Environment and Climate Change Canada
Environnement et Changement climatique Canada

CODE OF PRACTICE TO REDUCE FUGITIVE EMISSIONS OF TOTAL PARTICULATE MATTER AND VOLATILE ORGANIC COMPOUNDS FROM THE IRON, STEEL AND ILMENITE SECTOR

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Table of Contents

Tables

Figures

Abstract

This Code of Practice outlines best practices to reduce fugitive emissions of total particulate matter (TPM) and volatile organic compounds (VOCs) from the iron, steel and ilmenite sector. The sector is subdivided into three sub-sectors: integrated mills, mini-mills and ilmenite smelting facilities. These recommended practices can be used by this industry, regulatory agencies and the general public as sources of technical and policy guidance but do not negate any regulatory requirements.

Résumé

Le présent code de pratique décrit les pratiques exemplaires pour réduire les émissions fugitives de matières particulaires totales et de composés organiques volatils provenant du secteur du fer, de l'acier et de l'ilménite. Ce secteur est subdivisé en trois sous-secteurs : aciéries intégrées, mini-aciéries et usines de réduction d’ilménite. Ces pratiques recommandées peuvent être utilisées par cette industrie, les organismes de réglementation et le grand public en tant que sources d'orientation technique et stratégique, mais elles ne se substituent pas aux exigences réglementaires.

1.0 Introduction

1.1 Background

The iron, steel and ilmenite sector is subdivided into three sub-sectors: integrated mills, mini-mills and ilmenite smelting facilities. In Canada, the integrated steel mill sub-sector consists of 4 plants, all located in Ontario. There are 10 mini-mills located in Alberta (1), Saskatchewan (1), Manitoba (1), Ontario (5) and Quebec (2). Worldwide, there are only 5 ilmenite smelting facilities, 1 of which is located in Quebec. The 15 facilities that make up the sector in Canada are listed in Table 1.1 and shown in Figure 1.1. Integrated mills commonly include cokemaking, ironmaking, basic oxygen furnace steelmaking and steel finishing activities, while the mini-mills include electric arc furnace steelmaking, direct reduction ironmaking (DRI) and steel finishing. Ilmenite smelting facilities produce titanium slag and may produce iron as a by-product.

In October 2012, federal, provincial and territorial environment ministers took action to better protect human health and the environment by endorsing and implementing the new Air Quality Management System (AQMS). The AQMS includes Canadian Ambient Air Quality Standards for fine particulate matter and ground-level ozone, Base Level Industrial Emissions Requirements (BLIERs) and local Air Zone Management by the provincial/territorial jurisdictions. For the iron, steel and ilmenite sector, BLIERs were developed for NO_x, SO_2 and total particulate matter (TPM), and it was recommended that a code of practice (Code) be developed to help reduce fugitive emissions of TPM from all sub-sectors and volatile organic compounds (VOCs) from integrated mills and mini-mills.

Table 1.1: Canadian Steel Plants (2013)

Facility No.	Facility Company/Name	Location	Sub-sector	Liquid Steel Capacity (tonnes)[1]
1	AltaSteel	Edmonton, AB	MM	400 000
2	Evraz Inc. NA	Regina, SK	MM	1 100 000
3	Gerdau Ameristeel Manitoba	Selkirk, MB	MM	450 000
4	Essar Steel Algoma	Sault Ste. Marie, ON	IM	4 000 000
5	ArcelorMittal Dofasco	Hamilton, ON	IM	4 400 000
6	U.S. Steel Canada – Hamilton Works	Hamilton, ON	IM	2 570 000
7	U.S. Steel Canada – Lake Erie Works	Nanticoke, ON	IM	2 400 000
8	Hamilton Specialty Bar Corp.	Hamilton, ON	MM	400 000[2]
9	Gerdau Ameristeel – Cambridge	Cambridge, ON	MM	320 000
10	Gerdau Ameristeel – Whitby	Whitby, ON	MM	1 000 000
11	ASW Steel	Welland, ON	MM	180 000[3]
12	Ivaco Rolling Mills	L'Orignal, ON	MM	450 000
13	ArcelorMittal Contrecoeur	Contrecoeur, QC	DRM	2 000 000
14	ArcelorMittal Contrecoeur – Ouest	Contrecoeur, QC	MM	650 000
15	Rio Tinto – Fer et Titane Inc.	Sorel-Tracy, QC	IS	500 000[4]

Legend:

MM	Mini-mill
IM	Integrated mill
DRM	Mini-mill (including direct reduction ironmaking)
IS	Ilmenite smelting facility

Facility numbers refer to locations shown in Figure 1.1.

