

# FERROALLOYS

By Michael D. Fenton

**Domestic survey data and tables were prepared by Jo-Ann S. Sterling, statistical assistant, and the international survey data and table were prepared by Glenn J. Wallace, international data coordinator.**

Ferroalloys are alloys of iron that contain one or more other chemical elements. These alloys are used to add these other elements into molten metal, usually in steelmaking. The following text contains some salient information on the ferroalloys of manganese, silicon, and chromium. These and other ferroalloys are discussed in more detail, including domestic data coverage and outlook, in the respective commodity chapters in the U.S. Geological Survey Minerals Yearbook. These chapters are also published individually in the Mineral Industry Surveys Annual Review series. The tables in this chapter comprise information on all ferroalloys for which data are available. The top five ferroalloy producers in the world in 1998, in decreasing order, were China, South Africa, Norway, Ukraine, and Japan.

Manganese ferroalloys, consisting of various grades of ferromanganese and silicomanganese, are used to provide a key ingredient for steelmaking (Matricardi and Downing, 1995, p. 970). The sole domestic producer of manganese ferroalloys was Elkem Metals Co. at its plant near Marietta, OH. As detailed in the Manganese chapter of the 1998 Minerals Yearbook, most of the U.S. supply was imported; Australia, France, Mexico, and South Africa were leading sources. China was by far the largest foreign producer of manganese ferroalloys, with an output more than twice that of either South Africa or Ukraine, the countries with the next largest outputs. The trend toward international merging of manganese ferroalloy production facilities was exemplified by the joining under common ownership of plants in Australia and South Africa and the start of commercial production of refined manganese ferroalloys in South Africa by two Japanese and South African joint ventures.

Demand for silicon ferroalloys is driven principally by the production of steel and cast iron (Dosaj, 1997, p. 1115). On the basis of content, U.S. production of silicon ferroalloys corresponded to roughly two-thirds of apparent consumption of ferrosilicon; Norway was the leading source of U.S. imports. China was estimated to be the world's largest producer of ferrosilicon, with an output of more than twice that of either Norway or Russia, the countries with the next largest outputs. Silicon metal, which generally was produced like ferrosilicon in

submerged-arc electric furnaces, was used not as a ferroalloy, but rather for alloying with aluminum and for production of chemicals, especially silicones (Dosaj, 1997, p. 1108).

The major chromite-ore-producing countries were India, Kazakhstan, South Africa, and Turkey. Brazil, Finland, and Zimbabwe were significant chromite-ore-producing countries. Most chromite ore was smelted in an electric arc furnace to produce ferrochromium for use by the metallurgical industry. Stainless steel manufacture consumed most ferrochromium. The major ferrochromium-producing country was South Africa. China, Finland, India, Kazakhstan, Russia, and Zimbabwe were significant ferrochromium-producing countries. The major stainless-steel-producing areas of the world—Europe (including Western Europe and Scandinavia), Japan and Korea in Asia, and the United States—accounted for about 70% of world stainless steel production.

The world chromium industry in 1998 operated with supply capacity in excess of demand. In South Africa, ferrochromium production capacity was brought into production, new furnaces were planned and under construction, and chromium recovery from slag processes were implemented. Further vertical integration of the chromium industry was anticipated as Finland and South Africa planned to increase their stainless-steel-production capacities. Three industry process trends were evolving—chromium recovery from slag in the ferrochromium industry, supply of molten ferrochromium to stainless steel production, and strategic alliances between the two industries. The ferrochromium industry developed in close proximity to the stainless steel industry; however, ferrochromium producers have been opening new plants in chromite-producing areas and closing facilities in traditional ferrochromium-producing areas.

## References Cited

- Dosaj, Vishu, 1997, Silicon and silicon alloys—Chemical and metallurgical, *in* Kirk-Othmer encyclopedia of chemical technology (4th ed.): New York, John Wiley and Sons, v. 21, p. 1104-1122.
- Matricardi, L.R., and Downing, James, 1995, Manganese and manganese alloys, *in* Kirk-Othmer encyclopedia of chemical technology (4th ed.): New York, John Wiley and Sons, v. 15, p. 963-990.

TABLE 1  
GOVERNMENT INVENTORY OF FERROALLOYS, DECEMBER 31, 1998 1/

(Metric tons of alloys, unless otherwise specified)

Alloy	Stockpile grade	Nonstockpile grade	Total
Ferrochromium:			
High-carbon	644,000	601	645,000
Low-carbon	268,000	6,890	274,000
Ferrochromium-silicon	48,200	1,240	49,400
Ferrocolumbium (kilograms contained columbium)	203,000	121,000	324,000
Ferromanganese, high carbon	878,000	--	878,000
Ferrotungsten (kilograms contained tungsten)	385,000	533,000	918,000

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Defense Logistics Agency; Inventory of Stockpile Material L-1.

