

FERROALLOYS

By Michael Fenton

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 chromium, manganese, and silicon. 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 1997, in decreasing order, were China, South Africa, Norway, Ukraine, and Japan.

The major world chromite ore producing countries are India, Kazakstan, South Africa, and Turkey. Brazil, Finland, and Zimbabwe are also significant chromite ore producing countries. Most chromite ore is smelted in an electric arc furnace to produce ferrochromium for use by the metallurgical industry. Stainless steel manufacture is the major end use of ferrochromium. The country with the largest ferrochromium production is South Africa. China, Finland, India, Japan, Kazakstan, and Zimbabwe are also significant ferrochromium producing countries. The major stainless steel producing areas of the world, Europe (including Western Europe and Scandinavia), Japan, and the United States, account for about 70 % of world stainless steel production. The ferrochromium industry developed in close proximity to the stainless steel industry. Since then, ferrochromium production capacity has moved to chromite producing areas. In 1997, the world chromium industry operated with supply capacity in excess of demand. Even before all existing ferrochromium production capacity was brought into production, new furnaces were planned in South Africa, and chromium recovery from slag processes were planned or implemented. Further vertical integration of the chromium industry is taking place as Finland and South Africa increase their stainless steel production capacities. Two industry process trends were evolving:

chromium recovery from slag in the ferrochromium industry and supply of molten ferrochromium to stainless steel production. Both of these trends improve chromium recovery efficiency.

Manganese ferroalloys, consisting of various grades of ferromanganese and silicomanganese, are used to provide a key ingredient for steelmaking (Matricardi and Downing, 1995). Most of U.S. supply was imported; Australia, France, Mexico, and South Africa were leading sources. The sole domestic producer of manganese ferroalloys was Elkem Metals Co. at its plant near Marietta, OH. 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. Production of refined and/or specialty grades of ferromanganese and silicomanganese was receiving increased emphasis, highlighted by two Japanese and South African joint ventures that were coming on-stream in South Africa.

Demand for ferrosilicon is driven principally by the production of steel and cast iron (Dosaj, 1997). On the basis of content, U.S. production of ferrosilicon 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. China's output was estimated to be almost as great as that of the next three largest producing countries combined, which were Norway, Russia, and the United States. Silicon metal, which like ferrosilicon was produced in submerged-arc electric furnaces, was used not as a ferroalloy, but rather for alloying with aluminum and for production of chemicals, especially silicones.

References Cited

- Dosaj, Vishu, 1997, Silicon and silicon alloys—Chemical and metallurgical, *in* Kirk-Othmer encyclopedia of chemical technology (4th ed.): New York, Wiley, 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, Wiley, v. 15, p. 963-990.

TABLE 1
GOVERNMENT INVENTORY OF FERROALLOYS, DECEMBER 31, 1997 1/

(Metric tons of alloys, unless otherwise specified)

Alloy	Stockpile grade	Nonstockpile grade	Total
Ferrochromium:			
High-carbon	652,000	601	652,000
Low-carbon	269,000	10,400	279,000
Ferrochromium-silicon	48,200	1,240	49,400
Ferrocolumbium (kilograms contained columbium)	261,000	148,000	409,000
Ferromanganese:			
High-carbon	939,000	--	939,000
Medium-carbon	8,910	--	8,910
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 AS ADDITIVES IN 1997, BY END USE 1/ 2/

(Metric tons of alloys, unless otherwise specified)

End use	FeMn	SiMn	FeSi	FeTi	FeP	FeB
Steel:						
Carbon	265,000	98,100	38,700	3,540	4,410	1,150
Stainless and heat-resisting	15,900 3/	5,780	50,900	1,510	(4/)	66
Other alloy	49,100 3/	24,900	39,500 4/	150	1,270	152
Tool	(3/)	(3/)	2,440	(4/)	--	--
Unspecified	1,190	364	12,200	(4/)	(4/)	--
Total steel	331,000	129,000	144,000	5,200	5,680	1,370
Cast irons	8,070	783	116,000 5/	(6/)	608	--
Superalloys	155 6/	--	135 7/	797	(6/)	(6/)
Alloys (excluding alloy steels and superalloys)	20,400	(8/)	W	537	122	193
Miscellaneous and unspecified	(6/)	(8/)	243,000	(6/)	(6/)	--
Grand total	359,000	130,000	503,000	6,530	6,410	1,560
Total 1996	326,000	137,000	646,000 r/	6,790 r/	5,670 r/	1,280 r/
Percent of 1996	109	94	77	96	113	123
Consumer stocks, December 31, 1997	24,800 9/	8,950 9/	25,500	681	1,110	287

r/ Revised. 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/ FeMn, ferromanganese, including spiegeleisen and manganese metal; SiMn, silicomanganese; FeSi, ferrosilicon, including silicon metal, silvery pig iron, and inoculant alloys; FeTi, ferrotitanium, including titanium scrap and other titanium materials; FeP, ferrophosphorus, including other phosphorus materials; and FeB, ferrobore, including other boron materials.

