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FERROALLOYS

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Ferroalloys

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Ferroalloys are alloys of iron employed to add chemical elements into molten metal, usually during steelmaking. The alloying elements delivered by ferroalloys impart distinctive qualities to steel and cast iron or serve important functions during production. The leading ferroalloy-producing countries in 2011 were, in decreasing order of production, China (57%), South Africa (10%), India (6%), Russia (4%), and Kazakhstan (4%) (table 7). These countries accounted for 81% of world ferroalloy production. World production of bulk ferroalloys—chromium, manganese, and silicon—was estimated to have been 36.8 million metric tons (Mt) in 2011, a 5% increase compared with the revised figure of 34.9 Mt for 2010 (table 7).

Twelve companies in the United States produced 7 ferroalloys at 12 plants (table 1). With the exception of ferrosilicon from 2007–10, production statistics for most ferroalloys were concealed to avoid disclosing company proprietary data (table 7). U.S. reported consumption of bulk ferroalloys in 2011 was approximately 0.9 Mt of manganese and silicon ferroalloys (table 3) and about 0.3 Mt of contained chromium in ferrochromium (table 4). Comparing reported consumption in 2011 with that of 2010, ferrochromium decreased slightly, ferromanganese (including silicomanganese) increased by 4%, and ferrosilicon increased by 8%. The United States was a net importer of ferroalloys and ferroalloy metals in 2011. On a gross-weight basis and compared with that in 2010, U.S. total ferroalloy and ferroalloy metal imports increased by 7% and exports increased by 6%, which resulted in a net import increase of 7% (table 6).

Boron, chromium, cobalt, copper, molybdenum, nickel, niobium (columbium), phosphorus, silicon, titanium, tungsten, vanadium, zirconium, and the rare-earth elements are some of the other alloying elements used for the characteristics they provide to steels and cast irons (Brown and Murphy, 1985, p. 265).

Ferrochromium

The leading world chromite ore-producing countries in 2011 were South Africa (more than 10 Mt), India (more than 3 Mt), and Kazakhstan (more than 3 Mt). Chromite ore was mostly smelted in electric-arc furnaces to produce ferrochromium for the metallurgical industry. The leading world ferrochromium-producing countries were China (2.6 Mt), Kazakhstan (1.3 Mt), and South Africa (3.7 Mt). India produced in excess of 0.8 Mt of ferrochromium. Most of the 9.55 Mt of ferrochromium produced was consumed in the manufacture of stainless steel. The leading stainless steel producing areas of the world—Asia (primarily China, India, Japan, the Republic of Korea, and Taiwan), Europe (primarily Western Europe and Scandinavia including Belgium, Finland, France, Germany, Italy, Spain, Sweden, and the United Kingdom), and the Americas (primarily Brazil and the United States)—accounted for most of world stainless steel production. World stainless steel production exceeded 32 Mt in 2011 (Papp, 2013).

In response to anticipated future increases in demand, new ferrochromium-producing plants were under construction or planned in Kazakhstan and South Africa. Four industry trends were evolving—ferrochromium was being increasingly produced using more environmentally friendly, energy- and recovery-efficient, prereduction, closed-furnace processes; chromium was being recovered from ferrochromium slag; the ferrochromium and stainless steel production industries were consolidating ownership; and strategic alliances between those two industries were being developed.

Ferromanganese

Two manganese ferroalloys, ferromanganese and silicomanganese, are key ingredients for steelmaking. Manganese ferroalloys were produced domestically by two companies—Eramet Marietta Inc. (owned by France's Eramet Group) and Felman Production Inc. (owned by Ukraine's Privat Group) (table 1). In addition to domestic production in 2011, the United States imported 697,000 metric tons (t) of ferromanganese and silicomanganese (gross weight). Of that amount, 78% was imported from South Africa (351,000 t), Georgia (100,000 t), Norway (57,695 t), and Ukraine (31,100 t). China was the leading world producer of manganese ferroalloys, with output about 232% greater than that of the next three major producers—India, South Africa, and Ukraine—combined (table 7).

Ferromolybdenum

Chile, China, and the United States accounted for about 80% of world production of molybdenite ore in 2011. Three other molybdenite ore-producing countries—Canada, Mexico, and Peru—supplied an additional 15% of world production. Molybdenite concentrates are roasted to form molybdic oxide, which can then be converted into ferromolybdenum, molybdenum chemicals, or molybdenum metal. About 44% of the total reported molybdenum materials consumed in the United States (19,300 t) was in the form of molybdic oxides, and about 29% was consumed as ferromolybdenum. Although the United States was the second leading molybdenum-producing country in the world, it imported more than one-half of its ferromolybdenum requirements in 2011 (Polyak, 2012a). The steel industry accounted for most of the ferromolybdenum consumed in the United States in 2011, principally in the production of stainless and full alloy steels (table 4).

Ferronickel

In the United States, the steel industry accounted for virtually all the ferronickel consumed in 2011, with more than 97% used in stainless, heat-resistant, and certain alloy steels. No ferronickel was produced in the United States from either domestic or imported ores in 2011. The International Metals Reclamation Co. (INMETCO), however, produced a remelt alloy that was used as a substitute for ferrochromium and ferronickel in the production of austenitic stainless steel. INMETCO operated the sole secondary smelter in North America dedicated to recycling both chromium and nickel from waste materials. The INMETCO smelter in Ellwood City, PA, has been producing a remelt alloy since 1978 that typically averages 13% chromium and 12% nickel.

In 2011, the major ferronickel-producing countries were Japan (342,000 t gross weight), New Caledonia (149,000 t), and Colombia (104,000 t). Together, these three countries accounted for about 48% of world production if China is excluded. Indonesia, Brazil, Greece, Macedonia, Kosovo, and Ukraine, in descending order of gross weight output, accounted for an additional 38%—again excluding China. China was not included in these calculations because its industry produced large tonnages of nickel pig iron in addition to a spectrum of conventional ferronickel grades, for an estimated output of 800,000 t gross weight, and discrete ferronickel production data were not available. The nickel content of individual Chinese products varied from about 1.6% to as much as 80%, depending upon customer end use. A large part of the nickel pig iron was produced from lateritic ores imported from Indonesia and the Philippines.

