



PROCESS DESCRIPTION

This guideline covers the various ferrous metal processing operations that take place after casting (see Iron & Steel Production Guidelines). Other Metal Finishing processes are covered in a separate guideline.

The main processes are:

- Pickling and Cleaning
- Hot Rolling
- Cold Forming

Pickling and Cleaning

An oxide coating forms on the surface of hot-formed product which is removed by passing it through an acid pickling bath and rinsing to remove any trace of acid. Hydrochloric acid is the most common acid used but some plants use sulphuric acid and a mixture of nitric acid and hydrofluoric acid is used for stainless steel.

Alkali or solvent cleaning is used to remove oil that remains on the product from the cold forming operation prior to annealing or coating to prevent surface staining or contamination.

Hot Rolling

In hot rolling the size, shape and properties are changed by repeatedly compressing the hot metal between electrically powered rollers. The steel input may be cast ingots or more commonly the output from the continuous casting process in an integrated steel mill. Surface preparation by scarfing or grinding of the input is required to produce flawless surfaces in the finished product. A uniformly distributed rolling temperature of between 1050 and 1300°C

is obtained using a reheating furnace. The rolled products are cooled rapidly with water.

Cold Forming

In cold rolling, the properties are changed without prior heating of the input. The input is a coil from the hot rolling mill. The first step is acid pickling to remove the oxide coating formed during hot rolling. The steel strip or sheet is then compressed between rollers to the required thickness and specification. Annealing may be performed to restore ductility lost during rolling. Some flat-rolled products have a final pass in a temper mill to meet flatness and surface hardness requirements.

Wire is formed by drawing wire rod coil (from the hot rolling mill) through cone-shaped dies of decreasing cross-section. Down to 1-2mm, a dry soap-based lubricant is used, below this a soap or oil emulsion is used as a lubricant.

KEY ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Energy Consumption

Hot and cold forming processes are highly energy intensive requiring substantial inputs as:

- Fuel to heat the stock in the reheat furnace prior to rolling and for annealing
- Electrical energy to move and reshape the product by hot and cold rolling

Significant savings can be made by integrating the casting and rolling processes by reducing inter-process reheat requirements.



Air Emissions

Potential air emissions are:

- Combustion products (oxides of nitrogen, sulphur and carbon) from reheat and annealing furnaces and flame cutting operations;
- Fine particulate and metal fume in exhausts from scarfing machines and rolling mills;
- Coarser particles from grinding and descaling;
- Acid mists (sulphuric, hydrochloric, nitric and hydrofluoric acids) from pickling tanks and acid reclamation;
- Volatile organic compounds in oil mists from rolling mills;
- Ammonia from some Nitrogen Oxides emission control systems.

Noise and Vibration

Noise and vibration are significant hazards in rolling mills. The sources of these include:

- Furnace charging
- Descaling feedstock or product by shot blasting, grinding or scarfing;
- Powerful motors and fans
- Metal moving quickly over steel rollers
- Product movement in stockyards, loading vehicles and vehicle movements.

Noise may reach levels that are hazardous to health. Process buildings and noisy equipment should be enclosed and insulated.

Hand-arm vibration syndrome from the prolonged use of vibrating tools and machinery causes effects on the body's blood circulation known as 'vibration white finger' (VWF). Other damage may be caused to the nerves and muscles of the fingers and hands causing numbness and tingling, reduced grip strength and sensitivity. Pain and stiffness in the hands, and joints of the wrists, elbows and shoulders are other possible symptoms.

Appropriate PPE should be provided and good occupational health systems are required to monitor and control employee long-term exposure to noise and vibration.

Water Consumption

The sector uses large amounts of water for descaling during hot rolling, for cooling and for emulsions used in cold rolling. Good water management is required to avoid cross-contamination of clean and dirty water.

Acid Effluents and Wastewater

Waste hydrochloric and sulphuric acid pickling liquors are processed in acid regeneration plants to enable reuse of the acid and the recovery of iron oxide for recycling or sale. The nitric/hydrofluoric acid mixture is less easy to reclaim and must be treated as a waste.

Wastewater from:

- Hot rolling is generated mainly from the high-pressure water descaling of the hot steel and includes suspended solids, oil and grease.



- Cold rolling is generated from rolling oil filtering systems, leaks and spills and contains suspended solids and oil.
- Pickling and cleaning includes acid rinse water and scrubber effluent. The wastewater contains suspended solids, oil, grease, metals and acids.