3/ All or part included with "Steel: Unspecified."

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

5/ Part included with "Miscellaneous and unspecified."

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

7/ Part included with "Cast irons."

8/ Withheld to avoid disclosing company proprietary data.

9/ Includes producer stocks.

TABLE 3
REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ALLOYING ELEMENTS IN 1997, BY END USE 1/ 2/

(Metric tons of contained elements, unless otherwise specified)

End use	FeCr	FeMo	FeW	FeV	FeCb	FeNi
Steel:						
Carbon	14,000	600	(3/)	2,750	1,360	--
Stainless and heat-resisting	182,000 3/	455	(3/)	20	473	21,000
Other alloy	20,700 3/	2,010	103	908	1,080	1,090
Tool	3,310	89	360	481	10	--
Unspecified	(4/)	--	(3/)	W	21	--
Total steel	220,000	3,160	463	4,150	2,940	22,100
Cast irons	4,820	667	--	W	--	(4/)
Superalloys	5,380 4/	(4/)	(4/)	24	838	--
Alloys (excluding alloy steels and superalloys)	865	211	9	506	W	410
Miscellaneous and unspecified 5/	--	--	--	44	9	--
Grand total	231,000	4,030	473	4,730	3,790	22,500
Total 1996 r/	185,000	3,820	522	4,630	3,370	22,900
Percent of 1996	125	106	91	102	112	98
Consumer stocks, December 31, 1997	10,300 6/ 7/	202	28	329	NA	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/ FeCr, ferrochromium, including other chromium ferroalloys; FeMo, ferromolybdenum, including calcium molybdate; FeW, ferrotungsten; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; FeCb, ferrocolumbium, including nickel columbium; and FeNi, ferronickel.

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

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

5/ Includes mill products made from metal powder, pigments, catalysts, and other chemicals or ceramic uses.

6/ Includes some producer stocks.

7/ Part withheld to avoid disclosing company proprietary data.

TABLE 4
FERROALLOY PRICES IN 1997

	High	Low	Average 1/
Standard-grade ferromanganese 2/	525.00	465.00	489.80
Medium-carbon ferromanganese 3/	47.00	37.00	42.92
Silicomanganese 4/	31.00	23.50	26.91
Charge-grade ferrochromium 3/	50.00	40.00	47.86
High-carbon ferrochromium 3/	57.00	41.50	48.93
Low-carbon ferrochromium 3/	120.00	82.00	102.99
50%-grade ferrosilicon 3/	65.00	51.00	54.61
75%-grade ferrosilicon 3/	56.00	44.00	47.99
Silicon metal 4/	88.50	68.00	81.25
Ferromolybdenum 5/	5.60	4.80	5.30
Molybdenum oxide 5/	4.90	3.52	4.29
Ferrovanadium 6/	29.00	15.40	19.56

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 Metals Week.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS AND FERROALLOY METALS IN 1997 1/

(Metric tons)

