

FERROALLOYS

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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, and U.S. Government stockpile, 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 contain information on all ferroalloys for which data are available. The top five ferroalloy producers in the world in 1999, in decreasing order, were China, South Africa, Norway, Russia, and Ukraine.

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). Most U.S. supply was imported; Australia, France, Mexico, and South Africa were leading sources. Manganese ferroalloys were produced domestically only at a plant near Marietta, OH. In 1999, this plant was operated in the first one-half of the year by Elkem Metals Co. and in the second one half by Eramet. The change in ownership resulted from acquisition of the manganese business of Norway's Elkem ASA by France's Eramet, which made Eramet the world's largest producer of manganese ferroalloys. On a country basis, China was by far the largest producer of manganese ferroalloys, with an output more than twice that of either South Africa or Ukraine, the countries with the next largest production.

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 approximately 60% 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 production more than twice that of either Norway or Russia, the countries with the next largest production. 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 world chromite ore producing countries were India, Kazakhstan, South Africa, and Turkey. Brazil, Finland, and Zimbabwe were other significant chromite ore producing countries. Most chromite ore was smelted in electric arc furnaces 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 other 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 and Canada in North America, account for about 70 % of world stainless steel production.

The ferrochromium industry developed in close proximity to the stainless steel industry. In recent years, however, ferrochromium production capacity has been moving to chromite producing areas by closing facilities in historically producing areas, while opening new plants in currently producing chromite areas.

The world chromium industry in 1999 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 still melted ferrochromium to stainless steel production; and strategic alliances between the two industries (ferrochromium and stainless steel).

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, 1999 1/

(Metric tons of alloy unless otherwise specified)

Alloy	Stockpile grade	Nonstockpile grade	Total
Ferrochromium: 2/			
High-carbon	644,000	401	645,000
Low-carbon	271,000	6,890	277,000
Ferrochromium-silicon 2/	49,500	1,210	50,700
Ferrocolumbium (contained columbium) 3/	112	--	112
Ferromanganese, high carbon 3/	862,000	--	862,000
Ferrotungsten (kilograms contained tungsten) 3/	381,000	383,000	764,000

-- Zero.

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

2/ Source: Defense National Stockpile Center; Inventory of Stockpile Material L.

3/ Source: Defense National Stockpile Center; Inventory of Stockpile Material L-1.

TABLE 2
REPORTED U.S. CONSUMPTION OF FERROALLOYS AS ADDITIVES BY END USE 1/ 2/

(Metric tons of alloys unless otherwise specified)

End use	Manganese					
	FeB	FeMn	SiMn	FeP	FeSi	FeTi
1998:						
Steel:						
Carbon	957	229,000	91,300	4,500	44,700 3/	3,630
Stainless and heat-resisting	(4/)	13,800 3/	5,430	(4/)	48,100 3/	1,410
Other alloy	565	49,100 3/	28,700	386	10,000 3/	128
Tool	--	(3/)	(3/)	--	25,200 3/	(4/)
Unspecified	--	779	261	(4/)	16,700	--
Total	1,520	292,000	126,000	4,890	144,000	5,170
Cast irons	--	10,100	783	1,670 r/	117,000	(5/)
Superalloys	(5/)	131 5/	--	(6/)	171 7/	893 r/
Alloys (excluding alloy steels and superalloys)	224	20,800	(8/)	(6/)	(6/ 7/)	352 r/
Miscellaneous and unspecified	--	(5/)	(8/)	(6/)	240,000	(5/)
Grand total	1,750	323,000	126,000	6,560 r/	501,000	6,410 r/
Total 1997	1,570	337,000	130,000	7,160	527,000 r/	7,520
Percentage of 1997	111	96	97	92	95	85
Consumer stocks, December 31	384 r/	31,200 9/	8,660 9/	882	20,100	857 r/
1999:						
Steel:						
Carbon	880	222,000	83,500	4,440	40,900 3/	4,200
Stainless and heat-resisting	87	15,600 3/	6,590	(4/)	49,800 3/	1,760
Other alloy	257	45,600 3/	26,400	653	11,500 3/	93
Tool	--	(3/)	(3/)	--	25,800 3/	(4/)
Unspecified	--	759	--	(4/)	9,550	--
Total	1,220	284,000	116,000	5,090	138,000	6,050
Cast irons	--	10,700	1,090	1,350	104,000	W
Superalloys	(5/)	(5/)	--	(6/)	177 7/	681
Alloys (excluding alloy steels and superalloys)	491	21,000	(8/)	(6/)	(6/)	617
Miscellaneous and unspecified	(5/)	(5/)	(8/)	(6/)	239,000 6/	48
Grand total	1,710	316,000	118,000	6,440	481,000	7,400
Total 1998	1,750	323,000	126,000	6,560	501,000	6,410
Percentage of 1998	98	98	93	98	96	115
Consumer stocks, December 31	337	22,600 9/	9,180 9/	1,130	15,500	1,080

