

## VANADIUM

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

**Domestic Production and Use:** In 2015, six U.S. firms that compose most of the domestic vanadium industry produced ferrovandium, vanadium pentoxide, vanadium metal, and vanadium-bearing chemicals or specialty alloys by processing materials such as petroleum residues, spent catalysts, utility ash, and vanadium-bearing pig iron slag. In 2009–13, small quantities of vanadium were produced as a coproduct from the mining of uranium-bearing sandstones on the Colorado Plateau. All coproduct vanadium production was suspended in 2014 and 2015. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 93% of the domestic vanadium consumption in 2015. Of the other uses for vanadium, the major nonmetallurgical use was in catalysts for the production of maleic anhydride and sulfuric acid.

<b>Salient Statistics—United States:</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015<sup>e</sup></b>
Production, mine, mill	590	106	591	—	—
Imports for consumption:					
Ferrovanadium	2,220	4,190	3,710	3,230	3,300
Vanadium pentoxide, anhydride	2,800	1,640	2,040	3,410	3,500
Oxides and hydroxides, other	886	905	205	104	35
Aluminum-vanadium master alloys (gross weight)	86	115	169	431	260
Ash and residues	1,510	2,210	4,190	6,160	2,200
Sulfates	42	29	30	19	18
Vanadates	303	280	276	197	64
Vanadium metal, including waste & scrap (gross weight)	44	154	35	161	113
Exports:					
Ferrovanadium	316	337	299	253	120
Vanadium pentoxide, anhydride	89	62	90	201	105
Oxides and hydroxides, other	264	305	427	350	200
Aluminum-vanadium master alloys (gross weight)	318	432	347	443	45
Vanadium metal, including waste & scrap (gross weight)	102	26	58	32	14
Consumption:					
Reported	4,140	3,960	3,980	4,070	3,600
Apparent	7,570	8,530	10,100	12,300	9,100
Price, average, dollars per pound V <sub>2</sub> O <sub>5</sub>	6.76	6.49	6.04	5.61	4.40
Stocks, consumer, yearend <sup>1</sup>	193	219	220	225	180
Net import reliance <sup>2</sup> as a percentage of apparent consumption	92	99	94	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. Some tool steel scrap was recycled primarily for its vanadium content but this only accounted for a small percentage of total vanadium used.

**Import Sources (2011–14):** Ferrovandium: Czech Republic, 43%; Canada, 22%; Republic of Korea, 18%; Austria, 14%; and other, 3%. Vanadium pentoxide: South Africa, 40%; Russia, 35%; China, 18%; and other, 7%.

**Tariff:** Ash, residues, slag, and waste and scrap enter duty-free.

Item	Number	Normal Trade Relations <u>12–31–15</u>
Vanadium pentoxide anhydride	2825.30.0010	5.5% ad val.
Vanadium oxides and hydroxides, other	2825.30.0050	5.5% ad val.
Vanadates	2841.90.1000	5.5% ad val.
Ferrovanadium	7202.92.0000	4.2% ad val.
Vanadium and articles thereof <sup>3</sup>	8112.99.2000	2.0% ad val.

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

**Government Stockpile:** None.

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**Events, Trends, and Issues:** U.S. reported consumption of vanadium in 2015 was slightly more than that of 2014. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength low-alloy steels accounted for 16%, 43%, and 34%, respectively, of domestic consumption. U.S. imports for consumption of vanadium in 2015 decreased by 31% from those of the previous year. The main decrease was in imports of vanadium-bearing ash and residues (64% decrease from those of 2014). U.S. exports decreased by 55% from those of the previous year. The decrease was seen across all materials being exported, not just one specific material.

In April 2015, a vanadium producer in South Africa announced that it planned to apply for bankruptcy protection. The company had been suffering from ongoing energy supply interruptions as well as rising energy costs that affected ferrovanadium (FeV) production costs. South African FeV export prices have gradually declined since 2009. Any disruption in the supply of feedstock by the company could affect vanadium production in Austria, South Africa, and the United States. Products dependent on the feedstock from South Africa included aluminum-vanadium, FeV, vanadium chemicals, and vanadium oxides.

Vanadium pentoxide ( $V_2O_5$ ) and FeV prices continued to decrease throughout 2015. In May 2015,  $V_2O_5$  prices were \$4.15 per pound. Weak demand for vanadium, triggered by a slowdown of the Chinese economy, was a contributing factor. If prices continue to decrease or remain at 2015 levels, more secondary vanadium producers are expected to temporarily suspend vanadium production.

### World Mine Production and Reserves:

	Mine production		Reserves <sup>4</sup> (thousand metric tons)
	2014	2015 <sup>e</sup>	
United States	—	—	45
Australia	—	—	1,800
Brazil	1,030	2,800	NA
China	45,000	42,000	5,100
Russia	15,100	15,000	5,000
South Africa	21,000	19,000	3,500
Other countries	580	600	NA
World total (rounded)	82,700	79,400	15,000

**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 in aerospace titanium alloys.

<sup>e</sup>Estimated. NA Not available. — Zero.

<sup>1</sup>Does not include vanadium pentoxide.

<sup>2</sup>Defined as imports – exports + adjustments for industry stock changes.

<sup>3</sup>Aluminum-vanadium master alloy consisting of 35% aluminum and 64.5% vanadium.

<sup>4</sup>See [Appendix C](#) for resource/reserve definitions and information concerning data sources.