

## VANADIUM

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

**Domestic Production and Use:** Seven U.S. firms that compose most of the domestic vanadium industry produced ferrovanadium, 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 2009–12, small amounts of vanadium were produced as a coproduct from the mining of uraniumiferous sandstones on the Colorado Plateau. In the second quarter of 2012, the only coproduct producer of vanadium was acquired by a new company and all coproduct vanadium production for 2013 was suspended. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 93% of the domestic vanadium consumption in 2013. 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>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013<sup>e</sup></b>
Production, mine, mill	230	1,060	590	272	—
Imports for consumption:					
Ferrovanadium	353	1,340	2,220	4,190	4,080
Vanadium pentoxide, anhydride	1,120	4,000	2,810	1,640	1,590
Oxides and hydroxides, other	25	167	886	905	350
Aluminum-vanadium master alloys <sup>1</sup> (gross weight)	25	63	86	115	40
Ash and residues	791	521	1,420	2,040	3,040
Sulfates	16	48	42	29	50
Vanadates	214	158	303	280	390
Vanadium metal, including waste & scrap (gross weight)	22	10	44	154	140
Exports:					
Ferrovanadium	672	611	314	337	500
Vanadium pentoxide, anhydride	401	140	98	62	100
Oxides and hydroxides, other	506	1,100	254	287	540
Aluminum-vanadium master alloys <sup>1</sup> (gross weight)	67	133	318	432	10
Vanadium metal, including waste & scrap	23	21	102	26	60
Consumption:					
Apparent	1,190	5,450	7,490	8,530	8,350
Reported	4,690	5,030	4,140	3,980	3,700
Price, average, dollars per pound V <sub>2</sub> O <sub>5</sub>	5.43	6.46	6.76	6.49	6.25
Stocks, consumer, yearend	295	248	<sup>2</sup> 193	<sup>2</sup> 223	<sup>2</sup> 298
Net import reliance <sup>3</sup> as a percentage of apparent consumption	81	81	92	97	100

**Recycling:** Some tool steel scrap was recycled primarily for its vanadium content. The vanadium content of other recycled steels was lost to slag during processing and was not recovered. The quantity of vanadium recycled from spent chemical process catalysts was significant and may comprise as much as 40% of total supply.

**Import Sources (2009–12):** Ferrovanadium: Canada, 28%; Czech Republic, 28%; Republic of Korea, 23%; Austria, 19%; and other, 2%. Vanadium pentoxide: Russia, 43%; South Africa, 37%; China, 15%; and other, 5%.

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

Item	Number	Normal Trade Relations <u>12–31–13</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.
Aluminum-vanadium master alloys	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. apparent consumption of vanadium in 2013 decreased slightly from its 2012 level. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength low-alloy steels accounted for 17%, 44%, and 33%, respectively, of domestic consumption. U.S. imports for consumption of vanadium in 2013 increased slightly from those of the previous year. U.S. exports increased by 6% from those of the previous year.

In January 2012, vanadium pentoxide ( $V_2O_5$ ) prices were at their year-to-date low of \$5.83 per pound of  $V_2O_5$ , but gradually increased to a year-to-date high of \$6.75 per pound of  $V_2O_5$  in October. Starting in November 2012, prices slowly decreased until March 2013. In June 2013, prices averaged \$6.10 per pound of  $V_2O_5$ . U.S. ferrovanadium (FeV) prices trended upward from January 2012 and reached a year-to-date high of \$17.00 per pound FeV (contained vanadium) in June 2012. In July 2012, prices decreased until February 2013 when prices began to increase. In May 2013, prices began to decrease again. In June 2013, prices averaged \$13.25 per pound of FeV.

### **World Mine Production and Reserves:**

	Mine production		Reserves <sup>4</sup> (thousand metric tons)
	<u>2012</u>	<u>2013<sup>e</sup></u>	
United States	272	—	45
China	39,000	40,000	5,100
Russia	15,000	15,000	5,000
South Africa	19,500	20,000	3,500
Other countries	<u>600</u>	<u>600</u>	<u>NA</u>
World total (rounded)	74,000	76,000	14,000

**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 amounts 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. While domestic resources and secondary recovery are adequate to supply a large portion of domestic needs, a substantial part of U.S. demand is currently met by foreign material.

**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>In previous years, imports and exports of aluminum-vanadium master alloys (HTS 7601.20.9030) were reported. Starting with MCS 2014, imports and exports of aluminum-vanadium master alloys (HTS 8112.99.2000) consisting of 35% aluminum and 64.5% vanadium were reported, resulting in changes to apparent consumption calculations.

<sup>2</sup>Does not include vanadium pentoxide.

<sup>3</sup>Defined as imports – exports + adjustments for Government and industry stock changes.

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