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National Pollutant Inventory

Emission estimation technique manual for

Ferrous Foundries
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Department of the Environment
GPO Box 787
Canberra, ACT 2601
e-mail: npi@environment.gov.au
web: www.npi.gov.au

Disclaimer

The manual was prepared in conjunction with Australian states and territories according to the *National Environment Protection (National Pollutant Inventory) Measure.*

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1 Introduction

National Pollutant Inventory (NPI) Emission Estimation Technique (EET) manuals provide guidance to assist facility reporters to report emissions and transfers of NPI substances to the NPI. This manual describes the procedures and recommended approaches for estimating emissions and transfers from ferrous foundries.

NPI substances are those that, when emitted at certain levels, have the potential to be harmful to human health or the environment. Australian state and territory governments have legislated that industry will report these emissions on an annual basis. Reportable NPI substances are listed in the NPI Guide and are classified into six categories, with different reporting thresholds. If your facility trips a threshold in a reporting year for an NPI substance, all emissions of that substance to air, water and land from your facility must be reported. Transfers of NPI substances must also be reported for each substance tripped in Categories 1, 1b and 3. Reporting of transfers depends on whether the NPI substance is transferred to a mandatory or voluntary reporting transfer destination. For more information on the NPI program, please consult the NPI Guide, which is available from the NPI website at www.npi.gov.au.

The ANZSIC code and ANZSIC code descriptions that apply to this Manual are as follows:

EET MANUAL	Ferrous Foundries
2006 ANZSIC code and description	2121 Iron and Steel Casting 2122 Steel Pipe and Tube Manufacturing

The ANZSIC code is part of NPI reporting requirements. The NPI Guide contains an explanation of the ANZSIC classification system. Under Clause 14 of the *NPI National Environment Protection Measure* (NPI NEPM), a facility is only required to report under the NPI if the ANZSIC code for one or more activities undertaken at the facility is included by the Commonwealth on a published list as an industry type required to report. The NPI publishes a list of participating ANZSIC codes under the NPI NEPM.

This manual has been developed through a process of national consultation involving state and territory environmental authorities and key industry stakeholders. Particular thanks are due to Australian Foundry Institute for their review of this manual.

2 Process description

Ferrous foundries (iron and steel) involve the casting and forging of iron. Products include castings for machinery parts, transportation manufacturing, and non-industrial components such as hand-tools and motor vehicle equipment. Grey, ductile and malleable iron, steel, and scrap iron/steel are typically used as raw materials. The key processing steps undertaken by ferrous foundries are as follows:

1. Raw material handling and preparation;
2. Metal melting;
3. Mould and core production; and
4. Casting and finishing.

The final product is determined by the composition of the iron, design of casting, rate of cooling, and heat treatment. The first step in estimating emissions and transfers of NPI substances from a facility is to create a facility process diagram, highlighting points in the process where emissions and transfers may occur.

Table 1 shows the coverage of relevant substance emissions and transfers in this and other NPI manuals.

Figure 1 illustrates a typical ferrous foundry facility process diagram, showing likely emission sources and transfers.

Table 1 – Location of Emission and Transfer Sources in this Manual and Coverage in the NPI

Activity/ Process	Threshold category	Substances	Destination	Emission Calculations
Furnace operation	2a & 2b	Category 2a and 2b substances	Air point	Table 4 & 5
Heat treatment ovens and ladle heaters	2a & 2b	Category 2a and 2b substances	Air point	Combustion in Boilers manual
Use of solvents for degreasing/cleaning	1 & 1a	TVOCs and individual VOCs including acetone, dichloromethane, ethanol, methanol, methyl ethyl ketone, methyl isobutyl ketone, tetrachloroethylene, trichloroethylene, xylenes	Air fugitive	Table 6 or mass balance
Acid usage	1	hydrochloric acid, sulfuric acid	Air fugitive	Use mass balance
Operation of vehicles, engines, forklifts etc.	2a & 2b	Category 2a and 2b substances	Air fugitive	Combustion Engines manual
Ancillary operations for Grey Iron	2a	PM10	Air fugitive	Table 7
Ancillary operations for steel	2a	PM10, PM2.5 and oxides of nitrogen	Air fugitive	Table 8
Use of binders	1, 1a, 2a	See Tables 9-11	Air fugitive	Tables 9-11
Wastewater and sludges	1, 1a, 1b	Metals and other substances	Transfer (landfill, sewer etc) or emission to water (watercourse)	Section 5 and 4.2
Accidental spills	1, 1a, 1b	Various	Unrecovered amounts are emissions to land	Section 4.3

