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2017 Minerals Yearbook

FERROALLOYS [ADVANCE RELEASE]

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FERROALLOYS

By Ruth F. Schulte

George M. Bedinger contributed data for ferrotitanium, Lisa A. Corathers for ferromanganese and silicomanganese, Michele E. McRae for ferronickel, Désirée E. Polyak for ferromolybdenum and ferrovanadium, Emily K. Schnebele for ferrosilicon, and Kim B. Shedd for ferrotungsten. Domestic survey data and tables were prepared by Hodan A. Fatah, statistical assistant.

U.S. production of bulk ferroalloys in 2017 increased by 7% to 395,000 metric tons (t) from 369,000 t in 2016. Estimated production of noble ferroalloys in 2017 decreased by 31% to 13,300 t from 19,100 t (revised) in 2016 (table 1). Ferroalloy exports increased by 47% to 54,400 t (gross weight) compared with 37,000 t (revised) in 2016 (table 7). Ferroalloy imports increased by 27% to 1,610,000 t (gross weight) compared with 1,260,000 t in 2016 (table 8). World production of total ferroalloys was estimated to be 44.8 million metric tons (Mt) (gross weight) in 2017, a 5% decrease compared with 47.4 Mt (revised) in 2016 (table 9). Among the bulk ferroalloys, China was the leading country in the production of ferrochromium, ferromanganese, ferrosilicon, and silicomanganese, and Kazakhstan was the leading country in ferrosilicon-chromium in 2017. Among the noble ferroalloys, China was the leading country in the production of ferromolybdenum, ferronickel, and ferrovanadium; Brazil was the leading country in ferroniobium; and Russia was estimated to be the leading country in ferrotitanium and the only country with reported ferrophosphorus production. India was the only country that produced ferrosilicomagnesium in 2017.

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

Ferroalloys can be classified as either bulk ferroalloys or 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 (including ferrosilicozirconium), 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 (FY) 2017 (October 1, 2016, through September 30, 2017) Annual Materials Plan (AMP). Maximum disposal limits were based on the FY 2017 AMP, which were set at 21,300 t of ferrochromium and 45,400 t of ferromanganese (Defense Logistics Agency Strategic Materials, 2016a). The DLA Strategic Materials administered acquisitions of ferroniobium from the NDS under the same AMP. Maximum acquisition limits were 209 t of ferroniobium (Defense Logistics Agency Strategic Materials, 2016b). As of the end of FY 2017 (September 30, 2017), the ferroalloy inventory (gross weight) was as follows: 50,000 t of high-carbon ferrochromium, 29,100 t of low-carbon ferrochromium, and 213 t of ferromanganese (Corathers, 2018, p. 105; Singerling, 2018, p. 47).

Production

In 2017, 11 companies in the United States produced ferroalloys (table 2). Domestic data for ferroalloy materials were collected by the U.S. Geological Survey by means of the "Consolidated Consumers' Report," "Manganese Ore and Products," "Nickel Stocks, Purchases, and Consumption," "Silicon Alloys," "Specialty Ferroalloys," and "Vanadium" surveys.

U.S. production of bulk ferroalloys in 2017 increased by 7% to 395,000 t from 369,000 t in 2016. Estimated production of noble ferroalloys in 2017 decreased by 31% to 13,300 t from 19,100 t (revised) in 2016 (table 1). Unlike in previous years, the trend in bulk ferroalloy production increased more than that of crude steel, where domestic production of raw steel increased by 4% to 81.6 Mt in 2017 from 78.5 Mt in 2016 (Tuck, 2019). Excluding the United States, world production of bulk ferroalloys was essentially unchanged and noble ferroalloys decreased by 19% in 2017 (tables 1, 9).

Consumption

Domestic bulk ferroalloy reported consumption was 1.16 Mt in 2017, a slight increase from 1.15 Mt (revised) in 2016. Noble ferroalloy reported consumption was essentially unchanged in 2017 compared with the consumption in 2016 (table 1).

Prices

The prices for bulk ferroalloys varied in 2017. The annual average prices for grades of low-carbon ferrochromium (less than 3% carbon) increased by an average of 6%, whereas the average prices for high-carbon ferrochromium (more than 4% carbon) increased by an average of 48% compared with those in 2016 (table 6). Compared with prices in 2016, the average U.S. spot-market prices for medium-carbon ferromanganese increased by 37%, high-carbon ferromanganese increased by 67%, and silicomanganese prices increased by 51%. Average prices for 50%-grade ferrosilicon and 75%-grade ferrosilicon increased by 14% and 23%, respectively, from those in 2016.

For the noble ferroalloys, the 2017 annual average prices of ferromolybdenum increased by 26%, ferrotitanium by 9%, ferrotungsten by 25%, and ferrovanadium by 66%. The average annual price of nickel metal, with 99.81% minimum purity, increased by 8% (table 6).

Foreign Trade

The United States was a net importer of ferroalloys in 2017 (tables 7, 8). On a gross-weight basis, U.S. total bulk ferroalloy exports increased by 65% compared with exports in 2016 (table 7). Exports of chromium ferroalloys increased by 37%, manganese ferroalloys increased by 97%, and silicon ferroalloys increased by 47% compared with exports in 2016. Exports of noble ferroalloys increased by 14% compared with exports in 2016. Exports of ferromolybdenum decreased slightly, ferronickel decreased by 87%, and ferrovanadium decreased by 44%. Ferroniobium exports increased by 3%, ferrotitanium and ferrosilicon-titanium by 20%, and ferrotungsten and ferrosilicon-tungsten by 96%.

Ferroalloy Review

Ferroboron.—Boron is added to steel to increase hardenability (the depth to which steel is hardened upon quenching at high temperatures). Boron is also added to some stainless steels to improve creep resistance; control hot shortness (the propensity for some alloys to separate along grain boundaries when stressed or deformed at near melting-point temperatures); and, in some cases, promote neutron absorption, which is critical in advanced technological fields such as nuclear power. Ferroboron is typically added to alloy steels, high-strength low-alloy steels, structure steels, and stainless steels. Ferroboron also increases the magnetic susceptibility of alloys, enabling it to be used in magnetic applications such as neodymium-iron-boron magnets.

