April 2009

Emission Factor Documentation for AP-42 Section 12.5.1

Iron and Steel Production - Steel Minimills

Final Report

Prepared for
U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

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Prepared for:

Office of Air Quality Planning and Standards
Emissions, Monitoring, and Analysis Division
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EPA Contract No. EP-D-07-019
EC/R Project No. MME-201

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NOTICE

PREFACE

Portions of this report were prepared by Alpha-Gamma Technologies for the Office of Air Quality Planning and Standards (OAQPS), U. S. Environmental Protection Agency (EPA). Mr. Mike Ciolek was the requester of the work. Final revisions to the report were made by EC/R under EPA Contract No. EP-D-07-019. Mr. Mike Ciolek was the requestor of the work comprising the final revisions.

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1.0 INTRODUCTION

The EPA publishes emission factors in its Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources (AP-42). The document has been published since 1972 as the primary compilation of EPA's emission factor information. Supplements to AP-42 have been routinely published to add new emission source categories and to update existing emission factors. AP-42 is routinely updated by the EPA to respond to new emission factor needs of the EPA, state and local air pollution control programs, and industry. Federal, state, and local agencies, consultants, and industry use the document to identify major contributors of atmospheric pollutants, develop emission control strategies, determine applicability of permitting programs, and compile emission inventories for ambient air impact analyses and State Implementation Plans (SIPs). An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors usually are expressed as weight of pollutant divided by the unit weight, volume distance, or duration of the activity that emits the pollutant. The emission factors presented in AP-42 may be appropriate to use in a number of situations, such as making source-specific emission estimates for area-wide inventories for dispersion modeling, developing control strategies, screening sources for compliance purposes, establishing operating permit fees, and making permit applicability determinations. The purpose of this background report is to provide technical documentation supporting the revisions to AP-42 Section 12.5, Iron and Steel Production. The AP-42 section described in this report updates the section published in November 2006. This document focuses on the data gathered for non-integrated facilities, commonly known as "steel minimills."

Including the introduction (Section 1), this report contains five sections. Section 2 provides statistics regarding the production of coke as a byproduct of the iron and steel industry, as well as descriptions of the different production processes, emissions from these processes, and the techniques used to control these emissions.
Section 3 is a review of emissions data collection and analysis procedures. It describes the screening of emission data and the quality rating system for both emission data and emission factors. Section 4 details revisions to the existing AP-42 section narrative and pollutant emission factor developments. It includes the review of specific data sets and a description of how candidate emission factors were developed.
Section 5 presents the proposed AP-42 Section 12.2--Coke Production.

2.0 INDUSTRY DESCRIPTION

The U.S. steel industry produced about 106 million tons of raw steel in 2006, and approximately 93 "minimills" that recycle ferrous scrap metal accounted for 57 percent of the total U.S. steel production. The production of steel in minimills has increased dramatically over the past 30 years. Minimills accounted for 10 percent of the national steel production in 1970, 30 to 40 percent in the 1980s, 40 to 50 percent in the 1990s, and (as noted) 57 percent in 2006. The growth has been attributed in part to an expansion in the types and quality of steel products that minimills can produce, including heavy structural shapes, rail, plate, specialty bar, hot rolled, cold rolled, galvanized, and stainless flat rolled products.

Minimills produce a variety of steel products that vary in their carbon content and in the amount and composition of alloying elements. Most of the steel produced in minimills is carbon steel used in the manufacture of construction materials, automobiles, appliances, and other applications. Approximately 4 percent (about 2 million tons) is specialty and stainless steel. Stainless and alloy steels contain less carbon and zinc and more chromium, manganese, and nickel than carbon steels. Typical stainless steel grades contain 12 to 28 percent chromium and 4 to 25 percent nickel.

Minimills are the largest recyclers in the United States. Recycled iron and steel scrap nationwide in 2004 included 25 percent “home scrap” (from current operations at the plant), 26 percent “prompt scrap” (from plants manufacturing steel products), and 49 percent post-consumer scrap. The primary source of post-consumer scrap is the automobile, and in 2004, the steel industry recycled 14.2 million tons of iron and steel scrap from 14 million vehicles.

2.1 Process Description

In a minimill, scrap metal is melted and refined in an electric arc furnace (EAF) to make steel products. Generally, molten steel is produced in an EAF and then tapped from the EAF to a ladle. The molten steel is then usually further refined with the addition of alloys. Semi-finished product is then produced using continuous casting or ingot casting. Multiple finishing processes may then be used to produce finished steel products. A general flow diagram for a minimill is presented in Figure 2-1.

The amount, type, age, and operation of equipment used in minimills varies widely. Some facilities operate one or more small EAFs and have relatively low production volume of finished goods. Other facilities operate multiple EAFs, Argon Oxygen Decarburization (AOD) and other refining processes, casters and product finishing lines. Some facilities produce steel in a narrow composition range; other facilities produce a wide variety of types and metallurgies of steel products. Some facilities can recycle only certain types of ferrous scrap, other facilities produce products that can be made utilizing scrap metal from a variety of sources. All of these factors affect the quantity and characteristics of emissions.

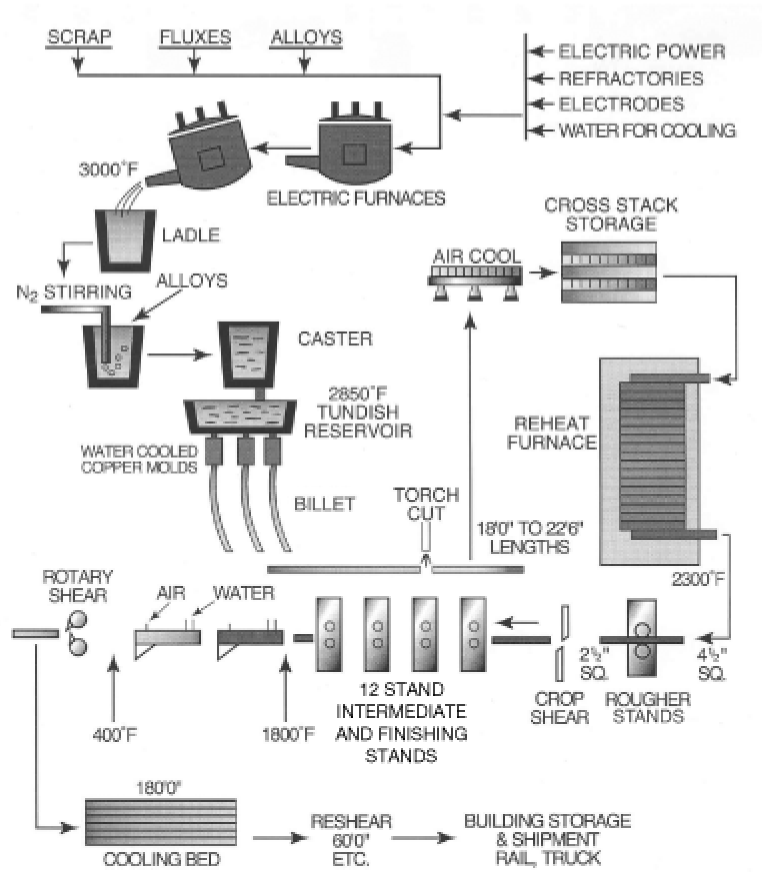

Figure 2-1. General Flow Diagram of a Steel Minimill

2.1.1 Electric Arc Furnace

The input material for an EAF is typically nearly 100 percent ferrous scrap. An EAF is a cylindrical, refractory-lined container. Carbon electrodes can be raised and lowered through openings in the furnace roof. With electrodes retracted, the furnace roof can be rotated aside to permit scrap metal to be placed ("charged") into the EAF by overhead crane. Some furnaces are charged through a shaft or continuously charged from a conveyor without the removal of the furnace roof. Electric current generates heat between the electrodes and through the scrap to melt the scrap.

