

**EMISSION FACTOR DOCUMENTATION
FOR AP-42 SECTION 12.5.1,
IRON AND STEEL PRODUCTION**

Prepared for:

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Emission Factor Documentation for AP-42 Section 12.5 Iron and Steel Production

1.0 Introduction

The EPA publishes emission factors in its Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources, EPA Publication No. AP-42 (AP-42). The document has been published since 1968 as the primary compilation of EPA's emission factor information. 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). Volume I is published by the Emission Factor Inventory Group (EFIG) in EPA's Office of Air Quality Planning and Standards (OAQPS). The OAQPS is located in Research Triangle Park, NC.

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 October 1986. This document focuses on the data gathered for non-integrated facilities, commonly known as "minimills."

2.0 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 given as an attachment to this background document.

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. 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 in Table 2-1, along with the database Facility ID, which will be discussed in Section 4 below.

3.0 Review of Data

All of the source test data references that were gathered for minimills are listed at the end of this section. Each reference was screened to determine whether it could be used in updating the section. In the review of available references, emissions data were accepted if:

sufficient information about the facility and any pollution control devices was known,
emissions levels were measured by a current test method,
emission test results were reported in appropriate units, and
sufficient data existed to characterize operating conditions during testing.

A brief description of each reference that was gathered for the revision of Section 12.5, including the process and pollutants tested, is given in Table 3-1. Following Table 3-1 is a complete list of all of the references.

Table 2-1. Summary of Facilities

Facility ID	Facility Name	City	State
1	Northwestern Steel and Wire	Sterling	IL
2	IPSCO Montpelier Works	Muscatine	IA
3	Oregon Steel Mills	Portland	OR
4	Nucor Steel	Crawfordsville	IN
5	Quanex Corporation – MacSteel Division	Ft Smith	AR
6	Charter Steel Division	Saukville	WI
7	The Timkin Company – Faircrest Plant	Canton	OH
8	Bayou Steel	La Place	LA
9	Gallatin Steel	Ghent	KY
10	Newport Steel	Newport	KY
11	Kentucky Electric Steel	Ashland	KY
12	Nucor Plate Mill	Cofield	NC
13	Steel Dynamics	Columbia City	IN
14	Steel Dynamics	Pittsboro	IN
15	Nucor Steel Corporation	Plainfield	IN
16	Gerdau Ameristeel	St Paul	MN
17	Gerdau Ameristeel	Baldwin	FL

Table 3-1. Summary of References Collected for the Revision of Section 12.5.1

Facility ID	Database ID	Process tested	Pollutants Tested	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	

Table 3-1. Summary of References Collected for the Revision of Section 12.5.1 (Continued)

Facility ID	Database ID	Process tested	Pollutants Tested	Notes
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.
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 may be slightly high due to excessive drift during testing; the results are drift corrected.
4	4.1	PPFF Baghouse Inlet Duct	PM, CPM, CO, NO _x , SO ₂ , Pb	
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	

Table 3-1. Summary of References Collected for the Revision of Section 12.5.1 (Continued)

Facility ID	Database ID	Process tested	Pollutants Tested	Notes
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.
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	13.1	EAF Baghouse Exhaust Stack	PM, CPM, VOC, NO _x , CO, SO ₂ , Fluoride, Be, Pb, Mn, Hg	

Table 3-1. Summary of References Collected for the Revision of Section 12.5.1 (Continued)

Facility ID	Database ID	Process tested	Pollutants Tested	Notes
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	15.1	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	
17	17.1	EAF Baghouse Exhaust Stack	PM	
17	17.2	Billet Reheat Furnace	PM, NO _x , CO	

^a EAF: electric arc furnace. AOD: argon oxygen decarburization.

^b LMF: ladle metallurgical furnace.

^c CPM: condensable particulate matter.

^d IDEM: Indiana Department of Environmental Management.

^e DRI: direct reduced iron.

References for Update to Section 12.5

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.

4.0 Emissions Database

The data that met acceptance criteria were entered into a database to facilitate the calculation of emission factors. The database consists of four tables, which are described in greater detail below.

