

# TUNGSTEN

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Tungsten is a whitish-gray metal with many unique properties and a wide variety of commercial, industrial, and military applications. The largest use is as tungsten carbide in cemented carbides, which are wear-resistant materials used by the metalworking, mining, and construction industries. Tungsten metal wires, electrodes, and contacts are used in lighting, electronic, electrical, heating, and welding applications. Tungsten is also used to make heavy-metal alloys for armaments, heat sinks, radiation shielding, and weights and counterweights; superalloys for turbine blades; tool steels; and wear-resistant alloy parts and coatings. Tungsten alloys and composites are used as a substitute for lead in bullets and shot. Tungsten chemicals are used to make catalysts, inorganic pigments, high-temperature lubricants, and semiconductors.

U.S. apparent consumption of all tungsten materials in 2002 was 18% lower than apparent consumption in 2001, primarily because of lower consumption of tungsten scrap and lower shipments from the National Defense Stockpile (NDS). No U.S. tungsten mine production was reported in 2002. U.S. supply of tungsten raw materials comprised imports, tungsten-bearing scrap, releases from industry stocks, and sales of excess materials from the NDS. China continued to be the world's leading producer of tungsten concentrates and the largest supplier of imported tungsten materials to the United States. In 2002, the Cantung Mine in Northwest Territories, Canada, restarted production, providing a new source of concentrates to two major tungsten consumers. Over the course of the year, tungsten prices decreased from the high levels reported in 2001. Salient U.S. and world tungsten statistics for 2002 and the previous 4 years are listed in table 1.

Most data in this report have been rounded to three significant digits. Totals and percentages were calculated from unrounded numbers. Unless otherwise specified, all statistics in this report are in metric tons of contained tungsten.

Tungsten prices and many tungsten statistics from other sources are quoted in units of tungsten trioxide ( $WO_3$ ). The short ton unit, which is used in the United States, is 1% of a short ton (20 pounds), and  $WO_3$  is 79.3% tungsten. A short ton unit of  $WO_3$ , therefore, equals 20 pounds of  $WO_3$  and contains 7.19 kilograms (kg) (15.86 pounds) of tungsten. The metric ton unit, which is used in most other countries, is 1% of a metric ton (10 kg). A metric ton unit of  $WO_3$ , therefore, equals 10 kg of  $WO_3$  and contains 7.93 kg (17.48 pounds) of tungsten.

## Legislation and Government Programs

The Defense National Stockpile Center (DNSC), U.S. Department of Defense, continued its negotiated sales of tungsten materials from the NDS. Four bid offerings were held during calendar year 2002—two for ferrotungsten, one in April and one in August; one for tungsten metal powder in May; and

one for ores and concentrates in October. Although the DNSC had awarded a multiyear contract for ores and concentrates to Comsup Commodities Inc. in March 2001, the agency reportedly chose not to exercise the option to continue the contract beyond the first year (American Metal Market, 2002).

As shown in table 2, during fiscal year 2002 (October 1, 2001, through September 30, 2002), 281 metric tons (t) of contained tungsten was sold. Of the tungsten materials sold, the following quantities, in metric tons of contained tungsten, had not been shipped by the end of the fiscal year: ferrotungsten, 404; tungsten ores and concentrates, 17; tungsten metal powder, 11; and tungsten carbide powder, 4 (U.S. Department of Defense, 2003, p. 55).

During the calendar year, 1,650 t of tungsten contained in ores and concentrates, ferrotungsten, and tungsten metal powder was sold. The quantities of tungsten materials remaining in the stockpile at the end of the calendar year, including those committed for sale and pending shipment, are listed in tables 1 and 2.

The Annual Materials Plan (AMP) for fiscal year 2002, which represented the maximum quantities of tungsten materials that could be sold, is listed in table 2. These quantities remained the same for fiscal year 2003 (October 1, 2002, through September 30, 2003) (U.S. Department of Defense, 2003, p. 10).

## Production

Domestic production statistics for tungsten are based on data collected by the U.S. Geological Survey (USGS) by means of two separate voluntary surveys. Statistics that result from these surveys are listed in tables 1 and 3.

The annual Tungsten Ore and Concentrate Survey covered the production, purchases, disposition, and stocks of tungsten ores and concentrates. No tungsten mine output was reported for the United States in 2002.

The monthly Tungsten Concentrate and Tungsten Products Survey canvassed companies that produced tungsten carbide powder, tungsten chemicals, and/or tungsten metal powder from ammonium paratungstate, tungsten-bearing scrap, and tungsten concentrate. The USGS received responses from 9 of the 10 processing operations on the survey; estimates were made for the nonresponding operation. Major U.S. processors of tungsten materials operating in 2002 included Allegheny Technologies Inc.'s Metalworking Products business, Huntsville, AL; Buffalo Tungsten Inc., Depew, NY; General Electric Co., Euclid, OH; Kennametal Inc., Latrobe, PA, and Fallon, NV; OM Group, Inc. (OMG), Midland, MI, and St. George, UT; and Osram Sylvania, Inc., Towanda, PA.

In 2002, consumption of tungsten concentrates by U.S. processors increased significantly from that of 2001 and returned to approximately the level consumed in 2000. U.S.

processors consumed significantly less tungsten-bearing scrap and 4% less ammonium paratungstate than they did in 2001. Domestic production of ammonium paratungstate was significantly higher than that of 2001. Net production of hydrogen-reduced tungsten metal powder and tungsten carbide powder produced from metal powder increased by 26% in 2002 compared with that of 2001.

