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Ferroalloys

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Ferroalloys are alloys of iron used 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. Twelve companies in the United States produced seven ferroalloys at 13 plants (table 1); production statistics were concealed to avoid disclosing proprietary data. The leading ferroalloy-producing countries in 2013 were, in decreasing order of production, China (65%), South Africa (7%), India (5%), and Russia and Kazakhstan (3% each) (table 7). These five countries accounted for 84% of world ferroalloy production. World production of bulk ferroalloys—ferrochromium (including ferrochromium-silicon), ferromanganese, ferrosilicon (excluding U.S. production), and silicomanganese—was estimated to have been 37.9 million metric tons (Mt) in 2013, a 4% increase compared with the revised figure of 36.6 Mt for 2012 (table 7).

In 2013, the average price for all grades of ferrochromium decreased by 7% to 8% from that in 2012. The average price for medium-carbon ferromanganese decreased by 5% in 2013, whereas the average prices for standard high-carbon ferromanganese and silicomanganese decreased by 14% and 17%, respectively. Average prices for 50%-grade ferrosilicon and 75%-grade ferrosilicon increased by 3% from those in 2012. The weighted average price for ferrotungsten, in 2013, was $47.22 per kilogram of contained tungsten, a 6% decrease from $50.18 in 2012. The weekly price range for 70%-grade ferrotitanium was $2.93 to $3.09 per pound of contained titanium, a 7% decrease from $3.20 to $3.25 per pound of contained titanium in 2012. Ferrovanadium decreased to $13.43 per pound of contained vanadium in 2013, 10% lower than $14.88 per pound of contained vanadium in 2012.

U.S. reported consumption, by gross weight, of ferromanganese, ferrosilicon, and silicomanganese in 2013 was approximately 1.02 Mt, a 3% increase from that in 2012 (table 3). U.S. consumption of ferrochromium in 2013, by alloying element content, was 252,000 metric tons (t) (table 4). In 2013, individual reported consumption, by alloying element content, of ferrochromium, ferrosilicon, and silicomanganese each decreased slightly from that in 2012, whereas ferromanganese increased by 9%. Among other alloys, ferrotungsten had the largest decrease in consumption (41%), followed by ferromolybdenum (13%), ferrophosphorous (6%), and ferrotitanium (5%) (tables 3, 4).

The United States was a net importer of ferroalloys in 2013. On a gross-weight basis, U.S. total ferroalloy imports decreased by 8% and exports decreased by 16% compared with those of 2012, which resulted in an 8% decrease in net imports (table 6). Ferromanganese had the largest decrease in net imports in 2013 (67,300 t), followed by ferrochromium (33,600 t), silicomanganese (18,800 t), ferrochromium-silicon (13,800 t), ferroniobium (1,750 t), and ferrotitanium (including ferrosilicon-titanium) (1,230 t). Ferronickel had the largest increase in net imports in 2013 (11,100 t), followed by silicon ferroalloys (7,110 t), other ferroalloys (1,560 t), and ferrophosphorus (1,210 t).

Ferrochromium

The leading chromite-ore-producing countries in 2013, in descending order of production, were South Africa (14 Mt), Kazakhstan (4 Mt), India (3 Mt), and Turkey (3 Mt) (John F. Papp, Mineral Commodity Specialist, U.S. Geological Survey, unpub. data, June 4, 2015). Chromite ore was mostly smelted in electric arc furnaces to produce ferrochromium for the metallurgical industry. The leading ferrochromium-producing countries, in descending order of production, were China (32%), South Africa (32%), Kazakhstan (13%), and India (9%) (table 7). Most of the 9.93 Mt of ferrochromium produced globally was consumed in the manufacture of stainless steel. In 2013, 38 Mt of stainless steel was produced globally. The leading stainless-steel-producing areas of the world were 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).

Four industry trends were evolving in 2013—ferrochromium was being increasingly produced using 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.

For more information on chromium and ferrochromium, visit the National Minerals Information Center's Chromium—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/chromium/*.

Ferromanganese

Two manganese ferroalloys, ferromanganese and silicomanganese, are key ingredients for steelmaking. In the United States, two companies produced manganese ferroalloys: Eramet Marietta Inc. (owned by France's Eramet Group) and Felman Production LLC (owned by Miami-based Georgian American Alloys, Inc.) (table 1). In addition to domestic production in 2013, the United States imported 659,000 t of ferromanganese and silicomanganese (gross weight) (table 6). Of that amount, 41% was imported from

South Africa (270,000 t), 16% from Australia (106,000 t), 16% from Georgia (106,000 t), and 11% from Norway (72,100 t) (Corathers, 2014). China was the leading world producer of manganese ferroalloys, with output about 300% greater than that of the next three major producers—India, South Africa, and Ukraine—combined (table 7).

For more information on ferromanganese, manganese, and silicomanganese, visit the National Minerals Information Center's Manganese—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/manganese/*.

Ferromolybdenum

Chile, China, and the United States accounted for about 78% of the global production of molybdenite ore in 2013. 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 46% of the total reported molybdenum materials consumed in the United States (18,600 t) was in the form of molybdic oxides and about 23% 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 2013 (Polyak, 2015a). The steel industry accounted for most of the ferromolybdenum consumed in the United States in 2013, principally in the production of stainless and full alloy steels (table 4).

