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2016 Minerals Yearbook

FERROALLOYS [ADVANCE RELEASE]

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Ferroalloys

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U.S. production of bulk ferroalloys in 2016 decreased by 13% to 369,000 metric tons (t) from 424,000 t in 2015. Estimated production (consumption minus imports plus exports, not including stock changes) of noble ferroalloys in 2016 decreased by 8% to 19,400 t from 21,100 t in 2015 (table 1). Ferroalloy exports increased by 6% to 37,200 t in 2016 compared with 35,200 t in 2015 (table 7). Ferroalloy imports decreased by 4% to 1,260,000 t compared with a revised value of 1,310,000 t in 2015, based on U.S. Census Bureau trade data for ferroalloys (table 8). World production of total ferroalloys was estimated to be 63.1 million metric tons (Mt) in 2016, a slight decrease compared with the revised amount of 64.3 Mt in 2015 (table 9). Among the bulk ferroalloys, China was the leading producing country for ferrochromium, ferromanganese, ferrosilicon, and silicomanganese. Kazakhstan was the leading ferrosilicon-chromium-producing country in 2016. Of the noble ferroalloys, China was the leading producing country for ferromolybdenum, ferronickel, and ferrovanadium; Brazil was the leading producing country for ferroniobium. Russia was the leading producing country for ferrophosphorus and ferrotitanium. India was the only country that produced ferrosilicomagnesium in 2016.

Ferroalloys are alloys of iron with one or more other elements that are added to metal melts during the production of steel. They are used to impart distinctive qualities to steel or to serve important functions during steel refining, such as control of inclusions, corrosion resistance, desulfurization, and heat strength.

Ferroalloys can be subdivided into bulk ferroalloys and noble ferroalloys (also referred to as special or specialty ferroalloys). Bulk ferroalloys are produced in large quantities and include ferrochromium (including ferrosilicon-chromium), ferromanganese, ferrosilicon, and silicomanganese (also known as ferrosilicomanganese or ferrosilicon-manganese). Noble ferroalloys are produced in smaller quantities and typically include ferroaluminum, ferroboron, ferromolybdenum, ferronickel, ferroniobium, ferrophosphorus, ferrosilicomagnesium, ferrosilicon-titanium and ferrotitanium, ferrosilicon-tungsten and ferrotungsten, ferrovanadium, and ferrozirconium, among others.

Legislation and Government Programs

Stockpile.—The Defense Logistics Agency Strategic Materials (DLA Strategic Materials), U.S. Department of Defense, administered disposals of ferrochromium and ferromanganese materials from the National Defense Stockpile (NDS) under its fiscal year 2016 (October 1, 2015, through September 30, 2016) Annual Materials Plan (AMP). Maximum disposal limits were set at 21,319 t of ferrochromium and 45,359 t of ferromanganese (Defense Logistics Agency Strategic Materials, 2015a). The DLA Strategic Materials announced potential acquisitions of ferroniobium for the NDS under the 2016 AMP. The maximum acquisition limit was 104.5 t of ferroniobium (Defense Logistics Agency Strategic Materials, 2015b).

Production

In 2016, 11 companies in the United States produced seven ferroalloys at 13 plants (table 2). Domestic data for ferroalloy materials were collected by the USGS by means of the "Consolidated Consumers' Report," "Manganese Ore and Products," "Silicon Alloys," "Specialty Ferroalloys," and "Vanadium" surveys.

Production of bulk ferroalloys in 2016 decreased by 13% to 369,000 t from 424,000 t in 2015. Apparent production of noble ferroalloys in 2016 decreased by 8% to 19,400 t from a revised 21,100 t in 2015 (table 1). Unlike previous years, trends of ferroalloy production did not closely follow those of crude steel, for which domestic production decreased only slightly to 78.5 Mt in 2016 from 78.8 Mt in 2015 (Fenton, 2018).

World production of bulk ferroalloys decreased by 3%, and production of noble ferroalloys was essentially unchanged in 2016 (table 1).

Consumption

U.S. reported consumption, by gross weight, of bulk ferroalloys in 2016 decreased by 2% to 1.15 Mt from 1.18 Mt in 2015 (table 1). Consumption of ferrochromium decreased slightly, and ferrosilicon consumption decreased by 6%. Ferromanganese consumption was essentially unchanged in 2016 compared with 2015, whereas silicomanganese consumption increased slightly (table 4). U.S. reported consumption, by gross weight, of noble ferroalloys decreased by 6% to 59,500 t in 2016 compared with 63,200 t (revised) in 2015 (table 1). Among the noble ferroalloys, on a contained-weight basis, ferrotungsten consumption decreased by 43%, ferromolybdenum decreased by 9%, ferronickel decreased by 4%, ferrovanadium decreased by 3%, and ferroniobium decreased slightly. On a gross-weight basis, ferrophosphorus consumption increased slightly, whereas ferroboron decreased by 7% and ferrotitanium decreased slightly (table 5).

Prices

The average prices for bulk ferroalloys varied in 2016. The annual average prices for grades of low-carbon ferrochromium decreased by 4% for ferrochromium with 0.05% carbon content, by 13% for 0.10% carbon, and by 13% for 0.15% carbon compared with those in 2015 (table 6). The average prices for high-carbon ferrochromium in 2016 decreased by 13% for charge-chrome ferrochromium (47% to 55% chromium) and by 12% for high-grade ferrochromium (60% to 70% chromium) compared with prices in 2015 (table 6). The average

U.S. spot-market prices for medium-carbon ferromanganese and high-carbon ferromanganese decreased by 14% and 3%, respectively, compared with prices in 2015. The annual average silicomanganese price decreased by 13%. Average prices for 50%-grade ferrosilicon and 75%-grade ferrosilicon decreased by 18% and 20%, respectively, from those in 2015.

For the noble ferroalloys, the 2016 annual average price of ferromolybdenum decreased by 5%, and the ferrotungsten price decreased slightly. The ferrovanadium price increased slightly, and the 70%-grade ferrotitanium price decreased by 28%. The average annual price of nickel metal with 99.81% minimum purity decreased by 19% (table 6).

Foreign Trade

The United States was a net importer of ferroalloys in 2016 (table 1). On a gross-weight basis, U.S. total bulk ferroalloy imports decreased by 3% and noble ferroalloy imports decreased by 10% compared with imports in 2015 (table 8). U.S. total bulk ferroalloy exports were essentially unchanged compared with exports in 2015. Exports of chromium ferroalloys increased by 43%, manganese ferroalloys increased by 41%, and silicon ferroalloys decreased by 19% compared with exports in 2015 (table 7). Exports of noble ferroalloys increased by 19% compared with exports in 2015. Exports of ferrophosphorus decreased by 53%, ferrozirconium by 51%, ferromolybdenum by 20%, ferrotungsten and ferrosilicon-tungsten by 19%, and ferrotitanium and ferrosilicon-titanium decreased slightly. Exports of ferrovanadium increased by 227%, ferronickel by 5%, and ferroniobium by 2% (table 7).