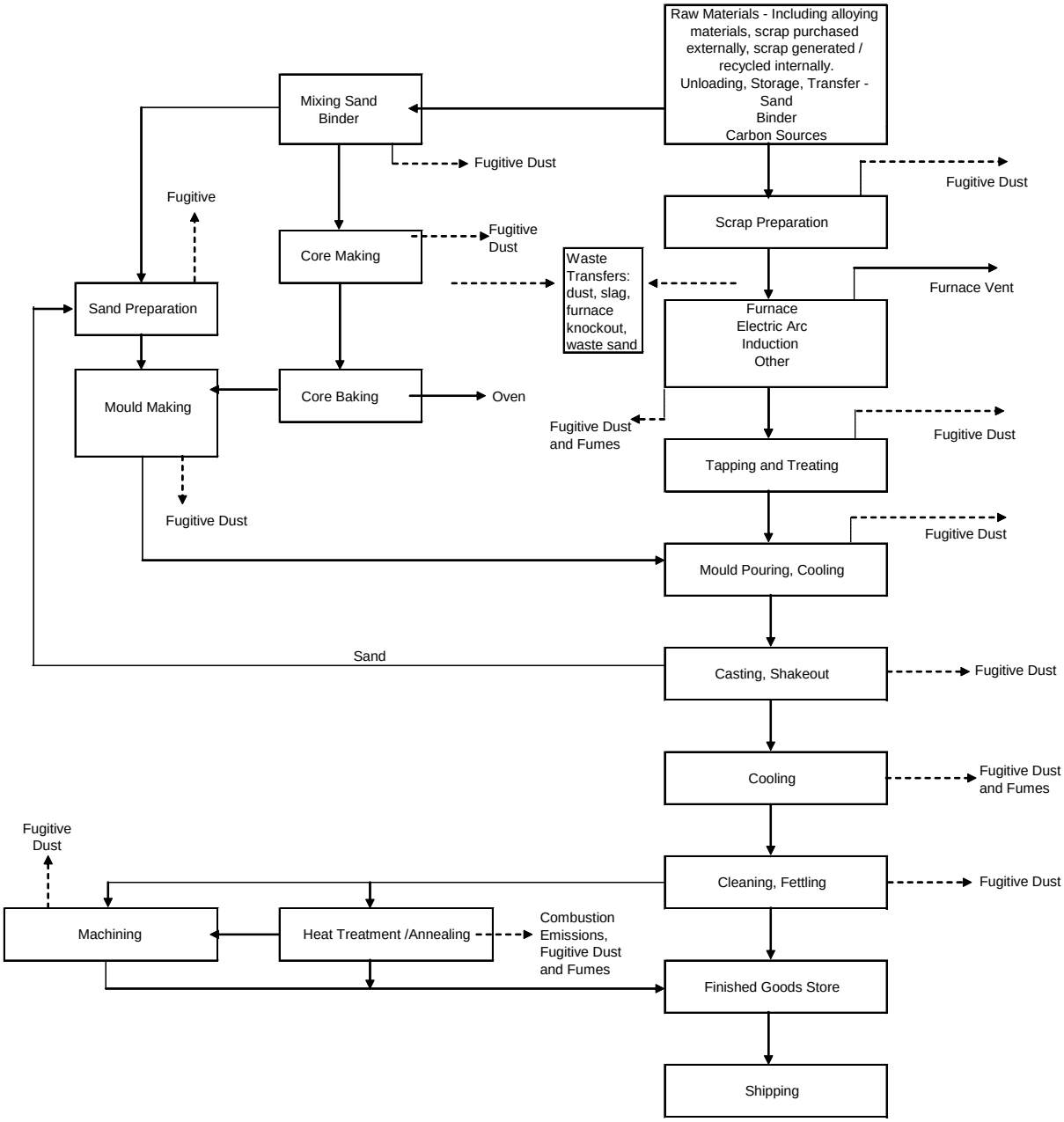

Figure 1: Process diagram for a typical ferrous foundry facility
Cast Metals Association, 1998, with transfers added 2013