Boron occurs in nature as borate minerals, such as borax, and borosilicates, a type of glass with silica and boron trioxide. Borate ore is converted to boric acid and then reduced in an electric arc furnace with carbon steel or along with aluminum and iron ore to produce ferroboron. The United States did not produce ferroboron in 2017 and relied on imports. There are no Harmonized Tariff Schedule of the United States codes specific to ferroboron; thus, exact import quantities were not available. India reported ferroboron production in previous years, but there was no ferroboron production reported in 2017 (table 9).

Ferrochromium.—Chromium is added to steel to impart corrosion and oxidation resistance, increase hardenability, improve wear resistance, and bolster strength at elevated temperatures. The primary end uses for ferrochromium are stainless and heat-resisting steels. There is no substitute for chromium in stainless steel; it is an essential component in all stainless-steel products. Chromium is also used in tool steels, superalloys, and other specialty metals. Chromite ore is the mineral source of chromium. The ore can be smelted in electric arc furnaces to produce ferrochromium for the metallurgical industry.

In 2017, world stainless and heat-resisting steel melt shop production (ingot or slab equivalent) was 48.1 Mt, an increase of 5% from production in 2016 (International Stainless Steel Forum, 2018, p. 8). The American Iron and Steel Institute (2016, 2017) estimated U.S. stainless-steel production to be 2.8 Mt, an increase of 11% from 2016. Countries that led stainless-steel production, listed in descending order, were China, India, Japan, and the United States (International Stainless Steel Forum, 2018).

The United States did not produce ferrochromium and imported 590,000 t (gross weight) of ferrochromium in 2017, an increase of 23% from 2016 (table 8). The leading countries for ferrochromium production were China (39%), South Africa (29%), and Kazakhstan (13%) (table 9).

Ferromanganese and Silicomanganese.—Manganese ferroalloys include ferromanganese and silicomanganese, which are essential for desulfurization and deoxidation in steelmaking. Ferromanganese and silicomanganese also increase the hardenability of steel. Steelmaking was the leading end use of manganese ferroalloys in the United States in 2017, with carbon and high-strength low-alloy steels as the primary end products (table 4). Ferromanganese is produced by mixing manganese ore, specifically the mineral pyrolusite, and iron ore with carbon in electric arc furnaces or, less frequently, blast furnaces. Silicomanganese is similarly produced but includes silicon in the melt to increase the deoxidation properties of the steel.

The United States produced manganese ferroalloys at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2017, imports of ferromanganese and silicomanganese were 682,000 t (gross weight), an increase of 38% from imports in 2016 (table 8). Excluding the United States, the leading country in manganese ferroalloy production was China, followed by India and Ukraine (table 9).

Ferromolybdenum.—Molybdenum is added to steel for a variety of different uses, such as improving corrosion and wear resistance, and increasing hardenability and strength at high temperatures. Ferromolybdenum is used to produce alloy and stainless steels, alloy cast irons, full steel, carbon steel, high-strength low-alloy steel, tool steel, and superalloys. The mineral molybdenite is mined from primary ores, such as low-grade porphyry molybdenum deposits, or obtained as a byproduct from the production of other metals, typically low-grade copper porphyry deposits. The molybdenite ore is then concentrated and roasted to form molybdic oxide, which can then be converted into ferromolybdenum, molybdenum chemicals, or molybdenum metal. Molybdic oxide is easily reduced in an electric arc furnace or by argon oxygen decarburization processes. Molybdenum can also be recovered from alloy scrap if the molybdenum content of the scrap is well known.

The United States produced ferromolybdenum at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2017, 7,590 t (gross weight) of ferromolybdenum was imported, almost triple that of imports in 2016 (table 8). The leading global producer of ferromolybdenum was China, with more than 90% of world production. Ferromolybdenum was also produced in Armenia and India (table 9).

Ferronickel.—Nickel is added to steel to promote solid-solution strengthening, toughness at low temperatures, and hardenability. Nickel can also be used to improve resistance to corrosion and oxidation. The primary end uses for ferronickel include cryogenic steels, stainless steels, superalloys, ultrahigh-strength steels, and wrought steels, with stainless steel as the leading end use.

Nickel ore mined from laterite deposits, which contain nickel-bearing minerals such as limonite and garnierite, is smelted in electric arc furnaces to produce ferronickel. The United States did not produce ferronickel and imported 76,500 t (gross weight) of ferronickel in 2017, almost double that of 2016 (table 8). The International Metals Reclamation Corp. recovered chromium- and nickel-bearing waste and scrap at its secondary smelter in Ellwood City, PA, to produce an iron-base remelt alloy with an average nickel content of 12% to 13%. Stainless-steel producers used the remelt as a substitute for ferrochromium and ferronickel.

China and Indonesia were the only countries that produced nickel pig iron, a type of 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 the nickel pig iron, China was the leading ferronickel producer in 2017, with 52% of world production. Indonesia was estimated to account for 9% of production. Japan, New Caledonia, and the Republic of Korea were the next leading ferronickel producers, with 8%, 7%, and 6% of world production, respectively (table 9).

Ferroniobium.—Niobium is added to steel as a microalloying element and improves toughness and wear resistance, increases yield strength, and enables retention of grain size at elevated temperatures. Carbon steels, high-strength low-alloy steels, stainless steels, and superalloys were the leading ferroniobium products in 2017. Niobium does not occur naturally as a metal; however, it is contained in the mineral structure of the mineral pyrochlore, typically found in carbonatite deposits in zoned alkaline igneous complexes. Carbonatite ores can be concentrated to produce a niobium mineral (pyrochlore) concentrate. Niobium concentrate is then smelted in electric arc furnaces to produce ferroniobium for metallurgical uses. The United States produced ferroniobium at one facility; production was withheld to avoid disclosing company proprietary data (table 2). In 2017, 10,500 t (gross weight) of ferroniobium was imported, an increase of 12% from that of 2016 (table 8). Brazil, Canada, and Russia were the only other countries that produced ferroniobium in 2017, with Brazil dominating world production with more than 88% of reported world production, excluding production in the United States (table 9).