Ferroalloy Review

Ferroboron.—Boron is added to steel to improve creep properties, increase hardenability (the depth to which steel is hardened upon quenching at high temperatures), and promote neutron absorption, which is critical in advanced technology fields such as atomic power. Ferroboron is typically added to alloy steels, high-strength low-alloy steels, structural steels, and stainless steels for use in the nuclear industry.

Boron occurs in nature as borates, such as borate minerals (for example, borax) and borosilicates. Borate ore is smelted in electric arc furnaces, along with aluminum and iron oxide, to produce ferroboron. The United States did not produce ferroboron in 2016 and relied on imports. There is no specific Harmonized Tariff Schedule of the United States code for ferroboron; as such, exact import quantities were not available. India reported ferroboron production in previous years, but no ferroboron production was reported in 2016 (table 9).

Ferrochromium.—Chromium is added to steel to impart corrosion and oxidation resistance, improve wear resistance, increase hardenability, and promote strength at elevated temperatures. The primary end uses for ferrochromium and ferrosilicon-chromium are stainless and heat-resisting steels. Chromium is an essential component in all stainless steel. To a lesser extent, chromium is used in tool steels, superalloys, and other specialty metals. Chromite ore is the mineral source of chromium and is smelted in electric arc furnaces to produce ferrochromium for the metallurgical industry.

In 2016, world stainless and heat-resisting steel melt shop production—ingot and (or) slab equivalent—was 45.8 Mt (International Stainless Steel Forum, 2017, p. 8). U.S. stainless steel production was reported to be 2.5 Mt, an increase of 6% from that of 2015 (American Iron and Steel Institute, 2015, 2016). The United States did not produce ferrochromium and imported 480,000 t (gross weight) of ferrochromium, including ferrosilicon-chromium, an increase of 18% from imports in 2015 (table 8).

Countries that led stainless-steel production, listed in descending order, were China, India, Japan, and the United States. The leading countries for ferrochromium production were China (38%), South Africa (30%), and Kazakhstan (12%) (table 9).

Ferromanganese and Silicomanganese.—Two manganese ferroalloys, ferromanganese and silicomanganese, are key ingredients in steelmaking. Ferromanganese and silicomanganese act as desulfurizing and deoxidizing agents and increase hardenability. Steelmaking was the leading end use of manganese ferroalloys in the United States in 2016, with carbon and high-strength low-alloy steels as the primary end products (table 4). To produce ferromanganese, manganese ore is mixed with carbon and iron ore and then smelted in electric arc furnaces or, less frequently, blast furnaces. The production of silicomanganese is similar, but silicon is included in the melt to increase the deoxidation properties of the steel. Other elements can be added depending on the requested specifications for the final steel product.

Manganese ferroalloys were produced by two companies in the United States; production was withheld to avoid disclosing company proprietary data (table 2). In 2016, 494,000 t (gross weight) of ferromanganese and silicomanganese were imported, a decrease of 17% from imports in 2015 (table 8). The leading countries for manganese-ferroalloy production were China (57%), followed by India (13%) and Ukraine (5%) (table 9).

Ferromolybdenum.—Molybdenum is added to steel to improve corrosion resistance, increase hardenability, and promote strength at high temperatures. The primary products in which ferromolybdenum is used include alloy and stainless steels, alloy cast irons, carbon steel, and superalloys. Molybdenite is mined from primary ores, such as porphyry molybdenum deposits, or obtained as a byproduct from other ores, such as copper ore from porphyry copper deposits. Molybdenite ore is concentrated and roasted to form molybdic oxide, which can then be converted into ferromolybdenum, molybdenum chemicals, or molybdenum metal. Molybdic oxide is easily reduced to metal in an electric arc furnace, which has been a driving reason for the increased use of the oxide over the ferroalloy. Molybdenum can also be recovered from alloy scrap.

The United States produced ferromolybdenum at two facilities and imported 2,750 t (gross weight) of ferromolybdenum in 2016, an increase of 16% from 2015 imports (tables 2, 8). More than one-half of the world's ferromolybdenum was produced in China. The remainder was produced in Armenia, India, and Japan, both for the domestic steel industry and for export (table 9).

Ferronickel.—Nickel is added to steel to increase atmospheric corrosion resistance and hardenability, as well as promote solid-solution strengthening and strength at low temperatures. Cryogenic steels, stainless steels, superalloys,

ultrahigh-strength steels, and wrought steels are the primary products that incorporate ferronickel, with stainless steel as the leading end use.

Nickel ore is mined from laterites and smelted in electric arc furnaces to produce ferronickel. The United States did not produce ferronickel and imported 38,800 t (gross weight) of ferronickel in 2016, a decrease of 9% from imports in 2015 (table 8). China and Indonesia were the only countries that produced nickel pig iron, a nickel-iron alloy containing less than 15% nickel. Nickel pig iron is a low-grade product with 4% to 13% nickel relative to conventional ferronickel grades, which range from 18% to 80% nickel. After accounting for nickel content in nickel pig iron, China was the leading ferronickel producer in 2016, with one-half of world production, and Indonesia was estimated to account for 13% of production. Japan, New Caledonia, and Brazil were the next leading producers of ferronickel, with 9%, 7%, and 6% of ferronickel production, respectively (table 9).

Ferroniobium.—Niobium is a microalloying element added to steel to improve toughness, improve wear resistance, increase yield strength, and retain grain size at elevated temperatures. Low-temperature structural steels, rebar, stainless steels, and superalloys were the primary ferroniobium products in 2016. Niobium does not occur naturally as a metal and is concentrated from the mineral pyrochlore, which is found in carbonatite deposits in zoned alkaline igneous complexes. Niobium concentrates are smelted in electric arc furnaces to produce ferroniobium for ferrous and nonferrous metallurgical uses. The United States produced ferroniobium at one facility and imported 9,350 t (gross weight) of ferroniobium in 2016 (tables 2, 8). Brazil (50,000 t), Canada (10,355 t), and Russia (500 t) were the only other countries that produced ferroniobium in 2016.

Ferrophosphorus.—Although phosphorus is typically considered an impurity in iron ores, it is sometimes added to steel as ferrophosphorus to improve atmospheric corrosion resistance, machinability, and strength. Ferrophosphorus is produced from iron ore slag as a byproduct during steel manufacturing and is used primarily in high-strength low-alloy steel. The United States did not produce ferrophosphorus in 2016 and imported 5,550 t (gross weight), which was a 10% decrease from imports in 2015 (table 8). Most of the imports (96%) came from China, with Sweden (3%), Japan (1%), the United Kingdom (less than 1%), and Canada (less than 1%) as the other sources. Russia was the only country with estimated ferrophosphorus production (3,500 t). Ferrophosphorus was thought to have been produced in other countries; however, production information was inadequate to make reliable estimates of output (table 9).

