SILICON

By Thomas S. Jones

Silicon (Si) is a light chemical element having metallic and nonmetallic characteristics. In nature, silicon combines with oxygen and other elements to form silicates. Silicon in the form of silicates constitutes more than 25% of the Earth's crust. Silica is a silicate consisting entirely of silicon and oxygen. Silica (SiO_2) as quartz or quartzite is used to produce silicon-based products for the aluminum, chemical, and iron and steel industries.

Silicon metal and ferrosilicon are referred to by the approximate percentage of silicon contained in the material and by the maximum amount of trace impurities present. There are two standard grades of ferrosilicon; one grade is about 50% silicon, and the other, 75% silicon by weight. Almost all ferrosilicon products are consumed by the iron and steel industry.

Metallurgical-grade silicon metal is used by the chemical, primary aluminum, and secondary aluminum industries. The products sold to these industries vary considerably in their specifications. The chemical and primary aluminum industries generally require more stringent specifications than those of the secondary aluminum industry. In addition, the chemical industry requires that the metal be ground into a fine powder rather than the lump form used by the aluminum industry.

The average annual dealer import price for ferrosilicon and silicon metal increased from that of 1995. On the basis of contained silicon, overall domestic silicon production increased to about 412,000 metric tons, and consumption of silicon decreased to about 594,000 tons.

Overall U.S. trade volume, gross weight, of silicon exports was up by about 3%, while overall trade volume of silicon imports was down by about 8%. The U.S. net import reliance for silicon products was estimated to be about 31%.

Legislation and Government Programs

The Generalized System of Preferences (GSP) program expired on July 31, 1995. On August 20, 1996, the President signed the Small Business Job Protection Act of 1996, which contained provisions entitled the GSP Renewal Act of 1996. The Act provides that GSP duty-free treatment will apply to eligible articles from designated beneficiary countries that are entered or withdrawn from warehouse for consumption on or after October 1, 1996, through May 31, 1997. Additionally, GSP duty-free treatment will have certain retroactive applications to articles entered after July 31, 1995, and before October 1, 1996 (U.S. Department of the Treasury, 1996). Under GSP, the United States grants duty-free access to goods from qualifying developing countries and territories. In 1996, U.S. import duties for selected silicon materials ranged from duty free to 7.6% ad valorem for most-favored-nation (MFN) status and from $0.044 per kilogram of contained silicon to 45% ad valorem for non-MFN status.

In a preliminary determination by the International Trade Administration (ITA) on July 25, silicon metal from Argentina was subject to dumping margins for the period of investigation of September 1, 1992, through August 31, 1993—8.52% for Electrometalurgica Andina, 24.62% for Silarsa S.A., and 17.87% for "all others" (U.S. Department of Commerce, 1996b).

On September 5, the ITA made a final determination that silicon metal from Brazil was subject to dumping margins for the period of investigation of July 1, 1992, through June 30, 1993—16.81% for Companhia Brasileira Carbureto de Calcio (CBCC) and 31.60% for Rima Electrometalurgia S.A. (RIMA) (U.S. Department of Commerce, 1996c). The ITA also made a preliminary determination that silicon metal from Brazil was subject to dumping margins for the period of investigation of July 1, 1993, through June 30, 1994—57.32% for CBCC, 31.60% for RIMA, and 9.29% for Camargo Correa Metais S.A. (CCM) (U.S. Department of Commerce, 1996e). Additionally, the ITA made a preliminary determination that dumping margins exist for silicon metal from Brazil for the period of investigation of July 1, 1994, through June 30, 1995—7.54% for CBCC, 2.12% for Companhia Ferroligas Minas Gerais Minasligas, 9.95% for Eletrosilex Belo Horizonte, 3.67% for RIMA, and 93.2% for CCM (U.S. Department of Commerce, 1996d).

On November 22, the ITA made a final determination that ferrosilicon from Companhia de Ferro Ligas da Bahia of Brazil would be subject to a dumping margin of 0.05% for the period of investigation of August 16, 1993, through February 28, 1995 (U.S. Department of Commerce, 1996a).