The production of steel in an EAF is a batch process. Stages include charging, melting, refining, slagging, and tapping. During the charging stage, scrap metal is introduced into the EAF. The charge can also include carbon and lime, a fluxing agent. Direct reduced iron (DRI) or other iron-bearing material can supplement the scrap metal used as charge material.

After the charging stage, the next step is the melting phase, during which electrical energy is supplied to the furnace interior. Oxy-fuel burners and oxygen lances may also be used to supply chemical energy. Oxy-fuel burners, which burn natural gas and oxygen, use convection and flame radiation to transfer heat to the scrap metal. During oxygen lancing, oxygen is injected directly into the molten steel; exothermic reactions with the iron and other components provide additional energy to assist in the melting of the scrap and removal of excess carbon. Alloying elements may be added to achieve the desired composition.

Refining of the molten steel can occur simultaneously with melting, especially in EAF operations where oxygen is introduced throughout the batch. During the refining process, substances that are incompatible with iron and steel are separated out by forming a layer of slag on top of the molten metal. Chemically, the slag layer consists primarily of oxides of calcium, iron, silicon, phosphorus, sulfur, aluminum, magnesium, and manganese in complexes of calcium silicates, aluminosilicates and aluminoferrite. The slag is typically removed by tipping the furnace backwards and pouring the molten slag out through a slag door[1], at which point the slag is further processed (*i.e*., cooled, cured, and sized) into a product.

After completion of the batch, the tap hole is opened, and the steel is poured from the EAF into a ladle for transfer to the next operation.

2.1.2 Argon Oxygen Decarburization

Argon oxygen decarburization (AOD) is a process used to further refine the steel outside the EAF during the production of certain stainless and specialty steels. In the AOD process, steel from the EAF is transferred into an AOD vessel and gaseous mixtures containing argon and oxygen or nitrogen are blown into the vessel to reduce the carbon content of the steel. Argon assists the carbon removal by increasing the affinity of carbon for oxygen.[3]

2.1.3 Ladle Metallurgy

After initial melting and refining of the steel in the EAF, molten steel is often further refined in a ladle metallurgy process. There are numerous ladle metallurgy processes including ladle temperature control, composition control, deoxidation, degassing, cleanliness control, and others.[3] Alloys may be added to the molten steel to produce the desired metallurgy.[4] Electric arc heating is generally used in the final refining process.

2.1.4 Casting and Finishing

Most steel follows one of two major routes to final processing. The most common finishing method is continuous casting. In this process, a ladle with molten steel is lifted to the top of a continuous caster, where it flows into a reservoir (called a tundish) and then into the molds of the continuous casting machine. As the steel passes through the molds and is cooled, a thin skin forms on the outside of the steel. Various designs of the casters shape the steel as it continues to flow. The steel is shaped into semi-finished products such as blooms, billets, or slabs.

Another finishing route, which is not used as frequently as continuous casting, is ingot casting. Molten steel is poured from the ladle into an ingot mold, where it cools and begins to solidify. The molds are stripped away, and the ingots are transported to a soaking pit or reheat furnace where they are heated to a uniform temperature. The ingots are shaped by rolling into semi-finished products, usually blooms, billets, slabs, or by forging.

The semi-finished products may be further processed by a number of different steps, such as annealing, hot forming, cold rolling, pickling, galvanizing, coating, or painting. Some of these steps require additional heating or reheating. The additional heating or reheating is accomplished using furnaces usually fired with natural gas. The furnaces are custom designed for the type of steel, the dimensions of the semi-finished steel pieces, and the desired temperature.

2.2 Emissions and Controls

Emissions from steel minimills include criteria pollutants; particulate matter (PM), both filterable and condensable, carbon monoxide (CO), nitrogen oxide (NO_X), sulfur dioxide (SO_2), and volatile organic compounds (VOC). In addition, numerous trace metals; arsenic, beryllium, cadmium, chromium, lead, mercury, manganese, and nickel and other compounds, such as fluoride are emitted from the processes at a steel minimill. The operations which generate emissions during the steelmaking process are charging scrap, melting and refining, removing slag, and tapping steel. These processes produce metal dusts and gaseous products. The amount and composition of the particulate matter (PM) emitted can vary depending on the scrap composition and types and amounts of furnace additives such as fluxes that are added to aid in slag formation. Iron or iron oxides are the primary component of the PM. In addition, zinc, chromium, nickel, lead, cadmium, and other metals (and the oxides of the metals) may also be present in the PM. Gaseous pollutants, such as NO_X and CO, may also be emitted in amounts that depend on the equipment and operating practices. Substantial emissions are also obtained from ancillary operations such as boilers, wastewater treatment, cooling towers, and roads. Emission factors for these operations are available in other parts of AP-42.

Emissions from the steelmaking process are generally captured using direct shell evacuation supplemented with a canopy hood located above the EAF. In general, the captured gases and particulate from the EAF are routed to baghouses for PM control. Some minimills have a common baghouse through which emissions from the EAF as well as emissions from the ladle metallurgy process and/or continuous caster are ducted and subsequently controlled.

3.0 DATA GATHERING EFFORT

An initial scoping study was conducted to assess new information and data that could be used to update the existing section. Several potential sources of information were analyzed, including the Background Information Document (BID) for the proposed NESHAP for Integrated Iron and Steel Plants, the *Air Pollution Engineering Manual - Second Edition*, and PM data for iron production and sinter plants developed by the International Institute for Applied Systems Analysis in their RAINS PM module. None of these sources were found to provide data that could be used to update the existing section. A copy of the scoping study is presented as Attachment A to this background document.

3.1 Literature Search and Screening

In addition to the sources investigated during the initial scoping study, several state and local air pollution control agencies were contacted regarding the availability of source test data for iron and steel production facilities. The agencies contacted were primarily chosen based on a survey of the locations of existing minimills from the EPA's RACT/BACT/LAER Clearinghouse (http://cfpub.epa.gov/rblc/htm/bl02.cfm). The following agencies were contacted:

- Alabama Department of Environmental Management
- Arkansas Department of Environmental Quality
- Canton (OH) City Health Department
- Hamilton County (OH) Department of Environmental Services
- Indiana Department of Environmental Management
- Iowa Department of Natural Resources
- Kentucky Department for Environmental Protection
- North Carolina Department of Environment and Natural Resources
- Ohio Environmental Protection Agency
- Oregon Department of Environmental Quality
- Pennsylvania Department of Environmental Protection
- South Carolina Department of Health and Environmental Control
- Virginia Department of Environmental Quality
- Wisconsin Department of Natural Resources.

Stack test data were received from facilities in Alabama, Indiana, Iowa, Kentucky, Oregon, South Carolina, and Virginia. The names and locations of these facilities are listed along with the database Facility ID, which will be discussed in Section 4 below.

To screen out unusable test reports, documents and information from which emission factors could not be developed, the following general criteria were used:

1. Emission data must be from a primary reference:
    a. Source testing must be from a referenced study that does not reiterate information from previous studies unless the original reference is not available.
    b. The document must constitute the original source test data. For example, a technical paper was not included if the original study was contained in a previous

document. If the exact source of the data could not be determined, the document was usually eliminated.