TABLE 2  
REPORTED U.S. CONSUMPTION OF FERROALLOYS IN 1998, BY END USE 1/ 2/ 3/

(Metric tons, unless otherwise specified)

End use	Additives (gross weight)			Alloying elements (contained weight)			
	FeTi	FeP	FeB	FeMo	FeW	FeV	FeCb
Steel:							
Carbon	3,630	4,500	957	280	(4/)	2,560	1,410
Stainless and heat-resisting	1,410	(4/)	414	664	52	31	522
Other alloy	128	386	151	2,160	31	891	980
Tool	(4/)	--	--	88	411	77	W
Unspecified	(4/)	(4/)	--	--	23	(5/)	21
Total	5,170	4,890	1,520	3,190	516	3,560	2,930
Cast irons	(6/)	785	--	843	--	(5/)	--
Superalloys	837	(6/)	(6/)	(6/)	(6/)	11	694
Alloys (excluding alloy steels and superalloys)	480	642	224	217	11	5	W
Miscellaneous and unspecified	(6/)	(6/)	--	--	--	--	13
Grand total	6,490	6,310	1,750	4,250	527	3,580	3,640
Total 1997	7,520 r/	7,160 r/	1,570 r/	4,170	473 r/	3,880 r/	4,000 r/
Percentage of 1997	86	88	111	102	111	92	91
Consumer stocks, December 31, 1998	833	882	316	393	26	302	NA

r/ Revised. NA Not available. W Withheld to avoid disclosing company proprietary data, included with "Miscellaneous and unspecified."

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ FeTi, ferrotitanium, including titanium scrap and other titanium materials; FeP, ferrophosphorus, including other phosphorus materials; FeB, ferroboron, including other boron materials; FeMo, ferromolybdenum, including calcium molybdate; FeW, ferrotungsten; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; and FeCb, ferrocolumbium, including nickel columbium.

3/ Data for ferromanganese, including manganese metal; silicomanganese; ferrosilicon, including silicon metal, silvery pig iron, and inoculant alloys; ferrochromium including other chromium ferroalloys; and ferronickel were not available as of September 13, 1999.

4/ All or part included with "Steel: Other alloy."

5/ Withheld to avoid disclosing company proprietary data.

6/ All or part included with "Alloys (excluding alloy steels and superalloys)."

TABLE 3  
FERROALLOY PRICES IN 1998

	High	Low	Average 1/
Standard-grade ferromanganese 2/	530.00	475.00	501.83
Medium-carbon ferromanganese 3/	42.00	37.00	40.68
Silicomanganese 4/	27.00	20.00	23.57
Charge-grade ferrochromium 3/	50.00	35.00	46.67
High-carbon ferrochromium 3/	47.00	35.00	44.73
Low-carbon ferrochromium 3/	90.00	77.00	84.99
50%-grade ferrosilicon 3/	54.00	50.00	52.12
75%-grade ferrosilicon 3/	47.00	39.00	43.23
Silicon metal 4/	76.00	63.00	70.54
Ferromolybdenum 5/	5.45	3.70	4.64
Molybdenum oxide 5/	4.35	2.18	2.57
Ferrovandium 6/	33.00	12.00	25.62

1/ Annual weighted average.

2/ Dollars per long ton.

3/ Cents per pound of contained element.

4/ Cents per pound.

5/ Dollars per pound of contained element.

6/ Dollars per kilogram of contained element.

Source: Platt's Metal Week.

TABLE 4  
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS AND FERROALLOY METALS IN 1998 1/

(Metric tons)