Late in the year, OMG announced that it would be selling its noncore assets as part of a restructuring program designed to improve cash flow and strengthen its balance sheet. In November, OMG ceased production of submicron-sized tungsten carbide powders at its Midland, MI, operations, and in December, the company began closing its OMG Apex plant in St. George, UT. This plant produced ammonium paratungstate and cobalt compounds from cemented carbide scrap (OM Group, Inc., 2002a, b).

### Consumption

U.S. apparent consumption of all tungsten materials, as calculated from net imports, primary and secondary production, and changes in Government and industry stock levels, was 11,900 t in 2002, which was 18% lower than the revised 2001 apparent consumption of 14,500 t. In 2002, the United States consumed significantly less tungsten scrap and the U.S. Government shipped significantly less tungsten from the NDS than in 2001.

Statistics on consumption of tungsten in end-use applications by U.S. metal consumers were developed from the voluntary Consolidated Consumers Survey. For this survey, approximately 70 tungsten consumers were canvassed on a monthly or annual basis. Reported consumption and stocks data in tables 1 and 4 include estimates to account for nonrespondents. Total U.S. reported consumption of tungsten materials to make end-use products increased by 4% in 2002 compared with that of 2001. Producers of mill products for lighting and other industries and chemical products used more tungsten in 2002 than in 2001; producers of cemented carbides, steels, superalloys, and other alloys used less tungsten in 2002 than in 2001. As compared with consumption in 2001, in 2002, U.S. industry consumed more tungsten metal powder and tungsten chemicals, and less ferrotungsten, tungsten carbide powder, and tungsten scrap.

Weekly reports of the number of operating drilling rigs give an indication of the demand for cemented carbide components used by industry to explore for or produce oil and natural gas. During the first quarter of 2002, the downward trend in the number of rigs that operated in the United States that began in early August 2001 continued. The highest number of operating rigs was 883 during the first week of the year. The rig count decreased to 738 in early April and then recovered to 859 by late May. From June through December, the count remained relatively stable between 826 and 875 rigs. In 2002, the average number of operating rigs in the United States was 830, 28% lower than the average of 1,156 operating rigs in 2001 (Baker Hughes Inc., undated<sup>1</sup>).

In 2002, total consumption of tungsten scrap by U.S. processors and consumers was 4,380 t of contained tungsten, which was a 19% decrease from the 5,390 t of scrap consumed in 2001.

### Prices

Because ammonium paratungstate is the most widely traded primary tungsten material, its price has become a reference price for upstream materials such as tungsten ore concentrates and downstream materials such as tungsten metal powders and tungsten carbide powders (International Tungsten Industry Association, 1997, p. 32; Ross, 2001, p. 5). In 2002, published prices for ammonium paratungstate in the U.S. market decreased from the high levels reported in 2001 (table 1). The U.S. ammonium paratungstate price reported by Platts Metals Week began the year at \$70 to \$80 per short ton unit [\$77 to \$88 per metric ton unit (mtu)] and steadily decreased to \$45 to \$55 per short ton unit (\$50 to \$61 per mtu) by yearend. The U.S. ammonium paratungstate price reported by Metal Bulletin began the year at \$74 to \$80 per short ton unit (\$82 to \$88 per mtu), was \$65 to \$75 per short ton unit (\$72 to \$83 per mtu) from late January through June, then decreased to a low of \$55 to \$60 per short ton unit (\$61 to \$66 per mtu) for most of July. In late July, the price increased to \$56.30 to \$61.50 per short ton unit (approximately \$62 to \$68 per mtu) and in mid-August, it increased again to \$58 to \$62.50 per short ton unit (\$64 to approximately \$69 per mtu), where it remained through yearend.

Prices of tungsten concentrates also decreased from the high levels reported in 2001 (tables 1 and 5). The U.S. spot tungsten ore concentrate price reported by Platts Metals Week began the year at \$50 to \$60 per short ton unit (\$55 to \$66 per mtu) and then decreased to \$40 to \$55 per short ton unit (\$44 to \$61 per mtu) from mid-April to yearend. The concentrate price reported by Metal Bulletin began the year at \$40 to \$48 per mtu and then steadily decreased to a low of \$25 to \$45 per mtu by late March. In early May, the price increased to \$32 to \$45 per mtu, where it remained through yearend.

### Foreign Trade

The total tungsten content of U.S. exports was 3,310 t, 35% lower than the 5,080 t exported in 2001. As shown in tables 6 through 10, with the exception of exports of ferrotungsten and combined exports of unwrought tungsten and waste and scrap, exports of all tungsten materials decreased as compared with those of 2001. In 2002, the U.S. Census Bureau reported exports of unwrought tungsten separately from those of waste and scrap. In table 10, exports of these materials were combined to be comparable with those of 2001. On the basis of estimated content, 66% of the total 2002 exports in this combined category was unwrought tungsten and 34% was waste and scrap.

The total tungsten content of U.S. imports was slightly lower than that of 2001. China, which continued to be the largest supplier of imported tungsten to the United States, provided 41% of all tungsten imports in 2002. The total tungsten content of imports from China decreased by 33% in 2002 to 4,390 t, from 6,570 t in 2001. Of the imports from China, 46% was ammonium paratungstate; 18%, tungsten oxides; 10%, ferrotungsten; ores and concentrates, tungsten metal powders, and tungsten waste and scrap each represented 6% of

<sup>1</sup>References that include a section mark (§) are found in the Internet References Cited section.

imports from China; 4% was tungsten carbide powder; and the remainder was other tungsten compounds, unwrought tungsten, and wrought tungsten.