Facility Data Table

This table contains information about the facilities, such as location and state agency contact. Each facility is assigned a unique Facility ID number. The fields in the table are as follows:

- *Facility ID* - unique ID number for each facility
- *Facility Name* - name of facility
- *City* - city where facility is located
- *State* - state where facility is located
- *Agency* - state agency that provided data for the facility
- *Agency Contact* - contact person at state agency
- *Agency Contact Phone* - phone number for state agency contact
- *Agency Contact Email* - email address for state agency contact
- *Facility Type* - integrated mill or minimill
- *Description* - brief description of facility
- *Capacity* - overall capacity of facility
- *Capacity Unit* - unit for capacity (ex. tons/year)
- *Data Source* - describes the source of the data
- *Notes* - any notes about the facility.

Source Description Table

Information about the different types of sources at each facility is contained in this table. The table contains the Facility ID, and each source at the facility is assigned a different Source ID number. The fields in the table are as follows:

- *Facility ID* - the facility ID for the source
- *Emission Source ID* - the ID number for the source
- *Unit Number* - if given, the unit number at the plant (for example “reheat furnace #3)
- *Source Cat ID* - the source classification number for the source. This links to the “Source Category Lookup” table.
- *Source Description* - a detailed description of the source
- *Burners* - information on any type of burners used by the source, if applicable
- *Lancing* - information on any type of lancing used by the source, if applicable
- *Control* - the type of control device used by the source
- *Control Notes* - notes on the control device.

Source Category Lookup

This is a lookup table used for assembling the data for various facilities that have similar processes. This table contains all of the distinct emission sources that were identified from the source test data. An example of a distinct type of source is “Annealing furnace, natural gas-fired, with low-NOx burners.” The fields in the table are as follows:

- *Source Cat ID* - unique ID number for the source category
- *Source Category* - brief description of the source category
- *Processes* - description of the processes for the source category (for example, charging, tapping, etc.)
- *Notes* - any notes about the source category.

Test Data

All of the stack test data is contained in this table. The data is identified by a Facility ID, Source 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
- *Source ID* - the source 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”)
- *Airflow* - the average airflow during the test
- *Airflow Unit* - the unit of the average airflow
- *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
- *Notes* - any notes about the testing, particularly any reasons for excluding the test data.

5.0 AP-42 Emission Factor Development

The emission factors developed for the revision of Section 12.5 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 database Test IDs for each of the tests. Emission factors that were based on tests done at greater than two facilities were given a “D” rating, while those based on tests done at two or fewer facilities were given an “E” rating. No emission factors were given a rating higher than “D” due to the small number of facilities represented. 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.

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 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	0.020	lb/ton	13	27	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

^a Unit of lb/ton is lb/ton of steel produced.

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 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	0.029	lb/ton	8	18	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
Electric arc furnace, ladle metallurgy, and melt shop 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	0.010	lb/ton	8	18	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

^a Unit of lb/ton is lb/ton of steel produced.

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 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	0.059	lb/ton	8	18	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

^a Unit of lb/ton is lb/ton of steel produced.

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 Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	B	0.20	lb/ton	9	26	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
Reheat furnace, natural gas-fired Controlled by low NO _x burners	E	0.24	lb/ton	3	5	2.1, 2.3, 2.4, 13.4, 16.2
Annealing furnace, natural gas-fired Uncontrolled	E	0.26	lb/ton	1	1	4.3
Annealing furnace, natural gas-fired Controlled by low NO _x burners	E	0.074	lb/ton	1	4	4.11, 4.12, 4.13, 4.14

^a Unit of lb/ton is lb/ton of steel produced.

Table 5-5. 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 Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	B	2.0	lb/ton	9	17	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
Annealing furnace, natural gas-fired Uncontrolled	E	0.0018	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. SO₂ 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 Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	C	0.22	lb/ton	6	16	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

^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 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	0.00056	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 Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	C	0.023	lb/ton	8	10	1.1, 4.1, 7.3, 12.1, 12.2, 12.3, 13.4, 14.1, 15.1, 16.1

^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 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 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 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 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 Charging, melting, slagging, tapping, ladle transfer to ladle furnace, ladle preheater, alloy addition to ladle furnace, ladle furnace melting, continuous casting Uncontrolled	Mercury	E	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 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 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 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	0.059	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 Test Reports Not Used for Emission Factor Calculation

The objective of revising this AP-42 Section 12.5.1 was to use the newest and most complete test data available. Many of the emission factors that were developed in earlier versions of this section were based on test summary tables without any supporting documentation. The following list was previous data that was considered to be “C” rated data or below and was not used to calculate these emission factors.