For more information on ferromolybdenum and molybdenum, visit the National Minerals Information Center's Molybdenum—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/molybdenum/*.

Ferronickel

In 2013, more than 86% of ferronickel consumed in the United States was used in stainless, heat-resistant, and certain alloy steels (table 4). No ferronickel was produced in the United States from lateritic ores in 2013. The International Metals Reclamation Co. produced a remelt alloy from recycled materials, which was used as a substitute for ferrochromium and ferronickel in the production of austenitic stainless steel. In 2013, the major ferronickel-producing countries, by gross weight, were China (2.5 Mt, including nickel pig iron), Japan (403,000 t), New Caledonia (175,000 t), Brazil (149,000 t), and Colombia (139,000 t) (table 7). In 2013, China and Indonesia were the only two countries producing nickel pig iron, a nickel-iron alloy containing less than 15% nickel. Nickel pig iron is a low-grade product as opposed to conventional ferronickel grades, which range from 18% to 80% nickel content.

For more information on ferronickel and nickel, visit the National Minerals Information Center's Nickel—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/nickel/*.

Ferrosilicon

Silicon ferroalloy consumption is driven by cast iron and steel production, where silicon alloys are used as deoxidizers. Silicon metal was also used as an alloying agent with iron. Domestic data 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. In 2013, total domestic ferrosilicon and silicon metal production decreased by 6% to 468,000 t, gross weight, from 499,000 t, gross weight, in 2012. In addition to domestic production in 2013, the United States imported 373,000 t of ferrosilicon and silicon metal (gross weight). Of that amount, 23% was imported from Russia (85,400 t), 20% from China (75,400 t), 14% from Canada (51,200 t), and 8% from Brazil (29,600 t). China produced more ferrosilicon and silicon metal than the rest of the world combined—about four times the output of the next three major producing countries—Russia, Norway, and Brazil. China's ferrosilicon and silicon metal production was 70% and 67% of the world total, respectively, excluding net production in the United States (Emily K. Schnebele, Mineral Commodity Specialist, U.S. Geological Survey, unpub. data, June 4, 2015).

For more information on ferrosilicon, silicon, and silicon metal, visit the National Minerals Information Center's Silicon—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/silicon/*.

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 it has a lower melting temperature and higher density than titanium scrap. Steels with relatively high titanium content include interstitial-free, stainless, and high-strength low-alloy steels. Ferrotitanium is typically 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. The leading ferrotitanium-producing countries in 2013 were India, Russia, and the United States.

In the United States, reported domestic consumption of titanium products in steel and other alloys was 11,800 t (gross weight), a 5% decrease compared with that of 2012. The steel industry accounted for most of the ferrotitanium consumed in the United States in 2013. In 2013, the average U.S. spot-market price range for 70%-grade ferrotitanium reported by Platts Metals Week decreased to $2.93 to $3.09 per pound of contained titanium from $3.20 to $3.25 per pound of contained titanium in 2012.

For more information on ferrotitanium and titanium, visit the National Minerals Information Center's Titanium—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/titanium/*.

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 typically containing

between 75% and 80% tungsten; (2) tungsten melting base, which is a master alloy containing as much as 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; however, production data were not available. China's leading producers were in Fujian, Hunan, Jiangxi, Jilin, and Sichuan Provinces. Ferrotungsten was produced in Russia, Sweden, and Vietnam and may have been produced in Brazil and India. U.S. reported consumption of ferrotungsten decreased from that of 2012. Platts Metals Daily weekly ferrotungsten prices trended upward in 2013, ranging between $41 and $65 per kilogram of contained tungsten. The annual average price for 1 kilogram of contained tungsten was $47.22, which, despite the increasing price trend, averaged 6% less than the annual average of $50.18 per kilogram of contained tungsten in 2012.

For more information on ferrotungsten and tungsten, visit the National Minerals Information Center's Tungsten—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/tungsten/*.

Ferrovanadium

In 2013, China, Russia, and South Africa accounted for 99% of world vanadium mine production. In these countries, vanadium was primarily recovered from titanium-bearing magnetite ore processed to produce pig iron. The process produced a slag containing 20% to 24% vanadium pentoxide, which was further processed to ferrovanadium containing 40% to 50% vanadium (Polyak, 2015b).

In 2013, vanadium recovered 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. In 2013, the majority of U.S.-reported vanadium consumption was used for steelmaking, principally in carbon, full alloy, and high-strength low-alloy steels. Steel manufacturing consumed almost all of the ferrovanadium in 2013 (table 4).

For more information on ferrovanadium and vanadium, visit the National Minerals Information Center's Vanadium—Statistics and Information Web page at *http://minerals.usgs.gov/minerals/pubs/commodity/vanadium/*.

Outlook

The near-term trend for domestic ferroalloy consumption is 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 2013 U.S. Geological Survey Minerals Yearbook, volume I, Metals and Minerals. Raw steel production in the United States decreased slightly to 86.9 Mt in 2013 from 88.7 Mt in 2012 (Michael D. Fenton, Mineral Commodity Specialist, U.S. Geological Survey, unpub. data, June 4, 2015). According to the World Steel Association (2014a), world raw steel production in 2013 increased by 3.5% to 1.61 billion metric tons (Gt) from 1.55 Gt in 2012. Raw steel production in China, the world's leading producer of raw steel, increased by 7.5% to about 779 Mt, followed by Japan (111 Mt), the United States (87 Mt), India (81 Mt), and Russia (69 Mt).