Other significant suppliers of tungsten materials were as follows: Canada, with 27% of the total tungsten imports to the United States; and Bolivia, Germany, and Portugal, with 5% each. Total imports from Russia, which was the second largest supplier of imported tungsten materials to the United States before 2001, decreased by 77% in 2002 to 106 t of contained tungsten, as compared with 466 t in 2001. In 2002, Russian imports were mainly ferrotungsten (41%), ammonium paratungstate (40%), and tungsten waste and scrap (16%).

As shown in table 11, U.S. imports of tungsten ores and concentrates increased by 52% in 2002 compared with those of 2001. Canada became the largest supplier of tungsten ore concentrates, as a result of the reopening of the Cantung Mine (discussed in the World Review section of this report). Imports of ores and concentrates from China decreased by 77% as compared with those of 2001. No ores or concentrates were imported from Kazakhstan and Russia, two countries that supplied significant quantities of these materials prior to 2001. In 2002, 94% of U.S. imports of ores and concentrates were from four countries—Canada (61%), Bolivia and Portugal (13% each), and China (7%).

U.S. imports of ammonium paratungstate decreased by 12% as compared with those of 2001 (table 12). China continued to be the dominant supplier, providing 84% of U.S. ammonium paratungstate imports.

In 2002, imports of ferrotungsten, other tungsten compounds, wrought tungsten, and unwrought tungsten increased compared with those of 2001, but those of calcium tungstate, other tungstates, tungsten carbide powder, tungsten metal powders, tungsten oxides, and tungsten waste and scrap decreased (tables 13-14).

Net import reliance as a percent of apparent consumption is used to measure the adequacy of current domestic production to meet U.S. demand. Net import reliance was defined as imports minus exports plus adjustments for Government and industry stock changes. Releases from stocks, including shipments from the NDS, were counted as part of import reliance, regardless of whether they were imported or produced in the United States. In 2002, net import reliance as a percent of apparent consumption was 69%. Because there was no recorded U.S. mine production in 2002, about 69% of U.S. tungsten supply was from imports and stock releases and 31% was from scrap materials generated in the United States.

## World Review

As shown in table 15, China remained the leading world producer of tungsten concentrates. Estimated world production of tungsten concentrates increased in 2002, primarily because of an increase in estimated production from China and the reopening of the Cantung Mine in Northwest Territories, Canada. In addition to mine production and tungsten recovered from scrap, tungsten materials from stockpiles in Russia and other countries in the Commonwealth of Independent States (CIS) have been a significant component of world supply in recent years. Between 1992, when exports of tungsten from CIS

countries first entered western markets, and the end of 2001, an estimated 47,900 t of tungsten was exported from CIS countries. Information on the amount of tungsten that remained in CIS stockpiles and whether these materials would be released for export continued to be unavailable (Maby, 2002, p. 4).

**Australia.**—Australian Tungsten Pty. Ltd. reportedly purchased the King Island scheelite mine from Rio Tinto Ltd. in 2001. The mine, located on King Island northwest of Tasmania, is an open pit and underground operation, which has been dormant since 1990. Australian Tungsten planned to reopen the mine with initial production of concentrates at a level of 250,000 to 300,000 mtu (approximately 2,000 to 2,400 t of tungsten) per year. Production could begin approximately 1 year after marketing agreements were concluded. The company was conducting a feasibility study, working on plant design, and making financing arrangements (Metal Bulletin, 2002a; Platts Metals Week, 2002).

**Austria.**—Wolfram Bergbau und Hütten GmbH Nfg KG produced tungsten concentrates from the Mittersill scheelite mine in the Province of Salzburg. All these concentrates were converted to primary tungsten products at Wolfram Bergbau's Bergla tungsten processing plant in the Province of Steiermark.

**Brazil.**—Verena Minerals Corp. of Toronto, Ontario, Canada, completed a prefeasibility study on its 100%-owned Bonfim property in Rio Grande do Norte State in northeastern Brazil. The study confirmed that the deposit, which was a gold-tungsten-bismuth skarn, might contain total resources of more than 1 million ounces of gold and 30,000 t of WO<sub>3</sub>. Metallurgical testwork on samples from the deposit indicated that more than 90% of the gold could be recovered by using cyanide leaching and that a high-grade scheelite concentrate could be produced by using standard shaking tables. In March, Verena purchased the property immediately north of Bonfim, where tungsten had been mined from 1969 until 1981. Verena planned to continue fieldwork on the expanded property and to build a pilot plant for metallurgical testwork (Verena Minerals Corp., 2002, p. 2, 5; 2003, p. 4, 9).

**Canada.**—North American Tungsten Corp. Ltd. restarted production from the Cantung Mine in Northwest Territories. The mine had been on care and maintenance since closing in 1986 pending improved market conditions. In 2001, Osram Sylvania Products Inc. and Sandvik AB of Stockholm, Sweden, agreed to provide North American Tungsten a cash advance to retrofit and restart the mine in exchange for a contract to purchase 100% of the tungsten ore concentrates produced. North American Tungsten completed startup and pre-production activities during the first quarter of 2002 and by early April, the mine was in commercial production. Output of high-grade tungsten concentrates steadily increased during the year, exceeding production targets. North American Tungsten initially planned to produce 300,000 mtu of concentrates (approximately 2,400 t of tungsten) per year, but during the first 6 months of operation, the company produced 198,000 mtu of concentrates (1,570 t of tungsten). During the December quarter, the mine set a production record of 123,585 mtu of concentrate (980 t of tungsten). In early January 2003, North American Tungsten announced that it was required to scale back future production to a quarterly maximum of 101,000 mtu (800 t of tungsten) to meet its customers' quota, which was imposed

because of uncertain global economic conditions and reduced demand for tungsten concentrates (North American Tungsten Corp. Ltd., 2003a, p. 10-11, 14; 2003b).