The Brazilian nickel industry completed construction of two greenfield ferronickel complexes in late 2010. In March 2011, Anglo American Brasil Limitada poured the first deliverable ferronickel at its $1.9 billion Barro Alto complex in Goias State. The new smelter-refinery was scheduled to reach full production—41,000 t/yr of nickel-in-ferronickel—in early 2013. The Barro Alto complex is approximately 170 kilometers from Anglo American's older, but still active, Codemin nickel operation in Niquelandia. The open pit mine at Barro Alto, which has been operating since 2004, continued to supply ore to the Codemin ferronickel plant. In 2011, the Codemin plant produced 9,500 t of of nickel-in-ferronickel; the Barro Alto plant, 6,200 t. At yearend 2011, the Barro Alto Mine had 52.2 Mt of proven and probable reserves averaging 1.60% nickel. These figures equated to 833,000 t of nickel (Anglo American plc, 2012, p. 2, 16–18, 72–75, 178–179).

In March, Vale S.A. formally commissioned its $2.84 billion Onça Puma smelting complex in Para State and began producing ferronickel from one of two furnaces. The second furnace was started in the second half of 2011. The processing complex was designed to produce 53,000 t/yr of nickel-in-ferronickel, but only produced 7,000 t in 2011. Operational issues with both furnaces have slowed full ramp up. At yearend 2011, the Onça Puma Mine had 82.9 Mt of proven and probable reserves averaging 1.52% nickel (Vale S.A., 2011; 2012, p. 20, 38, 59; Spinetto, 2012).

China Nonferrous Metals Mining Group Co. Ltd. and Taiyuan Iron and Steel (Group) Co. Ltd. have been developing a laterite mine and constructing an adjacent ferronickel smelter at Tagaung Tang, near Thabeikkyin in the Mandalay region of Burma. The project was expected to cost between $790 million and $900 million. According to the Myanmar Ministry of Mines, the Tagaung Tang Mine was commissioned in March 2011. The mine reportedly has 40 Mt of reserves averaging 2.02% nickel (Thet, 2012, p. 11, 26–29).

Ferrosilicon

Silicon ferroalloy consumption is driven by cast iron and steel production, where silicon alloys are used as deoxidizers. Some silicon metal was also used as an alloying agent with iron. Starting in 2011, domestic statistics for silicon metal containing less than 99.9% silicon—silicon metal used as feedstocks for chemical, electronic, and metallurgical applications—were aggregated with those of ferrosilicon to avoid disclosing company proprietary data for both material categories. Therefore, comparisons of domestic production could not be made between 2010 and 2011. In 2011, total domestic ferrosilicon and silicon metal production was 437,000 t on a gross-weight basis (table 7). China produced more ferrosilicon and silicon metal than the rest of the world combined and about five times that of the next two major producing countries—Russia and the United States—combined. China's ferrosilicon production comprised 70% of the world total, excluding net production in the United States.

Ferrotitanium

Titanium is used in steelmaking for deoxidation, grain-size control, and carbon and nitrogen control and stabilization. During steelmaking, titanium is usually introduced as ferrotitanium, because of its lower melting temperature and higher density compared with those of titanium scrap. Steels with relatively high titanium content include interstitial-free, stainless, and high-strength low-alloy steels. Ferrotitanium is usually produced by induction melting of titanium scrap with iron or steel; however, it also is produced directly from titanium mineral concentrates. The standard grades of ferrotitanium are 30% and 70% titanium. U.S. producers of ferrotitanium were Global Titanium Inc. (Detroit, MI), with 10,000 t/yr of ferrotitanium production capacity, and RTI International Metals, Inc. (Canton, OH), with 7,260 t/yr of ferrotitanium and specialty alloy production capacity. The leading ferrotitanium producing countries were China, India, Russia, Ukraine, the United Kingdom, and the United States.

In the United States, reported domestic consumption of titanium products in steel and other alloys was 12,400 t (gross weight), a 6% increase compared with that of 2010. Increased global steel production in 2011 increased the need for ferrotitanium. Because of increased consumption from steel producers, the average U.S. spot-market price range for 70%-grade ferrotitanium increased to $3.50 to $4.38 per pound, compared with $3.18 to $3.25 per pound in 2010.

Ferrotungsten

Tungsten is an important alloying element in high-speed and other tool steels, and is used to a lesser extent in some stainless

and structural steels. Tungsten can be added to steel melts as (1) ferrotungsten, which is a master alloy containing between 75% and 80% tungsten; (2) tungsten melting base, which is a master alloy containing up to 38% tungsten; (3) tungsten metal scrap; or (4) scheelite ore concentrates (Lassner and Schubert, 1999, p. 307–312; Roskill Information Services Ltd., 2007, p. 167–168, 174, 178–179).

World ferrotungsten production was dominated by China. In 2011, Chinese production of ferrotungsten increased by 11% from that of 2010 to an estimated 7,500 t, gross weight. Chinese ferrotungsten exports decreased by 23% in 2011 to 748 t, contained tungsten, from 971 t, contained tungsten, in 2010 (Fang, 2012, p. 10, 12, 27). U.S. reported consumption of ferrotungsten was lower than that of 2010. Ferrotungsten prices were significantly higher than those of 2010; the Platts Metals Week price ranged between $46 and $57 per kilogram of contained tungsten during the year.

Ferrovanadium

In 2011, China, Russia, and South Africa accounted for 96% of world vanadium mine production. In these three countries, vanadium was primarily recovered from titanium-bearing magnetite ore processed to produce pig iron. The process produces a slag containing 20% to 24% vanadium pentoxide, which can be further processed to ferrovanadium containing 40% to 50% vanadium (Polyak, 2012b).

In 2011, vanadium recovery from various industrial waste materials, such as vanadium-bearing fly ash, petroleum residues, pig iron slag, and spent catalysts was the leading source of U.S. vanadium production. A small amount of vanadium was obtained as a coproduct from the mining of uraniferous sandstones on the Colorado Plateau (Polyak, 2012b).

The domestic steel industry accounted for the majority of U.S. reported vanadium consumption in 2011, principally in carbon, full alloy and high-strength, low-alloy steels. Ferrovanadium supplied 84% of the 5,000 t of vanadium consumed in the United States; this was a slight increase compared with 2010. Steel manufacturing consumed almost all of the ferrovanadium in 2011 (table 4).