3 Thresholds

Iron and steel foundries and allied manufacturing may involve the handling and use of numerous listed NPI substances. These include volatile organic compounds present in solvents and cleaning aids, metal compounds (e.g. those containing manganese, zinc or other NPI listed metals) and other substances (e.g. hydrochloric acid). Each process may be slightly different, and emit a different range of NPI-listed substances.

Table 2 – NPI-Listed Substances Commonly Used in Iron and Steel Foundries

Organics	Inorganic Acids	Metals
Acetone Ammonia Dichloromethane Ethanol Methanol Methyl ethyl ketone Methyl isobutyl ketone Tetrachloroethylene Toluene Trichloroethylene Xylenes (individual or mixed isomers)	Hydrochloric acid Sulfuric acid	Copper and compounds Chromium (III) compounds Chromium (VI) compounds Manganese and compounds Nickel and compounds Zinc and compounds

QLD Department of Environment, 1998, NPI substances as per 2011/12 reporting year added

The NPI Guide lists all of the reportable substances and the associated thresholds. You should consult the Guide to determine if your facility handles, manufactures, or otherwise uses any of the listed substances in excess of the threshold and, therefore, whether you are required to report emissions of these substances.

Reporting of metals

The threshold for Category 1 substances or Category 1b substances that are listed as "(a metal) and compounds" refers to the total amount of the metal and its compounds used (for example, "chromium (III) compounds" refers to chromium (III) and all compounds that incorporate chromium (III)).

The amount emitted or transferred in relation to a substance listed as "(a metal) and compounds" refers only to the amount of the metal emitted or transferred (for example, the amount of "chromium (III) and compounds" emitted refers only to the amount of chromium (III) emitted).

For example if chromite sand (Cr_2O_3:Fe_2O_3) was used the total weight should be used to determine whether the 10 tonnes usage threshold has been tripped. If you are reporting emissions or transfers, then only the weight of the chromium (III) part of the compound should be reported.

Example 1 – Chromite sand: threshold determination and transfers

In a reporting year 450 tonnes of chromite sand (Cr_2O_3:Fe_2O_3) was used at a facility. To determine whether the threshold has been tripped the total amount of chromium (III) and compounds was used. Since the category 1 threshold of 10 tonnes has been exceeded all emissions and transfers of chromium (III) compounds must be reported.

At this facility 400 tonnes of waste chromite sand (Cr_2O_3:Fe_2O_3) was sent to landfill. Only the chromium (III) part of this compound should be reported for the transfer.

The molecular weight of chromium (Cr) is 52, oxygen (O) is 16 and iron (Fe) is 55.85.
The total molecular weight of the compound is:

$$Cr(52 \times 2) + O(16 \times 6) + Fe(55.85 \times 2) = 311.7$$

The total molecular weight of the chromium in that compound is 104.

Therefore the amount of chromium (III) as a fraction of the 400t of waste sand needs to be calculated.

$$(104 / 311.7) * 400 = 133.5t$$

133 500kg of chromium (III) compounds would be reported as a mandatory transfer to off-site landfill.

4 Emissions of NPI substances

General information regarding emissions of NPI substances can be located in the NPI Guide. Emissions from ferrous foundries will generally be generated from fuel burning, solvents or particulate matter associated with fugitive dust.

4.1 Emissions to air

4.1.1 Fugitive emissions

These are emissions that are not released through a vent or stack. Examples of fugitive emissions include dust from stockpiles, volatilisation of vapour from vats, open vessels, or spills and materials handling. Emissions emanating from ridgeline roof-vents, louvres, and open doors of a building as well as equipment leaks, and leaks from valves and flanges are also examples of fugitive emissions. Emission factors are the usual method for determining fugitive losses. Fugitive emissions from equipment cleaning should be determined by mass balance i.e. amount bought, minus amount collected and transferred for disposal.