Copper Ridge Explorations Inc. continued to evaluate the potential of the Kalzas property in central Yukon Territory to support a small high-grade tungsten operation with an open pit mine and a simple gravity circuit mill. The company planned to examine the feasibility of conducting a drill program on the property during 2003 (Copper Ridge Explorations Inc., 2002).

**China.**—The Chinese Government continued with its efforts to make full use of its tungsten resources and to try to stabilize world tungsten prices. The Ministry of Foreign Trade and Economic Cooperation (MOFTEC) reportedly set the annual quota for exports of tungsten materials from China at 17,000 t of contained tungsten, equal to the quota set for 2001. In late December 2001 and April 2002, the Ministry of Land and Resources announced lists of specific tungsten mines that were licensed to operate. Following these announcements, tungsten mining was limited to 123 operations, as compared with the more than 170 mines that operated in 2001. In July, the Ministry announced that it planned to restrict China's total 2002 tungsten mine output to 22,150 t, tungsten content. The breakdown by province or autonomous region, converted from tons of concentrates to percent of total output, was as follows: Jiangxi (60%), Hunan (20%), Yunnan (8%), Guangdong (6%), Guangxi and Inner Mongolia (2% each), Fujian and Zhejiang (1% each), and Anhui and Qin Hai (0.1% each) (Guang, 2002; Maby, 2002, p. 3; Metal Bulletin, 2002b).

**Kyrgyzstan.**—Kyrgyzstan's Foreign Trade and Industry Ministry reportedly was looking for a partner to set up a joint venture to process tin-tungsten ore from the Trudovoye deposit (Interfax International Ltd., 2002a).

**Peru.**—As part of a corporate objective to focus on gold mining, Avocet Mining PLC agreed to sell its tungsten assets to Salish Ventures Inc. of Vancouver, British Columbia. The assets included a non-interest bearing loan of \$1 million to Minera Malaga Santolalla and a back-in right to acquire two-thirds of the share capital of Minera Malaga for nominal additional consideration. Minera Malaga owns tungsten mining and exploration interests in Peru, which include the Pasto Bueno Mine (Salish Ventures Inc., 2002).

**Portugal.**—In September, Avocet Mining completed a memorandum of understanding to sell its tungsten assets to Salish Ventures. The principal asset in the agreement was Avocet's 100% interest in Beralt Tin & Wolfram S.A., the Portuguese company that owned the Panasqueira Mine in east central Portugal. During the year, Beralt limited production from Panasqueira to that for customers with long-term contracts. It mined approximately 30,000 metric tons per month of ore and produced 7,000 to 8,000 mtu of concentrates per month (approximately 60 t of tungsten) (Salish Ventures Inc., 2002).

**Russia.**—According to the State Statistics Committee, Russian production of tungsten concentrates was 2.8% lower than that of 2001, and production of metallic tungsten was 17.8% lower than that of 2001 (Interfax International Ltd., 2003a). Several large plants in Russia produced ferrotungsten, some of which was used domestically for the production of various steel grades and some of which was exported (Visser, 2002, p. 7).

Avocet agreed to sell its 10.6% interest in Lermontovskaya Gornorudnaya Compania, a Russian Open Stock company with tungsten mining and exploration interests in the Russian Far East, to Salish Ventures. The Lermontov Mine in Primorskiy Krai was Lermontovskaya Gornorudnaya's principal asset. In 2002, 1,700 t of tungsten concentrates reportedly was produced from the mine, 13% more than production in 2001 (Salish Ventures Inc., 2002; Interfax International Ltd., 2003b).

Geolink Group GmbH, a Moscow-based trading and investment group, studied the feasibility of developing a new ore body at the Tyrnauz Tungsten and Molybdenum Combine in Kabardino-Balkaria. The study focused on the exploration of a deposit that contained 20 million metric tons (Mt) of ore containing 0.35% WO<sub>3</sub> and 0.04% molybdenum. Concentrates produced from this deposit would be processed into ammonium paratungstate and yellow tungsten oxide at the Hydrometallurg plant in Nalchik (Visser, 2002, p. 7-8).

In an overview of the Russian tungsten industry, one analyst predicted that Russia would follow the same development pattern as China has in recent years—exports of tungsten concentrates would decrease, more concentrates would be processed domestically, and exports of higher value downstream materials and products would increase (Visser, 2002, p. 8).

**Spain.**—In late 2001, Wolfram Bergbau of Austria signed a contract for the purchase of scheelite concentrates from the Los Santos deposit in Castilia y Leon region in Spain. Mining was to begin as an open pit operation, which would later be developed into an underground operation. Development of the open pit mine was delayed because of a shortage of water in the area and increased production costs associated with the tailing ponds (Metal Bulletin, 2001; Walsler, 2002, p. 1).

**Uganda.**—In recent years, M/S Krone Uganda Ltd. has mined tungsten from the Nyamuliro deposit near Kabale. Production has been limited by outdated equipment, poor road conditions in the vicinity of the mine, and a lack of electricity, other than that provided by generators (Olaki, 2002§).

**Uzbekistan.**—Metek Metal Technology Ltd. of Beer-Sheva, Israel, was reportedly in the final stage of preparing a feasibility study on developing tungsten deposits in Uzbekistan. Production from the deposits would be processed at the newly modernized facilities of the Uzbek Refractory and High-Temperature Metals Plant in Chirchik, Tashkent region. This plant has been running at less than one-third capacity in recent years because of reduced demand and a shortage of working capital. Metek is a producer of tungsten alloys, carbide powder, metal powder, and oxide from secondary (scrap) feeds (Interfax International Ltd., 2002b; Visser, 2002, p. 7; Radio Free Europe/Radio Liberty, 2001§; Ramat Hovav Local Industrial Council, undated§).

