Final Draft BAT Guidance Note on Best Available Techniques for Ferrous Metal Processing and the Pressing, Drawing and Stamping of Large Castings where the Production Area exceeds 500 Square Metres

September 2012

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1. INTRODUCTION

1.1 GENERAL

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

– applicants seeking Integrated Pollution Prevention and Control (IPPC) licenses under Part IV of Environmental Protection Agency Acts, 1992 to 2011,

– existing Integrated Pollution Prevention and Control (IPPC) Licensees whose license is to be reviewed under the Environmental Protection Agency Acts, 1992 to 2011,

– applicants seeking Waste Licenses under Part V of the Waste Management Acts 1996 to 2011,

– existing Waste Licensees whose license is to be reviewed under the Waste Management Acts 1996 to 2011.

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

1.2 BAT GUIDANCE NOTE STRUCTURE

This Guidance Note has been structured as follows:

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

Where relevant, references are made to other detailed guidance, such as the Guidance Note for Storage and Transfer of Materials for Scheduled Activities, the determination of BAT should be made giving regard to these.

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

2. INTERPRETATION OF BAT

2.1 STATUS OF THIS GUIDANCE NOTE

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

Techniques identified in this Guidance Notes are considered to be current best practice at the time of writing. The EPA encourages the development and introduction of new and innovative technologies and techniques, which meet BAT criteria and look for continuous improvement in the overall environmental performance of the sector's activities as part of sustainable development.

2.2 INTERPRETATION OF BAT

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

Best available techniques (BAT) is defined in Section 5 of the Environmental Protection Agency Acts, 1992 to 2011, and Section 5(2) of the Waste Management Acts 1996 to 2011, as the "most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission values designed to prevent or eliminate or where that is not practicable, generally to reduce an emission and its impacts on the environment as a whole" where:

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

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

T **"techniques"** includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

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

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

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

The overall objective of ensuring a high level of protection for the environment as a whole will often involve making a judgment between different types of environmental impact, and these judgments will often be influenced by local considerations. On the other hand, the obligation to ensure a high level of environmental protection including the minimisation of long-distance or transboundary pollution implies that the most appropriate techniques cannot be set on the basis of purely local considerations.

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

2.3 BAT HIERARCHY

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

The IPPC Directive 2008/1/EC and the Environmental Protection Agency Acts 1992 to 2011 (Section 5(3)), require the determination of BAT to consider in particular the following, having regard to the likely costs and advantages of measures and to the principles of precaution and prevention:

(i) the use of low-waste technology,

(ii) the use of less hazardous substances,

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

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

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

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

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

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

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

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

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

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

3. SECTOR COVERED BY THIS GUIDANCE NOTE

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

3.2.1 The processing of Ferrous Metals:

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

(b) smitheries with hammers the energy of which exceeds 50 kilojoule per hammer, where the calorific power used exceeds 20 MW*

(c) application of protective fused metal coats with an input exceeding 2 tonnes of crude steel per hour.

3.2.2 The processing of iron and steel in forges, drawing plants and rolling mills where the production area exceeds 500 square meters, not included in paragraph 3.2.1

3.8 The pressing, drawing and stamping of large castings where the production area exceeds 500 square meters.

* Annex I of the IPPC Directive states threshold values for smitheries and foundries. The TWG reported during the compilation of the Best Available Techniques Reference Document on Smitheries and Foundries that no ‘smitheries with hammers the energy of which exceeds 50 kJ per hammer, (and) where the calorific power used exceeds 20 MW’ installations in operation in Europe that fall within the threshold values. Hence these are not covered in the BREF and hence will not be detailed herein.

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

(Note: Any reference to FM BREF in this document means the *Reference Document on Best Available Techniques in the Ferrous Metals Processing Industry*, published by the European Commission, December 2001). Any reference to Smitheries & Foundries BREF in this document means the *Reference Document on Best Available Techniques in Smitheries & Foundries* published by the European Commission May 2005.

The general production sequences involved in the Ferrous Metals Processing Industry Classes 3.2.1 and 3.2.2 and the Pressing Drawing & Stamping of Large Castings Class 3.8 are described herein, the risks to the environment are outlined in section 4.2.

4.1 DESCRIPTION OF PROCESS

The processing of ferrous metals in the aforementioned classes 3.2.1 and 3.2.2 & 3.8 can be divided in to the following sub-sectors:

- Hot and Cold Forming;
- Continuous Coating;
- Pressing drawing and stamping of large castings.

4.1.1 Hot and Cold Forming

Hot and cold forming activities included in this BAT are hot rolling, cold rolling and drawing of steel.

4.1.1.1 *Hot Rolling (FM BREF A.2.1.1)*

In hot rolling the size, shape and metallurgical properties of the steel input material (ingots, slabs, blooms and billets) is changed by repeatedly compressing the hot metal between electrically powered rollers. Hot rolling mills comprise the following process steps:

- Conditioning of the input (scarfing, grinding)
- Heating to rolling temperature
- Descaling (removal of scale during reheating)
- Rolling (roughing including width reduction, rolling to final dimension and properties)
- Finishing (trimming, slitting, cutting).

4.1.1.1.1 *Conditioning of Input and Surface Rectification (FM BREF A.2.1.2)*

Such processes remove surface defects from input material prior to processing. *Scarfing* removes surface defects in carbon steel grades while *grinding* is used for stainless steels and special steel grades.

4.1.1.1.2 *Heating input to rolling temperature (FM BREF A.2.1.3)*

The steel input must be heated to a temperature range of 1,050 to 1,300^{o}C. Batch furnaces are used for specialty steels and forgings (FM BREF A.2.1.3.1) whereas large furnaces like the walking beam and rotary hearth furnace are fed continuously (FM BREF A.2.1.3.2).

4.1.1.1.3 Descaling (FM BREF A.2.1.4)

Adherent scale formed during reheating must be removed before rolling to avoid a contamination of the surface by scale impressed by the rolls ('rolled in matter'). This is done by breaking and spraying off the scale by high-pressure water. Descaling occurs throughout the whole rolling process.

4.1.1.1.4 Rolling

The term rolling encompasses many different processes which modify the shape and thickness of the ferrous product these include:

- *Edging* (FM BREF A.2.1.5): slab width is reduced to a specific dimension
- *Roughing* (FM BREF A.2.1.6): incoming hot roll stock has thickness reduced
- *Strip Rolling* (FM BREF A.2.1.7): thickness reduction done over a number of rolling stands
- *Rod rolling* (FM BREF A.2.1.8): rods put through alternating horizontal and vertical rollers
- *Plate rolling* (FM BREF A.2.1.9): slabs are stretched, turned 90^{o}C, spread and rolled.

4.1.1.1.5 Finishing

During the finishing process the steel may be cut, trimmed and further rolled to achieve the characteristics and dimensions of the final product.

4.1.1.1.6 Cooling lines (FM BREF A.2.11)

After finishing the steel product may pass through a cooling line where the steel is rapidly cooled using water sprays, water walls or laminar flows.

4.1.1.1.7 Sheet and Plate Production (FM BREF A.2.12)

In sheet production hot produced coils are decoiled and supplied to a shearing line where they are straightened in to strips. Plate production is carried out on shearing lines following the rolling process. The plates are trimmed, cropped and cut to the required length.

4.1.1.1.8 Plate Heat Treatment (FM BREF A.2.1.13)

Finished plates may undergo further heat treatment processes:

- *Annealing*: where the steel is heated to a sub-critical temperature to relieve stresses
- *Normalizing:* where the steel is heated above its critical temperature to refine grain sizes and obtain a carbide distribution in which austenite will readily dissolve
- *Quenching:* where the steel is cooled quickly to a lower temperature by immersion in an oil or water bath
- *Tempering:* where the steel is subjected to a light rolling pass to reduce the thickness and modify the mechanical properties.

4.1.1.2 Cold Rolling (FM BREF A.2.2.1)

In cold rolling the mechanical properties of the steel such as thickness, ductility and mechanical strength are changed by compression between rollers without previous heating of the input material. The processing steps and sequences in a cold rolling mill will differ depending on whether low alloy steels (carbon steel) or high alloy steels (stainless steel) are being treated.

Cold rolling mills comprise of the following process steps:

- Continuous pickling line
- Cold rolling mill
- Annealing facilities
- Temper mills
- Inspection and finishing lines
- Packaging lines for coils or sheets
- Roll shop.

4.1.1.2.1 Pickling of Low Alloy and Alloy HR steel (FM BREF A.2.2.2)

In this process a thin layer of scale containing oxides is removed from the surface of the hot rolled coil by treating it with hydrochloric or sulphuric acid in the temperature range of 75^{o}C to 95^{o}C. Once pickled the sheet or strip is thoroughly rinsed with demineralised water, dried and oil applied to the surface.

The high alloy steels (FM BREF A.2.2.3) require an initial annealing step due to the hardness of the steel before pickling. The annealing process consists of three steps, heating to annealing temperature, temperature equalisation and cooling. This can be carried out in batch or continuous process. Ferritic grades are annealed as tightly wound coils in a batch heat treatment facility. Heating is carried out in the furnace chamber by gas firing or electrical heating, in an inert atmosphere of nitrogen/hydrogen at temperatures up to 800^{o}C.

Austenitic steels are annealed in a continuous process where the steel coil is unwound and passed through one or more heat treatment furnaces. Heating is carried out by gas in an oxidizing atmosphere to form an oxygen rich scale to facilitate better pickling. Temperatures up to 1,100^{o}C are required for this process. The steel strip is cooled using gas jets, air, water sprays or water quenching.

Mechanical descaling such as shot blasting or scale breaking is used to remove the heavy scale burden after annealing. Final scale removal including the removal of the chromium depleted layer under the scale is done by pickling in a mixture of 10 – 18% nitric and 1 – 5% hydrofluoric acids at temperatures up to 70^{o}C. The steel strip is rinsed with water and dried.

4.1.1.2.2 Cold rolling of Low Alloy and Alloy HR Steel (FM BREF A.2.2.4.1)

In cold rolling the pickled hot rolled bars, sheets or strips are passed through sets of rolls on reversing mills or on continuous in-line mills. The low carbon steels are rolled in multi-stand tandem mills where the strip enters the first stand and undergoes an initial thickness reduction, further reductions continue until the final gauge is achieved. For a low carbon strip, an oil in water emulsion is required for lubrication, cooling of the strip and backup rolls and removal of iron particles. The strip is cleaned to remove any remaining soap or oil following rolling.

Conventional discontinuous rolling where the hot rolled strip is fed in to the cold rolling mill coil by coil offers a high degree of process flexibility. Continuous rolling where the coils are joined by a welding machine and the strip is fed to the mill continuously offers good control of strip thickness and surface quality.

Following initial annealing and pickling the high alloy steel (FM BREF A.2.2.4.2) is rolled to the required thickness on reversing cluster mills for a number of passes until the desired dimensions are achieved and work hardening necessitates further annealing. Mineral oils are generally used as rolling oil and close control of oil cleanliness is achieved using oil filtration circuits. Extraction hoods operate continuously to remove oil mists generated in the mill.

4.1.1.2.3 Annealing of Low Alloy and Alloy Steel (FM BREF A.2.2.5)

This involves three stages of the annealing process, heating to annealing temperature, holding at annealing temperature and cooling can be carried out in batch or continuous furnaces.

In batch annealing the strip must be cleaned to remove oil residues from the steel surface. The steel sheet is unwound from the coil and passed through cleaning tanks containing alkali solutions, rinsed with water and recoiled. The coiled strips are stacked in a hood furnace for annealing. The combustion chamber is heated by oil or gas and heat passes through a protective hood in to the chamber. The atmosphere is usually a HNX gas (a nitrogen-hydrogen mixture). During the heating stage, the CO/CO_2, H_2, FeOx and CH_4 may be liberated. The strip is heated to 700^oC, the annealing temperature resulting in the complete re-crystallisation of the cold rolled steel. To cool the coils the heating hood is removed and cooling can be enhanced by spraying water on the hood, blowing air on it or using a cooling by-pass system. Annealing using this method can take 2 to 7 days, is slow and is not suitable for certain steel grades.

For continuous annealing the coils are welded together and undergo the following process steps:

- Alkaline / electrolytic cleaning of the strips
- Heating and holding at the annealing temperature
- Cooling (slow jet cooling, high gas jet cooling, overaging, roll cooling, final cooling, mist jet cooling).

The continuous annealing is carried out by passing steel strip through a multi-zone heating furnace with heating chamber, annealing chamber, cooling zone, tempering zone and a second cooling zone. The steel is heated to between 650^oC and 830^oC and cooled by gas jets, gas-water sprays, contact rolls or water quenching. The furnaces are fired by gas or electrically heated. The atmosphere in the furnace is an inert gas or a reducing gas.

4.1.1.2.4 Final Annealing and Pickling of High Alloy Steel Following Rolling (FM BREF A.2.2.6)

Before the final annealing step the strip is unwound and passed through a series of tanks containing alkali solutions to remove contaminants from the steel surface. The strip is rinsed with demineralised water. The final annealing and pickling processes depends on the surface finish required. Steel with an

EN standard finish ‘2R’ requires bright annealing treatment where annealing is done under a protective inert atmosphere of nitrogen and or hydrogen in a batch or continuous process. For steel with an EN surface finish ‘2B’ treatment takes place in an oxygen rich atmosphere to ensure the scale generated in the furnace can be removed by the downstream chemical pickling process. The annealing process is carried out on continuous annealing and pickling lines.

Mechanical descaling techniques cannot be used at this stage of the process due to surface damage which would affect the final cold rolled strip. Therefore only chemical pickling is used as described in Section 4.1.1.2.2 above. Pretreatment processes such as electrolytic descaling can be installed prior to the mixed acid section to assist in the removal of oxides.

