2005 Minerals Yearbook

FERROALLOYS

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Ferroalloys

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Ferroalloys are alloys of iron used to add one or more chemical elements into molten metal, usually during steelmaking. Ferroalloys impart distinctive qualities to steel and cast iron or serve important functions during production. The leading ferroalloy-producing countries in 2005 were, in decreasing order of production, China, South Africa, Ukraine, Russia, and Kazakhstan (table 6). These countries accounted for 70% of global ferroalloy production.

The ferroalloy industry is closely associated with the iron and steel industry, the leading consumer of its products. World production of bulk ferroalloys—chromium, manganese, and silicon—was estimated to be 24.4 million metric tons (Mt) in 2005, a 3% increase compared with the revised figure for 2004. U.S. bulk ferroalloy reported consumption in 2005 was 0.9 Mt of manganese and silicon ferroalloys (table 2) and 0.3 Mt of contained chromium in ferrochromium (table 3). Compared with that of 2004, ferrochromium consumption decreased by 4%, ferromanganese (including silicomanganese), by 13%, and ferrosilicon, by 1%. On a gross weight basis, U.S. total ferroalloy production (table 6), decreased by 3%; total ferroalloy imports (table 5) increased by less than 1% and exports (table 5) increased almost 150%, which resulted in a net import decrease of more than 2%. These percentages were reflected in a slight slowdown in the U.S. alloyed steel industry, counterbalanced by growth in worldwide steel production during 2005.

Manganese is an essential alloying element in the production of virtually all steels and is important to the production of cast iron. Manganese neutralizes the harmful effect of sulfur. Silicon is primarily used as an alloying element to deoxidize steel. It is also an alloying element in the production of cast iron. Boron, chromium, cobalt, columbium (niobium), copper, molybdenum, nickel, phosphorus, 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).

U.S. domestic production of ferroalloys was relatively low other than silicon and manganese compared with that of the major ferroalloy-producing countries. On the basis of silicon content, U.S. ferrosilicon net production, which included miscellaneous silicon alloys, was 52% of U.S. ferrosilicon apparent consumption in 2005. On the basis of silicon, U.S. silicon metal net production, excluding semiconductor-grade material, was 52% of U.S. silicon metal apparent consumption in 2005.

The trend in countries that produce economically competitive mineral resources is toward increased production of value-added products, such as ferroalloys. U.S. production of ferroalloys is unlikely to expand because the economics of development of U.S. mineral resources for most of the ferroalloy metals are not competitive in the world market. Domestic ferroalloy production is in decline, as evidenced by the shutdown of ferronickel and common ferrochromium grades by 1999. In both cases, production ceased owing to low-grade resources, reliance on imported ore for feedstock, and high production costs. Ferrosilicon and manganese ferroalloy production has generally trended downward in the past 5 years with ferrosilicon production in 2005 14% lower than that in 2001.

Ferrochromium

In 2005, the major world chromite ore-producing countries were South Africa (more than 7 Mt), India (more than 3 Mt), and Kazakhstan (more than 3 Mt). More than 90% of chromite ore was smelted in electric arc furnaces to produce ferrochromium for the metallurgical industry. The major world ferrochromium-producing countries were South Africa (more than 2.5 Mt) and Kazakhstan (more than 1 Mt). China, India, and Russia each produced in excess of 0.5 Mt of ferrochromium. Most of the 6.6 Mt of ferrochromium produced globally was consumed in the manufacture of stainless steel. Europe (primarily Western Europe and Scandinavia including Belgium, Finland, France, Germany, Italy, Spain, Sweden, and the United Kingdom), Asia (China, Japan, the Republic of Korea, and Taiwan), and North and South America (Brazil and the United States)—the major stainless steel producing areas of the world—accounted for about 80% of world stainless steel production. World stainless steel production exceeded 24 Mt in 2005 and was expected to reach about 27 Mt in 2006.

The Western World ferrochromium industry developed in close proximity to the stainless steel industry. However, the closing of ferrochromium facilities in historically stainless steel-producing areas has resulted in the migration of ferrochromium production to areas where chromite is mined. China deviates from this model because its ferrochromium industry preceded its stainless steel industry. The Soviet Union deviated from this model because ferrochromium plants were located for political reasons. The world chromium industry in 2005 operated with production capacity in excess of demand. Ferrochromium production increased by 0.4 Mt from 2001 to 2002, by more than 1 Mt from 2002 to 2003, by more than 0.5 Mt from 2003 to 2004, and decreased slightly from 2004 to 2005. Ferrochromium production increased by nearly 2 Mt, or more than 40%, during those years. During the same time period, stainless steel production increased to 24 Mt from 19 Mt, representing a growth in consumption of 1 Mt of contained chromium.

In response to growth in demand and in anticipation of further increases, 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 environmentally friendly, energy- and recovery-efficient, prereduction, closed-furnace processes; chromium was being recovered more often from ferrochromium slag; the ferrochromium and stainless steel production industries were consolidating ownership; and strategic alliances were being formed between those two industries.

Ferromanganese

Manganese ferroalloys in various grades of ferromanganese and silicomanganese provide a key ingredient for steelmaking (Matricardi and Downing, 1995, p. 970). In 2005, most of the U.S. supply was imported. The leading foreign source of ferromanganese and silicomanganese, on a gross weight basis, was South Africa, whose exports of manganese ferroalloys to the United States were greater than those of the next five major exporting countries combined (Australia, China, Mexico, Norway, and Romania). Manganese ferroalloys were produced domestically mainly at a plant near Marietta, OH, which was owned by France's Eramet Group. Some silicomanganese production came from the Highlanders Alloys LLC plant at New Haven, WV; the company reportedly shut down a furnace in April after restarting it in October 2004, resumed production in August, and then shut down again in October and November (Ryan's Notes, 2005a, b). In 2005, the Eramet Group, Ukrainian producer Nikopol Ferroalloys Plant, and BHP Billiton plc of the United Kingdom accounted for a significant portion of the world's production of manganese ferroalloys. In addition to its U.S. plant, the Eramet Group produced from plants in China, France, Italy, and Norway, while BHP Billiton owned plants in Australia and South Africa. China was the leading producer of manganese ferroalloys, with an output almost twice as great as that of the next three major producers, Brazil, South Africa and Ukraine, combined (table 6).