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified." -- Zero.

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

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

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

4/ Included with "Steel: Other alloy."

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

6/ All or part included with "Cast irons."

7/ All or part included with "Miscellaneous and unspecified."

8/ Withheld to avoid disclosing company proprietary data.

9/ Includes producer stocks.

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

(Metric tons of contained elements unless otherwise specified)

End use	FeCr	FeMo	FeNb	FeNi	FeV	FeW
1998:						
Steel:						
Carbon	8,320	280	1,410	--	1,650 r/	--
Stainless and heat-resisting	133,000	672 r/	522	15,800	31	(3/)
Other alloy	22,300	2,160	980	802	1,840 r/	(3/)
Tool	W	77 r/	(4/)	--	77	(3/)
Unspecified	--	--	17 r/	--	W	(3/)
Total	163,000	3,190	2,930	16,600	3,600 r/	527 5/
Cast irons	1,430	783 r/	--	(6/)	W	--
Superalloys	3,710	(6/)	694	--	11	--
Alloys (excluding alloy steels and superalloys)	1,020	217	W	197	5	(3/)
Miscellaneous and unspecified	22,100	--	13	--	41 r/	--
Grand total	192,000	4,190 r/	3,640	16,800	3,650 r/	527
Total 1997	225,000	4,170	3,770 r/	22,500	3,920 r/	473
Percentage of 1997	85	100	96	75	93	111
Consumer stocks, December 31	9,970	392	NA	881	306 r/	26
1999:						
Steel:						
Carbon	7,230	339	1,270	--	1,240	--
Stainless and heat-resisting	158,000	497	603	12,500	W	(3/)
Other alloy	16,500	89	856	104	1,670	(3/)
Tool	W	2,120	(7/)	--	69	(3/)
Unspecified	--	--	--	--	W	(3/)
Total	182,000	3,050	2,730	12,600	2,980	484 5/
Cast irons	952	715	--	(6/)	W	--
Superalloys	5,150	(6/)	639	--	8	--
Alloys (excluding alloy steels and superalloys)	1,180	125	W	58	6	(3/)
Miscellaneous and unspecified	26,900	--	9	(6/)	140	--
Grand total	215,000	3,890	3,380	12,700	3,130	484
Total 1998	192,000	4,190	3,640	16,800	3,650	527
Percentage of 1998	113	93	93	75	86	92
Consumer stocks, December 31	13,500	207	NA	418	343	33

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/ Included in "Total steel."

4/ Included with "Steel: Unspecified."

5/ Includes FeW in "Alloys (excluding alloy steels and superalloys)."

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

7/ Included with "Steel: Other alloy."

TABLE 4
FERROALLOY PRICES IN 1999

	High	Low	Average 1/
Chromium:			
Charge-grade ferrochromium 2/	40.00	35.00	36.61
High-carbon ferrochromium 2/	41.00	35.00	36.63
Low-carbon ferrochromium 2/	79.00	67.00	71.00
Columbium:			
High-purity (vacuum-grade) ferrocolumbium 3/	18.00	17.50	17.75
Regular-grade ferrocolumbium 3/	7.00	6.75	6.88
Manganese:			
Medium-carbon ferromanganese 2/	41.00	35.00	37.40
Standard-grade ferromanganese 4/	500.00	410.00	459.00
Silicomanganese 5/	26.00	19.00	22.10
Molybdenum:			
Ferromolybdenum 3/	3.95	3.40	3.70
Molybdenum oxide 3/	2.90	2.48	2.66
Silicon:			
50% ferrosilicon 2/	53.00	43.00	49.10
75% ferrosilicon 2/	44.00	34.00	40.20
Silicon metal 5/	70.00	50.00	58.10
Vanadium, ferrovanadium 6/	14.00	9.50	9.75

1/ Annual time-weighted average.