1 AIST (Association for Iron & Steel Technology, *2010 AIST Directory of Iron and Steel Plants*, Warrendale, PA.

2 Hamilton Specialty Bar Corporation, Company Profile – *Plant capacity of engineering steels*, www.hsbsteel.com

3 Highest production year, telephone conversation with Gary Mayne, ASW Steel, January 22, 2013.

4 Rio Tinto – Fer et Titane Inc., *Sorel-Tracy Complex, Profile*, www.qit.com, Capacity for the production of billets

Figure 1.1: Steel Plant Locations by Province (2013)

1.2 Objective, Scope and Development

The objective of the Code is to identify and promote best practices in order to facilitate and encourage continual improvement in environmental performance of fugitive TPM and VOC emissions from steel mills. The voluntary Code is intended to be a resource for the Steel Sector, regulatory agencies and the general public. A commitment by companies to implement the recommendations found in the Code does not remove obligations for such companies to comply with all applicable laws and regulations.

The Code identifies sources of fugitive TPM and VOC emissions and makes recommendations to reduce these types of emissions. The Code is complementary to the existing published steel codes of practice.[5] Recommendations are based on best available techniques for pollution prevention and control. Although the recommendations are intended to be clear and specific, they are not intended to discourage the use of alternative technologies and practices that can achieve an equivalent or better level of environmental protection. The Code does not take into consideration practices that would require an existing facility to make major technological changes. In designing a

[5] Environment Canada, *Environmental Code of Practice for Integrated Steel Mills*, First Edition, EPS 1/MM/7 – March 2001, and Environment Canada, *Environmental Code of Practice for Non-Integrated Steel Mills*, First Edition, EPS 1/MM/8 – March 2001

new facility, other technologies can be taken into consideration to further minimize emissions, such as non-recovery (or heat-recovery) cokemaking and DRI technology.

The Code was developed by Environment and Climate Change Canada in consultation with a broad range of stakeholders. Relevant information from various sources was considered in the development of the recommendations in the Code. Sources included technical and scientific journals, reports and literature from provinces, Environment and Climate Change Canada, the Canadian Council of Ministers of the Environment, the United States Environmental Protection Agency, the European Union, the United Nations Economic Commission for Europe, the United Nations Environment Programme, and the World Bank.

2.0 Sources of Fugitive TPM and VOC Emissions

Fugitive emissions are often uncontrolled, and sources can be distributed spatially over a wide area. Table 2.1 provides an overview of activities or equipment where emissions of fugitive TPM and VOCs may be released into the atmosphere. These sources of emissions may vary between sub-sectors and between facilities within the same sub-sector.

Fugitive emissions can result from process leaks and spills that are associated with certain activities related to raw material storage and material handling, cokemaking, ironmaking, steelmaking, and some related process operations. These emissions can also result from leaks from pipes, ducts, valves or pumps.

Table 2.1: Common Sources of Fugitive Emissions

Common Sources of Process Fugitive Emissions		
Activity	**Sub-sector***	**Source**
Materials handling	All	**TPM** • Disturbing granular material • Unloading/loading materials • Transferring materials to conveyors or transfer points
Materials movement	All	**TPM** • Conveying systems • Transporting materials using vehicles
Materials storage	All	**TPM** • Piling • Leaking from buildings **VOC**** • Leaking from buildings • Storing of drums, containers and tanks
Materials preparation	All	**TPM** • Crushing • Grinding • Blending • Screening