Ferromolybdenum

Chile, China, and the United States accounted for about 79% of world production of molybdenite ore in 2005. Other significant molybdenite ore-producing countries, including Canada, Mexico, and Peru supplied an additional 16% of world production. Molybdenite concentrates are roasted to form molybdic oxide which can be converted into ferromolybdenum, molybdenum chemicals, or metal. About 46% of the molybdenum consumed in the United States was in the form of molybdic oxides, and about 26% was as ferromolybdenum. Although the United States was the leading molybdenum-producing country in the world, it imported more than 84% of its ferromolybdenum requirements in 2005. The steel industry accounted for about 84% of all molybdenum consumed in the United States in 2005, principally in the production of stainless and full alloy steels.

Ferronickel

The major ferronickel-producing countries in 2005 were, in descending order of gross weight output, Japan, New Caledonia, and Colombia with each country producing greater than 100,000 t of ferronickel. These three countries accounted for than 62% of world production. Greece, Ukraine, the Dominican Republic, and Venezuela, in descending order of gross weight output, all produced between 50,000 and 100,000 t of ferronickel, accounting for an additional 28%. Key producing companies included Anglo American Plc, BHP Billiton Group, Eramet Group, Falconbridge Ltd., Hyuga Smelting Co. Ltd., Larco G.M.M. S.A., and Pacific Metals Co., Ltd.

At Cerro Matoso (Colombia), Doniambo (New Caledonia), and several other smelters, primary ferronickel was obtained by first calcining the iron- and nickel-bearing laterite ore in a kiln and then smelting the calcined ore in an electric furnace. In Austria and Russia, secondary ferronickel was produced in relatively small amounts by melting nickel-bearing scrap in an electric furnace and upgrading the melt with nickel cathode. Most of the world's ferronickel operations were operating at full capacity in 2005 in order to meet strong demand from stainless steel producers.

In the United States, the steel industry accounted for virtually all the primary ferronickel consumed in 2005, with more than 99% used in stainless and heat-resistant steels. No primary ferronickel was produced in the United States in 2005. Almost all U.S. ferronickel exports were either re-exports or material upgraded for specialty purposes. U.S. ferronickel consumption in 2005 was 3% less than that of 2004 owing to a global ferronickel shortfall, with scrap and nickel cathode being used as substitutes. On a gross weight basis, ferronickel net imports were 48,600 t with an import- to-export ratio of 341 to 1.

Falconbridge Ltd., involved in a takeover bid from Inco Limited (Canada) at yearend 2005, and its joint-venture partners were still planning to construct a ferronickel smelter at Koniambo on the main island of New Caledonia. The partners had applied for the necessary regulatory permits and were finalizing a financial support package with the French Government. The Koniambo smelter would have a capacity of 54,000 metric tons per year of nickel in ferronickel and would use lateritic ores from the Koniambo massif as feedstock. At yearend 2005, Eramet Group lost a court battle to take over the Koniambo nickel project. Eramet claimed that Falconbridge had not upheld the terms of a 1998 agreement regarding the development of the project (Reuters, 2005§[1]).

GlobeStar Mining Corporation (Canada) controlled 70 square kilometers and began exploration for nickel laterites in the vicinity of Cerro Maimon in the Dominican Republic. Some of the concessions were relatively close to the Falcondo nickel laterite mine and ferronickel smelter (GlobeStar Mining Corporation, 2005§). In 2005, Falcondo processed 3.8 Mt of ore grading 1.2% nickel.

Ferrosilicon

Silicon ferroalloy demand is driven by cast iron and steel production, where silicon alloys are used as deoxidizers (Dosaj, 1997, p. 1115). On the basis of silicon content, U.S. net

[1]References that include a section mark (§) are found in the Internet References Cited section.

production of silicon ferroalloys (ferrosilicon and miscellaneous silicon alloys) and silicon metal decreased by 4% to 243,000 metric tons (t) from the revised figure of 249,000 t in 2004. On a gross weight basis, U.S. net production of silicon ferroalloys and metal in 2005 decreased by 3% compared with that of 2004 (table 6).

China was estimated to be the world's leading producer of ferrosilicon, with production greater than that of the rest of the world combined and almost three times that of the next two major producing countries, Norway and Russia, combined. In 2005, most silicon metal was used as an alloying agent with aluminum and in the production of chemicals, especially silicones. Some silicon metal was also used as an alloying agent with iron.

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. World ferrotitanium production capacity is led by, in descending order, the United Kingdom, Russia, Japan, and the United States. In 2005, domestic producers of ferrotitanium were Global Titanium, Inc. (Detroit, MI) and Galt Alloys Inc. (North Canton, OH). Producers of interstitial-free, stainless, and high-strength low-alloy steels are the major consumers of titanium within the steel industry.

In 2005, increased demand for titanium metal by commercial aerospace and military markets combined with demand for ferrotitanium for steel production exceeded the available supply of metal. As a result, ferrotitanium prices dramatically increased. The yearend price for ferrotitanium with 70% contained titanium was about $9.00 per pound, a 41% increase compared with the yearend price of 2004. U.S. imports of ferrotitanium and ferrosilicon titanium were 16,900 t, a 143% increase compared with those of 2004.