Alloy	Imports			Exports		
	Gross weight	Contained weight	Value (thousands)	Gross weight	Contained weight	Value (thousands)
Ferroalloys:						
Chromium ferroalloys:						
Ferrochromium containing:						
More than 4% of carbon	331,000	182,000	\$186,000	7,220	4,330	\$6,980
More than 3% but not more than 4% of carbon	1,550	834	842	XX	XX	XX
Not more than 3% of carbon	59,100	39,000	82,500	1,740	963	3,010
Ferrochromium-silicon	36,500	14,700	23,700	214	75	238
Total ferrochromium alloys	428,000	237,000	293,000	9,180	5,360	10,200
Manganese ferroalloys:						
Ferromanganese containing:						
More than 4% of carbon	234,000	178,000	92,400	XX	XX	XX
More than 2% of carbon	XX	XX	XX	3,340	2,640	1,920
More than 1% but not more than 2% of carbon	58,300	46,900	41,700	XX	XX	XX
Not more than 1% of carbon	11,700	9,970	14,900	XX	XX	XX
Ferromanganese, other	XX	XX	XX	8,440	6,660	7,350
Silicomanganese	306,000	203,000	152,000	5,360	3,480	3,290
Total ferromanganese alloys	609,000	438,000	301,000	17,100	12,800	12,600
Silicon ferroalloys:						
Ferrosilicon containing:						
More than 55% of silicon	XX	XX	XX	12,800	7,750	100,000
More than 55% but not more than 80% of silicon and more than 3% of calcium	1,900	1,390	2,190	XX	XX	XX
More than 55% but not more than 80% of silicon and not more than 3% of calcium	159,000	120,000	123,000	XX	XX	XX
Magnesium ferrosilicon	15,200	7,350	15,700	XX	XX	XX
Ferrosilicon, other	16,500	5,930	10,400	397,000	19,600	32,100
Total ferrosilicon alloys	193,000	135,000	152,000	410,000	27,400	132,000
Other ferroalloys:						
Ferrocerium and other pyrophoric alloys and other	136	(2/)	2,070	XX	XX	XX
Ferromolybdenum	5,840	3,640	36,700	1,250	678	13,000
Ferronickel	38,200	13,500	87,700	12,100	6,950	53,000
Ferroniobium (columbium)						
Ferrophosphorus	11,500	(2/)	4,010	2,600	(2/)	1,330
Ferrotitanium and ferrosilicon-titanium	6,230	(2/)	16,100	1,470	(2/)	3,210
Ferrotungsten and ferrosilicon-tungsten	1,050	803	4,440	21	10	98
Ferrovandium	2,310	1,840	32,400	590	446	9,780
Ferrozirconium	84	(2/)	167	39	(2/)	189
Ferroalloys, other	37,700	(2/)	57,500	3,680	(2/)	6,100
Total other ferroalloys	103,000	XX	241,000	21,800	XX	86,700
Total ferroalloys	1,330,000	XX	987,000	45,800	XX	242,000
Metals:						
Chromium	9,770	(2/)	72,500	2,340	(2/)	17,400
Manganese:						
Unwrought	14,000	(2/)	22,600	7,890 3/	XX	18,700
Other	465	(2/)	1,780	XX	XX	XX
Silicon:						
Less than 99% of silicon	62,400	62,500	85,800	16,600	16,100	25,700
Less than 99.99% but not less than 99% of silicon	57,600	56,500	96,500	2,250	2,230	4,050
Not less than 99.99% silicon	1,750	1,750	99,300	4,010	4,010	253,000
Total ferroalloy metals	146,000	XX	378,000	33,100	XX	319,000
Grand total	1,480,000	XX	1,360,000	491,000	XX	561,000

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 6
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY, FURNACE TYPE, AND ALLOY TYPE 1/ 2/

(Metric tons, gross weight)