Alloy	Imports			Exports		
	Gross weight	Contained weight	Value (thousands)	Gross weight	Contained weight	Value (thousands)
<b>Ferroalloys:</b>						
Chromium ferroalloys:						
Ferrochromium containing:						
More than 4% of carbon	363,000	204,000	\$182,000	4,840	2,990	\$4,210
More than 3% but not more than 4% of carbon	1,370	858	614	XX	XX	XX
Not more than 3% of carbon	53,800	35,400	62,100	1,380	841	2,100
Ferrochromium-silicon	20,000	6,770	12,500	387	135	402
Total ferrochromium alloys	438,000	247,000	257,000	6,610	3,960	6,710
Manganese ferroalloys:						
Ferromanganese containing:						
More than 4% of carbon	259,000	201,000	103,000	XX	XX	XX
More than 2% of carbon	78	67	89	XX	XX	XX
More than 1% but not more than 2% of carbon	65,200	52,800	40,200	XX	XX	XX
Not more than 1% of carbon	14,500	12,800	19,100	XX	XX	XX
Ferromanganese, all grades	XX	XX	XX	13,800	XX	8,450
Silicomanganese	346,000	231,000	159,000	6,720	XX	4,190
Total ferromanganese alloys	685,000	498,000	321,000	20,500	XX	12,600
Silicon ferroalloys:						
Ferosilicon containing:						
More than 55% of silicon	XX	XX	XX	14,900	9,080	11,100
More than 55% but not more than 80% of silicon and more than 3% of calcium	6,700	484	4,220	XX	XX	XX
More than 55% but not more than 80% of silicon and not more than 3% of calcium	166,000	126,000	113,000	XX	XX	XX
Magnesium ferosilicon	15,400	7,010	15,200	XX	XX	XX
Ferosilicon, other	13,100	4,250	10,800	29,900	14,900	24,900
Total ferosilicon alloys	201,000	138,000	143,000	44,800	24,000	35,900
Other ferroalloys:						
Ferrocerium and other pyrophoric alloys and other	131	(2/)	1,870	XX	XX	XX
Ferromolybdenum	7,690	4,830	44,000	1,400	760	11,400
Ferronickel	NA	NA	NA	NA	NA	NA
Ferroniobium (columbium)	7,530	(2/)	68,400	23	(2/)	206
Ferrophosphorus	13,700	(2/)	4,280	2,150	(2/)	1,020
Ferrotitanium and ferosilicon-titanium	7,340	(2/)	19,200	2,030	(2/)	5,840
Ferrotungsten and ferosilicon-tungsten	787	599	3,890	80	40	1,460
Ferrovandium	2,090	1,620	39,300	764	579	13,700
Ferrozirconium	61	(2/)	116	130	(2/)	597
Ferroalloys, other	34,800	(2/)	55,500	2,110	(2/)	3,260
Total other ferroalloys	74,100	XX	236,000	8,690	XX	37,500
Total ferroalloys	1,400,000	XX	958,000	80,600	XX	92,700
<b>Metals:</b>						
Chromium	9,500	(2/)	72,100	1,040	(2/)	13,000
Manganese:						
Unwrought	14,600	(2/)	22,800	5,710 3/	XX	13,200 3/
Other	744	(2/)	2,440	XX	XX	XX
Silicon:						
Less than 99% of silicon	52,300	48,500	60,400	13,200	16,700	24,400
Less than 99.99% but not less than 99% of silicon	51,100	49,600	77,700	2,150	2,140	3,090
Not less than 99.99% silicon	1,390	XX	85,400	4,350	XX	251,000
Total ferroalloy metals	130,000	XX	321,000	26,400	XX	305,000
Grand total	1,530,000	XX	1,280,000	107,000	XX	397,000

NA Not available. XX Not applicable.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Not recorded.

3/ Includes "Manganese: Other" and waste and scrap, if any.

Source: Bureau of the Census.