Ferrosilicon.—Silicon is added to steel to improve high-temperature oxidation resistance, increase hardenability, and promote solid-solution strengthening. Automotive engine steels, electrical steels, heat-treatable and resisting steels, and ultrahigh-strength steels were the primary products for ferrosilicon use. Quartz sand and quartzite are the primary sources for silica, which is smelted in submerged electric arc furnaces to produce ferrosilicon for the ferrous and nonferrous metallurgical industries. The United States produced ferrosilicon at three facilities and imported 222,000 t (gross weight) in 2016 (tables 2, 8). Excluding the United States, China was the leading silicon-ferroalloy-producing country, with 63% of world production, followed by Russia (15%) and Norway (5%) (table 9).

Ferrotitanium.—Titanium is added to steel to act as a decarbonizing, denitrogenizing, deoxidizing, and desulfurizing agent and to promote grain refinement. High-strength low-alloy steels, maraging steels, and stainless steels were the primary end products for ferrotitanium use. Ferrotitanium is typically produced by induction melting of titanium scrap with iron or steel; however, it can also be produced directly from smelting titanium mineral concentrates produced from the minerals rutile and ilmenite. Ferrotitanium grades are 30% and 70% titanium.

The United States produced ferrotitanium at two facilities and imported 3,140 t (gross weight) of ferrotitanium in 2016, an 81% increase from imports in 2015 (tables 2, 8). Alcoa Inc. acquired RTI International Metals, Inc. in 2015, adding the production of ferrotitanium to its portfolio (Arconic Inc., 2015). In 2016, Alcoa Inc. separated into two companies—Alcoa Corp. and Arconic Inc. Arconic received the downstream assets focused on products for the aerospace and automobile industries, which included ferrotitanium production (Alcoa Inc., 2015; Arconic Inc., 2016). Russia (10,741 t) and India (231 t) were the only other countries that reported ferrotitanium production (table 9).

Ferrotungsten.—Tungsten is added to steel to improve hot hardness, increase wear resistance, and promote strength at high temperatures. The primary products in which ferrotungsten is used include high-speed and other tool steels and, to a lesser extent, some high-temperature stainless steels and high-temperature structural steels. Tungsten can be added to steel melts as ferrotungsten, a master alloy containing between 75% and 85% tungsten; a tungsten melting base, which is a master alloy containing up to 38% tungsten; scheelite ore concentrates; or tungsten metal scrap. Ferrotungsten can be produced from calcium tungstate (artificial scheelite); concentrates of the minerals scheelite or wolframite, which contain tungsten; high-grade tungsten ore; or soft scrap. To produce ferrotungsten, tungsten materials are reduced by aluminothermic or silicothermic reactions or smelted in electric arc furnaces, a metallothermic process using silicon and (or) aluminum, or a combination of carbothermic and metallothermic processes (Lassner and Schubert, 1999, p. 307–312; Roskill Information Services Ltd., 2014, p. 234–238).

The United States did not produce ferrotungsten or ferrosilicon-tungsten in 2016 and imported 328 t (gross weight) of ferrotungsten, an 11% decrease from imports in 2015 (table 8). Vietnam was the leading import source with 176 t, and China supplied 128 t of imports. Although no world production of ferrotungsten was reported in 2016, China has been responsible for most ferrotungsten production in recent years (Seddon, 2014, p. 16–20). Ferrotungsten has also been produced in Brazil, Germany, India, the Republic of Korea, Russia, Sweden, and Vietnam, but available information was inadequate to make reliable estimates of output.

Ferrovanadium.—Vanadium is primarily used to increase hardenability in steel, promote fine grain size at high temperatures, and improve wear resistance. High-strength

low-alloy steels, structural and engineering alloy steels, and tool and die steels are the primary end uses for ferrovanadium. Vanadium, recovered as a byproduct of processing titanium-bearing magnetite or from recycling titanium-bearing materials, is smelted with iron oxides in electric arc furnaces to produce ferrovanadium. Secondary vanadium can be produced from various industrial waste materials, such as petroleum residues, pig iron slag, spent catalysts, and vanadium-bearing coal ash.

Secondary vanadium was the primary source of U.S. ferrovanadium production in 2016. In the United States, ferrovanadium was produced at two facilities and 2,220 t (gross weight) was imported, a 17% decrease compared with imports in 2015 (tables 2, 8). China produced an estimated 30,600 t of ferrovanadium in 2016 and was the leading producer worldwide, with an estimated 52% of global ferrovanadium production (excluding production in the United States). South Africa (with an estimated 13,000 t) and Russia (with an estimated 9,000 t) were also leading producers of ferrovanadium (table 9).

Ferrozirconium.—Zirconium is added to steel to act as a denitrogenizing and deoxidizing agent. In addition, zirconium is used to control sulfide inclusions. High-strength low-alloy steels and several nonferrous alloys are the primary products that use ferrozirconium. Zirconium is most commonly obtained from the mineral zircon, which is recovered as a byproduct or coproduct of heavy-mineral-sand mining and processing. Zirconium is added to the ladle or ingot molds during steel manufacturing to produce ferrozirconium-bearing steels. In 2016, the United States did not produce ferrozirconium and imported 59 t (gross weight), a decrease of 63% from imports in 2015 (table 8). Ferrozirconium may have been produced in China and Canada, but production information was inadequate to make reliable estimates of output.

Outlook

Domestic consumption of ferroalloys was expected to follow closely the trend in U.S. steel production. Global steel consumption increased slightly to 1.52 billion metric tons (Gt) in 2016, and consumption was expected to increase to 1.62 Gt in 2017 and 1.65 Gt in 2018 (World Steel Association, 2017, p. 9).

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GENERAL SOURCES OF INFORMATION

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Manganese. Ch. in Minerals Yearbook, annual
Molybdenum. Ch. in Minerals Yearbook, annual
Niobium. Ch. in Minerals Yearbook, annual
Silicon. Ch. in Minerals Yearbook, annual
Titanium. Ch. in Minerals Yearbook, annual
Tungsten. Ch. in Minerals Yearbook, annual

TABLE 1
SALIENT FERROALLOYS STATISTICS[1]

(Metric tons, gross weight)

	2012	2013	2014	2015	2016
United States:					
Bulk ferroalloys:[2]					
Production	564,000	503,000 r	517,000	424,000	369,000
Consumption	1,440,000	1,270,000	1,230,000	1,180,000	1,150,000
Exports	37,200 r	30,700 r	29,500	24,200	24,100
Imports for consumption	1,550,000 r	1,400,000 r	1,730,000	1,240,000	1,200,000
Noble ferroalloys:					
Production[3]	16,300	18,300 r	15,100	21,100 r	19,400
Consumption	68,900	58,400	68,600	63,200 r	59,500
Exports	12,300	11,600 r	15,700	10,900 r	13,100
Imports for consumption	80,400 r	90,800 r	115,000	76,700	69,300
World production:					
Bulk ferroalloys	36,400,000 r	38,000,000 r	38,900,000 r	37,000,000 r	35,900,000
Noble ferroalloys	14,500,000 r	19,000,000 r	27,600,000 r	27,200,000 r	27,200,000

rRevised.
[1]Table includes data available through June 26, 2019. Data are rounded to no more than three significant digits.
[2]Bulk ferroalloys data for the United States include ferromanganese, ferrosilicon, and silicomanganese.
[3]Noble ferroalloys production data for the United States include ferromolybdenum, ferroniobium, ferrotitanium, and ferrotungsten. Calculated as consumption minus imports plus exports; only for noble ferroalloys with production in the United States.