Country, 3/ furnace type, 4/ and alloy type 5/	1993	1994	1995	1996	1997 e/
Albania: Electric furnace, ferrochromium	35,600	33,764	42,986	31,189	31,445 6/
Argentina: Electric furnace:					
Ferromanganese	5,400	8,117	5,836	6,000 e/	6,000
Ferro-silicon	19,579	11,669	14,017 r/	14,000 r/ e/	14,000
Silicomanganese	18,500	29,358	27,344	28,000	28,000
Other e/ 7/	5,821 6/	3,700	3,850	3,750	3,800
Total	49,300	52,844	51,047 r/	51,750 r/	51,800
Australia: Electric furnace: e/					
Ferromanganese	75,000	100,000	110,000	110,000	95,000
Silicomanganese	75,000	100,000	100,000	95,000	95,000
Silicon metal	30,000	30,000	30,000	30,000	30,000
Total	180,000	230,000	240,000	235,000	220,000
Austria: Electric furnace:					
Feronickel	8,000	5,250	6,200	5,000	5,000
Other e/	5,900	5,900	5,900	5,900	5,900
Total	13,900	11,150	12,100	10,900	10,900
Belgium: Electric furnace, ferromanganese e/	25,000	25,000	25,000	25,000	25,000
Bhutan: Electric furnace, ferro-silicon e/	--	2,000	12,000	13,000 r/	13,000
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/	83,892	77,165 r/	95,840 r/	72,609	73,000
Ferrochromiumsilicon e/	4,500	5,000	5,000	5,000	5,000
Ferromanganese	201,518	200,000	130,000	215,260 r/	153,000
Feronickel	34,732	35,260	32,928 r/	35,518 r/	37,400
Ferro-silicon	248,147	198,505	243,824	236,838 r/	214,000
Silicomanganese	284,147	248,000	167,000	232,218 r/	175,000
Silicon metal	106,000	110,000	116,000	150,054 r/	135,000
Other e/	76,000	76,000	76,000	76,000	76,000
Total	1,038,936	949,930 r/	866,592 r/	1,023,497 r/	868,000
Bulgaria: Electric furnace: e/					
Ferro-silicon	18,000	8,000	7,550	8,300	8,000
Other	2,000	2,000	2,000	2,000	2,000
Total	20,000	10,000	9,550	10,300	10,000
Canada: Electric furnace: e/					
Ferro-silicon	55,000	55,000	56,000	56,000	56,000
Ferrovanadium	2,000	2,000	1,000	1,000	1,000
Silicon metal	20,000	20,000	22,000	22,000	22,000
Total	77,000	77,000	79,000	79,000	79,000
Chile: Electric furnace:					
Ferrochromium	680	1,579	2,730	2,079 r/	2,000
Ferromanganese	8,916	9,646 r/	7,987 r/	8,500 e/	8,500
Ferromolybdenum e/	2,202 6/	2,300	2,300	2,300	2,300
Ferro-silicon e/	7,550	5,600	5,600	5,500	5,500
Silicomanganese	1,612	995 r/	1,617 r/	1,600 e/	1,600
Total e/	21,000	20,100 r/	20,200 r/	20,000 r/	19,900
China: 9/					
Blast furnace:					
Ferromanganese	520,000	567,000	400,000	450,000 r/	400,000
Other e/	200,000	210,000	210,000	200,000	200,000
Electric furnace:					
Ferrochromium e/	372,000	370,000	500,000 r/	423,000 r/	387,000
Ferromanganese	220,000	350,000	605,000	700,000 r/	600,000
Ferro-silicon	1,035,000	1,100,000	1,210,000	1,490,000 r/	1,270,000
Silicomanganese	525,000	657,000	830,000	840,000 r/	800,000
Other e/	58,000	110,000	80,000	77,000 r/	70,000
Total	2,930,000	3,364,000	3,835,000 r/	4,180,000 r/	3,730,000
Colombia: Electric furnace, ferro-nickel	48,624	50,827	59,917	57,335	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, 3/ furnace type, 4/ and alloy type 5/	1993	1994	1995	1996	1997 e/
Croatia: Electric furnace:					
Ferrochromium	27,336	31,704	26,081	10,559	24,231 6/
Ferromanganese e/	10,000	562 r/	-- r/	-- r/	--
Silicomanganese e/	40,000	22,071 r/ 6/	-- r/	-- r/	--
Total e/	77,300	54,300 r/	26,100 r/	10,600 r/	24,231 6/
Czech Republic: Electric furnace e/					
Total	1,000	1,000	1,000	1,000	1,000
Dominican Republic: Electric furnace, ferronickel					
Total	60,774 r/	80,193 r/	80,711 r/	78,488 r/	84,000
Egypt: Electric furnace:					
Ferromanganese e/	30,000	35,000	35,000	35,000	35,000
Ferrosilicon	40,136	44,000	44,000 e/	44,000 e/	40,000
Total	70,136	79,000	79,000 e/	79,000 e/	75,000
Finland: Electric furnace, ferrochromium					
Total	218,370	253,501	246,805	227,811 r/	236,652 6/
France:					
Blast furnace, ferromanganese	300,000	294,000	348,000 r/	337,000 r/	326,000
Electric furnace:					
Ferromanganese	57,000	66,200	46,000 r/	65,000 r/	60,000
Ferrosilicon	84,000	111,000	108,000	130,000 r/ e/	130,000
Silicomanganese e/ 10/	80,000 5/	66,000 r/	71,000 r/	61,000 r/	66,000
Silicon metal	59,000	66,000	71,450 r/	73,800 r/	74,000
Other e/	29,000	20,000	20,000	20,000	20,000
Total e/	609,000	623,000 r/	664,000 r/	687,000 r/	676,000
Georgia: Electric furnace: e/					
Ferromanganese	20,000 r/	10,000	5,000	5,000	6,000
Silicomanganese	20,000 r/	10,000 r/	10,000 r/	10,000 r/	15,000
Other	5,000 r/	5,000	3,000 r/	2,000 r/	3,000
Total	45,000 r/	25,000 r/	18,000 r/	17,000 r/	24,000
Germany: e/					
Blast furnace, ferromanganese 11/	100,000	--	--	--	--
Electric furnace:					
Ferrochromium	16,400 6/	17,283 6/	21,665 r/ 6/	25,303 r/ 6/	25,856 6/
Ferromanganese 12/	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 13/	30,000	30,000	30,000	30,000	30,000
Total	187,000	87,800	92,200 r/	95,800 r/	96,400
Greece: Electric furnace, ferronickel					
Total	52,067	77,129	81,733	72,700 r/	70,000
Hungary: 14/ Electric furnace: e/					
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	1,000	--	--	--
Total	9,000	9,000	8,000	8,000	8,000
Iceland: Electric furnace, ferrosilicon					
Total	67,375	66,003	71,410	70,520 r/	71,000
India: Electric furnace: e/					
Ferrochromium 15/	234,500 6/	251,459 6/	300,000	300,000	286,973 6/
Ferrosilicon	8,000	8,000	9,000	9,000	10,000
Ferromanganese	137,291 6/	200,000 r/	180,000 r/	190,000 r/	190,000
Ferrosilicon	67,600	85,000	85,000	85,000	90,000
Silicomanganese	85,000 6/	170,000 r/	190,000 r/	170,000 r/	170,000
Other	8,600	8,500	8,500	8,500	9,000
Total	541,000	723,000 r/	773,000 r/	763,000 r/	756,000
Indonesia: Electric furnace:					
Ferromanganese e/	10,000	10,000	14,000	14,000	15,000
Ferronickel	26,330	28,725	53,675	47,800 r/	50,000
Silicomanganese e/	--	--	7,000	7,000	7,000
Total	36,330	38,725	74,675	68,800 r/	72,000
Iran: Electric furnace:					
Ferrosilicon 16/	--	7,150 r/	11,900 r/	10,500 r/	11,450 6/
Ferrosilicon e/	--	--	10,000	20,000	20,000
Total	--	7,150 r/	21,900 r/	30,500 r/	31,500