Ferrophosphorus.—Phosphorus is typically considered an impurity in iron ore and eliminated in the early stages of the steelmaking process. However, phosphorus is sometimes added to steel as ferrophosphorus to improve strength and machinability and to increase resistance to atmospheric corrosion. Ferrophosphorus is produced from iron ore slag as a byproduct during steel manufacturing and then added to steel melts as briquettes after the deoxidation process is complete. The leading end uses for ferrophosphorus are carbon steel, followed by full steel, electrical steel, and high-strength low-alloy steel. The United States did not produce ferrophosphorus in 2017 and imported 8,420 t (gross weight), which was a 52% increase from imports in 2016 (table 8). World production of ferrophosphorus was limited to Russia, which produced a reported 1,538 t ferrophosphorus in 2017 (table 9).

Ferrosilicon.—Silicon is added to steel to increase resistance to oxidation at high temperatures, improve hardenability, and promote solid-solution strengthening. Steel and cast-iron alloys were the primary products for ferrosilicon use. High-purity quartz sand and quartzite are sources for silica, which are smelted in blast or submerged electric arc furnaces to produce ferrosilicon. The United States produced ferrosilicon at three facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2017, 217,000 t (gross weight) of ferrosilicon was imported, a slight decrease from imports in 2016 (table 8). Excluding the United States, China was the leading silicon-ferroalloy-producing country, followed by Russia and Norway (table 9). There was a significant decrease in the amount of ferrosilicon produced in Macedonia related to the temporary shutdown of the Jugohrom Ferroalloys plant, which had failed to comply with Government-required pollution reduction systems (Mikhaylova, 2017).

Ferrotitanium.—Titanium is added to steel to promote grain refinement and to act as a decarbonizing, denitrogenizing, deoxidizing, and desulfurizing agent. Ferrotitanium is produced for use in carbon steels, high-strength low-alloy steels, maraging steels, and stainless steels. Titanium scrap that contains iron or steel is the primary source for ferrotitanium. Commercial purity titanium scrap can also be used. Typically, titanium scrap is smelted in an electric induction furnace to produce ferrotitanium. However, ferrotitanium can also be produced by aluminothermic reduction of ilmenite or rutile, which are the main mineral sources for titanium. The most common ferrotitanium grades are 30% and 70% titanium.

The United States produced ferrotitanium at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2017, 2,550 t (gross weight) of ferrotitanium was imported, a decrease of 19% from imports in 2016 (table 8). Russia and India also produced ferrotitanium in 2017, with 96% and 4% of global production excluding the United States production, respectively (table 9).

Ferrotungsten.—The addition of tungsten to steel improves hot hardness, increases wear resistance, and promotes strength at high temperatures. As a result, the primary end uses for ferrotungsten are high-speed and other tool steels. To a lesser extent, ferrotungsten can also be added to some high-temperature stainless and structural steels.

Ferrotungsten is produced from high-grade tungsten ore or derived from the tungsten oxide minerals scheelite or wolframite, calcium tungstate (an artificial scheelite), or soft scrap. To produce ferrotungsten, tungsten materials are reduced by aluminothermic or silicothermic reactions or smelted in electric arc furnaces in 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).

Tungsten is then added to steel melts as ferrotungsten, a master alloy containing between 75% and 85% tungsten. Tungsten can also be added as a tungsten melting base, which is a master alloy containing up to 38% tungsten, or tungsten metal scrap. Specialty-steel mills equipped with argon-oxygen decarburization can accommodate scheelite ore concentrates.

The United States did not produce ferrotungsten or ferrosilicon-tungsten in 2017 and imported 276 t (gross weight) of ferrotungsten and ferrosilicon-tungsten, a 16% decrease from imports in 2016 (table 8). Although there was no reported world production of ferrotungsten in 2017, China has produced most of the world's ferrotungsten in recent years (Seddon, 2014, p. 10–14). 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 added to steel to promote fine grain size and inhibit grain growth at high temperatures, increase hardenability in steel, and improve wear resistance. Structural and engineering alloy steels, such as carbon steels; full alloy and high-strength low-alloy steels; and tool and die steels were the leading end uses for ferrovanadium in 2017. Vanadium is primarily recovered as a byproduct of processing titanium-bearing magnetite or from recycling titanium-bearing materials. Secondary vanadium can also be produced from various industrial waste materials, such as vanadium-bearing coal ash, petroleum residues, pig iron slag, and spent catalysts. To produce ferrovanadium, the recovered vanadium slag is smelted with iron oxides in electric arc furnaces. Secondary vanadium was the main source of U.S. ferrovanadium production in 2017.

In the United States, ferrovanadium was produced at two facilities; production was withheld to avoid disclosing company proprietary data (table 2). In 2017, 3,880 t (gross weight) of ferrovanadium was imported, an increase of 74% from imports in 2016 (table 8). Excluding the United States, China was the leading ferrovanadium-producing country (table 9).

Ferrozirconium.—Zirconium is added to steel to control sulfide inclusions and fix nitrogen, particularly in boron steels. In addition, zirconium can act as a deoxidizing agent and inhibit grain growth and strain aging. High-strength low-alloy steels are the leading end use for ferrozirconium and ferrosilicozirconium; nonferrous alloys, such as zircaloy, also include some 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. The zirconium ore is then added to the ladle or as ingot molds during the steel manufacturing process. In 2017, the United States did not produce ferrozirconium and imported 161 t (gross weight), an increase of 173% from imports in 2016 (table 8). World production of ferrozirconium was not reported in 2017 or prior, but it may have been included in the unspecified category for some countries. India reported ferrosilicozirconium production in the past, but no production was reported in 2017 and available information was inadequate to make reliable estimates of output.

Outlook

Domestic consumption of ferroalloys is expected to follow closely the trend in U.S. steel production. Global steel production increased by 5.3% to 1.69 billion metric tons in 2017, and demand is expected to increase by 3.9% in 2018 and slightly in 2019 (World Steel Association, 2018a, b).