Outlook

The near-term trend for domestic ferroalloy consumption was expected to follow closely that of U.S. steel production. Details of the outlook for the steel industry are discussed in the Outlook section of the Iron and Steel chapter of the 2011 USGS Minerals Yearbook, volume I, Metals and Minerals. Crude steel production in the United States increased by 7% to 86.4 Mt in 2011 from that in 2010 (Fenton, 2013) (table 1). According to the World Steel Association (2012b), raw steel production in 2011, compared with that in 2010, increased by 6.8% worldwide to slightly more than 1.5 billion metric tons (Gt). Raw steel production in China, the leading world producer of raw steel, increased by 8.9% to about 696 Mt. MEPS (International) Ltd. (2012) forecast a 4% increase in world raw steel production to 1.6 Gt in 2012 from that in 2011.

Changes in steel production reflect changes in apparent use of steel. The World Steel Association (2012a) forecast world apparent steel use would increase by 2.1% to 1.41 Gt in 2012 from that in 2011 and by 3.2% to 1.45 Gt in 2013 from that in 2012. Apparent steel use in North America was expected to increase by 7.5% in 2012 to 130.4 Mt from that in 2011, as a result of continued economic recovery across the region.

Chromium, manganese, silicon, and other ferroalloy metals are discussed in more detail, including domestic data coverage, outlook, and U.S. Government stockpile information, in the respective mineral commodity chapters in the U.S. Geological Survey Minerals Yearbook, volume I, Metals and Minerals.

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TABLE 1
DOMESTIC PRODUCERS OF FERROALLOYS IN 2011

Company	Plant location	Products[1]						
		FeMo	FeMn	FeNb	FeSi	FeTi	FeV	SiMn
Bear Metallurgical Co.	Butler, PA	X					X	
CC Metals & Alloys, LLC	Calvert City, KY				X			
Core Metals Group[2]	Bridgeport, AL				X			
Eramet Marietta Inc.	Marietta, OH		X					X
Felman Production Inc.	Letart, WV							X
Global Titanium Inc.	Detroit, MI					X		
Globe Metallurgical Inc.[2]	Beverly, OH				X			
Metallurg Vanadium Corp.	Cambridge, OH						X	
Reading Alloys Inc.	Robesonia, PA			X				
RTI International Metals, Inc.	Canton, OH					X		
Stratcor, Inc.	Hot Springs, AR						X	
Thompson Creek Metals Co. Inc.	Langeloth, PA	X						

[1]FeMo, ferromolybdenum; FeMn, ferromanganese; FeNb, ferroniobium; FeSi, ferrosilicon; FeTi, ferrotitanium; FeV, ferrovanadium; SiMn, silicomanganese.
[2]Owned by Globe Specialty Metals.

TABLE 2
GOVERNMENT INVENTORY OF FERROALLOYS, DECEMBER 31, 2011[1, 2]

(Metric tons of alloys unless otherwise specified)

Alloy	Inventory
Ferrochromium:	
High-carbon	95,200
Low-carbon	54,300
Ferromanganese, high carbon	336,000

[1]Data are rounded to no more than three significant digits.
[2]Data are uncommitted inventory.

Source: Defense Logistics Agency, DLA Strategic Materials.

TABLE 3
REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS BY END USE IN 2011[1, 2]

(Metric tons of alloys unless otherwise specified)

End use	FeB	Manganese		FeP	FeSi	FeTi
		FeMn	SiMn			
Steel:						
Carbon and high-strength low-alloy	479	258,000	65,000	4,020	60,300	6,910
Stainless and heat-resisting	225	10,400	15,200	(3)	47,100	3,120
Other alloy	(3)	28,100	21,600	(3)	14,700	409
Tool	(3)	(3)	(3)	(3)	(3)	(4)
Unspecified	69	2,730	956	887	41,100	(4)
Total steel	773	299,000	103,000	4,900	163,000	10,400
Cast irons	(5)	6,920	490	506	86,000	16
Superalloys	45	316	--	(5)	164	686
Alloys (excluding alloy steels and superalloys)	(5)	11,200	2,920	(5)	52,500	1,240
Miscellaneous and unspecified	577	(6)	(6)	337	203,000	41
Grand total	1,400	317,000	106,000 [7]	5,750	505,000	12,400
Total 2010	1,190	308,000 [r]	97,300 [r, 7]	5,370	468,000 [r]	11,700 [r]
Percentage of 2010	117	103	109	107	108	106
Consumer stocks, December 31	109	25,300 [8]	21,700 [8]	742	14,500	926

[r]Revised. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]FeB, ferroboron, including other boron materials; FeMn, ferromanganese, including manganese metal; SiMn, silicomanganese; FeP, ferrophosphorus, including other phosphorus materials; FeSi, ferrosilicon, including silicon metal, silvery pig iron, silicon carbide, and inoculant alloys; FeTi, ferrotitanium, including titanium scrap and other titanium materials.
[3]All or part included with "Steel, unspecified."
[4]All or part included with "Steel, other alloy."
[5]All or part included with "Miscellaneous and unspecified."
[6]All or part included with "Alloys (excluding alloy steels and superalloys)."
[7]Internal evaluation indicates that silicomanganese consumption is considerably understated.
[8]Consumer and producer stocks.

TABLE 4
REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS BY END USE IN 2011[1, 2]

(Metric tons of contained elements unless otherwise specified)

End use	FeCr	FeMo	FeNb	FeNi	FeV	FeW
Steel:						
Carbon	3,570	310	1,630	--	677	(3)
High-strength low-alloy	1,930	122	(3)	(4)	W	--
Stainless and heat-resisting	209,000	784	684	12,700	62	(3)
Other alloy	18,900	3,750	331	158	1,920	(3)
Tool	(4)	W	17	(4)	W	(3)
Unspecified	10,200	--	1,510	(4)	--	115
Total	244,000	4,970	4,160	12,900	2,660	115
Cast irons	(5)	337	--	--	W	--
Superalloys	6,110	(6)	3,020	(5)	11	(3)
Alloys (excluding alloy steels and superalloys)	2,260	139	21	335	W	(3)
Miscellaneous and unspecified	(5)	93	--	(5)	1,570	--
Grand total	252,000	5,540	7,210	13,200	4,240	115
Total 2010	252,000 [r]	4,670	5,590	11,400	4,210	129
Percentage of 2010	100	119	129	116	101	89
Consumer stocks, December 31	6,070	355	406	989	122	18

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "miscellaneous and unspecified." -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]FeCr, ferrochromium, including other chromium ferroalloys and chromium metal; FeMo, ferromolybdenum, including calcium molybdate; FeNb, ferroniobium, including nickel niobium; FeNi, ferronickel; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; and FeW, ferrotungsten.
[3]Included with "Steel, unspecified."
[4]All or part included with "Steel, other alloy."
[5]Withheld to avoid disclosing company proprietary data.
[6]Included with "Alloys (excluding alloy steels and superalloys)."