2/ Cents per pound of contained element.

3/ Dollars per pound of contained element.

4/ Dollars per long ton.

5/ Cents per pound.

6/ Dollars per kilogram of contained element.

Sources: American Metal Market and Platt's Metal Week.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION AND EXPORTS OF FERROALLOYS AND METALS IN 1999 1/

(Metric tons unless otherwise specified)

Alloy	Imports			Exports		
	Gross weight	Contained weight	Value (thousands)	Gross weight	Contained weight	Value (thousands)
Ferroalloys:						
Chromium ferroalloys:						
Ferrochromium containing:						
More than 4% carbon	562,000	331,000	\$218,000	4,250	2,550	\$3,180
More than 3% but not more than 4% carbon	3,000	1,950	1,120	XX	XX	XX
Not more than 3% carbon	39,000	26,100	40,700	1,290	776	1,560
Ferrochromium-silicon	36,000	12,700	18,700	250	88	243
Total	640,000	371,000	278,000	5,790	3,420	4,980
Manganese ferroalloys:						
Ferromanganese containing:						
More than 4% carbon	224,000	173,000	88,300	XX	XX	XX
More than 1% but not more than 2% carbon	71,300	57,600	43,400	XX	XX	XX
Not more than 1% carbon	17,600	15,000	17,600	XX	XX	XX
Ferromanganese, all grades	XX	XX	XX	11,600	XX	6,510
Silicomanganese	301,000	202,000	121,000	3,700	XX	2,180
Total	614,000	448,000	270,000	15,300	XX	8,690
Silicon ferroalloys:						
Ferosilicon containing:						
More than 55% silicon	XX	XX	XX	10,500	6,420	8,500
More than 55% but not more than 80% silicon and more than 3% calcium	13,700	10,300	7,930	XX	XX	XX
More than 55% but not more than 80% silicon and not more than 3% calcium	198,000	149,000	122,000	XX	XX	XX
Magnesium ferosilicon	23,900	10,900	21,000	XX	XX	XX
Ferosilicon, other 2/	10,800	3,640	9,060	36,100	18,100	31,600
Total	246,000	174,000	160,000	46,600	24,500	40,100
Other ferroalloys:						
Ferrocerium and other pyrophoric alloys	136	NA	1,920	XX	XX	XX
Ferromolybdenum	8,350	5,160	37,300	XX	1,510	12,400
Ferronickel	37,100	14,300	73,000	84	59	161
Ferroniobium (columbium)	6,850	NA	62,200	166	NA	1,110
Ferrophosphorus	10,600	NA	3,050	1,100	NA	699
Ferrotitanium and ferosilicon-titanium	4,750	NA	8,620	1,210	NA	2,650
Ferrotungsten and ferosilicon-tungsten	895	669	3,760	7	4	46
Ferrovandium	2,620	1,930	20,700	284	213	3,180
Ferrozirconium	100	NA	173	51	NA	155
Ferroalloys, other	32,000	NA	46,600	3,370	NA	6,030
Total	103,000	XX	257,000	6,270	XX	26,400
Total ferroalloys	1,600,000	XX	966,000	74,000	XX	80,200
Metals:						
Chromium	9,030	NA	56,600	2,370	NA	17,100
Manganese, other:						
Unwrought	12,900	NA	20,100	3,540	NA	7,940
Other	2,040	NA	2,550	XX	XX	XX
Silicon:						
Less than 99% silicon	1,690	XX	95,600	33,200	32,200	44,500
Less than 99.99% but not less 99% silicon	69,300	67,500	89,000	484	480	698
Not less than 99.99% silicon	45,300	44,200	50,000	4,090	XX	236,000
Total	116,000	112,000	235,000	37,800	32,700	281,000
Total metals	140,000	XX	314,000	43,700	XX	306,000
Grand total	1,740,000	XX	1,280,000	118,000	XX	386,000