4.1.1.2.5 Tempering of Low Alloy and Alloy Steel (FM BREF A.2.2.7.1)

Tempering is carried out after annealing to modify the surface finish and mechanical properties of the steel. The steel strip is subjected to a light rolling pass in a temper mill where the thickness is reduced by 0.3 to 2%. Before tempering the strip temperature must be less than 50^{o}C.

The tempering of high alloy steel (FM BREF A.2.2.7.2) is carried out to attain the desired surface finish on the steel. There is a reduction in gauge of up to 2% and the process is done dry without the application of oil for cooling.

4.1.1.2.6 Finishing (FM BREF A.2.2.8)

The finishing process is the same for both the low alloy and high alloy steels except oiling is not required for stainless steel. The finishing process comprises of the following steps:

- Dimensional control (width, thickness and length)
- Inspection of surface defects and removal of same
- Sampling to determine mechanical and technical properties
- Trimming the coils to exact width
- Straightening the strips to optimum flatness
- Oiling the strips with anticorrosive oils or prelubes
- Marking the finished product with production date, coil number
- Welding of smaller coils to bigger coils.

Additional treatments may be required to remove defects and can include annealing, temper rolling, straightening or strip grinding.

4.1.1.2.7 Packaging (FM BREF A.2.2.8)

The material is packed in protective packaging and is ready for dispatch.

4.1.1.2.8 Roll Shop (FM BREF A.2.2.9)

The rolls used in the cold rolling process steps are maintained and conditioned in the roll shop. Activities in the roll shop include dismantling of the chocks, grinding of the rolls, texturing of the rolls and reassembling of the rolls.

4.1.1.3 Wire Drawing (FM BREF A.2.3.1)

The products obtained from wire drawing are cable, mesh, barbed wire, wire fencing, grills, springs and nails. Wire drawing is a process in which wire rods/wires obtained from hot rolling mills are reduced in size by drawing them through cone shaped openings of a smaller cross section called dies. The wire drawing process consists of the following steps:

- Pre-treatment of the wire rod (mechanical descaling, pickling)
- Dry or wet drawing
- Heat treatment (continuous/discontinuous annealing, patenting, oil hardening);
- Finishing.

Wire is manufactured in different grades of steel: low carbon steel (carbon content up to 0.25%), high carbon steel (carbon content over 0.25%), stainless and other alloy steels.

Non alloy steel wire can be left uncoated or coated with zinc, copper, brass, tin, nickel, chrome, plastic or varnish.

4.1.1.3.1 Pre-treatment of the Wire Rod (FM BREF A2.3.2)

The iron oxide layer on the wire rod surface after the rolling process must be removed before further processing. This can be done by mechanical descaling (FM BREF A.2.3.2.1): or chemical descaling (FM BREF A.2.3.2.2) .The technique chosen depends on the individual processing plant, the product quality and economics.

In some cases a soap carrier (FM BREF A.2.3.2.3) is applied before drawing by dipping the wire in a water soap carrier solution. This enhances the adhesion of the lubricant to the wire. Soap carriers include sodium and potassium sulphate, chloride, borax and zinc phosphate.

4.1.1.3.2 Dry and Wet Drawing (FM BREF A.2.3.3)

Dry drawing is used to draw wire rod to a product diameter of 1 – 2 mm. The wire is passed through a dry lubricant before entering the dies. Cooling is done indirectly using water. Wet drawing is used to draw wire with an intermediate diameter of 1 – 2 mm to final diameter. The wire, dies and capstans are immersed in a lubricant liquid that provides lubrication and cooling.

4.1.1.3.3 Heat Treatment (FM BREF A.2.3.4)

A large percentage of the wire products do not require any heat-treatment processes however some wire products have specific mechanical and quality specifications that necessitate the heat treatment processes outlined below.

Batch annealing of low carbon steel wire (FM BREF A.2.3.4.1) is used to obtain a very soft and ductile end product. Coils of drawn wire are heated to 700^{o}C in gas atmospheres such as nitrogen, hydrogen, nitrogen/hydrogen mixtures and partly oxidized natural gas. This process takes many hours. The wire may be oiled immediately after annealing.

Continuous annealing of low carbon steel wire (FM BREF A.2.3.4.2) is a fast process where the wire is heated up the recrystallisation temperature (500^{o}C to 700^{o}C) by passing through a molten lead bath, kept at this temperature for a few seconds and cooled down by quenching in a water bath. Inline pickling with Hydrochloric may follow to remove oxides and dissolve lead residue from the bath.

In continuous annealing of stainless steel wire (FM BREF A.2.3.4.3), stainless steel and high alloy steel wire is continuously annealed to obtain suited metal crystal properties for drawing operations. The temperature profile can be between 700^{o}C – 1,100^{o}C depends on the alloy content (Ni, Cr or other alloys) of the stainless steel. Wire is passed through tubes or a muffle under a protective gas atmosphere of nitrogen, hydrogen or nitrogen/hydrogen mixture. The first part of the muffle is placed in an oven where there is indirect heating of the wire and the second part of the muffle is cooled indirectly.

Patenting (FM BREF A.2.3.4.4) is used for high carbon and alloyed steel products and provides a structure in the metal where the carbon is homogeneously distributed in the iron. The wire is heated to 850^{o}C – 1,000^{o}C, cooled quickly to 450^{o}C – 600^{o}C in a lead bath and quenched in water.

Oil hardening and oil tempering (FM BREF A.2.3.4.5) is used for steels that have a high percentage of martensite creating an increased hardness and wear resistance combined with good toughness. The wire is heated to 850 – 1,000^{o}C in a protective atmosphere with the quenching process carried out in oil, water or water solutions. Oil

tempering follows in which the wire is heated to 300 – 500^{o}C to remove the stresses caused by the extremely fast cooling.

Stress relieving (FM BREF A.2.3.4.6) removes the internal stresses in the wire caused by previous processing steps without changing the shape or structure of the steel crystal. This process is carried out at various temperatures (200 – 500^{o}C) depending on the required characteristics of the product. Following stress relief the wire is cooled slowly in air or water.

4.1.1.3.4 In-line Pickling (FM BREF A.2.3.5)

This is carried out after heat treatment and/or before hot-dip coating of wire to clean the wire and remove metal oxides. The wire is passed through acid baths and then rinsed in water.

4.1.1.3.5 Finishing (FM BREF A.2.3.5)

Wire finishing includes the application of metallic or non-metallic coatings.

4.1.2 Continuous Hot Dip Coating

In the hot dip coating process, the steel is continuously passed through molten metal. An alloying reaction occurs between the two metals leading to a good bond between coating and substrate.

The continuous hot dip coating industry can be divided in to two distinct sectors:

- Coatings for steel sheet
- Coatings for wire.

4.1.2.1 Coatings for Steel Sheet (FM BREF B.2.1)

The hot dip coatings used for steel sheet are zinc based (galvanizing process), aluminium based (aluminizing process) and lead based. Irrespective of the coating process used, the same general process steps apply:

- Surface cleaning
- Heat treatment
- Immersion in a bath of molten metal
- Finishing treatment.

4.1.2.1.1 Galvanizing of Steel Sheet (FM BREF B.2.2)

The steel strip is coated in zinc for corrosion protection. Galvanizing consists of the following steps:

- *Pickling (FM BREF B.2.2.1):* The steel sheet is pickled in HCl to remove scale and rinsed in water
- *Degreasing (FM BREF B.2.2.2):* The surface is cleaned of oil, grease or iron fines using an alkaline solution, rinsed with water and dried
- *Heat treatment (FM BREF B.2.2.3):* The steel is passed through a furnace where it is heated up, annealed and cooled to improve the mechanical properties and preheat the steel before dipping
- *Hot Dipping or Galvanizing (FM BREF B.2.2.4):* The strip is passed through a series of tank containing the molten metal (zinc and other additives) at a temperature of 440 – 490^{o}C. Jets of air or nitrogen placed above the baths blow excess zinc from the strip. After hot dipping the strip is gradually cooled by air coolers, quenched in a water tank and dried in a drier
- *Galvannealing (FM BREF B.2.2.5):* This post-treatment involves heating the strip to a temperature that allows the formation of a zinc-iron alloy to yield a smooth appearance of the product. Low carbon steels are heated to 500^{o}C and high strength steels are heated to 540^{o}C
- *Post Treatments (FM BREF B.2.2.6):* To prevent surface damages and flaws such as white rust caused by condensation and to improve processing properties such as painting oiling, passivating and phosphating may also be carried out
- *Finishing (see FM BREF B.2.2.7):* To achieve a special surface appearance or to meet width tolerances mini or no spangle treatment, mat milling and edge cutting can be utilised.

4.1.2.1.2 Aluminizing of Steel Sheet (FM BREF B.2.3)

Aluminizing consists of the following steps:

- *Pickling*: carried out to prevent an oxide layer from forming which would prevent the diffusion of aluminium into the steel substrate. The steel is chloride gas pickled prior to annealing
- *Heat treatment*: where the washed and pickled steel is passed through a furnace with a hydrogen atmosphere to eliminate oxygen and to prevent an oxide layer from being formed
- *Hot Dipping or Aluminizing*: the steel is dipped in a molten aluminium bath maintained at 690^{o}C. Some processes keep the bath saturated with hydrogen to prevent oxide layer formation
- *Post aluminizing heat treatment*: the coated coil can be further heat treated at 820 – 930^{o}C if a steel-aluminium alloy coating is required
- *Post Treatment*: to prevent surface damages and flaws such as white rust caused by condensation and anti-finger printing may be carried out.

4.1.2.1.3 Lead Tin Coating of Sheet (FM BREF B.2.4)

Lead tin alloy coatings comprise of 8 – 25% tin and up to 3% antimony and are referred to as ‘terne’ metal. This coating provides a high degree of corrosion resistance. Lead tin coating includes:

- *Degreasing and Pickling*: The cold reduced substrate is cleaned by degreasing electrolytically and is pickled in warm diluted hydrochloric or nitric acid
- *Nickel Flash Coating*: A thin nickel coating is applied electrolytically to improve wetting of the substrate by the alloy in the following hot dip step
- *Nickel Flash Plating*: The strip is passed through plating cells for nickel plating in the presence of an electrolyte at 65^{o}C and an acidic environment of pH 2.5 – 5.0
- *Coating bath*: The strip enters a molten 'terne' bath at a temperature of 310^{o}C through a zinc ammonium chloride flux. Air knives control the coating thickness. After coating the steel is cooled
- Post Treatment: Passivation and oiling may be carried out to seal the strip surface and protect any exposed areas against oxidation.

4.1.2.2 Coatings for Wire (FM BREF B.2.1 and B.2.5)

The hot dip coatings used for wire are primarily zinc (galvanizing process) and zinc alloys. The main function of these coatings is corrosion protection. Other coatings include tin which provides a shiny appearance and aluminium which provides corrosion protection. Continuous hot dip coating lines for wire comprise of the following steps:

- Pickling and rinsing
- Fluxing and drying
- Hot dipping (Galvanizing)
- Finishing.

4.1.2.2.1 Continuous Pickling of Wire (FM BREF B.2.5.1)

Pickling is done to remove surface debris and prepare the wire surface for the application of coatings. This can be done by immersing the wire in an acid bath or subjecting it to a neutral bipolar electrolysis cell. In acid pickling the wire is passed continuously through one or more hydrochloric or sulphuric acid baths. The wire is rinsed after pickling.

4.1.2.2.2 Fluxing and drying (see FM BREF B.2.5.2)

For good adhesion of the zinc coating, the wire is passed through a flux bath which consists of heated solution of zinc chloride and ammonium chloride. Pure zinc chloride is used for tin coatings. The wire is dried in a furnace or by the internal heat of the wire.

4.1.2.2.3 Hot Dipping (Galvanizing) (FM BREF B.2.5.3)

The wire is passed through a molten zinc bath at a temperature of 430 - 470^{o}C. An iron – zinc diffusion layer is formed. A zinc layer is formed on top of this when the wire leave the zinc bath. The wire is cooled to ambient temperature using air and cooling water.

4.1.2.2.4 Finishing (FM BREF B.2.5.4)

A wax layer is applied to protect against superficial corrosion of the zinc layer.

4.1.3 Pressing Drawing and Stamping of Large Castings

Pressing is used for forming and cutting material, a machine press is a tool used to work metal (typically steel) by changing its shape and internal structure. Metal is fed into the rollers, which are turning to pull the material through. The space between the rollers is smaller than the unfinished metal, and thus the metal is made thinner and/or

wider. A forge press reforms the work piece into a three dimensional object not only changing its visible shape but also the internal structure of the material. Bending is a typical operation performed and occurs by a machine pressing, or applying direct pressure, to the material and forcing it to change shape. A press brake is a typical machine for this operation.

Drawing is a metal-forming operation in which a piece of metal is pulled through a die in order to reduce the cross-section. Rod, wire and tubing are all produced by this process.

Stamping is a manufacturing method that can encompass punching, coining, bending and several ways of modifying the metal, combined with an automatic feeding system. The feeding system pushes a coil of metal through all of the stations of a progressive stamping die. Each station performs one or more operations until a finished part is made per the requirements on the print. The final operation is a cut off operation, which separates the finished part from the carrying web. The carrying web, along with metal that is punched away in previous operations, is considered scrap metal.

Specific process description can be found in the BREF documents as follows:

- Preparation of large castings (S & Fs BREF Section 2.6)
- Wire Drawing (Ferrous BREF Section A.2.3).