TABLE 5  
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/	1994	1995	1996	1997	1998 e/
Albania, electric furnace, ferrochromium	33,764	42,986	31,189	31,454 r/	29,960 6/
Argentina, electric furnace:					
Ferromanganese	4,500 r/	5,836	6,000 e/	6,000 e/	6,000
Ferro-silicon	11,669	14,017	14,000 e/	14,000 e/	14,000
Silicomanganese	29,358	27,344	28,000	28,000 e/	27,000
Other e/ 7/	3,700	3,850	3,750	3,800	3,800
Total	49,227 r/	51,047	51,750	51,800 e/	50,800
Australia, electric furnace: e/					
Ferromanganese	100,000	110,000	110,000	95,000	110,000
Silicomanganese	100,000	100,000	95,000	95,000	105,000
Silicon metal	30,000	30,000	30,000	30,000	30,000
Total	230,000	240,000	235,000	220,000	245,000
Austria, electric furnace:					
Ferro-nickel	5,250	5,000 r/	5,000	5,000 e/	4,500
Other e/	5,900	5,900	5,900	5,900	5,000
Total	11,150	10,900 r/	10,900	10,900 e/	9,500
Belgium, electric furnace, ferromanganese e/	25,000	25,000	25,000	25,000	20,000
Bhutan, electric furnace, ferro-silicon e/	2,000	12,000	13,000	15,000 r/	18,000
Bosnia and Herzegovina, electric furnace: e/					
Ferro-silicon	1,000	1,000	1,000	1,000	1,000
Silicon metal	200	200	200	200	200
Total	1,200	1,200	1,200	1,200	1,200
Brazil, electric furnace:					
Ferrochromium 8/	77,105 r/	100,969 r/	77,231 r/	112,274 r/	110,000
Ferrochromiumsilicon e/	5,000	5,000	5,000	5,000	5,000
Ferromanganese	200,000	130,000	215,260	153,000	123,000
Ferro-nickel	35,260	32,928	35,518	37,400	32,300 6/
Ferro-silicon	198,505	243,824	236,838	212,183 r/	210,000
Silicomanganese	248,000	167,000	232,218	175,000	125,000
Silicon metal	110,000	116,000	150,054	136,884 r/	120,000
Other e/	76,000	76,000	76,000	76,000	76,000
Total	949,870 r/	871,721 r/	1,028,119 r/	907,741 r/	801,000
Bulgaria, electric furnace: e/					
Ferro-silicon	8,000	7,550	8,300	8,000	8,000
Other	2,000	2,000	2,000	2,000	2,000
Total	10,000	9,550	10,300	10,000	10,000
Canada, electric furnace: e/					
Ferro-silicon	55,000	56,000	56,000	56,000	56,000
Ferrovanadium	2,000	1,000	1,000	1,000	1,000
Silicon metal	20,000	22,000	22,000	22,000	22,000
Total	77,000	79,000	79,000	79,000	79,000
Chile, electric furnace:					
Ferrochromium	1,579	2,730	2,700 r/	2,000	2,000
Ferromanganese	9,646	7,987	8,500 e/	8,550 r/ e/	8,560
Ferro-molybdenum e/	2,300	2,300	2,300	2,350 r/	2,300
Ferro-silicon e/	5,600	5,600	5,500	5,550 r/	5,620
Silicomanganese	995	1,617	1,600 e/	1,650 r/	1,650
Total e/	20,100	20,200	20,600 r/	20,100 r/	20,100
China: e/ 9/					
Blast furnace:					
Ferromanganese	567,000	400,000	450,000	500,000 r/	450,000
Other	210,000	210,000	200,000	100,000 r/	100,000
Electric furnace:					
Ferrochromium	370,000	500,000	423,000	480,000 r/	424,000
Ferromanganese	350,000	605,000	700,000	680,000 r/	600,000
Ferro-silicon	1,100,000	1,210,000	1,490,000	1,250,000 r/	1,100,000
Silicomanganese	657,000	830,000	840,000	770,000 r/	700,000
Other	110,000	80,000	77,000	260,000 r/	190,000
Total	3,360,000	3,840,000	4,180,000	4,040,000 r/	3,560,000
Colombia, electric furnace, ferro-nickel	50,827	59,917	57,335	58,000 e/	61,180 6/

See footnotes at end of table.