**Vietnam.**—In early 2003, Tiberon Minerals Ltd. of Calgary, Alberta, Canada, completed a prefeasibility study on developing the Nui Phao deposit 80 km north-northwest of Hanoi. The deposit is a polymetallic skarn and greisen containing tungsten-, gold-, copper-, bismuth-, and fluorine-bearing minerals, which could be mined by open pit methods. Following additional exploration drilling and engineering studies, Tiberon reported an increase in the estimated resource (including measured, indicated, and inferred resources) to 73.4 Mt grading 0.21% WO<sub>3</sub>, 0.21% copper, 0.22 grams per metric ton gold, 0.10% bismuth, and 8.0% fluorite. Initial bench-scale metallurgical

studies indicated that approximately 80% of the tungsten, which was present in the mineral scheelite, 75% of the copper, 70% of the fluorite, 20% of the gold, and 10% of the bismuth were recoverable by using a combination of conventional gravity and mineral flotation methods. The following process was used on the ore: three-stage crushing, grinding, sulfide mineral flotation to produce a copper-gold concentrate, gravity concentration of the scheelite, scheelite flotation of the gravity concentration rejects, and then fluorite flotation. Tiberon expected to begin the construction phase of the project in 2004. The Nui Phao project was a joint venture between Tiberon (70%) and two Vietnamese companies (30%) (Tiberon Minerals Ltd., 2002; 2003a; 2003b, p. 3, 11, 17-19).

## Outlook

Demand for tungsten tends to follow general economic conditions and is expected to increase as the world's economies improve. Future consumption of tungsten in cemented carbides, which is the largest end-use sector, will depend on the performance of the following industries: automotive and aircraft production; construction; mining; oil and gas drilling; electronics manufacturing, where cemented carbide microdrills are used on circuit boards; large equipment manufacturing; and general manufacturing. Some recent developments in uses for tungsten include the shift from lead to tungsten for ammunition and the use of tungsten by the sporting goods industry to make golf clubs and golf ball cores. Developments in metal injection molding technologies are expected to increase the use of sintered tungsten-copper pseudoalloys in smaller electronic devices that require intricately shaped heat sinks (Ross, 1999, p. 15; Payne, 2002, p. 11).

Demand for tungsten is also influenced by changes in government spending for defense applications. In 2000, the consumption of tungsten to produce 5.56-millimeter "green ammunition" for the military was forecast to grow from nearly zero to between 450 t and 800 t of tungsten in 2005 (Middleton, 2000, p. 22). Since that forecast was made, defense spending has increased for the fight against global terrorism, which is expected to impact U.S. demand for tungsten over the next few years. Estimated increases in tungsten demand, based on approved projects including green ammunition, total 2,200 t to 2,700 t by the year 2006, with 1,300 t to 1,500 t of this increased demand occurring in 2003. Other areas where tungsten is replacing lead in ammunition, such as commercial shotgun shell rounds and law enforcement bullet rounds, are expected to add another 170 t/yr to tungsten demand (Payne, 2002, p. 10-11).

World tungsten supply will continue to be dominated by Chinese production and exports. Future supply from China will be affected by the Chinese Government's success or failure in controlling the release of tungsten materials to the market. In November, MOFTEC announced that it planned to issue export licenses for a total of 16,300 t, gross weight, of tungsten products in calendar year 2003. This would be 4% less than the 17,000 t, gross weight, of tungsten products licensed for export in 2002. In addition to limiting the total volume of exports, the government was gradually reducing the export quotas for ammonium paratungstate and tungsten oxide, while increasing the quotas for tungsten metal powder and tungsten

carbide powder, which were higher valued downstream products (Guang, 2002; Metal Bulletin, 2002b).

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TABLE 1  
SALIENT TUNGSTEN STATISTICS<sup>1</sup>

(Metric tons, tungsten content, unless otherwise specified)

	1998	1999	2000	2001	2002
United States:					
Concentrates:					
Consumption	3,210 <sup>2</sup>	2,100 <sup>2</sup>	W	W	W
Exports	10	26	70	220	94
Imports for consumption	4,750	2,870	2,370	2,680	4,090
Stocks, December 31:					
Consumer	514	W	W	W	W
U.S. Government <sup>3</sup>	34,600	34,600	33,400	31,200 <sup>r,e</sup>	30,100
Price, per metric ton unit:					
U.S. spot quotation <sup>4</sup>	\$52	\$47	\$47	\$64	\$55
European <sup>5</sup>	\$44	\$40	\$45	\$65	\$38
Ammonium paratungstate:					
Production	838 <sup>6</sup>	7,050	W	W	W
Consumption	10,000	7,490	8,980	9,240	8,860
Stocks, December 31, producer and consumer	603	376	W	W	68
Price, per metric ton unit:					
U.S. free market <sup>7</sup>	\$66	\$56	\$66	\$99	\$72
U.S. market <sup>4</sup>	\$65	\$57	\$64	\$97	\$73
European free market <sup>7</sup>	\$55	\$51	\$60	\$89	\$54

See footnotes at end of table.