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GENERAL SOURCES OF INFORMATION

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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)

	2013	2014	2015	2016	2017
United States:					
Bulk ferroalloys:[2]					
Production	503,000	517,000	424,000	369,000	395,000
Consumption, reported	1,270,000	1,230,000	1,180,000	1,150,000	1,160,000
Exports	30,700	29,500	24,200	24,100	39,800
Imports for consumption	1,400,000	1,730,000	1,240,000	1,200,000	1,490,000
Noble ferroalloys:					
Production[e, 3]	18,300	15,100	21,000 r	19,100 r	13,300
Consumption, reported	58,400	68,600	63,200	55,500 r	55,400
Exports	11,600	15,700	10,800 r	12,900 r	14,600
Imports for consumption	90,800	115,000	76,700	69,300	117,000
World production:[4]					
Bulk ferroalloys	39,100,000 r	38,200,000 r	34,700,000 r	34,800,000 r	34,600,000
Noble ferroalloys	14,500,000 r	12,000,000 r	15,500,000 r	12,600,000 r	10,200,000

[e]Estimated. [r]Revised.
[1]Table includes data available through March 19, 2020. 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.
[4]World production data for bulk ferroalloys includes ferrochromium, ferromanganese, ferrosilicon, ferrosilicon-chromium, and silicomanganese. World production data for noble ferroalloys includes ferroaluminum, ferroboron, ferromolybdenum, ferronickel, ferroniobium, ferrophosphorus, ferrosilicomagnesium, ferrosilicozirconium, ferrotitanium, ferrovanadium, and unspecified ferroalloys. Production data for the United States are included in the noble ferroalloys total.

TABLE 2
DOMESTIC PRODUCERS OF FERROALLOYS IN 2017, BY U.S. CENSUS BUREAU REGIONS

		Products[1]						
		Bulk ferroalloys			Noble ferroalloys			
Company and region	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	48,300
Low-carbon	28,500
Ferromanganese, high-carbon	212,000
Ferroniobium	161

[1]Table includes data available through March 19, 2020. Data are rounded to no more than three significant digits.
[2]Inventory as of December 31, 2017.

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
2016:				
Steel:				
Carbon and high-strength low-alloy	6,400 r	268,000	99,400	71,100 [3]
Stainless and heat-resisting	366,000	9,820	15,600	44,200
Unspecified and other steels	33,700 r	57,300	20,800	59,300
Total steel	406,000 r	335,000	136,000	175,000 [3]
Alloys and superalloys	7,850 r	(4)	(4)	(4)
Cast irons	(4)	6,620	164	70,000 [3]
Miscellaneous and unspecified	5,280	553	2,700	839
Grand total	419,000 r	342,000	139,000 [5]	245,000 [3]
Consumer stocks, December 31	13,200 r	20,800 [6]	10,400 [6]	10,600
2017:				
Steel:				
Carbon and high-strength low-alloy	6,980	271,000	102,000	34,100
Stainless and heat-resisting	382,000	9,820	15,600	44,300
Unspecified and other steels	35,900	57,200	20,700	90,300
Total steel	425,000	338,000	138,000	169,000 [7]
Alloys and superalloys	9,710	(4)	(4)	(4)
Cast irons	(4)	6,530	255	70,200 [3]
Miscellaneous and unspecified	5,310	542	2,690	271 [3, 7]
Grand total	440,000	345,000	141,000 [5]	239,000
Consumer stocks, December 31	13,500	17,100 [6]	11,100 [6]	11,600

[r]Revised.
[1]Table includes data available through March 19, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Abbreviations and the forms of material included are as follows: FeCr, ferrochromium, including chromium metal; FeMn, ferromanganese; SiMn, silicomanganese; and FeSi, ferrosilicon, silvery pig iron, silicon carbide, and inoculant alloys.
[3]Consumption of silvery pig iron was withheld to avoid disclosing company proprietary data.
[4]All or part included with “Miscellaneous and unspecified.”
[5]Internal evaluation indicates that silicomanganese consumption is understated.
[6]Consumer and producer stocks.
[7]Does not include silicon carbide consumption to avoid disclosing proprietary data.

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]
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	10,800 r	61	(4)	206	(4)	(4)
Unspecified and other steels	2,170 r	3,100	28	2,230	100 r	430 r	4,400	4,040 r
Total	2,950 r	5,580	10,900 r	2,990	100 r	637 r	4,400	9,550 r
Alloys and superalloys	(5)	1,790	W	6	(4)	(5)	(6)	1,390 r
Cast irons	329	--	--	(5)	--	(5)	(5)	9 r
Miscellaneous and unspecified	134 r	--	W	7	--	28 r	389	98 r
Grand total	3,410	7,370	11,000 r	3,000	100 r	665 r	4,790	11,000 r
Consumer stocks, December 31	360	390	W	98 r	36 r	161 r	466	935
2017:								
Steel:								
Carbon	(4)	1,170	--	734	(4)	(4)	(4)	5,410
High-strength low-alloy	170	719	--	(4)	--	(4)	(4)	(4)
Stainless and heat-resisting	673	689	10,300	62	(4)	209	(4)	(4)
Unspecified and other steels	2,330	3,090	30	2,240	97	419	4,080	4,370
Total	3,180	5,670	10,300	3,040	97	628	4,080	9,790
Alloys and superalloys	(5)	1,840	W	2	--	(5)	(6)	1,720
Cast irons	316	--	--	(5)	--	(5)	(5)	5
Miscellaneous and unspecified	89	--	W	8	--	30	394	81
Grand total	3,580	7,510	10,300	3,050	97	658	4,470	11,600
Consumer stocks, December 31	398	393	W	87	36	164	453	961

[r]Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.

[1]Table includes data available through March 19, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Abbreviations and the forms of material included are as follows: 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.”

[6]Less than ½ unit.