4.1.2 Point source emissions

These emissions flow into a vent or stack, and emitted through a single point source into the atmosphere.

Air emission control technologies, such as electrostatic precipitators, fabric filters or baghouses, and wet scrubbers, are commonly installed to reduce emissions of NPI substances. Where such emission abatement equipment has been installed and where uncontrolled emission factors have been used in emission estimation, the control efficiency of the abatement equipment needs to be considered. Guidance on applying control efficiencies to emission factor equations is provided section 4.4.

With regards to emission controls for PM10 emissions (particulate matter with an equivalent aerodynamic diameter of 10 micrometres or less ie. $\leq 10\mu m$), in the absence of measured data, or knowledge of the control efficiency for a particular piece of equipment, a default efficiency of 90% should be used in the emission factor equation to calculate actual mass emissions.

4.1.3 Emission factors

The following tables contain default emission factors to assist you in estimating emissions from the various processes within your facility. These factors should be used in the absence of site-specific emission factors.

For more information on using emission factors, please refer to the *Combustion in Boilers EET Manual.*

Table 3 – General Emission Factors for Ferrous Foundries: Fugitive Sources

Process Description	Process Origin	Emission Factor	Emission Factor Rating
Flanges	Solvent with vapour pressure >5mm Hg 37^{o}C	0.00082 kg/hr [1]	C
Valves	Solvent with vapour pressure >5mm Hg 37^{o}C	0.0073 kg/hr [1]	C
Pump seal	Solvent with vapour pressure >5mm Hg 37^{o}C	0.050 kg/hr [1]	C
Sample connection	Solvent with vapour pressure >5mm Hg 37^{o}C	0.015 kg/hr [1]	C

[1] USEPA 560/4-88-004f (1988), use emission factor for each individual source.

Table 4 – Particulate Matter (PM10) Emission Factors for Iron Furnaces

Furnace Type	Control Device	PM10 Emission Factor [1] (kg/t)[2]	Emission Factor Rating
Cupola	Uncontrolled	6.9	E
	Venturi Scrubber	1.5	C
	Electrostatic Precipitator	0.7	E
	Baghouse	0.3	E
	Single Wet Cap	4.0	E
	Impingement Scrubber	2.5	E
	High Energy Scrubber	0.4	E
	Scrubber[3]	1.6	C
Electric Arc Furnace	Uncontrolled	6.3	C
	Baghouse	0.2	C
Electric Induction Furnace	Uncontrolled	0.5	E
	Baghouse	0.1	E
Reverberatory Furnace	Uncontrolled	1.1	E
	Baghouse	0.1	E

[1] USEPA AP-42 Section 12.10 (2003). Emission factors given as total PM. If size distribution data is not available, for the purposes of NPI reporting, total PM can be assumed to be the same as PM10.
[2] Units expressed as kg of PM10 emitted per t of iron produced.
[3] Includes averages for other scrubbers and wet caps not already mentioned.

Table 5 – Emission Factors for Iron and Steel Foundry Furnaces

Furnace Type	Substances Emitted	Emission Factor [1] (kg/t)[2]	Emission Factor Rating
Cupola Uncontrolled	Carbon monoxide	73	E
	Sulfur dioxide	0.6S[3]	E
	Lead	0.05-0.06[4]	E
Cupola High Energy Scrubber	Carbon monoxide	73	E
	Sulfur dioxide	0.3S[3]	E
Electric Arc Furnace	Carbon monoxide	0.5-19[4].	B
	Oxides of nitrogen	0.02-0.3[4]	E
	TVOCs	0.03-0.15[4]	E
Electric Induction Furnace	Lead	0.005-0.05[4]	E
Reverberatory	Lead	0.006-0.07[4]	E

[1] USEPA AP-42 Section 12.10 (2003)
[2] Units expressed as kg of substance emitted/t of iron produced.
[3] S = % sulfur in the coke (average sulfur content of Australian coal is 0.5%) and it is assumed 100% of the sulfur is converted to SO_2
[4] Use lower figure for high quality scrap or the higher figure for dirty scrap contaminated with paint, plastics and grease.