TABLE 5--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/	1994	1995	1996	1997	1998 e/
Croatia, electric furnace:					
Ferromanganese	31,704	26,081	10,559	24,231	11,770 6/
Ferromanganese e/	562	--	--	--	--
Silicomanganese e/	22,100	--	--	--	--
Total	54,300 e/	26,081	10,559	24,231	11,770 6/
Czech Republic, electric furnace, other e/					
	1,000	1,000	1,000	1,000	1,000
Dominican Republic, electric furnace, ferronickel					
	80,193	80,711	78,488	84,000 e/	68,041 6/
Egypt, electric furnace: e/					
Ferromanganese	35,000	35,000	35,000	35,000	35,000
Ferrosilicon	44,000 6/	44,000	44,000	40,000	40,000
Total	79,000	79,000	79,000	75,000	75,000
Finland, electric furnace, ferrochromium					
	253,501	246,805	227,811	236,652	230,906 6/
France:					
Blast furnace, ferromanganese					
	294,000	348,000	337,000	326,000	321,000
Electric furnace:					
Ferromanganese	66,200	85,000 r/	100,000 r/	100,000 r/	100,000
Ferrosilicon	111,000	108,000	103,000 r/ e/	109,000 r/ e/	110,000
Silicomanganese e/ 10/	66,000	71,000	61,000	66,000	65,000
Silicon metal	66,000	71,450	73,800	74,000 e/	75,000
Other e/	20,000	20,000	20,000	20,000	20,000
Total e/	623,000	703,000 r/	695,000 r/	695,000 r/	691,000
Georgia, electric furnace: e/					
Ferromanganese	10,000	5,000	5,000	6,000	10,000
Silicomanganese	10,000	10,000	10,000	20,000 r/	35,000
Other	-- r/	-- r/	-- r/	-- r/	--
Total	20,000 r/	15,000 r/	15,000 r/	26,000 r/	45,000
Germany, electric furnace: e/					
Ferromanganese	17,283 6/	21,665 6/	25,303 6/	25,856 6/	20,879 6/
Ferromanganese 11/	20,000	20,000	20,000	20,000	20,000
Ferrosilicon	20,000	20,000	20,000	20,000	20,000
Silicon metal	500	500	500	500	500
Other 12/	30,000	30,000	30,000	30,000	30,000
Total	87,800	92,200	95,800	96,400	91,400
Greece, electric furnace, ferronickel					
	77,129	68,656 r/	71,204 r/	70,440 r/	60,020 6/
Hungary, electric furnace: e/ 13/					
Ferrosilicon	7,000	7,000	7,000	7,000	7,000
Silicon metal	1,000	1,000	1,000	1,000	1,000
Other	1,000	--	--	--	--
Total	9,000	8,000	8,000	8,000	8,000
Iceland, electric furnace, ferrosilicon					
	66,003	71,410	70,520	70,000 r/ e/	61,000
India, electric furnace: e/					
Ferromanganese 14/	251,459 6/	303,537 r/ 6/	261,666 r/ 6/	286,973 6/	345,125 6/
Ferromanganese 15/	8,000	9,000	9,000	10,000	10,000
Ferromanganese	200,000	180,000	190,000	166,000 r/	138,000
Ferrosilicon	85,000	85,000	85,000	90,000	90,000
Silicomanganese	170,000	190,000	170,000	198,000 r/	188,000
Other	8,500	8,500	8,500	9,000	9,000
Total	723,000	776,000 r/	724,000 r/	760,000 r/	780,000
Indonesia, electric furnace:					
Ferromanganese e/	10,000	14,000	14,000	15,000	15,000
Ferronickel	28,725	53,675	47,800	50,000	42,260 6/
Silicomanganese e/	--	7,000	7,000	7,000	7,000
Total	38,725	74,675	68,800	72,000 e/	64,300
Iran, electric furnace:					
Ferromanganese 15/	7,150	11,900	10,500	11,450	13,745 6/
Ferrosilicon e/	--	10,000	20,000	20,000	20,000
Total	7,150	21,900	30,500	31,500 e/	33,700
Italy, electric furnace:					
Ferromanganese	22,650	51,017	29,915	11,295	11,487 6/
Ferromanganese	16,000 e/	20,216	25,143	16,000	16,000
Silicomanganese	40,000 e/	103,961	100,353	100,000 e/	100,000

See footnotes at end of table.