TABLE 5
FERROALLOY PRICES IN 2011

	High	Low	Average
Chromium:			
Ferrochromium:			
0.05% carbon[1]	247.44	243.82	245.63
0.10% carbon[1]	229.28	225.91	227.59
0.15% carbon[1]	220.49	216.56	218.53
Over 4% carbon:			
49–51% chromium[1]	118.01	112.92	115.46
60–65% chromium[1]	124.25	119.23	121.74
Manganese:			
Medium-carbon ferromanganese[1]	119.00	95.00	108.43
Standard high-carbon ferromanganese[2]	1,350.00	1,150.00	1,310.57
Silicomanganese[3]	67.00	49.00	59.70
Molybdenum:			
Ferromolybdenum[4]	17.83	17.49	17.66
Molybdenum oxide[4]	15.60	15.37	15.48
Silicon:			
50% ferrosilicon[1]	120.00	100.00	111.30
75% ferrosilicon[1]	110.00	89.00	102.20
Silicon metal[1]	166.00	142.00	157.57
Vanadium, ferrovanadium[4]	15.00	1,461.00	14.81

[1]Cents per pound of contained element.

[2]Dollars per gross ton.

[3]Cents per pound.

[4]Dollars per pound of contained element.

Sources: Platts Metals Week and Ryan's Notes.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS AND FERROALLOY METALS IN 2011[1]

Alloy	Imports			Exports		
	Gross weight (metric tons)	Contained weight (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained weight (metric tons)	Value (thousands)
Ferroalloys:						
Chromium ferroalloys:						
Ferrochromium containing:						
More than 4% carbon	462,000	265,000	$602,000	4,260	1,940	$5,360
Not more than 4% carbon	XX	XX	XX	1,030	549	2,250
More than 3% but not more than 4% carbon	1,510	855	1,200	XX	XX	XX
More than 0.5% but not more than 3% carbon	393	224	912	XX	XX	XX
Not more than 0.5% carbon	53,700	37,100	186,000	XX	XX	XX
Ferrochromium-silicon	20,000	7,820	33,600	28	10	64
Total	538,000	311,000	824,000	5,330	2,500	7,670
Manganese ferroalloys:						
Ferromanganese containing:						
More than 4% carbon	239,000	184,000	268,000	XX	XX	XX
More than 2% but not more than 4% carbon	380	331	928	XX	XX	XX
More than 1% but not more than 2% carbon	74,900	60,300	133,000	XX	XX	XX
Not more than 1% carbon	34,500	29,300	81,000	XX	XX	XX
Ferromanganese, all grades	XX	XX	XX	4,510	XX	7,780
Silicomanganese	348,000	232,000	417,000	8,470	XX	11,100
Total	697,000	506,000	899,000	13,000	XX	18,900
Silicon ferroalloys:						
Ferrosilicon containing:						
More than 55% silicon	XX	XX	XX	24,900	15,400	22,200
55% to 80% silicon and more than 3% calcium	8,300	5,390	19,300	XX	XX	XX
Magnesium ferrosilicon	16,500	7,610	34,000	XX	XX	XX
Ferrosilicon, other[2, 3]	208,000	143,000	329,000	9,090	4,180	18,400
Total	233,000	156,000	383,000	34,000	19,500	40,600
Other ferroalloys:						
Ferrocerium and other pyrophoric alloys	2,440	XX	10,700	XX	XX	XX
Ferromolybdenum	4,810	3,210	119,000	1,950	1,330	47,079
Ferronickel	37,700	11,700	269,000	39	23	630
Ferroniobium	10,600	XX	289,000	519	XX	5,640
Ferrophosphorus	8,690	XX	5,120	577	XX	1,240
Ferrotitanium and ferrosilicon-titanium	2,070	XX	11,700	3,210	XX	17,600
Ferrotungsten and ferrosilicon-tungsten	263	206	7,980	44	22	730
Ferrovanadium	2,800	2,220	64,600	444	314	9,980
Ferrozirconium	88	XX	406	2,680	XX	6,720
Ferroalloys, other	8,050	XX	32,400	8,700	XX	13,800
Total	77,600	17,300	810,000	18,200	1,690	103,000
Total ferroalloys	1,550,000	990,000	2,920,000	70,400	23,700	171,000
Metals:						
Chromium (total, all grades)	13,600	XX	192,000	557	XX	13,800
Manganese:						
Metal, including alloys and waste and scrap	XX	XX	XX	3,370	XX	10,100
Unwrought	34,200	XX	110,000	XX	XX	XX
Other manganese, wrought	369	XX	1,320	XX	XX	XX
Silicon:						
Less than 99% silicon	48,400	46,900	134,000	13,800	13,400	44,900
Less than 99.99% but not less 99% silicon	137,000	135,000	439,000	10,700	10,600	34,500
More than 99.99% silicon	4,420	XX	311,000	55,000	XX	2,560,000
Total metals	238,000	182,000	1,190,000	83,400	23,900	2,670,000
Grand total	1,780,000	1,170,000	4,100,000	154,000	47,700	2,840,000

XX Not applicable.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes less than 55% silicon and 55% to 80% silicon, other.

[3]Includes imports of ferrosilicon containing 80% to 90% silicon and more than 90% silicon.

Source: U.S. Census Bureau.