TABLE 2
DOMESTIC PRODUCERS OF FERROALLOYS IN 2016, BY U.S. CENSUS BUREAU REGION

		Products[1]						
		Bulk ferroalloys			Noble ferroalloys			
Region and company	Plant location	FeMn	SiMn	FeSi	FeMo	FeTi	FeV	FeNb
Midwest:								
AMG Vanadium, Inc.	Cambridge, OH						X	
Arconic Inc.	Canton, OH					X		
Eramet Marietta Inc.	Marietta, OH	X	X					
Global Titanium Inc.	Detroit, MI					X		
Globe Metallurgical, Inc.	Beverly, OH			X				
Northeast:								
Centerra Gold Inc.	Langeloth, PA				X			
Reading Alloys Inc.	Robesonia, PA							X
Yilmaden Holding Inc.	Butler, PA				X		X	
South:								
CC Metals & Alloys, LLC	Calvert City, KY			X				
Core Metals Group, LLC	Bridgeport, AL			X				
Felman Production, LLC	Letart, WV		X					

[1]Abbreviations are as follows: FeMn, ferromanganese; SiMn, silicomanganese; FeSi, ferrosilicon; FeMo, ferromolybdenum; FeTi, ferrotitanium; FeV, ferrovanadium; FeNb, ferroniobium.

TABLE 3
GOVERNMENT INVENTORY OF FERROALLOYS[1, 2]

(Metric tons, gross weight)

Alloy	Inventory
Ferrochromium:	
High-carbon	57,400
Low-carbon	30,700
Ferromanganese, high-carbon	224,000
Ferroniobium	39

[1]Table includes data available through June 26, 2019. Data are rounded to no more than three significant digits.
[2]Inventory as of December 31, 2016.

Source: Defense Logistics Agency Strategic Materials.

TABLE 4
REPORTED U.S. CONSUMPTION OF BULK FERROALLOYS BY END USE[1, 2]

(Metric tons, gross weight)

End use	FeCr	FeMn	SiMn	FeSi
2015:				
Steel:				
Carbon and high-strength low-alloy	6,620	270,000	99,500	34,500 [r]
Stainless and heat-resisting	378,000	9,830	15,600	44,700 [r]
Unspecified and other steels	38,000	56,800	19,700	98,000 [r]
Total steel	423,000	336,000	135,000	177,000
Alloys and superalloys	7,280	(3)	(3)	(3)
Cast irons	(3)	6,890	230	81,300 [r]
Miscellaneous and unspecified	5,440	510 [r]	2,590	1,590 [r]
Grand total	436,000	344,000	138,000 [4]	260,000
Consumer stocks, December 31	13,700	21,100 [5]	20,800 [5]	11,200
2016:				
Steel:				
Carbon and high-strength low-alloy	6,770	268,000	99,400	71,100
Stainless and heat-resisting	366,000	9,820	15,600	44,200
Unspecified and other steels	36,000	57,300	20,800	59,300
Total steel	409,000	335,000	136,000	175,000
Alloys and superalloys	11,800	(3)	(3)	(3)
Cast irons	(3)	6,620	164	70,000
Miscellaneous and unspecified	5,280	553	2,700	839
Grand total	426,000	342,000	139,000 [4]	245,000
Consumer stocks, December 31	13,800	20,800 [5]	10,400 [5]	10,600

[r]Revised.
[1]Table includes data available through June 26, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]FeCr, ferrochromium, including chromium metal; FeMn, ferromanganese; SiMn, silicomanganese; and FeSi, ferrosilicon, silvery pig iron, silicon carbide, and inoculant alloys.
[3]All or part included with "Miscellaneous and unspecified."
[4]Internal evaluation indicates that silicomanganese consumption is understated.
[5]Consumer and producer stocks.

TABLE 5
REPORTED U.S. CONSUMPTION OF NOBLE FERROALLOYS BY END USE[1, 2]

(Metric tons, contained weight, unless otherwise noted)

End use	FeMo	FeNb	FeNi	FeV	FeW	FeB[3]	FeP[3]	FeTi[3]
2015:								
Steel:								
Carbon	(4)	1,280	--	721	--	(4) r	(4) r	5,380
High-strength low-alloy	106	800	--	(4)	--	(4) r	(4) r	(4) r
Stainless and heat-resisting	682	712	13,500 r	61	(4)	206	(4)	(4) r
Unspecified and other steels	2,510 r	3,080	30	2,300	227	425 r	4,320 r	1,790 r
Total	3,290 r	5,870	13,500 r	3,080	227	631	4,320	7,180 r
Alloys and superalloys	(5)	1,640	91 r	6	(4)	(5) r	(5)	20 r
Cast irons	330	--	--	(5)	--	(5) r	(5)	7 r
Miscellaneous and unspecified	130 r	--	166 r	8	--	88 r	408 r	124 r
Grand total	3,760	7,510	13,800 r	3,090	227	719 r	4,730	7,330 r
Consumer stocks, December 31	357	372 r	W	148	35	170	489	851
2016:								
Steel:								
Carbon	(4)	1,180	--	697	--	(4)	(4)	5,510
High-strength low-alloy	103	680	--	(4)	--	(4)	(4)	(4)
Stainless and heat-resisting	674	615	13,200	61	(4)	206	(4)	(4)
Unspecified and other steels	2,200	3,100	28	2,230	130	434	4,400	1,600
Total	2,970	5,580	13,200	2,990	130	640	4,400	7,110
Alloys and superalloys	(5)	1,790	W	6	(4)	(5)	(5)	21
Cast irons	329	--	--	(5)	--	(5)	(5)	7
Miscellaneous and unspecified	113	--	W	7	--	31	389	125
Grand total	3,410	7,370	13,200	3,000	130	671	4,790	7,260
Consumer stocks, December 31	360	390	W	144	39	163	466	935

rRevised. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Table includes data available through June 26, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]FeMo, ferromolybdenum, including calcium molybdate; FeNb, ferroniobium, including nickel niobium; FeNi, ferronickel; FeV, ferrovanadium, including other vanadium-carbon-iron ferroalloys; FeW, ferrotungsten; FeB, ferroboron, including other boron materials; FeP, ferrophosphorus, including other phosphorus materials; and FeTi, ferrotitanium, including titanium scrap and other titanium materials.