4.2 RISKS TO THE ENVIRONMENT

4.2.1 Introduction

In this section, the major sources of emission to air, water and waste material are identified, as are the principal sources of waste from the sector. The identified list of sources is not all encompassing and neither will every plant falling within the individual sectors have all the emissions which are associated with the sector as a whole.

The main environmental issues of hot rolling are emissions to air, especially NOx and SOx; the energy consumption of furnaces; (fugitive) dust emissions from product handling, rolling or mechanical surface treatment; oil- and solid-containing effluents and oil-containing wastes.

The main environmental issues of cold rolling are: acidic wastes and waste water; degreaser fume, acidic and oil mist emissions to air; oil-containing wastes and waste water; dust, e.g., from descaling and decoiling; NOx from mixed acid pickling and combustion gases from furnace firing.

The main environmental aspects of wire drawing are: air emissions from pickling, acidic wastes

and waste water; fugitive soap dust (dry drawing), spent lubricant and effluents (wet drawing),

combustion gas from furnaces and emissions and lead-containing wastes from lead baths.

The main environmental issues with continuous are acidic air emissions, wastes and wastewater; air emissions and energy consumption of furnaces, Zinc-containing residues, oil and chrome containing wastewaters.

4.2.2 Emissions to Air

Gaseous waste is the largest waste source from the ferrous metal processing industry much of which consists of combustion gases from the furnace firing processes. Acidic gas fumes arise from surface treatment and pickling processes, dusts are produced from mechanical processing of the metals such as rolling and oil mists occur while keeping the steel lubricated during processing.

The principal atmospheric emissions for different processes in the industry are given in the following table.

Table 4.1: Summary of Sources and Emissions to Air

Process Stage	**Airborne Component**
Hot Rolling	
Conditioning of input (FM BREF A.3.1.2)	NO_X, CO , Steel dust
Heating to rolling temperature (FM BREF A.3.1.3)	Dust , NO_X , SO_2, VOC
Hot rolling (FM BREF A.3.1.5)	Dust, oxides, oil mists, filter dust
Cold Rolling	
Pickling low & high alloy steels (FM BREF A.3.2.2)	Acid Fumes (HCl , H_2SO_4), NO_x, HF
Cold rolling of low alloy steel (FM BREF A.3.2.3.1)	Dust, SO_x, CO, CO_2

Cold rolling of high alloy steel (FM BREF A.3.2.3.2)	Particulates (iron), hydrocarbon
Annealing of low alloy steel (FM BREF A.3.2.4)	Oil mists CO, CO_2, H_2, FeO_x, CH_4, SO_x, NO_x
Annealing of high alloy steel (FM BREF A.3.2.5)	CH_4, SO_x, NO_x, CO, CO_2, HF, dust
Roll shop (FM BREF A.3.2.8)	Waste gas containing dust & Cr
Wire Drawing	
Chemical descaling & pickling (see VBREF A.3.3.2.2)	Acid fumes (HCl), aerosols (H_2SO_4)
	CO, CO_2
Application of soap carrier (FM BREF A.3.3.2.3)	Soap dust
Dry drawing (FM BREF A.3.3.3.1)	CO, CO_2, alkanes, olefins
Batch annealing (FM BREF A.3.3.4.1)	Particulates (lead), VOC, CO
Continuous annealing (FM BREF A.3.3.4.2)	CO_2, Particulates (lead), NO_x, SO_2
Patenting (FM BREF A.3.3.4.3)	CO, CO_2 (exhaust gases)
Oil hardening and Tempering (FM BREF A.3.3.4.4)	Oil mists
Continuous Coating	
Galvanizing of steel	
Pickling (FM BREF B.3.2.1)	Acid fumes (HCL)
Degreasing (FM BREF B.3.2.2)	N_aOH, $(PO_4)^{2-}$
Heat treatment (FM BREF B.3.2.3)	CO, CO_2, NO_x, SO_2, hydrocarbons.
Galvannealing (FM BREF B.3.2.5)	CO, NO_x
Aluminizing of steel (FM BREF B.3.3)	CO, CO_2, NO_x, SO_2
Lead Tin Coatings of Sheet (FM BREF B.3.4)	HCl, CO_2, NO_2, SO_x, particulates
Coatings for Wire	
Continuous pickling (FM BREF B.3.5.1)	Acid fumes (HCl)
Hot dipping (FM BREF B.3.5.3)	CO, CO_2, particulates (zinc)

4.2.3 Emissions to Water

The waste water generated in the industry arises from rinsing cycles following acid pickling, acid scrubbing operations, cooling water systems in the plants and waste water treatment plants. In many cases the wastewater contains suspended solids (SS), metals, oils and scale.

The principal wastewater emissions for different processes in the industry are given in the following table.

Table 4.2: Summary of Sources and Emissions to Water

Process stage	Wastewater Component
Hot Rolling	
Descaling (FM BREF A.3.1.4)	Scale, oil
Hot rolling (FM BREF A.3.1.5)	Cooling water containing SS, oil
Waste water treatment plant (FM BREF A.3.1.8)	Discharged water with Cu, Zn, Cd, Al, Pb, Cr, Cr^{6+}, Mn, Fe, Ni, Hg
Cold Rolling	

Pickling low & high alloy steels (FM BREF A.3.2.2)	Rinsing water, water from acid fume scrubbers
Cold rolling of low alloy steel (FM BREF A.3.2.3.1)	Suspended solids, oil
Cold rolling of high alloy steel (FM BREF A.3.2.3.2)	Suspended solids, salts of iron and alloy metals, oil
Annealing of low alloy steel (FM BREF A.3.2.4)	Suspended solids, oil
Annealing of high alloy steel (FM BREF A.3.2.5)	Suspended solids, metals
Wire Drawing	
Chemical descaling & pickling (FM BREF A.3.3.2.2)	Rinse water with acid residues
Continuous annealing/lead bath(FM BREF A.3.3.4.2)	Quench water containing SS, Pb
Continuous pickling (FM BREF A.3.3.4.2)	Quench water containing Pb, wastewater from rinsing and scrubber
Patenting (FM BREF A.3.3.4.3)	Quench water containing SS, Pb
Oil hardening and Tempering (FM BREF A.3.3.4.4)	Wastewater (if water quenching used)
Continuous Coating **Galvanizing of Steel**	
Degreasing (FM BREF B.3.2.2)	Spent degreasing agent, spent water contains NaOH, $(PO_4)^{2-}$
Finishing (FM BREF B.3.2.7)	Emulsion effluent containing suspended solids, hydrocarbons, Zn
Waste water treatment plant (FM BREF B.3.2.8)	Discharged water with suspended solids, Fe, Ni, Zn, Pb, Cr, Cr^{6+}, TOC
Aluminizing of steel (FM BREF B.3.3)	Hydrocarbons, phosphorus Rinse water with acid residue
Lead Tin Coatings of Sheet Waste water treatments plant (FM BREF B.3.4)	Waste water with suspended solids, COD, Cr, Cr^{6+},Cu, Pb, Ni, Zn, Fe
Coatings for Wire Continuous pickling (FM BREF B.3.5.1)	Waste water from rinsing, scrubbing

4.2.4 Wastes

The main types of waste produced by the industry include acid waste streams and sludges from spent pickle liquors, scale material from pretreatment operations, oil contaminated wastes, scrap metal byproducts from cutting, finishing, pressing, drawing, stampling processes, waste treatment filter cakes, emulsions and sludges, fluxes and dross materials.
The principal waste for different processes in the industry are given in the following table.

Table 4.3 : Summary of Waste Produced

Process stage	Waste
Hot Rolling	
Heating to rolling temperature (FM BREF A.3.1.3)	Scale
Descaling (FM BREF A.3.1.4)	Scale (FeO, Fe_3O_4)
Hot rolling (FM BREF A.3.1.5)	Metallic byproducts, cuttings, rolling rejections, water treatment sludge
Cold Rolling	
Pickling low & high alloy steels (FM BREF A.3.2.2)	Scale, pickle tank sludge (Fe, Ni, Cr) Spent pickle liquors, salts of Fe_2O_3, $FeSO_4$ from acid regeneration
Cold rolling of low alloy steel (FM BREF A.3.2.3.1)	Oil, oil sludges
Cold rolling of high alloy steel (FM BREF A.3.2.3.2)	Oil contaminated waste filter media, scraps, cut offs
Annealing of low alloy steel (FM BREF A.3.2.4)	Sludge cake
Annealing of high alloy steel (FM BREF A.3.2.5)	Sludge cake
Tempering of low alloy/high alloy steel (FM BREF A.3.2.6)	Sludge cake, oil contaminated waste
Finishing (FM BREF A.3.2.7)	Scrap metal
Roll shop (FM BREF A.3.2.8)	Grinding sludge, oil contaminated waste
Wire Drawing	
Mechanical descaling (FM BREF A.3.3.2.1)	Scale (FeO, Fe_3O_4)
Chemical descaling & pickling (FM BREF A.3.3.2.2)	Spent acid (HCl, H_2SO_4), $FeSO_4$ salt
Application of soap carrier (FM BREF A.3.3.2.3)	Sludge cake ($FePO_4$), Spent Soap carrier fluid
Dry drawing (FM BREF A.3.3.3.1)	Spent soap lubricant with Fe, Zn.
Wet drawing (FM BREF A.3.3.3.2)	Spent waste drawing emulsion, sludge, suspended solids
Continuous annealing (FM BREF A.3.3.4.2)	PbO, spent Pb bath material,
Continuous pickling (FM BREF A.3.3.4.2)	Spent acid (HCl) contaminated with Pb, Fe, SS
Patenting (FM BREF A.3.3.4.3)	PbO, spent Pb bath material.
Oil hardening and Tempering (FM BREF A.3.3.4.4)	Waste quench oil (if oil quenching is used)
Continuous Coating **Galvanizing of steel**	
Degreasing (FM BREF B.3.2.2)	Oily sludge, salts (Fe_2O3, $FeSO_4$)
Hot dipping (FM BREF B.3.2.4)	Dross, plate scrap, Zn material, Cr,
Passivation (FM BREF B.3.2.6)	

Aluminizing of steel (FM BREF B.3.3) **Lead Lin Coatings of Sheet** (FM BREF B.3.4) **Coatings for Wire** Continuous pickling (FM BREF B.3.5.1) Fluxing (FM BREF B.3.5.2) Hot dipping (FM BREF B.3.5.3)	Dross, Waste treatment filter cake and sludge, caustic waste ZnCl, Chromate, oil , spent flux Spent pickle liquor containing Fe Spent flux Dross (Zn residues)
Pressing Drawing Stamping Large Castings	Oil, oil sludges, Spent waste drawing emulsion, sludge, scrap metal.

4.2.5 Noise

Noise can arise from product handling such as impact noise from large diameter pipes and heavy plates, high pressure descaling operations, stamping, drawing, pressing operations, rotating equipment, air brushes for cleaning wire using compressed air and burners of ovens. Specific sector noise emissions include:

- Hot rolling mills (FM BREF A.3.1.10)
- Cold rolling mills (FM BREF A.3.2.12)
- Wire Plant (FM BREF A.3.3.5).

These noise sources can potentially create a nuisance to site neighbours and the environment. Noise can either be continuous or intermittent depending on the operation of equipment.

4.2.6 Energy

The principal areas in ferrous industry requiring significant energy inputs are related to furnace operation and efficiency (FM BREF Section A.3.1.2, A.3.1.3 & A.3.1.5).

4.2.7 Environmental Liabilities, Restoration and Aftercare

A key element to understanding and managing environmental risk at an installation is the carrying out of an environmental liabilities risk assessment for known and unknown liabilities (including aftercare), and the financial provision for same. Regard should be had to the Environmental Liabilities Directive 2004/35/EC and consideration should be given to the EPA guidance on Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision.

Restoration is a process that will return a site to a condition suitable for the selected afteruse. Restoration includes measures such as soil spreading, final landform construction, landscaping works and aftercare. Aftercare involves any measures that are necessary to be taken in relation to the installation for the purposes of preventing environmental pollution following the cessation of the licensable activity at the site. The length of this aftercare period will vary from site to site and the licence holder remains responsible for the aftercare until the Agency accepts the surrender of a licence.

4.3 CONTROL TECHNIQUES

The existing or possible measures for eliminating, reducing and controlling emissions in the ferrous industry are described in this Section. References to more details and descriptions in the BREF document are given.

4.3.1 General Preventative Methods

An Environmental Management System (EMS) should be operated at the installation. This should address design, construction, operation, maintenance, and decommissioning issues in a systematic, demonstrable way. An EMS includes the organisational structure, responsibilities, practices, procedures, processes and resources for developing, implementing, maintaining, reviewing and monitoring the environmental policy and the system can be standardised or customised. Environmental Management Systems are most effective and efficient where they form an inherent part of the overall management and operation of an installation.

4.3.2 Techniques for Minimisation of Resource Consumption

A resource consumption technique generally applied in the industry is computer aided quality control (FM BREF A.4.1.2.3).