Common Sources of Process Fugitive Emissions		
Activity	**Sub-sector***	**Source**
Cokemaking	Integrated mills	**TPM** • Charging of coal • Leaking from coke oven battery doors, lids and gas off-takes • Pushing of coke • Quenching of coke **VOC** • Charging of coal • Leaking from coke oven battery doors, lids, tops and gas off-takes • Pushing of coke
Coke by-product plants	Integrated mills	**VOC** • Storing, handling, transferring and separating organic compounds (mostly benzene), ammonia and sulphur from coke oven gas • Associated equipment such as pumps, compressors, valves and control devices • Separating tar • Separating naphthalene • Recovering light oil • Leaking of heat exchangers at cooling towers
Blast furnace ironmaking	Integrated mills	**TPM** • Charging of materials to the furnace • Tapping molten metal from the furnace • Transporting molten metal • Crushing and screening of slag **VOC** • Incomplete combustion of coke in the furnace • Tap-holes, runners, skimmers and the ladle charging area • Runner systems where tar-based binders are still used
Direct reduction ironmaking	Mini-mills	**TPM** • Charging iron oxide to the top of the shaft furnace • Handling the iron oxide and the direct reduced iron
Ilmenite reduction	Ilmenite smelting facility	**TPM** • Charging of materials to the furnace • Tapping molten metal from the furnace • Cleaning cars • Crushing and screening of slag • Tapping of slag

Common Sources of Process Fugitive Emissions		
Activity	**Sub-sector***	**Source**
Basic oxygen furnace steelmaking	Integrated mills, ilmenite smelting facility	**TPM** • Charging of the furnace • Blowing oxygen • Handling of flux • Tapping of molten metal and slag **VOC**** • Hydrocarbons contained in the oils, wire casing, foam and plastics found in the steel scrap feedstock can vaporize when the iron is charged
Electric arc furnace steelmaking	Integrated mills, mini-mills	**TPM** • Charging of the furnace • Tapping of the molten metal and slag • Transporting molten metal **VOC** • Hydrocarbons contained in the oils, wire casing, foam and plastics found in the steel scrap feedstock can vaporize when melting takes place • Combusting auxiliary fuel • Decarburization of scrap • Charging of the furnace • Tapping of the molten metal and slag
Continuous casting	All	**TPM** • Transferring molten metal to the tundish • Cutting steel
Hot rolling	Integrated mills, mini-mills	**TPM** • Scarfing or grinding of the feedstock • Removing scale formed during hot rolling • Straightening and shearing of hot formed products **VOC** • Rolling and lubrication oils • Combusting fuel in the reheat furnaces
Cold forming	Integrated mills, mini-mills	**VOC** • Rolling and lubrication oils • Combusting fuel in the annealing furnace
Coating	Integrated mills, mini-mills	**TPM** • Straightening and shearing **VOC** • Spraying, immersion, rolling or brushing of non-metallic coatings (e.g., powders, paints and liquids containing organic compounds)
Transportation	All	**TPM** • Paved and unpaved roads (vehicular traffic)

Common Sources of Non-Process and Fuel Combustion Fugitive Emissions	
Sub-Sector*	**Source**
All	**VOC** and TPM** • Pumps • Compressors • Pressure relief devices in gas/vapour service • Sampling connection systems • Valves • Lines • Pressure relief devices in liquid service • Flanges and other connectors • Product accumulation vessels • Closed vent systems • Control devices

* Integrated mills, mini-mills, ilmenite smelting facility
** Excluding the ilmenite smelting facility

3.0 Recommended Best Practices

This section presents recommended methods and measures to mitigate fugitive TPM and VOC emissions. These recommendations were derived from regulatory and non-regulatory best environmental practices, published by various agencies, organizations and jurisdictions. Each of these recommendations should be applied where and when appropriate and practicable based on the particular circumstances of each facility.

3.1 General Recommendations

Prevention and Control of Fugitive Air Emissions

RECOMMENDATION R01 (TPM and VOC)

Potential sources of fugitive emissions should be identified, prevented and controlled through the use of appropriate mitigative measures. These sources may include roads (paved or unpaved), storage piles, materials conveyance systems, secondary material storage and waste disposal piles, leaks from pipes or storage tanks, and fugitive process emissions from buildings.

