAT 21. In order to prevent or reduce SO_2 emissions to air from heating, BAT is to use either electricity generated from fossil-free energy sources or a fuel, or a combination of fuels, with low sulphur content.

Description

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

Table 1.8

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)
	Cold rolling, wire drawing, hot dip coating of sheets		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 7.

BAT 22. In order 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 generated from fossil-free energy sources or an appropriate combination of the techniques given below.

	Technique	Description	Applicability
Reduction of generation of emissions			
a.	Use of a fuel or a combination of fuels with low NO_X 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.	Furnace automation and control	See Section 1.7.2.	Generally applicable.
c.	Combustion optimisation	See Section 1.7.2. Generally used in combination with other techniques.	Generally applicable.
d.	Low-NO_X burners	See Section 1.7.2.	Applicability may be restricted at existing plants by design and/or operational constraints.
e.	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.
f.	Limiting the temperature of air preheating	Limiting the air preheating temperature leads to a decrease of the concentration of NO_X emissions. 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 tube burners.
g.	Flameless combustion	See Section 1.7.2.	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. Applicability may be limited for processes where close control of the temperature or temperature profile is required (e.g. recrystallisation). 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.

h.	Oxy-fuel combustion	See Section 1.7.2.	Applicability may be restricted for furnaces processing high-alloy steel. Applicability to existing plants may be restricted by furnace design and the need for a minimum waste gas flow. Not applicable to furnaces equipped with radiant tube burners.
Waste gas treatment			
i.	Selective catalytic reduction (SCR)	See Section 1.7.2.	Applicability to existing plants may be restricted by a lack of space. Applicability may be restricted in batch annealing due to the varying temperatures during the annealing cycle.
j.	Selective non-catalytic reduction (SNCR)	See Section 1.7.2.	Applicability to existing plants may be restricted by the optimum temperature window and the residence time needed for the reaction. Applicability may be restricted in batch annealing due to the varying temperatures during the annealing cycle.
k.	Optimisation of the SNCR/SCR design and operation	See Section 1.7.2.	Only applicable where SNCR/SCR is used for the reduction of NO_X emissions.

Table 1.9

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/Nm³	New plants: 80–200 Existing plants: 100–350	No indicative level
		Intermediate heating	mg/Nm³	100–250	

		Post-heating	mg/Nm^3	100–200	
	Other fuels	Reheating, intermediate heating, post-heating	mg/Nm^3	100–350 (1)	
CO	100 % natural gas	Reheating	mg/Nm^3	No BAT-AEL	10–50
		Intermediate heating	mg/Nm^3		10–100
		Post-heating	mg/Nm^3		10–100
	Other fuels	Reheating, intermediate heating, post-heating	mg/Nm^3		10–50

(1) The higher end of the BAT-AEL range may be higher and up to 550 mg/Nm^3 when using a high share of coke oven gas or of CO-rich gas from ferrochromium production (> 50 % of energy input).

Table 1.10

BAT-associated emission levels (BAT-AELs) for channelled NOX 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
	Other fuels	mg/Nm^3	100–300 (2)	
CO	100 % natural gas	mg/Nm^3	No BAT-AEL	10–50
	Other fuels	mg/Nm^3	No BAT-AEL	10–100

(1) The higher end of the BAT-AEL range may be higher and up to 300 mg/Nm^3 in continuous annealing.

(2) The higher end of the BAT-AEL range may be higher and up to 550 mg/Nm^3 when using a high share of coke oven gas or of CO-rich gas from ferrochromium production (> 50 % of energy input).

Table 1.11

BAT-associated emission level (BAT-AEL) for channelled NOX 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 (Average over the sampling period)
NO_X	mg/Nm^3	100–250	No indicative level
CO	mg/Nm^3	No BAT-AEL	10–50

Table 1.12

BAT-associated emission level (BAT-AEL) for channelled NOX 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)	No indicative level
CO	mg/Nm^3	No BAT-AEL	10–100

(1) The higher end of the BAT-AEL range may be higher and up to 550 mg/Nm^3 when using a high share of coke oven gas or of CO-rich gas from ferrochromium production (> 50 % of energy input).