4.3.2.1 Minimisation of Energy Use

Energy use in the Ferrous Metals sector is controlled with effective energy management systems and process control techniques, specific techniques applied are:

- General measures for energy efficiency and low emission operation (FM BREF A.4.1.3.1)
- Furnace automation and furnace control (FM BREF A.4.1.3.2)
- Optimised furnace design (FM BREF A.4.1.3.3)
- Regenerative burners (FM BREF A.4.1.3.4)
- Recuperator and recuperative burners (FM BREF A.4.1.3.5)
- Oxy-fuel technology (FM BREF A.4.1.3.6)
- Reheat and heat treatment furnace (FM BREF A.3.1.3)
- Waste heat boiler (FM BREF A.4.1.11)
- Optimised skid design (FM BREF A.4.1.3.12)
- Use of stock transportation device (FM BREF A.4.1.3.13)
- Evaporative furnace skid cooling (FM BREF A.4.1.3.14)
- Feed stock preheating (FM BREF A.4.1.3.15)
- Heat conservation box thermal covers (FM BREF A.4.1.3.16)
- Hot charging/direct rolling (FM BREF A.4.1.17)
- Near shape casting (FM BREF A.4.1.3.18 & 19)
- Descaling material tracking (FM BREF A.4.1.4.1)
- Use of high pressure storage equipment (FM BREF A.4.1.4.2)
- Edging (FM BREF A.4.1.5)
- Roughing process automation (FM BREF A.4.1.6)

- Transport of rolled stock form roughing mill to finishing train (FM BREF A.4.1.7)
- Work rod lubrication system (FM BREF A.4.1.8.2)
- On-line heat treatment (FM BREF A.4.1.8.12)
- Thermo mechanical rolling operation(FM BREF A.4.1.813)
- Turbulence pickling (FM BREF A.4.2.2.5)
- Continuous rolling (FM BREF A.4.2.3.1)
- Batch annealing 100% hydrogen (FM BREF A.4.2.4.7)
- Pre-heating combustion air, use of regenerative furnaces (FM BREF A.4.2.4.9 & B.4.1.4.3)
- Steam production with recovery heat (FM BREF B.4.1.4.4)
- Pre-heating feedstock (FM BREF A.4.2.4.11).

4.3.2.2 Minimisation of Water Use

Process-integrated measures such as recycling involve recirculation of the liquid to the process where it has been generated. Reuse of an effluent means the re-circulation of one source of water for another purpose, specific techniques applied in the industry are:

- Water circuits/management hot rolling mills (FM BREF A.2.1.15)
- Water management cold rolling mills (FM BREF A.2.2.10)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.1)
- Cleaning and re-circulation of degreasing baths Cascade use of degreasing solutions (FM BREF B.4.1.3.2)
- Cooling water treatment (FM BREF A.4.1.12.3, A.4.2.3.10 & B.4.1.10)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4)
- Magnetic pumps (FM BREF A.4.2.2.25)
- Minimise rinsing water (A.4.3.3.9)
- Closed loop cooling water (FM BREF A.4.3.5.2 & A.4.3.6.1).

4.3.2.3 Raw Materials

Installations control raw material use by maintain inventory and control procedures including operational procedures to determine the most suitable material for use, thus preventing use of materials that may have an unacceptable environmental impact in their manufacture, end-use and ultimate disposal. Techniques applied in the industry are:

- Storage and handling hot rolling mills (FM BREF A.4.1.1)
- Edging (FM BREF A.4.1.5)
- Cleaning and re-circulation of degreasing baths (FM BREF B.4.1.3.1)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.2)
- Waste by-product treatment and recycling (FM BREF A.4.1.13)
- Mechanical pre-descaling (FM BREF A.4.2.2.3)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4)
- Cleaning and re-use of pickle liquor (FM BREF A.4.2.2.6)

- Hydrochloric acid regeneration (FM BREF A.4.2.2.7 & A.4.2.2.8)
- Sulphuric acid recovery (FM BREF A.4.2.2.10)
- Mixed acid regeneration (FM BREF A.4.2.2.11)
- Mixed acid recovery (FM BREF A.4.2.2.12, A.4.2.2.13 & A4.2.2.14)
- Pickling plant coupled with tandem mill (FM BREF A.4.2.3.2)
- Optimal choice of rolling oil and emulsion (FM BREF A.4.2.3.3 & A4.2.3.6)
- Continuous monitoring of emulsion quality (FM BREF A.4.2.3.4)
- Cleaning and re-use of emulsion (FM BREF A.4.2.3.7)
- Cleaning and re-use of degreasing solutions (FM BREF A.4.2.4.3)
- Emulsion optimisation (FM BREF A.4.2.5.1)
- Change to dry temper process (FM BREF A.4.3.1)
- Wire mill storage and handling of raw materials (FM BREF A.4.2.5.2)
- Cascade pickling (FM BREF A.4.3.3.4)
- Minimise pickling carry-out (FM BREF A.4.3.3.5)
- Separation and re-use of spent acid (FM BREF A.4.3.3.6)
- Patenting oven optimisation (FM BREF A.4.3.10.1)
- Cleaning and re-use of phosphating solution (FM BREF B.4.1.7.3)
- Cleaning and re-use of chromating solution (FM BREF B.4.1.7.4)
- Using squeeze rolls (FM BREF B.4.1.7.6)
- Use reverse osmosis for deionised water (FM BREF B.4.1.7.7).

4.3.3 Control techniques for specific unit operations

4.3.3.1 Hot Rolling

Process integrated and end of pipe control techniques for environmental protection and energy saving in hot rolling are provided in the FM BREF Section A.4.1.

4.3.3.2 Cold Rolling

Process integrated and end of pipe control techniques for cold rolling are provided in the FM BREF Sections A.4.2 and A4.11.

4.3.3.3 Wire Drawing

Process integrated and end of pipe control techniques for environmental protection and during wire drawing are provided in FM BREF Section A.4.3.5 and A.4.3.6.

4.3.3.4 Continuous Hot Dip Coating

Control techniques for environmental protection during hot dip coating are provided in the following sections of the FM BREF:

- Galvanising of sheet (FM BREF B.4.1)
- Aluminizing of sheet (FM BREF B.4.2)
- Lead-tin coating of sheet (FM BREF B.4.3).

4.3.3.5 Coating of Wire

Process integrated and end of pipe techniques for coating of wire are provided in the FM BREF Section B.4.4, FM BREF B.4.2, FM BREF B4.3.

4.3.4 Emission Control

4.3.4.1 Minimisation of Emissions to Air

For all ferrous metal operations fugitive air emissions are minimised by covering and sealing unit operations such as furnaces, buildings, process and storage areas, good housekeeping and regular preventative maintenance programmes including:

- Enclosing scarfing operation with waste gas cleaning (FM BREF A.4.1.2.1)
- Enclosing grinding operation with waste gas cleaning (FM BREF A.4.1.2.2)
- Rolling of edge type slabs with waste gas cleaning (FM BREF A.4.1.2.4)
- Furnace emissions (FM BREF A.4.1.3.6, A.4.1.3.7, A.4.1.3.8, A.4.1.3.9, A.4.1.3.10)
- Thermo mechanical rolling operation (FM BREF A.4.1.8.13)
- Leveller dust removal (FM BREF A.4.1.10.1)
- Reduction of dust emissions at recoilers (FM BREF A.4.2.2.2)
- Electrolytic pre-pickling (FM BREF A.4.2.2.15)
- Reduction of pickling emissions with gas scrubbing (FM BREF A.4.2.2.18, A.4.2.2.19, A.4.2.2.20)
- Nitric acid free pickling (FM BREF A.4.2.2.23)
- Reduction in NOx, low NOx burner (FM BREF A.4.2.4.10 & B.4.1.4.1)
- Optimise pickling baths (FM BREF A.4.3.3.1)
- Pickling tank fume control (FM BREF A.4.3.3.2)
- Lead bath good housekeeping (FM BREF A.4.3.8.1)
- Inductive heating of wire (FM BREF A.4.3.12.1)
- Induction electric furnace in hot dip coating (FM BREF B.4.1.6.1)
- Covering strip oiling machine (FM BREF B.4.1.7.1)
- Electrostatic oiling (FM BREF B.4.1.7.2)
- Covered process baths and storage tanks (FM BREF B.4.1.7.5).

4.3.4.2 Minimisation of Emissions to Water

For all ferrous metal operations control techniques for emissions to water include:

- Prevention of hydrocarbon contamination (FM BREF A.4.1.8.9)
- Reduction of water consumption and discharge (FM BREF A.4.1.12.1)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.1)
- Cleaning and re-circulation of degreasing baths Cascade use of degreasing solutions (FM BREF B.4.1.3.2)
- Reduction of waste water contaminant loading cold rolling mills (FM BREF B.4.2.2.1)

- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4 & B.4.3.1.7)
- Effluent free HCl strip pickling plant (FM BREF A.4.2.2.9)
- Sulphuric acid recovery (FM BREF A.4.2.2.10)
- Mixed acid recovery (FM BREF A.4.2.2.12, A.4.2.2.13 & A4.2.2.14)
- Prevention of contamination (FM BREF A.4.2.3.5)
- Cleaning and re-use of emulsion (FM BREF A.4.2.3.7)
- Treatment of spent degreasing bath and alkali wastewater (FM BREF A.4.2.4.4)
- Cleaning of temper mill emulsion (FM BREF A.4.2.5.4)
- Use of squeeze roles (FM BREF A.4.1.3.7).

4.3.4.3 Minimisation of Noise Emissions

Noise emissions are minimised with good maintenance preventing equipment such as fans and pumps from becoming unbalanced. The interconnections between equipment can be designed to prevent or minimise the transmission of noise. In addition buildings are constructed with acoustic cladding insulation. Patterns of raw material delivery are monitored to ensure that vehicle movements are avoided during specific periods and noisy activities are carried on indoors where possible.

4.3.4.4 Solid Waste Minimisation

Control techniques for solid waste minimisation in the Ferrous Metals industry include the following:

- Recycling of oil contamination waste (FM BREF B.4.1.1.2)
- Cleaning and re-circulation of degreasing baths (FM BREF B.4.1.3.1)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.2)
- Rolling of wedge type slabs (FM BREF A.4.1.2.4)
- Rolling crop optimisation (FM BREF A.4.1.8.1)
- Slab slitting (FM BREF A.4.1.2.5)
- Forced interstitial strip cooling Slab slitting (FM BREF A.4.1.8.3)
- Interstitial strip tension control Slab slitting (FM BREF A.4.1.8.4)
- Strip profile and flatness control Slab slitting (FM BREF A.4.1.8.5)
- Work rod condition slab slitting (FM BREF A.4.1.8.6)
- Finishing train automation slab slitting (FM BREF A.4.1.8.7)
- Waste by-product treatment and recycling (FM BREF A.4.1.13)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4)
- Cleaning and re-use of pickle liquor (FM BREF A.4.2.2.6)
- Hydrochloric acid regeneration (FM BREF A.4.2.2.7 & A.4.2.2.8)
- Mixed acid regeneration (FM BREF A.4.2.2.11 & B4.3.1.5)
- Mixed acid recovery (FM BREF A.4.2.2.12, A.4.2.2.13, A4.2.2.14 & B.4.3.1.3, B.4.3.1.4)
- Clean and re-use electrolytic pickle liquor (FM BREF A.4.2.2.16)
- Separation of scale and blast media (FM BREF A.4.3.4)

- Cleaning of drawing lubricant/coolant (FM BREF A.4.3.6.2 & A.4.3.3.6)
- Recycling of lead containing residues (FM BREF A.4.3.8.2)
- External recycling of coating material slag (FM BREF B.4.2.5.2).

4.3.5 Control Techniques for Abatement and Disposal

4.3.5.1 Air Emissions

Control techniques for air emissions in the ferrous metal industry include:

- Electrostatic precipitators (FM BREF A.4.1.2.1 & A.4.2.6)
- Cyclones (FM BREF A.2.4.2.5.4)
- Bag filters (FM BREF A.4.1.2.2)
- Fabric filters (FM BREF A.4.2.6.4 & A.4.1.2)
- Wet and dry filters FM BREF (A.4.2.5.4)
- Water sprays and exhaust systems (FM BREF A.4.1.8.8)
- Oil extraction hoods followed by mist eliminators and electrostatic precipitators (FM BREF A.4.2.6.1)
- Oil separators for cleaning (FM BREF A.4.2.3.9)
- Extraction of oil mist emissions and oil separation Cleaning and re-use of emulsion (FM BREF A.4.2.3.9)
- Extraction system for degreasing facilities (FM BREF A.4.2.4.5)
- Reduction of oil mist and dust (FM BREF A.4.2.5.4)
- Capture and abatement of oil mist (FM BREF A.4.2.6.1)
- Dust reduction form levelling and welding (FM BREF A.4.2.6.4)
- Control of air from drawing machines (FM BREF A.4.3.5.1)
- Burn purge of batch annealing protective gases (FM BREF A.4.3.7.1)
- Degreasing vapour collection and treatment (FM BREF B.4.1.3.6)
- Pickling bath air treatment (FM BREF B.4.3.1.1)
- Reduction of pickling emissions with gas scrubbing (FM BREF A.4.2.2.18, A.4.2.2.19, A.4.2.2.20)
- NOx reduction by catalytic reduction (FM BREF A.4.2.2.21, A.4.2.2.22)
- Treatment of pickling tank emissions (FM BREF A.4.3.3.3).

4.3.5.2 Wastewater

The control techniques for wastewater in the industry are as follows:

Treatment of scale and iron bearing wastewater (FM BREF A.4.1.12.2)

Cooling water treatment (FM BREF A.4.1.12.3)

Treatment of acidic wastewater (FM BREF A.4.2.2.28)

Treatment of spent emulsion, cleaning and re-use of emulsion (FM BREF A.4.2.3.8)

Treatment and disposal of waste drawing lubricant (FM BREF A.4.3.6.4)

Treatment of quench bath waste water (FM BREF A.4.3.8.3)

Collection and treatment of skin pass/temper solution (FM BREF B.4.1.8.1)

Finishing waste water treatment (FM BREF B.4.1.9).

4.3.5.3 Noise & Vibration

Control techniques used by the industry include:

- The use of embankments to screen the source of noise
- The enclosure of noisy plant or components in sound absorbing structures
- The use of anti-vibration supports and interconnections for equipment
- The orientation of noise emitting machinery
- The change of the frequency of the sound
- Use of acoustic screens around fixed/mobile plant and equipment
- Fitting silencing equipment to plant, e.g., baffles/muffles.