1. Performance Test Report PM10 Emissions Evaluation, Slater Specialty Steels, Ft. Wayne, Indiana. Prepared for Slater Specialty Steels, Ft. Wayne, IN. Prepared by FBT Testing and Environmental Services, West Chester, OH. December 1997.
2. Final Test Report Stainless Steel Processes, Slater Steels - Ft. Wayne Specialty Alloys Division, Ft. Wayne, Indiana. Prepared for Slater Steels, Ft. Wayne, IN. Prepared by FBT Testing and Environmental Services, West Chester, OH. July 1995.
3. Source Emissions Test Report for Triad Engineering, Inc. Performed at Steel Dynamics, Inc. Steel Processing Mill, Butler, IN, on the Twin Shell Electric Arc Furnace Baghouse Outlet-Exhaust Stack. Prepared for: Mr. Barry Smith, Triad Engineering, Inc., Fort Wayne, IN. G/SA Project No. 96-T-004. September 19 and 20, 1996.
4. Emission Test Report for Melt Shop Baghouse Stack. Prepared for: Steel Dynamics, Inc., Butler, IN. Dames & Moore Job No. 27892-006-140. September 18, 1997.
5. Source Emissions Test Report, Performed for Steel Dynamics, Inc., Butler, IN. Twin Shell Electric Arc Furnace Ladle Metallurgical Station. Prepared for: Mr. Barry Smith, Steel Dynamics, Inc., Butler, IN. G/SA Project No. 98-T-065. November 17-20, 1998.
6. Source Emissions Test Report, Performed for Steel Dynamics, Inc., Butler, IN. Twin Shell Electric Arc Furnace Ladle Metallurgical Station. Prepared for: Mr. Barry Smith, Steel Dynamics, Inc., Butler, IN. G/SA Project No. 99-T-069. February 2-3, 1999.
7. Source Emissions Test Report, Performed for Steel Dynamics, Inc., Butler, IN. Twin Shell Electric Arc Furnace Ladle Metallurgical Station Baghouse Outlets. Prepared for: Mr. Barry Smith, Steel Dynamics, Inc., Butler, IN. G/SA Project No. 01-T-136. July 26, 2001.
8. Emissions Test Report, Particulate and Carbon Monoxide, for Harrison Steel Castings Company ARC Furnace Baghouse Stack, Attica, IN. September 24, 1992. ATEC Project No. 52-10-92-00022.
10. Report on Particulate Compliance Testing. Performed for: Qualitech Steel Corporation, Pittsboro, IN, Baghouse Stack. By SESCO on January 15, 1999. SESCO Project No. 011599.
11. Report on SO₂/NO_x/CO/PB/VOC Compliance Testing. Performed for: Qualitech Steel Corporation, Pittsboro, IN, EAF, VTD Boiler and Reheat Furnace Stacks. By SESCO on September 7-10 and 15, 1999. SESCO Project No. 090799.