2. The referenced study should contain test results based on more than one test run. If results from only one run are presented, the emission factors must be down rated.

3. The report must contain sufficient data to evaluate the testing procedures and source operating conditions (e.g., one-page reports were generally rejected).

A final set of reference materials was compiled after a thorough review of the pertinent reports, documents, and information according to these criteria.

3.2 Emission Data Quality Rating System

The quantity and quality of the information contained in the final set of reference documents were evaluated. The following data were excluded from consideration.

1. Test series averages reported in units that cannot be converted to the selected reporting units;

2. Test series representing incompatible test methods (e.g., comparison of the EPA Method 5 front-half with the EPA Method 5 front- and back-half);
3. Test series of controlled emissions for which the control device is not specified;

4. Test series in which the source process is not clearly identified and described; and

5. Test series in which it is not clear whether the emissions were measured before or after the control device.

Data sets that were not excluded were assigned a quality rating. The rating system used was that specified by OAQPS for the preparation of AP-42 sections. The data were rated as follows:

A–Multiple tests performed on the same source using sound methodology and reported in enough detail for adequate validation. These tests do not necessarily conform to the methodology specified in the EPA Reference Methods, although these methods were certainly used as a guide for the methodology actually used.

B–Tests that were performed by a generally sound methodology but lack enough detail for adequate validation.

C–Tests that were based on an untested or new methodology or lacked a significant amount of background data.

D–Tests that were based on a generally unacceptable method but may provide an order-of- magnitude value for the source.

The following criteria were used to evaluate source test reports for sound methodology and adequate detail:

1. Source operation. The manner in which the source was operated is well documented in the report. The source was operating within typical parameters during the test.

2. Sampling procedures. The sampling procedures conformed to a generally acceptable methodology. If actual procedures deviated from accepted methods, the deviations are well documented. When this occurred, an evaluation was made of the extent to which such alternative procedures could influence the test results.

3. Sampling and process data. Adequate sampling and process data are documented in the report. Many variations can occur unnoticed and without warning during testing. Such variations can induce wide deviations in sampling results. If a large spread between test results cannot be explained by information contained in the test report, the data are suspect and were given a lower rating.

4. Analysis and calculations. The test reports contain original raw data sheets. The nomenclature and equations used were compared to those (if any) specified by the EPA to establish equivalency. The depth of review of the calculations was dictated by the reviewer’s confidence in the ability of the tester, which in turn was based on factors such as consistency of results and completeness of other areas of the test report.

3.3 Emission Factor Quality Rating System

The quality of the emission factors developed from analysis of the test data was rated utilizing the following general criteria:

A–Excellent: Developed only from A-rated test data taken from many randomly chosen facilities in the industry population. The source category is specific enough that variability within the source category population may be minimized.

B–Above average: Developed only from A-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As in the A-rating, the source category is specific enough so that variability within the source category population may be minimized.

C–Average: Developed only from A- and B-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As in the A-rating, the source category is specific enough so that variability within the source category population may be minimized.

D–Below average: The emission factor was developed only from A- and B-rated test data from a small number of facilities, and there is reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of the emission factor are noted in the emission factor table.

E–Poor: The emission factor was developed from C- and D-rated test data, and there is reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population. Limitations on the use of these factors are always noted. The use of these criteria is somewhat subjective and depends to an extent on the individual reviewer.

3.4 References for Section 3.0

1. Procedures for Preparing Emission Factor Documents, EPA-454/R-95-015. U. S. Environmental Protection Agency, Research Triangle Park, NC, 27711, May 1997.

4.0 POLLUTANT EMISSION FACTOR DEVELOPMENT

This section provides a summary of the test reports that were used to develop the revised AP-42 section on steel minimills. Table 4-1 provides a list of all of the test data which includes; the process, tested, pollutant tested, and any notes about the testing. The following sections present the emission factors for each of the pollutants.

The data that met acceptance criteria were entered into a spreadsheet to facilitate the calculation of emission factors. All of the stack test data is contained in this table. The data is identified by a Facility ID and Test ID. The Test ID is unique to each source test but may be repeated in the table if multiple pollutants were tested during the same source test. The fields in the table are as follows:

- *Facility ID* - the facility ID for the test
- *Test ID* - the ID for the source test - note that this is in the format “3.1”, with “3” being the facility ID
- *Pollutant* - the pollutant tested
- *Test Date* - the date of the test
- *Method* - the test method used
- *Throughput Run1* - the throughput during run 1 of the test
- *Throughput Run2* - the throughput during run 2 of the test
- *Throughput Run3* - the throughput during run 3 of the test
- *Throughput Avg* - the average throughput during the test
- *Throughput Unit* - the unit of the throughput (ex. lb/ton, lb/MMBtu)
- *Throughput Desc* - a description of the throughput (for example “of steel produced” or “heat input”)
- *LbHr Run1* - emissions in units of lb/hr during run 1 of the test
- *LbHr Run2* - emissions in units of lb/hr during run 2 of the test
- *LbHr Run3* - emissions in units of lb/hr during run 3 of the test
- *LbHr Avg* - average emissions in units of lb/hr during the test
- *LbTon Run1* - emissions in units of lb/ton during run 1 of the test
- *LbTon Run2* - emissions in units of lb/ton during run 2 of the test
- *LbTon Run3* - emissions in units of lb/ton during run 3 of the test
- *LbTon Avg* - average emissions in units of lb/ton during the test
- *LbMMBtu Run1* - emissions in units of lb/MMBtu during run 1 of the test
- *LbMMBtu Run2* - emissions in units of lb/MMBtu during run 2 of the test
- *LbMMBtu Run3* - emissions in units of lb/MMBtu during run 3 of the test
- *LbMMBtu Avg* - average emissions in units of lb/MMBtu during the test
- *GrDscf Run1* - emissions in units of gr/dscf during run 1 of the test
- *GrDscf Run2* - emissions in units of gr/dscf during run 2 of the test
- *GrDscf Run3* - emissions in units of gr/dscf during run 3 of the test
- *GrDscf Avg* - average emissions in units of gr/dscf during the test
- *PPM Run1* - emissions in units of ppm during run 1 of the test
- *PPM Run2* - emissions in units of ppm during run 2 of the test
- *PPM Run3* - emissions in units of ppm during run 3 of the test

- *PPM Avg* - average emissions in units of ppm during the test
- *PPM Unit* - more specific unit for emissions in units of ppm (ppmv or ppmw for example)
- *O2 Run1* - the percent oxygen during run 1 of the test
- *O2 Run2* - the percent oxygen during run 2 of the test
- *O2 Run3* - the percent oxygen during run 3 of the test
- *Other Run1* - emissions in any miscellaneous units during run 1 of the test
- *Other Run2* - emissions in any miscellaneous units during run 2 of the test
- *Other Run3* - emissions in any miscellaneous units during run 3 of the test
- *Other Avg* - average emissions in “other” units during the test
- *Other Unit* - unit for “other” runs
- *Test Rating* - rating of the test data included in the test report
- *Notes* - any notes about the testing, particularly any reasons for excluding the test data.

The database consists of four tables, which are described in greater detail below.