4.3.5.4 Waste

After all options for the reduction, recovery, reuse and recycling of wastes have been exhausted, appropriate treatment and disposal of such wastes is carried out.

Such techniques for waste treatment in the industry include:

- External use of spent acid liquor (FM BREF A.4.2.2.17);
- External recycling of scale (FM BREF A.4.3.2.1).

5. BEST AVAILABLE TECHNIQUES FOR THE FERROUS METAL INDUSTRY

5.1 INTRODUCTION

As explained in Section 2, this Guidance Note identifies BAT but obviously does so in the absence of site-specific information. Accordingly, it represents the requirements expected of any new activity covered by the Note, and ultimately the requirements expected of existing IPPC facilities by October 200, but does not include additional requirements, which may form part of the granting of a licence for a specific site.

The approach to be used in selecting BAT is based on the following hierarchy:

- Process design/redesign changes to eliminate emissions and wastes
- Waste reduction by means of process control, inventory control, etc.
- Substitution of fuels, etc., by environmentally less harmful materials
- Reuse of materials within the process and in products
- Recycling of wastes in other applications
- End-of-pipe techniques to control, abate or treat emissions
- Safe disposal.

Note that where hazardous materials are present such as flammable/explosive vapours or dusts are handled, safety procedures (acceptable to HSA) should be adopted and nothing in this note should be construed as advice to the contrary.

5.2 GENERAL PREVENTATIVE METHODS

5.2.1 Management Systems

Effective management is important in achieving good environmental performance. It is an important component of BAT and forms part of the definition of techniques given in Article 2 of the Directive. Management and communication systems are some of the most significant factors in this difference. Achievement of a good performance requires commitment at all levels within a company starting at board or policy level and includes the site management, supervision and operators.

The components of an environmental management system are outlined in section 4.3.1 above.

5.3 TECHNIQUES FOR PREVENTION AND MINIMISATION OF RESOURCE CONSUMPTION

5.3.1 Minimisation of Energy Use

BAT for minimisation of energy use involves the use of basic, low cost physical energy efficiency techniques, such as insulation, containment methods (such as seals and self-closing doors), and avoidance of unnecessary discharge of heated water or air (for example, by fitting simple control systems such as timers and sensors), gravity feed systems and the consideration of energy saving opportunities in process buildings, control rooms, offices required and when purchasing equipment for the activity. BAT for energy minimisation includes:

- General measures for energy efficiency and low emission operation (FM BREF A.4.1.3.1)
- Furnace automation and furnace control (FM BREF A.4.1.3.2)
- Optimised furnace design (FM BREF A.4.1.3.3)
- Regenerative burners (FM BREF A.4.1.3.4)
- Recuperator and recuperative burners (FM BREF A.4.1.3.5)
- Oxy-fuel technology (FM BREF A.4.1.3.6)
- Reheat and heat treatment furnace (FM BREF A.3.1.3)
- Waste heat boiler (FM BREF A.4.1.11)
- Optimised skid design (FM BREF A.4.1.3.12)
- Use of stock transportation device (FM BREF A.4.1.3.13)
- Evaporative furnace skid cooling (FM BREF A.4.1.3.14)
- Feed stock preheating (FM BREF A.4.1.3.15)
- Heat conservation box thermal covers (FM BREF A.4.1.3.16)
- Hot charging/direct rolling (FM BREF A.4.1.17)
- Near shape casting (FM BREF A.4.1.3.18 & 19)
- Descaling material tracking (FM BREF A.4.1.4.1)
- Use of high pressure storage equipment (FM BREF A.4.1.4.2)
- Edging (FM BREF A.4.1.5)
- Roughing process automation (FM BREF A.4.1.6)
- Transport of rolled stock form roughing mill to finishing train (FM BREF A.4.1.7)
- Work rod lubrication system (FM BREF A.4.1.8.2)
- On-line heat treatment (FM BREF A.4.1.8.12)
- Thermo mechanical rolling operation(FM BREF A.4.1.813)
- Turbulence pickling (FM BREF A.4.2.2.5)
- Continuous rolling (FM BREF A.4.2.3.1)
- Batch annealing 100% hydrogen (FM BREF A.4.2.4.7)
- Pre-heating combustion air, use of regenerative furnaces (FM BREF A.4.2.4.9 & B.4.1.4.3)
- Steam production with recovery heat (FM BREF B.4.1.4.4)
- Pre-heating feedstock (FM BREF A.4.2.4.11).

For additional guidance on the use of energy, refer to the EPA's Guidance Note on Energy Efficiency Auditing.

5.3.2 Minimisation of Water Use

The most frequent uses of water in the ferrous metals industry is as a coolant, in rinsing and in gas scrubbing systems. The use of water should be minimised within the BAT criteria for the prevention or reduction of emissions and be commensurate with the prudent use of water as a natural resource.

BAT for the industry is:

- Water circuits/management hot rolling mills (FM BREF A.2.1.15)
- Water management cold rolling mills (FM BREF A.2.2.10)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.1)
- Cleaning and re-circulation of degreasing baths Cascade use of degreasing solutions (FM BREF B.4.1.3.2)
- Cooling water treatment (FM BREF A.4.1.12.3, A.4.2.3.10 & B.4.1.10)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4)
- Magnetic pumps (FM BREF A.4.2.2.25)
- Minimise rinsing water (A.4.3.3.9)
- Closed loop cooling water (FM BREF A.4.3.5.2 & A.4.3.6.1)
- Review water consumption on an annual basis by completing a water efficiency audit
- Where water is used in cleaning and washing down, use should be minimised by:
  - Vacuuming, scraping or mopping in preference to hosing down
  - Evaluating the scope for re-using wash water
  - Trigger controls on all hoses, hand lances and washing equipment.

Drainage systems should be designed to avoid contamination of roof and surface water. Where possible this should be retained for use. That which cannot be used should be discharged separately.

5.3.3 Raw Materials

BAT for operations involves efficient raw material use by maintainance of inventory and control procedures including operational procedures to determine the most suitable material for use, thus preventing use of materials that may have an unacceptable environmental impact in their manufacture, end-use and ultimate disposal. BAT is:

- Efficient storage and handling hot rolling mills (FM BREF A.4.1.1)
- Edging (FM BREF A.4.1.5)
- Cleaning and re-circulation of degreasing baths (FM BREF B.4.1.3.1)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.2)
- Waste by-product treatment and recycling (FM BREF A.4.1.13)
- Mechanical pre-descaling (FM BREF A.4.2.2.3)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4)
- Cleaning and re-use of pickle liquor (FM BREF A.4.2.2.6)
- Hydrochloric acid regeneration (FM BREF A.4.2.2.7 & A.4.2.2.8)
- Sulphuric acid recovery (FM BREF A.4.2.2.10)
- Mixed acid regeneration (FM BREF A.4.2.2.11)
- Mixed acid recovery (FM BREF A.4.2.2.12, A.4.2.2.13 & A4.2.2.14)
- Pickling plant coupled with tandem mill (FM BREF A.4.2.3.2)

- Optimal choice of rolling oil and emulsion (FM BREF A.4.2.3.3 & A4.2.3.6)
- Continuous monitoring of emulsion quality (FM BREF A.4.2.3.4)
- Cleaning and re-use of emulsion (FM BREF A.4.2.3.7)
- Cleaning and re-use of degreasing solutions (FM BREF A.4.2.4.3)
- Emulsion optimisation (FM BREF A.4.2.5.1)
- Change to dry temper process (FM BREF A.4.3.1)
- Wire mill storage and handling of raw materials (FM BREF A.4.2.5.2)
- Cascade pickling (FM BREF A.4.3.3.4)
- Minimise pickling carry-out (FM BREF A.4.3.3.5)
- Separation and re-use of spent acid (FM BREF A.4.3.3.6)
- Patenting oven optimisation (FM BREF A.4.3.10.1)
- Cleaning and re-use of phosphating solution (FM BREF B.4.1.7.3)
- Cleaning and re-use of chromating solution (FM BREF B.4.1.7.4)
- Using squeeze rolls (FM BREF B.4.1.7.6)
- Use reverse osmosis for deionised water (FM BREF B.4.1.7.7)
- The facility designed and operated so as to prevent spillage or escape of substances that could pollute the surface or groundwater system with suitable emergency procedures as per the *EPA Guidance Note on Storage and Transfer of Materials for Scheduled Activities.*

In addition the Operator should:

- Maintain a detailed inventory of raw materials used on-site
- Have procedures for the regular review of new developments in raw materials and the implementation of any suitable ones which are less hazardous
- Quality assurance procedures for the control of the content of raw materials
- As part of the facility design, specify materials with minimal environmental impact should be selected and used
- Have operational procedures to determine the most suitable material for use, thus preventing use of materials that may have an unacceptable environmental impact in their manufacture, end-use and ultimate disposal
- Demonstrate the steps which have been, or may be, taken to:
    - Substitute less harmful materials or those which can be more readily abated and when abated lead to substances which in themselves are more readily dealt with.
    - Understand the fate of by-products and contaminants and their environmental impact.

5.4 PREVENTATIVE METHODS FOR SPECIFIC UNIT OPERATIONS

5.4.1 Hot Rolling

For all ferrous metal operations involving hot rolling, BAT (FM BREF A.5.1) is to do the following:

5.4.1.1 Storing and Handling of Raw Materials and Auxiliaries (FM BREF A.4.1.1)

- Collection of spillages and leakages by suitable measures, e.g., safety pits and drainage
- Separation of oil from the contaminated drainage water and reuse of recovered oil
- Treatment of separated water in the water treatment plant.

5.4.1.2 Machine Scarfing (FM BREF A.4.2.1)

- Enclosures for machine scarfing and dust abatement with fabric filters
- Electrostatic precipitator, where fabric filters cannot be operated because of very wet fume
- Separate collection of scale/swarf from scarfing (FM BREF A.4.3.4).

5.4.1.3 Grinding:

- Enclosures for machine grinding and dedicated booths equipped with collection hoods for manual grinding and dust abatement by fabric filters (FM BREF A.4.1.2.2).

5.4.1.4 All Surface Rectification Processes:

- Treatment and reuse of water from all surface rectification processes (separation of solids) (FM BREF A.2.1.15)
- Internal recycling or sale for recycling of scale, swarf and dust (FM BREF A.2.1.13).

5.4.1.5 Re-Heating and Heat Treatment Furnaces:

- General measures, e.g., regarding furnace design or operation & maintenance, as described in FM BREF A.4.1.3.1
- Avoiding excess air and heat loss during charging by operational measures (minimum door opening necessary for charging) or structural means (installation of multisegmented doors for tighter closure)
- Careful choice of fuel and implementation of furnace automation/control to optimise the firing conditions
- Limitation of sulphur content in fuel to < 1 % is BAT
- Lower S limit or additional SO_2 reduction measures is BAT
- Recovery of heat in the waste gas by feedstock pre-heating (FM BREF A.3.1.3)
- Recovery of heat in the waste gas by regenerative or recuperative burner systems
- Recovery of heat in the waste gas by waste heat boiler or evaporative skid cooling (where there is a need for steam) (FM BREF A.4.1.11)

- Second generation low-NOx burners (FM BREF A.4.1.3.6)
- Limiting the air pre-heating temperature (FM BREF A.4.2.4.9 &B.4.1.4.3)
- Trade-off energy saving vs. NOx emission; the advantages of reduced energy consumption and reductions in SO_2, CO_2 and CO have to be weighed against the disadvantage of potentially increased emissions of NOx
- SCR and SNCR are BAT (FM BREF D.2.4 & D.2.5)
- Reduction of heat loss in intermediate products; by minimizing the storage time and by insulating the slabs/blooms (heat conservation box or thermal covers) depending on production layout
- Change of logistic and intermediate storage to allow for a maximum rate of hot charging, direct charging or direct rolling (the maximum rate depends on production schemes and product quality)
- For new plants, near-net-shape casting and thin slab casting, as far as the product to be rolled can be produced by this technique.

5.4.1.6 Descaling:

- Material tracking to reduce water and energy consumption (FM BREF A.4.1.4 & A.5.1).

5.4.1.7 Transport of Rolled Stock:

- Reduce unwanted energy loss by coil boxes or coil recovery furnaces and heat shields for transfer bars (FM BREF A.4.1.7).

5.4.1.8 Finishing Train:

- Water sprays followed by wastewater treatment in which the solids (iron oxides) are separated and collected for reuse of iron content(FM BREF A.4.1.1.2.2)
- Exhaust systems with treatment of extracted air by fabric filters and recycling of collected dust.

5.4.1.9 Levelling and Welding

- Suction hoods and subsequent abatement by fabric filters split view on dust level (FM BREF A.4.1.10.1).

5.4.1.10 Cooling

- Separate cooling water systems operating in closed loops (FM BREF A.2.1.15).

5.4.1.11 Wastewater Treatment/ Scale- and Oil-Containing Process Water

- Operating closed loops with re-circulating rates of > 95 % (FM BREF A.2.1.15)
- Reduction of emissions by using a suitable combination of treatment techniques (FM BREF A.4.1.12.2 and D.10.1)
- Re-circulation of mill scale collected in water treatment to the metallurgical process
- Oily waste/sludge collected should be de-watered to allow for thermal utilisation or safe disposal.