To prevent fugitive emissions, documented procedures should be developed and facilities should implement good housekeeping and best environmental practices. These would, for example, include hoods and/or enclosure of process equipment, use of covered or enclosed conveyors and transfer points, and implementation of Leak Detection and Repair (LDAR) programs. Other emission control techniques include raw material storage pile optimum design and best environmental practices for bulk-material storage piles, such as covering of storage piles and application of crusting materials to bulk- material storage piles. Paving of yards and/or application of environmentally friendly dust-suppression material to unpaved roadways, scheduled washing of mobile equipment, and routing of runoff water to settling ponds could also be beneficial for minimizing fugitive emissions. The evaluation of conformance with operating specifications for each type of equipment may also help in minimizing fugitive emissions.

Collection and Control of Process Air Emissions

RECOMMENDATION R02 (TPM and VOC)

Emission control systems, including handling facilities for collected material, should be adequately sized, designed, constructed, operated and maintained to contain, control and minimize pollutant releases to ambient air from plant processes.

Emission control equipment should be designed on the basis of sound engineering considerations and should be able to maintain control of releases to the ambient air from all operational sources, and at different operational conditions including minimizing the effects of operational upset events.

Best emission control technologies and techniques should be researched and adopted on a site-specific basis to minimize emissions.

Minimization of Fugitive Air Emissions

RECOMMENDATION R03 (TPM and VOC)

Operating practices that minimize fugitive emissions from those operations that are not amenable to enclosure or hooding should be developed and implemented.

Monitoring and Reporting for Emission Control Systems

RECOMMENDATION R04 (TPM and VOC)

Control equipment should be monitored and inspected regularly in order to maintain proper collection of releases, therefore reducing fugitive emissions. Documentation of procedures for the monitoring and inspecting of emission control equipment should be developed. These procedures should include documenting the collection efficiencies of control equipment.

3.2 Materials Handling, Movement and Storage

Materials Handling

RECOMMENDATION R05 (TPM)

a) Adjust heights of loading/unloading/stockpiling equipment to minimize drop height.
b) Monitor moisture content of raw materials, secondary materials, wastes and by-products. For example, spray water with equipment such as portable water cannons for mobile sources and water spray nozzles for stationary sources.
c) Limit or restrict material handling based on wind conditions and visual inspections.

Materials Movement

RECOMMENDATION R06 (TPM)

a) Spray water on the open conveyors and transfer points.
b) Shroud conveyors/transfer points at critical points to avoid wind erosion on the material being transported.
c) Limit vehicle speed on unpaved roads using signs and training.
d) Pave yards and roads.
e) Wash vehicles.
f) Spray water or dust suppressants on the road surfaces.

g) Limit or restrict access to unnecessary roadways.
h) Maintain roads that have been damaged through usage over time.
i) Remove dust accumulated on the paved roads/areas using industrial sweepers.
j) Grow vegetation on open areas that are not used for traffic or materials storage.
k) Install wind breaks (e.g., fences, trees) to inhibit transport of dust.
l) Minimize egress of fugitive emissions through doors and openings as much as possible. Keep doors and other building openings closed where sources of dust operate.

Materials Storage

RECOMMENDATION R07 (TPM)

a) Set stockpile configuration in order to minimize fugitive dust emissions due to wind erosion:
   - Use large piles rather than several small piles, in order to minimize total surface area.
   - In case of piles with wide range of size distribution, dispose finer materials in the base and coarser materials in the top of the stockpiles.
   - Set pile orientation based on prevailing wind direction.
   - Include wind breaks in the pile set-up.
   - Minimize pile ridges.
b) Spray water or other dust suppressant on stockpile surface.
c) Seal stockpiles with coarse granular material or dust suppressants (e.g., crusting agents).
d) Limit or restrict reclaiming operations based on wind conditions and visual observation.
e) Cover stockpile.

Liquid Storage

RECOMMENDATION R08 (VOC)

The recommendations in the Canadian Council of Ministers of the Environment's *Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks*[6] should be applied to light oil, wash oil, crude liquor, liquid fuels, petroleum products, solvents and tar storage tanks.