Effluent streams may include both acidic and alkali discharges, which can be blending to minimise the requirement for pH adjustment prior to final discharge.

Spent solvents and oil-water emulsions are typically recycled off-site.

Solid Wastes

The most significant waste is mill scale, which may be oily or oil free. Oil free mill scale can normally be recycled to the sintering plant or electric arc furnace in iron and steel production or sold to another industry, e.g. in cement/concrete production. Oily scale is a hazardous waste with limited disposal options. A separate oil-free water circuit should be used to remove and transport mill scale.

Other wastes specific to this sector include:

- Scrap metal
- Oily turnings
- Oxide dust from abatement systems
- Oils, grease and other lubricants
- Wet sludges from water treatment systems and spent lubricating emulsions

- Acid liquors, dusts and iron oxide sludges from the acid recovery system.

Soil and Water Contamination

Direct soil and water pollution may occur from accidental leaks and spills. Most rolling mills are on sites that have been used for similar purposes for many years. There is a high probability that earlier operations will have caused ground contamination from the disposal of untreated liquid effluents to soakaways, spills in un-surfaced storage areas, and the wider deposition of contaminants via air emissions from the furnaces. Land may therefore be contaminated by either current or previous operations at the site. It is common for rolling operations to be co-located with smelting, refining and coking plants which may also give rise to contamination.

Respiratory Hazards

- Acid mists from pickling areas can cause skin, eye and respiratory irritation;
- Furnace relining and abrasive blasting produces silica dust known as respirable crystalline silica (RCS), this can cause silicosis which leads to disablement and death and is made worse by smoking.
- Ferrous foundry fume may cause cancer. Other foundry fumes and spray mists can cause lung diseases including asthma.
- Asbestos was used on a large scale for many years as a fire proofing and insulation materials and may be encountered in a wide range of forms within the fabric of older buildings. Asbestos fibres, which are extremely hazardous when inhaled (causing mesothelioma and fibrous thickening in the



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lungs), may be released when the asbestos containing material is disturbed during maintenance or demolition.

Burns and Heat Stress

High temperatures and direct infrared radiation (IR) can cause fatigue and dehydration for those working in the vicinity. Direct IR can also cause damage to sight. Burns and scalds may occur through contact with hot surfaces, metal or water especially during maintenance activities.

Fire & Explosion

Handling of liquid metal may result in explosions, causing metal run-out and burns. The hot melted metal may cause combustion of liquid fuels and flammable chemicals.

OTHER ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Electrical Hazards

Workers may be exposed to electrical hazards due to the presence of heavy-duty electrically powered equipment.

Materials Storage

Large quantities of hazardous materials will be stored on site in the form of fuel, acids, alkalis and solvents. Typical storage facilities are above ground bulk storage tanks. If improperly secured and contained, these materials can leak and cause contamination.

Confined Spaces

There is a risk of entrapment in storage areas and other confined spaces. Particularly at risk are maintenance workers performing repairs on

a furnace or servicing a fuel tank or trailer, sump, silo or bunker. Entry into confined spaces must be strictly controlled and avoided wherever possible.

Ionising Radiation

Gamma ray testing is used to determine steel quality and integrity. This should be conducted in a controlled restricted area.

All incoming scrap should be tested for radioactivity before use.

Polychlorinated Biphenyls (PCBs)

PCBs are a group of substances which are good electrical insulators. Typically, PCBs may be present as constituents of hydraulic oils or dielectric fluids in electrical switchgear, transformers and fluorescent light starters. PCBs are extremely toxic and become concentrated within the food chain. Any products that may contain PCBs must be disposed of by licensed contractors in accordance with national regulations.

Particular attention should be given to buildings constructed before the 1980s.

Machinery/Product Handling

Moving parts of machinery can result in entanglement and entrapment. Particular attention should be paid to rollers and handling, cutting and grinding activities.

Collision

Heavy loads are lifted and moved at elevated heights using hydraulic platforms and cranes presenting a serious safety hazard. Grinding and



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cutting activities may eject pieces of scrap metal causing injury.

Manual Handling and Repetitive Work

Lifting, repetitive work, poor posture and carrying heavy or awkwardly shaped objects, such as bags and heavy equipment can result in injuries.