TABLE 6

SELECTED DOMESTIC FERROALLOY PRICES[1]

Alloy	Unit[2]	2016 High	2016 Low	2016 Average[3]	2017 High	2017 Low	2017 Average[3]
Bulk ferroalloys:							
Ferrochromium:							
0.05% carbon	¢/lb	225.50	214.50	219.98	228.75	208.90	217.19
0.10% carbon	do.	202.00	176.81	183.55	218.75	198.10	205.60
0.15% carbon	do.	191.50	171.00	181.10	207.00	188.00	196.62
Over 4% carbon:							
47–55% chromium	do.	113.94	88.00	92.43	137.00	124.67	133.83
60–70% chromium	do.	125.94	87.00	95.37	151.25	138.00	145.04
Manganese ferroalloys:							
85% medium-carbon ferromanganese	¢/lb	96.00	76.00	80.80	115.00	94.00	110.46
76% high-carbon ferromanganese	$/lt	1,450.00	760.00	888.83	1,600.00	1,400.00	1,488.74
65% silicomanganese	¢/lb	72.00	34.00	43.37	72.00	60.00	65.59
Silicon ferroalloys:							
50% ferrosilicon	do.	84.70	80.70	82.70	96.63	92.32	94.47
75% ferrosilicon	do.	71.90	69.68	70.76	87.67	85.77	86.88
Nickel metal, 99.81% (minimum) purity[4]	do.	5.05	3.77	4.35	5.44	4.05	4.72
Noble ferroalloys:							
Ferromolybdenum	$/lb	8.97	6.55	7.74	10.77	8.73	9.72
Ferrotitanium, 70%-grade	do.	2.10	1.60	1.81	2.20	1.70	1.97
Ferrotungsten[5]	$/kg	42.00	22.00	29.88	49.00	30.00	37.28
Ferrovanadium	$/lb	11.96 r	5.95	9.29	21.10	12.18	15.42

[r]Revised. do. Ditto.

[1]Table includes data available through March 19, 2020.

[2]Abbreviations are as follows: ¢/lb, cents per pound; $/kg, dollars per kilogram; $/lt, dollars per long ton; and $/lb, dollars per pound.

[3]Arithmetic mean of high and low prices, weekly prices, or monthly prices.

[4]Nickel metal prices are reported in gross weight.

[5]Tungsten price unit reported as dollars per kilogram of contained tungsten.

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

TABLE 7

U.S. EXPORTS OF FERROALLOYS[1]

Alloy	2016 Gross weight (metric tons)	2016 Contained weight (metric tons)	2016 Value (thousands)	2017 Gross weight (metric tons)	2017 Contained weight (metric tons)	2017 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	675	374	$1,020 r	1,240	510	$1,400
Not more than 4% carbon	800	421	1,310	854	441	1,840
Ferrosilicon-chromium	61	21	64	15	5	31
Total, chromium ferroalloys	1,540	816	2,400	2,110	956	3,270
Manganese ferroalloys:						
Ferromanganese, all grades	6,580	5,200	6,850	9,230	7,290	14,200
Silicomanganese	2,410	1,560	2,290	8,460	5,500	11,900
Total, manganese ferroalloys	8,990	6,760	9,130	17,700	12,800	26,100
Silicon ferroalloys:						
Ferrosilicon, more than 55% silicon	4,670	2,860	8,840	11,100	6,720	15,500
Ferrosilicon, other	8,920	4,250	14,600	8,870	4,120	13,600
Total, silicon ferroalloys	13,600	7,110	23,400	20,000	10,800	29,100
Total, bulk ferroalloys	24,100	14,700	35,000	39,800	24,600	58,500
Noble ferroalloys:						
Ferromolybdenum	641 r	449 r	13,300	628	440	10,800
Ferronickel	207	123	3,400	26	15	435
Ferroniobium[2]	2,200 r	1,410	26,000 r	2,300	1,500	26,000
Ferrophosphorus	463	XX	855	2,430	XX	2,610
Ferrotitanium and ferrosilicon-titanium	2,020 r	XX	6,130 r	2,420	XX	8,560
Ferrotungsten and ferrosilicon-tungsten	46	23	308	90	45	673
Ferrovanadium	533	400	7,280	300	229	6,000
Ferrozirconium	476	XX	839	62	XX	154
Ferroalloys, other	6,300	XX	11,600	6,410	XX	9,660
Total, noble ferroalloys	12,900 r	2,410 r	69,700 r	14,700	2,230	64,900
Grand total	37,000 r	17,100 r	105,000	54,400	26,800	123,000

[r]Revised. XX Not applicable.

[1]Table includes data available through March 19, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Contained weight calculated assuming 65% contained Nb for ferroniobium.

Source: U.S. Census Bureau.

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

Alloy	2016 Gross weight (metric tons)	2016 Contained weight (metric tons)	2016 Value (thousands)	2017 Gross weight (metric tons)	2017 Contained weight (metric tons)	2017 Value (thousands)
Bulk ferroalloys:						
Chromium ferroalloys:						
Ferrochromium:						
More than 4% carbon	414,000	224,000	$328,000 r	507,000	272,000	$644,000
More than 3% but not more than 4% carbon	11,400	5,740	8,410	6,740	3,370	7,140
More than 0.5% but not more than 3% carbon	7,480	4,750	15,400	2,820	1,820	6,820
Not more than 0.5% carbon	39,700	26,900	106,000	51,600	33,900	135,000
Ferrosilicon-chromium	7,300	4,780	10,000	21,500	7,760	32,000
Total, chromium ferroalloys	480,000	266,000	467,000	590,000	319,000	826,000
Manganese ferroalloys:						
Ferromanganese:						
More than 4% carbon	130,000	91,300	91,500	201,000	149,000	247,000
More than 2% but not more than 4% carbon	374	294	320	142	106	147
More than 1% but not more than 2% carbon	58,600	47,200	67,300	73,600	59,300	119,000
Not more than 1% carbon	40,000	33,900	53,400	56,100	47,400	99,500
Silicomanganese	264,000	178,000	195,000	351,000	236,000	401,000
Total, manganese ferroalloys	494,000	350,000	408,000	682,000	492,000	867,000
Ferrosilicon:						
55%–80% silicon, more than 3% calcium	8,900	6,550	12,100	5,690	4,040	8,900
55%-80% silicon, other	177,000	133,000	188,000	162,000	123,000	218,000
80%–90% silicon	115	95	150	494	419	770
More than 90% silicon	2,640	2,490	1,280	4,820	4,450	2,420
Magnesium ferrosilicon	17,000	7,610	29,800	16,000	6,890	26,700
Ferrosilicon, other	16,900	5,120	14,700	27,800	7,620	18,400
Total, ferrosilicon	222,000	155,000	246,000	217,000	147,000	275,000
Total, bulk ferroalloys	1,200,000	771,000 r	1,120,000	1,490,000	957,000	1,970,000
Noble ferroalloys:						
Ferrocerium and other pyrophoric alloys	302 r	XX	4,360	--	XX	--
Ferromolybdenum	2,750	1,900	46,900	7,590	5,130	112,000
Ferronickel	38,800	8,090	102,000	76,500	22,700	243,000
Ferroniobium[2]	9,400 r	6,100	210,000 r	11,000	6,800	230,000
Ferrophosphorus	5,550	XX	2,850	8,420	XX	3,930
Ferrotitanium and ferrosilicon-titanium	3,140	XX	7,840	2,550	XX	7,570
Ferrotungsten and ferrosilicon-tungsten	328	236	6,130	276	209	5,800
Ferrovanadium	2,220	1,590	47,800	3,880	2,810	92,800
Ferrozirconium	59	XX	240	161	XX	601
Ferroalloys, other	6,760	XX	11,500	6,790	XX	16,400
Total, noble ferroalloys	69,300	17,900 r	441,000	117,000	37,700	712,000
Grand total	1,260,000	789,000 r	1,560,000	1,610,000	995,000	2,680,000