Changes in steel production reflect changes in apparent use of steel. World steel consumption increased by 3.6% in 2013 following stronger-than-expected performance in the second half of the year. Consumption of steel is expected to increase to 1.53 Gt and 1.58 Gt in 2014 and 2015, respectively. According to the World Steel Association (2014b), in 2013, the economic recovery in the United States gained strength and the economy of the European Union stabilized. Many emerging economies continued to struggle with infrastructure issues and financial market volatility. In conjunction with China's economic deceleration, World Steel forecast a slightly lower global growth rate for steel demand in 2014. In 2015, steel demand in most parts of the world is expected to increase owing to a steady recovery in developed and emerging economies. However, China's growth in steel demand may further decelerate, preventing broad recovery momentum and increased growth of steel demand for 2015. In 2013, global steel demand recovery continued but stabilized at a lower rate with continued volatility and uncertainty leading to a challenging environment for steel companies.

Changes in apparent steel use in 2014 are expected to be Central America and South America, 51 Mt (3.4% increase); China, 721 Mt (3.0% increase); Commonwealth of Independent States, 60 Mt (1.1% increase); European Union, 143 Mt (3.1 % increase); India, 76 Mt (3.3% increase); Japan, 65 Mt (1.0% decrease); Middle East and North Africa, 67 Mt (6.1% increase); and the United States, 99 Mt (4.0% increase) (World Steel Association, 2014b).

Information on individual commodities, including domestic data coverage, foreign trade by country, outlook, and U.S. Government stockpile information, can be found in the respective mineral commodity chapters in the U.S. Geological Survey Minerals Yearbook, volume I, Metals and Minerals or online at *http://minerals.usgs.gov/minerals*.

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TABLE 1
DOMESTIC PRODUCERS OF FERROALLOYS IN 2013

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

Do. ditto.
[1]FeMn, ferromanganese; FeMo, ferromolybdenum; FeNb, ferroniobium; FeSi, ferrosilicon; FeTi, ferrotitanium; FeV, ferrovanadium; SiMn, silicomanganese.

TABLE 2
GOVERNMENT INVENTORY OF FERROALLOYS[1, 2]

(Metric tons of alloys)

Alloy	Inventory
Ferrochromium:	
High carbon	85,100
Low carbon	44,300
Ferromanganese, high carbon	347,000

[1]Data are rounded to no more than three significant digits.
[2]Data are uncommitted inventory as of December 31, 2013.

Source: Defense Logistics Agency Strategic Materials.

TABLE 3
REPORTED U.S. CONSUMPTION OF FERROALLOYS BY END USE IN 2013[1, 2]

(Metric tons of alloy, gross weight)

End use	FeB	FeMn	SiMn	FeP	FeSi	FeTi
Steel:						
Carbon and high-strength low-alloy	371	291,000	106,000	3,670	71,000	5,670
Stainless and heat-resisting	207	9,770	15,600	(3)	45,700	3,460
Tool	(3)	(3)	(3)	(3)	(3)	(4)
Other alloy	(3)	48,200	24,900	(3)	8,330	808
Unspecified	225	59,000	2,660	849	47,800	(4)
Total steel	803	408,000	149,000	4,520	173,000	9,940
Alloys (excluding alloy steels and superalloys)	(5)	600	2,920	(5)	27,900	1,240
Cast irons	(5)	7,900	330	432	91,800	14
Superalloys	36	(6)	--	(5)	39	483
Miscellaneous and unspecified	691	(6)	(6)	476	163,000	137
Grand total, 2013	1,530	416,000	152,000 [7]	5,430	456,000	11,800
Grand total, 2012	1,510	382,000 [r]	154,000 [r, 7]	5,750	461,000 [r]	12,500
Consumer stocks, December 31	147	27,200 [8]	5,620 [8]	625	14,600	1,490

[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 2013[1, 2]

(Metric tons of contained alloying element)

End use	FeCr	FeMo	FeNb	FeNi	FeV	FeW
Steel:						
Carbon	2,900	173	1,250	--	649	(3)
High-strength low-alloy	1,330	112	(3)	(3)	(4)	--
Stainless and heat-resisting	215,000	645	828	12,900	61	(3)
Tool	(3)	(5)	17	(3)	(5)	(3)
Other alloy	(3)	2,910	368	(3)	2,410	(3)
Unspecified	23,600	--	3,440	96	--	97
Total	243,000	3,840	5,900	13,000	3,120	97
Alloys (excluding alloy steels and superalloys)	(5)	(5)	80	80	(5)	(3)
Cast irons	(5)	358	--	--	(5)	--
Superalloys	5,380	(5)	1,710	120	6	(3)
Miscellaneous and unspecified	3,850	138	--	1,980	10	--
Grand total, 2013	252,000	4,340	7,690	15,200	3,140	97
Grand total, 2012	255,000 [r]	5,010 [r]	7,670 [r]	14,900 [r]	3,140	165
Consumer stocks, December 31	7,760	330	388	1,010	140	W

[r]Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.