Table 4-1. Summary of Test Data Collected for the Revision of Section 12.5.1

Facility ID	Database ID	Process tested[a]	Pollutants Tested[b]	Notes
1	1.1	EAF #8 Baghouse Inlet Duct	SO_2, NO_X, CO, VOC	
1	1.2	EAF #8 Baghouse Exhaust	PM	
2	2.1	EAF/LMF Baghouse Exhaust Stack	PM, CPM, SO_2, NO_X, CO, VOC, Pb, Be, Fluoride	
2	2.2	EAF/LMF Baghouse Exhaust Stack	PM, CPM, SO_2, NO_X, CO, VOC, Pb	
2	2.3	Reheat Furnace	NO_X, CO	
2	2.4	Reheat Furnace	NO_X, CO	
2	2.5	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.6	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.7	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.8	EAF/LMF Baghouse Exhaust Stack	SO_2, NO_X	
2	2.9	EAF/LMF Baghouse Exhaust Stack	SO_2, NO_X	
2	2.10	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.11	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.12	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.13	EAF/LMF Baghouse Exhaust Stack	NO_X	
2	2.14	EAF/LMF Baghouse Exhaust Stack	PM, CPM, SO_2, NO_X, CO, VOC, Pb, Be, Fluoride	Sampling data sheets not included in test report.

Table 4-1. (continued)

Facility ID	Database ID	Process tested[a]	Pollutants Tested[b]	Notes
3	3.1	EAF Baghouse Exhaust Stack	PM, CO, NO_X, SO_2, VOC, Pb	VOC emissions are estimated.
3	3.2	EAF Baghouse Exhaust Stack	PM, CO, NO_X, SO_2, VOC, Pb	SO_2 results were drift corrected.
4	4.1	Baghouse Inlet Duct	PM, CPM, CO, NO_X, SO_2, Pb	Positive pressure baghouse.
4	4.2	Castrip Baghouse Stack	NO_X, CO	
4	4.3	Strip Caster Baghouse Stack	PM, CPM, NO_X, CO, SO_2, Pb	
4	4.4	Castrip Baghouse Stack	PM, CPM, NO_X, CO, SO_2, Pb	
4	4.5	Castrip Baghouse Stack	PM, CPM, NO_X, CO, SO_2, Pb	
5	5.1	EAF Baghouse Exhaust Stack	PM, VOC	
6	6.1	EAF Baghouse Exhaust Stack	PM, CPM, CO	
6	6.2	EAF Baghouse Exhaust Stack	PM, CPM, CO	
7	7.1	EAF Melt Shop Baghouse Exhaust Stack	Fluoride, SO_2	
7	7.2	EAF Melt Shop Baghouse Exhaust Stack	PM, SO_2	
7	7.3	EAF Melt Shop Baghouse Exhaust Stack	PM, CPM, CO, SO_2, NO_X, Pb, VOC, Fluoride	Sampling data sheets not included in test report.
8	8.1	EAF Baghouse Exhaust Stack	Pb, Hg	
9	9.1	EAF/CASTER LMF Baghouse Exhaust Stack	NO_X, SO_2	
9	9.2	EAF/CASTER LMF Baghouse Exhaust Stack	NO_X, SO_2	
10	10.1	EAF Baghouse Stack	PM, NO_X, CO, SO_2, Pb	Brandt positive pressure baghouse.
10	10.2	EAF Baghouse Stack	NO_X, CO, SO_2	Brandt positive pressure baghouse.

Table 4-1. (continued)

Facility ID	Database ID	Process tested[a]	Pollutants Tested[b]	Notes
11	11.1	EAF Baghouse Exhaust Stack	PM, CPM	Harsell positive pressure baghouse.
12	12.1	Meltshop Baghouse Exhaust System	PM, CPM, NO_X, CO, SO_2, Ar, Be, Cd, Pb, Mn, Hg, Ni, Cr, VOC	
12	12.2	Meltshop Baghouse Exhaust System	PM, CPM, NO_X, CO, SO_2, Ar, Be, Cd, Pb, Mn, Hg, Ni, Cr, VOC	
12	12.3	Meltshop Baghouse Exhaust System	PM, CPM, NO_X, CO, SO_2, Ar, Be, Cd, Pb, Mn, Hg, Ni, Cr, VOC	
13	13.1	EAF Baghouse Exhaust Stack	Fluoride, Hg	
13	13.2	EAF Baghouse Exhaust Stack	Pb	
13	13.3	EAF Baghouse Exhaust Stack	Pb	
13	13.4	EAF Baghouse Exhaust Stack	PM, CPM, VOC, NO_X, CO, SO_2, Fluoride, Be, Pb, Mn, Hg	
13	13.5	EAF Baghouse Exhaust Stack	Pb	
13	13.6	EAF Baghouse Exhaust Stack	Pb	
14	14.1	EAF Baghouse Outlet	PM, CPM, Pb	
14	14.2	EAF Baghouse Outlet	PM, CPM, NO_X	
15	15.1	EAF Baghouse Stack	PM, CPM, VOC, Pb, Hg	Positive pressure baghouse.
15	15.2	EAF Baghouse Stack	PM, CPM, Pb, Hg	Positive pressure baghouse.
16	16.1	EAF Baghouse Exhaust Stack	PM	
16	16.2	EAF Baghouse Exhaust Stack	PM	

Table 4-1. (continued)

Facility ID	Database ID	Process tested[a]	Pollutants Tested[b]	Notes
17	17.1	EAF Baghouse Exhaust Stack	PM	
17	17.2	Billet Reheat Furnace	PM, NO_X, CO	
18	18.1	Metallized Briquetter	PM	
18	18.2	Reheat Furnace	PM	
18	18.3	Reheat Furnace	PM	Shutdown during run #1
18	18.4	Metallized Briquetter	PM	
18	18.5	Reheat Furnace	PM	VE (Method 9) was 0 during the test.
18	18.6	Reheat Furnace	PM	VE (Method 9) was 0 during the test.
18	18.7	Reheat Furnace	PM	
18	18.8	Metallized Briquetter	PM	
18	18.9	Metallized Briquetter	PM	
18	18.10	Reheat Furnace	PM	
18	18.11	Reheat Furnace	PM	
18	18.12	DRI Reformer	NO_X, SO_2	
19	19.1	Reheat Furnace	PM, CPM, CO, VOC, NO_X	
19	19.2	Reheat Furnace	NO_X	
20	20.1	Cold Reversing Mill	PM	Average VE (Method 9) was 0.49 during the test.
20	20.2	Tunnel Furnace	NO_X	
20	20.3	Tunnel Furnace	NO_X	
21	21.1	EAF	SO_2, NO_X, CO	
21	21.1	Ladle Metallurgical Station	PM, CPM, SO_2, NO_X, CO	
21	21.2	EAF	SO_2, NO_X	
21	21.2	Ladle Metallurgical Station	SO_2	
21	21.2	EAF	PM, CPM, SO_2, NO_X, CO, VOC	
21	21.2	Ladle Metallurgical Station	PM, CPM, SO_2, NO_X, CO, VOC	

Table 4-1. (continued)

Facility ID	Database ID	Process tested[a]	Pollutants Tested[b]	Notes
22	22.1	Billet Cutting Torches, natural gas-fired	PM	
22	22.2	Ladle Heating and Transfer	PM	
22	22.3	Ladle Heating and Transfer	PM	
22	22.4	Ladle Heating and Transfer	PM	
22	22.5	Ladle Heating and Transfer	PM	
22	22.6	Ladle Heating and Transfer	PM	
22	22.7	Reheat Furnace with Ultra-Low NO_X Burners	NO_X	
22	22.8	Reheat Furnace with Ultra-Low NO_X Burners	NO_X	
22	22.9	Reheat Furnace with Ultra-Low NO_X Burners	NO_X	
22	22.10	Reheat Furnace with Ultra-Low NO_X Burners	NO_X	
22	22.11	Reheat Furnace with Ultra-Low NO_X Burners	NO_X	

[a] EAF: electric arc furnace, LMF: ladle metallurgical furnace, DRI: direct reduced iron.
[b] CPM: condensable particulate matter.