Table 1.13

BAT-associated emission level (BAT-AEL) for channelled NOX emissions to air and indicative emission level for channelled CO emissions to air from heating the galvanising kettle in batch galvanising

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	70–300	No indicative level
CO	mg/Nm^3	No BAT-AEL	10–100

The associated monitoring is given in BAT 7.

1.1.7.2. *emissions to air from degreasing*

BAT 23. In order 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.

Technique		Description
Collection of emissions		
a.	Closed degreasing tanks combined with air extraction in the case of continuous degreasing	Degreasing is carried out in closed tanks and air is extracted.

Waste gas treatment		
b.	Wet scrubbing	See Section 1.7.2.
c.	Demister	See Section 1.7.2.

The associated monitoring is given in BAT 7.

1.1.7.3. *Emissions to air from pickling*

BAT 24. In order to reduce emissions to air of dust, acids (HCl, HF, H_2SO_4) and SO_x from pickling in hot rolling, cold rolling, hot dip coating and wire drawing, BAT is to use technique (a) or technique (b) in combination with technique (c) given below.

Technique		Description
Collection of emissions		
a.	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.	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.
Waste gas treatment		
c.	Wet scrubbing followed by a demister	See Section 1.7.2.

Table 1.14

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

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
HCl	mg/Nm³	< 2–10 (1)
HF	mg/Nm³	< 1 (2)
SO_X	mg/Nm³	< 1–6 (3)

(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) This BAT-AEL only applies to pickling with sulphuric acid.

Table 1.15

BAT-associated emission level (BAT-AEL) for channelled HCl and SOX 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/Nm³	< 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 7.

BAT 25. In order 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.

Technique		Description	Applicability
	Reduction of generation of emissions		
a.	Nitric-acid-free pickling of high-alloy steel	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.
b.	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.
	Collection of emissions		
c.	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.	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.
	Waste gas treatment		
e.	Wet scrubbing with addition of an oxidising agent (e.g. hydrogen peroxide)	See Section 1.7.2. 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.	Selective catalytic reduction (SCR)	See Section 1.7.2.	Applicability to existing plants may be restricted by a lack of space.
g.	Optimisation of the SCR design and operation	See Section 1.7.2.	Only applicable where SCR is used for the reduction of NO_X emissions.

Table 1.16

BAT-associated emission level (BAT-AEL) for channelled NOX 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 7.

1.1.7.4. *Emissions to air from hot dipping*

BAT 26. In order to reduce emissions to air of dust and zinc from hot dipping after fluxing in hot dip coating of wires and in batch galvanising, 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.

	Technique	Description	Applicability
Reduction of generation of emissions			
a.	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.	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 15 (c)); — drying before dipping.	Generally applicable.
Collection of emissions			
c.	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.	Enclosed kettle combined with air extraction	Hot dipping is carried out in an enclosed kettle and air is extracted.	Applicability to existing plants may be limited where enclosure interferes with an existing transport system for workpieces in batch galvanising.
Waste gas treatment			
e.	Fabric filter	See Section 1.7.2.	Generally applicable.

Table 1.17

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

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 7.

1.1.7.4.1. Emissions to air from oiling

BAT 27. In order 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.

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.

1.1.7.5. *Emissions to air from post-treatment*

BAT 28. In order 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.

Technique		Description	Applicability
Collection of emissions			
a.	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: — lateral hood or lip extraction; — tanks equipped with moveable lids; — enclosing hoods; — placing the baths in enclosed areas. The captured emissions are then extracted.	Only applicable when the treatment is carried out by spraying or when volatile substances are used.

b.	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.
Waste gas treatment			
c.	Wet scrubbing	See Section 1.7.2.	Generally applicable.
d.	Demister	See Section 1.7.2.	Generally applicable.

1.1.7.6. *Emissions to air from acid recovery*

BAT 29. In order to reduce emissions to air from the recovery of spent acid of dust, acids (HCl, HF), SO_2 and NO_X (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.