American Alloys Inc. and Elkem Metals Co. were put on probation for 1 year and received fines of $100,000 and $1,000,000, respectively, as a consequence of their having entered guilty pleas to charges of having conspired to fix prices of ferrosilicon. These sentences were an outgrowth of an investigation by the U.S. Department of Justice of an alleged conspiracy by some domestic producers to fix prices of commodity ferrosilicon products sold in the United States during 1989-1991. A third company, SKW Metals & Alloys Inc., was indicted for allegedly conspiring to fix prices of silicon metal as well (American Metal Market, 1996b; Ryan's Notes, 1996b).

Production

Overall gross production of silicon products in the United

States increased by about 3% compared with that of 1995. Production of silicon metal was up by about 7%, and production of ferrosilicon and miscellaneous alloys was up slightly. Overall shipments of silicon-containing products were up slightly. Producer stocks of silicon-containing materials rose by more than 4% overall.

Domestic production data for silicon are derived from monthly and annual voluntary surveys and estimates for nonrespondents by the U.S. Geological Survey (USGS). The "Silicon Alloys" survey canvasses the operations listed in table 3. The figures in table 2 represent 100% of the production and shipments from these operations. *(See tables 1, 2, and 3.)*

Production of silicon metal and silicon alloys is extremely power intensive, requiring a power input for some operations of as much as 14,000 kilowatt-hours per ton of silicon content.

The location of ferrosilicon and silicon metal smelters is usually determined by balancing marketing costs against processing costs. Principal elements in the cost of silicon and ferrosilicon production are (1) delivered costs of the ore (quartz or quartzite), (2) energy cost, (3) cost of reductant coke or low ash coal, (4) cost of iron in the form of steel scrap, if required, and (5) labor.

Recovery of silicon from secondary sources is not generally practiced. The only secondary possibility is recovery from scrap metal. Any value of contained silicon is, however, incidental to the value of the primary metal. In 1996, the average price for silicon contained in ferrosilicon was about $0.63 per pound, and the average price for silicon metal was about $0.90 per pound. For the future, recycling of silicon in the form of ferrosilicon and silicon metal is expected to be insignificant.

In early May, the board of directors of Applied Industrial Materials Corp. (AIMCOR), Pittsburgh, PA, announced that the company had not only halted plans to sell off its metals group, but planned to invest capital in the group. The decision was influenced by improved market conditions, and the group's stronger performance and improved operating efficiencies (American Metal Market, 1996a). In late September 1993, AIMCOR had announced plans to sell off the company's metals and minerals groups, which included a ferrosilicon production facility in Bridgeport, AL.

In a joint venture with its subsidiary Kojundo Silicon, Mitsubishi Materials Corp. (Japan) announced plans to build a polycrystalline silicon (polysilicon) production plant in Mobile, AL. Mitsubishi will provide 80% of the capital needed for the $25 million venture, and Kojundo will provide the remaining 20%. Initial plant annual production capacity is anticipated at about 1,000 tons of polysilicon with potential capacity of up to 3,000 tons by the third year of operation (Roskill's Letter from Japan, 1996). Polysilicon is used mainly in the electronics industry in semiconductor devices.

Hemlock Semiconductor Corporation, Hemlock, MI, a joint venture between Dow Corning Corp., Shin-Etsu Handotai Co., and Mitsubishi Materials Corp., announced plans for a $100 million expansion at Hemlock's polysilicon plant. The expansion reportedly will increase annual production capacity at the plant by 40% to about 5,000 tons of polysilicon (Chemical Marketing Reporter, 1996).