4.1 References for Section 4.0

1. Test Report for Northwestern Steel and Wire, Sterling, IL. Testing conducted on April 11-12, 2001 (Test ID 1.1) and November 29-December 1, 2000 (Test ID 1.2). Reports prepared by ARI Environmental Inc.

2. Emission Test Report for IPSCO Steel, Muscatine, IA. Testing conducted on November 17-19, 1998 (Test ID 2.1); July 13-15, 2004 (Test ID 2.2); April 30, 1999 (Test ID 2.3); January 9, 2002 (Test ID 2.4); October 21, 2004 (Test ID 2.5); July 9, 2003 (Test ID 2.6); October 9, 2003 (Test ID 2.7); August 10, 2005 (Test ID 2.8); April 28, 2005 (Test ID 2.9); March 3, 2004 (Test ID 2.10); April 28, 2004 (Test ID 2.11); April 30, 2003 (Test ID 2.12); March 6, 2003 (Test ID 2.13); and October 14-16, 2002 (Test ID 2.14). Reports prepared by Ambient Air Services, Inc.

3. Source Evaluation Report for Oregon Steel Mills, Portland, OR. Testing conducted on November 7 2001 (Test ID 3.1); December 27, 2000 (Test ID 3.2); and November 6, 2002 (Test ID 3.3). Reports prepared by Horizon Engineering LLC.

4. Report on Emissions Testing for Nucor Steel, Crawfordsville, IN. Testing conducted on May 19, 2004 (Test ID 4.1), October 2-5, 2006 (Test ID 4.2); November 20-21, 2003 (Test ID 4.3); December 21, 2004 (Test ID 4.4); and January 3, 2003 (Test ID 4.5). Report prepared by Air Test Professionals, Inc.

5. Air Quality Test Report for Quanex Corporation – MacSteel Division, Ft Smith, AR. Testing conducted on April 17-20, 2007 (Test ID 5.1). Report prepared by White Star Environmental Consulting.

6. Stack Emission Tests for Charter Steel Division, Saukville, WI. Testing conducted on March 31-April 2, 2003 (Test ID 6.1); and April 12-14, 2005 (Test ID 6.2). Reports prepared by Environmental Technology and Engineering Corporation.

7. Final Test Report for The Timkin Company – Faircrest Plant, Canton, OH. Testing conducted on May 6, 2002 (Test ID 7.1); February 27, 1998 (Test ID 7.2); and March 17, 2002 (Test ID 7.3). Reports prepared by Blue Mountain Environmental Management Corporation.

8. Emission Compliance Test for Bayou Steel Corporation, La Place, LA. Testing conducted on July 23, 2004 (Test ID 8.1). Report prepared by Emission Testing Services, Inc.

9. Emissions Test Report for Gallatin Steel Company, Ghent, KY. Testing conducted on May 4, 2000 (Test ID 9.1); and May 3, 2001 (Test ID 9.2). Reports prepared by Ambient Air Services, Inc.

10. Air Emissions Test Report for Newport Steel Corporation, Newport, KY. Testing conducted on August 15-16, 2000 (Test ID 10.1); and October 3, 2000 (Test ID 10.2). Reports prepared by Environmental Quality Management, Inc.

11. Air Emissions Test Report for Kentucky Electric Steel, Inc., Ashland, KY. Testing conducted on May 11-12, 2000 (Test ID 11.1). Report prepared by Environmental Quality Management, Inc.

12.Compliance Test Report for Nucor Plate Mill, Cofield, NC. Testing conducted on May 1-3, 2007 (Test ID 12.1); June 20-22, 2006 (Test ID 12.2); and April 11-13, 2005 (Test ID 12.3). Report prepared by Desert Air Environmental Services, LLC.

13. Source Emissions Compliance Testing for Steel Dynamics, Inc., Columbia City, IN. Testing conducted on January 20, 2004 (Test ID 13.1); June 13, 2005 (Test ID 13.2); June 22, 2006 (Test ID 13.3); February 18-20, 2003 (Test ID 13.4); April 19-20, 2005 (Test ID 13.5); and August 6, 2004 (Test ID 13.6). Reports prepared by Guenther/Shackelford Associates.

14. Source Emissions Compliance Testing for Steel Dynamics, Inc., Pittsboro, IN. Testing conducted on October 27-28, 2004 (Test ID 14.1); and April 5, 19-20, 2007 (Test ID 14.2). Reports prepared by Guenther/Shackelford Associates.

15. Indiana Air Permit Compliance Testing for Nucor Steel Corporation, Plainfield, IN. Testing conducted on April 18-22, 2005 (Test ID 15.1); and May 19-21, 2004 (Test ID 15.2). Reports prepared by Air Test Professionals, Inc.

16. Results of Compliance Test for Gerdau Ameristeel, St. Paul, MN. Testing conducted on November 8, 2006 (Test ID 16.1); and October 4, 2005 (Test ID 16.2). Reports prepared by Eagle Mountain Scientific, Inc.

17. Compliance Test Report for Gerdau Ameristeel, Baldwin, FL. Testing conducted on April 17-19, 2007 (Test ID 17.1); and April 20, 2007 (Test ID 17 .2). Reports prepared by Ambient Air Services, Inc.

18. Source Emissions Testing for Georgetown Steel Corporation, Georgetown, SC. Testing conducted on June 3, 1991 (Test ID 18.1); June 6, 1991 (Test ID 18.2); June 23, 1993 (Test ID 18.3); June 24, 1993 (Test ID 18.4); June 14, 1995 (Test ID 18.5); June 15, 1995 (Test ID 18.6); June 24, 1997 (Test ID 18.7); June 25, 1997 (Test ID 18.8); June 15, 1999 (Test ID 18.9); June 16, 1999 (Test ID 18.10); June 19, 2001 (Test ID 18.11); and December 8, 1998 (Test ID 18.12). Reports supplied by the South Carolina Department of Health and Environmental Control.

19. Report of Emission Test for Beta Steel Corporation, Portage, IN. Testing conducted on November 4, 1999 (Test ID 19.1); and January 21, 1993 (Test ID 19.2). The test reports were prepared by Ambient Air Services and Monstardi-Platt Associates.

20. Summary of Emission Test Results for Nucor Steel, Huger, SC. Testing conducted on October 10, 2001 (Test ID 20.1); May 15, 1997 (Test ID 20.2); and August 18, 1997 (Test ID 20.3). Test summaries provided by the South Carolina Department of Health and Environmental Control.

21. Summary of Stack Emissions Testing for Steel Dynamics, Butler, IN. Testing conducted on February 2-3, 1999 (Test ID 21.1); July 26, 2001 (Test ID 21.2); and November 17-20, 1998 (Test ID 21.3). Test report summaries provided by the Indiana Department of Environmental Management.

22. Stack test summary information and Title V permit for Cascade Steel Rolling Mills, Inc., McMinnville, OR. Testing conducted on April 6, 1995; May 24, 1996; October 29-30, 1997; October 8-9, 1998; April 15-16, and October 21-22, 1999; June 14, and October 26-27, 2000; May 15-16 and October 30-31, 2001; February 26-27, 2002. Received from Gary Andes, Oregon Department of Environmental Quality on April 30, 2002.