TABLE 1--Continued  
SALIENT TUNGSTEN STATISTICS<sup>1</sup>

(Metric tons, tungsten content, unless otherwise specified)

	1998	1999	2000	2001	2002
United States--Continued:					
Primary products:					
Net production <sup>8</sup>	9,630	8,500	9,780	9,520	12,000
Consumption <sup>9</sup>	9,520	8,730	9,280	9,090	9,490
Stocks, December 31:					
Producer <sup>10</sup>	1,340	1,070	1,160	699	666
Consumer <sup>9</sup>	524	534	522	729	394
U.S. Government <sup>3</sup>	2,700	2,700	2,110	1,120 <sup>e</sup>	947
World, production of concentrate	37,000 <sup>r</sup>	37,700 <sup>r</sup>	44,000 <sup>r</sup>	45,300 <sup>r</sup>	59,100 <sup>e</sup>

<sup>e</sup>Estimated. <sup>r</sup>Revised. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Data are rounded to no more than three significant digits.

<sup>2</sup>Excludes 6 months of "Withheld" data.

<sup>3</sup>Defense National Stockpile Center. Includes material committed for sale pending shipment.

<sup>4</sup>Annual average calculated from weekly prices reported by Platts Metals Week.

<sup>5</sup>Annual average calculated from semiweekly prices reported by Metal Bulletin.

<sup>6</sup>Excludes 11 months of "Withheld" data.

<sup>7</sup>Annual average calculated from annual average high and low prices reported by Metal Bulletin.

<sup>8</sup>Includes only tungsten metal powder and tungsten carbide powder made from metal powder.

<sup>9</sup>Includes scrap.

<sup>10</sup>Data for 1998 exclude cast and crystalline tungsten carbide powder. Data for 1999-2002 exclude cast and crystalline tungsten carbide powder and chemicals.

TABLE 2  
U.S. GOVERNMENT NATIONAL DEFENSE STOCKPILE TUNGSTEN STATISTICS IN 2002<sup>1,2</sup>

(Metric tons, tungsten content)

Material	Inventory, yearend <sup>3</sup>		Annual Materials Plan, fiscal year <sup>5</sup>	Sales		Inventory decrease <sup>4</sup>	
	Fiscal year <sup>5</sup>	Calendar year		Fiscal year <sup>5</sup>	Calendar year	Fiscal year <sup>5</sup>	Calendar year <sup>e</sup>
	Ores and concentrates	30,100	30,100	1,810	--	1,370	1,970
Ferrotungsten	487	468	136	137	137	93	19
Tungsten metal powder	490	479	136	144	145	189	133
Tungsten carbide powder	4	--	XX	--	--	148	25
Total	31,100	31,000	2,090	281	1,650	2,390	1,320

<sup>e</sup>Estimated. XX Not applicable. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Includes stockpile- and nonstockpile-grade materials.

<sup>3</sup>Includes material committed for sale pending shipment.

<sup>4</sup>From previous year.

<sup>5</sup>Twelve-month period ending September 30, 2002.

Source: Defense National Stockpile Center.

TABLE 3  
U.S. NET PRODUCTION AND STOCKS OF TUNGSTEN PRODUCTS<sup>1, 2, 3</sup>

(Metric tons, tungsten content)

	Hydrogen reduced metal powder	Tungsten carbide powder made from metal powder	Total
Net production:			
2001	5,190	4,330	9,520
2002	7,970	4,070	12,000
Producer stocks:			
December 31, 2001	367	332	699
December 31, 2002	427	239	666

<sup>1</sup>Net production equals gross production less quantity used to make other products in table.

<sup>2</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>3</sup>Data for cast and crystalline tungsten carbide powder and tungsten chemicals are withheld to avoid disclosing company proprietary data; not included in "Total."

TABLE 4  
U.S. REPORTED CONSUMPTION AND STOCKS OF TUNGSTEN PRODUCTS<sup>1, 2, 3</sup>

(Metric tons, tungsten content)

	2001	2002
Consumption by end use:		
Steels	389	313
Superalloys	599	426
Other alloys <sup>4</sup>	W	W
Cemented carbides <sup>5</sup>	5,650	4,820
Mill products made from metal powder	W	W
Chemical uses	80	133
Total	9,090	9,490
Consumption by form:		
Ferrotungsten	343	285
Tungsten metal powder	2,360	3,790
Tungsten carbide powder	5,680	4,840
Tungsten scrap	618	437
Other tungsten materials <sup>6</sup>	80	133
Total	9,090	9,490
Consumer stocks, December 31:		
Ferrotungsten	37	20
Tungsten metal powder	34	26
Tungsten carbide powder	596	293
Tungsten scrap	43	23
Other tungsten materials <sup>6</sup>	19	32
Total	729	394

W Withheld to avoid disclosing company proprietary data, included in "Total."

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Does not include materials used in making primary tungsten products.

<sup>3</sup>Includes estimates.

<sup>4</sup>Includes welding and hard-facing rods and materials, wear- and corrosion-resistant alloys, and nonferrous alloys.

<sup>5</sup>Includes diamond tool matrices, cemented and sintered carbides, and cast carbide dies or parts.

<sup>6</sup>Includes tungsten chemicals.



TABLE 5  
MONTHLY PRICE QUOTATIONS OF TUNGSTEN CONCENTRATES IN 2002

Month	Metal Bulletin (London), European market, 65% WO <sub>3</sub> basis, c.i.f. <sup>1</sup>			Platts Metals Week, U.S. spot quotations, 65% WO <sub>3</sub> basis, c.i.f. U.S. ports, including duty <sup>2</sup>				
	Dollars per metric ton unit			Dollars per short ton unit, average	Dollars per short ton unit			Dollars per metric ton unit, average
	Low	High	Average		Low	High	Average	
January	34	48	41	37	50	60	55	61
February	28	45	37	33	50	60	55	61
March	25	45	35	32	50	60	55	61
April	25	45	35	32	40	60	50	55
May	32	45	39	35	40	55	48	52
June	32	45	39	35	40	55	48	52
July	32	45	39	35	40	55	48	52
August	32	45	39	35	40	55	48	52
September	32	45	39	35	40	55	48	52
October	32	45	39	35	40	55	48	52
November	32	45	39	35	40	55	48	52
December	32	45	39	35	40	55	48	52

<sup>1</sup>Combined wolframite and scheelite quotations. Low and high prices are reported semiweekly. Monthly averages are arithmetic averages of semiweekly low and high prices. The annual average price per metric ton unit of WO<sub>3</sub> of all semiweekly low and high prices was \$38 in 2002. The average equivalent price per short ton unit of WO<sub>3</sub> was \$35 in 2002.