TABLE 5--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/	1994	1995	1996	1997	1998 e/
<b>Italy, electric furnace--Continued:</b>					
Silicon metal e/	--	10,000	14,000	15,000	15,000
Other e/ 16/	12,000	12,000	10,000	10,000	10,000
Total	90,650	197,194	179,411	152,000 e/	152,000
<b>Japan, electric furnace:</b>					
Ferchromium 8/	192,989	210,445	193,695	186,432	142,931 6/
Ferromanganese	345,153	346,977	343,104	376,633	334,081 6/
Ferronickel	242,447	351,337	328,699	352,840	345,772 6/
Ferrosilicon	12,208	3,650	--	--	951 6/
Silicomanganese	69,183	64,870	75,802	78,323	70,886 6/
Other 17/	14,647	12,353	10,131	10,217	8,678 6/
Total	876,627	989,632	951,431	1,004,445	903,299 6/
<b>Kazakhstan, electric furnace: e/</b>					
Ferchromium	373,300 r/ 6/	511,600 r/ 6/	352,000 6/	600,000 r/ 6/	535,000 6/
Ferchromiumsiron	26,900 r/ 6/	21,300 r/ 6/	20,000	48,000 r/	33,550 6/
Ferrosilicon	208,000	256,000	119,000	133,000 r/	92,000 6/
Silicomanganese	40,000	20,000	50,000	55,000 r/	57,000 6/
Other	10,000	10,000	10,000	9,000	8,000
Total	658,000 r/	819,000 r/	551,000	845,000 r/	726,000
<b>Korea, North, electric furnace: e/</b>					
Ferromanganese 12/	9,000 r/	7,000 r/	6,000 r/	6,000 r/	6,000
Ferrosilicon	5,000 r/	4,000 r/	3,000 r/	3,000 r/	3,000
Other 13/	20,000	20,000	20,000	20,000	20,000
Total	34,000 r/	31,000 r/	29,000 r/	29,000 r/	29,000
<b>Korea, Republic of, electric furnace:</b>					
Ferromanganese	120,020	118,798	126,135	158,755	158,418 6/
Silicomanganese	89,023	97,785	83,375	77,078	106,997 6/
Other	3,084	2,698	4,687	2,174	2,805 6/
Total	212,127	219,281	214,197	238,007	268,220 6/
<b>Macedonia, electric furnace:</b>					
Ferchromium	3,164	3,765	3,780	460 r/	-- 6/
Ferronickel	10,500	9,200	7,900	7,900 e/	9,200
Ferrosilicon	58,740	57,200	57,220	55,000 e/	55,000
Silicon metal e/	1,000	1,000	1,000	1,000	1,000
Total e/	73,400	71,200	69,900	64,400 r/	65,200
<b>Mexico, electric furnace: 18/</b>					
Ferromanganese	67,000 e/	58,000	69,000	68,000	88,000
Ferrosilicon e/	400	--	--	--	--
Silicomanganese	64,000 e/	67,700	93,000	105,000	105,000
Other e/	300	--	--	--	--
Total	131,700	125,700	162,000	173,000	193,000
<b>New Caledonia, electric furnace, ferronickel</b>					
	157,952	168,800	168,700 r/	172,250 r/	177,200 6/
<b>Norway, electric furnace:</b>					
Ferchromium	120,000	148,000	108,900	145,124	170,000
Ferromanganese	248,648	213,000	215,000	235,000 r/ e/	235,000
Ferrosilicon	452,984	474,875	462,423	470,000 e/	470,000
Silicomanganese e/	197,328 6/	210,000	210,000	230,000 r/	230,000
Silicon metal	92,000	101,000	110,000 e/	110,000 e/	110,000
Other e/ 10/	14,000	15,000	15,000	15,000	15,000
Total e/	1,120,000	1,160,000	1,120,000	1,210,000 r/	1,230,000
<b>Peru, electric furnace, ferrosilicon e/</b>					
	600	600	600	600	600
<b>Philippines, electric furnace:</b>					
Ferchromium	16,186	50,450	6,736	--	--
Ferromanganese e/	5,000	5,000	--	--	--
Ferrosilicon e/	10,000	10,000	--	--	--
Total e/	31,200	65,500	6,736 6/	--	--
<b>Poland:</b>					
Blast furnace, ferromanganese	66,300	46,300	59,900	60,000 e/	65,000
<b>Electric furnace:</b>					
Ferchromium	7,353	18,334	3,785	5,900	3,600 6/
Ferrosilicon	54,200	70,400	71,800	70,000 e/	75,000

See footnotes at end of table.