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/	1995	1996	1997	1998	1999 e/
Albania, electric furnace, ferrochromium	42,986	31,189	31,454	29,960	28,500
Argentina, electric furnace:					
Ferromanganese	5,836	7,374 r/	8,381 r/	5,016 r/	5,000
Ferrosilicon	14,017	22,452 r/	17,835 r/	11,245 r/	11,200
Silicomanganese	27,344	24,654 r/	26,134 r/	25,388 r/	25,000
Other 6/	14,380 r/	21,286 r/	14,223 r/	22,974 r/	20,000
Total	61,577 r/	75,766 r/	66,573 r/	64,623 r/	61,200
Australia, electric furnace: e/					
Ferromanganese	110,000	110,000	95,000	110,000	95,000
Silicomanganese	100,000	95,000	95,000	105,000	105,000
Silicon metal	30,000	30,000	30,000	30,000	30,000
Total	240,000	235,000	220,000	245,000	230,000
Austria, electric furnace:					
Ferronickel	5,000	5,000	5,000 e/	4,500 e/	4,250
Other e/	5,900	5,900	5,900	5,000	5,000
Total	10,900	10,900	10,900 e/	9,500 e/	9,250
Belgium, electric furnace, ferromanganese e/	25,000	25,000	25,000	20,000	--
Bhutan, electric furnace, ferrosilicon e/	12,000	13,000	15,000	18,000	18,000
Bosnia and Herzegovina, electric furnace: e/					
Ferrosilicon	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 7/	100,969	77,231	76,250 r/	100,000 r/ e/	100,000
Ferrochromiumsilicon e/	5,000	5,000	5,000	5,000	5,000
Ferromanganese	130,000	215,260	153,000	122,000 r/	110,000
Ferronickel	30,591 r/	29,582 r/	32,015 r/	26,389 r/	22,700
Ferrosilicon	243,824	236,838	212,183	166,278 r/	150,000
Silicomanganese	167,000	232,218	175,000	124,000 r/	110,000
Silicon metal	116,000	150,054	136,884	126,744 r/	110,000
Other e/	76,000	76,000	76,000	76,000	76,000
Total	869,384 r/	1,022,183 r/	866,332 r/	746,411 r/	684,000
Bulgaria, electric furnace: e/					
Ferrosilicon	7,550	8,300	8,000	8,000	8,000
Other	2,000	2,000	2,000	2,000	2,000
Total	9,550	10,300	10,000	10,000	10,000
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	22,000	26,000 r/	30,000 r/	30,000 r/	30,000
Total	79,000	83,000 r/	87,000 r/	87,000 r/	87,000
Chile, electric furnace:					
Ferrochromium	2,730	2,079 r/	2,000	2,000 e/	2,000
Ferromanganese	7,987	8,498 r/	5,517 r/	3,652 r/	3,700
Ferromolybdenum	3,241 r/	4,222 r/	3,157 r/	1,978 r/	2,000
Ferrosilicon	4,279 r/	4,650 r/	1,294 r/	1,159 r/	1,160
Silicomanganese	1,617	1,599 r/	3,175 r/	3,921 r/	3,950
Total	19,854 r/	21,048 r/	15,143 r/	12,710 r/	12,800
China: e/ 8/					
Blast furnace:					
Ferromanganese	400,000	450,000	500,000	550,000 r/	500,000
Other	210,000	200,000	100,000	48,000 r/	100,000
Electric furnace:					
Ferrochromium	500,000	423,000	480,000	424,000	400,000
Ferromanganese	605,000	700,000	680,000	500,000 r/	550,000
Ferrosilicon	1,210,000	1,490,000	1,250,000	1,290,000 r/	1,400,000
Silicomanganese	830,000	840,000	770,000	639,000 r/	700,000
Other	80,000	77,000	260,000	110,000 r/	150,000
Total	3,840,000	4,180,000	4,040,000	3,560,000	3,800,000
Colombia, electric furnace, ferronickel	56,995 r/	52,241 r/	55,079 r/	61,180	61,620 9/
Croatia, electric furnace, ferrochromium	26,081	10,559	24,231	11,770	10,000
Czech Republic, electric furnace, other e/	1,000	1,000	1,000	1,000	1,000
Dominican Republic, electric furnace, ferronickel	80,711	78,488	84,897 r/	62,457 r/	61,200