Slips, Trips and Falls

These often occur on the same level and are primarily caused by uneven surfaces, inappropriate footwear, lighting, weather conditions, trailing cables and pipe work especially during unblocking, maintenance and cleaning activities.

Permitting

Foundry operations in the EU are subject to national regulations under the Integrated Pollution Prevention and Control Directive (2008/1/EC). Operations outside the EU will also be subject to local regulations.

KEY SOCIAL, LABOUR AND COMMUNITY RISK/LIABILITY ISSUES

Air Quality

Particulate emissions from some works can have a significant impact on local air quality and for large installations, the risk of transboundary pollution must be considered.

Noise

Many parts of the process are noisy and may cause disturbance to the local neighbourhood e.g.

- Vehicle and delivery operations;
- The mould shake-out stage;
- Sand reclamation;
- Fettling, dressing and finishing of castings.

OTHER SOCIAL, LABOUR AND COMMUNITY RISK/LIABILITY ISSUES

Dust

Public/environmental health and nuisance issues associated with dust and vented fumes can arise from production activities and may have a significant effect on neighbouring locations. This may be important if there are neighbouring residential and industrial activities in the area;

Transport

Transport of products by road can be a significant issue. This might lead to road noise and traffic congestion.

FINANCIAL IMPLICATIONS

- Many countries are signatories to the Kyoto Protocol and have adopted targets for the reduction of CO₂ emissions. Where Governments have set up carbon emission reduction programmes industrial processes have been required to reduce their CO₂ emissions through the setting of targets. This can result in a need for substantial investment in new/clean technologies to achieve the emission targets. These targets may be reflected in environmental permits.;
- Under the EU Emissions Trading Scheme (ETS) Member States allocate allowances for carbon emissions to industrial sites, including



refineries. The scheme can create both financial assets or liabilities and entities can trade their carbon allowances;

- Injuries may lead to increased payroll costs to replace skilled workers and lost production time;
- Capital investment may be required to comply with new environmental, health and safety requirements;
- There is a relatively high potential for soil and groundwater contamination to be present which can be very costly to remediate;
- Fines, penalties and third party claims may be incurred for non-compliance with environment, health and safety regulations.

IMPROVEMENTS

Environmental, Health and Safety Improvements

General

- Environment, health and safety training for all employees and contractors;
- Good housekeeping should be maintained at all times in all areas to reduce likelihood of accidents and incidents that result in pollution or health and safety impacts;
- Systems should be subject to frequent and proper inspection;
- Conduct routine plant maintenance to keep small leaks and spills to a minimum and maintain plant efficiency;

- Controls should be implemented to minimise the exposure to fume and dust, noise and vibration, e.g.
 - Mechanical controls such as enclosures, use of filters and PPE;
 - Administrative controls such as limiting exposure time, health surveillance;
 - Operator behaviour through training and instructions.

Airborne Emissions

- Installation or upgrade of abatement technology to minimise exposure to toxic raw materials and product and to control the release of emissions, e.g. enclosure of equipment, use of wet de-dusting systems, appropriate ventilation with filters, gas balancing systems, cyclones, filters, and wet or alkali scrubbers;

Noise & Vibration

- Enclosure of noisy machines to isolate people from the noise where practicable;
- Reduction of exposure times for people working near noisy machinery and provide personal protective equipment where people have to enter noisy areas;

Heat

- Shield surfaces where close contact is expected. Implement safety buffer zones;
- Install cooling ventilation;
- Reduce exposure times for people working in extreme heat and provide personal protective



equipment to provide protection from hot surfaces and materials.

Water and Wastewater

- Supply indirect cooling for motors through a closed loop circuit;
- Use separate, oil free water circuit to transport mill scale;
- Segregate process water, rainwater and indirect cooling water streams to reduce the hydraulic loading to waste water treatment equipment or sewers;
- Design effluent system to accommodate blending of acid and alkali discharges to reduce need for pH adjustment;
- Consider upgrades to wastewater treatment facilities;
- Recycle wastewater where possible back to the processes or to secondary uses such as for cleaning;
- Emergency storage lagoons may be needed to prevent contaminated firewater reaching controlled waters;
- Maintain on site abatement equipment and wastewater treatment plant;

Energy Efficiency

- Improve insulation to minimise heat loss;
- Use heat and energy recovery techniques;
- Use of waste gas through a heat exchanger to recover thermal energy and as a fuel to produce hot water, air, steam and power;