<sup>2</sup>Low and high prices are reported weekly. Monthly averages are arithmetic averages of weekly low and high prices. The annual average price per short ton unit of WO<sub>3</sub> of all weekly low and high prices was \$50 in 2002. The average equivalent price per metric ton unit of WO<sub>3</sub> was \$55 in 2002.

TABLE 6  
U.S. EXPORTS OF TUNGSTEN ORES AND CONCENTRATES, BY COUNTRY<sup>1</sup>

Country of destination	2001			2002		
	Gross weight (metric tons)	Tungsten content <sup>2</sup> (metric tons)	Value (thousands)	Gross weight (metric tons)	Tungsten content <sup>2</sup> (metric tons)	Value (thousands)
Australia	--	--	--	(3)	(3)	\$4
Austria	18	9	\$181	4	2	59
Belgium	2	1	41	--	--	--
China	9	4	158	2	1	28
France	--	--	--	(3)	(3)	3
Germany	36	19	1,180	20	10	397
Hong Kong	(3)	(3)	5	--	--	--
Ireland	--	--	--	1	(3)	9
Italy	4	2	62	--	--	--
Japan	9	4	159	3	1	42
Korea, Republic of	4	2	59	1	(3)	8
Mexico	--	--	--	1	1	26
Netherlands	83	43	815	11	6	168
Russia	164	85	1,300	--	--	--
Singapore	(3)	(3)	8	--	--	--
Sweden	30	16	517	--	--	--
Switzerland	(3)	(3)	3	(3)	(3)	4
Taiwan	(3)	(3)	4	(3)	(3)	5
Ukraine	--	--	--	1	1	16
United Kingdom	66	34	1,050	138	71	2,230
Total	426	220	5,550	181	94	2,990

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Content estimated from reported gross weight.

<sup>3</sup>Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 7  
U.S. EXPORTS OF AMMONIUM PARATUNGSTATE, BY COUNTRY<sup>1</sup>

Country of destination	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Czech Republic	50	\$367	--	--
Germany	137	1,030	11	\$101
Hungary	2	13	--	--
Japan	--	--	17	151
Korea, Republic of	2	22	--	--
Mexico	1	9	--	--
Netherlands	63	525	38	324
Spain	1	20	2	20
Venezuela	1	7	--	--
Total	257	2,000	69	596

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 8  
U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY<sup>1,2</sup>

Country of destination	2001			2002		
	Gross weight (metric tons)	Tungsten content <sup>3</sup> (metric tons)	Value (thousands)	Gross weight (metric tons)	Tungsten content <sup>3</sup> (metric tons)	Value (thousands)
Australia	14	11	\$437	14	11	\$485
Belgium	8	6	123	1	1	34
Brazil	22	17	610	20	16	572
Canada	60	48	1,910	39	31	1,070
Chile	1	1	38	1	1	36
China	10	8	126	(4)	(4)	12
Czech Republic	(4)	(4)	6	2	2	26
France	11	9	645	18	14	855
Germany	380	304	13,200	333	266	9,980
Hong Kong	2	1	126	1	1	50
India	4	4	175	2	2	67
Israel	22	18	377	52	42	553
Italy	6	5	376	13	10	516
Japan	15	12	741	16	13	727
Korea, Republic of	2	2	122	3	3	136
Mexico	10	8	133	6	5	142
Netherlands	13	10	161	1	1	40
Peru	1	1	48	2	2	64
Saudi Arabia	3	2	53	--	--	--
Singapore	7	5	486	9	7	504
South Africa	(4)	(4)	22	3	2	89
Spain	2	2	100	3	2	109
Sweden	18	15	105	1	1	25
Switzerland	3	2	130	3	2	115
Taiwan	20	16	509	31	25	761
Thailand	1	1	13	2	2	42
Turkey	2	2	86	2	2	96
United Kingdom	72	57	2,810	38	30	1,750
Other	3 <sup>r</sup>	3 <sup>r</sup>	133 <sup>r</sup>	4	3	167
Total	712	569	23,800	620	496	19,000

See footnotes at end of table.

TABLE 8--Continued  
U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY<sup>1,2</sup>

<sup>1</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>May include tungsten alloy powders.

<sup>3</sup>Content estimated from reported gross weight.