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/	1995	1996	1997	1998	1999 e/
Egypt, electric furnace: e/					
Ferromanganese	35,000	35,000	35,000	35,000	35,000
Ferrosilicon	44,000	44,000	44,000 r/	44,000 r/	44,000
Total	79,000	79,000	79,000 r/	79,000 r/	79,000
Finland, electric furnace, ferrochromium					
	246,805	227,811	236,652	230,906	235,000
France:					
Blast furnace, ferromanganese	348,000	337,000	326,000	321,000 e/	302,000
Electric furnace:					
Ferromanganese	85,000	100,000	100,000	100,000 e/	100,000
Ferrosilicon e/	108,000 9/	103,000	109,000	110,000	110,000
Silicomanganese e/ 10/	71,000	61,000	66,000	65,000	65,000
Silicon metal	71,450	73,800	74,000 e/	75,000 e/	75,000
Other e/	20,000	20,000	20,000	20,000	20,000
Total e/	703,000	695,000	695,000	691,000	672,000
Georgia, electric furnace: e/					
Ferromanganese	12,600 r/	7,600 r/	4,000 r/	10,000	15,000
Silicomanganese	7,600 r/	7,000 r/	16,600 r/	35,000	50,000
Total	20,200 r/	14,600 r/	20,600 r/	45,000	65,000
Germany, electric furnace: e/					
Ferrochromium	21,665 9/	25,303 9/	25,856 9/	20,879 9/	16,960 9/
Ferromanganese 11/	20,000	20,000	20,000	10,000	10,000
Ferrosilicon	-- r/	-- r/	-- r/	-- r/	--
Silicon metal	20,000 r/	20,000 r/	20,000 r/	20,000 r/	20,000
Other 12/	30,000	30,000	30,000	30,000	30,000
Total	91,700 r/	95,300 r/	95,900 r/	80,900 r/	77,000
Greece, electric furnace, ferronickel					
	68,656	71,204	70,440	60,020	51,856 9/
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
Total	8,000	8,000	8,000	8,000	8,000
Iceland, electric furnace, ferrosilicon					
	71,410	70,520	70,000 e/	68,000 r/	75,000
India, electric furnace: e/					
Ferrochromium 14/	303,537 9/	261,666 9/	286,973 9/	345,125 9/	350,000
Ferrosilicon	9,000	9,000	10,000	10,000	10,000
Ferromanganese	180,000	190,000	166,000	165,000	160,000
Ferrosilicon	75,000 r/	78,000 r/	74,000 r/	65,000 r/	55,000
Silicomanganese	190,000	170,000	198,000	193,000	190,000
Other	8,500	8,500	9,000	9,000	9,000
Total	766,000 r/	717,000 r/	744,000 r/	787,000 r/	774,000
Indonesia, electric furnace:					
Ferromanganese e/	14,000	14,000	15,000	13,000 r/	14,000
Ferronickel	53,675	47,800	50,000	42,260	50,000
Silicomanganese e/	7,000	7,000	7,000	7,000	7,000
Total	74,675	68,800	72,000 e/	62,260 r/	71,000
Iran, electric furnace:					
Ferrochromium	11,900	10,500	11,450	13,745	14,000
Ferrosilicon e/	10,000	20,000	20,000	20,000	20,000
Total	21,900	30,500	31,500 e/	33,700 e/	34,000
Italy, electric furnace:					
Ferrochromium	51,017	29,915	11,295	11,487	12,000
Ferromanganese	20,216	25,143	16,000	16,000 e/	16,000
Silicomanganese	103,961	100,353	100,000 e/	100,000 e/	100,000
Silicon metal e/	10,000	14,000	15,000	15,000	15,000
Other e/ 15/	12,000	10,000	10,000	10,000	10,000
Total	197,194	179,411	152,000 e/	152,000 e/	153,000
Japan, electric furnace:					
Ferrochromium 7/	210,445	193,695	186,432	142,931	119,777 9/
Ferromanganese	346,977	343,104	376,633	334,081	315,152 9/
Ferronickel	351,337	328,699	352,840	345,772	332,353 9/
Ferrosilicon	3,650	--	--	951	1,452 9/
Silicomanganese	64,870	75,802	78,323	70,886	65,744 9/
Other 16/	12,353	10,131	10,217	8,678	12,535 9/
Total	989,632	951,431	1,004,445	903,299	847,013 9/