5.4.1.12 Prevention of Hydrocarbon Contamination

- Preventive periodic checks and preventive maintenance of seals, gaskets, pumps and pipelines (FM BREF A.4.18.9)
- Use of bearings and bearing seals of modern design for work- and back-up rolls, installation of leakage indicators in the lubricant lines (e.g., at hydrostatic bearings)
- Collection and treatment of contaminated drainage water at the various consumers (hydraulic aggregates), separation and use of oil fraction, e.g., thermal utilisation by blast furnace injection. Further processing of the separated water either in the water treatment plant or in dressing plants with ultra filtration or vacuum evaporator.

5.4.1.13 Roll Shops

- Use of water-based degreasing as far as technically acceptable for the degree of cleanliness required
- If organic solvents have to be used, preference is to be given to non-chlorinated solvents
- Collection of grease removed from roll trunnions and proper disposal, such as by incineration
- Treatment of grinding sludge by magnetic separation for recovery of metal particles and recirculation into the steelmaking process
- Disposal of oil- and grease-containing residues from grinding wheels, e.g., by incineration
- Deposition of mineral residues from grinding wheels and of worn grinding wheels in landfills
- Treatment of cooling liquids and cutting emulsions for oil/water separation. Proper disposal of oily residues, e.g., by incineration
- Treatment of waste water effluents from cooling and degreasing as well as from emulsion separation in the hot rolling mill water treatment plant
- Recycling of steel and iron turnings into the steelmaking process.

5.4.2 Cold Rolling

For all ferrous metal operations involving cold rolling, BAT includes the following:

5.4.2.1 Decoiling

- Water curtains followed by waste water treatment in which the solids are separated and collected for reuse of iron content
- Exhaust systems with treatment of extracted air by fabric filters and recycling of collected dust.

5.4.2.2 Pickling

General measures to reduce acid consumption and waste acid generation as described in FM BREF A.4.2.2.1. should be applied as far as possible, especially the following techniques:

- Prevention of steel corrosion by appropriate storage and handling, cooling, etc.
- Reduction of load on pickling step by mechanical pre-descaling in a closed unit, with an extraction system and fabric filters

- Use of electrolytic pre-pickling
- Use of modern, optimised pickling facilities (spray or turbulence pickling instead of dip pickling)
- Mechanical filtration and recirculation for lifetime extension of pickling baths
- Side stream ion exchange or electro-dialysis (for mixed acid) or other method for free acid reclamation (FM BREF D.6.9) for bath regeneration.

5.4.2.3 HCl pickling (FM BREF A.5.2)

- Reuse of spent HCl or Regeneration of the acid by spray roasting or fluidized bed (or equivalent process) with recirculation of the regenerate; air scrubbing system for the regeneration plant; reuse of Fe_2O_3 by-product (FM BREF A.4.2.2.11)
- Totally enclosed equipment or equipment fitted with hoods and scrubbing of extracted air (FM BREF A.4.2.2.18 & A4.2.2.19 & A.4.2.2.20).

5.4.2.4 H_2SO_4 Pickling (FM BREF A.5.2 & 4.2.2.10)

- Recovery of the free acid by crystallisation; air scrubbing devices for recovery plant (FM BREF A.4.2.2.1)
- Totally enclosed equipment or equipment fitted with hoods and scrubbing of extracted air (FM BREF A.4.2.2.18 & A.4.2.2.19 & A.4.2.2.20).

5.4.2.5 Mixed Acid Pickling (FM BREF A.5.2)

- Free acid reclamation (by side-stream ion exchange or dialysis) or acid regeneration (spray roasting or by evaporation process)
- Enclosed equipment/hoods and scrubbing, and additionally scrubbing with H_2O_2, urea, etc., or NOx suppression by adding H_2O_2 or urea to the pickling Bath or SCR(FM BREF A.4.2.2.11)
- Alternative: use of nitric acid-free pickling plus enclosed equipment or equipment fitted with hoods and scrubbing.

5.4.2.6 Heating of Acids:

- Indirect heating by heat exchangers or, if steam for heat exchangers has to be produced first, by submerged combustion FM BREF A.4.2.2.26)
- Not using direct injection of steam (FM BREF A.2.2.27).

5.4.2.7 Minimisation of Waste Water (FM BREF A.5.2)

- Cascade rinsing systems with internal re-use of overflow (e.g., in pickling baths or scrubbing)
- Careful tuning and managing of the ‘pickling-acid regeneration-rinsing’ system.

5.4.2.8 Wastewater Treatment (FM BREF A.5.2)

- Treatment by neutralisation, flocculation, etc., where acidic water blow-down from the system cannot be avoided.

5.4.2.9 Emulsion Systems (FM BREF A.4.2.3)

- Prevention of contamination by regular checking of seals, pipework, etc., and leakage control

- Continuous monitoring of emulsion quality (FM BREF A.4.2.5.1)
- Operation of emulsion circuits with cleaning and reuse of emulsion to extend lifetime
- Treatment of spent emulsion to reduce oil content, e.g., by ultrafiltration or electrolytic splitting.

5.4.2.10 Rolling and Tempering (FM BREF A.5.2):

- Exhaust system with treatment of extracted air by mist eliminators (droplet separator).

5.4.2.11 Degreasing (FM BREF A.4.2.4.3):

- Degreasing circuit with cleaning and reuse of the degreaser solution. Appropriate measures for cleaning are mechanical methods and membrane filtration (FM BREF A.4.2.4.3)
- Treatment of spent degreasing solution by electrolytic emulsion splitting or ultrafiltration to reduce the oil content; reuse of separated oil fraction; treatment (neutralization, etc.) of separated water fraction prior to discharge
- Extraction system for degreasing fume and scrubbing.

5.4.2.12 Annealing Furnaces (FM BREF A.5.2)

- For continuous furnaces, low NOx burners;
- Combustion air pre-heating by regenerative or recuperative burners or pre-heating of stock by waste gas.

5.4.2.13 Finishing/Oiling (FM BREF 4.2.6.1)

- Extraction hoods followed by mist eliminators and/or electrostatic precipitators or electrostatic oiling.

5.4.2.14 Levelling and Welding (FM BREF A.4.2.6.4)

- Extraction hoods with dust abatement by fabric filters.

5.4.2.15 Cooling

- Separate cooling water systems operating in closed loops.

5.4.2.16 Roll Shops

- Refer to BATs listed for roll shops in hot rolling above.

5.4.2.17 Metallic By-products

Collection of scrap from cutting, heads and tails and recirculation into the metallurgical process.

5.4.3 Wire Drawing

For all ferrous metal operations involving wire drawing, BAT is to do the following:

5.4.3.1 Batch pickling

- Close monitoring of bath parameters: temperature and concentration (FM BREF D.5.1)

- Operating within the limits given in FM BREF D.6.1 'Open Pickling Bath Operation', for of pickling baths with high vapour emission, e.g., heated or concentrated HCl-bath: installation of lateral extraction and possibly treating of the extraction air for both new and existing installations.

5.4.3.2 Pickling

- Cascade Pickling (capacity >15 000 tonne wire rod per year) or reclamation of free acid fraction and reuse in pickling plant (FM BREF A.4.3.3.4 & A.4.3.3.6)
- External regeneration of spent acid (FM BREF A.4.3.3.7)
- Recycling of spent acid as secondary raw material (FM BREF A.4.3.3.8)
- Non-acid descaling, e.g., shot blasting, if quality requirements allow it (FM BREF A.4.3.4)
- Counter current cascade rinsing (FM BREF A.4.3.3.9).

5.4.3.3 Dry Drawing

- Enclosing the drawing machine (and connecting to a filter or similar device when necessary), for all new machines with drawing speed ≥ 4 m/s (FM BREF A.4.3.5.1).

5.4.3.4 Wet Drawing

- Cleaning and reuse of drawing lubricant (FM BREF A.4.3.6.2)
- Treatment of spent lubricant to reduce oil content in the discharge and/or to reduce waste volume, e.g., by chemical breaking, electrolytic emulsion splitting or ultra-filtration (FM BREF D.3.1)
- Treatment of discharge water fraction.

5.4.3.5 Dry and Wet Drawing

- Closed cooling-water loops
- Not using once-through cooling water systems.

5.4.3.6 Batch Annealing Furnaces, Continuous Annealing Furnaces for Stainless Steel and Furnaces Used in Oil Hardening and Tempering:

- Burning of the protective gas purge (FM BREF A.4.3.7.1).

5.4.3.8 Continuous Annealing of Low Carbon Wire and Patenting:

- Good housekeeping measures, as described in FM BREF A.4.3.7 for the lead bath
- Separate storage of Pb-containing wastes, protected from rain and wind
- Recycling of Pb-containing wastes in non-ferrous metals industry (FM BREF A.4.3.8.2)
- Closed loop operation of quench bath (FM BREF A.4.3.8.3).

5.4.3.9 Oil-hardening Lines:

- Evacuation of the oil mist from quench baths and removal of the oil mists, when appropriate (FM BREF A.4.3.11.2).

5.4.4 Continuous Hot Dip Coating

For all ferrous metal operations involving hot dip coating (zinc based-galvanizing, aluminum based- aluminizing and lead based) BAT is to do the following:

5.4.4.1 Pickling

- Refer to the BAT for cold rolling mills above.

5.4.4.2 Degreasing (FM BREF B.5.1)

- Cascade degreasing
- Cleaning and recirculation of degreasing solution; appropriate measures for cleaning are mechanical methods and membrane filtration
- Treatment of spent degreasing solution by electrolytic emulsion splitting or ultrafiltration to reduce the oil content; neutralisation of separated oil fraction such as thermal treatment of the separated water fraction
- Covered tanks with extraction and cleaning of extracted air by scrubber or demister
- Use of squeeze rolls to minimise drag-out.

5.4.4.3 Heat treatment furnaces (FM BREF B.5.1)

- Low-NOx burners
- Air pre-heating by regenerative or recuperative burners
- Pre-heating of strip
- Steam production to recover heat from waste gas.

5.4.4.4 Hot dipping (FM BREF 4.1.5.1)

- Separate collection and recycling in the non-ferrous metals industry for zinc-containing residues, dross or hard zinc.

5.4.4.5 Galvannealing

- Low-NOx burners
- Regenerative or recuperative burner systems.

5.4.4.6 Oiling

- Covering the strip oiling machine or electrostatic oiling.

5.4.4.7 Phosphating and Passivation/Chromating (FM BREF B.4.1.7)

- Covered process baths
- Cleaning and reuse of phosphating solution
- Cleaning and reuse of passivation solution
- Use of squeeze rolls
- Collection of skinpass/temper solution and treatment in waste water treatment plant.

5.4.4.8 Cooling (FM BREF B.4.1.10)

- Separate cooling water systems operating in closed loops.

5.4.4.9 Wastewater (FM BREF B.4.1.9)

- Waste water treatment by a combination of sedimentation, filtration and/or flotation/ precipitation/flocculation. Techniques described in FM BREF D.4 or equally efficient combinations of individual treatment measures
- For existing continuous water treatment plants which only achieve Zn < 4 mg/l, switch to batch treatment.

5.4.4.10 BAT for Lead-Tin Coating of Sheet (is as follows);

- Pickling:
  - Enclosed tanks and venting to a wet scrubber, treatment of waste water from the scrubber and pickling tank.
- Nickel plating:
  - Enclosed process, ventilated to a wet scrubber.
- Hot dipping:
  - Air knives to control coating thickness.
- Passivation:
  - A no-rinse system and hence no rinse waters.
- Oiling:
  - Electrostatic oiling machine.
- Wastewater:
  - Waste water treatment by neutralising with sodium hydroxide solution, flocculation/precipitation
  - Filter cake de-watering and disposed to landfill.

5.4.5 Coating of Wire:

For pickling processes in the coating of wire (FM BREF B.4.3), the following techniques are considered BAT:

5.4.5.1 Pickling:

- Enclosed equipment or equipment fitted with hoods and scrubbing of extracted air
- Cascade pickling for new installations above a capacity of 15 000 tonnes/year per line
- Recovery of free acid fraction (FM BREF A.4.2.2.12 & A.4.2.2.13)
- External regeneration of spent acid for all installations (FM BREF A.4.2.2.11)
- Reuse of spent acid as secondary raw material (FM BREF A.4.2.2.6).

5.4.5.2 Water consumption:

- Cascaded rinsing, possibly in combination with other methods to minimise water consumption, for all new and all large installations (> 15 000 tonnes/year) (FM BREF B.4.3).

5.4.5.3 Wastewater:

- Waste water treatment by physico-chemical treatment (neutralisation, flocculation, etc.) (FM BREF B.4.3).

5.4.5.4 Fluxing (FM BREF B.4.3):

- Good housekeeping with special focus on reducing iron carry-over and bath maintenance
- Regeneration of flux baths on site (side-stream iron removal)
- External re-utilisation of spent flux solution.

5.4.5.5 Hot dipping (FM BREF B.4.3):

- Good housekeeping measures.

5.4.5.6 Zn-containing wastes:

- Separate storage and protection from rain and wind, and reuse in the non-ferrous metals industry (FM BREF B.4.3).

5.4.5.7 Cooling Water (after the zinc bath):

- Closed loop or reuse of this relatively pure water as makeup water for other applications
- Enclosed pickling baths or baths to be fitted with hoods or covers. The extracted air to be treated by scrubbing with water
- Cascade pickling for new installations above a capacity of 15,000 tonne/year per line
- Recovery of the free acid fraction (FM BREF A.4.2.2.12, A.4.2.2.13 & A.4.2.2.14)
- External regeneration of spent acid for all installations (FM BREF A.4.2.2.11)
- Reuse of spent acid as a secondary raw material (FM BREF A.4.2.2.6).