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, 3/ furnace type, 4/ and alloy type 5/	1993	1994	1995	1996	1997 e/
Italy: Electric furnace: e/					
Ferrochromium	53,504 6/	22,650 6/	51,017 6/	29,915 6/	11,295 6/
Ferromanganese	17,000	16,000	20,216 r/ 6/	25,143 r/ 6/	16,000
Silicomanganese	50,000	40,000	103,961 r/ 6/	100,353 r/ 6/	100,000
Silicon metal	10,000	--	10,000 r/	14,000 r/	15,000
Other 17/	12,000	12,000	12,000	10,000	10,000
Total	143,000	90,700	197,000 r/	179,000 r/	152,000
Japan: Electric furnace:					
Ferrochromium 18/	204,719	192,989	210,445	193,695	186,432 6/
Ferromanganese	382,912	345,153	346,977	343,104	376,633 6/
Ferronickel	257,316	242,447	351,337	328,699	352,840 6/
Ferrosilicon	29,084	12,208	3,650	--	-- 6/
Silicomanganese	64,758	69,183	64,870	75,802	78,323 6/
Other 19/	13,666	14,647	12,353	10,131 r/	10,217 6/
Total	952,455	876,627	989,632	951,431 r/	1,004,445 6/
Kazakstan: Electric furnace: e/					
Ferrochromium	327,896 6/	200,000	486,000 6/	352,000 6/	300,000
Ferrochromiumsilicon	30,000	20,000	25,000	20,000	15,000
Ferrosilicon	418,000 r/	208,000 r/	256,000	119,000	100,000
Silicomanganese	--	40,000	20,000	50,000	40,000
Other	15,000	10,000	10,000	10,000	9,000
Total	791,000 r/	478,000 r/	797,000	551,000	464,000
Korea, North: Electric furnace: e/					
Ferromanganese 13/	70,000	70,000	70,000	70,000	70,000
Ferrosilicon	30,000	30,000	30,000	30,000	30,000
Other 14/	20,000	20,000	20,000	20,000	20,000
Total	120,000	120,000	120,000	120,000	120,000
Korea, Republic of: Electric furnace:					
Ferromanganese	100,630	120,020	118,798	126,135 r/	158,755 6/
Silicomanganese	81,996	89,023	97,785	83,375 r/	77,078 6/
Other	2,803	3,084	2,698	4,687	2,174 6/
Total	185,429 r/	212,127 r/	219,281 r/	214,197 r/	238,007 6/
Macedonia: Electric furnace:					
Ferrochromium	4,376	3,164	3,765	3,780	3,460 6/
Ferronickel	11,800 r/	10,500 r/	9,200 r/	7,900 r/	7,900
Ferrosilicon	20,000	58,740 r/	57,200 r/	57,220 r/	55,000
Silicon metal e/	1,000	1,000	1,000	1,000	1,000
Total e/	37,200 r/	73,400 r/	71,200 r/	69,900 r/	67,400
Mexico: Electric furnace: e/ 20/					
Ferromanganese	70,000	67,000	58,000 6/	69,000 6/	68,000 6/
Ferrosilicon	400	400	--	--	--
Silicomanganese	55,000	64,000	67,700 6/	93,000 6/	105,000 6/
Other	300	300	--	--	--
Total	126,000	132,000	125,700 6/	162,000 6/	173,000 6/
New Caledonia: Electric furnace, ferronickel					
	147,400	157,952	168,800	169,000	169,000
Norway: Electric furnace:					
Ferrochromium	80,000	120,000	148,000 r/	108,900 r/	145,124 6/
Ferromanganese	226,018	248,648	213,000 r/	215,000 r/	215,000
Ferrosilicon	399,559	452,984	474,875 r/	462,423 r/	470,000
Silicomanganese	218,566	197,328	210,000 r/ e/	210,000 r/ e/	210,000
Silicon metal	81,000	92,000	101,000	110,000 e/	110,000
Other e/ 10/	14,000	14,000	15,000	15,000	15,000
Total e/	1,020,000	1,120,000	1,160,000 r/	1,120,000	1,170,000
Peru: Electric furnace, ferrosilicon e/					
	600	600	600	600	600
Philippines: Electric furnace:					
Ferrochromium	11,908	16,186	50,450	6,736 r/	--
Ferromanganese e/	5,000	5,000	5,000	--	--
Ferrosilicon e/	10,000	10,000	10,000	--	--
Total e/	26,900	31,200	65,500	6,736 r/ 6/	--