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

[2]FeCr, ferrochromium, including 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]Withheld to avoid disclosing company proprietary data; included with “Steel, unspecified.”

[4]Withheld to avoid disclosing company proprietary data; all or part included with “Steel, other alloy.”

[5]Withheld to avoid disclosing company proprietary data; included with “Miscellaneous and unspecified.”

TABLE 5
SELECTED FERROALLOY PRICES IN 2013

	High	Low	Average
Chromium:[1]			
Ferrochromium:			
0.05% carbon	218.61	217.30	217.95
0.10% carbon	204.38	201.76	203.07
0.15% carbon	195.39	191.76	193.58
Over 4% carbon:			
49–51% chromium	101.09	98.06	99.57
60–65% chromium	102.71	98.80	100.75
Manganese:			
Medium-carbon ferromanganese[1]	90.00	83.00	86.50
Standard high-carbon ferromanganese[2]	1,100.00	990.00	1,045.00
Silicomanganese[3]	54.00	49.50	51.75
Molybdenum:[4]			
Ferromolybdenum	11.93	11.73	11.83
Molybdenum oxide	10.42	10.29	10.36
Nickel metal, London Metal Exchange[5]	17,728.63	13,702.17	15,715.40 [6]
Silicon:[1]			
50% ferrosilicon	109.00	97.00	103.00
75% ferrosilicon	100.00	88.50	94.25
Titanium, ferrotitanium[4]	3.25	2.75	3.00
Tungsten, ferrotungsten[7]	65.00	41.00	53.00 [6]
Vanadium, ferrovanadium[4]	13.67	13.19	13.43

[1]Cents per pound of contained alloying element.
[2]Dollars per gross ton.
[3]Cents per pound.
[4]Dollars per pound of contained alloying element.
[5]Dollars per metric ton, 99.81% purity (minimum).
[6]Weighted average.
[7]Dollars per kilogram of contained alloying element.

Sources: London Metal Exchange, Platts Metals Week, and Ryan's Notes.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS IN 2013[1]

Alloy	Imports			Exports		
	Gross weight (metric tons)	Contained weight (metric tons)	Value (thousands)	Gross weight (metric tons)	Contained weight (metric tons)	Value (thousands)
Chromium ferroalloys:						
Ferrochromium containing:						
More than 4% carbon	416,000	227,000	$417,000	4,460	2,320	$6,580
Not more than 4% carbon	XX	XX	XX	379	169	698
More than 3% but not more than 4% carbon	370	210	238	XX	XX	XX
More than 0.5% but not more than 3% carbon	13,800	9,410	33,100	XX	XX	XX
Not more than 0.5% carbon	36,500	24,800	113,000	XX	XX	XX
Ferrochromium-silicon	12,000	4,230	16,200	16	6	23
Total, chromium ferroalloys	478,000	266,000	580,000	4,850	2,500	7,300
Manganese ferroalloys:						
Ferromanganese containing:						
More than 4% carbon	259,000	198,000	247,000	XX	XX	XX
More than 2% but not more than 4% carbon	18	14	40	XX	XX	XX
More than 1% but not more than 2% carbon	42,300	33,900	56,900	XX	XX	XX
Not more than 1% carbon	29,100	24,800	51,500	XX	XX	XX
Ferromanganese, all grades	XX	XX	XX	1,970	XX	3,300
Silicomanganese	329,000	223,000	339,000	5,890	XX	6,500
Total, manganese ferroalloys	659,000	479,000	694,000	7,860	XX	9,800
Silicon ferroalloys:						
Ferrosilicon containing:						
More than 55% silicon	XX	XX	XX	10,800	6,820	18,100
55% to 80% silicon and more than 3% calcium	4,400	3,270	6,400	XX	XX	XX
Magnesium ferrosilicon	19,000	8,620	35,200	XX	XX	XX
Ferrosilicon, other[2, 3]	230,000	147,000	302,000	6,500	2,930	13,700
Total, silicon ferroalloys	254,000	159,000	343,000	17,300	9,750	31,800
Other ferroalloys:						
Ferrocerium and other pyrophoric alloys	1,390	XX	12,100	XX	XX	XX
Ferromolybdenum	6,120	4,090	108,000	1,240	862	22,900
Ferronickel	50,300	13,700	212,000	541	479	8,040
Ferroniobium	9,450	XX	267,000	290	XX	3,240
Ferrophosphorus	8,740	XX	4,580	619	XX	1,310
Ferrotitanium and ferrosilicon-titanium	1,680	XX	7,260	4,110	XX	17,100
Ferrotungsten and ferrosilicon-tungsten	613	470	19,200	80	31	774
Ferrovanadium	4,910	3,710	89,800	395	299	8,790
Ferrozirconium	4	XX	44	1,980	XX	5,000
Ferroalloys, other	8,600	XX	30,600	2,120	XX	5,730
Total, other ferroalloys	91,800	21,900	750,000	11,400	1,670	72,900
Grand total	1,480,000	926,000	2,370,000	41,400	13,900	122,000

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]

(Metric tons, gross weight)