[3]Gross weight.

[4]Withheld to avoid disclosing company proprietary data; included with "Steel, unspecified and other steels."

[5]Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."

TABLE 6
SELECTED DOMESTIC FERROALLOY PRICES[1]

(Contained weight basis)

Alloy	Unit[2]	2015			2016		
		High[3]	Low[3]	Average[4]	High[3]	Low[3]	Average[4]
Bulk ferroalloys:							
Ferrochromium:							
0.05% carbon	¢/lb	XX	XX	228.30	XX	XX	219.98
0.10% carbon	do.	XX	XX	210.20	XX	XX	183.55
0.15% carbon	do.	XX	XX	207.82	XX	XX	181.10
Over 4% carbon:							
47–55% chromium	do.	XX	XX	105.71 r	XX	XX	92.43
60–70% chromium	do.	XX	XX	108.47	XX	XX	95.37
Manganese ferroalloys:							
85% medium-carbon ferromanganese	do.	98.00	82.00	93.49	96.00	76.00	80.80
76% high-carbon ferromanganese	$/lt	1,080.00	790.00	915.36	1,450.00	760.00	888.83
65% silicomanganese	¢/lb	58.00	36.00	49.60	72.00	34.00	43.37
Silicon ferroalloys:							
50% ferrosilicon	do.	102.91 r	99.47 r	101.19 r	84.70	80.70	82.70
75% ferrosilicon	do.	89.15 r	86.77 r	88.11 r	71.90	69.68	70.76
Nickel metal, 99.81% (minimum) purity[5]	do.	6.70 r	3.94 r	5.37 r	5.05	3.77	4.35
Noble ferroalloys:							
Ferromolybdenum	$/lb	10.78 r	6.05 r	8.14	8.97	6.55	7.74
Ferrotitanium, 70%-grade	do.	3.10	1.90 r	2.51 r	2.10	1.60	1.81
Ferrotungsten	$/kg	37.00	22.00	30.21	42.00	22.00	29.88
Ferrovanadium	$/lb	12.25 r	6.19 r	9.20 r	11.09	5.95	9.29

rRevised. do. Ditto. XX Not applicable.
[1]Table includes data available through June 26, 2019.
[2]Abbreviations are as follows: ¢/lb, cents per pound; $/kg, dollars per kilogram; $/lt, dollars per long ton; and $/lb, dollars per pound.
[3]For some commodities, high and low prices are averages of monthly prices.
[4]Arithmetic mean of weekly or monthly prices.
[5]Nickel metal prices are reported in gross weight.

Sources: London Metal Exchange, Platts Metals Week, and CRU Group.

TABLE 7
U.S. EXPORTS OF FERROALLOYS[1]

Alloy	2015 Gross weight (metric tons)	2015 Contained weight (metric tons)	2015 Value (thousands)	2016 Gross weight (metric tons)	2016 Contained weight (metric tons)	2016 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	723	354	$1,020	675	374	$1,030
Not more than 4% carbon	279	154	717	800	421	1,310
Ferrosilicon-chromium	73	26	85	61	21	64
Total, chromium ferroalloys	1,070 r	534 r	1,820	1,540	816	2,400
Manganese ferroalloys:						
Ferromanganese, all grades	5,140	4,060	5,630	6,580	5,200	6,850
Silicomanganese	1,220	721	1,340	2,410	1,560	2,290
Total, manganese ferroalloys	6,370 r	4,780	6,970	8,990	6,760	9,130
Silicon ferroalloys:						
Ferrosilicon, more than 55% silicon	5,760	3,580	11,800	4,670	2,860	8,840
Ferrosilicon, other	11,000	5,220 r	19,500	8,920	4,250	14,600
Total, silicon ferroalloys	16,800	8,800 r	31,400	13,600	7,110	23,400
Total, bulk ferroalloys	24,200	14,100	40,100	24,100	14,700	35,000
Noble ferroalloys:						
Ferromolybdenum	810 r	565 r	15,000 r	650	455	13,300
Ferronickel	198	118	3,270	207	123	3,400
Ferroniobium	2,140	XX	26,300	2,180	XX	25,500
Ferrophosphorus	976	XX	1,760	463	XX	855
Ferrotitanium and ferrosilicon-titanium	2,250 r	XX	9,520 r	2,210	XX	6,670
Ferrotungsten and ferrosilicon-tungsten	57	29	102	46	23	308
Ferrovanadium	163	122	3,190	533	400	7,280
Ferrozirconium	973	XX	2,330	476	XX	839
Ferroalloys, other	3,380	XX	9,530	6,300	XX	11,600
Total, noble ferroalloys	10,900 r	834 r	71,000 r	13,100	1,000	69,800
Grand total	35,200 r	15,000	111,000	37,200	15,700	105,000

rRevised. XX Not applicable.
[1]Table includes data available through June 26, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF FERROALLOYS[1]

Alloy	2015 Gross weight (metric tons)	2015 Contained weight (metric tons)	2015 Value (thousands)	2016 Gross weight (metric tons)	2016 Contained weight (metric tons)	2016 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	348,000	189,000	$356,000	414,000	224,000	$327,000
More than 3% but not more than 4% carbon	2,590	1,320	2,180	11,400	5,740	8,410
More than 0.5% but not more than 3% carbon	3,960	2,660	9,650	7,480	4,750	15,400
Not more than 0.5% carbon	48,300	32,800	141,000	39,700	26,900	106,000
Ferrosilicon-chromium	5,810	2,240	8,020	7,300	4,780	10,000
Total, chromium ferroalloys	408,000	228,000	517,000	480,000	266,000	467,000
Manganese ferroalloys:						
Ferromanganese:						
More than 4% carbon	175,000	132,000	153,000	130,000	91,300	91,500
More than 2% but not more than 4% carbon	608	479	1,470	374	294	320
More than 1% but not more than 2% carbon	65,100	52,000	100,000	58,600	47,200	67,300
Not more than 1% carbon	50,900	43,300	88,900	40,000	33,900	53,400
Silicomanganese	301,000 r	203,000 r	304,000	264,000	178,000	195,000
Total, manganese ferroalloys	593,000 r	431,000 r	647,000	494,000	350,000	408,000
Ferrosilicon:						
55%–80% silicon, more than 3% calcium	5,210	3,790	7,530	8,900	6,550	12,100
55%–80% silicon, other	188,000	142,000	260,000	177,000	133,000	188,000
80%–90% ferrosilicon	283	234	241	115	95	150
More than 90% ferrosilicon	559	513	851	2,640	2,490	1,280
Magnesium ferrosilicon	16,700	7,570	31,200	17,000	7,610	29,800
Ferrosilicon, other	27,000	7,290	21,700	16,900	5,120	14,700
Total, ferrosilicon	237,000	162,000 r	322,000 r	222,000	155,000	246,000
Total, bulk ferroalloys	1,240,000	821,000 r	1,490,000 r	1,200,000	771,000	1,120,000
Noble ferroalloys:						
Ferrocerium and other pyrophoric alloys	401	XX	6,310	303	XX	4,360
Ferromolybdenum	2,380	1,610	36,300	2,750	1,900	46,900
Ferronickel	42,600	11,100	139,000	38,800	8,090	102,000
Ferroniobium	10,100	XX	271,000	9,350	XX	211,000
Ferrophosphorus	6,160	XX	3,450	5,550	XX	2,850
Ferrotitanium and ferrosilicon-titanium	1,730	XX	6,260	3,140	XX	7,840
Ferrotungsten and ferrosilicon-tungsten	369	269	9,060	328	236	6,130
Ferrovanadium	2,680	1,980	64,100	2,220	1,590	47,800
Ferrozirconium	158	XX	669	59	XX	240
Ferroalloys, other	10,100	XX	20,900	6,760	XX	11,500
Total, noble ferroalloys	76,700	15,000 r	557,000	69,300	11,800	441,000
Grand total	1,310,000 r	836,000 r	2,040,000	1,260,000	783,000	1,560,000