5.0 AP-42 EMISSION FACTOR DEVELOPMENT

Section 12.5.1 of AP-42 of Chapter 12 was revised and sent out for public comment in 2004. The main issue that was raised from these public comments was that the published emission factors were based on “C” and “D” rated data, and hence the emission factors were “D” or “E” rated emission factors. Based on the public comments, EPA contacted numerous State agencies requesting complete test reports in 2007. During that period, we received 45 complete test reports, which included the appendices. After review, it was determined that 30 of these test reports could be used to calculate emission factors for steel minimills. Some of the reports were not used because the facility was not a steel minimill, or the report did not provide any process data that could be used to calculate an emission factor. The new test data was added to the existing database of emission data, and new emission factors were calculated. A memorandum explaining the changes and comparison of the new and old emission factors is provided in Attachment B.

The emission factors developed for the revision of Section 12.5.1 are presented in Tables 5-1 through 5-9. These tables show the source, emission factor rating, emission factor, emission factor unit, the number of facilities and tests that were used in calculating the emission factor, and the Test IDs for each of the tests. If multiple tests on the same process were conducted at a facility, these values were averaged to determine an average value for that facility/process. This value was then averaged with the average value(s) of similar processes at other facilities to determine the final emission factor.

5.1 Changes from October 2008 Update

This update includes the auxiliary process equipment emission factors that were omitted from the October 2008 update of this AP-42 emission factor document. However, some of these auxiliary process emission factors have been changed. The following provides a list of the changes and the reason for the changes to these emission factors.

Filterable PM Emission Factors

Reheat furnace, natural gas-fired
(SCC 3-04-003-14) Uncontrolled
Old EF value: 0.036 lb/ton
New EF value: 0.032 lb/ton
The emission factor value was changed because an additional test point was received and added to the data set. (i.e., the emission factor is based on 6 data points instead of 5 data points.)

Cold reversing mill
(SCC 3-04-003-30) Controlled by high efficiency mist eliminator
Old EF value: 0.021 lb/ton
New EF value: 0.019 lb/ton
This emission factor is based on one test data point and the lb/ton number listed in the database is incorrect.

NO_X Emission Factors

Ladle metallurgy station (SCC 3-04-003-17) Uncontrolled
Old EF value: 0.011 lb/ton
New EF value: 0.024 lb/ton
The emission factor value was changed because an additional test point was received and added to the data set. (i.e., the emission factor is based on 2 data points instead of 1 data point.)

Tunnel, natural gas-fired (SCC 3-04-003-14) Uncontrolled
Old EF value: 0.072 lb/ton
New EF value: 0.076 lb/ton
The emission factor value was changed because two additional test point were received and added to the data set. (i.e., the emission factor is based on 4 data points instead of 2 data points.)

CO Emission Factors

Ladle metallurgy station (SCC 3-04-003-17) Uncontrolled
Old EF value: 0.016 lb/ton
New EF value: 0.025 lb/ton
The emission factor value was changed because an additional test point was received and added to the data set. (i.e., the emission factor is based on 2 data points instead of 1 data point.)

Reheat furnace, natural gas-fired (SCC 3-04-003-14) Uncontrolled
Old EF value: SCR 0.0006 lb/MMBtu
LNB 0.021 lb MMBtu
LNB/FGR 0.00021 lb/MMBtu
New EF value: 0.0013 lb/MMBtu
This emission factor change is based on the belief that SCR, LNB, and LNB/FGR do not have any effect on the CO emissions, and therefore the test data values should be combined into a single emission factor.

Table 5-1. FILTERABLE PM EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	B	2.0E-2	lb/ton	14	28	1.2, 2.1, 2.2, 3.1, 3.2, 3.3, 4.2, 4.3, 4.4, 4.5, 5.1 (2 tests), 6.1, 6.2, 7.2, 7.3, 12.1, 12.2, 12.3, 13.4, 14.1, 14.2, 15.1, 15.2, 16.1, 16.2, 17.1, 21.3
Metallized briquetter (SCC 3-04-003-19) Controlled by wet scrubber	E	1.5E-1	lb/ton	1	5	18.1, 18.4, 18.6, 18.8, 18.9
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Uncontrolled	E	3.2E-2	lb/ton	1	6	18.2, 18.3, 18.5, 18.7, 18.10, 18.11
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Uncontrolled	E	3.5E-2	lb/MMBtu	1	1	19.1
Cold reversing mill (SCC 3-04-003-30) Controlled by high efficiency mist eliminator	E	1.9E-2	lb/ton	1	1	20.1
Billet cutting torches, natural gas-fired (SCC 3-04-003-60) Uncontrolled	E	3.2E-2	lb/ton	1	1	22.1

Table 5-1. (continued)

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Ladle metallurgy station (SCC 3-04-003-17) Controlled by baghouse	E	3.4E-2	lb/ton	1	2	21.1, 21.3
Ladle heating and transfer and continuous casting (SCC 3-04-003-17) Controlled by baghouse	E	1.2E-1	lb/ton	1	5	22.2, 22.3, 22.4, 22.5, 22.6

[a] Unit of lb/ton is calculated based on ton/hr of steel produced.
Unit of lb/MMBtu is calculated based on MMBtu/hr of heat input.

Table 5-2. CONDENSABLE PM EMISSION FACTORS FOR MINIMILLS

Source	Condensable	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Aqueous	C	2.9E-2	lb/ton	9	19	2.1, 2.2, 4.2, 4.3, 4.4, 4.5, 6.1, 6.2, 12.1, 12.2, 12.3, 13.4, 14.1, 14.2, 15.1, 15.2, 16.1, 16.2, 21.3
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Organic	C	1.0E-2	lb/ton	9	19	2.1, 2.2, 4.2, 4.3, 4.4, 4.5, 6.1, 6.2, 12.1, 12.2, 12.3, 13.4, 14.1, 14.2, 15.1, 15.2, 16.1, 16.2, 21.3
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Uncontrolled	Aqueous & Organic	E	9.3E-3	lb/MMBtu	1	1	19.1
Ladle metallurgy station (SCC 3-04-003-17) Controlled by baghouse	Aqueous	E	1.1E-2	lb/ton	1	2	21.1, 21.3

Table 5-2. (continued)

Source	Condensable	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Ladle metallurgy station (SCC 3-04-003-17) Controlled by baghouse	Organic	E	1.3E-1	lb/ton	1	2	21.1, 21.3

[a] Unit of lb/ton is calculated based on ton/hr of steel produced.
Unit of lb/MMBtu is calculated based on MMBtu/hr of heat input.

Table 5-3. TOTAL PM (FILTERABLE + CONDENSABLE) EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	C	5.9E-2	lb/ton	10	20	2.1, 2.2, 4.2, 4.3, 4.4, 4.5, 6.1, 6.2, 7.3, 12.1, 12.2, 12.3, 13.4, 14.1, 14.2, 15.1, 15.2, 16.1, 16.2, 21.3
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Uncontrolled	E	1.3E-2	lb/MMBtu	1	1	19.1
Ladle metallurgy station (SCC 3-04-003-17) Controlled by baghouse	E	1.4E-1	lb/ton	1	2	21.1, 21.3

[a] Unit of lb/ton is calculated based on ton/hr of steel produced.
Unit of lb/MMBtu is calculated based on MMBtu/hr of heat input.