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 ferrotungsten, which is a master alloy containing between 75% and 80% tungsten; tungsten melting base, which is a master alloy containing up to 36% tungsten; tungsten metal scrap; or scheelite ore concentrates (Lassner and Schubert, 1999, p. 307-312; Roskill Information Services Ltd., 2003, p. 106, 109, 119, 130).

In 2005, world ferrotungsten production was dominated by China, which produced 11,100 t, gross weight (Juqiu, 2006, p. 5, 9). Inadequate supplies of tungsten concentrates within China, combined with increased demand for tungsten materials in China and elsewhere, resulted in steep increases in the prices of tungsten concentrates and downstream materials, including ferrotungsten. The Platts Metals Week price for ferrotungsten rose from $12 to $13 per kilogram contained tungsten at the beginning of the year to $32 to $34 per kilogram contained tungsten at yearend.

In 2005, National Defense Stockpile shipments of ferrotungsten increased to 262 t contained tungsten compared with 41 t shipped in 2004, as the stockpile's supply of ferrotungsten was sold off. U.S. ferrotungsten imports and reported consumption were similar to those of 2004. Ferrotungsten exports decreased significantly to 29 t contained tungsten from 99 t exported in 2004.

Ferrovanadium

The major vanadium-producing countries in 2005 were China and South Africa, accounting for 72% of world production, with Russia, the other significant vanadium-producing country, accounting for an additional 26%. In these three countries, vanadium is primarily recovered from titanium-bearing magnetite ore processed to produce liquid pig iron. The process produces a slag containing 20% to 24% vanadium pentoxide, which can be further processed to 40% to 50% vanadium-content ferrovanadium.

In 2005, there was no primary production of vanadium oxides in the United States. Rather, vanadium oxides were recovered from ashes, petroleum residues, and poisoned refinery catalysts. Vanadium oxides were used to produce catalysts, chemicals, and 75% to 80% vanadium-content ferrovanadium.

The domestic steel industry accounted for 93% of U.S. vanadium consumption in 2005, principally in carbon, full alloy and high-strength, low-alloy steels. Of the vanadium consumed, 84% was ferrovanadium, and the United States imported 100% of its ferrovanadium requirements in 2005.

In 2005, the production of vanadium increased in China, Russia, and South Africa to offset the permanent closures of the Windimurra Mine in Australia and the VanTec Mine in South Africa in 2004. Ferrovanadium imports increased dramatically from the Czech Republic as they became the primary converter of Russian-origin vanadium pentoxide into ferrovanadium. Production from petroleum-base vanadium recovery (ashes, catalysts, residues) continued to increase.

Outlook

Substitutes, principally alloy scrap and oxide (for some ferroalloys), have gained moderately on ferroalloy use per ton of steel produced during the past 20 years. A decline in unit ferroalloy consumption is significant during the long term for the ferroalloy industry because it would moderate any increase in ferroalloy consumption resulting from increased steel production. This general decline in unit consumption of the major ferroalloys in steelmaking has been caused by a combination of factors, including changes in availability, price, and technology.

Growing U.S. customer needs for alloy and stainless steel for many applications have been and will continue to be a strong positive influence on the demand for ferroalloys. The steel industry will continue to improve process technology, reducing raw material needs and developing steels with lower alloying metal content with equal or better performance, while lowering material costs. Many stainless steel applications have no acceptable substitutes, and their key constituents, chromium and nickel, are essential. Technology and industry practices will continue to find more innovative uses for ferroalloys, resulting in strong demand for ferroalloy metals used in steel for construction, the chemical industry, transportation, and household appliances. This is expected to more than offset any reduction in unit consumption. Competition from substitute materials, such as plastics and nonferrous metals, especially in the transportation sector, will be strong, but ferroalloys are expected to remain competitive for many years through the use of lightweight, high-strength steel (Sibley and others, 2001, p. 40).

Chromium, manganese, silicon, and other ferroalloy metals are discussed in more detail, including domestic data coverage and outlook and U.S. Government stockpile, 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

GOVERNMENT INVENTORY OF FERROALLOYS, DECEMBER 31, 2005[1, 2]

(Metric tons of alloys unless otherwise specified)

Alloy	Inventory
Ferrochromium:	
High-carbon	318,000
Low-carbon	171,000
Ferromanganese, high carbon	612,000
Ferrotungsten, contained tungsten	(3)

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

[2]Data are uncommitted inventory.

[3]The last of the ferrotungsten was sold off in 2005.

Source: Defense National Stockpile Center.

TABLE 2

REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS BY END USE IN 2005[1, 2]

(Metric tons of alloys unless otherwise specified)

End use	FeB	Manganese: FeMn	Manganese: SiMn	FeP	FeSi	FeTi
Steel:						
Carbon and high-strength low-alloy	681	235,000	55,900	4,230	19,000 [3]	4,610
Stainless and heat-resisting	200	10,100	13,600	153	51,000 [3]	3,370
Other alloy	105	22,600	19,400	836	7,430 [3]	50
Tool	--	(3)	(3)	--	29,800	106
Unspecified	--	2,980	736	(4)	36,600 [5]	--
Total steel	986	271,000	89,600	5,220	144,000	8,130
Cast irons	--	7,260	440	1,560	96,800 [5]	17
Superalloys	36	(6)	--	(7)	279 [5, 7]	1,310
Alloys (excluding alloy steels and superalloys)	420	17,800	2,980	(7)	59,300 [5]	1,500
Miscellaneous and unspecified	--	(6)	(8)	--	179,000	--
Grand total	1,440	293,000	93,000	6,770	479,000	11,000
Total 2004	1,420	335,000	110,000	6,600	484,000 [r]	10,200
Percentage of 2004	101	87	84	103	99	107
Consumer stocks, December 31	1,220	18,300	4,800 [9]	1,120	16,300	1,020

[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 and other manganese alloys; 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]Included with 'Steel, other alloy."