rRevised. XX Not applicable.
[1]Table includes data available through June 26, 2019. Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 9
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality, alloy type, and furnace type	2012	2013	2014	2015	2016
Albania, ferrochromium	24,018	24,692	34,897	38,000 r, e	38,900
Argentina:					
Ferrosilicon[e]	14,000	15,000	17,000	12,700	12,000
Silicomanganese	11,000 e	13,000	10,000	8,000	8,000
Total	25,000	28,000	27,000	20,700	20,000
Armenia, ferromolybdenum	5,836	6,619	6,528	5,576	6,518
Australia:[e]					
Ferromanganese	131,000 r	147,000 r	165,000 r	153,000 r	153,000
Silicomanganese	50,800	110,000 r	119,000 r	131,000 r	131,000
Total	182,000 r	257,000	285,000 r	284,000 r	284,000
Austria:					
Ferronickel	2,500 r	2,500 r	2,500	2,500 r	2,500
Other, unspecified	14,500 r	14,500 r	14,500 r	14,500 r	14,500 e
Total	17,000 r	17,000 r	17,000 r	17,000 r	17,000
Bahrain:					
Ferromanganese	5,300	--	--	--	--
Silicomanganese	6,000	20,000	20,000 r	17,000 r	15,000
Total	11,300	20,000	20,000 r	17,000 r	15,000
Bhutan, ferrosilicon	82,091 r	82,992 r	79,485 r	104,406 r	106,036
Brazil:					
Ferrochromium[3]	165,532	189,088	285,340 r	261,778 r	212,521
Ferromanganese	94,000	93,000	93,000 r	89,000 r	89,000
Ferronickel	100,208 r	107,243 r	113,721 r	171,000 r	214,000
Ferroniobium	50,562 r	46,555 r	51,737 r	50,000 r, e	50,000 e
Ferrosilicon[e]	145,000	147,000	98,000	88,300 r	62,300
Ferrosilicon-chromium	-- r	-- r	-- r	-- r	9,700
Silicomanganese[e]	213,000	218,000	218,000 r	209,000 r	209,000
Total	768,000 r	801,000 r	860,000 r	869,000 r	847,000
Burma, ferronickel[e]	--	4,800 r	57,000 r	60,000 r	34,000
Canada:					
Ferroniobium	7,840 r, e	8,190 r, e	9,620 r, e	8,975 r	10,355
Ferrosilicon	31,979	38,871	32,000 e	38,000 e	38,000 e
Ferrovanadium[e]	1,300 r	1,300 r	1,300 r	1,300 r	1,000
Total	41,100 r	48,400 r	42,900 r	48,300 r	49,400
China:					
Ferrochromium	3,041,900 r	3,928,700 r	4,300,000 r, e	4,500,000 r, e	4,500,000 e
Ferromanganese:					
Blast furnace	295,600 r	452,600 r	457,000 r, e	446,000 r, e	340,000
Electric furnace	3,016,700 r	2,148,600 r	2,170,000 r, e	2,120,000 r, e	1,610,000
Ferromolybdenum[e]	181,000 r	120,000 r	120,000 r	116,000 r	127,000
Ferronickel equivalent, nickel pig iron[e, 4]	1,770,000 r	2,400,000 r	2,360,000 r	1,930,000 r	1,870,000
Ferrosilicon[e]	5,760,000	5,940,000 r	5,500,000	4,730,000	4,300,000
Ferrovanadium[e]	37,900	61,400	40,000	20,400	30,600
Silicomanganese	7,406,000 r	7,919,400 r	7,990,000 r, e	7,810,000 r, e	7,810,000 e
Other, unspecified	9,952,500 r	13,947,600 r	22,431,100 r	22,394,620 r	22,253,710
Total	31,500,000 r	36,900,000 r	45,400,000 r	44,100,000 r	42,800,000
Colombia, ferronickel[e]	151,000	139,000	138,000	123,000	124,000
Dominican Republic, ferronickel[e]	40,000 r	24,700 r	--	--	26,000
Egypt:					
Ferromanganese[e]	30,000	30,000	12,000	12,000	12,000
Ferrosilicon[5]	55,300 e	50,800 e	56,794 r	56,093 r	56,000 e
Total	85,300	80,800	68,794 r	68,093 r	68,000
Finland, ferrochromium	228,744	433,677	441,292	460,000 e	480,000 e
France:[e]					
Ferromanganese	101,000	104,000	116,000	126,000	126,000
Ferrosilicon	63,000 r	50,000 r	50,000 r	35,000	35,000
Silicomanganese	69,000	92,000 r	108,000 r	98,000 r	82,000
Total	233,000 r	246,000 r	274,000 r	259,000 r	243,000

See footnotes at end of table.

