

## VANADIUM

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

**Domestic Production and Use:** Eight U.S. firms that make up 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. Metallurgical use, primarily as an alloying agent for iron and steel, accounted for about 94% of the domestic vanadium consumption. 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>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005<sup>e</sup></b>
Production, mine, mill <sup>1</sup>	—	—	—	—	—
Imports for consumption:					
Ash, ore, residues, slag	1,670	1,870	3,060	2,350	3,370
Vanadium pentoxide, anhydride	804	455	679	1,230	1,520
Oxides and hydroxides, other	57	66	74	133	234
Aluminum-vanadium master alloys (gross weight)	10	98	232	19	—
Ferrovanadium	2,550	2,520	1,360	3,020	4,460
Exports:					
Vanadium pentoxide, anhydride	71	91	185	240	232
Oxides and hydroxides, other	63	203	284	584	819
Aluminum-vanadium master alloys (gross weight)	363	529	677	887	1920
Ferrovanadium	70	142	397	267	488
Consumption, reported	3,210	3,080	3,240	4,050	4,180
Price, average, dollars per pound V <sub>2</sub> O <sub>5</sub>	1.37	1.34	2.21	5.28	17.50
Stocks, consumer, yearend	251	221	250	305	275
Employment, mine and mill, number <sup>1</sup>	—	—	—	—	—
Net import reliance <sup>2</sup> as a percentage of reported consumption	100	100	100	100	100

**Recycling:** Some tool steel scrap was recycled primarily for its vanadium content, and vanadium was recycled from spent chemical process catalysts, but these two sources together accounted for only a very small percentage of total vanadium used. The vanadium content of other recycled steels was lost to slag during processing and was not recovered.

**Import Sources (2001-04):** Ferrovanadium: Czech Republic, 33%; Canada, 16%; South Africa, 14%; Swaziland, 14%; and other, 23%. Vanadium pentoxide: South Africa, 92%; Mexico, 2%; and other, 6%.

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

Item	Number	Normal Trade Relations <u>12-31-05</u>
Vanadium pentoxide anhydride	2825.30.0010	6.6% ad val.
Vanadium oxides and hydroxides, other	2825.30.0050	6.6% ad val.
Vanadates	2841.90.1000	6.1% ad val.
Ferrovanadium	7202.92.0000	4.2% ad val.
Aluminum-vanadium master alloys	7601.20.9030	Free.

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

**Government Stockpile:** None.

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**Events, Trends, and Issues:** Preliminary data indicate that U.S. vanadium consumption in 2005 increased about 3% from that of the previous year. Among the major uses for vanadium, production of carbon, full-alloy, and high-strength low-alloy steels accounted for 34%, 28%, and 30% of domestic consumption, respectively. Steel production in 2005 was expected to be 2% to 3% higher than that of 2004.

Both ferrovanadium and vanadium pentoxide prices increased significantly during 2005. Industry analysts attributed the price rise primarily to strong demand in the steel and aerospace industries and the inability of producers to increase production of vanadium in a timely manner. Prices spiked in the second quarter of 2005 but dropped by about 50% by the end of the year. Closure of the Windimurra Mine in Australia and the Vantec Mine in South Africa in 2004, which rectified oversupply on the world market that had existed from 1999 to 2003, combined with increasing demand resulted in supply shortages in 2005.

### **World Mine Production, Reserves, and Reserve Base:**

	Mine production		Reserves <sup>3</sup>	Reserve base <sup>3</sup>
	<u>2004</u>	<u>2005<sup>e</sup></u>		
United States	—	—	45,000	4,000,000
China	14,000	14,500	5,000,000	14,000,000
Russia	8,000	9,000	5,000,000	7,000,000
South Africa	17,200	18,000	3,000,000	12,000,000
Other countries	<u>1,000</u>	<u>1,000</u>	NA	<u>1,000,000</u>
World total (rounded)	40,200	42,500	13,000,000	38,000,000

**World Resources:** World resources of vanadium exceed 63 million tons. Vanadium occurs in deposits of titaniferous magnetite, phosphate rock, 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 crude oil, coal, oil shale, and tar sands. Because vanadium is usually 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 because it is currently uneconomic to mine vanadium in the United States.

**Substitutes:** Steels containing various combinations of other alloying elements can be substituted for steels containing vanadium. Metals, such as columbium (niobium), manganese, molybdenum, 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. There is currently no acceptable substitute for vanadium in aerospace titanium alloys.

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

<sup>1</sup>Domestic vanadium mine production stopped in 1999.

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

<sup>3</sup>[See Appendix C for definitions.](#)