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, 3/ furnace type, 4/ and alloy type 5/	1993	1994	1995	1996	1997 e/
Poland:					
Blast furnace: Ferromanganese	56,400	66,300	46,300	59,900 r/	60,000
Electric furnace:					
Ferrochromium	38,449	7,353	18,334	3,785 r/	5,900
Ferromanganese	1,100	--	--	--	--
Ferrosilicon	43,100	54,200	70,400	71,800 r/	70,000
Silicomanganese e/	27,000 r/	31,800 r/	20,000 r/	25,000	25,000
Silicon metal e/	1,300	1,300	1,300	1,300	1,400
Other e/ 14/	20,000	20,000	20,000	20,000	20,000
Total e/	187,000 r/	181,000 r/	176,000 r/	182,000 r/	182,000
Romania: Electric furnace:					
Ferrochromium	3,907	3,885	15,053	9,650	950 6/
Ferromanganese	16,400 e/	31,295	28,410	20,150	11,505 6/
Ferrosilicon	23,600	28,385	19,320	23,827	9,620 6/
Silicomanganese	22,000 e/	35,215	57,149	78,590	62,570 6/
Silicon metal e/	400	300	300	300	300
Total e/	66,300	99,100	120,000	133,000	84,900
Russia: e/					
Blast furnace:					
Ferromanganese	150,000	55,000	55,000	55,000	55,000
Ferrophosphorus	25,000	20,000	20,000	20,000	20,000
Spiegeleisen	8,000	7,000	7,000	7,000	7,000
Electric furnace:					
Ferrochromium	255,900 6/	265,525 6/	290,000 r/	135,000 r/	247,000
Ferrochromiumsilicon	40,000	40,000	30,000	5,000	5,000
Feronickel	47,000 6/	59,000 6/	77,000 6/	75,000 6/	40,000
Ferrosilicon	400,000	350,000	350,000	460,000 r/	496,000 6/
Silicomanganese	--	--	700	--	--
Silicon metal	50,000	40,000	40,000	40,000	40,000
Other	50,000	40,000	40,000	40,000	40,000
Total	1,030,000	877,000	910,000 r/	837,000 r/	950,000
Serbia and Montenegro: Electric furnace, ferronickel	1,283	1,763	2,414	6,554 r/	6,600
Slovakia: Electric furnace: e/					
Ferrochromium	50,600 6/	48,555 6/	65,260 6/	19,900 r/ 6/	11,394 6/
Ferromanganese	22,000	25,000	25,000	25,000	20,000
Ferrosilicon	22,000	30,000	30,000	30,000	30,000
Silicomanganese	12,000	12,000	12,000	12,000	10,000
Other	8,000	8,000	8,000	8,000	5,000
Total	115,000	124,000	140,000	94,900 r/	76,400
Slovenia: Electric furnace:					
Ferrochromium	8,812 r/	13,412 r/	23,247 r/	22,819 r/	9,232 6/
Ferrosilicon e/	12,000	12,000	12,000	10,000	8,000
Other e/ 7/	200	200	200	200	200
Total e/	21,000 r/	25,600 r/	35,400 r/	33,000 r/	17,400
South Africa: Electric furnace:					
Ferrochromium 21/	833,600	1,103,612	1,386,400	1,478,000 r/	1,979,000 6/
Ferromanganese	393,372	590,535	507,000	562,000 r/ e/	550,000
Ferrosilicon	98,800	119,714	92,667	117,600 r/	126,100 6/
Silicomanganese	268,123	290,400	251,000	241,000 r/ e/	235,000
Silicon metal	38,279	36,169	30,082	28,500 r/	34,000
Other e/ 22/	1,000	1,000	1,000	1,000	1,000
Total e/	1,630,000	2,140,000	2,270,000	2,430,000 r/	2,930,000
Spain: Electric furnace: e/					
Ferrochromium	2,390 6/	2,300 6/	1,320 6/	805 6/	490 6/
Ferromanganese	40,000	35,000	25,000	30,000 r/	35,000
Ferrosilicon	30,000	25,000	30,000	30,000	30,000
Silicomanganese	35,000	35,000	50,000	70,000 r/	100,000
Silicon metal	5,000	3,000	5,000	5,000	15,000
Other	5,000	4,000	5,000	5,000	5,000
Total	117,000	104,000	116,000	141,000 r/	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, 3/ furnace type, 4/ and alloy type 5/	1993	1994	1995	1996	1997 e/
Sweden: Electric furnace:					
Ferromanganese	127,543	134,076	130,170	138,110	101,842 6/
Ferrosilicon	20,381	21,392	21,970	21,287 r/	22,000
Total	147,924	155,468	152,140	159,397 r/	124,000
Switzerland: Electric furnace: e/					
Ferrosilicon	3,000	--	--	--	--
Silicon metal	2,000	--	--	--	--
Total	5,000	--	--	--	--
Taiwan: Electric furnace: e/					
Ferromanganese	13,628 6/	7,000	5,000	5,000	5,000
Ferrosilicon	689 6/	500	400	500	500
Total	14,317 6/	7,500	5,400	5,500	5,500
Thailand: Electric furnace:					
Ferromanganese	70	140	-- r/	-- r/	--
Silicomanganese	1,503	689	-- r/	-- r/	--
Total	1,573	829	-- r/	-- r/	--
Turkey: Electric furnace:					
Ferromanganese	90,030	97,585	94,251	101,450	100,000
Ferrosilicon	4,680	4,930	4,900 r/ e/	5,000 r/ e/	5,000
Total	94,710	102,515	99,151 r/	106,450 r/	105,000
Ukraine: e/					
Blast furnace:					
Ferromanganese	40,000	30,000	25,000	25,000 r/	30,000
Spiegeleisen	4,000	3,000	2,500	2,500	2,500
Electric furnace:					
Ferromanganese	140,000	170,000	170,000	170,000 r/	160,000
Ferronickel	50,000 6/	23,000 6/	23,000 6/	8,300 6/	--
Ferrosilicon	400,000	300,000	300,000	300,000	300,000
Silicomanganese	735,000	600,000	600,000	600,000 r/	560,000
Other	30,000	25,000	25,000	25,000	25,000
Total	1,400,000	1,150,000	1,150,000	1,130,000 r/	1,080,000
United Kingdom:					
Blast furnace, ferromanganese	45,000	--	--	--	--
Electric furnace, other e/	10,000	--	--	--	--
Total e/	55,000	--	--	--	--
United States: Electric furnace:					
Ferromanganese 23/	63,000	67,400	72,500	36,800	60,700 6/
Ferromanganese 24/	(25/)	(25/)	(25/)	(25/)	W
Ferronickel	9,930	--	16,800	30,500	32,100 6/
Ferrosilicon	323,000	359,000	358,000	362,000	359,000 6/
Silicon metal	159,000	158,000	158,000	171,000	183,000 6/
Other 26/	161,000	200,000	188,000	194,000 r/	W
Total	715,000	784,000	793,000	795,000 r/	635,000 6/
Uruguay: Electric furnace, ferrosilicon e/					
Total	250	250	200	200 r/	200
Venezuela: Electric furnace:					
Ferrosilicon e/	47,000	41,000	50,000	63,000 r/	60,000
Silicomanganese	42,237	46,841 r/	48,373 r/	24,786 r/	37,293 6/
Total	89,237	87,841 r/	98,373 r/	87,786 r/	97,300
Zimbabwe: Electric furnace:					
Ferromanganese	124,000	182,852	254,142	261,918	230,000
Ferromanganesiumsilicon	10,000 e/	36,531	46,667	33,175	30,000
Ferrosilicon	2,151	--	--	--	--
Total	136,151	219,383	300,809	295,093	260,000