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 21 and BAT 22 (a).	Generally applicable.
b.	Combustion optimisation	See Section 1.7.2. Generally used in combination with other techniques.	Generally applicable.
c.	Low-NO_X burners	See Section 1.7.2.	Applicability may be restricted at existing plants by design and/or operational constraints.
d.	Wet scrubbing followed by a demister	See Section 1.7.2. 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 Section 1.7.2.	Applicability to existing plants may be restricted by a lack of space.
f.	Optimisation of the SCR design and operation	See Section 1.7.2.	Only applicable where SCR is used for the reduction of NO_X emissions.

Table 1.18

BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, HCl, SO2 and NOX 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
SO_2	mg/Nm^3	< 10
NO_X	mg/Nm^3	50-180

Table 1.19

BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, HF and NOX 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)
HF	mg/Nm^3	< 1
NO_X	mg/Nm^3	50–100 (1)
Dust	mg/Nm^3	< 2–10

(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 7.

1.1.8. Emissions to water

BAT 30. In order 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 31), 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 34 (f)).

BAT 31. In order to reduce emissions to water, BAT is to treat waste water using a combination of the techniques given below.

Technique (1)		Typical pollutants targeted
Preliminary, primary and general treatment, e.g.		
a.	Equalisation	All pollutants
b.	Neutralisation	Acids, alkalis
c.	Physical separation, e.g. screens, sieves, grit separators, grease separators, hydrocyclones, oil-water separation or primary settlement tanks	Gross solids, suspended solids, oil/grease

Physico-chemical treatment, e.g.		
d.	Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants, e.g. hydrocarbons, mercury
e.	Chemical precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants, e.g. metals, phosphorus, fluoride
f.	Chemical reduction	Reducible dissolved non-biodegradable or inhibitory pollutants, e.g. hexavalent chromium
g.	Nanofiltration/reverse osmosis	Soluble non-biodegradable or inhibitory pollutants, e.g. salts, metals
Biological treatment, e.g.		
h.	Aerobic treatment	Biodegradable organic compounds
Solids removal, e.g.		
i.	Coagulation and flocculation	Suspended solids and particulate-bound metals
j.	Sedimentation	
k.	Filtration (e.g. sand filtration, microfiltration, ultrafiltration)	
l.	Flotation	

(1) The descriptions of the techniques are given in Section 1.7.3.

Table 1.20

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
Metals	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)

Total phosphorus (Total P)	mg/l	0,2–1	Phosphating
Fluoride (F^-)	mg/l	1–15	Pickling with acid mixtures containing hydrofluoric acid

(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 waste water 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.

(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.

Table 1.21

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
Metals	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 waste water 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 waste water 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.

(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.

The associated monitoring is given in BAT 8.

1.1.9. Noise and vibrations

BAT 32. In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the EMS (see BAT 1), that includes all of the following elements:

i. a protocol containing appropriate actions and timelines;

ii. a protocol for conducting noise and vibration monitoring;

iii. a protocol for response to identified noise and vibration events, e.g. complaints;

iv. a noise and vibration reduction programme designed to identify the source(s), to measure/estimate noise and vibration exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.

Applicability

The applicability is restricted to cases where a noise or vibration nuisance at sensitive receptors is expected and/or has been substantiated.

BAT 33. In order 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.

Technique		Description	Applicability
a.	Appropriate location of equipment and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating the exits or entrances of the buildings.	For existing plants, the relocation of equipment and the exits or entrances of the buildings may not be applicable due to a lack of space and/or excessive costs.
b.	Operational measures	These include techniques such as: — inspection and maintenance of equipment; — closing of doors and windows of enclosed areas, if possible; — equipment operation by experienced staff; — avoidance of noisy activities at night, if possible; — provisions for noise control, e.g. during production and maintenance activities, transport and handling of feedstock and materials.	Generally applicable.
c.	Low-noise equipment	This includes techniques such as direct drive motors, low-noise compressors, pumps and fans.	

d.	Noise and vibration control equipment	This includes techniques such as: — noise reducers; — acoustic and vibrational insulation of equipment; — enclosure of noisy equipment (e.g. scarfing and grinding machines, wire drawing machines, air jets); — building materials with high sound insulation properties (e.g. for walls, roofs, windows, doors).	Applicability to existing plants may be restricted by a lack of space.
e.	Noise abatement	Inserting obstacles between emitters and receivers (e.g. protection walls, embankments and buildings).	Only applicable to existing plants, as the design of new plants should make this technique unnecessary. For existing plants, the insertion of obstacles may not be applicable due to a lack of space.