Advanced Silicon Materials Inc. (ASIMI), Moses Lake, WA, plans to increase its annual polysilicon production capacity by 3,800 tons at Butte, MT. The construction will be in two phases. The $250 million first phase began in early 1996 and will have a workforce of about 165 people when operational in early 1998. The second phase will begin in 1997 and will have an additional 100 people when completed in 1999. Also, ongoing expansion at ASIMI's Moses Lake polysilicon operation was expected to increase annual production capacity at that facility from 1,200 to 2,100 tons by yearend 1996 (Advanced Silicon Materials Inc., 1996).

Consumption

The aluminum industry used silicon metal in the production of wrought and cast products, and ferrosilicon was used primarily as a deoxidizing and alloying agent in the production of iron and steel products. Metallurgical-grade silicon metal also was used as the basic raw material in the manufacturing of many chemical products and intermediates, such as silicones and silanes.

U.S. apparent consumption of silicon metal and silicon-containing ferroalloys was estimated to be about 594,000 tons of contained silicon, a decrease from that in 1995. Consumption of silicon metal was estimated to be about 233,000 tons, and consumption of ferrosilicon and miscellaneous silicon alloys was estimated to be about 361,000 tons. Compared with that of 1995, consumption of silicon metal increased by about 2%, and consumption of ferrosilicon and miscellaneous silicon alloys decreased by about 5%. Ferrosilicon and miscellaneous silicon alloys continued to account for more than 60% of all the silicon materials consumed, based on silicon content.

Prices

Demand for metallurgical-grade silicon alloys and metal is determined by the level of activity in the steel, ferrous foundry, aluminum, and chemical industries. As a result, prices tend to vary widely with changes in demand and supply.

The overall Platt's Metals Week "dealer import" price, posted in cents per pound of contained silicon, for 50%- and 75%-grade ferrosilicon increased by about 10% and 7%, respectively, compared with that in 1995. *(See table 1.)* The import price for 50%-grade ferrosilicon fell slightly from a range of $0.64 to $0.66 per pound to a range of $0.63 to $0.65 in mid-January, where it remained through yearend. The import price for 75%-grade ferrosilicon started the year at a range of $0.63 to $0.645 per pound, fell to $0.62 to $0.64 through September, and then retreated to a range of $0.54 to $0.58 by yearend. The fall in price in the fourth quarter was attributed to a decline in demand from the steelmaking sector.

The overall Platt's Metals Week "dealer import" price for silicon metal, posted in cents per pound of contained silicon, increased by almost 30% compared with that of 1995. *(See table 1.)* The import price for silicon metal started the year at a

range of $0.75 to $0.77 per pound, rose to $0.93 to $0.98 by mid-June, and then fell to $0.85 to $0.88 by yearend. Silicon metal prices were influenced by a strong demand from the chemical sector and antidumping duties imposed in the United States.

Foreign Trade

U.S. exports of ferrosilicon increased by almost 25% on the basis of gross weight compared with that of 1995, and total value of exports was up by about 14%. *(See table 5.)* Canada and the United Kingdom were the major recipients of the materials, with about 66% of the total. Silicon metal exports decreased overall by more than 30% on the basis of gross weight, with the total value of the exports up by about 7%. More than 60% of the total was shipped to Canada, Japan, the Republic of Korea, and Malaysia.

U.S. imports of silicon-containing alloys were down by about 5% compared with that of 1995. *(See table 6.)* The total value of the exports was up by about 13%. Imports of ferrosilicon categorized as "55% to 80% silicon, other" decreased by about 10% on the basis of gross weight, with the total value for this category increasing by about 9%. Brazil, Iceland, and Norway remained the leading suppliers for this category, with more than 70% of the total. Imports of ferrosilicon categorized as "Other," which included all ferrosilicon of less than 55% silicon content, increased by more than 30%, with Canada accounting for more than 60% of the imports. Norway accounted for about 38% of total ferrosilicon imports.

Overall imports of silicon metal products declined by about 15%, with the total value of imports up by about 20%. Imports of silicon metal categorized as "99.00% to 99.99% silicon" decreased by about 10%, with Brazil, Canada, and France providing about 75% of total volume and value. Imports of "Other" silicon metal decreased by about 20%, with Russia supplying almost 70% of volume and value for this category. Brazil, Canada, France, and Russia accounted for more than 70% of total silicon metal imports.