TABLE 5--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/	1994	1995	1996	1997	1998 e/
<b>Poland, electric furnace--Continued:</b>					
Silicomanganese e/	31,800	20,000	25,000	25,000	25,000
Silicon metal e/	1,300	1,300	1,300	1,400	1,400
Other e/ 13/	20,000	20,000	20,000	20,000	20,000
Total e/	181,000	176,000	182,000	182,000	190,000
<b>Romania, electric furnace:</b>					
Ferrochromium	3,885	15,053	9,650	950	850 6/
Ferromanganese	31,295	28,410	20,150	11,505	11,000
Ferrosilicon	28,385	19,320	23,827	9,620	9,500
Silicomanganese	35,215	57,149	78,590	62,570	60,000
Silicon metal e/	300	300	300	300	300
Total e/	99,100	120,000	133,000	84,900	81,700
<b>Russia: e/</b>					
<b>Blast furnace:</b>					
Ferromanganese	80,000 r/	82,500 r/ 6/	67,000 r/ 6/	47,100 r/ 6/	45,000 6/
Ferrophosphorus	2,000 r/	-- r/ 6/	2,300 r/ 6/	3,600 r/ 6/	3,500
Spiegeleisen	7,000	7,000	7,000	7,000	7,000
<b>Electric furnace:</b>					
Ferrochromium	265,525 6/	290,000	135,000	247,000	203,000 6/
Ferrochromiumsilicon	40,000	30,000	5,000	5,000	4,000
Ferronickel	59,000 6/	77,000 6/	75,000 6/	40,000	30,000
Ferrosilicon	350,000	350,000	460,000	510,000 r/	496,000 6/
Silicomanganese	--	700	--	--	--
Silicon metal	40,000	40,000	40,000	40,000	40,000
Other	40,000	40,000	40,000	40,000	40,000
Total	884,000 r/	917,000 r/	831,000 r/	940,000 r/	869,000
Serbia and Montenegro, electric furnace, ferronickel	1,763	2,414	6,501 r/	6,500 r/ e/	4,000
<b>Slovakia, electric furnace: e/</b>					
Ferrochromium	48,555 6/	65,260 6/	19,900 6/	11,394 6/	11,715 6/
Ferromanganese	25,000	25,000	25,000	20,000	20,000
Ferrosilicon	30,000	30,000	30,000	30,000	30,000
Silicomanganese	12,000	12,000	12,000	10,000	10,000
Other	8,000	8,000	8,000	5,000	5,000
Total	124,000	140,000	94,900	76,400	76,700
<b>Slovenia, electric furnace:</b>					
Ferrochromium	13,412	23,247	22,819	9,232	10,621 6/
Ferrosilicon e/	12,000	12,000	10,000	8,000	8,000
Other e/ 7/	200	200	200	200	200
Total e/	25,600	35,400	33,000	17,400	18,800
<b>South Africa, electric furnace:</b>					
Ferrochromium 19/	1,103,612	1,341,000 r/	1,478,000	1,890,000 r/	2,184,974 6/
Ferromanganese	590,535	507,000	562,000 e/	499,000 r/	525,000
Ferrosilicon	119,714	92,667	117,600	102,000 r/	100,000
Silicomanganese	290,400	251,000	241,000 e/	286,000 r/ e/	290,000
Silicon metal	36,169	30,082	28,500	34,000 e/	34,000
Other e/ 20/	1,000	1,000	1,000	1,000	1,000
Total e/	2,140,000	2,220,000 r/	2,430,000	2,810,000 r/	3,130,000
<b>Spain, electric furnace: e/</b>					
Ferrochromium	2,300 6/	1,320 6/	805 6/	490 6/	1,145 6/
Ferromanganese	35,000	25,000	30,000	35,000	35,000
Ferrosilicon	25,000	30,000	30,000	30,000	30,000
Silicomanganese	35,000	50,000	70,000	100,000	100,000
Silicon metal	3,000	5,000	5,000	15,000	15,000
Other	4,000	5,000	5,000	5,000	5,000
Total	104,000	116,000	141,000	185,000	186,000
<b>Sweden, electric furnace:</b>					
Ferrochromium	134,076	130,170	138,110	101,842	123,958 6/
Ferrosilicon	21,392	21,970	21,287	22,412 r/	22,000
Total	155,468	152,140	159,397	124,254 r/	146,000
<b>Taiwan, electric furnace:</b>					
Ferromanganese	1,179 r/	13,136 r/	14,059 r/	12,130 r/	12,500

See footnotes at end of table.