RECOMMENDATION R09 (VOC)

a) Liquid storage and containment facilities should be designed and constructed to meet the requirements of the appropriate standards, regulations and guidelines of the pertinent regulatory agency. Each facility should develop, document and implement a storage tank management program. This recommendation applies to liquid fuels, acids, petroleum products, solvents and other liquids that are combustible or potentially harmful to the environment.
b) Vapours from loading or transferring high-vapour pressure liquids—e.g., benzole and coal oils—should be vented to abatement equipment or returned to the storage tank. Tank and drum lids should always be closed.

[6] Canadian Council of Ministers of the Environment, *CCME Environmental Guidelines for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks*, CCME-EPC-87E, June 1995.

c) Storage tanks of volatile liquids venting directly to air should have pressure/vacuum release valves to minimize vapour losses. Vacuum pumps should vent to process or collection equipment.
d) Tank paint with low solar absorbency, temperature control tank insulation and inventory management should be used (together or in any combination with other techniques) to reduce losses from storage tanks at atmospheric pressure.
e) Storage tanks should include secondary seals and a floating roof to reduce VOC emissions.
f) The loading, unloading, handling and storage of liquid fuels and bulk chemicals should be carried out so as to prevent leakage and spillage.
g) Inert gas blanketing systems should be employed to reduce emissions from storage and handling system.

3.3 Cokemaking

Recovery Coke Ovens, Charging Operations

RECOMMENDATION R10 (TPM and VOC)

Develop, document and implement procedures for:

a) The nature and frequency of equipment inspections.
b) Replacement or repair of emission control equipment and the method used to audit the effectiveness of the inspection and repair program.
c) Enclosure and/or hooding with emission controls of the charging of coal.
d) Filling of larry car hoppers.
e) Alignment of larry cars over the oven to be charged.
f) Filling of the ovens (e.g., procedures for staged or sequential charging).
g) Levelling of coal in the ovens.
h) The inspection and cleaning of offtake systems (including standpipes, standpipe caps, goosenecks, dampers and mains), oven roofs, charging holes, topside port lids, steam supply system and liquor sprays.

Coke Oven Doors

RECOMMENDATION R11 (TPM and VOC)

Develop, document and implement procedures for:

a) A program for the inspection, maintenance, repair and replacement of coke oven doors, jambs, seals and any other equipment used to control emissions from coke oven doors.
b) The method to be used to evaluate conformance with operating specifications for each type of equipment.
c) The methods to be used to audit the effectiveness of the inspection and repair program.
d) Identifying leaks that indicate a failure of the emissions control technology.
e) A clearly defined chain of command for communicating information on leaks and procedures for corrective action.
f) Cleaning sealing surfaces of doors and jambs that include the identification of equipment that will be used and a specified schedule or frequency for the cleaning of the sealing surfaces.

g) The use of supplemental gasketing and luting materials, and hand luting.
h) Maintaining spare coke oven doors and jambs on site.
i) Monitoring and controlling back pressure in the collecting main, including corrective action if pressure control problems occur.
j) Improved coke oven door sealing.

Topside Port Lids, Offtake Systems, Coke Wet Quenching

RECOMMENDATION R12 (TPM and VOC)

Develop, document and implement procedures for:

a) The inspection, maintenance and replacement or repair of topside port lids and port lid mating and sealing surfaces.
b) The frequency of inspections.
c) The evaluation of conformance with operating specifications for each type of equipment.
d) An audit to determine the effectiveness of the inspection and repair programs.
e) The identification, management and repair of leaks from the offtake system.

Coke Oven Battery Stacks

RECOMMENDATION R13 (TPM and VOC)

Develop, document and implement procedures for:

a) Frequency and method of recording underfiring gas parameters and battery operating temperatures.
b) Frequency and method for inspecting flues, burners, nozzles, mixing and injection systems.
c) A preventive maintenance program to address results of inspection findings.
d) A method for the investigation and remedy of the cause(s) of:
    - Sudden increase in opacity exceeding applicable opacity emission standards.
    - Malfunction or upset of the combustion control system.