The schedule of tariffs applied during 1996 to U.S. imports of selected silicon materials can be found in U.S. International Trade Commission (1995).

The U.S. net import reliances for ferrosilicon and silicon metal products were estimated to be 33% and 26%, respectively, compared with 38% and 30%, respectively, in 1995. The overall import reliance for silicon products was estimated to be 31% compared with 35% in 1995.

World Review

World production of ferrosilicon, was estimated to be about 3.9 million tons compared with about 4 million tons in 1995. The major producers were, in decreasing order, China, Norway, the United States, Russia, Ukraine, Brazil, Kazakstan, and France, accounting for more than 80% of total production. For the same period, production of silicon metal, excluding that of China, was estimated at about 652,000 tons compared with about 577,000 tons in 1995. Australia, Brazil, France, Norway, Russia, South Africa, and the United States accounted for about 95% of total production. The reader is referred to the annual review for 1996 for Ferroalloys in the Mineral Industry Surveys series of the USGS for annual world production of ferrosilicon and silicon metal, by country.

Western world consumption of ferrosilicon in 1996 was estimated by CRU International Inc., London, England, to be more than 2.3 million tons. The major consuming countries were, in decreasing order, Japan, the United States, Germany, Italy, France, and the United Kingdom, accounting for about 60% of the total. For silicon metal, Western world consumption was estimated to be more than 820,000 tons, an all-time high. The major consuming countries were, in decreasing order, the United States, Japan, Germany, the United Kingdom, France, and Italy, accounting for almost 80% of the total.

Outlook

Demand for silicon metal is driven by consumption in the aluminum and chemical industries. U.S. secondary aluminum producers were predicting a 3% to 5% increase in silicon metal demand in 1997. Within the chemical industry, silicon metal is used to produce a wide variety of silicone-based products and intermediates. Industry sources indicate that demand for silicon metal in the chemical sector is expected to rise by 8% to 10% in 1997. By 2005, Western world silicon metal consumption in the aluminum sector is expected to be about 626,000 tons, and consumption in the chemical sector will be about 676,000 tons (Ryan's Notes, 1996a, 1997).

The demand trend for ferrosilicon follows the trend of the iron and steel industry. The reader is referred to the outlook section of the annual review for 1996 for Iron and Steel in the Mineral Industry Surveys series of the USGS for discussion of the outlook for the steel industry. The industry uses ferrosilicon for deoxidation of molten metal and as an alloying agent. The annual growth rate for world steel consumption through 2000 is expected to be almost 2%. Most growth will occur in China; other Asian countries, with the exception of Japan; and Latin America. Asia was projected to account for 47% of world steel consumption by 2000 (Iron & Steelmaker, 1996).

For 1997, it is estimated that domestic production of silicon-containing ferroalloys and metal will be more than 400,000 tons and that U.S. apparent consumption will be about 600,000 tons.

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[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT SILICON STATISTICS 1/

(Thousand metric tons of silicon content unless otherwise specified)

	1992	1993	1994	1995	1996
United States:					
Production	370	367	390	396	412
Exports:					
Ferrosilicon	30	21	20	22	27
Silicon metal	8	10	12	25	17
Imports for consumption:					
Ferrosilicon	161	141	147	158	148
Silicon metal	32	71	108	92	79
Apparent consumption:					
Ferrosilicon	337	335	360	381	361
Silicon metal	195	222	256	228	233
Price, average per pound Si: 2/					
Ferrosilicon, 50% Si	$0.369	$0.408	$0.439	$0.579	$0.640
Ferrosilicon, 75% Si	$0.354	$0.406	$0.408	$0.581	$0.622
Silicon metal	$0.600	$0.664	$0.641	$0.695	$0.897
World: Production (gross weight): e/					
Ferrosilicon	4,100	4,000	3,800 r/	4,000 r/	3,900
Silicon metal	570 r/	560 r/	560 r/	580 r/	650

e/ Estimated. r/ Revised.
1/ Data are rounded to three significant digits.
2/ Platt's Metals Week dealer import prices.