TABLE 7
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country, furnace type, and alloy type[3, 4, 5]	2007	2008	2009	2010	2011[e]
Albania, electric furnace, ferrochromium	--	11,916	7,556	8,000 [e]	8,000
Argentina, electric furnace:					
Ferrosilicon[e]	15,000	10,400	11,300	11,000	11,000
Silicomanganese	8,917	9,172	6,644	10,900 [r]	10,900 [6]
Total[e]	23,900	19,600	17,900	21,900 [r]	21,900
Armenia, electric furnace:					
Ferromolybdenum	5,977	5,325	5,144	5,126	5,300
Ferrotungsten	45	-- [r]	-- [r]	-- [r]	--
Total	6,022	5,325 [r]	5,144 [r]	5,126 [r]	5,300
Australia, electric furnace:[e]					
Ferromanganese	115,000	147,000	87,000	136,000	146,000
Silicomanganese	110,000	125,000	74,000	131,000	130,000
Silicon metal	35,000	35,000	30,000	30,000	30,000
Total	260,000	307,000	191,000	297,000	306,000
Austria, electric furnace:[e]					
Ferronickel, including ferronickel molybdenum	2,250	2,000	1,750	1,500	1,500
Other	11,000 [r]	11,000 [r]	10,200 [r]	12,000 [r]	12,000
Total	13,300 [r]	13,000 [r]	12,000 [r]	13,500 [r]	13,500
Bahrain, electric furnace:					
Ferromanganese	--	--	5,700	5,600	35,300 [6]
Silicomanganese	--	--	6,500	3,700	3,000 [6]
Total	--	--	12,200	9,300	38,300 [6]
Bhutan, electric furnace, ferrosilicon, exports	40,313 [r]	30,824 [r]	90,798 [r]	97,528 [r]	94,000
Bosnia and Herzegovina, electric furnace, net exports:[e]					
Ferrosilicon	860	640	470	870	1,800
Silicon metal	11,600	12,400	11,000	17,300	17,500
Total	12,500	13,000	11,500	18,200	19,300
Brazil, electric furnace:					
Ferrochromium[7]	195,890	194,324	131,048	277,114 [r]	277,200 [p]
Ferrochromium silicon	11,600 [e]	11,507	11,510	11,600	11,700
Ferromanganese[e]	205,000	190,000	75,000	72,600 [r, 6]	65,400 [6]
Ferronickel	39,672	36,544	37,708	33,860	86,800 [p]
Ferroniobium (ferrocolumbium)	52,442	53,839	34,746	52,588 [r]	52,600 [p]
Ferrosilicon[e]	146,000	144,832 [6]	145,000	145,000	145,000
Ferrotitanium	4,988	4,002	482	498	500
Silicomanganese[e]	214,000	198,000	79,000	168,600 [r, 6]	169,900 [6]
Silicon metal[e]	133,000	131,940 [6]	132,000	132,000	133,000
Other[e]	19,500	19,344 [6]	19,350 [6]	19,400	19,500
Total[e]	1,020,000	984,000	666,000	913,000 [r]	962,000
Bulgaria, electric furnace, ferrosilicon[e]	10,000	6,000 [6]	3,000 [6]	--	--
Canada, electric furnace:[e]					
Ferroniobium (ferrocolumbium)	4,337 [r, 6]	4,384 [r, 6]	4,620 [r]	4,620 [r]	4,620
Ferrosilicon	35,000	35,000	25,820 [r, 6]	36,786 [r, 6]	31,039 [6]
Ferrovanadium	1,000	1,000	900	900	900
Silicon metal	30,000	50,000	30,000	30,000	30,000
Total	70,300 [r]	90,400 [r]	61,300 [r]	72,300 [r]	66,600
Chile, electric furnace, ferromolybdenum	14,828	16,918	10,820	12,485	17,177 [6]
China:[e]					
Blast furnace:					
Ferromanganese	600,000	600,000	350,000	350,000	350,000
Other	50,000	50,000	30,000	30,000	30,000
Electric furnace:					
Ferrochromium	1,300,000	1,500,000	1,810,000	2,400,000 [r]	2,600,000
Ferromanganese	1,930,000	2,100,000	2,070,000	2,300,000	2,400,000
Ferromolybdenum	60,000	80,000	90,000	90,000	100,000
Ferronickel and high nickel pig iron[8]	845,000	590,000	600,000	900,000	800,000
Ferrosilicon	4,710,000	4,900,000	5,100,000	5,300,000	5,400,000

See footnotes at end of table.

TABLE 7—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country, furnace type, and alloy type[3, 4, 5]	2007	2008	2009	2010	2011[e]
China—Continued:[e]					
Electric furnace—Continued:					
Ferrotitanium	10,000	14,000	300	5,600 [r]	5,000
Silicomanganese	4,340,000	5,000,000	5,430,000	5,840,000 [r]	6,000,000
Silicon metal	950,000	980,000	1,230,000	1,300,000 [r]	1,400,000
Other	3,560,000	3,230,000	6,620,000	7,600,000	8,000,000
Total, blast and electric furnaces	18,400,000	19,000,000	23,300,000	26,100,000 [r]	27,100,000
Colombia, electric furnace, ferronickel	145,282	126,638	153,628	145,239	103,779 [p, 6]
Czech Republic, electric furnace, other[e]	2,800	2,800	--	--	--
Dominican Republic, electric furnace, ferronickel	75,067	47,408	--	--	34,610 [p, 6]
Egypt, electric furnace:					
Ferromanganese	30,000	28,800 [r]	26,300 [r]	20,000 [r]	30,000
Ferrosilicon[e]	48,000	59,000	78,000	78,000 [r]	78,000
Total[e]	78,000	87,800 [r]	104,000 [r]	98,000 [r]	108,000
Finland, electric furnace, ferrochromium	241,760	233,550	123,310	125,000 [e]	125,000
France, electric furnace:					
Ferromanganese	143,900 [r]	46,600	46,000	138,100 [r]	130,500 [6]
Ferrosilicon[e]	31,000	30,000	18,300	27,000	59,000
Silicomanganese	65,400	60,200	54,100	62,400 [r]	63,400 [6]
Silicon metal[e]	120,000	118,000	80,000	112,000 [r]	128,000
Other[e]	60,000	60,000	60,000	60,000	60,000
Total[e]	420,000 [r]	315,000	258,000	400,000 [r]	441,000
Georgia, electric furnace:[e]					
Ferromanganese	5,000	5,000	4,500 [r, 6]	8,700 [r, 6]	9,300
Silicomanganese	120,000	120,000	112,016 [6]	203,464 [6]	220,000
Total	125,000	125,000	116,516 [r, 6]	212,164 [r, 6]	229,300
Germany, electric furnace:					
Ferrochromium	22,030	26,960	13,667	17,300 [r, e]	17,800
Silicon metal	35,245	29,092 [r]	27,620 [r]	30,105 [r]	30,134 [6]
Other[e, 9]	5,000	5,000	6,336 [r, 6]	9,200 [r]	9,000
Total[e]	62,300	61,100 [r]	47,623 [r, 6]	56,600 [r]	56,900
Greece, electric furnace, ferronickel[e]	90,000	87,664 [6]	42,423 [6]	66,000	80,200
Iceland, electric furnace, ferrosilicon	110,000 [e]	100,000 [e]	112,993	114,231	120,076 [6]
India, electric furnace:[10]					
Ferroaluminum	9,377	8,170	7,017	7,000 [e]	7,000
Ferroboron[e]	80	83	90 [6]	95	98
Ferrochromium[e, 11]	820,000	750,000	873,385 [6]	850,000	830,000
Ferromanganese[12]	367,700 [r]	386,200 [r]	399,100 [r]	440,000 [r]	440,000 [6]
Ferromolybdenum	2,899	2,162	2,822	3,000 [e]	3,200
Ferronickel magnesium	122	221	209	210 [e]	210
Ferrosilicomagnesium	13,525	13,400	17,342 [r]	17,000 [e]	18,000
Ferrosilicon[e]	80,000	92,000	101,337 [6]	101,000	105,000
Ferrosilicozirconium	109	87	120	150 [e]	170
Ferrotitanium	1,937	1,661	2,379	2,200 [e]	2,300
Ferrotungsten	51	150	150	160 [e]	160
Ferrovanadium	1,585	1,501	1,769	1,800 [e]	1,850
Silicomanganese[12]	790,100 [r]	848,700 [r]	875,500 [r]	1,000,000	1,296,000 [6]
Total[e]	2,090,000 [r]	2,100,000 [r]	2,280,000 [r]	2,420,000 [r]	2,700,000
Indonesia, electric furnace:					
Ferromanganese[e]	12,000	12,000	12,000	12,000	12,000
Ferronickel	92,500	87,800	62,700	93,300 [e]	98,200
Silicomanganese[e]	6,000	7,000	7,000	8,000	8,000
Total[e]	111,000	107,000	81,700	113,000	118,000
Iran, electric furnace:[e]					
Ferrochromium	8,000	8,000	8,000	8,000	8,000
Ferrosilicon	45,000	45,000	45,000	45,000	45,000
Total	53,000	53,000	53,000	53,000	53,000