Coke Pushing and Transfer to Quench Station

RECOMMENDATION R14 (TPM and VOC)

Develop, document and implement procedures for:

a) Minimizing the occurrence and severity of “green” pushes.
b) Dampering off ovens before a push.
c) The inspection and replacement or repair of pushing emission control system components.
d) The frequency of inspections.
e) An audit to determine the effectiveness of the inspection and repair program.
f) Minimizing emissions from the transfer of hot coke to the quench station.
g) The prevention of pushing an oven out of sequence, pushing prematurely, and undercharging or overcharging.
h) Identifying pushing emissions that indicate occurrences of incomplete coking or a failure of the emissions control technology to function properly, which include a clearly defined chain of command for communicating information on such occurrences and procedures for corrective action.

Oven Doors, Lids and Ascension Pipes (stand pipes)

RECOMMENDATION R15 (TPM and VOC)

Develop, document and implement procedures for:

a) Regular maintenance of doors in a repair bay to prevent deterioration of seals and correct any mechanical damage.
b) Charge hole rims and lids to prevent leakage.
c) The use of effective sealants.
d) The use of water-sealed caps for ascension pipes and good maintenance of the caps.

Bypass/Bleeder and Flare Stacks (coke oven gas flaring)

RECOMMENDATION R16 (TPM AND VOC)

Develop, document and implement procedures for:

a) The flaring of coke oven gas.
b) The inspection, repair and replacement of flare system components.
c) The evaluation of conformance with operating specifications of the flare system.
d) The minimization of the volume of gas flared.
e) Optimizing combustion efficiency to minimize visible emissions.
f) Reporting and correcting malfunctions of the flare system.

3.4 Coke By-product Plant

Coke By-Product Plant

RECOMMENDATION R17 (VOC)

The recommendations in the Canadian Council of Ministers of the Environment's *Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks*.[7] should be followed.

Benzene Transfer Operations

RECOMMENDATION R18 (VOC)

A vapour collection system should be used to contain benzene vapours during the transfer of benzene-containing liquids to tank trucks or rail cars.

Open Trenches and Sumps

RECOMMENDATION R19 (VOC)

Process trenches and sumps associated with coke oven gas, crude liquor, light oil, wash oil and tar handling should be enclosed and the vapours collected for treatment.

Containment of Process Pumps and Tanks

RECOMMENDATION R20 (VOC)

Process pumps and tanks should be installed on impervious pads with containment dikes and drainage to wastewater treatment facilities to contain spills.

[7] Canadian Council of Ministers of the Environment, *CCME Environmental Code of Practice for the Measurement and Control of Fugitive VOC Emissions from Equipment Leaks,* CCME-EPC-73E, October 1993.

Equipment Leaks[8]

RECOMMENDATION R21 (VOC)

a) Compressors should be equipped with seal systems including barrier fluid system to prevent leakages. Barrier fluid systems require seal failure sensors, and should be checked daily or equipped with an audible alarm.

b) Pressure relief devices in gas/vapour service should operate with no detectable emissions, except during pressure releases. Devices should be returned to a state of no detectable releases within five days of release, and conditions monitored.

c) Each sampling connection system should be equipped with a closed-purge system or closed-vent system. The purged process fluid should be returned to the process line, or collected and recycled, or captured and transported to a control device.

d) Open-ended valves and lines should be equipped with a cap, blind flange, plug or second valve.

e) Leaks from pumps, compressors, valves, pressure relief devices, connectors, closed-vent systems and control devices should be detected using appropriate methods. Once detected, leaks should be repaired.

f) Product accumulator vessels should be equipped with closed-vent systems capable of capturing and transporting leakages to a control device.

g) Delay of repair of equipment for which leaks have been detected could be allowed if the repair is technically infeasible without process unit shutdown.

h) Vapour recovery systems and enclosed combustion devices should recover organic vapours with an efficiency of 95% or to an exit concentration of 20 parts per million by volume. Closed-vent systems should operate with no detectable emissions; otherwise, repair is required.