TABLE 2
PRODUCTION, SHIPMENTS, AND STOCKS OF SILVERY PIG IRON,
FERROSILICON, AND SILICON METAL IN THE UNITED STATES IN 1996 1/

(Metric tons, gross weight, unless otherwise specified)

	Silicon content (percentage)		Producers' stocks, Dec. 31,			Producers' stocks, Dec. 31,
Material	Range	Typical	1995	Gross production 2/	Net shipments	1996
Silvery pig iron	5-24	18	W	W	W	W
Ferrosilicon	25-55	48	19,900	182,000	116,000	22,700
Do.	56-95	76	19,300	132,000	139,000	16,900
Silicon metal (excluding semiconductor grades)	96-99	98	5,080	175,000	174,000	5,590
Miscellaneous silicon alloys (excluding silicomanganese)	32-65	--	11,400	110,000	95,900	13,000

W Withheld to avoid disclosing company proprietary data.
1/ Data are rounded to three significant digits.
2/ Ferrosilicon production includes material consumed in the production of miscellaneous silicon alloys.

TABLE 3
PRINCIPAL PRODUCERS OF SILICON ALLOYS AND/OR SILICON METAL
IN THE UNITED STATES IN 1996

Producer	Plant location	Product 1/
American Alloys Inc.	New Haven, WV	FeSi and Si.
American Silicon Technologies	Rock Island, WA	Si.
Applied Industrial Minerals Corp.	Bridgeport, AL	FeSi.
Elkem Metals Co.	Alloy, WV	Si.
Globe Metallurgical Inc.	Beverly, OH	FeSi and Si.
Do.	Niagara Falls, NY	FeSi and Si.
Do.	Selma, AL	Si.
Do.	Springfield, OR	Si.
Keokuk Ferro-Sil Inc.	Keokuk, IA	FeSi and silvery pig iron.
Simcala Inc.	Montgomery, AL	Si.
SKW Metals and Alloys Inc.	Calvert City, KY	FeSi.

1/ FeSi, ferrosilicon; Si, silicon metal.

TABLE 4
REPORTED CONSUMPTION, BY MAJOR END USE, AND STOCKS OF SILICON ALLOYS AND METALS IN THE UNITED STATES IN 1996 1/ 2/

(Metric tons, gross weight, unless otherwise specified)

Silicon content (percentage)	Silvery pig iron	Ferrosilicon 3/				Silicon metal	Miscellaneous silicon alloys 4/	Silicon carbide 5/
Range	5-24	25-55	56-70	71-80	81-95	96-99	--	63-70
typical	18	48	65	76	85	98	48	64
End use								
Steel:								
Carbon	--	16,600	--	22,400	(6/)	(6/)	(6/)	(6/)
Stainless and heat-resisting	--	(6/)	--	32,900	(6/)	(6/)	(6/)	--
Other alloy	(6/)	5,520	--	(6/)	(6/)	(6/)	(6/)	(6/)
Tool	--	--	--	2,800	(6/)	--	(6/)	--
Unspecified	27	7,270	--	26,800	558	12,700	2,410	593
Total	27	29,400	--	84,900	558	12,700	2,410	593
Cast irons	21,800	84,600	1,450	25,700	665	W	W	28,700
Superalloys	--	W	W	W	33	W	--	--
Alloys (excluding superalloy and alloy steel)	W	W	--	W	--	W	--	W
Miscellaneous and unspecified	(7/)	2,690	(7/)	433	(7/)	233,000 8/	116,000	(7/)
Grand total	21,800	117,000	1,450	111,000	1,260	246,000	119,000	29,300
Consumers' stocks, December 31	1,170	5,470	193	8,300	50	2,810	2,000	1,080

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/ Includes U.S. Geological Survey estimates.
3/ Includes briquets.
4/ Primarily magnesium-ferrsilicon but also includes other silicon alloys.
5/ Does not include silicon carbide for abrasive or refractory uses.
6/ Included with "Steel: Unspecified."
7/ Included with "Cast irons."
8/ Includes silicones, silanes, fumed silica, and other chemicals.