TABLE 9—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality, alloy type, and furnace type	2012	2013	2014	2015	2016
Gabon, silicomanganese	--	--	4,000	20,000 e	30,000 e
Georgia, silicomanganese	261,075	253,361	256,677	217,300 r	244,600
Germany:					
Ferrochromium[e]	17,800	17,800	17,800	17,800	17,700
Other, unspecified	8,250 r	8,200 e	8,200 e	8,200 e	8,200 e
Total	26,000	26,000	26,000	26,000	25,900
Greece, ferronickel[e]	98,000 r	89,000 r	95,000 r	89,100 r	90,000
Guatemala, ferronickel[e]	--	--	15,300	32,800	26,300
Iceland, ferrosilicon	131,818	125,204	109,739 r	121,556 r	122,000 e
India:[6]					
Ferroaluminum	5,386 r	5,108 r	4,596 r	3,009 r	4,139
Ferroboron	34 r	30 r	45 r	218 r, e	--
Ferrochromium	944,000 r	944,000	944,000	944,000 r	944,000
Ferromanganese	419,200	455,400	533,300	476,300	518,000
Ferromolybdenum	1,057 r	1,151 r	1,281 r	1,281 r	1,614
Ferrosilicomagnesium	18,246 r	21,365 r	25,788 r	21,887 r	21,140
Ferrosilicon	90,000	92,013	92,014	92,000	90,000
Ferrosilicozirconium	-- r	--	-- r	10 e	--
Ferrotitanium	542 r	692 r	760 r	204 r	231
Ferrovanadium	815 r	815 r	1,031 r	879 r	1,266
Silicomanganese	1,693,100	1,917,000	1,786,000	1,691,300	1,700,000 e
Total	3,172,380 r	3,437,574 r	3,388,815 r	3,231,088 r	3,280,390
Indonesia:[e]					
Ferromanganese	13,000 r	12,000 r	12,000 r	12,000 r	12,000
Ferronickel	91,500	91,000 r	82,600	85,700	101,000
Ferronickel equivalent, high-nickel pig iron[4]	--	--	--	136,000	379,000
Silicomanganese	9,000 r	8,000 r	8,000 r	8,000 r	8,000
Total	114,000 r	111,000 r	103,000 r	242,000 r	500,000
Iran, ferrochromium	-- r	-- r	-- r	-- r	--
Italy:					
Ferromanganese	12,000	6,000	--	--	--
Silicomanganese	24,000	--	--	--	--
Other, unspecified[e]	10,000	10,000	10,000	10,000	10,000
Total	46,000	16,000	10,000	10,000	10,000
Japan:					
Ferrochromium	19,392	21,671	22,000	20,000 r	22,500 e
Ferromanganese	436,171	460,936	463,345	465,952	465,000 e
Ferromolybdenum	4,616	4,550	4,500	4,500	4,000
Ferronickel	371,913 r	402,768 r	379,291 r	396,969 r	333,448
Ferrovanadium	4,403	4,433	4,400 e	4,000 r, e	4,000
Silicomanganese	52,287	24,741	26,500 e	22,700	22,700 e
Other, unspecified	19,364	19,394	79,912 r	73,651 r	77,453
Total	908,146 r	938,493 r	979,948 r	987,772 r	929,101
Kazakhstan:					
Ferrochromium	1,305,343	1,336,532 r	1,351,803 r	1,141,476 r	1,430,000 e
Ferrosilicon	494	472	395 r	86,984 r	58,000 e
Ferrosilicon-chromium	164,853	165,195	158,826	74,609 r	94,468
Silicomanganese	252,000 r, e	204,000 r, e	200,000 r, e	164,000 r, e	135,885
Other, unspecified	1,845	81	3,735 r	1,662 r	1,987
Total	1,720,000 r	1,710,000 r	1,720,000 r	1,470,000 r	1,720,000
Korea, Republic of:					
Ferromanganese	364,800	330,000 e	306,000 e	300,000 e	300,000 e
Ferronickel[e]	54,100	65,800	59,100	103,000 r	120,000
Silicomanganese	184,700	216,000	240,000	200,000 e	200,000 e
Total	604,000 r	612,000 r	605,000 r	603,000 r	620,000
Kosovo, ferronickel[e]	20,200 r	34,300 r	38,500 r	56,500 r	6,000

See footnotes at end of table.

TABLE 9—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality, alloy type, and furnace type	2012	2013	2014	2015	2016
Macedonia:					
Ferronickel[e]	83,700	87,000 [r]	78,500 [r]	77,000 [r]	46,100
Ferrosilicon	42,402	72,279	73,014	45,698	36,000 [e]
Silicomanganese	14,179	--	--	--	-- [e]
Total	140,000 [r]	159,000 [r]	152,000 [r]	123,000 [r]	82,100
Malaysia, ferrosilicon	--	--	8,641	46,832	126,261
Mexico:[e]					
Ferromanganese	61,800 [r]	60,700 [r]	67,500	67,900	68,000
Silicomanganese	161,000 [r]	158,000 [r]	165,000 [r]	139,000 [r]	140,000
Total	223,000 [r]	219,000 [r]	232,000 [r]	207,000 [r]	208,000
New Caledonia, ferronickel	184,476 [r]	174,078 [r]	224,884 [r]	228,484 [r]	261,420
Norway:					
Ferromanganese[e]	338,000 [r]	307,000 [r]	295,000 [r]	309,000 [r]	300,000
Ferrosilicon	250,000 [e]	349,389	350,000 [e]	350,000 [e]	350,000
Silicomanganese	271,400	301,400	314,300	309,900	309,000
Total	859,400 [r]	957,789 [r]	959,300 [r]	968,900 [r]	959,000
Oman, ferrochromium	--	20,625	44,063	63,750	64,000 [e]
Poland:					
Ferromanganese, blast furnace	800	820 [r]	549 [r]	460 [r]	500
Ferrosilicon	78,115	73,589 [r]	62,878 [r]	77,138 [r]	77,000 [e]
Silicomanganese	200 [r]	100	32 [r, e]	-- [r]	-- [e]
Other, unspecified	300	11,250 [r]	24,909 [r]	--	--
Total	79,415 [r]	85,759 [r]	88,368 [r]	77,598 [r]	77,500
Romania, silicomanganese	17,000 [e]	--	--	--	--
Russia:					
Ferrochromium	546,360 [r]	487,810 [r]	439,600 [r]	363,286 [r]	268,000 [e]
Ferromanganese, blast furnace	160,800	181,400	178,600	155,700 [r]	124,200
Ferronickel, high-nickel[e]	11,500	--	--	--	--
Ferronickel, other[e, 7]	8,520	--	--	--	--
Ferroniobium[e]	700 [r]	600 [r]	600 [r]	600 [r]	500
Ferrophosphorus[e]	3,600	3,500 [r]	3,500 [r]	3,500 [r]	3,500
Ferrosilicon	1,036,930	1,012,740	1,026,190	1,059,000	1,060,000 [e]
Ferrosilicon-chromium	57,450	58,130	67,160 [r]	102,000 [r]	75,000 [e]
Ferrotitanium	7,500 [e]	7,500 [r, e]	7,500 [r, e]	9,961 [r]	10,741
Ferrovanadium[e]	8,280 [r]	10,500 [r]	11,400 [r]	11,000 [r]	9,000
Silicomanganese	164,350	169,190	179,910 [r]	188,895 [r]	203,216
Other, unspecified[e]	9,000 [r]	8,500	6,000 [r]	6,500 [r]	6,000
Total	2,014,990 [r]	1,939,880 [r]	1,920,440 [r]	1,900,442 [r]	1,760,596
Saudi Arabia:					
Silicomanganese	80,000	96,000 [r]	60,000	63,000	60,000
Other, unspecified	196,000 [r]	196,000 [r]	196,000 [r]	200,000 [r]	200,000 [e]
Total	276,000 [r]	292,000 [r]	256,000 [r]	263,000 [r]	260,000
Slovakia:					
Ferromanganese	12,862	2,120 [r, e]	20,554 [r]	25,376	35,589
Ferrosilicon	36,869	41,664	47,019 [r]	45,961 [r]	46,000 [e]
Silicomanganese	50,089	26,794	29,643	27,036	35,700 [e]
Total	99,820	70,577	97,216 [r]	98,373 [r]	117,308
South Africa:					
Ferrochromium[3]	3,063,257	3,219,162 [r]	3,719,010 [r]	3,684,598 [r]	3,600,000
Ferromanganese	706,000 [r]	681,000 [r]	772,000 [r]	512,000 [r]	261,146
Ferrosilicon	83,100 [r]	78,400	87,700 [r]	87,700 [r, e]	71,200 [e]
Ferrovanadium[e]	18,000	18,000	19,000	15,000 [r]	13,000
Silicomanganese	148,800	133,600	228,100	210,200	144,000
Total	4,019,157 [r]	4,130,162 [r]	4,825,810 [r]	4,509,498 [r]	4,089,346
Spain:					
Ferromanganese	79,800	107,200	133,200	126,200	126,000
Ferrosilicon[e]	68,600	80,500	80,500	80,000	80,000
Silicomanganese	148,000	136,000	129,000	134,000	134,000
Total	296,400	323,700 [r]	342,700 [r]	340,200 [r]	340,000