Country, furnace type, and alloy type[2]	2009	2010	2011	2012	2013[e]
Albania, electric furnace, ferrochromium	7,556	23,233	28,694	24,018 r	24,692 [3]
Argentina, electric furnace:[e]					
Ferrosilicon	11,300	11,000	11,000	11,000	11,000
Silicomanganese[4]	6,644 [3]	10,900 [3]	11,000	11,000	11,000
Total	17,900	21,900	22,000	22,000	22,000
Armenia, electric furnace, ferromolybdenum	5,144	5,126	5,525	5,836 r	6,619 [3]
Australia, electric furnace:[e]					
Ferromanganese	87,000	138,000 r	146,000	102,000	230,000
Silicomanganese	74,000	131,000	130,000	96,000	200,000
Total	161,000 r	269,000 r	276,000 r	198,000 r	430,000
Austria, electric furnace:					
Ferronickel, including ferronickel molybdenum[e]	1,750	1,500	1,750	2,000	2,000
Other	586,250	635,500	648,250	648,000 r	648,000
Total[e]	588,000	637,000	650,000	650,000 r	650,000
Bahrain, electric furnace:					
Ferromanganese[4]	5,700	5,600	35,300	35,000 r	35,000
Ferrosilicon	6,500	3,700	3,000	3,000 e	3,000
Total	12,200	9,300	38,300	38,000 r, e	38,000
Bhutan, electric furnace, ferrosilicon, exports	90,798	97,528	79,804 r	82,091 r	82,978 [3]
Bosnia and Herzegovina, electric furnace, ferrosilicon, net exports[e]	470	870	1,800	--	--
Brazil, electric furnace:[5]					
Ferrochromium[6]	131,048	277,114	145,122	165,532 r	164,500 [3]
Ferrochromium silicon	11,506 r	16,020 r	8,378 r	9,556 r	10,200 [3]
Ferromanganese[4]	154,000 r	305,808 r	295,923 r	334,926 r	330,100 [3]
Ferronickel	37,708	33,860	67,000	135,400	149,000 [3]
Ferroniobium (ferrocolumbium)	34,746 r	52,588 r	81,350	76,609 r	70,538 [3]
Ferrosilicon[e]	145,000	145,000	145,000	145,000	147,000
Ferrotitanium	482	806	59	105	105
Silicomanganese[4]	178,600 r	179,000 r	179,000 r	179,000 r	179,000
Other	25,865 r	32,897 r	34,462 r	33,449 r	33,500
Total[e]	719,000 r	1,040,000 r	956,000 r	1,080,000 r	1,080,000
Bulgaria, electric furnace, ferrosilicon	3,000	--	--	--	--
Burma, electric furnace, ferronickel	--	--	--	--	27,000 [3]
Canada, electric furnace:					
Ferroniobium (ferrocolumbium)	6,561 r	6,695 r	7,018 r	7,132 r	7,974 [3]
Ferrosilicon	25,820	36,786	31,039	31,979	38,817 [3]
Ferrovanadium[e]	900	900	900	800	800
Total[e]	33,300 r	44,400 r	39,000 r	39,900 r	47,600
Chile, electric furnace:					
Ferrochromium[e]	11	184	35	67	70
Ferromolybdenum	10,820	12,485	17,177	15,451 r	15,500
Total[e]	10,800	12,700	17,200	15,500	15,600
China:[e]					
Blast furnace:					
Ferromanganese	350,000	350,000	350,000	300,000 r	300,000
Other	30,000	30,000	--	--	--
Electric furnace:					
Ferrochromium	1,810,000	2,400,000	2,700,000	3,040,000 r	3,200,000
Ferromanganese	2,070,000	2,300,000	2,600,000	3,020,000 r	3,300,000
Ferromolybdenum	90,000	90,000	53,000	180,000 r	200,000
Ferronickel and high-nickel pig iron[7]	600,000	900,000	1,280,000	1,400,000	2,510,000
Ferrosilicon	5,100,000	5,300,000	5,400,000	5,760,000 r	6,000,000
Ferrotitanium	300	5,600	5,000	-- r	--

See footnotes at end of table.

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

(Metric tons, gross weight)