3.5 Ironmaking

Blast Furnace Ironmaking

RECOMMENDATION R22 (TPM and VOC)

a) Enclosure and/or hooding with emission controls of the blast furnace tapping operations and discharge of molten metal and slag.

b) Cover ladles containing molten metal.

c) Maximize capture efficiencies by having tapping and discharge operations located within a controlled area of the facility.

d) Cast house fugitive emissions should be minimized by covering the runners and evacuation points (tap-holes, runners, skimmers, ladle charging and by using tar-free runner linings).

Direct Reduction Ironmaking

RECOMMENDATION R23 (TPM)

a) Enclosure and/or hooding with emission controls of the shaft furnace operations and discharge of iron.

[8] U.S National Emission Standard for Equipment Leaks (Fugitive Emission Sources) – www.gpo.gov/fdsys

b) Maximize capture efficiencies by having discharge operations located within a controlled area of the facility.

Ilmenite Reduction Furnace

RECOMMENDATION R24 (TPM)

a) Enclosure and/or hooding with emission controls of the charging and tapping operations.
b) Maximize capture efficiencies by having tapping and discharge operations located within a controlled area of the facility.
c) Cover ladles containing molten metal.
d) Continual improvement of the baghouse operation and collection efficiency.
e) Enclosure of the filter dust collection and discharge.

3.6 Steelmaking

Basic Oxygen Furnace Steelmaking

RECOMMENDATION R25 (TPM and VOC)

a) Enclosure and/or hooding with emission controls of the molten metal transfer, charging and tapping operations.
b) Maximize capture efficiencies by having tapping and discharge operations located within a controlled area of the facility.
c) Cover ladles containing molten metal.
d) Scrap Management Program for the prevention or minimization of contaminants in steel scrap and other feed materials:
   - Non-ferrous contaminants should be minimized to the extent practicable.
   - All grades of scrap should be free of excessive dirt, oil and grease.

Electric Arc Furnace Steelmaking

RECOMMENDATION R26 (TPM and VOC)

a) Enclosure and/or hooding with emission controls of the charging and tapping operations.
b) Maximize capture efficiencies by having tapping and discharge operations located within a controlled area of the facility.
c) Cover ladles containing molten metal.
d) Continual improvement of the baghouse operation and collection efficiency.
e) Enclosure of the filter dust collection and discharge.
f) Scrap Management Program for the prevention or minimization of contaminants in steel scrap and other feed materials:
   - Non-ferrous contaminants should be minimized to the extent practicable.
   - All grades of scrap should be free of excessive dirt, oil and grease.

3.7 Steel Finishing

Continuous Casting

RECOMMENDATION R27 (TPM)

a) Enclosure and/or hooding with emission controls of the area where the tundish is filled.
b) Maximize capture efficiencies by having tapping and discharge operations located within a controlled area of the facility.
c) Cover ladles containing molten metal.

Hot Rolling and Cold Forming

RECOMMENDATION R28 (TPM and VOC)

a) Enclosure and/or hooding with emission controls throughout the process (cold forming only).
b) Design and installation of a hooding system and oil mist emission collection system to collect and capture rolling oil mists (cold forming only).
c) Collection, interception and disposal of oil spills and leakages.
d) Implementation of an environmentally responsible oil disposal system.
e) Minimizing oil inputs is also part of best environmental practices.

Coating

RECOMMENDATION R29 (VOC)

a) Use of low-VOC products.
b) Consider local hooding and wet scrubber for interception and treatment of fugitive VOC emissions during application by brushing, rolling, spraying or immersion of organic compounds in the form of powders, paints and liquids.

3.8 Combustion, Boilers and Reheat Furnaces

Combustion, Boilers and Reheat Furnaces

RECOMMENDATION R30 (VOC)

Each facility should develop and implement best environmental practices for minimization of VOC emissions with a preventive maintenance program, including documented methods of investigation and repair, and development of a protocol for the calculation of the VOC emissions. The primary control method for VOC emissions from boilers and reheat furnaces is the optimization of combustion efficiency and the use of natural gas where by-product fuel is not available.