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/	1995	1996	1997	1998	1999 e/
Kazakhstan, electric furnace:					
Ferrochromium	511,600	352,000	600,000	535,000	597,946 9/
Ferrochromiumsilicon	21,300	20,000 e/	48,000 e/	33,550	60,000
Ferrosilicon e/	256,000	119,000	133,000	92,000	120,000
Silicomanganese e/	20,000	50,000	55,000	57,000	75,000
Other	10,000	10,000	9,000	8,000	9,000
Total	818,900 r/	551,000	845,000	725,550 r/	862,000
Korea, North, electric furnace: e/					
Ferromanganese 12/	7,000	6,000	6,000	6,000	6,000
Ferrosilicon	4,000	3,000	3,000	3,000	3,000
Other 13/	1,000 r/	1,000 r/	1,000 r/	1,000 r/	1,000
Total	12,000 r/	10,000 r/	10,000 r/	10,000 r/	10,000
Korea, Republic of, electric furnace:					
Ferromanganese	118,798	126,135	158,755	158,418	140,000
Silicomanganese	97,785	83,375	77,078	106,997	100,000
Other	2,698	4,687	2,174	2,805	3,000
Total	219,281	214,197	238,007	268,220	243,000
Macedonia, electric furnace:					
Ferrochromium	3,765	3,780	460	--	--
Ferronickel	9,200	7,900	14,000 r/	15,200 r/	5,000
Ferrosilicon	57,200	57,220	55,000 e/	55,000 e/	50,000
Silicon metal e/	1,000	1,000	1,000	500 r/	--
Total e/	71,200	69,900	70,500 r/	70,700 r/	55,000
Mexico, electric furnace: 17/					
Ferromanganese	58,000	69,000	68,000	87,000 r/	79,000 9/
Silicomanganese	67,700	93,000	105,000	105,000	114,000 9/
Total	125,700	162,000	173,000	192,000 r/	193,000 9/
New Caledonia, electric furnace, ferronickel	168,800	168,700	172,250	157,959 r/	157,592 9/
Norway, electric furnace:					
Ferrochromium	148,000	108,900	145,124	174,678 r/	159,714 9/
Ferromanganese	213,000	215,000	235,000 e/	235,000 e/	235,000
Ferrosilicon	474,875	462,423	470,000 e/	470,000 e/	470,000
Silicomanganese e/	210,000	210,000	230,000	230,000	230,000
Silicon metal e/	101,000 9/	110,000	110,000	110,000	100,000
Other e/ 10/	15,000	15,000	15,000	15,000	15,000
Total e/	1,160,000	1,120,000	1,210,000	1,230,000	1,210,000
Peru, electric furnace, ferrosilicon e/	600	600	600	600	600
Philippines, electric furnace:					
Ferrochromium	50,450	6,736	--	-- e/	--
Ferromanganese e/	5,000	--	--	--	--
Ferrosilicon e/	10,000	--	--	--	--
Total e/	65,450	6,736 9/	--	--	--
Poland:					
Blast furnace, ferromanganese	46,300	59,900	47,500 r/ e/	50,152 r/	60,000
Electric furnace:					
Ferrochromium	18,334	3,785	5,900	3,600	3,500
Ferrosilicon	70,400	71,800	77,300 r/	75,000 e/	70,000
Silicomanganese e/	20,500 r/	25,000 9/	20,000	25,000	25,000
Silicon metal e/	1,300	1,300	1,400	1,400	1,200
Other e/ 13/	20,000	20,000	20,000	20,000	20,000
Total e/	177,000 r/	182,000	172,000 r/	175,000 r/	180,000
Romania, electric furnace:					
Ferrochromium	15,053	9,650	950	873 r/	--
Ferromanganese	28,410	20,150	11,505	4,170 e/	25
Ferrosilicon	19,320	23,827	9,620	5,553 r/	5,000
Silicomanganese	57,149	78,590	62,570	83,617 r/	550
Silicon metal e/	300	300	300	150 r/	--
Total e/	120,000	133,000	84,900	94,400 r/	5,580
Russia: e/					
Blast furnace:					
Ferromanganese	82,500 9/	67,000 9/	47,100 9/	65,000 r/ 9/	90,000
Ferrophosphorus	-- 9/	2,300 9/	3,600 9/	3,500	3,500
Spiegeleisen	7,000	7,000	7,000	7,000	7,000