5.5 TECHNIQUES FOR THE PREVENTION AND MINIMISATION OF EMISSIONS

5.5.1 Minimisation of Emissions to Air

For all ferrous metal operations, BAT for minimisation of air emissions is as follows:

- Covering of skips, tanks and vessels (FM BREF B.4.1.7.5)
- Sealing of furnaces (FM BREF A.4.1.3.6, A.4.1.3.7, A.4.1.3.8, A.4.1.3.9, A.4.1.3.10)
- Enclosing scarfing operation with waste gas cleaning (FM BREF A.4.1.2.1)
- Enclosing grinding operation with waste gas cleaning (FM BREF A.4.1.2.2)
- Enclose pickling bath operations or install hoods and extraction systems
- Leveller dust removal (FM BREF A.4.1.10.1)
- Reduction of pickling emissions with gas scrubbing (FM BREF A.4.2.2.18, A.4.2.2.19, A.4.2.2.20)
- Reduction in NOx, low NOx burner (FM BREF A.4.2.4.10 & B.4.1.4.1)

- Optimise pickling baths (FM BREF A.4.3.3.1)
- Pickling tank fume control (FM BREF A.4.3.3.2)
- Lead bath good housekeeping (FM BREF A.4.3.8.1)
- Inductive heating of wire (FM BREF A.4.3.12.1)
- Induction electric furnace in hot dip coating (FM BREF B.4.1.6.1)
- Covering strip oiling machine (FM BREF B.4.1.7.1)
- Regular housekeeping, external surfaces of the process building, ancillary plant and open yards and storage areas should be inspected at least annually and cleaned if necessary to prevent the accumulation of dusty material in circumstances where the dust may become wind entrained
- Enclosed buildings can be designed to have a negative air pressure to prevent odour emissions from doorways.

5.5.2 Minimisation of Emissions to Water

BAT for minimisation of water emissions is:

- Prevention of hydrocarbon contamination (FM BREF A.4.1.8.9)
- Reduction of water consumption and discharge (FM BREF A.4.1.12.1)
- Cascade use of degreasing solutions (FM BREF B.4.1.3.1)
- Cleaning and re-circulation of degreasing baths (FM BREF B.4.1.3.2)
- Reduction of waste water contaminant loading cold rolling mills (FM BREF B.4.2.2.1)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4 & B.4.3.1.7)
- Effluent free HCl strip pickling plant (FM BREF A.4.2.2.9)
- Sulphuric acid recovery (FM BREF A.4.2.2.10)
- Mixed acid recovery (FM BREF A.4.2.2.12, A.4.2.2.13 & A4.2.2.14)
- Prevention of contamination (FM BREF A.4.2.3.5)
- Cleaning and re-use of emulsion (FM BREF A.4.2.3.7)
- The facility designed and operated so as to prevent spillage or escape of substances that could pollute the surface or groundwater system with suitable emergency procedures as per the *EPA Guidance Note on Storage and Transfer of Materials for Scheduled Activities.*

5.5.3 Minimisation of Noise Emissions

Best Available Techniques correctly for noise minimisation from the various processes used by the ferrous metal industry should reference the EPA *Guidance Notes for Noise in Relation to Scheduled Activities 2006.*

5.5.4 Solid Waste Minimisation

BAT for solid waste minimisation is:

- Recycling of oil contamination waste (FM BREF B.4.1.1.2)
- Rolling of wedge type slabs (FM BREF A.4.1.2.4)
- Rolling crop optimisation (FM BREF A.4.1.8.1)

- Slab slitting (FM BREF A.4.1.2.5, A.4.1.8)
- Waste by-product treatment and recycling (FM BREF A.4.1.13)
- Separation of scale and blast media (FM BREF A.4.3.4)
- Recycling of lead containing residues (FM BREF A.4.3.8.2)
- External recycling of coating material slag (FM BREF B.4.2.5.2)
- Monitoring of materials usage and reporting against key performance measures
- Reduction of other residues arising from the production of ferrous metals using techniques such as:
    - Regular maintenance, repairs and preventive maintenance can minimise oil loss by leakage and increases the intervals between the oil change
    - Use of oil filtration, which gives an extension of the service life. For example by-pass filters may be installed to continuously clean a small part of the oil.

5.6 TECHNIQUES FOR TREATMENT ABATEMENT AND DISPOSAL

5.6.1 Air Emissions

For all ferrous metal operations, BAT is:

- All operations generating emissions to air are contained and adequately extracted to suitable abatement plant, where this is necessary to meet specified emission limits
- Hot emissions take place from the minimum practicable number of stacks, in order to obtain maximum advantage from thermal buoyancy, if practicable a multi-flue stack should be used
- Stack heights are sufficient to ensure adequate dispersion under normal conditions
- Exhaust gases discharged through a stack achieve an exit velocity greater than 15 m / sec during normal operating conditions to achieve adequate dispersion
- Electrostatic precipitators (FM BREF A.4.1.2.1 & A.4.2.6)
- Cyclones (FM BREF A.2.4.2.5.4)
- Bag filters (FM BREF A.4.1.2.2)
- Fabric filters (FM BREF A.4.2.6.4 & A.4.1.2)
- Wet and dry filters FM BREF (A.4.2.5.4)
- Water sprays and exhaust systems (FM BREF A.4.1.8.8)
- Oil extraction hoods followed by mist eliminators and electrostatic precipitators (FM BREF A.4.2.6.1)
- Oil separators for cleaning (FM BREF A.4.2.3.9)
- Extraction of oil mist emissions and oil separation Cleaning and re-use of emulsion (FM BREF A.4.2.3.9)
- Extraction system for degreasing facilities (FM BREF A.4.2.4.5)
- Reduction of oil mist and dust (FM BREF A.4.2.5.4)
- Capture and abatement of oil mist (FM BREF A.4.2.6.1)

- Dust reduction form levelling and welding (FM BREF A.4.2.6.4)
- Control of air from drawing machines (FM BREF A.4.3.5.1)
- Burn purge of batch annealing protective gases (FM BREF A.4.3.7.1)
- Degreasing vapour collection and treatment (FM BREF B.4.1.3.6)
- Pickling bath air treatment (FM BREF B.4.3.1.1)
- Reduction of pickling emissions with gas scrubbing (FM BREF A.4.2.2.18, A.4.2.2.19, A.4.2.2.20)
- NOx reduction by catalytic reduction (FM BREF A.4.2.2.21, A.4.2.2.22)
- Treatment of pickling tank emissions (FM BREF A.4.3.3.3)
- Process control techniques on collection and abatement equipment including:
    - Reagent metering systems
    - Microprocessor control of reagent feed and plant performance is used
    - On-line monitoring of temperature, pressure drop, particulates or other pollutants emitted, EP current and voltage and scrubber liquor flow and pH
    - Alarms provided to indicate operational problems such as pump failure
    - Operators and maintenance personnel trained and assessed in the use of operating instructions and the use of the modern control techniques described.

5.6.2 Wastewater

BAT for wastewater treatment is:

- Treatment of scale and iron bearing waste water (FM BREF A.4.1.12.2)
- Cooling water treatment (FM BREF A.4.1.12.3)
- Treatment of acidic waste water (FM BREF A.4.2.2.28)
- Treatment of spent emulsion Cleaning and re-use of emulsion (FM BREF A.4.2.3.8)
- Treatment and disposal of waste drawing lubricant (FM BREF A.4.3.6.4)
- Treatment of quench bath waste water (FM BREF A.4.3.8.3)
- Collection and treatment of skin pass/temper solution (FM BREF B.4.1.8.1)
- Finishing waste water treatment (FM BREF B.4.1.9)
- Optimised rinsing procedure/cascade rinsing (FM BREF A.4.2.2.4)
- Clean and re-use electrolytic pickle liquor (FM BREF A.4.2.2.16)
- Wastewater treatment process control techniques including:
    - Reagent metering systems
    - Microprocessor control of reagent feed and plant performance
    - On-line monitoring of temperature, turbidity, pH, conductivity, REDOX, TOC, individual metals and flow is used
    - Operators, maintenance personnel trained and assessed in the use of operating instructions and the use of the process control techniques.

- Where effluent is treated off-site at a Local Authority sewage treatment works, the operator may be required to demonstrate that:
  - All appropriate measures have been taken to reduce effluent volume and pollutant concentration
  - The treatment provided at the sewage treatment works is as good as would be achieved if the emission was treated on-site, based on reduction of load (not concentration) of each substance to the receiving water
  - A suitable monitoring programme is in place for emissions to sewer, taking into consideration the potential inhibition of any downstream biological processes.

5.6.3 Noise & Vibration

Noise and vibration can arise from the movement and storage of raw materials and products, large fans and air filtration systems, grinding and milling operations, casting installations, venting of steam and use of pumps. This can potentially create a nuisance to site neighbours and the environment. Noise can either be continuous or intermittent depending on the operation of equipment.

Having taken into account the measures outlined in section 5.5.3 on noise minimisation, the following Best Available Techniques correctly designed, constructed and sized for the application can be used for the noise abatement from the various processes used by the industry such as:

- The use of embankments to screen the source of noise
- The enclosure of noisy plant or components in sound absorbing structures
- The use of anti-vibration supports and interconnections for equipment
- The orientation of noise emitting machinery
- The change of the frequency of the sound
- Use of acoustic screens around fixed/mobile plant and equipment.

For additional guidance on measures in relation to noise, have regard to the EPA Guidance Note for Noise in relation to scheduled activities (2006) and any other relevant guidance issued by the EPA.

5.6.4 Waste

After all options for the reduction, recovery, reuse and recycling of wastes have been exhausted, appropriate treatment and disposal of such wastes should be carried out.

BAT for waste treatment is:

- Recycling of oil contamination waste (FM BREF B.4.1.1.2)
- Cleaning and re-circulation of degreasing baths (FM BREF B.4.1.3.1)
- Cleaning and re-use of pickle liquor (FM BREF A.4.2.2.6)
- Hydrochloric acid regeneration (FM BREF A.4.2.2.7 & A.4.2.2.8)
- Mixed acid regeneration (FM BREF A.4.2.2.11 & B4.3.1.5)
- Mixed acid recovery (FM BREF A.4.2.2.12, A.4.2.2.13, A4.2.2.14 & B.4.3.1.3, B.4.3.1.4)
- Waste by-product treatment and recycling (FM BREF A.4.1.13)

- Separation of scale and blast media (FM BREF A.4.3.4)
- Cleaning of drawing lubricant/coolant (FM BREF A.4.3.6.2 & A.4.3.3.6)
- Recycling of lead containing residues (FM BREF A.4.3.8.2)
- External recycling of coating material slag (FM BREF B.4.2.5.2).

6. BAT ASSOCIATED EMISSION LEVELS

This section contains emission limits and other requirements that are representative of BAT within the Ferrous Metals Sector.

6.1 EMISSION LEVEL VALUES FOR DISCHARGES TO AIR

The BAT-associate emission levels for emissions to air are given below in Table 6.1.

All parameters will not be relevant to every installation and will depend on the type of substances and processes in use at the installation, and other site-specific factors. Due consideration must be given to existing ambient background conditions as well as relevant Air Quality Standards set either under the *Irish Air Quality Standards Regulations 2002 (S.I. No. 271/2002)* or the *EU Framework Directive on Air Quality (96/62/EC) and its Daughter Directives (1999/30/EC and 2000/69/EC) and current air quality legislative requirements.*

Table 6.1: BAT-Associated Emission Levels for Emissions to Air

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

	- 1,2-dichloroethane - 1,2-propylene oxide (1,2-epoxy propane) - styrene oxide - o-toluidine - trichloroethane - vinyl chloride		
Vaporous or Gaseous Inorganic Substances	**Class I (limits set on a per substance basis)** - arsine - cyanogen chloride - phosgene - phosphine	0.5	2.5
	Class II (limits set on a per substance basis) - bromine and its gaseous compounds, as Hydrogen bromide - chlorine - hydrocyanic acid - fluorine and its gaseous compounds, as HF - hydrogen sulphide	3	15
	Class III (limits set on a per substance basis) - ammonia - gaseous inorganic compounds of chlorine, as HCl	30	150
	Class IV (limits set on a per substance basis) - sulphur oxides (sulphur dioxide and sulphur trioxide), as SO_2 - nitrogen oxides (nitrogen monoxide and nitrogen dioxide), as NO_2 - nitrogen monoxide and nitrogen dioxide, as NO_2 (thermal or catalytic post combustion facilities) - Carbon monoxide	350	1800
Inorganic Dust Particles Note 5	**Class I (limits set on a per substance basis)** - mercury and its compounds, as Hg - thallium and its compounds, as Tl	0.05	0.25
	Class II (limits set for class total) - lead and its compounds, as Pb - cobalt and its compounds, as Co - nickel and its compounds, as Ni - selenium and its compounds, as Se	0.5	2.5

	- tellurium and its compounds, as Te		
	Class III (limits set for class total) - antimony and its compounds, as Sb - chromium and its compounds, as Cr - easily soluble cyanides (e.g., NaCN), as CN - easily soluble fluorides (e.g., NaF), as F - copper and its compounds, as Cu - manganese and its compounds, as Mn - vanadium and its compounds, as V - tin and its compounds, as Sn - Other substances with risk phrases R40, R62 or R63	1	5
Lead		0.5 - 2	2.5
Zinc		5	
Total particulates		5-20	
Volatile organic compounds		50	500
Other			Note 6

Notes to Table 6.1:

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

Note 2: Unless stated otherwise.

Note 3: The Mass Flow Threshold is calculated in g/hr or kg/hr and is determined to be the maximum emission which can occur over any one hour period of plant operation. Where the Mass Flow in the raw gas exceeds the mass flow threshold given in the table, abatement will be required to reduce the emission to below the appropriate emission level or mass flow threshold.