TABLE 5
U.S. EXPORTS OF FERROSILICON AND SILICON METAL, BY GRADE AND COUNTRY, IN 1996 1/

(Metric tons)

Country	Gross weight	Contained weight	Value
Ferrosilicon:			
More than 55% silicon:			
Australia	49	34	$81,100
Brazil	164	99	224,000
Canada	8,150	4,890	6,490,000
Germany	82	57	115,000
Japan	18	11	22,800
Korea, Republic of	887	532	789,000
Malaysia	50	38	79,200
Mexico	3,020	1,890	2,670,000
Venezuela	27	16	22,500
Total	12,400	7,560	10,500,000
Other ferrosilicon:			
Australia	1,720	860	1,600,000
Canada	10,700	5,340	8,420,000
China	413	240	598,000
India	1,660	829	2,990,000
Japan	4,840	2,420	8,030,000
Korea, Republic of	1,180	588	1,450,000
Mexico	1,670	827	1,560,000

See footnotes at end of table.

TABLE 5--Continued
U.S. EXPORTS OF FERROSILICON AND SILICON METAL, BY GRADE AND COUNTRY, IN 1996 1/

(Metric tons)

Country	Gross weight	Contained weight	Value
Other ferrosilicon--Continued:			
Taiwan	238	119	280,000
Turkey	394	197	395,000
United Kingdom	15,100	7,560	8,670,000
Other	1,360	681	1,570,000
Total	39,300	19,700	35,600,000
Total ferrosilicon	51,700	27,200	46,100,000
Metal:			
More than 99.99% silicon:			
China	77	77	$3,350,000
Denmark	45	45	3,810,000
Germany	79	79	4,180,000
Italy	50	50	1,140,000
Japan	1,450	1,450	88,900,000
Korea, Republic of	633	633	27,700,000
Malaysia	179	179	45,100,000
Netherlands	39	39	1,840,000
Poland	31	31	1,380,000
Taiwan	50	50	1,980,000
Other	122	122	8,330,000
Total	2,750	2,750	188,000,000
99.00% - 99.99% silicon:			
Belgium	18	18	25,200
Germany	24	23	50,700
Ghana	118	117	229,000
Israel	335	332	786,000
Japan	307	305	854,000
Korea, Republic of	1,320	1,310	1,860,000
Malaysia	2,270	2,250	3,200,000
Mexico	267	265	441,000
Trinidad and Tobago	200	198	138,000
United Kingdom	283	280	399,000
Other	44	43	63,200
Total	5,180	5,140	8,050,000
Other silicon:			
Australia	185	179	257,000
Canada	3,260	3,170	3,440,000
China	492	478	660,000
Germany	344	334	499,000
Hong Kong	258	250	347,000
Japan	969	940	2,130,000
Korea, Republic of	363	352	633,000
Mexico	1,130	1,100	1,870,000
Taiwan	1,180	1,140	1,630,000
United Kingdom	267	260	384,000
Other	627	609	1,350,000
Total	9,080	8,820	13,200,000
Total silicon metal	17,000	16,700	209,000,000

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

Source: Bureau of the Census.