1.1.10. **Residues**

BAT 34. In order 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.

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. 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.	Pretreatment of oily mill scale for further use	This includes techniques such as: — briquetting or pelletising, — 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.
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 35. In order 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.

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 36. In order 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:

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

BAT 37. In order 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.

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 Section 1.4.4 of these BAT conclusions.

1.2. BAT *conclusions for hot rolling*

The BAT conclusions in this section apply in addition to the general BAT conclusions given in Section 1.1.

1.2.1. Energy efficiency

BAT 38. In order to increase energy efficiency in feedstock heating, BAT is to use a combination of the techniques given in BAT 11 together with an appropriate combination of the techniques given below.

Technique		Description	Applicability
a.	Near-net-shape casting for thin slabs and beam blanks followed by rolling	See Section 1.7.1.	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 of 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 Section 1.7.1.	Generally applicable.
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 39 (a). 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 39. In order to increase energy efficiency in rolling, BAT is to use a combination of the techniques given below.

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, reducing significantly 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 Section 1.7.1.	Only applicable to hot strip mills.
d.	Coil boxes	See Section 1.7.1.	Generally applicable.
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 Section 1.7.1.	Only applicable to plants adjacent to continuous casting and within the limitations of the plant layout and product specifications.

Table 1.22

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 6.

1.2.2. Material efficiency

BAT 40. In order 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.

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 41. In order 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.

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.

1.2.3. Emissions to air

BAT 42. In order to reduce emissions to air of dust, nickel and lead in mechanical processing (including slitting, descaling, grinding, roughing, rolling, finishing, levelling), 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.

Technique		Description	Applicability
Collection of emissions			
a.	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.	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 43).	May not be applicable for welding in the case of low levels of dust generation, e.g. below 50 g/h.
Waste gas treatment			
c.	Electrostatic precipitator	See Section 1.7.2.	Generally applicable.

d.	Fabric filter	See Section 1.7.2.	May not be applicable in the case of waste gases with a high moisture content.
e.	Wet scrubbing	See Section 1.7.2.	Generally applicable.

Table 1.23

BAT-associated emission levels (BAT-AELs) for channelled emissions of dust, lead and nickel to air from mechanical processing (including slitting, descaling, grinding, roughing, rolling, finishing, levelling), 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		0,01–0,1 (^{2})
Pb		0,01–0,035 (^{2})

(^{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 7.

BAT 43. In order 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 42 (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 31).

1.3. *BAT conclusions for cold rolling*

The BAT conclusions in this section apply in addition to the general BAT conclusions given in Section 1.1.

1.3.1. Energy efficiency

BAT 44. In order to increase energy efficiency in rolling, BAT is to use a combination of the techniques given below.

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 Section 1.7.1.	Generally applicable.

c.	Computer-aided rolling optimisation	The thickness reduction is controlled using a computer to minimise the number of rolling passes.	Generally applicable.

Table 1.24

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 6.

1.3.2. Material efficiency

BAT 45. In order 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.

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: — regular control and preventive maintenance of the hydraulic system and the emulsion circulation system; — 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: — good lubrication; — potential for easy separation of contaminants; — stability of the emulsion and dispersion of the oil in the emulsion; — non-degradation of the oil over a long idling time.	Generally applicable.
e.	Minimisation of oil/rolling emulsion consumption	The consumption of oil/rolling emulsion is minimised by using techniques such as: — limiting the oil concentration to the minimum required for lubrication; — limiting carry-over of emulsion from the previous stands (e.g. by separating the emulsion cellars, shielding of the mill stands); — using air knives combined with edge suction to reduce the residual emulsion and oil on the strip.	Generally applicable.