Country, furnace type, and alloy type[2]	2009	2010	2011	2012	2013[e]
China:[e]—Continued					
Electric furnace:—Continued					
Silicomanganese	5,430,000	5,840,000	6,700,000	7,400,000 [r]	7,700,000
Other	6,620,000	7,600,000	8,000,000	9,200,000 [r]	13,900,000
Total, blast and electric furnaces	22,100,000 [r]	24,800,000 [r]	27,100,000 [r]	30,300,000 [r]	37,100,000
Colombia, electric furnace, ferronickel	153,628	145,239	103,371	127,509	139,000 [3]
Dominican Republic, electric furnace, ferronickel	--	--	34,610	38,852 [r]	45,001 [3]
Egypt, electric furnace:[e]					
Ferromanganese[4]	26,300 [3]	20,000 [3]	30,000	30,000	30,000
Ferrosilicon	78,000	78,000	78,000	78,000	78,000
Total	104,000	98,000	108,000	108,000	108,000
Finland, electric furnace, ferrochromium	123,310	283,000 [r]	231,000 [r]	288,000 [r]	434,000 [3]
France, electric furnace:[e]					
Ferromanganese[4]	46,000	138,100	130,500	101,000	100,000
Ferrosilicon	22,400 [r]	32,000 [r]	71,500 [r]	63,300 [r]	49,600
Silicomanganese[4]	54,100	62,400	63,400	63,000	60,000
Other	60,000	60,000	60,000	60,000	60,000
Total	137,000 [r]	154,000 [r]	195,000 [r]	186,000 [r]	170,000
Georgia, electric furnace:[4]					
Ferromanganese	1,838 [8]	824 [8]	195 [r, 8]	--	--
Silicomanganese	112,016	203,464	242,746	257,421	250,000
Total	113,854	204,288	242,941 [r]	257,421	250,000
Germany, electric furnace:					
Ferrochromium[e]	13,667 [3]	18,300 [r]	18,500 [r]	17,800 [r]	17,500
Other	6,336	9,200	9,985 [r]	8,248 [r]	8,500
Total[e]	20,003 [r, 3]	27,500 [r]	28,500 [r]	26,000 [r]	26,000
Greece, electric furnace, ferronickel	42,423	69,596	93,905	96,435	87,100
Iceland, electric furnace, ferrosilicon	112,993	114,231	120,076	115,000	115,000
India, electric furnace:[e, 9]					
Ferroaluminum	7,017 [3]	7,000	7,000	7,100	7,100
Ferroboron	90 [3]	95	98	95	96
Ferrochromium[10]	873,385 [3]	850,000	890,916 [r, 3]	1,001,582 [r, 3]	902,840 [3]
Ferrochromium silicon	10,000	10,000	11,000	11,000	11,000
Ferromanganese[4]	399,100 [3]	413,000	420,000	402,017 [r, 3]	446,733 [3]
Ferromolybdenum	2,822 [3]	3,000	3,200	3,100	3,200
Ferronickel magnesium	208 [r, 3]	227 [r]	253 [r]	270 [r]	473 [3]
Ferrosilicomagnesium	17,342 [3]	17,000	18,000	18,000	19,000
Ferrosilicon	101,337 [3]	115,164 [r, 3]	127,092 [r, 3]	130,000 [r]	132,000
Ferrosilicozirconium	120 [3]	150	170	180	190
Ferrotitanium	2,379 [3]	2,200	2,300	2,400	2,500
Ferrotungsten	150 [3]	150 [r, 3]	225 [r, 3]	230 [r]	230
Ferrovanadium	1,769 [3]	1,800	1,850	1,900	1,950
Silicomanganese[3, 4]	875,500	1,170,000	1,433,600	1,522,600	1,418,844
Total	2,290,000 [r]	2,590,000 [r]	2,920,000 [r]	3,100,000 [r]	2,950,000
Indonesia, electric furnace:[e]					
Ferromanganese	12,000	12,000	12,000	13,000	13,000
Ferronickel	62,700	93,300	98,200	91,600 [r]	91,000
Silicomanganese	7,000	8,000	8,000	9,000	9,000
Total	81,700	113,000	118,000	114,000	113,000
Italy, electric furnace:					
Ferromanganese[4]	5,500	17,000	18,000	18,000 [e]	18,000
Ferrosilicon[e]	10,000	10,000	10,000	10,000	10,000
Silicomanganese[4]	17,000	22,900	24,600	42,000 [e]	42,000
Other, excluding calcium-silicon[e]	10,000	10,000	10,000	10,000	10,000
Total[e]	42,500 [r]	59,900 [r]	62,600 [r]	80,000 [r]	80,000

See footnotes at end of table.

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

(Metric tons, gross weight)