[5]Part included with "Miscellaneous and unspecified."

[6]Included with "Alloys (excluding alloy steels and superalloys)."

[7]All or part included with "Cast irons."

[8]All or part withheld to avoid disclosing company proprietary data.

[9]Consumer and producer stock.

TABLE 3

REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS BY END USE IN 2005[1, 2]

(Metric tons of contained elements unless otherwise specified)

End use	FeCr	FeMo	FeNb	FeNi	FeV	FeW
Steel:						
Carbon and high-strength low-alloy	3,870 [3]	518	2,390	--	2,150	(4)
Stainless and heat-resisting	205,000	766	562	13,200	60	(4)
Other alloy	17,000 [5]	2,590	(6)	W	1,010	(4)
Tool	3,250	W	(6)	--	402	(4)
Unspecified	W	--	--	--	--	(4)
Total	229,000	3,870	2,950	13,200	3,620	250
Cast irons	W	736	W	--	W	--
Superalloys	12,600	23	1,220	--	36	(4)
Alloys (excluding alloy steels and superalloys)	1,390	96	W	W	W	(4)
Miscellaneous and unspecified	13,400 [7]	91	3	117	259	--
Grand total	257,000	4,816	4,170	13,300	3,910	250
Total 2004	268,000	4,700 [r]	3,650 [r]	13,700 [r]	4,060	248
Percentage of 2004	96	102	114	97	96	101
Consumer stocks, December 31	8,600	604	NA	944	326	24

[r]Revised. NA Not available. 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, ferrocolumbium, including nickel columbium; FeNi, ferronickel; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; and FeW, ferrotungsten.

[3]All or part included with "Steel, other alloy."

[4]Included with "Steel, total."

[5]Includes full alloy and high-strength low-alloy steel.

[6]Included with "Carbon and high-strength low-alloy."

[7]Includes cast irons, electrical steel, and unspecified uses.

TABLE 4
FERROALLOY PRICES IN 2005

	High	Low	Average[1]
Chromium:			
Ferrochromium:			
0.05% carbon[2]	126.00	108.00	118.00
0.10% carbon[2]	118.00	91.00	104.47
0.15% carbon[2]	110.00	83.00	100.03
Over 4% carbon:			
50-55% chromium[2]	77.00	59.00	68.40
60-65% chromium[2]	77.00	52.00	67.32
Manganese:			
Medium-carbon ferromanganese[2]	82.00	44.00	59.41
Standard-grade ferromanganese[3]	950.00	500.00	638.15
Silicomanganese[4]	43.00	29.00	34.73
Molybdenum:			
Ferromolybdenum[5]	43.00	23.50	36.65
Molybdenum oxide[5]	40.00	22.25	31.79
Silicon:			
50% ferrosilicon[2]	68.00	47.00	55.00
75% ferrosilicon[2]	56.00	41.00	48.03
Silicon metal[5]	82.00	69.00	76.18
Vanadium, ferrovanadium[5]	61.00	21.00	32.96

[1]Annual time-weighted average.
[2]Cents per pound of contained element.
[3]Dollars per long ton.
[4]Cents per pound.
[5]Dollars per pound of contained element.

Sources: American Metal Market, Platts Metals Week, and Ryan's Notes.

TABLE 5

U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS AND FERROALLOY METALS IN 2005[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	398,000	232,000	$303,000	30,700	20,100	$31,100
Not more than 4% carbon	XX	XX	XX	5,460	3,540	7,560
More than 0.5% but not more than 3% carbon	3,530	2,300	4,330	XX	XX	XX
Not more than 0.5% carbon	43,000	29,300	68,500	XX	XX	XX
Ferrochromium-silicon	33,700	14,100	31,600	147	51	186
Total	478,000	278,000	408,000	36,300	23,700	38,900
Manganese ferroalloys:						
Ferromanganese containing:						
More than 4% carbon	162,000	126,000	90,900	XX	XX	XX
More than 2% but not more than 4% carbon	61	48	31	XX	XX	XX
More than 1% but not more than 2% carbon	60,300	48,500	63,400	XX	XX	XX
Not more than 1% carbon	32,200	26,600	45,300	XX	XX	XX
Ferromanganese, all grades	XX	XX	XX	14,400	XX	14,900
Silicomanganese	327,000	218,000	231,000	899	XX	1,220
Total	582,000	419,000	431,000	15,300	XX	16,100
Silicon ferroalloys:						
Ferrosilicon containing:						
More than 55% silicon	XX	XX	XX	9,830	5,940	9,590
More than 55% but not more than 80% silicon and more than 3% calcium	606	373	985	XX	XX	XX
Magnesium ferrosilicon	30,000	13,900	26,900	XX	XX	XX
Ferrosilicon, other[2]	259,000	183,000	187,000	3,610	1,800	3,780
Total	290,000	197,000	215,000	13,400	7,740	13,400
Other ferroalloys:						
Ferrocerium and other pyrophoric alloys and other	147	XX	2,050	XX	XX	XX
Ferrocolumbium	7,400	XX	60,000	410	XX	4,210
Ferromolybdenum	6,340	4,050	278,000	3,480	2,090	43,400
Ferronickel	48,800	19,300	185,000	143	72	520
Ferrophosphorus	12,100	XX	3,940	1,780	XX	1,150
Ferrotitanium and ferrosilicon-titanium	16,900	XX	76,700	3,630	XX	21,300
Ferrotungsten and ferrosilicon-tungsten	493	385	5,390	57	29	196
Ferrovanadium	NA	11,900	131,000	NA	504	19,300
Ferrozirconium	306	XX	675	65	XX	100
Ferroalloys, other	7,500	XX	15,000	2,200	XX	3,190
Total	99,900	XX	758,000	11,800	XX	93,400
Total ferroalloys	1,450,000	XX	1,810,000	76,800	XX	162,000
Metals:						
Chromium (total, all grades)	11,000	XX	87,700	1,020	XX	16,900
Manganese, other:						
Unwrought	31,300	XX	54,500	XX	XX	XX
Other	451	XX	1,180	XX	XX	XX
Silicon:						
Less than 99% silicon	32,800	30,300	48,500	6,760	6,560	12,700
Less than 99.99% but not less 99% silicon	122,000	120,000	187,000	1,780	1,770	4,210
Not less than 99.99% silicon	2,070	XX	131,000	14,800	XX	830,000
Total metals	200,000	XX	510,000	24,400	XX	864,000
Grand total	1,650,000	XX	2,320,000	101,000	XX	1,030,000

NA Not available. 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 greater than 80% silicon.