12. Compliance Emission Testing for Particulate, Nitrogen Oxide, Carbon Monoxide, Sulfur Dioxide, Volatile Organic Carbon, and Hydrogen Chloride on the Melt Shop Baghouse, Roller Hearth Furnace, Acid Regeneration, HCL Pickle Line, and Cold Reversing Mill at Nucor Steel, Crawfordsville, IN. Test Date: July 17-20, 1990. ATI Job Number: 90T02010.
13. Source Sampling - Acid Regeneration Unit, Pickle Line, and EAF Baghouse. Nucor Steel, Crawfordsville, IN. February 21 through 24, 1995.
14. Source Sampling for NO_x Emissions, Annealing Furnace Outlet Stack. Nucor Steel, Crawfordsville, IN. May 23 and 24, 1995.
15. Source Sampling for CO Emissions, EAF Baghouse. Nucor Steel, Crawfordsville, IN. September 22, 1995.
16. Source Sampling for Particulate Emissions, EAF Baghouse. Nucor Steel, Crawfordsville, IN. November 28, 1995.
17. Source Sampling for Particulate, HCl, CO and Visible Emissions, Pickle Line and EAF Baghouse Inlet. Nucor Steel, Crawfordsville, IN. May 14-16, 1996.
18. Source Sampling for Particulate, HCl, CO and Visual Emissions, Baghouse, Acid Regeneration Unit, and Pickle Line. Nucor Steel, Crawfordsville, IN. October 8-9 and 11, 1996.
19. Source Sampling for Particulate, HCl, CO and Visible Emissions, Acid Regenerator, EAF Baghouse and Pickle Line. Permit No. CP-107-5235. Nucor Steel, Crawfordsville, IN. March 3-4, 1997.
20. Source Sampling for Particulate and Visible Emissions, EAF Baghouse. Permit No. CP-107-5235. Nucor Steel, Crawfordsville, IN. June 6, 1997.
21. Source Sampling for Particulate, HCl, CO and Visible Emissions, Acid Regenerator, EAF Baghouse and Pickle Line. Permit No. CP-107-5235. Nucor Steel, Crawfordsville, IN. September 30 - October 1-2, 1997.
22. Report on Particulate/PM10 Compliance Testing. Performed for: Nucor Steel, Crawfordsville, IN, RT Mill Baghouse Stack. By: RCP Environmental on March 31, 1998. RCP Project No.: 033198.
23. Report on NO_x and CO Emissions. Annealing Furnace #9. Performed for: Nucor Steel, Crawfordsville, IN. August 24, 2001.
24. Report on NO_x and CO Emissions. Annealing Furnace #13. Performed for: Nucor Steel, Crawfordsville, IN. August 24, 2001.
25. Report on NO_x and CO Emissions. Annealing Furnace #15. Performed for: Nucor Steel, Crawfordsville, IN. August 23, 2001.

26. Report on NO_x and CO Emissions. Annealing Furnace. Performed for: Nucor Steel, Crawfordsville, IN. June 6, 2001.
27. Report on Particulate Compliance Testing. Positive Pressure Baghouse. Performed for: Nucor Steel, Crawfordsville, IN. By: SESCO. October 31, 2001. SESCO Project No. 4214.
28. Gaseous Emission Compliance Study. Performed for Beta Steel Corporation at the Steel Reheat Furnace Stack. Portage, IN. January 21, 1993. Project No. 30317.
29. Report of Emissions Test. Beta Steel Corp - Portage, Indiana Plant. Plant ID No. 127-00036. Hot Strip Mill Slab Reheat Furnace Stack Selective Catalytic Reduction (SCR) Unit. November 4, 1999. Prepared for: Beta Steel Corp, Portage, IN. Prepared by: Industrial Environmental Management Consultants, Inc. Chesterton, IN and Ambient Air Services, Inc., Starke, FL. December 1999.
30. Source Emissions Test. Performed for Beta Steel Corporation, Portage, IN. Meltshop Baghouse Outlet, Portage, IN. November 13-14, 2000. G/SA Project No. 00-T-118. Prepared for: Mr. Joe Gazarkiewicz, Beta Steel Corporation, Portage, IN.
31. Source Emissions Test. Performed for Beta Steel Corporation, Portage, IN. Melt Shop Facility Baghouse Inlet, Slag Pit and Baghouse Outlet, Portage, IN. September 24-25, 2001. G/SA Project No. 01-T-141. Prepared for: Mr. Joe Gazarkiewicz, Beta Steel Corporation, Portage, IN.
32. Particulate Matter Emissions Evaluation, Melt Line Furnace Baghouse, Green River Steel, Owensboro, KY. Prepared for Green River Steel, Owensboro, KY. Prepared by FBT Testing & Environmental Services, West Chester, OH. August, 1999.
33. Stack test reports for IPSCO Steel, Montpelier, IA. Testing conducted on November 17-19, 1998; April 30, 1999; January 9, 2002; March 6, 2003; April 30, 2003; July 9, 2003; October 9, 2003; March 3, 2004; April 28, 2004; July 13-15, 2004; October 21, 2004; April 28, 2005; and August 10, 2005. Received from Marnie Stein, Iowa Department of Natural Resources, Air Quality Bureau on September 11, 2006.
34. Stack test summary information and Title V permit for Cascade Steel Rolling Mills, Inc., McMinnville, OR. Testing conducted on August 9, 1991; May 20, 1994; March 3, April 6, August 1, September 13, and October 3, 1995; May 24 and October 22-23, 1996; May 15 and October 29-30, 1997; June 29, August 8, and October 8-9, 1998; April 15-16, October 21-22, and November 16, 1999; June 14, June 19, October 26-17, 2000; May 15-16 and October 30-31, 2001; February 26-27 and March 13, 2002. Received from Gary Andes, Oregon Department of Environmental Quality on April 30, 2002.
35. Stack test results memorandum and excerpts from test report for stack testing at Roanoke Electric Steel, Roanoke, VA. Testing conducted on April 9-10, 1992 and July 20-21, 1992. Received from Robina Jordan, Virginia Department of Environmental Quality.