Glossary of Terms

Basic Oxygen Furnace (BOF)	A pear-shaped furnace, lined with heat resistant (refractory) material, that converts molten iron and recycled steel (scrap) into new steel.
Blast Furnace	A towering cylinder lined with heat-resistant (refractory) bricks, used by integrated steel mills to smelt iron from iron ore.
Blast Furnace Gas	A low-calorific-value gaseous fuel that is generated in the blast furnace during the iron reduction process. Blast furnace gas is used as a fuel for coke ovens, blast furnace stoves and boilers.
Coating	The process of covering steel with another material (e.g., tin, chrome, zinc and aluminum-zinc), primarily for corrosion resistance.
Coke By-product Plant	Processes cooled coke oven gas (liquid condensate and gas) to recover chemicals and to condition the gas for use as a fuel.
Coke Oven Battery	Consists of a group of ovens connected by common walls to convert coal into coke by distillation. Generally, a coke oven battery will consist of 45 to 100 ovens.
Coke Oven Gas	A medium-calorific-value gaseous fuel that is generated when volatile materials are driven out of coal during the coking process. Coke oven gas is used as a fuel for coke ovens, blast furnace stoves, reheat furnaces and boilers.
Cokemaking	A process where coal is heated in the absence of air to produce metallurgical coke.
Cold Forming	Process, subsequent to hot rolling, where primarily flat-rolled products are compressed between electrically powered rolls in order to change the shape of the steel progressively to the final desired form.
Continuous Casting	The process whereby molten steel is solidified into a “semi-finished” billet, bloom or slab for subsequent rolling.
Direct Reduced Iron (DRI)	The product of an iron ore briquette or pellet that has been heated to a temperature of 1000–1200^{o}C in a chemically reducing atmosphere. The iron content of the resultant product is typically 90–95%. DRI is used as a scrap substitute in EAF steelmaking and is sometimes added to the blast furnace or BOF charge.
Electric Arc Furnace (EAF)	Steelmaking furnace where scrap is generally 100% of the charge, but liquid iron, DRI or other scrap sources could also

	be used. Heat is supplied from electricity that arcs from the graphite electrodes to the metal bath, usually supplemented by oxy fuel burners. Furnaces may be either alternating current or direct current.
Facility	A facility (or contiguous facility) is defined as all buildings, equipment, structures and stationary items that are located on a single site, or on contiguous sites or adjacent sites, that are owned or operated by the same person and that function as a single integrated site, including wastewater collection systems that release treated or untreated wastewater into surface waters.
Flux	An iron cleaning agent. Limestone and lime react with impurities within the metallic pool to form a slag that floats to the top of the relatively heavier (and now more pure) liquid iron or steel.
Hot Rolling	Process where steel slabs, blooms, billets or beams are compressed between electrically powered rolls in order to change the shape of the steel progressively to the final desired form.
Ilmenite	A weak magnetic crystalline titanium-iron oxide mineral ($FeTiO_3$).
Ilmenite Reduction Furnace	A refractory-lined vessel that smelts ilmenite ore to titanium slag. Iron is a by-product of this process.
Ladle Metallurgy Furnace	An intermediate steel processing unit that further refines the chemistry and temperature of molten steel while still in the ladle. The ladle metallurgy step comes after the steel is melted and refined in the EAF or BOF but before the steel is sent to the continuous caster.
Molten Metal	Liquid pig iron produced in the blast furnace or ilmenite reduction furnace, or liquid steel produced in BOF or EAF steelmaking
Reheat Furnace	A refractory-lined furnace used to normalize steel shapes directly from continuous casting or heat cold steel shapes from storage to the hot rolling temperature. The steel shapes move in a continuous stream.
Release	Includes discharge, spray, inject, inoculate, abandon, deposit, spill, leak, seep, pour, emit, empty, throw, dump, place and exhaust.
Shaft Furnace	A refractory-lined vertical cylinder where iron pellets or other

	materials are fed into the top of the furnace through a large number of distributor pipes. The distributor pipes reduce the possibility of size separation and gas channelling.
Slag	A molten layer formed on top of a bath of liquid metal or matte when impurities in the charge combine with the flux.
VOCs	Photochemically reactive hydrocarbons, and therefore exclude compounds such as methane, ethane and several chlorinated organics. Also known as reactive organic gases (ROG) or non-methane volatile organic compounds (N-MVOC).

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