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, 3/ furnace type, 4/ and alloy type 5/	1993	1994	1995	1996	1997 e/
Grand total:	15,700,000 r/	16,300,000 r/	17,700,000 r/	17,900,000 r/	17,600,000
Of which:					
Blast furnace:					
Ferromanganese 27/	1,210,000	1,010,000	874,000 r/	927,000 r/	871,000
Spiegeleisen 27/	12,000	10,000	9,500	9,500	9,500
Other 28/	225,000	230,000	230,000	220,000	220,000
Total, blast furnace	1,450,000	1,250,000	1,110,000 r/	1,160,000 r/	1,100,000
Electric furnace:					
Ferrosilicon 29/	3,270,000 r/	3,530,000 r/	4,550,000 r/	4,010,000 r/	4,470,000
Ferrosiliconsilicon	62,500	89,500	90,700	52,200	50,000
Ferromanganese 30/ 31/	2,320,000	2,770,000 r/	2,780,000 r/	3,050,000 r/	2,900,000
Ferrochromium	755,000 r/	772,000 r/	964,000 r/	923,000 r/	913,000
Ferrosilicon	4,010,000 r/	3,830,000 r/	4,070,000 r/	4,370,000 r/	4,130,000
Silicomanganese 31/ 32/	2,740,000 r/	2,850,000 r/	3,010,000 r/	3,110,000 r/	3,000,000
Silicon metal	564,000	559,000	588,000 r/	649,000 r/	662,000
Other 33/	575,000 r/	635,000 r/	589,000 r/	589,000 r/	383,000
Total, electric furnace	14,300,000 r/	15,000,000	16,600,000 r/	16,700,000 r/	16,500,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data.