[r]Revised. XX Not applicable. -- Zero.
[1]Table includes data available through March 19, 2020. Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Contained weight calculated assuming 65% contained Nb for ferroniobium.

Source: U.S. Census Bureau.

TABLE 9

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

(Metric tons, gross weight)

Country or locality	2013	2014	2015	2016	2017
Albania, ferrochromium	24,692	34,897	43,669 r	44,551 r	49,000
Argentina:					
Ferrosilicon[e]	15,000	17,000	12,700	12,000	13,000
Silicomanganese	-- r	-- r	-- r	10,000 r	--
Total	15,000 r	17,000 r	12,700 r	22,000 r	13,000
Armenia, ferromolybdenum	6,619	6,528	5,576	6,526 r	6,588
Australia:					
Ferromanganese	143,900 r	161,900 r	150,000 r	116,900 r	125,100
Silicomanganese	110,100 r	119,400 r	130,700 r	83,700 r	120,200
Total	254,000 r	281,300 r	280,700 r	200,600 r	245,300
Austria:					
Ferronickel	2,500	2,500	2,500	2,500	2,500 e
Other, unspecified	12,000 r	12,000 r	12,000 r	12,000 r	12,000
Total	14,500 r	14,500 r	14,500 r	14,500 r	14,500
Bahrain, silicomanganese	6,000 r	6,000 r	6,000 r	5,000 r	--
Bhutan, ferrosilicon[3]	82,992	79,485	104,406	106,234 r	84,593
Brazil:					
Ferrochromium[4]	189,088	285,340	173,467 r	150,240 r	171,531
Ferromanganese	106,980 r	110,270 r	84,160 r	83,780 r	123,470
Ferronickel	113,721 r	107,243 r	171,000 e	214,000 e	214,000 e
Ferroniobium	71,000 r	80,000 r	80,000 r	73,000 r	81,000
Ferrosilicon[e]	147,000	98,000	88,300	62,300	88,000
Silicomanganese	228,000 r	214,000 r	141,540 r	166,680 r	202,520
Total	855,789 r	894,853 r	738,467 r	750,000 r	880,521
Burma, ferronickel[e]	4,800	59,000 r	60,000	33,600 r	98,000
Canada:					
Ferroniobium	7,600 r	8,900 r	8,300 r	9,600 r	11,000
Ferrosilicon[e]	39,000 r	32,000	38,000	38,000	40,000
Ferrovanadium[e]	1,000 r	1,000 r	1,000 r	1,000	1,000
Total	47,600 r	41,900 r	47,300 r	48,600 r	52,000
China:					
Ferrochromium	3,928,700	4,120,000 r	3,940,000 r	4,230,000 r	4,940,000
Ferromanganese:					
Blast furnace	452,600	457,000 e	446,000 e	340,000 e	220,000 e
Electric furnace	3,150,300 r	2,170,000 e	2,120,000 e	1,610,000 e	1,560,000 e
Ferromolybdenum	120,000	120,000	116,000	127,000	141,000
Ferronickel equivalent, nickel pig iron[e, 5]	2,400,000	2,400,000 r	1,900,000 r	1,900,000 r	2,100,000
Ferrosilicon	5,940,000	5,500,000	4,730,000	4,300,000	3,650,000
Ferrovanadium	61,400	40,000 e	20,380 r	30,590 r	30,500 e
Silicomanganese	7,919,400	7,319,000 r	5,870,000 r	7,267,000 r	6,610,000
Other, unspecified	9,530,000 r	6,970,000 r	10,700,000 r	7,700,000 r	5,230,000
Total	33,502,400 r	29,096,000 r	29,842,380 r	27,504,590 r	24,481,500
Colombia, ferronickel[e]	170,000 r	142,000 r	126,000 r	128,000 r	140,000
Dominican Republic, ferronickel	23,419 r	--	--	33,203 r	43,894
Egypt:					
Ferromanganese	30,000	12,000	12,000	12,000	12,000
Ferrosilicon[6]	50,800 e	56,794	56,093	60,477 r	60,500 e
Total	80,800	68,794	68,093	72,477 r	72,500
Finland, ferrochromium	433,677	441,291 r	457,063 r	469,141 r	416,285
France:					
Ferromanganese	104,000	116,000 e	126,000	119,000 r	95,400
Ferrosilicon[e]	50,000	50,000	35,000	35,000	35,000
Silicomanganese	64,900 r	64,800 r	65,100 r	58,200 r	58,400
Total	218,900 r	230,800 r	226,100 r	212,200 r	188,800
Gabon, silicomanganese	--	4,000 e	14,500 r	14,900 r	21,300
Georgia, silicomanganese	253,361	256,677	217,300	244,228 r	284,034

See footnotes at end of table.