See footnotes at end of table.

TABLE 7—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country, furnace type, and alloy type[3, 4, 5]	2007	2008	2009	2010	2011[e]
Italy, electric furnace:					
Ferromanganese	4,800	8,500	5,500	17,000	18,000 [6]
Silicomanganese	37,000	25,500	17,000	22,900 [r]	24,600 [6]
Other[e, 13]	10,000	10,000	10,000	10,000	10,000
Total[e]	51,800	44,000	32,500	49,900 [r]	52,600
Japan, electric furnace:					
Ferrochromium[14]	12,016	13,888	7,698	16,208	16,000
Ferromanganese	420,151	431,181	361,375	453,265	456,798 [6]
Ferromolybdenum	4,573	4,554	3,598	4,615	4,500
Ferronickel	351,503	301,361	284,884	348,420	342,252 [p, 6]
Ferrotitanium	NA	NA	NA	NA	NA
Ferrovanadium	3,205	3,477	2,560	4,190	4,000
Silicomanganese	52,901	58,884	49,205	49,865	48,798 [6]
Other[15]	13,982	14,478	12,957	16,374	16,000
Total	858,331	827,823	722,277	892,937	888,000
Kazakhstan, electric furnace:					
Ferrochromium	1,307,536	1,220,315	1,173,286	1,311,302 [r]	1,300,000
Ferrochromium silicon	145,695	133,828	60,829	159,765 [r]	130,000
Ferrosilicon	59,886	54,964	33,100	4,813 [r]	10,000
Silicomanganese	188,445	179,939	200,374	224,627 [r]	220,000
Silicon metal	--	--	--	1,500 [e]	8,000
Total	1,701,562	1,589,046	1,467,589	1,700,000 [r, e]	1,670,000
Korea, North, electric furnace, other[e]	10,000	10,000	10,000	10,000	10,000
Korea, Republic of, electric furnace:					
Ferromanganese	209,321	251,125	216,400 [r]	286,259 [r]	355,047 [6]
Ferronickel	--	6,600	56,911	55,215	50,069 [p, 6]
Silicomanganese	105,607	76,184	151,100 [r]	120,779 [r]	195,650 [6]
Other	4,224	4,000 [e]	--	--	--
Total	319,152	338,000 [e]	424,411 [r]	462,253 [r]	600,766 [6]
Kosovo, ferronickel[e]	3,500	24,300	27,700	30,400	68,100 [p]
Laos, silicon metal, net exports[e]	--	3,020	7,350	7,770	3,000
Macedonia, electric furnace:					
Ferromanganese	--	12,623	--	--	--
Ferronickel[e]	66,600	65,300	52,200	60,900	70,800
Ferrosilicon	34,215	42,674	7,657	30,044 [r]	56,167 [6]
Silicomanganese	70,472	54,931	--	36,705 [r]	50,756 [6]
Total[e]	171,000	176,000	59,900	128,000 [r]	178,000
Mexico, electric furnace:					
Ferromanganese	74,578	97,366	42,492	81,000 [r]	74,000 [6]
Silicomanganese	109,286	114,320	85,065	132,500 [r]	139,000 [6]
Total	183,864	211,686	127,557	213,500 [r]	213,000 [6]
New Caledonia, electric furnace, ferronickel	151,100	144,300	147,200	145,000	148,500 [p, 6]
Norway, electric furnace:					
Ferromanganese	291,400 [r]	308,400 [r]	196,700 [r]	297,300 [r]	337,900 [6]
Ferrosilicon	217,000 [e]	250,575	207,337	210,000 [e]	200,000
Silicomanganese	305,600 [r]	262,400 [r]	231,300 [r]	248,700 [r]	266,000 [6]
Silicon metal	145,782	180,135	169,643	170,000 [e]	170,000
Other[e, 9]	60,000 [r]	60,000 [r]	150,000 [r]	150,000 [r]	150,000
Total[e]	1,020,000 [r]	1,060,000 [r]	955,000 [r]	1,080,000 [r]	1,120,000
Peru, electric furnace, ferrosilicon[e]	600	600	600	600	600
Poland:					
Blast furnace, ferromanganese	2,100	8,500	1,700	2,000 [e]	2,000
Electric furnace:					
Ferrosilicon	58,538	56,031	9,685	53,206 [r]	53,000
Silicomanganese	15,600	25,100	-- [r]	-- [r]	--
Total, blast and electric furnaces	76,238	89,631	11,385 [r]	55,200 [r, e]	55,000

See footnotes at end of table.