Storage

- Bulk containment must be:
 - inspected regularly to prevent leakage;
 - provided with secondary spill containment;
 - installed with automatic alarms and shut off systems;
- Pave stockyards to prevent pollutant infiltration to soil and groundwater;

Waste

- Implement acid recovery processes to recover iron oxide and reusable acids;
- Recover and re-use raw materials and waste products where practicable. Consider opportunities for commercial sale of slag;

Health & Safety

- Provision of personal protective equipment (PPE) that is fit for the task to prevent injury and maintain hygiene standards. Staff should be trained in the correct selection, use and maintenance of PPE.
- Redesign manual processes to avoid heavy lifting/repetitive activities;
- Install mechanical lifting aids where possible and rotate work tasks to reduce repetitive activities;
- Separate people from vehicles and machinery where practicable;



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- Ensure that the process layout reduces opportunities for process activities to cross paths;
- Installation of safeguards on moving parts of conveyor belts to reduce risk of entrapment of employees;
- Install walkways and signage to separate people from vehicle movements to reduce risk of collision;
- Route cables and pipework under walkways to prevent slips, trips and falls;
- Construct walkways of non slip materials;

Fire & Explosion

- Control the effect of fires and explosions by segregating process, storage, utility and safe areas;
- Provide the local fire department with a list and volume of products stored on the premises;
- Avoid potential sources of ignition including banning smoking in and around facilities;
- Use explosion-proof equipment and conductive materials and ensure that equipment is grounded and bonded;
- Introduce accident, fire and explosion precautions and emergency response procedures;

Social Community and Labour Improvements

- Implement a programme of assessment of routine monitoring of worker health;

- Implement a grievance/dispute resolution mechanism for workers and members of the community to raise issues with the Company.

GUIDE TO INITIAL DUE DILIGENCE SITE VISITS

During the initial site visit, the issues will vary according to the type of process being used and product being produced and depending on the level of environment, health and safety management already introduced.

General

- Confirm organisational responsibilities and systems for environment, health and safety. Confirm that these extend to all employees and sub contractors;
- What process chemicals are used? Which are hazardous? Have associated risks been documented?
- Note signs of poor housekeeping, such as signs of spillages and high numbers of empty or partially full drums. Note the condition of the drums. Particularly note any recent spills.
- Note the noise levels at the site. Is there any evidence of noise abatement measures deployed?
- Check the condition of any assets, facilities, equipment and production areas. What systems are in place to monitor and maintain physical assets? What investment in asset management is planned? Look for wear and tear and poor maintenance.



Air Emissions Management

- Are there any dust control measures? Do these work and are these used? Is there any build-up of dust on machinery or other surfaces?
- Is powdered material/sand moved around the site by conveyor or by vehicle?

Noise

- Note the noise levels at the site. Is there any evidence of noise abatement measures deployed?

Water Abstraction & Management

- What amounts and quality of water are required? Where is the water obtained from? Is the water recycled? If changes are proposed will there be adequate water resources to meet any planned increases in production? Have the potential impacts been assessed?

Waste Water Management

- What liquid effluents are produced? What discharge control measures are employed?
- Is effluent and wastewater treated before discharge? If so, check the condition of the treatment plant and location of discharge points for effluent and wastewater from the facility.
- What does the quality of these discharges look like? Note the colour and appearance of adjacent watercourses;
- Note whether the wastewater treatment plant discharges to ground, a local watercourse or

the municipal wastewater treatment works. Higher environmental risks will be associated with facilities discharging to water courses without adequate treatment prior to discharge;

- Is the water quality tested? What are the waters tested for? Where are the samples taken from, how often? Do the discharges have to meet set standards? Does the waste water treatment plant have the capacity to deal with any planned expansion at the site?

Solid Waste Management

- Note nature of solid waste disposal.
- Check that solid waste storage equipment is in a good condition;
- Check that waste storage areas are clear of debris and that skips are covered to prevent waste escaping, for example, check that waste containers have lids or are stored in an area with a roof;
- Check for distressed flora/vegetation zones near storage sites.

Transport of Finished Product from the Site

- Is this by rail, road or water or a combination of these?
- Where are the areas for loading of material located? Are they located near any water bodies or other possibly sensitive features? Is there any containment to prevent run-off of contaminated water?
- Does road haulage cause excessive traffic through any neighbouring residential areas?