36. Stack test report summary sheets for Trico Steel, Decatur, AL. Testing conducted on September 2, 1997; October 9, 1999; and October 24, 2000. Received from Doug Carr, Alabama Department of Environmental Management on April 10, 2002.
37. Stack test report summary sheets for IPSCO Steel, Mobile, AL. Testing conducted on October 2, 2001. Received from Doug Carr, Alabama Department of Environmental Management on April 10, 2002.
38. Stack test report summary sheets for Tuscaloosa Steel, Tuscaloosa, AL. Testing conducted on April 25, 2001. Received from Doug Carr, Alabama Department of Environmental Management on April 10, 2002.
39. Summary of stack test results for SMI Steel (formerly Owens Electric Steel - Cayce, SC). Testing conducted on February 3-4, April 1, and June 30, 1993; February 23-24, 1995; April 17-18, 1997; April 14, and 21-22, 1999; February 22-23 and July 11, 2001; May 20-21, 2002; and May 13-14, 2003. Received from Anthony Keeler, South Carolina Department of Health and Environmental Control on September 16, 2002.
40. Summary of stack test results for Nucor Steel (Darlington SC). Testing conducted on July 17, 1990; February 5-6, February 28, July 23, 1991; September 18, October 27, and December 10, 1992; November 2-3, 1994; February 15-16, 1995; February 25-26, 1997; February 23-24, 1999; January 16 and November 13-15, 2001. Received from Anthony Keeler, South Carolina Department of Health and Environmental Control on September 16, 2002.
41. Summary of stack test results for Nucor Steel (Huger SC). Testing conducted on May 14-15, August 5-8, and December 4, 1997; December 1, 1998; April 20 and May 15, 1999; January 8, February 27, and August 23-23, 2001. Received from Anthony Keeler, South Carolina Department of Health and Environmental Control on September 16, 2002.
42. Summary of stack test results for Georgetown Steel (Georgetown, SC). Testing conducted on March 27-28, 1990; June 3, June 6, November 13, and December 19 1991; June 2-3, 1992; June 23-24 and December 22, 1993; February 16-17, June 14-15, and December 13, 1995; June 20, 1996; April 17-18, and June 24-25, 1997; June 15 and December 8, 1998; April 12-13 and June 15-16, 1999; March 26 and June 19, 2001. Received from Anthony Keeler, South Carolina Department of Health and Environmental Control on September 16, 2002.
43. Stack reports for IPSCO Steel Alabama Inc. (Axis, AL). Testing conducted on October 2-3, 2001; September 24-25, 2002; and October 21-22, 2003.
44. Stack test report for North Star Steel (Wilton, IA). Testing conducted on August 17, 1999.
45. Stack test reports for The Timken Company – Harrison Plant (Canton, OH). Testing conducted on July 18-19, 2001; and March 19-27, 2002.
46. Stack test reports for Nucor Steel Utah Division (Plymouth, UT). Testing conducted on March 5-6, 2001; March 7-8, 2002; and March 25-26, 2003.

47. Stack test reports for North Star Steel (St Paul, MN). Testing conducted on November 7, 2002; April 16, 2003; and September 29, 2003.

Appendix A
Memo: Summary of Steel Minimills Data for
Establishing AP-42 Emission Factors
October 7, 2008

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

<i>Pollutant</i>	<i>Revised EF Rating</i>	<i>Revised EF</i>	<i>Previous EF Rating</i>	<i>Previous EF</i>
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.