TABLE 9—Continued

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

(Metric tons, gross weight)

Country or locality	2013	2014	2015	2016	2017
Germany:[e]					
Ferrochromium	17,500 [r]	17,000 [r]	17,000 [r]	17,000 [r]	17,000
Other, unspecified	8,200	8,200	8,200	8,200	8,200
Total	25,700 [r]	25,200 [r]	25,200 [r]	25,200 [r]	25,200
Greece, ferronickel	88,910 [r]	94,950	89,130 [r]	87,880 [r]	86,140
Guatemala, ferronickel[e]	--	15,300	32,800	26,300	37,600
Iceland, ferrosilicon	125,204	112,657 [r]	121,556	128,019 [r]	116,811
India:					
Ferroaluminum	5,108	4,596	3,010 [r]	4,140 [r]	4,337
Ferroboron	29 [r]	45	42 [r]	--	--
Ferrochromium[7]	944,000	944,000	944,000	944,000	944,000
Ferromanganese	370,000 [r]	474,000 [r]	460,000 [r]	455,000 [r]	520,000
Ferromolybdenum	1,151	1,281	1,281	1,614	1,315
Ferrosilicomagnesium	21,365	25,788	21,887	21,140	16,669
Ferrosilicon[7]	92,013	92,014	92,000	90,000	90,000
Ferrosilicozirconium	--	--	-- [r]	--	--
Ferrotitanium	691 [r]	760	204	231	393
Ferrovanadium	815	1,031	879	1,266	1,318
Silicomanganese	1,920,000 [r]	1,790,000 [r]	1,618,000 [r]	1,645,000 [r]	1,900,000
Total	3,355,172 [r]	3,333,515 [r]	3,141,303 [r]	3,162,391 [r]	3,478,032
Indonesia:					
Ferronickel[e]	91,000	82,600	85,700	101,000	109,000
Ferronickel equivalent, nickel pig iron[e, 5]	--	--	136,000	379,000	245,000
Silicomanganese	23,000 [r]	25,000 [r]	30,000 [r]	40,000 [r]	40,000
Total	114,000 [r]	107,600 [r]	251,700 [r]	520,000 [r]	394,000
Italy:					
Ferromanganese	6,000	--	--	--	--
Other, unspecified	-- [r]	-- [r]	-- [r]	-- [r]	--
Total	6,000 [r]	-- [r]	-- [r]	-- [r]	--
Japan:					
Ferrochromium	21,671	16,000 [r, e]	15,000 [r, e]	15,000 [r, e]	16,000 [e]
Ferromanganese	460,936	463,345	465,952	473,740 [r]	456,460
Ferromolybdenum	4,550	4,500	4,500	4,000	--
Ferronickel	402,768	379,291	396,969	333,448	312,324
Ferrovanadium	4,433	4,400 [e]	4,000 [e]	4,000	--
Silicomanganese	24,741	26,500	-- [r]	-- [r]	--
Other, unspecified	19,394	79,912	73,651	77,453	79,809
Total	938,493	973,948 [r]	960,072 [r]	907,641 [r]	864,593
Kazakhstan:					
Ferrochromium	1,336,532	1,351,803	1,414,476 [r]	1,525,221 [r]	1,640,300
Ferrosilicon	472	395 [e]	86,984	68,779 [r]	59,926
Ferrosilicon-chromium	165,195	158,825 [r]	74,609	94,468	110,497
Silicomanganese	203,986 [r]	200,379 [r]	164,189 [r]	135,885	123,977
Other, unspecified	81	3,735	1,662	1,987	--
Total	1,706,266 [r]	1,715,137 [r]	1,741,920 [r]	1,826,340 [r]	1,934,700
Korea, Republic of:					
Ferromanganese	335,000 [r]	360,000 [r]	300,000	295,000 [r]	301,958
Ferronickel	127,000 [r]	114,000 [r]	195,000 [r]	228,000 [r]	237,000
Silicomanganese	268,000 [r]	235,000 [r]	175,000 [r]	135,000 [r]	140,937
Total	730,000 [r]	709,000 [r]	670,000 [r]	658,000 [r]	679,895
Kosovo, ferronickel[e]	35,000 [r]	38,700 [r]	56,500	12,700 [r]	38,500
Macedonia:					
Ferronickel[e]	90,900 [r]	82,100 [r]	80,500 [r]	48,200 [r]	32,600
Ferrosilicon	72,279	73,014	45,698	24,431 [r]	21
Total	163,179 [r]	155,078 [r]	126,148 [r]	72,626 [r]	32,635
Malaysia, ferrosilicon	--	8,641	104,554 [r]	126,261	174,540

See footnotes at end of table.

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

(Metric tons, gross weight)