Table 5-4. NO_X EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	B	2.2E-1	lb/ton	10	29	1.1, 2.1, 2.2, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 4.1, 4.2, 4.3, 4.4, 4.5, 7.3, 9.1, 9.2, 12.1, 12.2, 12.3, 13.4, 14.1, 14.2, 16.1, 21.1, 21.2, 21.3
Ladle metallurgy station (SCC 3-04-003-17) Uncontrolled	E	2.4E-2	lb/ton	1	2	21.1, 21.3
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Controlled by low NO_X burners	E	1.9E-1	lb/MMBtu	3	5	2.1, 2.3, 2.4, 13.4, 16.2
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Controlled by low NO_X burners and flue gas recirculation	E	1.7E-1	lb/MMBtu	2	8	2.1, 2.3, 2.4, 22.7, 22.8, 22.9, 22.10, 22.11
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Controlled by SCR	E	8.5E-2	lb/MMBtu	1	2	19.1, 19.2
Annealing furnace, natural gas-fired (SCC 3-04-003-05) Uncontrolled	E	2.6E-1	lb/MMBtu	1	1	4.3

Table 5-4. (continued)

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Annealing furnace, natural gas-fired (SCC 3-04-003-05) Controlled by low NO_X burners	E	8.5E-2	lb/MMBtu	1	4	4.11, 4.12, 4.13, 4.14
Direct reduced iron reformer (SCC 3-04-003-20) Uncontrolled	E	9.6E-1	lb/ton	1	1	18.12
Tunnel furnace, natural gas fired (SCC 3-04-003-02) Uncontrolled	E	7.6E-2	lb/MMBtu	1	4	20.2 (2 tests), 20.3 (2 tests)

[a] Unit of lb/ton is calculated based on ton/hr of steel produced.
Unit of lb/MMBtu is calculated based on MMBtu/hr of heat input.

Table 5-5. CO EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	B	1.8	lb/ton	10	19	1.1, 2.1, 2.2, 3.3, 4.1, 4.2, 4.3, 4.4, 4.5, 6.1, 6.2, 7.3, 10.2, 12.1, 12.2, 12.3, 16.1, 21.1, 21.3
Ladle metallurgy station (SCC 3-04-003-17) Uncontrolled	E	2.5E-2	lb/ton	1	2	21.1, 21.3
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Controlled by low NO_X burners	E	1.3E-3	lb/MMBtu	3	5	2.1, 2.3, 2.4, 13.4, 16.2
Annealing furnace, natural gas-fired (SCC 3-04-003-05) Uncontrolled	E	1.8E-3	lb/ton	1	4	4.11, 4.12, 4.13, 4.14

[a] Unit of lb/ton is lb/ton of steel produced.

Table 5-6. SO_2 EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	C	2.0E-1	lb/ton	7	19	1.1, 2.1, 2.2, 2.8, 4.1, 4.2, 4.3, 4.4, 4.5, 7.1, 7.2, 7.3, 12.1, 12.2, 12.3, 13.4, 21.1, 21.2, 21.3
Ladle metallurgy station (SCC 3-04-003-17) Uncontrolled	E	3.5E-2	lb/ton	1	2	21.1, 21.2
Direct reduced iron reformer (SCC 3-04-003-20) Uncontrolled	E	4.8E-2	lb/ton	1	1	18.12

[a] Unit of lb/ton is lb/ton of steel produced.

Table 5-7. LEAD EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	C	5.6E-4	lb/ton	9	21	2.1, 2.2, 4.2, 4.3, 4.4, 4.5, 7.3, 8.1, 12.1, 12.2, 12.3, 13.2, 13.3, 13.4, 13.5, 13.6, 14.1, 14.2, 15.1, 15.2, 16.1

[a] Unit of lb/ton is lb/ton of steel produced.

Table 5-8. VOC EMISSION FACTORS FOR MINIMILLS

Source	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	C	2.3E-2	lb/ton	9	11	1.1, 4.1, 7.3, 12.1, 12.2, 12.3, 13.4, 14.1, 15.1, 16.1, 21.3
Ladle metallurgy station (SCC 3-04-003-17) Uncontrolled	E	3.3E-3	lb/ton	1	1	21.3
Reheat furnace, natural gas-fired (SCC 3-04-003-14) Uncontrolled	E	3.0E-4	lb/MMBtu	1	1	19.1

[a] Unit of lb/ton is lb/ton of steel produced.

Table 5-9. OTHER EMISSION FACTORS FOR MINIMILLS

Source	Pollutant	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Arsenic	E	6.2E-06	lb/ton	1	3	12.1, 12.2, 12.3
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Beryllium	D	2.8E-07	lb/ton	3	5	2.1, 12.1, 12.2, 12.3, 13.4

Table 5-9. (Continued)

Source	Pollutant	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Cadmium	E	5.0E-06	lb/ton	1	3	12.1, 12.2, 12.3
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Chromium	E	3.5E-06	lb/ton	1	3	12.1, 12.2, 12.3

Table 5-9. (Continued)

Source	Pollutant	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	Mercury	D	1.1E-04	lb/ton	4	8	8.1, 12.1, 12.2, 12.3, 13.1, 13.4, 15.1, 15.2
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Manganese	E	3.0E-04	lb/ton	2	4	12.1, 12.2, 12.3, 13.4

Table 5-9. (Continued)

Source	Pollutant	EMISSION FACTOR RATING	Emission Factor	Unit[a]	Number of Facilities	Number of Tests	Test IDs
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Nickel	E	5.5E-06	lb/ton	1	3	12.1, 12.2, 12.3
Electric arc furnace, ladle metallurgy, and melt shop (SCC 3-04-003-04) Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Controlled by direct shell evacuation and roof canopy hood exhausted to baghouse	Fluoride	D	5.9E-2	lb/ton	3	5	2.1, 7.1, 7.3, 13.1, 13.4

[a] Unit of lb/ton is lb/ton of steel produced.

6.0 SPECIATED PM DATA

One objective of the revision to Section 12.5 was to obtain speciated PM data. However, the data gathering effort found that only a limited amount of speciated PM data was available. A total of seven tests with speciated PM data were found; of those tests, six are for PM-10. Because of the limited data, these numbers were not incorporated into the revised section; for informational purposes only, they are shown in Table 6-1.

Table 6-1. Speciated PM Data

Test ID	Facility	Source	Pollutant	Average Lb/ton
7.1	Roanoke Electric Steel	EAF with oxy-fuel burners and oxygen lancing, controlled by baghouse	PM-3.5	0.12
13.1	Slater Steels - Fort Wayne Specialty Alloys Division	EAF and AOD vessel, controlled by baghouse	PM-10 filterable + condensable	1.0
			PM-10 filterable	0.088
			PM-10 organic condensable	0.67
15.3	Steel Dynamics	EAF with oxy-fuel burners and oxygen lancing, controlled by baghouse	PM-10 condensable	0.035
2.2	IPSCO Montpelier Works	EAF Baghouse	PM-10 filterable	0.017
2.14	IPSCO Montpelier Works	EAF Baghouse	PM-10 filterable	0.043
2.2	IPSCO Montpelier Works	EAF Baghouse	PM-10 filterable + condensables	0.15
2.14	IPSCO Montpelier Works	EAF Baghouse	PM-10 filterable + condensables	0.16

Attachment A
Initial Scoping Study for Revision to Section 12.5 of AP-42

MEMORANDUM

DATE: March 4, 2002

SUBJECT: Initial Scoping Study for Revision to Section 12.5 of AP-42

FROM: Melanie Taylor and Michael Sink
Alpha-Gamma Technologies, Inc.