Country, furnace type, and alloy type[2]	2009	2010	2011	2012	2013[e]
Japan, electric furnace:					
Ferrochromium	7,698	16,208	17,217	19,392 [r]	20,000
Ferromanganese	361,375	453,265	456,798	436,171	440,000
Ferromolybdenum	3,598	4,615	5,167	4,616 [r]	4,500
Ferronickel	284,884	348,420	279,944	371,913	402,768 [3]
Ferrovanadium	2,560	4,190	3,980	4,403 [r]	4,500
Silicomanganese	49,205	49,865	49,798	52,287	50,000
Other	12,957	16,374	20,913	19,364 [r]	20,000
Total	722,277	892,937	833,817	908,146 [r]	942,000
Kazakhstan, electric furnace:					
Ferrochromium	1,173,286	1,311,302	1,289,917	1,305,566	1,300,000
Ferrochromium silicon	60,829	159,765	143,296	164,854	165,000
Ferrosilicon	33,100	4,813	1,683	494 [r]	472 [3]
Silicomanganese	200,374	224,627	232,039	251,445	250,000
Other	1,205	1,283	1,754	1,845	1,900
Total	1,468,794	1,701,790 [r]	1,668,689 [r]	1,724,204 [r]	1,720,000
Korea, Republic of, electric furnace:					
Ferromanganese	216,400	286,259	355,047	364,800	365,000
Ferronickel	56,911	54,022 [r]	50,069	54,933 [r]	74,007 [3]
Silicomanganese	151,100	120,779	195,650	184,700	185,000
Total	424,411	461,060 [r]	600,766	604,433 [r]	624,000
Kosovo, ferronickel	27,700 [r]	30,400 [r]	27,948 [r]	16,044 [r]	27,512 [3]
Macedonia, electric furnace:					
Ferronickel	52,200	62,700	75,200	83,700	87,000
Ferrosilicon	7,657	30,044	56,167	42,402	72,279 [3]
Silicomanganese	--	36,705	50,756	14,179	--
Total	59,857	129,449	182,123	140,281	159,000
Mexico, electric furnace:[4]					
Ferromanganese	42,492	81,019	73,684	61,939	62,000
Silicomanganese	85,065	134,470	139,044	161,336	160,000
Total	127,557	215,489	212,728	223,275	222,000
New Caledonia, electric furnace, ferronickel	156,553 [r]	165,506 [r]	169,513 [r]	184,125 [r]	175,451 [3]
Norway, electric furnace:					
Ferromanganese[4]	196,700	297,300	337,900	325,900	320,000
Ferrosilicon[e]	233,974 [3]	225,000	170,102 [3]	250,000 [r]	285,000
Silicomanganese[4]	231,300	248,700	266,000	271,400	270,000
Total[e]	662,000 [r]	771,000 [r]	774,000 [r]	847,000 [r]	875,000
Peru, electric furnace, ferrosilicon[e]	600	600	600	600	600
Poland:					
Blast furnace, ferromanganese[e]	1,700 [4]	800 [4]	800	800	760
Electric furnace:					
Ferrosilicon	9,685	53,206	72,668	78,115 [r]	75,500
Silicomanganese[4]	--	100	400 [r]	200 [r]	190
Other	4,200	200	300	300	280
Total, blast and electric furnaces	15,585 [r]	54,306 [r]	74,200 [r, e]	79,400 [r, e]	76,700
Romania, electric furnace:					
Ferrochromium	15,000	14,000	--	--	--
Silicomanganese[e, 4]	--	20,000	31,000	17,000 [r]	--
Total[e]	15,000	34,000	31,000	17,000 [r]	--
Russia:[e]					
Blast furnace:					
Ferromanganese[4]	88,000 [3]	171,600 [3]	146,000	165,000	160,000
Ferrophosphorus	3,000	3,600	3,600	3,600	3,600
Spiegeleisen	6,500	5,500	6,000	6,000	6,000
Electric furnace:					
Ferrochromium	378,000 [3]	414,288 [3]	501,700 [3]	477,600 [r, 3]	480,000

See footnotes at end of table.

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

(Metric tons, gross weight)

Country, furnace type, and alloy type[2]	2009	2010	2011	2012	2013[e]
Russia:[e]—Continued					
Electric furnace:—Continued					
Ferrochromium silicon	3,500	4,200	4,200	4,100 r	4,100
Ferronickel:					
High-nickel	17,489 r, 3	19,763 3	19,881 3	11,529 3	--
Other[11]	14,040 3	14,600	14,700	8,520	--
Ferroniobium (ferrocolumbium)	300 r, 3	330 r, 3	462 r, 3	462 r	462
Ferrosilicon	745,000	916,000	1,030,000	1,042,000 r, 3	1,050,000
Ferrotitanium	NA	4,000	4,000	4,000	4,000
Ferrovanadium	8,029 3	13,057 3	13,500	12,500 r	12,500
Silicomanganese	98,700 3	147,900 3	150,000	160,000	160,000
Other	20,000	18,000	18,000	18,000	18,000
Total, blast and electric furnaces	1,380,000 r	1,730,000 r	1,910,000 r	1,910,000 r	1,900,000
Saudi Arabia, electric furnace:[e]					
Ferromanganese[4]	37,500	26,000	26,000	26,000	25,000
Silicomanganese[4]	60,000	61,300	96,000	80,000	80,000
Other	80,000	90,000	90,000	90,000	80,000
Total	178,000	177,000	212,000	196,000	185,000
Slovakia, electric furnace:					
Ferromanganese	21,000	35,449	18,180	12,862	13,000
Ferrosilicon	8,622	37,034	38,771	32,726 r	33,500
Silicomanganese	32,000	34,960	25,023	50,089	50,000
Total	61,622	107,443	81,974	95,677 r	96,500
South Africa, electric furnace:					
Ferrochromium[12]	2,346,132	3,607,132	3,425,911	3,063,257 r	3,219,000 3
Ferromanganese[4]	275,000 r	473,000	714,000	706,000 r, e	697,000
Ferronickel, high-nickel	1,067	1,040	933 r	950 r, e	820
Ferrosilicon	110,400	127,700 r	126,200 r	83,000 r	78,100 3
Ferrovanadium[e]	14,000	19,000	19,000	18,000 r	18,000
Silicomanganese[4]	135,100	274,400	313,600	148,800	134,000
Total[e]	2,880,000 r	4,500,000 r	4,600,000 r	4,020,000 r	4,150,000
Spain, electric furnace:					
Ferromanganese[4]	23,400	102,200	92,100	80,200 e	80,500
Ferrosilicon[e]	53,300 r	76,300 r	69,700 r	68,600 r	80,500
Silicomanganese[4]	64,100	134,200	142,300	148,100	148,500 3
Other	-- r	-- r	-- r	-- r	--
Total	141,000 r	313,000 r	304,000 r	297,000 r	310,000
Sweden, electric furnace, ferrochromium[e]	31,345 3	32,000 r	32,000 r	32,000 r	32,000
Turkey, electric furnace:[e]					
Ferrochromium	41,028 3	50,000 r	40,000 r	40,000 r	35,000
Ferrosilicon	2,903 r, 3	3,000 r	3,000 r	3,000 r	4,000
Total	43,931 r, 3	53,000 r	43,000 r	43,000 r	39,000
Ukraine, electric furnace:					
Ferromanganese	129,400	280,100	180,500	157,100 r	160,000
Ferronickel	76,487 r	102,940	89,903	119,652	121,586 3
Ferrosilicon	150,300	195,500	150,900	119,400	147,700 3
Silicomanganese	741,900	940,400	843,500	734,200 r	735,000
Other[e]	23,900	28,500	28,500 r	35,000 r	35,000
Total[e]	1,120,000 r	1,550,000	1,290,000	1,170,000 r	1,200,000
United States, electric furnace:					
Ferrochromium[12]	W	--	--	--	--
Ferrosilicon	193,774	245,987	W r	W r	W
Other	W	W	W	W	W
Total[13]	W r	W r	W r	W r	W
Venezuela, electric furnace:					
Ferromanganese[4]	15,800	5,300	12,000	9,000	9,000
Ferronickel[e]	40,113 3	45,200	51,800	31,300 r	--