Energy Efficiency

- Improve insulation to minimise heat loss;
- Potentially use heat and energy recovery techniques, such as steam rising boilers to capture hot gases and re-use elsewhere in operation or for generating energy.

Fuel and Storage of Materials in Bulk

- What fuels and materials are stored in bulk on site?
- To gauge the potential for spillages and leaks consider the following:
 - Are there any underground storage tanks?
 - Are surface storage tanks and usage areas hard surfaced and bunded? Are these in good condition or are cracks present? Are these regularly tested for leakages?
 - Is the size of the bunding adequate for the volume of the materials stored?
 - Are the bunds regularly cleaned out to avoid loss of capacity due to holding rainwater etc.?

Health & Safety

- Are staff wearing PPE?
- Check signage around the site:
 - Does it convey the health and safety risks?

- Are fire exits and/or evacuation routes clearly marked?
- Are there demarcated routes for pedestrians and vehicles?
- Check for automatic safeguards on machinery to prevent accidental injury;
- Is there worker health monitoring programme? What does it check for?

Incident Management

- Is fire fighting and first aid equipment available? Is there a trained and competent fire fighting resource on site?
- Have there been any recent (within the last three years) incidents on site such as fatalities, fires/explosions, spills?
- Assess emergency response to fires, major spills, etc.
- Is insurance in place to cover such incidents?
- Assess emergency responses to fires, major spills and major spills (in some countries it may be a legal requirement to have an emergency response plan). Does the organisation have an emergency response plan?

Inspections & Regulation

- Check the conditions and duration of validity for all permits;
- What systems are in place to check and maintain assets and infrastructure?



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- Have the premises been inspected recently by the regulatory authorities for health, safety, hygiene, labour and environment? What were their findings?
- Has the organisation been subject to environment, health and safety or quality audits by customers/insurers? What was the outcome of these audits?
- Find out what insurances are in place (health, hygiene, fire etc). Identify number and type of claims against insurance. Have insurers made any environment, health and safety audits of the facility? What were there findings and actions taken by management to address these
- Have the premises been inspected recently (within the past 2 years) by the regulatory authorities for health, hygiene and environment? What were their findings?
- Does the organisation have insurance in place to cover the recall of products? Have there been any recent product recall incidents? If yes, what did these relate to?
- Does the organisation have insurance to cover any significant damage to the environment/community/operations? Review the terms of the cover and identify any exclusions relevant to environmental and health and safety matters.
- Review historical and projected trends for environmental fees and fines. It is also suggested that contact is made with local regulatory agencies to determine compliance and whether complaints have been made by the public.

Investment

- Review budgets for capital expenditure (capex) and operational expenditure to cover EHS matters. Does the business plan have line items for environment, health, safety and social improvements as well as asset management and maintenance?
- If investment or refinancing will lead to restructuring of the organisation what will be the potential impacts on health and safety at the operation and wider community? Have these been considered and assessed by the company?
- If the company plans to invest in new technology, what will be the impacts and benefits for human resources?

Social, Labour and Community

- Check that labour standards, contracting and remuneration are in line with national law and are consistent with the average for the sector;
- Check that hours worked, including overtime, are recorded and staff should receive written details of hours worked and payment received;
- Check that wages and working hours are consistent with the average for the sector and national standards;
- Has the Company received inspections from the local labour inspectorate in the previous three years? Have these resulted in any penalties, fines, major recommendations or corrective action plans?



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- Does the organisation have a grievance mechanism which allows employees to raise workplace concerns?
 - Are employees free to form, or join, a worker's organisation of their choosing?
 - Waste management plan (waste minimisation, re-use, recycling, monitoring);
 - Senior management review/demonstrated involvement in environment, health, safety and hygiene management. Financial investment plans directly and indirectly related to management of environment and health and safety.
- Take note/ask questions relating to any activities that address the improvements listed in the improvements section of this document

ACTION PLANS

Dependent on the individual business, select appropriate improvements from the list above to include in the action plan. As a minimum, any business should be required to have the following in place:

Environmental, Health and Safety

- Operational procedures to manage environmental, health, safety and social risks;
- Monitoring programmes;
- Improvement objectives, targets and project plans;
- Training for personnel;
- Regular inspections, checks and audits with records to demonstrate achievement of the required level of performance against legal requirements and improvement action;
- Operational procedures to manage environmental, health, safety and social risks;
- Emergency plans for environment, health and safety accidents;



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