VANADIUM

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

Domestic Production and Use: In January 2019, byproduct vanadium production resumed in Utah and an estimated 470 tons of contained vanadium with an estimated value of $6.8 million was produced. In 2009–13, small quantities of vanadium were similarly produced as a byproduct from the mining of uraniferous sandstones on the Colorado Plateau. 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. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 94% of domestic reported vanadium consumption in 2019. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts to produce maleic anhydride and sulfuric acid.

Salient Statistics—United States:	2015	2016	2017	2018	2019[e]
Production, mine, mill	—	—	—	—	470
Imports for consumption:					
Vanadium ores and concentrates	72	18	1	330	41
Ferrovanadium	1,980	1,590	2,810	3,130	2,500
Vanadium pentoxide, anhydride	2,870	2,460	3,400	4,600	4,000
Oxides and hydroxides, other	94	660	148	98	140
Aluminum-vanadium master alloys	143	157	288	281	240
Ash and residues	4,600	2,820	2,540	2,810	2,100
Vanadium chemicals[1]	292	407	526	470	150
Vanadium metal[2]	135	33	54	28	60
Exports:					
Vanadium ores and concentrates	166	260	37	29	47
Ferrovanadium	122	394	229	575	380
Vanadium pentoxide, anhydride	356	5	126	563	210
Oxides and hydroxides, other	100	81	148	53	480
Aluminum-vanadium master alloys	128	53	132	90	20
Ash and residues	43	123	322	289	270
Vanadium metal[2]	4	15	45	30	15
Consumption:					
Apparent[3]	9,300	7,220	8,740	10,100	8,300
Reported	4,720	4,620	4,680	5,660	4,600
Price, average, dollars per pound vanadium pentoxide[4]	4.16	3.38	7.61	16.4	11.8
Stocks, yearend[5]	136	138	125	185	190
Net import reliance[6] as a percentage of apparent consumption	100	100	100	100	94

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 (2015–18): Ferrovanadium: Austria, 48%; Canada, 22%; Russia, 14%; Republic of Korea, 11%; and other, 5%. Vanadium pentoxide: South Africa, 44%; Brazil, 29%; China, 11%; Taiwan, 6%; and other, 10%.

Tariff: Item	Number	Normal Trade Relations 12–31–19
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[7]	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 2019 decreased by 18% from that of 2018. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength low-alloy steels accounted for 18%, 45%, and 31%, respectively, of domestic consumption. Average 2019 vanadium pentoxide prices decreased by 28% compared with 2018 prices, and ferrovanadium prices decreased by 41% to $23 per pound in 2019 compared with 2018. In January 2019, ferrovanadium prices averaged $43.10 per pound but continued to decrease for the remainder of 2019. Byproduct vanadium production in the United States resumed in early 2019 at the White Mesa mill in Utah. The company expected to continue production, subject to successful recovery and suitable prices. An iron and vanadium mine in South Africa remained closed leaving South Africa with only two major producers of vanadium. A producer in Brazil that started production in 2014 began construction on an expansion project in 2018 that would increase its production capacity by 25%. The expansion was expected to be completed by the end of the third quarter of 2019.

The implementation of the new high-strength rebar standards by the Standardization Administration of China has been enforced more gradually than originally expected. Larger mills began implementation in 2018; however, smaller mills have been slower to implement the new standards. Enforcement of the new standards was also reportedly more difficult to monitor at smaller mills. The increase of vanadium in rebar was originally expected to increase overall consumption of vanadium in China by approximately 10,000 tons per year.

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

	Mine production		Reserves[8]
	2018	2019[e]	(thousand metric tons)
United States	—	470	45
Australia	—	—	[9]4,000
Brazil	5,500	7,000	120
China	40,000	40,000	9,500
Russia	18,000	18,000	5,000
South Africa	7,700	8,000	3,500
World total (rounded)	71,200	73,000	22,000

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]Includes hydrides, nitrides, sulfates, and vanadates of vanadium.

[2]Vanadium metal includes waste and scrap.

[3]Defined as production + net import reliance.

[4]Prices for 2015–2016 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 China monthly average prices for July 2017–December 2017. The prices for 2018–2019 are the China annual average vanadium pentoxide prices.

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

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

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

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

[9]For Australia, Joint Ore Reserves Committee-compliant reserves were 1.1 million tons.