TABLE 5--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/	1994	1995	1996	1997	1998 e/
Taiwan, electric furnace--Continued:					
Ferrosilicon	646 r/	288 r/	2,481 r/	3,391 r/	4,000
Total	1,825 r/	13,424 r/	16,540 r/	15,521 r/	16,500
Thailand, electric furnace:					
Ferromanganese	140	--	--	--	--
Silicomanganese	689	--	--	--	--
Total	829	--	--	--	--
Turkey, electric furnace:					
Ferrochromium	97,585	94,251	101,450	108,726 r/	89,570 6/
Ferrosilicon e/	4,930 6/	4,900	4,460 r/	4,500 r/	4,500
Total	102,515	99,151	105,910 r/	113,226 r/	94,100
Ukraine: e/					
Blast furnace:					
Ferromanganese	30,000	25,000	25,000	30,000	30,000
Spiegeleisen	3,000	2,500	2,500	2,500	2,500
Electric furnace:					
Ferromanganese	170,000	170,000	170,000	160,000	150,000
Ferronickel	23,000 6/	23,000 6/	8,300 6/	--	--
Ferrosilicon	300,000	300,000	300,000	300,000	300,000
Silicomanganese	600,000	600,000	600,000	560,000	500,000
Other	25,000	25,000	25,000	25,000	20,000
Total	1,150,000	1,150,000	1,130,000	1,080,000	1,000,000
United States, electric furnace:					
Ferrochromium 21/	67,400	72,500	36,800	60,700	W
Ferromanganese 22/	(23/)	(23/)	(23/)	W	W
Ferronickel	--	16,800	30,500	32,100	8,590 6/
Ferrosilicon	359,000	358,000	362,000	359,000	334,000
Silicon metal	158,000	158,000	171,000	183,000	188,000
Other 24/	200,000	188,000	194,000	W	W
Total	784,000	793,000	795,000	635,000	531,000
Uruguay, electric furnace, ferrosilicon e/	250	200	200	200	200
Venezuela, electric furnace:					
Ferrosilicon e/	41,000	50,000	63,000	60,000	60,000
Silicomanganese	46,841	48,373	24,786	37,293	35,000
Total	87,841	98,373	87,786	97,300 e/	95,000
Zimbabwe, electric furnace:					
Ferrochromium	182,852	254,142	243,000 r/	233,386 r/	246,782 6/
Ferrochromiumsilicon	36,531	46,667	33,175	41,000 r/ e/	400,000
Total	219,383	300,809	276,175 r/	274,386 r/	647,000
Grand total:	16,400,000 r/	17,700,000	17,800,000 r/	18,200,000 r/	17,900,000
Of which:					
Blast furnace:					
Ferromanganese 25/	1,040,000 r/	902,000 r/	939,000 r/	963,000 r/	911,000
Spiegeleisen 25/	10,000	9,500	9,500	9,500	9,500
Other 26/	212,000 r/	210,000 r/	202,000 r/	104,000 r/	104,000
Total, blast furnace	1,260,000 r/	1,120,000 r/	1,150,000 r/	1,080,000 r/	1,020,000
Electric furnace:					
Ferrochromium 27/	3,700,000 r/	4,540,000 r/	3,950,000 r/	4,820,000 r/	4,920,000
Ferrochromiumsilicon	89,500	90,700	52,200	61,000 r/	419,000
Ferromanganese 28/ 29/	2,690,000 r/	2,760,000 r/	3,030,000 r/	2,910,000 r/	2,780,000
Ferronickel	772,000	949,000 r/	921,000	916,000 r/	843,000
Ferrosilicon	3,810,000 r/	4,040,000 r/	4,310,000 r/	4,090,000 r/	3,860,000
Silicomanganese 29/ 30/	2,850,000	3,010,000	3,110,000	3,090,000 r/	2,940,000
Silicon metal	559,000	588,000	649,000	664,000 r/	653,000
Other 31/	630,000 r/	586,000 r/	587,000 r/	570,000 r/	492,000
Total, electric furnace	15,100,000 r/	16,600,000	16,600,000 r/	17,100,000 r/	16,900,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in total.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through August 27, 1999.

3/ In addition to the countries listed, Iran is believed to have produced ferromanganese and silicomanganese, but production figures are not reported; general information is inadequate for the formulation of reliable estimates of output levels. Production of ferrosilicon, manganese ferroalloys, and silicon metal began in 1996 in Saudi Arabia, but data for actual production were not available.

TABLE 5--Continued  
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE 1/ 2/

4/ To the extent possible, ferroalloy production of each country has been separated according to the furnace type 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/ Estimated to have had an annual production capacity for silicon metal in excess of 200,000 tons in 1995. Data for actual production are not available.

10/ Includes silicospiegeleisen, if any.

11/ Includes silicomanganese, if any.

12/ Includes ferrochromiumsilicon and ferronickel, if any.

13/ Hungary is believed to produce some blast furnace ferromanganese.

14/ Includes charge chrome and ferrochrome.

15/ Production began in 1994.

16/ Excludes calcium-silicon.

17/ Includes calcium-silicon, ferrocolumbium, ferromolybdenum, ferrotungsten, ferrovanadium, and other ferroalloys.

18/ Salable products from Autlán.

19/ Includes production from Bophuthatswana and net production of ferrochromiumsilicon, if any.

20/ Includes ferronickel, if any.

21/ U.S. output of ferrochromium includes chromium metal, high- and low-carbon ferrochromium, ferrochromiumsilicon, and other chromium materials.

22/ U.S. output of ferromanganese includes manganese metal and silicomanganese.

23/ Withheld to avoid disclosing company proprietary data; included with "Other."

24/ May include ferroboration, ferrocolumbium, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrotungsten, ferrovanadium, nickel columbium, and silvery pig iron.

25/ Spiegeleisen, if any, for Germany is included with blast furnace ferromanganese.

26/ Includes ferrophosphorus and data contained in "Blast furnace: Other."

27/ Ferrochromium includes ferrochromiumsilicon, if any, for Japan, South Africa, and the United States.

28/ Ferromanganese includes silicomanganese, if any, for North Korea.

29/ U.S. production is included with "Other."

30/ Includes silicospiegeleisen, if any, for France.

31/ Includes calcium-silicon, ferromolybdenum, ferrovanadium, silicomanganese for the United States, and data contained in "Electric furnace: Other" for each country indicated.