TABLE 7—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country, furnace type, and alloy type[3, 4, 5]	2007	2008	2009	2010	2011[e]
Romania, electric furnace:					
Ferrochromium	--	6,000 [r]	15,000 [r]	14,000 [r]	--
Silicomanganese[e]	26,868 [6]	10,000	--	21,000 [r]	29,000
Total	26,868	16,000 [r, e]	15,000 [r]	35,000 [r, e]	29,000
Russia:[e]					
Blast furnace:					
Ferromanganese	120,000	110,000	88,000 [6]	171,600 [6]	160,000
Ferrophosphorus	3,500	3,500	3,000	3,600 [r]	3,600
Spiegeleisen	7,000	7,000	6,500	5,500	5,000
Electric furnace:					
Ferrochromium	570,000	490,000	378,000 [6]	414,000	430,000
Ferrochromium silicon	4,000	4,000	3,500	3,600 [r]	3,600
Ferronickel:					
High-nickel[6, 16]	19,031	17,971	17,489	19,763	19,881
Other[17]	12,840	13,440	14,040	14,600	14,600
Ferroniobium (ferrocolumbium)	80 [r]	80 [r]	79 [r]	80 [r]	80
Ferrosilicon	896,100 [6]	850,000	745,000	916,000	920,000
Ferrotitanium	NA	NA	NA	4,000	4,000
Ferrovanadium	12,000	12,000	8,029 [6]	13,057 [r, 6]	13,500
Silicomanganese	40,000	40,000	98,700 [6]	147,900 [6]	150,000
Silicon metal	54,000	54,000	23,900	48,700	50,000
Other	22,000	22,000	20,000	18,000	20,000
Total, blast and electric furnaces	1,760,000 [r]	1,620,000 [r]	1,410,000 [r]	1,780,000 [r]	1,790,000
Saudi Arabia, electric furnace:					
Ferromanganese	24,800	38,500	37,500	26,000	26,000
Silicomanganese	50,400	57,700	60,000	61,300	96,000
Other[e]	85,000	90,000	80,000	90,000	90,000
Total[e]	160,000	186,000	178,000	177,000	212,000
Slovakia, electric furnace:					
Ferromanganese	74,065	61,194	21,000	35,449 [r]	18,180 [6]
Ferrosilicon	8,583	10,844	8,622	37,034	38,771 [6]
Silicomanganese	71,587	59,940	32,000	34,960 [r]	25,023 [6]
Other	5,000 [e]	--	--	--	--
Total	159,000 [e]	131,978	61,622	107,443 [r]	81,974 [6]
Slovenia, electric furnace, ferrosilicon	6,000 [e]	--	--	--	--
South Africa, electric furnace:					
Ferrochromium	3,551,983	3,268,659	2,346,132 [r]	3,607,132	3,700,000
Ferromanganese	699,000 [r]	503,000 [e]	239,100 [r]	239,100 [r]	690,000
Ferronickel, high-nickel	6,667	5,733	1,067	1,040	1,070
Ferrosilicon	140,000	135,000	110,000 [r]	118,000 [r]	112,000
Ferrovanadium[e]	19,000	19,000	14,000 [r]	19,000 [r]	20,000
Silicomanganese	298,400 [r]	237,100 [r]	135,100 [r]	274,400 [r]	313,600 [6]
Silicon metal	50,000 [r]	52,000 [r]	39,000 [r]	56,400 [r]	70,600
Total[e]	4,770,000 [r]	4,220,000 [r]	2,880,000 [r]	4,320,000 [r]	4,910,000
Spain, electric furnace:[e]					
Ferromanganese	156,000 [r]	161,000 [r]	60,100 [r]	134,000 [r]	108,000
Ferrosilicon	71,000	74,000	44,000	64,400	57,000
Silicomanganese	154,000 [r]	158,000 [r]	59,200 [r]	132,000 [r]	164,000
Silicon metal	32,000	33,000	23,000	32,500	43,000
Other	5,000	5,000	5,000	5,000	5,000
Total	418,000 [r]	431,000 [r]	191,000 [r]	368,000 [r]	377,000
Sweden, electric furnace:					
Ferrochromium	124,403	117,053	31,345	36,000 [e]	36,000
Ferrosilicon[e]	5,000	5,000	5,000	5,000	5,000
Total[e]	129,000	122,000	36,300	41,000	41,000

See footnotes at end of table.