TO: Dallas Safriet, EPA OAQPS EMAD Emission Factor and Inventories Group

The purpose of this memorandum is to document the initial results of the scoping study to assess new information and data that could be used to update the existing Iron and Steel Production section of AP-42. The sources of new information that have been analyzed to date are discussed in the following sections.

Iron and Steel Reference List

The test reports referenced in the "Documentation for Revised Emission Factors: Section 7.5 - Iron and Steel Production and Section 7.2 - Coke Manufacturing" were found to be among those listed on the Iron and Steel Reference List for AP-42 Revision. Therefore, this reference contains no new data.

IIASA Data

Alpha-Gamma examined uncontrolled PM emission factors for iron production and sinter plants developed by the International Institute for Applied Systems Analysis in their RAINS PM module. The emissions factors that are presented for different processes are all taken directly from sections 12.5, 12.10, and 12.13 of AP-42. Emission factors for PM2.5, PM10, and TSP are cited from other sources; these emission factors are given for pig iron production and sinter processes and are not broken down any further by process type. Therefore, the information contained in this reference is marginally useful at best.

RACT/BACT/LAER Clearinghouse (RBLC)

Alpha-Gamma has researched the RBLC database using the four relevant process descriptions. They are Iron Foundries (81.004), Stainless Steel/Specialty Steel Manufacturing (81.005), Steel Foundries (81.006), and Steel Manufacturing (81.007). A total of 87 processes are included in the RBLC database. We have compiled the information into a large spreadsheet which is enclosed. In general, we believe this is the most promising path to obtain recent emission factor information for a modest amount of effort.

The enclosed spreadsheets are organized as follows: first we have summary of the facilities on a region and state basis. Second, we have specific information on the facilities including permit number, contact name, and if PM data is available.

Then, for all four categories, we have a listing of the facilities in the category, followed by PM information (when available) for a given facility.

It is our recommendation to proceed with contacting some of the more promising facilities to obtain permit information, enabling an emission factor to be calculated. These factors will then be compared against the existing AP-42 factors to help ascertain if a full section update is warranted.

NESHAP for Integrated Iron and Steel Plants - Background Information for Proposed Standards

Alpha-Gamma investigated the Background Information Document (BID) for the proposed NESHAP for Integrated Iron and Steel Plants as a source of information. All of the PM data in the BID is for total PM, there is no speciated data. There is minimal new information in the BID. Many of the emission factors used to estimate emissions are from AP-42. For the BOPF shop processes, the document states that they do have emission estimates from companies but many of the companies only reported emissions from the discharge stacks and did not estimate fugitive emissions that escaped through the roof monitor. Therefore the writers of the BID chose to use the AP-42 emission factors “in an attempt to account for both primary system emissions and fugitive emissions.” One exception to this is for closed-hood BOPFs; the document states that the AP-42 emission factor was not consistent with the test measurements submitted by three plants with closed hood shops.

Emission factors not taken from AP-42 are presented for the following processes:
- Sintering - windbox - controlled by venturi scrubber
- Sintering - windbox - controlled by baghouse
- Sinter discharge - controlled by baghouse
- Sinter discharge - controlled by venturi scrubber
- Sinter cooler
- Blast furnace slip
- Blast furnace casthouse

- Blast furnace - raw material handling
- Blast furnace - stove

The BID does not cover many of the other sources listed in Section 12.5 of AP-42, such as electric arc furnace processes, open hearth furnaces, teeming, and machine scarfing.

Air Pollution Engineering Manual - Second Edition

The *Air Pollution Engineering Manual - Second Edition*[1] was investigated as a source of emissions data for the iron and steel industry. Alpha-Gamma found that the emissions information on the iron and steel industry discussed in the book is not new information; most of the references cited are from the 1970's and 1980's. The emissions data presented in the book is primarily taken directly from AP-42. Therefore it is our conclusion that this book does not provide new emissions data that could be used to update the existing Iron and Steel Section of AP-42.

[1] Air Pollution Engineering Manual Second Edition. Air and Waste Management Association, Edited by Wayne T. Davis, John Wiley and Sons, March 1, 2000.

Attachment B
Summary of Steel Minimills Data for Establishing AP-42 Emission Factors

MEMORANDUM

DATE: October 7, 2008

SUBJECT: Summary of Steel Minimills Data for Establishing AP-42 Emission Factors

FROM: Bradley Nelson, EC/R Inc.

TO: Michael Ciolek, EPA/OAQPS/SPPD/MPG

1.0 INTRODUCTION

This memorandum presents a summary of the current test data available for determining emission factors for Section 12.5.1 of the Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition (AP-42). The current test data includes older test data that were used to determine the previous emission factors in addition to new data collected during the current revisions to Section 12.5.1.

2.0 BACKGROUND

Section 12.5.1 of AP-42 of Chapter 12 was revised and sent out for public comment in 2004. The main issue that was raised from these public comments was that the published emission factors were based on “C” and “D” rated data, and hence the emission factors were “D” or “E” rated emission factors. Based on the public comments, EPA contacted numerous State agencies requesting complete test reports in 2007. During that period, we received 45 complete test reports, which included the appendices. After review, it was determined that 30 of these test reports could be used to calculate emission factors for steel minimills. Some of the reports were not used because the facility was not a steel minimill, or the report did not provide any process data that could be used to calculate an emission factor. The new test data was added to the existing database of emission data, and new emission factors were calculated.

3.0 EMISSION FACTOR CHANGES

The revised emission factors are based on 52 “A” or “B” rated test reports from 17 steel minimill facilities. The most significant changes are the addition of new test data and the consolidation of the melt shop processes into a single process emission factor. This was done since many of the processes are performed in the same building and are controlled by the same control device. Therefore this consolidates many of the process emission factors from the previous version of the AP-42 section into a single emission factor for Electric Arc Furnaces (EAF) and other processes in the melt shop. The revised emission factors also include emission factors for arsenic, cadmium, chromium, mercury, manganese, and nickel. A summary of the changes to the emission factors for EAFs are presented in Table 1.

Table 1. Summary of Emission Factor Changes

Pollutant	***Revised EF Rating***	***Revised EF***	***Previous EF Rating***	***Previous EF***
Filterable PM	B	0.020	B	0.083
Condensable PM – Aqueous	C	0.029	D	0.073
Condensable PM - Organic	C	0.010		
Total PM	C	0.059	C	0.064
NO_X	B	0.20	D	0.22
CO	B	2.0	C	1.6
SO_2	C	0.22	D	0.090
Lead	C	0.00056	E	0.00066
VOC	C	0.023	E	0.17
Arsenic	E	6.2E-06	N/A	N/A
Beryllium	D	2.8E-07	E	7.4E-08
Cadmium	E	5.0E-06	N/A	N/A
Chromium	E	3.5E-06	N/A	N/A
Mercury	D	1.1E-04	N/A	N/A
Manganese	E	3.0E-04	N/A	N/A
Nickel	E	5.5E-06	N/A	N/A
Fluoride	D	0.059	E	0.075

As the table shows, there were only a few significant changes to the emission factors from the December 20, 2006 published emission factors in comparison to the revised September 2008 emission factors. The most significant changes were to the filterable and condensable PM emission factors and the VOC emission factors. These changes are due to the addition of new test data for each of these emission factors.