Note 4: Where substances of several classes are present, in addition to the above limit, the sum of Classes I & II shall not exceed the Class II limit and the sum of Classes I & III, II &III or I, II & III shall not exceed the Class III limit.

Note 5: For organic substances reference should be made to the EPA BAT Guidance Document for the Organic Chemical Sector.

Note 6: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations 2004.

6.2 EMISSION LEVEL VALUES FOR DISCHARGES TO WATER

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

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

Compliance with the Water Framework Directive (2000/60/EC) is required where relevant.

These values apply prior to any dilution with for example uncontaminated storm waters or cooling waters. All values refer to daily averages, except where otherwise stated to the contrary, and except for pH which refers to continuous values.

Table 6.3: BAT-Associated Emission Levels for Discharges to Water *

Constituent Group or Parameter	Emission Levels mg/l unless stated otherwise	Percentage Reduction [4]
pH	6 – 9 pH Units	
BOD [1]	25	>90%
COD	40	>75%
Suspended Solids	35	
Toxicity [2]	1 TU	
Nitrates [5]	50	
Phosphorus (as P) [5]	2	
Sulphates (as SO_4)	200	
Conductivity mS/cm@20^oC	1,000	
Turbidity NTU	10	
Fluorides (as F)	0.5 (<100mg/l CaC_3) 1.5 (>100mg/l CaC_3)	
Chlorides	250	
Total Hydrocarbons	2	
Fish Tainting [3]	No tainting	
Cadmium [6]	0.010	
Nickel [6]	0.008 (<100mg/l CaC_3) 0.05 (>100mg/l CaC_3)	
Silver [6]	0.1	
Lead [6]	0.005 (<100mg/l CaC_3) 0.01 (>100mg/l CaC_3)	
Arsenic [6]	0.025	
Chromium (VI) [6]	0.005 (<100mg/l $CaCO_3$) 0.03 (>100mg/l $CaCO_3$)	

Chromium [6]	0.5	
Zinc [6]	0.08(<10mg/l $CaCO_3$) 0.05(<100mg/l $CaCO_3$) 0.1 (>100mg/l $CaCO_3$)	
Copper [6]	0.005 *(water hardness < 100 $CaCO_3$ mg/l)* 0.022 (*water hardness 10-50 $CaCO_3$ mg/l)* *0.04* *(water hardness 50-100 $CaCO_3$ mg/l)* *0.112* *(water hardness > 100 $CaCO_3$ mg/l)*	
Aluminium [6]	0.5	
Mercury [6]	0.005	
Manganese [6]	10	
Mineral Oil	20	
Sulphides	0.1	
Other [6,7]		

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

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

Note 1: Mean value of 3mg/l O_2 (salmonid & cyprinid) BOD_5 at 20^{o}C without nitrification.

Note 2: The number of toxic units (TU) = 100/x hour EC/LC50 in percentage vol/vol so that higher TU values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

Note 3: No substance shall be discharged in a manner which, or at a concentration which, following initial dilution causes tainting of fish or shell fish, interfere with normal patterns of fish migration or which accumulates in sediments or biological issues to the detriment of fish, wildlife or their predators.

Note 4: Reduction in relation to influent load.

Note 5: Limits will depend on the sensitivity of the receiving waterbody.

Note 6: BAT associated emission levels are highly dependent on production process, wastewater matrix and treatment. These parameters shall be considered on a site-specific basis when setting emission limit values.

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

All releases to waters are subject to a licence from the Agency. However any discharge to a Local Authority sewer will require the consent of the relevant Local Authority.

Only roof-water and water from unpaved areas are appropriate for direct discharge to surface waters. No foul water shall be discharged to surface water. For other surface water discharges they must be passed through an interceptor (I.S. EN 585-2:2003 Part 2).

Discharges to Sewer

For discharges to foul sewer, foul water/final effluent quality must meet standards set by the receiving sewage treatment works to adequately treat the wastewaters it receives. The Agency will typically accept discharges to sewers that have been approved by the receiving Local Authority, who ultimately accepts responsibility for any discharge to the aquatic environment through their treatment works' discharge consent. The *Urban Wastewater Treatment Regulations, SI 214/199*4, place specific conditions regarding emission limits from sewage treatment works. They also specify discharge quality conditions on dischargers to sewer to protect the sewer collection systems. The regulations prevent discharges of harmful substances that may be injurious to the health of sewer workers and to the sewer condition.

6.3 EMISSION LEVEL VALUES FOR DISCHARGES TO GROUNDWATER

It is unlikely that an Iron and Steel facility would wish to discharge drainage to groundwater, however, the *Groundwater Directive 80/68/EEC and* Directive 2006/118/EC on the protection of groundwater against pollution and deterioration prohibit direct emissions and requires strict controls to prevent indirect emissions of substances scheduled in List I of the Directive. The designer should consider the proposed operations of the site and consider the most appropriate method of disposal. The EPA sets strict controls and ELVs on a case-by-case basis for substances contained in List II of the *Directive* and requirements are made to limit indirect discharges of List II substances. An inventory of authorisations given for direct discharge of List II substances to groundwater is maintained by the Agency.

6.4 EMISSION LEVEL VALUES FOR NOISE

Emission levels for noise are presented in the table below.

Table 6.4: Emission Levels for Noise

Location	**Generally Applicable Limit Values** [Note 1]
Nearest sensitive receptor/ Installation boundary	55 dB LAeq daytime 45 dB LAeq night time

Note 1: No tonal or impulsive noise evident from the development

For further information in relation to noise refer to the *Guidance Notes for Noise in Relation to Scheduled Activities,* Environmental Protection Agency, 2006.

7. COMPLIANCE MONITORING

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

7.1 MONITORING OF AIR EMISSIONS

The most common components measured in the Ferrous Industry are particulates, metals, sulphur dioxide, VOCs, dioxins and nitrogen oxides. Acids including HCl and HF are determined for some processes as are chlorides and fluorides.

Gas flow should be measured or otherwise determined to relate concentrations to mass releases. Temperature and pressure must be measured and recorded to relate measurements to reference conditions and water vapour content must be measured where it is likely to exceed 3% unless the measuring techniques used provide results on a dry basis. Periodic visual and olfactory assessment of releases should be undertaken where appropriate, to ensure that all final releases to air are essentially colourless, free from persistent mist or fume and from droplets.

- Stack sampling periodically, as required by licence, taking account of the nature, magnitude and variability of the emission and the reliability of the control techniques.
- Continuous monitoring on main emissions where technically feasible (e.g. Particulates,Oxides of Nitrogen (as NO_2), Sulphur Dioxide(as SO_2) and Chlorides as HCl).
- Monitor solvent / VOC usage by annual mass balance reports and use to determine fugitive emissions.
- Annual monitoring of boiler stack emissions for SOx, NOx, CO and particulates, as required by the licence, taking account of the nature, magnitude and variability of the emission and the reliability of the controls.
- Monitoring of boiler combustion efficiency in accordance with the manufacturer's instructions at a frequency determined by the Agency.
- Periodic monitoring for other parameters as determined by the Agency. Parameters to consider include: Fluorides as HF, Bromides as HBr, Chlorine as Cl_2, VOCs as C, copper, lead, zinc Cadmium, arsenic, nickel, mercury or their compounds and platinum group metals.

The determination of a requirement for continuous monitoring for any parameter is based on:

- The potentially significant environmental impact or the concentration of the substance varies widely
- Where a substance is abated and continuous monitoring is required to show the abatement plant performance; or
- Where other control measures are required to achieve satisfactory levels of emission.

7.2 MONITORING OF AQUEOUS EMISSIONS

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

7.3 MONITORING OF EMISSIONS TO GROUNDWATER

- There should be no direct process emissions to groundwater, including during the extraction and treatment of groundwater.
- Periodic groundwater monitoring, as determined by the Agency, to determine the existing groundwater quality and to detect any contamination of groundwater that may arise from the facility.

7.4 MONITORING OF SOLID WASTE EMISSIONS

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

7.5 MONITORING OF NOISE EMISSIONS

- Noise monitoring should be carried out in accordance with the *Guidance Note for Noise in Relation to Scheduled Activities*, 2nd Edition, 2006, at a frequency as specified by the Agency.

7.6 ENVIRONMENTAL MONITORING BEYOND THE INSTALLATION

The operator should consider the need for environmental monitoring to assess the effects of emissions to controlled water, groundwater, air or land or emissions of noise or odour. External environmental monitoring may be required, e.g., when:

- The emissions are a significant contributor to an Environmental Quality Standard (EQS) which may be at risk
- The operator is looking for departures from standards based on lack of effect on the environment
- To validate modelling work.

The need for external environmental monitoring should be considered for:

- Groundwater, where it should be designed to characterise both quality and flow and take into account short- and long-term variations in both. Monitoring will need to take place both up-gradient and down-gradient of the site
- Surface water, where consideration will be needed for sampling, analysis and reporting for upstream and downstream quality of the controlled water including chemical and biological parameters
- Air, including odour, dust deposition and PM_{10}'s (Table 7.4)
- Noise.

7.7 MONITORING OF PROCESS VARIABLES

Some process variables will have potential environmental impact and these should be identified and monitored as appropriate. Examples might be:

- Raw materials monitoring for contaminants where contaminants are likely and there is inadequate supplier information
- Oxygen, carbon monoxide, pressure or temperature in the furnace atmosphere or off-gases
- Plant efficiency where it has an environmental relevance
- Energy consumption across the plant and at individual points of use in accordance with the energy plan.
- Water use across the activities and at individual points of use should be monitored as part of the water efficiency plan.
- The quantity of each class of waste generated.

Appendix 1

PRINCIPAL REFERENCES

1. E. C.

– BREF 2001, European Commission. Reference Document on Best Available Techniques in the Ferrous Metals Processing Industry.
– BREF 2001, European Commission. Reference Document on Best Available Techniques on production of Iron and steel.
– BREF 2004, European Commission IPPC Reference Document on BAT in the Smitheries and Foundries Industry.
– BREF 2001, European Commission. Reference Document on Best Available Techniques in the Non Ferrous Metals Industry.

2. LEGISLATION

– Environment Protection Agency Acts, 1992 to 2011.

– Protection of the Environment Act, 2003.

– Local Government (Water Pollution) Act, 1977.

– Council Directive *80/68/EEC* on the protection of groundwater against pollution caused by certain dangerous substances. *(OJ L20, 26/01/8*0). [amended by 85/208/EC *(OJ L89, 29/03/8*5); 87/144/EC *(OJ L57, 27/02/8*7); 2000/60/EC *(OJ L 327, 22/12/00*)].

– Protection of Groundwater Regulations 1999 *(SI 41/1999*).

– Local Government (Water Pollution) (Amendment) Regulations 1999 *(SI 42/1999).*

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Appendix 2

GLOSSARY OF TERMS AND ABBREVIATIONS

Baseline monitoring: monitoring in and around the location of a proposed facility so as to establish background environmental conditions prior to any development of the proposed facility.

BAT: Best Available Technique as defined in Section 5 (2) of the WMA.

Biochemical oxygen demand (BOD): is a measure of the rate at which micro-organisms use dissolved oxygen in the bacterial breakdown of organic matter (food) under aerobic conditions. The BOD, test indicates the organic strength of a wastewater and is determined by measuring the dissolved oxygen concentration before and after the incubation of a sample at 20ºC for five days in the dark. An inhibitor may be added to prevent nitrification from occurring.

Borehole: a shaft installed for the monitoring of and/or the extraction of groundwater. Established by placing a casing and well screen into the boring.

Chemical oxygen demand (COD): is a measure of the amount of oxygen consumed from a chemical oxidising agent under controlled conditions. The COD is generally greater than the BOD as the chemical agent will often oxidise more compounds than is possible under biological conditions.

Direct discharge: introduction into groundwater of substances in Lists I or II without percolation through the ground or subsoil.

Decommissioning: works carried out on a facility or to allow planned afteruse.

Effluent: a liquid, which flows from a process or system.

Emission: as defined in the EPA Act, 1992.

Groundwater: water, which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil.

Indirect discharge: introduction into groundwater of substances in Lists I or II after percolation through the ground or subsoil.

List I/II substances: substances referred to in the EU Directives on Dangerous Substances (76/464/EEC) and Groundwater (80/68/EC).

Receiving water: a body of water, flowing or otherwise, such as a stream, river, lake, estuary or sea, into which water or wastewater is discharged.

Total organic carbon (TOC): mass concentration of carbon present in the organic matter, which is dissolved or suspended in water.

Trigger level: is a value which when encountered requires certain actions to be taken.

Appendix 3

GLOSSARY OF TERMS AND ABBREVIATIONS

BAT	Best Available Techniques
BATNEEC	Best Available Techniques Not Entailing Excessive Cost
BOD	Biological Oxygen Demand
BREF	BAT reference – sector notes being produced by the European Commission
°C	Degree Celsius
CO	Carbon monoxide
CO_2	Carbon dioxide
DMEA	Dimethylethylamine
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
ELV	Emission Limit Value
EMP	Environmental Management Programme
EMS	Environmental Management System
EPA	Environmental Protection Agency
EQO	Environmental Quality Objective
EQS	Environmental Quality Standard
IPC	Integrated Pollution Control; as established by the EPA Act of 1992.
IPPC	Integrated Pollution Prevention and Control
Mg	Milligram
Iron & Steel BREF	Reference Document on Best Available Techniques on the production of Iron and Steel, published by the European Commission
Nm^3	Normal cubic metre (101.3 kPa, 273 K)
NOx	Nitrogen oxides
POE	Protection of the Environment Act 2003
TEA	Triethylamine
US EPA	United States Environmental Protection Agency
WMA	Waste Management Act
VOC	Volatile Organic Compound