Table 6 – Solvent Emission Factors

Solvent Used	Use in industry	Emission Factor [1] (kg/kg solvent used)	Emission Factor Rating
Dichloromethane	Vapour degreasing Cold Cleaners		
Uncontrolled		0.930	E
Controlled		0.890	E
Tetrachloroethylene	Vapour degreasing Cold Cleaners		
Uncontrolled		0.890	E
Controlled		0.850	E
Trichloroethylene	Vapour degreasing Cold Cleaners		
Uncontrolled		0.910	E
Controlled		0.870	E

[1] USEPA EPA 560/4-90-012. (1990)

Table 7 – PM10 Emission Factors for Foundry Ancillary Operations for Grey Iron

Process	Control Device	PM10 Emission Factor [1] (kg/t)[2]	Emission Factor Rating
Scrap and charge handling, heating	Uncontrolled	0.3	E
Magnesium treatment	Uncontrolled	0.9	E
Refining	Uncontrolled	2.0	E
Pouring and cooling	Uncontrolled	2.1	E
Shakeout	Uncontrolled	1.6	E
Cleaning and finishing	Uncontrolled	8.5	E
Sand handling (in kg/t of sand handled)	Uncontrolled	1.8	E
	Scrubber	0.023	D
	Baghouse	0.1	E
Core making, baking	Uncontrolled	0.6	E

[1] USEPA AP-42 Section 12.10, Table 12.10-6 (2003) Emission factors given as total PM. If size distribution data is not available, for the purposes of NPI reporting, total PM can be assumed to be the same as PM10.
[2] Units expressed as kg of PM10 emitted/t of iron produced (unless specified otherwise).

Table 8 – Emission Factors for Foundry Ancillary Operations for Steel: Melting

Process	Oxides of Nitrogen [1] (kg/t)[2]	PM10 Emission Factor [1] (kg/t)[2]	Emission Factor Rating
Electric arc	0.1	6.5[3]	E
Open hearth	0.005	5.5[3]	E
Electric induction		0.045	E
Refining (boiling)		2[4]	E
Sand grinding/handling in mould and core making		0.27[5] 3.0	E E
Core ovens		1.11[5] 0.45	E E
Pouring and casting		1.4	E
Casting cleaning		0.85	E
Charge handling		0.18	E
Casting cooling		0.7	E

[1] USEPA AP-42 Section 12.13, Table 12.13-1 (1995).
[2] Units expressed as kg of Oxides of Nitrogen or PM10 emitted /t of metal processed (unless specified otherwise).
[3] Emission factor given as Filterable Particulate (TSP). If size distribution data is not available, for the purposes of NPI reporting, total PM can be assumed to be the same as PM10.
[4] USEPA AP-42 Section 12.10 average for range Table 12.10-6 (2003).
[5] Emission factor is kg of pollutant per t of sand handled.

4.1.4 Binders

Tables 9-11 contain emission factors for listed substances within binders or generated when binders are heated (core is baked). An example of how to use these emission factors is provided below:

Example 2 – Calculating Binder Total Volatile Organic Compounds (TVOCs) Emissions
If you were to determine TVOCs emissions during the year from the use of 100 t of Phenolic Nobake Binder, you would multiply the Phenolic Nobake Binder TVOCs emission factor in Table 9 by the weight of binder used.

Emission Factor * Weight of Binder = Emission of TVOCs

$$12.059 kg/t * 100 t = 1205.9 kg$$

If the category 1a threshold of 25 t has been tripped for the facility, or category 2a or 2b have been tripped then all emissions of TVOCs need to be estimated and included in the NPI report.

Table 9 – Emissions from Common Foundry Binders: Phenolic and Green Sand

Substance	Binder Emission Factor[1] (kg/t)[2]			
	Phenolic Nobake	Phenolic Urethane	Phenolic Hotbox	Green Sand
Ammonia	0.039	0.083	10.931	0.065
Hydrogen Sulfide	1.462	0.057	0.009	0.832
Oxides of Nitrogen	0.029	0.044	0.638	0.562
Sulfur Dioxide	15.107	0.061	0.036	0.253
Benzene	11.209	5.351	1.002	0.611
Formaldehyde	0.01	0.022	0.006	0.004
Cyanide (inorganic) compounds	0.029	1.053	1.184	0.118
Xylenes[3]	0.146	0.571	0.151	0.042
Phenol	0.975	3.904	0.203	0.131
Toluene	0.694	0.833	0.182	0.063
Total volatile organic compounds[4]	12.059	6.777	1.341	0.72