Source: U.S. Census Bureau.

TABLE 6

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]	2001	2002	2003	2004[e]	2005[e]
Albania, electric furnace, ferrochromium	11,900	22,100	37,800	47,700 [r, 6]	35,780 [6]
Argentina, electric furnace:					
Ferrosilicon[e]	2,740 [6]	2,700	2,700	2,700	2,700
Silicomanganese[e]	5,150 [6]	5,000	5,000	5,000	5,000
Silicon metal[e]	8,000	8,000	8,000	8,000	8,000
Other[7]	9,925	17,289	15,000 [e]	15,000	15,000
Total	25,815	32,989	30,700 [e]	30,700	30,700
Australia, electric furnace:[e]					
Ferromanganese	115,000	115,000	115,000	115,000	120,000
Silicomanganese	135,000	135,000	135,000	135,000	140,000
Silicon metal	30,000	30,000	30,000	30,000	35,000
Total	280,000	280,000	280,000	280,000	295,000
Austria, electric furnace:[e]					
Ferronickel	3,700 [r]	2,500 [r]	3,700 [r]	750 [r]	1,000
Other	4,000	4,000	4,000	4,000	4,000
Total	7,700 [r]	6,500 [r]	7,700 [r]	4,750 [r]	5,000
Bhutan, electric furnace, ferrosilicon[e]	16,000	21,000	21,000	20,000	20,000
Bosnia and Herzegovina, electric furnace:[e]					
Ferrosilicon	1,000	1,000	1,000	1,000	1,000
Silicon metal	200	200	--	--	--
Total	1,200	1,200	1,000	1,000	1,000
Brazil, electric furnace:					
Ferrochromium[8]	110,468	164,140 [r]	204,339	216,277 [r, 6]	185,533 [p, 6]
Ferrochromiumsilicon	5,899	10,522	10,500	11,560 [r, 6]	11,600 [p, 6]
Ferromanganese	276,000 [r]	339,000 [r]	438,000 [r]	508,000 [r]	510,000 [p]
Ferronickel	17,966	19,874	19,378 [r]	20,338 [r, 6]	21,200 [p]
Ferrosilicon	159,345	145,910	146,000	146,000	146,000
Silicomanganese	180,235	182,731	180,200	180,000 [r]	108,200 [p, 6]
Silicon metal	112,123	133,390	133,400	133,400	133,400 [p, 6]
Other[e]	79,750	87,398	86,400	86,400	86,500 [p]
Total	941,786 [r]	1,082,965 [r]	1,218,217 [r]	1,301,975 [r, 6]	1,202,433 [p, 6]
Bulgaria, electric furnace:[e]					
Ferrosilicon	8,000	8,000	8,000	8,000	8,000
Other	10,000 [r]	10,000 [r]	10,000 [r]	10,000 [r]	10,000
Total	18,000 [r]	18,000 [r]	18,000 [r]	18,000 [r]	18,000
Canada, electric furnace:[e]					
Ferrosilicon	56,000	56,000	56,000	56,000	56,000
Ferrovanadium	1,000	1,000	1,000	1,000	1,000
Silicon metal	30,000	30,000	30,000	30,000	30,000
Total	87,000	87,000	87,000	87,000	87,000
Chile, electric furnace:					
Ferromanganese	2,213	--	--	--	--
Ferromolybdenum	1,740 [r]	3,160 [r]	4,070 [r]	5,760 [r]	5,800
Total	3,953 [r]	3,160 [r]	4,070 [r]	5,760 [r]	5,800
China:[e]					
Blast furnace:					
Ferromanganese	500,000	500,000	550,000	590,000 [r]	600,000
Other	100,000	100,000	100,000	100,000	100,000
Electric furnace:					
Ferrochromium	310,000	330,000	500,000	640,000 [r]	750,000
Ferromanganese	670,000	490,000	700,000	1,120,000 [r]	1,100,000
Ferromolybdenum	37,700	29,600	60,000 [r]	70,000 [r]	60,000
Ferrosilicon	1,320,000	1,500,000	2,200,000	3,000,000	2,800,000

See footnotes at end of table.