1.3.3. Emissions to air

BAT 46. In order 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).

Technique		Description	Applicability
Collection of emissions			
a.	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.
Waste gas treatment			
b.	Fabric filter	See Section 1.7.2.	Generally applicable.

Table 1.25

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/Nm³	< 2–5
Ni		0,01–0,1 (¹)
Pb		≤ 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 7.

BAT 47. In order to prevent or reduce oil mist emissions to air from tempering, BAT is to use one of the techniques given below.

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.
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 48. In order 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.

Technique		Description
Collection of emissions		
a.	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.

Waste gas treatment		
b.	Demister	See Section 1.7.2.
c.	Oil mist separator	Separators containing baffle packing, impingement plates or mesh pads are used to separate the oil from the extracted air.

Table 1.26

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 7.

1.4. BAT conclusions for wire drawing

The BAT conclusions in this section apply in addition to the general BAT conclusions given in Section 1.1.

1.4.1. Energy efficiency

BAT 49. In order 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.

1.4.2. Material efficiency

BAT 50. In order 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.

1.4.3. Emissions to air

BAT 51. In order to reduce emissions to air of dust and lead from lead baths, BAT is to use all of the techniques given below.

Technique		Description
Reduction of generation of emissions		
a.	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.	Floating protective layer or tank cover	See BAT 49. Floating protective layers and tank covers also reduce emissions to air.
Collection of emissions		
c.	Air extraction as close as possible to the emission source	Emissions from the lead bath are collected, for example using hood or lip extraction.

Waste gas treatment		
d.	Fabric filter	See Section 1.7.2.

Table 1.27

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/Nm³	< 2–5
Pb	mg/Nm³	≤ 0,5

The associated monitoring is given in BAT 7.

BAT 52. In order 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.

	Technique	Description	Applicability
Collection of emissions			
a.	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.	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.
Waste gas treatment			
c.	Fabric filter	See Section 1.7.2.	Generally applicable.

Table 1.28

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/Nm³	< 2–5

The associated monitoring is given in BAT 7.

BAT 53. In order to reduce oil mist emissions to air from oil quench baths, BAT is to use both of the techniques given below.

	Technique	Description
Collection of emissions		
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.

Waste gas treatment		
b.	Demister	See Section 1.7.2.

The associated monitoring is given in BAT 7.

1.4.4. Residues

BAT 54. In order 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 55. In order 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.

1.5. *BAT conclusions for hot dip coating of sheets and wires*

The BAT conclusions in this section apply in addition to the general BAT conclusions given in Section 1.1.

1.5.1. Material efficiency

BAT 56. In order to increase material efficiency in continuous hot dipping of strips, BAT is to avoid excess coating with metals by using both of the techniques given below.

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 galvanising 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 57. In order 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.

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 galvanising 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 takes the surplus coating metal off the wire surface back into the galvanising kettle.

1.6. *BAT conclusions for batch galvanising*

The BAT conclusions in this section apply in addition to the general BAT conclusions given in Section 1.1.

1.6.1. Residues

BAT 58. In order to prevent the generation of spent acids with high zinc and high iron concentrations or, where that is not practicable, to reduce their quantity sent for disposal, BAT is to carry out pickling separately from stripping.

Description

Pickling and stripping are carried out in separate tanks in order to prevent the generation of spent acids with high zinc and high iron concentrations or to reduce their quantity sent for disposal.

Applicability

Applicability to existing plants may be restricted by a lack of space in the event that additional tanks for stripping are needed.

BAT 59. In order to reduce the quantity of spent stripping solutions with high zinc concentrations sent for disposal, BAT is to recover the spent stripping solutions and/or the $ZnCl_2$ and NH_4Cl contained therein.

Description

Techniques to recover spent stripping solutions with high zinc concentrations on site or off site include the following:

- Zinc removal by ion exchange. The treated acid can be used in pickling, while the $ZnCl_2$- and NH_4Cl-containing solution resulting from the stripping of the ion-exchange resin can be used for fluxing.
- Zinc removal by solvent extraction. The treated acid can be used in pickling, while the zinc-containing concentrate resulting from stripping and evaporation can be used for other purposes.

