VANADIUM

(Data in metric tons of vanadium content unless otherwise noted)

Domestic Production and Use: In 2018, secondary vanadium production continued primarily in Arkansas, Delaware, Ohio, Pennsylvania, and Texas, where processed waste materials (petroleum residues, spent catalysts, utility ash, and vanadium-bearing pig iron slag) were used to produce ferrovanadium, vanadium-bearing chemicals or specialty alloys, vanadium metal, and vanadium pentoxide. In 2009–13, small quantities of vanadium were produced as a byproduct from the mining of uraniferous sandstones on the Colorado Plateau. All byproduct vanadium production has been suspended since 2014. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 93% of domestic vanadium consumption in 2018. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid.

Salient Statistics—United States:	2014	2015	2016	2017	2018[e]
Production, mine, mill	—	—	—	—	—
Imports for consumption:					
Vanadium ores and concentrates	—	72	18	1	18
Ferrovanadium	3,230	1,980	1,590	2,810	3,000
Vanadium pentoxide, anhydride	3,410	2,870	2,460	3,400	4,700
Oxides and hydroxides, other	104	94	660	148	160
Aluminum-vanadium master alloys	320	143	157	288	300
Ash and residues	3,450	4,600	2,820	2,540	2,400
Sulfate	19	13	12	4	3
Vanadates	197	173	313	349	340
Vanadium metal[1]	117	135	33	54	20
Exports:					
Vanadium ores and concentrates	40	276	433	60	21
Ferrovanadium	253	122	400	229	280
Vanadium pentoxide, anhydride	171	303	4	108	400
Oxides and hydroxides, other	231	66	53	98	50
Aluminum-vanadium master alloys	248	128	53	132	140
Ash and residues	258	41	123	322	290
Vanadium metal[1]	25	4	15	45	40
Consumption:					
Apparent[2]	9,650	9,340	7,400	8,670	9,800
Reported	4,070	3,930	3,830	3,880	3,800
Price, average, dollars per pound vanadium pentoxide[3]	5.61	4.16	3.38	7.61	14
Stocks, yearend[4]	170	166	168	155	180
Net import reliance[5] as a percentage of apparent consumption	100	100	100	100	100

Recycling: The quantity of vanadium recycled from spent chemical process catalysts was significant and may compose as much as 40% of total vanadium catalysts.

Import Sources (2014–17): Ferrovanadium: Austria, 34%; Canada, 22%; Republic of Korea, 16%; Russia, 13%; and other, 15%. Vanadium pentoxide: South Africa, 46%; Russia, 18%; Brazil, 13%; China, 10%; and other, 13%.

Tariff: Item	Number	Normal Trade Relations 12–31–18
Vanadium ores and concentrates	2615.90.6090	Free.
Vanadium bearing ash and residues	2620.40.0030	Free.
Vanadium bearing ash and residues, other	2620.99.1000	Free.
Chemical compounds:		
Vanadium pentoxide anhydride	2825.30.0010	5.5% ad val.
Vanadium oxides and hydroxides, other	2825.30.0050	5.5% ad val.
Vanadium sulfates	2833.29.3000	5.5% ad val.
Vanadates	2841.90.1000	5.5% ad val.
Hydrides & nitrides, of vanadium	2850.00.2000	5.5% ad val.
Ferrovanadium	7202.92.0000	4.2% ad val.
Vanadium metal	8112.92.7000	2.0% ad val.
Vanadium and articles thereof[6]	8112.99.2000	2.0% ad val.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

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VANADIUM

Government Stockpile: None.

Events, Trends, and Issues: U.S. apparent consumption of vanadium in 2018 increased by 13% from that of 2017. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength low-alloy steels accounted for 18%, 44%, and 33%, respectively, of domestic consumption. Average 2018 vanadium pentoxide prices almost doubled compared with 2017 prices, and ferrovanadium prices more than doubled to $33 per pound in 2018 compared with 2017. In September 2018, ferrovanadium prices averaged $39.60 per pound. Prices had not been this high since March 2008. Byproduct vanadium production in the United States was expected to resume by early 2019 at the White Mesa mill in Utah. An iron and vanadium mine in South Africa remained closed and left South Africa with only two major producers of vanadium. Few new vanadium operations have been commissioned in recent years, with the exception of a producer in Brazil that started production in 2014. The producer began construction on an expansion plan in June 2018 that would further increase capacity.

In February 2018, the Standardization Administration of China released a new high-strength rebar standard that would decrease the use of substandard steels in construction. The implementation date was expected to be November 1, 2018. The increase of vanadium in rebar was expected to increase overall consumption of vanadium in China by approximately 10,000 tons per year, depending on the degree of enforcement.

In May 2018, the U.S. Department of the Interior, in coordination with other executive branch agencies, published a list of 35 critical minerals (83 FR 23295), including vanadium. This list was developed to serve as an initial focus, pursuant to Executive Order 13817, ‘‘A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals” (82 FR 60835).

World Mine Production and Reserves: Reserves for Brazil and China were revised based on Government reports.

	Mine production		Reserves[7]
	2017	2018[e]	(thousand metric tons)
United States	—	—	45
Australia	—	—	[8]2,100
Brazil	5,210	6,300	130
China	40,000	40,000	9,500
Russia	18,000	18,000	5,000
South Africa	7,960	9,100	3,500
World total (rounded)	71,200	73,000	20,000

World Resources: World resources of vanadium exceed 63 million tons. Vanadium occurs in deposits of phosphate rock, titaniferous magnetite, and uraniferous sandstone and siltstone, in which it constitutes less than 2% of the host rock. Significant quantities are also present in bauxite and carboniferous materials, such as coal, crude oil, oil shale, and tar sands. Because vanadium is typically recovered as a byproduct or coproduct, demonstrated world resources of the element are not fully indicative of available supplies. Although domestic resources and secondary recovery are adequate to supply a large portion of domestic needs, all of U.S. demand is currently met by foreign sources.

Substitutes: Steels containing various combinations of other alloying elements can be substituted for steels containing vanadium. Certain metals, such as manganese, molybdenum, niobium (columbium), titanium, and tungsten, are to some degree interchangeable with vanadium as alloying elements in steel. Platinum and nickel can replace vanadium compounds as catalysts in some chemical processes. Currently, no acceptable substitute for vanadium is available for use in aerospace titanium alloys.

[e]Estimated. — Zero.

[1]Vanadium metal includes waste and scrap.

[2]Defined as production + net import reliance.

[3]Prices for 2014–2016 are U.S. annual average vanadium pentoxide prices. The 2017 annual average vanadium pentoxide price includes U.S. monthly averages for January 2017–June 2017 and Chinese monthly average prices for July 2017–December 2017. The price for 2018 is the Chinese annual average vanadium pentoxide price.

[4]Includes chlorides, ferrovanadium, vanadates, vanadium-aluminum alloy, other vanadium alloys, vanadium metal, vanadium pentoxide, and other specialty chemicals.

[5]Defined as imports – exports + adjustments for industry stock changes.

[6]Aluminum-vanadium master alloy consisting of 35% aluminum and 64.5% vanadium.

[7]See Appendix C for resource and reserve definitions and information concerning data sources.

[8]For Australia, Joint Ore Reserves Committee-compliant reserves were about 1.3 million tons.