TABLE 6—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]	2001	2002	2003	2004[e]	2005[e]
China—Continued:[e]					
Electric furnace—Continued:					
Silicomanganese	1,170,000	1,580,000	1,800,000	2,600,000	3,800,000
Other	392,000	310,000	461,000	800,000	1,400,000
Total	4,500,000	4,840,000	6,370,000 r	8,920,000 r	10,600,000
Colombia, electric furnace, ferronickel	91,475	111,952	111,324	113,647 r, 6	123,000
Croatia, electric furnace, ferrochromium[e]	361 6	--	--	--	--
Czech Republic, electric furnace, other[e]	1,000	1,000	1,000	1,000	1,000
Dominican Republic, electric furnace, ferronickel	60,654	58,101 r	69,628 r	75,763 r, 6	75,800
Egypt, electric furnace:[e]					
Ferromanganese	30,000	30,000	30,000	30,000	30,000
Ferrosilicon	55,000	55,000	55,000	55,000	55,000
Total	85,000	85,000	85,000	85,000	85,000
Finland, electric furnace, ferrochromium	236,710	248,181	250,490	264,492 6	234,881 6
France:[e]					
Blast furnace, ferromanganese	300,000	300,000	180,000	--	--
Electric furnace:					
Ferromanganese	130,000	130,000	120,000	106,000	110,000
Ferrosilicon	100,000	100,000	100,000	100,000	100,000
Silicomanganese[9]	50,000	50,000	107,000	64,000	65,000
Silicon metal	75,000	75,000	75,000	75,000	75,000
Other	65,000	65,000	65,000	65,000	65,000
Total	720,000	720,000	647,000	410,000	415,000
Georgia, electric furnace:[e]					
Ferromanganese	100 6	-- 6	--	--	--
Silicomanganese	25,000	25,000	25,000	25,000	25,000
Total	25,100	25,000	25,000	25,000	25,000
Germany, electric furnace:					
Ferrochromium	19,308	20,018	18,318	24,857 6	22,672 6
Other[10]	52,700 r	60,000 r	61,700 r	55,000 r	55,000
Total	72,008 r	80,018 r	80,018 r	79,857 r, 6	77,672 6
Greece, electric furnace, ferronickel	88,755	97,761	95,376	96,000 e	95,000
Hungary, electric furnace:[e, 11]					
Ferrosilicon	7,000	7,000	7,000	7,000	7,000
Silicon metal	1,000	1,000	1,000	500	500
Total	8,000	8,000	8,000	7,500	7,500
Iceland, electric furnace, ferrosilicon	111,948	120,624	117,171 r	118,000 r	120,000
India, electric furnace:[e]					
Ferrochromium[12]	267,395 6	311,927 6	468,677 6	527,100 6	611,373 6
Ferrochromiumsilicon	10,000	10,000	10,000	10,000	10,000
Ferromanganese	165,000	165,000	165,000	170,000	170,000
Ferrosilicon	50,000	52,000	54,000	55,000	56,000
Silicomanganese	150,000	150,000	160,000	160,000	170,000
Other	9,000	9,000	9,000	9,000	9,000
Total	651,000	698,000	867,000	931,000	1,030,000
Indonesia, electric furnace:					
Ferromanganese[e]	12,000	12,000	12,000	12,000	12,000
Ferronickel	47,769	42,306	43,894 r	39,538 r, 6	36,690 6
Silicomanganese[e]	7,000	7,000	7,000	7,000	4,000
Total	66,769	61,306	62,894 r	58,538 r, 6	52,690 6
Iran, electric furnace:					
Ferrochromium	8,430	8,000 r, e	10,000 r, e	7,750 r, 6	8,000
Ferrosilicon[e]	40,000	41,700	40,297 r, 6	50,150 r, 6	50,000
Total	48,430	49,700	50,297 r	57,900 r, 6	58,000

See footnotes at end of table.

TABLE 6—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]	2001	2002	2003	2004[e]	2005[e]
Italy, electric furnace:[e]					
Ferromanganese	40,000	40,000	40,000	40,000	40,000
Silicomanganese	90,000	90,000	90,000	90,000	90,000
Silicon metal	6,000	6,000	6,000	6,000	6,000
Other[13]	10,000	10,000	10,000	10,000	10,000
Total	146,000	146,000	146,000	146,000	146,000
Japan, electric furnace:					
Ferrochromium[14]	111,167	91,937	19,427	13,472 [r, 6]	12,367 [6]
Ferromanganese	368,293	356,717	371,831	437,389 [r, 6]	448,616 [6]
Ferronickel	367,739	370,973	369,099 [r]	374,213 [r, 6]	391,074 [6]
Silicomanganese	62,238	70,965	58,043	73,041 [r, 6]	94,725 [6]
Other[15]	12,940	12,352	10,007	12,822 [r, 6]	16,436 [6]
Total	922,377	902,944	828,407 [r]	910,937 [r, 6]	963,218 [6]
Kazakhstan, electric furnace:					
Ferrochromium	761,900	835,800	993,000	1,080,993 [r, 6]	1,156,168 [6]
Ferrochromiumsilicon	79,800	102,200	98,130	104,800 [r, 6]	97,870 [6]
Ferromanganese	5,349	2,278	1,931	2,000	2,100
Ferrosilicon	145,800	127,300	127,300	103,580 [r, 6]	104,185 [6]
Silicomanganese	141,200	164,000	178,920	155,324 [r, 6]	170,214 [6]
Other[e]	9,000	9,000	9,000	9,000	9,000
Total	1,143,049	1,240,578	1,408,281	1,455,697 [r, 6]	1,539,537 [6]
Korea, North, electric furnace:[e]					
Ferromanganese[10]	6,000	6,000	6,000	6,000	6,000
Ferrosilicon	3,000	3,000	3,000	3,000	3,000
Other	1,000	1,000	1,000	1,000	1,000
Total	10,000	10,000	10,000	10,000	10,000
Korea, Republic of, electric furnace:					
Ferromanganese	143,525	137,000 [e]	141,000	165,525 [r, 6]	165,000
Silicomanganese	101,877	94,000 [e]	90,942 [r]	82,917 [r, 6]	83,000
Other	4,452	--	--	--	--
Total	249,854	231,000 [e]	231,942 [r]	248,442 [r, 6]	248,000
Macedonia, electric furnace:[e]					
Ferronickel	10,300	17,000	19,000	18,800	28,000
Ferrosilicon	50,000	50,000	50,000	50,000	50,000
Total	60,300	67,000	69,000	68,800	78,000
Mexico, electric furnace:[16]					
Ferromanganese	60,014	38,532	55,903	72,471 [6]	89,641 [6]
Silicomanganese	74,290	73,263	81,223	103,206 [6]	104,780 [6]
Total	134,304	111,795	137,126	175,677 [6]	194,421 [6]
New Caledonia, electric furnace, ferronickel[e]	162,000	171,000	175,000	149,000 [6]	169,000
Norway, electric furnace:[e]					
Ferrochromium	82,600 [6]	61,100 [6]	--	--	--
Ferromanganese	240,000	240,000	245,000	245,000	250,000
Ferrosilicon	450,000	390,000	350,000	300,000	270,000
Silicomanganese	230,000	230,000	230,000	230,000	230,000
Silicon metal	100,000	105,000	100,000	105,000	105,000
Other[9]	15,000	15,000	15,000	15,000	15,000
Total	1,120,000	1,040,000	940,000	895,000	870,000
Peru, electric furnace, ferrosilicon[e]	600	600	600	600	600
Poland:[e]					
Blast furnace, ferromanganese	500	600	1,000 [r]	1,000 [r]	1,000
Electric furnace:					
Ferrosilicon	48,600 [6]	41,800	92,700 [r]	90,000 [r]	90,000