TABLE 6
U.S. IMPORTS FOR CONSUMPTION OF FERROSILICON AND SILICON METAL, BY GRADE AND COUNTRY, IN 1996 1/

(Metric tons)

Country	Gross weight	Contained weight	Value
Ferrosilicon:			
55% - 80% silicon, more than 3% Ca:			
Canada	1	1	$1,590
Egypt	708	517	620,000
France	330	204	466,000
United Kingdom	27	19	155,000
Total	1,070	740	1,240,000
55% - 80% silicon, Other:			
Brazil	18,400	14,000	16,100,000
Canada	4,800	3,630	4,350,000
Egypt	9,480	6,750	8,010,000
Iceland	33,400	25,300	29,800,000
Italy	4,400	3,280	3,660,000
Macedonia	6,750	5,060	5,610,000
Norway	76,000	57,300	71,800,000
Poland	11,600	8,660	9,740,000
Romania	4,000	3,000	3,320,000
South Africa	3,590	2,750	3,230,000
Other	7,910	5,900	8,760,000
Total	180,000	136,000	164,000,000
80% - 90% silicon:			
Argentina	1,720	1,390	1,530,000
Canada	19	15	12,800
Total	1,740	1,400	1,540,000
More than 90% silicon:			
Italy	95	91	111,000
Romania	82	77	94,900
Total	177	168	206,000
Magnesium ferrosilicon:			
Brazil	5,010	2,300	4,840,000
Canada	1,620	772	1,330,000
China	72	19	73,400
Germany	66	33	172,000
Japan	132	55	285,000
Norway	2,010	926	2,530,000
Total	8,910	4,100	9,230,000
Other ferrosilicon:			
Brazil	390	184	439,000
Canada	10,700 2/	3,170	5,790,000
China	999 3/	150	120,000
Egypt	2,260	1,190	823,000
Mexico	1	(4/)	1,300
Norway	1,310	647	1,010,000
Poland	1,210	588	594,000
South Africa	9	2	7,550
United Kingdom	5	2	18,700
Total	16,900	5,930	8,810,000
Total ferrosilicon	209,000	148,000	185,000,000

See footnotes at the end of table.

TABLE 6--Continued
U.S. IMPORTS FOR CONSUMPTION OF FERROSILICON AND SILICON METAL, BY GRADE AND COUNTRY, IN 1996 1/

(Metric tons)

Country	Gross weight	Contained weight	Value
Metal:			
More than 99.99% silicon:			
Australia	40	40	$78,800
China	39	39	6,400,000
Germany	725	725	38,900,000
Italy	183	183	18,700,000
Japan	249	249	11,100,000
Korea, Republic of	185	185	9,750,000
Russia	24	24	3,680,000
Taiwan	12	12	576,000
Ukraine	12	12	609,000
United Kingdom	33	33	1,750,000
Other	16	16	788,000
Total	1,520	1,520	92,400,000
99.00% - 99.99% silicon:			
Australia	3,810 5/	3,760	5,970,000
Brazil	10,300 6/	9,700	17,300,000
Canada	12,800	12,700	20,000,000
China	183	181	230,000
France	6,930	6,880	11,900,000
India	1,130	1,120	1,860,000
Norway	2,010	2,000	3,870,000
Romania	492	489	596,000
South Africa	1,280	1,270	1,910,000
Spain	860	852	1,390,000
Other	185	184	404,000
Total	40,000	39,100	65,400,000
Other silicon:			
Brazil	618	595	1,010,000
Canada	779	761	1,280,000
China	3,210 7/	3,020	3,860,000
India	1,130	1,090	1,880,000
Japan	282	270	355,000
Macedonia	1,100	1,080	1,830,000
Romania	344	336	459,000
Russia	27,900 8/	26,100	38,600,000
South Africa	3,510	3,440	4,830,000
Spain	397	389	632,000
Other	1,080 9/	995	1,630,000
Total	40,300	38,100	56,400,000
Total silicon metal	81,800	78,800	214,000,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Contains 4,130 tons of material with silicon content not yet verified.
3/ Silicon content of material not yet verified.
4/ Less than ½ unit.
5/ Contains 220 tons of material with silicon content not yet verified.
6/ Contains 540 tons of material with silicon content not yet verified.
7/ Contains 125 tons of material with silicon content not yet verified.
8/ Contains 1,230 tons of material with silicon content not yet verified.
9/ Contains 398 tons of material with silicon content not yet verified.

Source: Bureau of the Census.