TABLE 7—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country, furnace type, and alloy type[3, 4, 5]	2007	2008	2009	2010	2011[e]
Thailand, electric furnace, silicon metal	--	--	NA	22,500 [e]	20,000
Turkey, electric furnace:					
Ferrochromium	69,730	79,840	41,028	60,000 [e]	60,000
Ferrosilicon[e]	5,000	4,500	4,000	4,000	4,000
Total[e]	74,700	84,300	45,000	64,000	64,000
Ukraine:					
Blast furnace:[e]					
Ferromanganese	26,700	16,000	--	--	--
Spiegeleisen	4,730	2,000	--	--	--
Electric furnace:					
Ferromanganese	368,000	362,400	129,400	280,100	180,500 [6]
Ferronickel	79,530	89,825	61,449	62,000 [e]	62,000
Ferrosilicon	218,000	152,800	150,300	195,500	150,900 [6]
Ferrotitanium	NA	NA	NA	NA	NA
Silicomanganese	1,281,000	894,900	741,900	940,400	843,500 [6]
Other[e]	23,700	23,000	23,900	28,500	28,500
Total, blast and electric furnaces[e]	2,000,000	1,540,000	1,110,000	1,510,000	1,270,000
United Kingdom, electric furnace, ferrotitanium	NA	NA	NA	NA	NA
United States, electric furnace:					
Ferrochromium[18]	W	W	W	-- [r]	--
Ferromanganese[19]	W	W	W	W	W
Ferroniobium (ferrocolumbium)	NA	NA	NA	NA	NA
Ferrosilicon[20]	220,091	247,655	193,774	370,381 [r]	(21)
Ferrotitanium	NA	NA	NA	NA	NA
Silicon metal[20]	W	W	W	W	(21)
Other[22]	W	W	W	W	W
Total	220,091	247,655	193,774	370,381 [r]	437,010 [6, 23, 24]
Uruguay, electric furnace, ferrosilicon[e]	200	200	200	200	200
Venezuela, electric furnace:[e]					
Ferromanganese	20,000 [r]	20,000 [r]	15,800 [r]	5,300 [r]	12,000
Ferronickel[6]	68,506	42,300	40,113	45,200 [r]	51,800
Ferrosilicon	94,000	88,000	52,100	76,800	70,000
Silicomanganese	52,000 [r]	52,000 [r]	45,800 [r]	16,500 [r]	24,000
Total	235,000 [r]	202,000 [r]	154,000 [r]	144,000 [r]	158,000
Zimbabwe, electric furnace:					
Ferrochromium	187,327	145,430	72,223	146,000 [r, e]	140,000
Ferrochromium silicon	3,097	1,612	603	--	--
Total	190,424	147,042	72,826	146,000 [r, e]	140,000
Grand total:	38,100,000 [r]	37,500,000 [r]	38,100,000 [r]	45,200,000 [r]	47,300,000
Of which:					
Blast furnace:					
Ferromanganese	749,000	735,000	440,000	524,000	512,000
Spiegeleisen	11,700	9,000	6,500	5,500	5,000
Other[25]	53,500	53,500	33,000	33,600	33,600
Electric furnace:					
Ferrochromium[26]	8,410,000	8,070,000 [r]	7,030,000 [r]	9,290,000 [r]	9,550,000
Ferrochromium silicon	164,000	151,000	76,400	175,000 [r]	145,000
Ferromanganese	5,150,000 [r]	5,170,000 [r]	4,050,000 [r]	4,990,000 [r]	5,540,000
Ferromolybdenum	88,300	109,000	112,000	115,000	130,000
Ferronickel[16, 17]	2,050,000	1,690,000	1,600,000	2,020,000	2,030,000
Ferroniobium (ferrocolumbium)	56,900 [r]	58,300 [r]	39,400 [r]	57,300 [r]	57,300
Ferrosilicon	7,310,000	7,430,000	7,300,000 [r]	8,040,000 [r]	7,770,000 [27]
Ferrovanadium[e]	36,800	37,000	27,300 [r]	38,900 [r]	40,300
Silicomanganese	8,510,000 [r]	8,670,000 [r]	8,550,000 [r]	9,890,000 [r]	10,500,000
Silicon metal	1,600,000	1,680,000	1,800,000 [r]	1,990,000 [r]	2,130,000 [28]
Other[29]	3,940,000 [r]	3,610,000 [r]	7,060,000 [r]	8,070,000 [r]	8,900,000 [23]

[e]Estimated. [p]Preliminary. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." NA Not available. -- Zero.

TABLE 7—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.
[2]Table includes data available through December 13, 2012.
[3]In addition to the countries listed, ferrotungsten is produced in China, Russia, and Vietnam; Austria, China, and Germany are thought to have produced ferroniobium (ferrocolumbium); and Iran is thought to have produced ferromolybdenum and silicomanganese, but production information is inadequate for the formulation of estimates of output levels.
[4]To the extent possible, ferroalloy production of each country has been separated according to the furnace from which production is obtained; production derived from metallothermic operation is included with electric furnace production.
[5]To the extent possible, ferroalloy production of each country has been separated to show the following individual major types of ferroalloys: ferrochromium, ferrochromium silicon, ferromanganese, ferromolybdenum, ferronickel, ferroniobium (ferrocolumbium), ferrosilicon, ferrovanadium, silicomanganese, silicon metal, and spiegeleisen. Ferroalloys other than those listed that have been identified specifically in sources, as well as those ferroalloys not identified specifically, but which definitely exclude those listed previously in this footnote, have been reported as "Other." Where one or more of the individual ferroalloys listed separately in this footnote have been inseparable from other ferroalloys owing to a nation's reporting system, deviations are indicated by individual footnotes.
[6]Reported figure.
[7]Includes high- and low-carbon ferrochromium.
[8]China currently makes several different types of ferronickel. These products range from a low nickel pig iron (for example, Zhejiang Huaguang Smelting Group Co., Ltd., 8.5% to 9.0% nickel) to high nickel ferronickel carbonyl powder (Jilin Jien Nickel Industry Co., Ltd., 70% to 80% nickel). The gross weight figures are based on average estimated content ranging from 20% to 25% nickel.
[9]Includes, if any, ferrochromium silicon and ferronickel.
[10]Reported on a fiscal year basis, which is from April 1 to March 31, unless otherwise noted.
[11]Includes charge chrome and ferrochrome.
[12]Reported on a calendar year basis.
[13]Excludes calcium-silicon.
[14]Includes high- and low-carbon ferrochromium and ferrochromium silicon.
[15]Includes calcium-silicon, ferrocolumbium, and other ferroalloys.
[16]Low-iron ferronickel containing greater than 85% nickel.
[17]Includes ferronickel chromium and nickel-resist cast iron produced from scrap.
[18]U.S. output of ferrochromium includes chromium metal, high- and low-carbon ferrochromium, ferrochromium silicon, and other chromium materials.
[19]U.S. output of ferromanganese includes silicomanganese.
[20]Net production.
[21]Withheld to avoid disclosing company proprietary undifferentiated data; data included in "United States, total" and excluded from "Grand total."
[22]May include ferroboron, ferrocolumbium, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrovanadium, nickel columbium, and silvery pig iron.
[23]Includes undifferentiated ferrosilicon and silicon metal to avoid disclosing company proprietary data.
[24]For January 2011, data include ferrosilicon and silicon alloys only.
[25]Includes ferrophosphorus and data contained in "Blast furnace: Other."
[26]Ferrochromium includes ferrochromium silicon, if any, for Japan, South Africa, and the United States.
[27]Excludes total U.S. net production of ferrosilicon.
[28]Excludes total U.S. net production of silicon metal.
[29]Includes ferroaluminum, ferroboron, ferronickel magnesium, ferrosilicomagnesium, ferrosilicozirconium, ferrotitanium, ferrotungsten, and U.S. total silicon materials for 2011.