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/	1995	1996	1997	1998	1999 e/
Russia--continued: e/					
Electric furnace:					
Ferrochromium	290,000	135,000	247,000	203,000 9/	249,000 9/
Ferrochromiumsilicon	30,000	5,000	5,000	4,000	4,500
Ferronickel	77,000 9/	75,000 9/	40,000	30,000	33,000
Ferrosilicon	350,000	460,000	510,000	496,000 9/	601,000 9/
Silicomanganese	700	--	--	-- 18/	-- 18/
Silicon metal	40,000	40,000	40,000	40,000	40,000
Other	40,000	40,000	40,000	40,000	40,000
Total	917,000	831,000	940,000	889,000 r/	1,070,000
Serbia and Montenegro, electric furnace, ferronickel	2,414	6,501	6,338 r/	1,243 r/	--
Slovakia, electric furnace: e/					
Ferrochromium	65,260 9/	19,900 9/	11,394 9/	11,715 9/	6,986 9/
Ferromanganese	25,000	25,000	20,000	20,000	20,000
Ferrosilicon	30,000	30,000	30,000	30,000	20,000
Silicomanganese	12,000	12,000	10,000	10,000	10,000
Other	8,000	8,000	5,000	5,000	5,000
Total	140,000	94,900	76,400	76,700	62,000
Slovenia, electric furnace:					
Ferrochromium	23,247	22,819	9,232	10,621	560 9/
Ferrosilicon e/	12,000	10,000	8,000	8,000	8,000
Other e/ 6/	200	200	200	200	200
Total e/	35,400	33,000	17,400	18,800	8,760
South Africa, electric furnace:					
Ferrochromium 19/	1,517,100 r/	1,478,000	1,939,500 r/	2,025,300 r/	2,263,021 9/
Ferromanganese	507,000	562,000 e/	499,000 r/	542,000 r/	510,000
Ferrosilicon	92,667	117,600	102,000	108,000 r/	97,000
Silicomanganese e/	251,000 9/	241,000	286,000	265,000 r/	240,000
Silicon metal	30,082	28,500	34,000 e/	33,000 r/	33,000
Other e/ 20/	1,000	1,000	48,000 r/	15,000 r/	20,000
Total e/	2,400,000 r/	2,430,000	2,910,000 r/	2,990,000 r/	3,160,000
Spain, electric furnace: e/					
Ferrochromium	1,320 9/	805 9/	490 9/	1,145 9/	935 9/
Ferromanganese	25,000	30,000	35,000	35,000	35,000
Ferrosilicon	30,000	30,000	30,000	30,000	40,000
Silicomanganese	50,000	70,000	100,000	100,000	100,000
Silicon metal	5,000	5,000	15,000	25,000 r/	30,000
Other	5,000	5,000	5,000	5,000	5,000
Total	116,000	141,000	185,000	196,000 r/	211,000
Sweden, electric furnace:					
Ferrochromium	130,170	138,110	101,842	123,958	113,140 9/
Ferrosilicon	21,970	21,287	22,412	22,000 e/	22,000
Total	152,140	159,397	124,254	146,000 e/	135,000
Taiwan, electric furnace:					
Ferromanganese	13,136	14,059	12,130	12,532 r/	-- 9/
Ferrosilicon	288	2,481	3,391	3,775 r/	3,212 9/
Total	13,424	16,540	15,521	16,307 r/	3,212 9/
Turkey, electric furnace:					
Ferrochromium	94,251	101,450	108,320 r/	110,175 r/	110,000
Ferrosilicon e/	4,900	4,460	4,730 r/	4,810 r/ 9/	4,800
Total	99,151	105,910	113,050 r/	114,985 r/	115,000
Ukraine: e/					
Blast furnace:					
Ferromanganese	100,000 r/	100,000 r/	125,000 r/	112,400 r/ 9/	57,800
Spiegeleisen	2,500	2,500	2,500	2,500	2,500
Electric furnace:					
Ferromanganese	170,000	170,000	160,000	150,000	200,000
Ferronickel	23,000 9/	8,300 9/	--	--	--
Ferrosilicon	300,000	250,000 r/	300,000	222,511 r/ 9/	243,600 9/
Silicomanganese	600,000	600,000	560,000	485,560 r/ 9/	498,905 9/
Other	25,000	25,000	25,000	20,000	25,000
Total	1,220,000 r/	1,160,000 r/	1,170,000 r/	993,000 r/	1,030,000