[1] Mosher (1994)
[2] Units expressed as kg of chemical released to air per t of seacoal or index resin
[3] Sum of m-xylene and o-xylene
[4] Sum of benzene, formaldehyde, m-xylene, o-xylene and toluene

Table 10 – Emissions from Common Foundry Binders: Core oil, Shell, Alkyd Isocyanate and Sodium Silicate-Ester

Substance	Binder Emission Factor[1] (kg/t)[2]			
	Core Oil	Shell	Alkyd Isocyanate	Sodium Silicate-Ester
Ammonia	0.038	3.86	0.037	0.038
Hydrogen sulfide	0.057	0.094	0.007	0.197
Oxides of nitrogen	0.081	0.994	0.355	0.028
Sulfur dioxide	0.115	3.509	0.04	0.244
Benzene	2.344	6.667	5.336	1.41
Formaldehyde	0.098	0.035	0.106	0.169
Cyanide (inorganic) compounds	0.086	10.526	0.175	0.179
Xylenes[3]	0.526	0.702	6.36	0.188
Phenol	0.057	2.456	0.11	0.273
Toluene	0.478	2.907	1.535	0.282
Total volatile organic compounds[4]	3.446	10.311	13.337	2.049

[1] Mosher (1994)
[2] Units expressed as kg of chemical released to air per t of index resin.
[3] Sum of m-xylene and o-xylene
[4] Sum of benzene, formaldehyde, m-xylene, o-xylene and toluene

Table 11 – Emissions from Common Foundry Binders: Furan

Substance	Binder Emission Factor[1] (kg/t)[2]		
	Low Nitrogen Furan	Medium Nitrogen Furan TSA Catalyst	Furan Hotbox
Ammonia	0.04	0.202	19.579
Hydrogen sulfide	0.405	0.485	0.06
Oxides of nitrogen	0.012	0.372	0.411
Sulfur dioxide	0.607	4.858	0.088
Benzene	0.648	4.534	0.537
Formaldehyde	0.257	0.065	0.009
Hydrogen cyanide	0.368	0.607	3.474
Xylenes[3]	2.956	0.283	0.064
Phenol	0.024	0.101	0.016
Toluene	0.121	8.825	0.032
Total volatile organic compounds[4]	3.982	13.707	0.642

[1] Mosher (1994)
[2] Units expressed as kg of chemical released to air per t of index resin.
[3] Sum of m-xylene and o-xylene
[4] Sum of benzene, formaldehyde, m-xylene, o-xylene and toluene

4.2 Emissions to water

Emissions of toxic substances to waterways may pose environmental hazards. Facilities that emit NPI substances to water are generally required by their state or territory environment authority to closely monitor and report such emissions to comply with their licensing conditions. Existing sampling data can be used to calculate annual emissions for NPI reporting purposes.

NPI substances contained in liquid wastewater discharged to sewer or a tailings dam are regarded as transfers. Information on how to report transfers from ferrous foundries can be found in Section Five of this manual and Section Four of the NPI Guide.

In general, it is unlikely that ferrous foundries will be required to report emissions to water to the NPI.

4.3 Emissions to land

In general, it is unlikely that ferrous foundries will be required to report emissions to land to the NPI.
A mass balance EET can be applied to emissions of NPI substances as a result of accidental spills and leaks.

A mass balance requires consideration of:

- the total volume of material spilled or leaked
- the volume of material recovered.

The difference between these volumes would be considered to be emissions to land.

4.4 Control technologies

Abatement equipment and control technologies, such as baghouses, cyclones and scrubbers are often used to reduce emissions in foundries. If you have installed these, or other abatement equipment at your facility, or if you have implemented work practices that reduce emissions, you should multiply the uncontrolled emission by the control efficiency of the technology or practice adopted.