1.6.2. Material efficiency

BAT 60. In order to increase material efficiency in hot dipping, BAT is to use both of the techniques given below.

Technique		Description
a.	Optimised dipping time	The dipping time is limited to the duration required to achieve the coating thickness specifications.
b.	Slow withdrawal of workpieces from the bath	By withdrawing the galvanised workpieces slowly from the galvanising kettle, the drain-off is improved and zinc splashes are reduced.

BAT 61. In order to increase material efficiency and to reduce the quantity of waste sent for disposal from blowing off excess zinc from galvanised tubes, BAT is to recover zinc-containing particles and to reuse them in the galvanising kettle or to send them for zinc recovery.

1.6.3. Emissions to air

BAT 62. In order to reduce emissions of HCl to air from pickling and stripping in batch galvanising, BAT is to control the operating parameters (i.e. temperature and acid concentration in the bath) and to use the techniques given below with the following order of priority:

- **technique (a) in combination with technique (c);**
- **technique (b) in combination with technique (c);**
- **technique (d) in combination with technique (b);**
- **technique (d).**

Technique (d) is BAT only for existing plants and provided that it ensures at least an equivalent level of environmental protection compared to using technique (c) in combination with techniques (a) or (b).

	Technique	Description	Applicability
Collection of emissions			
a.	Enclosed pretreatment section with extraction	The entire pretreatment section (e.g. degreasing, pickling, fluxing) is encapsulated and the fumes are extracted from the enclosure.	Only applicable to new plants and major plant upgrades
b.	Extraction by lateral hood or lip extraction	Acid fumes from the pickling tanks are extracted using lateral hoods or lip extraction at the edge of the pickling tanks. This may also include emissions from degreasing tanks.	Applicability in existing plants may be restricted by a lack of space.
Waste gas treatment			
c.	Wet scrubbing followed by a demister	See Section 1.7.2.	Generally applicable
Reduction of generation of emissions			
d.	Restricted operating range for hydrochloric acid open pickling baths	Hydrochloric acid baths are strictly operated within the temperature and HCl concentration range determined by the following conditions: (a) $4\ °C < T < (80 - 4w)\ °C$; (b) 2 wt-% $< w < (20 - T/4)$ wt-%, where T is the pickling acid temperature expressed in °C and w the HCl concentration expressed in wt-%. The bath temperature is measured at least once every day. The HCl concentration in the bath is measured every time fresh acid is replenished and in any case at least once every week. To limit evaporation, movement of air across the bath surfaces (e.g. due to ventilation) is minimised.	Generally applicable

Table 1.29

BAT-associated emission level (BAT-AEL) for channelled HCl emissions to air from pickling and stripping with hydrochloric acid in batch galvanising

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

The associated monitoring is given in BAT 7.

1.6.4. Waste water discharge

BAT 63. It is not BAT to discharge waste water from batch galvanising.

Description

Only liquid residues (e.g. spent pickling acid, spent degreasing solutions and spent fluxing solutions) are generated. These residues are collected. They are appropriately treated for recycling or recovery and/or sent for disposal (see BAT 18 and BAT 59).

1.7. *Descriptions of techniques*

1.7.1. 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.
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 HR, 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.

1.7.2. Techniques to reduce emissions to air

Technique	Description
Combustion optimisation	See Section 1.7.1.
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.
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 Section 1.7.1.
Furnace automation and control	See Section 1.7.1.
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 Section 1.7.1.
Oxy-fuel combustion	See Section 1.7.1.
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.

1.7.3. **Techniques to reduce emissions to water**

Technique	Description
Adsorption	The removal of soluble substances (solutes) from the waste water 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 waste water 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 waste water treatment by using central tanks. Equalisation may be decentralised or carried out using other management techniques.
Filtration	The separation of solids from waste water by passing them through a porous medium, e.g. sand filtration, microfiltration and ultrafiltration.
Flotation	The separation of solid or liquid particles from waste water 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.
Neutralisation	The adjustment of the pH of waste water to a neutral level (approximately 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 and/or metal particles from the waste water 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.