See footnotes at end of table.

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

(Metric tons, gross weight)

Country, furnace type, and alloy type[2]	2009	2010	2011	2012	2013[e]
Venezuela, electric furnace:—Continued					
Ferrosilicon	63,600 [r]	91,000 [r]	84,700 [r]	72,300 [r]	74,300
Silicomanganese[4]	45,800	16,500	24,000	14,200 [r]	14,200
Total	165,313 [r]	158,000 [r]	173,000 [r]	127,000 [r]	98,000
Zimbabwe, electric furnace:[e]					
Ferrochromium	72,223 [3]	146,000	140,000	137,534 [3]	100,000
Ferrochromium silicon	603 [3]	--	--	--	--
Total	72,826 [3]	146,000	140,000	137,534 [3]	100,000
Grand total	37,000,000 [r]	44,400,000 [r]	47,000,000 [r]	49,900,000 [r]	57,100,000
Of which:					
Blast furnace:					
Ferromanganese[4]	440,000	522,000	497,000	466,000 [r]	461,000
Spiegeleisen	6,500	5,500	6,000	6,000	6,000
Other	33,000	33,600	3,600	3,600	3,600
Electric furnace:					
Ferrochromium	7,020,000	9,440,000 [r]	9,460,000 [r]	9,610,000 [r]	9,930,000
Ferrochromium silicon	86,400 [r]	190,000 [r]	167,000 [r]	190,000 [r]	190,000
Ferromanganese[4]	4,130,000 [r]	5,390,000 [r]	5,950,000 [r]	6,240,000 [r]	6,670,000
Ferromolybdenum	112,000	115,000	84,100	209,000 [r]	230,000
Ferronickel	1,630,000 [r]	2,090,000 [r]	2,460,000 [r]	2,770,000 [r]	3,940,000
Ferroniobium (ferrocolumbium)	41,600 [r]	59,600 [r]	88,800 [r]	84,200 [r]	790,000
Ferrosilicon	7,320,000 [r]	7,950,000 [r]	7,880,000 [r]	8,220,000 [r]	8,570,000
Ferrovanadium[e]	27,300	38,900	39,200	37,600 [r]	37,800
Silicomanganese[4]	8,650,000 [r]	10,100,000 [r]	11,400,000	11,900,000 [r]	12,100,000
Other[14]	7,480,000 [r]	8,540,000 [r]	8,960,000 [r]	10,200,000 [r]	14,800,000

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

[1]Grand totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown. Includes data available through June 11, 2015.

[2]To the extent possible, ferroalloy production of each country shown has been separated according to the furnace from which production is obtained; production derived from metallothermic operation is included with electric furnace production. Ferroalloys may be produced in other countries, but production information is inadequate for the formulation of estimates of output levels.

[3]Reported figure.

[4]Reported by the International Manganese Institute.

[5]Reported by Brazil's Departamento Nacional de Produção Mineral in its Sumário Mineral 2009–2013.

[6]Includes high- and low-carbon ferrochromium.

[7]Ferronickel figures were derived from data published by Beijing Antaike Information Development Co., Ltd. Nickeliferous pig iron produced from laterite ores imported from Indonesia, New Caledonia, and the Philippines.

[8]Net exports.

[9]Reported on a fiscal year basis, which is from April 1 to March 31.

[10]Includes ferrochromium and charge ferrochromium.

[11]Includes ferronickel, ferrochromium, and nickel-resistant cast iron.

[12]Includes high- and low-carbon ferrochromium and ferrochromium silicon.

[13]Includes ferrochromium (before 2010), ferromanganese (including silicomanganese), ferromolybdenum, ferroniobium (ferrocolumbium), ferrosilicon (2011–2013), ferrotitanium, and ferrovanadium; data for ferrochromium (before 2010) and ferrosilicon (2011–2013) are excluded from "Grand total."

[14]May include ferroboron, ferrophosphorus, ferrotitanium, nickel columbium, silvery pig iron, and spiegeleisen.