Table 12 provides expected control efficiencies for emissions to air on commonly used abatement equipment. In the absence of site-specific data on the efficiencies of control equipment at your facility, you should assume that any abatement equipment used reduces PM10 emissions by 90%. To obtain an emission total from a controlled source using a control efficiency of 90%, multiply the uncontrolled emission total by 0.1.

Table 12 – Control Technologies for Air Emissions

	Emission Type[1]			
Method	**Organic Vapours**	**Inorganic Vapours**	**Particulates**	**Control Efficiency (%)**
Cyclones			X	85[2]
Fabric Filter			X	99.5[8]
Wet Scrubbers	X[3]	X	X	95
Electrostatic Precipitators			X	99.7[2]
Carbon Adsorption	X[4]	X		74.5[2]
Absorption	X[5]			94.5[2]
Condensation	X	X[6]		72.5[2,7]
Thermal Incineration	X			99
Catalytic Incineration	X			97[2]
Dust Suppression by Water Sprays			X	90[8]
Water Curtain	X		X	90[8]

[1] Eastern Research Group, 1997.
[2] Average used for range.
[3] Depends on material, should be miscible in water.
[4] Carbon adsorption or fired-bed systems.
[5] Material must be readily soluble in water or other solvents.
[6] Depends on vapourisation point of material.
[7] Highly dependent on the emission stream characteristics.
[8] As per Table 9 Fugitive Emissions version 2.0 January 2012.

4.5 Estimating for annual reporting

Large foundries in Australia may operate continuously over 24 hours. Therefore, such facilities potentially emit NPI substances (e.g., VOCs, metal compounds, particulates) continuously. In contrast, smaller plants may only work single shifts of around 8 hours per day.

In the absence of other data, it may be assumed for the purposes of NPI reporting that emissions are relatively consistent during the year. You will need to convert your emission estimations from mass per hour, or per batch, into annual averages. When providing data on your average yearly emissions, it is important to apply EETs to an average production run to give a reliable estimate of your emissions over the reporting year.

5 Transfers of NPI substances

General information regarding transfers of NPI substances can be located in the NPI Guide and the Transfers Information Booklet. Transfers from ferrous foundries may include waste sand, dust, furnace knockout, sludges from scrubbers, waste from fabric filters or slag. The amounts of NPI substances present in these waste streams can be determined through laboratory analysis or mass balance. Common NPI substances transferred for ferrous foundries include chromium (III) compounds, fluoride compounds, manganese and compounds and zinc and compounds.

Table 13 – General Transfer Factors for Ferrous Foundries

Process Description	Process Origin	Emission Factor	Emission Factor Rating
Discarded raw materials containers	Materials remaining in discarded containers, bags, and vessels	1% of vessel contents (10 kg/t [1]	E
Waste solvents	Equipment cleaning using solvent	1% of vessel contents per clean (10kg/t) [1]	

[1] USEPA 560/4-88-004f (1988)

6 Next steps for reporting

This manual has been written to reflect the common processes employed by ferrous foundries facilities. To ensure a complete report of the emissions and transfers from the facility, it may be necessary to refer to other EET manuals and guidance material such as, but not limited to:

- Fuel and organic liquid storage,
- Transfer information booklet,
- Combustion engines,
- Combustion in boilers,
- Surface Coating,
- Structural & Fabricated Metal Product Manufacture and
- Fugitive emissions.

When estimates of substance emissions and transfers from the facility are complete, report the emissions and transfers according to the instructions in the NPI Guide.

7 References

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The following guidance materials referred to in this manual are available from the NPI website www.npi.gov.au

- The National Pollutant Inventory (NPI) Guide
- Emission Estimation Technique Manual for Fuel and organic liquid storage
- Emission Estimation Technique Manual for Combustion in Boilers
- Emission Estimation Technique Manual for Combustion Engines
- Transfers Information Booklet
- Emission Estimation Technique Manual for Fugitive Emissions
- Emission Estimation Technique Manual for Surface Coating and
- Emission Estimation Technique Manual for Structural & Fabricated Metal Product Manufacture