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 October 8, 1998.

3/ Production of manganese ferroalloys, ferrosilicon, and silicon metal began in 1996 for Saudi Arabia, but data for actual production were not available.

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: ferrosilicon, ferrosiliconsilicon, ferromanganese, ferrochromium, 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 ferrosilicon.

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 spiegeleisen, if any.

12/ Includes silicomanganese, if any.

13/ Includes ferrosiliconsilicon and ferrochromium, if any.

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

15/ Includes ferrochrome and charge chrome.

16/ Production began in 1994.

17/ Series excludes calcium-silicon.

18/ Includes net consumption of ferrosiliconsilicon.

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

20/ Salable products from Autlán.

21/ Includes production from Bophuthatswana and net production of ferrosiliconsilicon, if any.

22/ Includes ferrochromium, if any.

23/ U.S. output of ferrosilicon includes high- and low-carbon ferrosilicon, ferrosiliconsilicon, chromium metal, and other chromium materials.

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

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

26/ May include ferroaluminum, ferroboration, and other complex boron additive alloys, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrovanadium, and silvery pig iron.

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

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

29/ Ferrosilicon includes ferrosiliconsilicon, if any, for Japan, South Africa, and the United States.

30/ Ferromanganese includes silicomanganese, if any, for countries carrying footnote 12 on "Ferromanganese" data line.

31/ U.S. production under "Other."

32/ Includes silicospiegeleisen, if any, for France.

33/ Includes calcium-silicon, ferromolybdenum, ferrovanadium, and data contained in "Electric furnace: Other" for each country indicated.