See footnotes at end of table.

TABLE 6—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]	2001	2002	2003	2004[e]	2005[e]
Poland—Continued:[e]					
Electric furnace—Continued:					
Silicomanganese	20,000 [6]	7,500	-- [r]	-- [r]	--
Silicon metal	-- [r]	-- [r]	-- [r]	-- [r]	--
Total	69,100 [r, 6]	49,900 [r]	93,700 [r]	91,000 [r]	91,000
Romania, electric furnace:					
Ferromanganese	384	--	-- [e]	--	--
Ferrosilicon	5,823	--	-- [e]	--	--
Silicomanganese	71,921	84,720 [r]	141,899 [r]	194,945 [r, 6]	200,000
Total	78,128	84,720 [r]	141,899 [r]	194,945 [r, 6]	200,000
Russia:[e]					
Blast furnace:					
Ferromanganese	55,000	105,000	101,000	108,000	108,000
Ferrophosphorus	3,500	3,500	3,500	3,500	3,500
Spiegeleisen	7,000	7,000	7,000	7,000	7,000
Electric furnace:					
Ferrochromium	210,600 [6]	210,000 [6]	357,000 [6]	454,000	578,000 [6]
Ferrochromiumsilicon	4,000	4,000	4,000	4,000	4,000
Ferronickel[17]	30,000 [6]	45,000	23,500 [r]	28,700 [r]	24,100
Ferrosilicon	707,100 [6]	701,000	760,000	721,000	742,000 [6]
Ferrovanadium	18,800	15,100	8,000	13,700 [r]	12,880 [6]
Silicomanganese	124,000	127,000	83,000	143,000	145,000
Silicon metal	40,000	40,000	45,000	45,000	45,000
Other	16,200	14,900	22,000	22,000	22,000
Total	1,220,000	1,270,000	1,410,000 [r]	1,550,000 [r]	1,690,000
Saudi Arabia, electric furnace, other[e]	78,000	75,000	75,000	85,000 [r]	85,000
Slovakia, electric furnace:[e]					
Ferrochromium	5,968 [6]	5,695 [6]	1,924 [6]	1,784 [6]	867 [6]
Ferromanganese	20,000	20,000	20,000	20,000	20,000
Ferrosilicon	50,000	50,000	50,000	50,000	50,000
Silicomanganese	35,000	35,000	35,000	35,000	35,000
Other	5,000	5,000	5,000 [r]	5,000 [r]	5,000
Total	116,000	116,000	112,000 [r]	112,000 [r]	111,000
Slovenia, electric furnace:[e]					
Ferrosilicon	8,000	8,000	9,000	9,000	9,000
Other[7]	200	200	--	--	--
Total	8,200	8,200	9,000	9,000	9,000
South Africa, electric furnace:					
Ferrochromium	2,141,000	2,351,122	2,813,000	2,965,000 [r, 6]	2,581,578 [6]
Ferromanganese	524,000 [r]	618,954 [r]	607,362	612,000 [r, 6]	510,000
Ferrosilicon	107,600	141,700	135,000 [r]	141,000 [r, 6]	125,000
Ferrovanadium	18,184	25,227	27,172	25,000 [r]	22,000
Silicomanganese	253,000	315,802	313,152	340,000	280,000
Silicon metal	39,400	42,500	48,500 [r]	50,500 [r, 6]	51,000
Other[e, 18]	64,000	85,000 [r]	80,000 [r]	80,000 [r]	80,000
Total	3,147,184 [r]	3,580,305 [r]	4,024,186 [r]	4,213,500 [r, 6]	3,650,000
Spain, electric furnace:[e]					
Ferromanganese	10,000	10,000	10,000	10,000	10,000
Ferrosilicon	40,000	40,000	40,000	40,000	40,000
Silicomanganese	100,000	100,000	100,000	100,000	100,000
Silicon metal	30,000	30,000	30,000	30,000	30,000
Other	5,000	5,000	5,000	5,000	5,000
Total	185,000	185,000	185,000	185,000	185,000

See footnotes at end of table.