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/	1995	1996	1997	1998	1999 e/
United States, electric furnace:					
Ferrochromium 21/	72,500	36,800	60,700	W	W
Ferromanganese 22/	(23/)	(23/)	W	W	W
Ferronickel	16,800	30,500	32,100	8,590	-- 9/
Ferrosilicon	358,000	362,000	359,000	334,000	325,000 9/
Silicon metal	158,000	171,000	183,000	188,000	186,000 9/
Other 24/	188,000	194,000	W	W	W
Total	793,000	795,000	635,000	531,000	511,000
Uruguay, electric furnace, ferrosilicon e/	200	200	200	200	200
Venezuela, electric furnace:					
Ferrosilicon e/	50,000	63,000	60,000	60,000	57,000
Silicomanganese	48,373	24,786	37,293	35,000 e/	35,000
Total	98,373	87,786	97,300 e/	95,000 e/	92,000
Zimbabwe, electric furnace:					
Ferrochromium	254,142	243,000	233,386	246,782	240,000
Ferrosilicon	46,667	33,175	17,000 r/	21,000 r/	20,000
Total	300,809	276,175	250,386 r/	267,782 r/	260,000
Grand total:	17,900,000 r/	17,800,000 r/	18,300,000 r/	17,400,000 r/	17,700,000
Of which:					
Blast furnace:					
Ferromanganese 25/	977,000 r/	1,010,000 r/	1,050,000 r/	1,100,000 r/	1,010,000
Spiegeleisen 25/	9,500	9,500	9,500	9,500	9,500
Other 26/	210,000	202,000	104,000	51,500 r/	103,500
Total	1,200,000 r/	1,230,000 r/	1,160,000 r/	1,160,000 r/	1,120,000
Electric furnace:					
Ferrochromium 27/	4,710,000 r/	3,950,000	4,840,000 r/	4,780,000 r/	5,030,000
Ferrosilicon	90,700	52,200	37,000 r/	40,000 r/	39,500
Ferromanganese 28/ 29/	2,770,000 r/	3,040,000 r/	2,900,000 r/	2,690,000 r/	2,650,000
Ferronickel	944,000 r/	910,000 r/	915,000 r/	816,000 r/	780,000
Ferrosilicon	4,010,000 r/	4,240,000 r/	4,060,000 r/	3,880,000 r/	4,100,000
Silicomanganese 29/ 30/	3,010,000	3,100,000 r/	3,080,000 r/	2,870,000 r/	2,850,000
Silicon metal	607,000 r/	672,000 r/	692,000 r/	696,000 r/	671,000
Other 31/	578,000 r/	586,000 r/	609,000 r/	427,000 r/	479,000
Total	16,700,000 r/	16,600,000	17,100,000	16,200,000 r/	16,600,000

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 September 1, 2000.

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.

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/ Includes calcium-silicon.

7/ Includes high- and low-carbon ferrochromium.

8/ 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.

9/ Reported figure.

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/ Excludes calcium-silicon.

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

17/ Salable products from Autlán.

18/ Production appears to have resumed, but information is unavailable to form reliable estimates.

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."

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

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- 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 in "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.