See footnotes at end of table.

TABLE 9—Continued
FERROALLOYS: WORLD PRODUCTION, BY COUNTRY OR LOCALITY, FURNACE TYPE, AND ALLOY TYPE[1, 2]

(Metric tons, gross weight)

Country or locality, alloy type, and furnace type	2012	2013	2014	2015	2016
Sweden, ferrochromium[e]	39,900 [r]	49,000	67,000	90,500 [r]	79,100
Turkey:[e]					
Ferrochromium	69,600 [r]	133,000 [r]	86,000 [r]	82,600 [r]	90,000
Ferrosilicon	2,000	2,000	2,000 [r]	2,000 [r]	2,000
Total	71,600	135,000	88,000 [r]	84,600 [r]	92,000
Ukraine:					
Ferromanganese	163,921	88,626	102,934 [r]	87,740	104,470
Ferronickel	119,652 [r]	121,586 [r]	114,222 [r]	95,209 [r]	106,000 [e]
Ferrosilicon	150,265	191,207	167,977 [r]	114,826 [r]	101,000 [e]
Silicomanganese	823,131	724,892	840,433 [r]	698,400	814,970
Other, unspecified	22,115	15,908	15,326 [r]	19,360 [r]	--
Total	1,279,084 [r]	1,142,219 [r]	1,240,892 [r]	1,015,535 [r]	1,126,540
United States:[8]					
Bulk ferroalloys	564,000	503,000 [r]	517,000	424,000	369,000
Noble ferroalloys	16,300	18,300 [r]	15,100	21,100 [r]	19,400
Total	580,000	521,000 [r]	532,000	445,000	389,000
Venezuela:					
Ferromanganese	9,000	9,000	8,000	8,000	8,000
Ferronickel	33,800 [r]	--	20,800 [r]	16,700 [r]	--
Ferrosilicon[e]	72,300	74,300	74,300	74,300	37,000
Silicomanganese	58,000	63,000	39,000	35,000	35,000
Total	173,000 [r]	146,000	142,000 [r]	134,000 [r]	80,000
Zimbabwe, ferrochromium	137,543 [r]	150,060 [r]	214,110 [r]	115,586 [r]	149,000 [e]
Grand total[8]	51,000,000 [r]	57,000,000 [r]	66,600,000 [r]	64,300,000 [r]	63,100,000
Of which:					
Ferroaluminum	5,390 [r]	5,110 [r]	4,600 [r]	3,010 [r]	4,140
Ferroboron	34 [r]	30 [r]	45 [r]	218 [r, e]	--
Ferrochromium	9,600,000 [r]	11,000,000 [r]	12,000,000 [r]	11,800,000 [r]	11,900,000
Ferromanganese:					
Blast furnace	457,000 [r]	635,000 [r]	636,000 [r]	602,000 [r]	465,000
Electric furnace	5,990,000 [r]	5,040,000 [r]	5,270,000 [r]	4,890,000 [r]	4,190,000
Ferromolybdenum	193,000 [r]	132,000 [r]	132,000 [r]	127,000 [r]	139,000
Ferronickel	3,140,000 [r]	3,740,000 [r]	3,780,000 [r]	3,600,000 [r]	3,740,000
Ferroniobium	59,100 [r]	55,300 [r]	62,000 [r]	59,600 [r]	60,900
Ferrophosphorus	3,600 [r]	3,500 [r]	3,500 [r]	3,500 [r]	3,500
Ferrosilicomagnesium	18,200 [r]	21,400 [r]	25,800 [r]	21,900 [r]	21,100
Ferrosilicon	8,190,000 [r]	8,520,000 [r]	8,020,000	7,350,000 [r]	6,870,000
Ferrosilicon-chromium	222,000 [r]	223,000 [r]	226,000 [r]	177,000 [r]	179,000
Ferrosilicozirconium	-- [r]	-- [r]	-- [r]	10 [r, e]	--
Ferrotitanium	8,040 [r]	8,190 [r]	8,260 [r]	10,200 [r]	11,000
Ferrovanadium	70,700 [r]	96,500 [r]	77,100 [r]	52,600 [r]	58,900
Silicomanganese	12,200,000 [r]	12,800,000 [r]	13,000,000 [r]	12,400,000 [r]	12,500,000
Other, unspecified[8]	10,800,000	14,800,000 [r]	23,300,000 [r]	23,200,000 [r]	23,000,000

[e]Estimated. [r]Revised. -- Zero.

[1]Table includes data available through March 10, 2018. All data are reported unless otherwise noted. Grand totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]All production shown is from electric arc furnaces unless otherwise noted. Production derived from metallothermic operations is included with electric furnace production. Ferroalloys may have been produced in other countries and (or) localities, but production information was inadequate to make reliable estimates of output.

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

[4]In order to facilitate comparison with other ferronickel-producing countries and (or) localities, gross weight has been estimated using a nickel content of 20%. Although there are no formal specifications, ferronickel has historically referred to products containing a minimum of 15% nickel, but nickel pig iron may contain as little as 3% nickel.

[5]Production is based on fiscal year, with a starting date of July 1.

[6]Production is based on fiscal year, with a starting date of April 1.

[7]Includes ferronickel chromium and nickel-resist cast iron.

[8]Data for the United States are included only in the "Grand total" and its "Other, unspecified" category, not in any of the commodity-specific subtotals.