TABLE 6—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]	2001	2002	2003	2004[e]	2005[e]
Sweden, electric furnace:					
Ferrochromium	109,198	118,823	110,529	128,191 [6]	127,451 [6]
Ferrosilicon[e]	22,000	23,000	24,000	24,000	25,000
Total	131,198	141,823	134,529	152,191 [r, 6]	152,451 [6]
Taiwan, electric furnace, ferrosilicon	1,181	--	--	--	--
Turkey, electric furnace:					
Ferrochromium	50,735	11,200 [e]	35,393	28,701 [r, 6]	26,043 [6]
Ferrosilicon	5,895	7,245	7,000 [e]	-- [r]	--
Total	56,630	18,445	42,393	28,701 [r, 6]	26,043 [6]
Ukraine:					
Blast furnace:[e]					
Ferromanganese	85,000	85,000	85,000	79,000 [r]	30,000
Spiegeleisen	5,000	5,000	5,000	5,000	5,000
Electric furnace:					
Ferromanganese	231,000	250,617	250,000 [e]	375,990 [6]	330,000
Ferronickel[e]	41,000	31,000	-- [r]	78,000	78,000
Ferrosilicon	231,000	250,617	250,000 [e]	248,060 [6]	248,000
Silicomanganese	702,389	732,592	740,000 [e]	1,060,000 [6]	1,000,000
Other[e]	25,000	25,000	25,000	25,000	25,000
Total	1,320,389	1,379,826	1,360,000 [r, e]	1,871,050 [r, 6]	1,720,000
United States, electric furnace:					
Ferrochromium[19]	W	W	W	W	W
Ferromanganese[20]	W	W	W	W	W
Ferrosilicon[21]	191,000	182,000	148,000	171,000 [6]	164,000 [6]
Silicon metal[21]	131,000	108,000	134,000	144,000 [6]	143,000 [6]
Other[22]	W	W	W	W	W
Total	322,000	290,000	282,000	315,000 [6]	307,000 [6]
Uruguay, electric furnace, ferrosilicon[e]	200	200	200	200	200
Venezuela, electric furnace:					
Ferromanganese[e]	12,715 [6]	12,000	12,000	15,000	15,000
Ferronickel	32,300	51,700 [e]	57,300 [e]	58,000 [r]	56,300
Ferrosilicon	46,236	99,576	90,543	92,000	92,000
Silicomanganese	56,640	36,974	30,632	35,000	35,000
Total	147,891	200,250	190,475	200,000 [r]	198,000
Zimbabwe, electric furnace:					
Ferrochromium	243,584	258,164	245,200	193,077 [6]	235,000
Ferrochromiumsilicon	16,848	--	--	1,000 [r]	5,000
Total	260,432	258,164	245,200	194,077 [r, 6]	240,000
Grand total	19,200,000 [r]	20,300,000 [r]	22,800,000 [r]	26,300,000 [r]	27,600,000
Of which:					
Blast furnace:					
Ferromanganese	941,000	991,000	917,000 [r]	778,000 [r]	739,000
Spiegeleisen	12,000	12,000	12,000	12,000	12,000
Other[23]	104,000	104,000	104,000	104,000	104,000
Total, blast furnace	1,060,000	1,110,000	1,030,000 [r]	894,000 [r]	855,000
Electric furnace:					
Ferrochromium[24]	4,680,000 [r]	5,050,000 [r]	6,070,000 [r]	6,590,000 [r]	6,570,000
Ferrochromiumsilicon	117,000 [r]	127,000	123,000	131,000 [r]	128,000
Ferromanganese	3,060,000 [r]	3,010,000 [r]	3,340,000 [r]	4,060,000 [r]	3,940,000
Ferronickel	954,000	1,020,000 [r]	987,000 [r]	1,050,000 [r]	1,100,000
Ferrosilicon	4,040,000	4,230,000	4,950,000 [r]	5,660,000 [r]	5,430,000
Silicomanganese	3,780,000	4,300,000 [r]	4,590,000 [r]	5,820,000 [r]	6,880,000

See footnotes at end of table.

TABLE 6—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]	2001	2002	2003	2004[e]	2005[e]
Grand total—Continued					
Of which—Continued:					
Electric furnace—Continued:					
Silicon metal	603,000 r	610,000 r	641,000 r	658,000 r	662,000
Other[25]	947,000 r	896,000 r	1,070,000 r	1,430,000 r	2,020,000
Total, electric furnace	18,200,000 r	19,200,000 r	21,800,000 r	25,400,000 r	26,700,000

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

[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 August 16, 2006.

[3]In addition to the countries listed, Iran is believed to have produced ferromanganese, ferromolybdenum, and silicomanganese, but production information is inadequate for 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, ferrochromiumsilicon, ferromanganese, ferronickel, ferrosilicon, 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 calcium-silicon.

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

[9]Includes, if any, silicospiegeleisen.

[10]Includes, if any, ferrochromiumsilicon, ferronickel, and silicomanganese.

[11]Hungary is believed to produce some blast furnace ferromanganese.

[12]Includes charge chrome and ferrochrome.

[13]Excludes calcium-silicon.

[14]Includes high- and low-carbon ferrochromium and ferrochromiumsilicon.

[15]Includes calcium-silicon, ferrocolumbium, ferromolybdenum, ferrotungsten, ferrovanadium, and other ferroalloys. Awamura Metal Industry Co. Ltd., which was the sole producer of ferrotungsten in Japan, reportedly was liquidated at the end of 2003.

[16]Salable products from Cía. Minera Autlán S.A. B. de C.V.

[17]In December 2001, Mechel OAO acquired a 79.9% interest in the South Urals Nickel Plant previously operated by Yuzhuralnikel Combine JSC. The new owner made substantial improvement to the Orsk ferronickel plant and produced a low-iron ferronickel (greater than 85% nickel).

[18]Includes, if any, ferronickel.

[19]U.S. output of ferrochromium includes chromium metal, high- and low-carbon ferrochromium, ferrochromiumsilicon, and other chromium materials.

[20]U.S. output of ferromanganese includes manganese metal and silicomanganese.

[21]Net production.

[22]May include ferroboron, ferrocolumbium, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrovanadium, nickel columbium, and silvery pig iron.

[23]Includes ferrophosphorus and data contained in "Blast furnace: Other."

[24]Ferrochromium includes ferrochromiumsilicon, if any, for Japan, South Africa, and the United States.

[25]Includes ferromolybdenum and ferrovanadium.