Country or locality	2013	2014	2015	2016	2017
Mexico:					
Ferromanganese	62,504 r	67,506 r	67,920 r	84,530 r	90,013
Silicomanganese	152,475 r	164,855 r	139,361 r	134,251 r	148,130
Total	214,979 r	232,361 r	207,281 r	218,781 r	238,143
New Caledonia, ferronickel	174,078	224,884	228,484	261,420	269,961
Norway:					
Ferromanganese	306,700 r	295,400 r	309,200 r	329,100 r	400,800
Ferrosilicon	349,389	350,000 e	350,000 e	350,000 e	350,000 e
Silicomanganese	301,400	314,300	309,900	306,100 r	284,500
Total	957,489 r	959,700 r	969,100 r	985,200 r	1,035,300
Oman, ferrochromium	20,625	44,063	63,750	90,063 r	79,563
Poland:					
Ferromanganese	820	549	460	450 r, e	510 e
Ferrosilicon	73,589	62,878	77,754 r	77,682 r	78,000 e
Silicomanganese	100	32 e	--	--	--
Other, unspecified	11,250	24,909	460 r	12,517 r	12,000 e
Total	85,759	88,368	78,674 r	90,649 r	90,510
Russia:					
Ferrochromium	487,810	439,600	363,286	268,439 r	436,280
Ferromanganese	181,400	178,600	155,700	124,200	167,100
Ferroniobium[e]	290 r	250 r	390 r	190 r	150
Ferrophosphorus	1,500 r, e	1,500 r, e	1,500 r, e	1,500 r, e	1,538
Ferrosilicon	1,012,740	1,026,190	1,057,909 r	935,912 r	840,765
Ferrosilicon-chromium	58,130	67,160	102,000	75,000 e	75,000 e
Ferrotitanium	7,500 e	7,500 e	9,961	10,741	10,000 e
Ferrovanadium	10,500 e	11,400 e	12,277 r	12,392 r	12,588
Silicomanganese	169,190	179,910	188,895	203,216	52,095
Other, unspecified[e]	6,000 r	6,500 r	8,000 r	9,000 r	10,000
Total	1,935,060 r	1,918,610 r	1,899,918 r	1,640,590 r	1,605,516
Saudi Arabia:					
Silicomanganese	84,000 r	60,000	63,000	60,000 e	65,000
Other, unspecified	196,000	196,000	200,000	200,000 e	200,000 e
Total	280,000 r	256,000	263,000	260,000 e	265,000
Slovakia:					
Ferromanganese	2,119 r	20,554	25,376	35,589	42,115
Ferrosilicon	41,664	47,019	45,961	38,030 r	52,436
Silicomanganese	26,794	29,643	27,036	35,719 r	40,265
Total	70,577	97,216	98,373	109,338 r	134,816
South Africa:					
Ferrochromium[8]	3,219,162	3,719,010	3,684,598	3,596,000 r	3,600,000 e
Ferromanganese	681,000	787,000 r	512,000	335,000 r	257,100
Ferrosilicon	78,400	87,700	91,800 r	73,200 r	34,000 e
Ferrovanadium[e]	18,000	19,000	15,000	7,000 r	7,000
Silicomanganese	133,600	228,100	210,200	144,000	160,400
Total	4,130,162	4,840,810 r	4,513,598 r	4,155,200 r	4,058,500
Spain:					
Ferromanganese	106,900 r	133,500 r	126,200	120,100 r	132,100
Ferrosilicon[e]	80,500	80,500	80,000	80,000	95,000
Silicomanganese	136,100 r	128,700 r	134,400 r	123,100 r	138,700
Total	323,500 r	342,700	340,600 r	323,200 r	365,800
Sweden, ferrochromium	49,000	67,000	90,480 r	81,900 r	92,390
Turkey:					
Ferrochromium	132,603 r	86,025 r	82,650 r	75,000 r	83,894
Ferrosilicon[9]	1,900 r	3,400 r	1,400 r	2,600 r	2,700
Total	134,503 r	89,425 r	84,050 r	77,600 r	86,594

See footnotes at end of table.

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

(Metric tons, gross weight)

Country or locality	2013	2014	2015	2016	2017
Ukraine:					
Ferromanganese	88,626	102,934	87,740	104,470	114,500
Ferronickel	121,586	114,222	95,209	79,900 r	72,500
Ferrosilicon	191,207	142,300 r	90,200 r	101,420 r	92,910
Silicomanganese	724,892	840,433	698,400	814,970	810,670
Other, unspecified	15,908	15,326	19,360	--	1,410
Total	1,142,219	1,215,215 r	990,909 r	1,100,760 r	1,091,990
United States:[10]					
Bulk ferroalloys	503,000	517,000	424,000	369,000	333,000
Noble ferroalloys e	18,300	15,100	21,000 r	19,100 r	13,300
Total	521,000	532,000	445,000	388,000 r	346,000
Venezuela:					
Ferromanganese	9,000	8,000	-- r	-- r	--
Ferronickel	--	20,800 e	16,700 e	--	--
Ferrosilicon e	74,300	74,300	74,300	37,000	--
Silicomanganese	48,000 r	39,000	35,000	42,000 r	18,670
Total	131,300 r	142,100 r	126,000 r	79,000 r	18,670
Zimbabwe, ferrochromium	150,063 r	235,256 r	115,586	78,200 r	142,800
Grand total[10]	53,600,000 r	50,200,000 r	50,100,000 r	47,400,000 r	44,800,000
Of which:					
Ferroaluminum	5,110	4,600	3,010	4,140	4,340
Ferroboron	29 r	45	42 r	--	--
Ferrochromium	11,000,000	11,800,000 r	11,400,000 r	11,600,000 r	12,600,000
Ferromanganese	6,600,000	5,920,000	5,450,000	4,640,000	4,620,000
Ferromolybdenum	132,000	132,000	127,000	139,000	149,000
Ferronickel	3,850,000 r	3,840,000 r	3,700,000 r	3,840,000 r	4,000,000
Ferroniobium	78,900 r	89,200 r	88,700 r	82,800 r	92,200
Ferrophosphorus	1,500 r, e	1,500 r, e	1,500 r, e	1,500 r, e	1,540
Ferrosilicomagnesium	21,400	25,800	21,900	21,100	16,700
Ferrosilicon	8,520,000 r	7,990,000 r	7,380,000 r	6,750,000 r	5,960,000
Ferrosilicon-chromium	223,000	226,000	177,000	169,000 r	185,000
Ferrosilicozirconium	--	--	-- r	--	--
Ferrotitanium	8,190	8,260	10,200	11,000	10,400
Ferrovanadium	96,200 r	76,800 r	53,500 r	56,200 r	52,400
Silicomanganese	12,800,000	12,200,000 r	10,200,000 r	11,700,000 r	11,200,000
Other, unspecified	10,300,000 r	7,850,000 r	11,500,000 r	8,410,000 r	5,900,000

[e]Estimated. [r]Revised. -- Zero.
[1]Table includes data available through March 19, 2019. 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]Ferroalloys may have been produced in other countries and (or) localities, but production information was inadequate to make reliable estimates of output.
[3]Total of imports received by all countries from Bhutan. Source: UN Comtrade.
[4]Includes high- and low-carbon ferrochromium.
[5]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.
[6]Production is based on fiscal year, with a starting date of July 1.
[7]Production is based on fiscal year, with a starting date of April 1.
[8]Includes high- and low-carbon ferrochromium and ferrosilicon-chromium.
[9]Exports. Source: UN Comtrade.
[10]Data for the United States are included in the “Other, unspecified” category and “Grand total” only. These data are not included in any commodity specific subtotals.