Appendix A: Definitions and abbreviations

ANZSIC	Australian and New Zealand Standard Industrial Classification
AP- 42	AP-42, Fifth Edition, Compilation of Air Pollutant Emission Factors
EET	Emission Estimation Technique
EF	Emission factor
Emission	For the purpose of NPI reporting means the release of a substance to the environment, whether in pure form or contained in other matter, and whether in solid, liquid or gaseous form. It does not include the transfer of a substance; however, it does include the release of a substance to the environment, during transfer and from a transfer destination.
Facility	Any building, land or offshore site from which an NPI substance may be emitted, together with any machinery, plant, appliance, equipment, implement, tool or other item used in connection with any activity carried out.
Mandatory reporting transfer destination	For the purposes of NPI reporting, mandatory reporting transfer destination means destination for containment, including landfill, tailings storage facility, underground injection or other long term purpose-built waste storage structure; an off-site destination for destruction; an off-site sewage system; or an off-site treatment facility which leads solely to one or more of the above.
NPI	National Pollutant Inventory
ORS	Online reporting system
PM	Particulate Matter
$PM_{2.5}$	Particulates which have an aerodynamic diameter equal to or less than 2.5 micrometers ($\leq 2.5\mu m$)
PM_{10}	Particulates which have an aerodynamic diameter equal to or less than 10 micrometers ($\leq 10\mu m$)
t	Tonne
TET	Transfer estimation technique

Total VOC	Total Volatile Organic Compounds The NPI defines total volatile organic compounds (TVOC) as the sum, by mass, of individual VOC, including non-NPI VOC. The NPI defines volatile organic compounds (VOC) as any compound containing carbon that: a) Has a vapour pressure greater than 0.01 kPa at 293.15 K (i.e. 20ºC), i.e., readily vapourises under normal indoor atmospheric conditions of temperature and pressure; and b) Is photochemically reactive, i.e., can contribute to photochemical smog formation. VOC comprises of a very large range of compounds, including some NPI substances. Specific substances for which the above definition of VOC does not apply for NPI reporting purposes are: • Carbon monoxide; • Methane; • Acrylamide; • Hexachlorobenzene; • Biphenyl; • Chlorophenols; • n- Dibutyl phthalate; • Ethylene glycol; • di- (2-Ethylhexyl) phthalate (DEHP); • 4,4- Methylene bis 2,4 aniline (MOCA); • Methylenebis; • Phenol; and • Toluene- 2,4-diisocyanate
Transfer	The transport or movement, on-site or off-site, of substances contained in waste for: • containment; • destruction; • treatment that leads to: o reuse, recycling or reprocessing; o purification or partial purifications; o remediation; or o immobilisation; • energy recovery.
Usage	The handling, manufacture, import, processing, coincidental production or other use of the substance.
USEPA	United States Environmental Protection Agency

VOC	Volatile Organic Compounds
Voluntary reporting transfer destination	Means a destination for reuse, recycling, reprocessing, purification, partial purification, immobilisation, remediation or energy recovery.

Appendix B: Modifications to the Ferrous Foundries Estimation Technique EET Manual

(Version 2.0 – January 2014)

Page	Outline of alteration
Throughout	Used new manual template
Throughout	Removed sections from tables with no data or non-NPI substances
2	Inclusion of Table 1: Location of Emission and Transfer Sources in this Manual and Coverage in the NPI
4	Addition of information box on reporting of metals
5	Addition of new example: Chromite sand: threshold determination and transfers
was 5-7	Removal of Section 3 Emission Estimation and Section 4 Emission Factor Rating as details are included in the NPI Guide
8	Table 7 (was Table 6) title now includes reference to grey iron
8	Inclusion of Table 8 - Emission Factors for Foundry Ancillary Operations for Steel
10-11	Tables 9-11: No longer including Total Aromatic Amines as Polycyclic Aromatic Hydrocarbons as they are not equivalent. Removal of Naphthalene as it is no longer a US EPA priority Polycyclic Aromatic Hydrocarbon. Xylenes added together. Total volatile organic compounds included as sum of individual substances included. Emission factor units changed to kg/t.
3, 13	Inclusion of transfers in process diagram and in Section 5
Appendix A	New definition for Total Volatile Organic Compounds

(Version 1.2 – 3 September 2004)

Page	Outline of alteration
15	Added details of the “Mosher” reference