<sup>4</sup>Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 9  
U.S. EXPORTS OF TUNGSTEN CARBIDE POWDER, BY COUNTRY<sup>1</sup>

Country of destination	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Argentina	--	--	1	\$20
Australia	17	\$541	4	116
Belgium	8	254	18	326
Brazil	6	170	4	73
Canada	158	4,090	103	2,460
China	3	105	18	283
Czech Republic	--	--	10	203
Denmark	1	14	--	--
France	141	1,990	50	835
Germany	304	5,980	283	3,800
India	4	109	6	165
Ireland	5	233	12	815
Israel	1	87	15	66
Italy	6	199	14	412
Japan	46	1,720	20	724
Korea, Republic of	16	323	29	588
Luxembourg	( <sup>2</sup> )	8	5	91
Mexico	1	49	( <sup>2</sup> )	29
Netherlands	32	373	15	78
Peru	--	--	1	28
Singapore	2	99	3	144
South Africa	17	276	11	152
Spain	( <sup>2</sup> )	4	1	46
Sweden	381	10,400	199	2,760
Switzerland	9	294	6	233
Taiwan	2	30	14	216
Thailand	1	41	1	24
Turkey	--	--	1	28
United Kingdom	783	20,000	407	5,600
Venezuela	1	33	--	--
Other	1	97 <sup>r</sup>	2	114
Total	1,950	47,400	1,250	20,400

<sup>1</sup>Revised. --Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 10  
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY<sup>1</sup>

Product and country of destination	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
<b>Ferrotungsten and ferrosilicon tungsten:</b>				
Canada	(2)	\$4	--	--
France	--	--	7	\$16
Mexico	1	7	--	--
United Kingdom	--	--	(2)	10
Total	1	11	7	26
<b>Unwrought tungsten and waste and scrap:<sup>3,4,5</sup></b>				
Australia	12	69	3	21
Belgium	10	38	21	169
Brazil	6	62	39	192
Canada	27	241	61	673
China	26	105	70	509
France	--	--	25	158
Germany	374	1,880	94	545
Hong Kong	51	702	58	521
Ireland	11	61	1	3
Israel	20	122	20	97
Italy	17	102	4	20
Japan	3	41	53	240
Korea, Republic of	9	54	14	60
Malaysia	(2)	14	10	41
Mexico	24	203	134	574
Netherlands	(2)	3	22	92
New Zealand	--	--	4	33
Philippines	16	91	20	84
Singapore	2	10	6	41
Sweden	4	29	4	27
Taiwan	69	500	127	739
United Kingdom	290	2,030	236	1,330
Other	1	19	11	160
Total	972	6,370	1,040	6,330
<b>Wrought tungsten--wire:<sup>3,4</sup></b>				
Belgium	1	148	1	77
Brazil	6	333	1	85
Canada	11	403	36	1,330
China	3	467	2	221
Finland	--	--	3	92
France	7	909	4	738
Germany	29	882	6	344
Hong Kong	4	85	(2)	3
Hungary	8	691	1	86
India	16	833	14	670
Indonesia	3	150	1	36
Italy	3	260	4	261
Japan	15	1,550	5	314
Mexico	43	4,670	27	2,780
Netherlands	10	577	(2)	33
Philippines	3	202	4	165
Singapore	1	63	(2)	48
Spain	19	1,350	13	521
Sweden	26	971	2	232
Taiwan	(2)	134	1	63
United Kingdom	3	476	4	338
Other	1	1,560 <sup>r</sup>	3	596
Total	214	16,700	132	9,040

See footnotes at end of table.

TABLE 10--Continued  
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY<sup>1</sup>

Product and country of destination	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
<b>Wrought tungsten, excluding wire.<sup>3,4</sup></b>				
Belgium	(2)	\$48	6	\$582
Canada	25	1,020	15	698
France	(2)	105	1	149
Germany	177	4,330	44	1,470
India	1	91	1	53
Italy	1	151	(2)	32
Japan	6	664	29	643
Korea, Republic of	1	99	2	206
Mexico	6	377	1	59
Spain	2	102	(2)	3
Sweden	10	311	(2)	23
Taiwan	2	126	1	75
United Arab Emirates	1	48	--	--
United Kingdom	1	119	4	156
Other	2	460 <sup>r</sup>	3	167
Total	236	8,050	108	4,310
<b>Other tungsten metal.<sup>3,4</sup></b>				
Australia	3	302	1	113
Brazil	2	3,230	(2)	160
Canada	13	686	12	683
Colombia	7	6,030	4	519
Ecuador	5	11,500	(2)	85
France	2	336	1	209
Germany	1	908	2	228
Hungary	7	6,860	4	627
India	(2)	14	1	82
Indonesia	1	1,860	(2)	121
Israel	1	218	2	550
Italy	(2)	100	1	245
Japan	5	2,880	3	1,340
Korea, Republic of	1	1,450	1	398
Mexico	9	5,370	4	613
Netherlands	2	508	1	212
Singapore	1	282	2	298
Taiwan	2	416	1	365
United Kingdom	6	764	6	942
Other	4 <sup>r</sup>	2,260 <sup>r</sup>	4	906
Total	72	45,900	52	8,700
<b>Tungsten compounds:<sup>6</sup></b>				
Belgium	--	--	(2)	6
Canada	12	26	3	7
Denmark	3	39	--	--
France	(2)	3	--	--
Mexico	--	--	1	13
Netherlands	579	2,130	60	210
United Kingdom	(2)	9	1	6
Total	594	2,210	65	243

<sup>r</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Less than 1/2 unit.

<sup>3</sup>May include alloys.

<sup>4</sup>Content estimated from reported gross weight.

<sup>5</sup>Includes bars and rods obtained by sintering.

<sup>6</sup>Includes only other tungstates.

Source: U.S. Census Bureau.

TABLE 11  
U.S. IMPORTS FOR CONSUMPTION OF TUNGSTEN ORES AND  
CONCENTRATES, BY COUNTRY<sup>1</sup>

Country of origin	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
Bolivia	610	\$4,290	513	\$2,700
Canada	--	--	2,510	14,400
China	1,260	9,160	285	1,550
Czech Republic	7	22	--	--
Germany	4	12	--	--
Hong Kong	96	574	61	308
India	--	--	22	108
Israel	3	54	4	77
Japan	7	50	--	--
Mexico	2	8	--	--
Mongolia	62	372	25	108
Peru	48	456	55	380
Portugal	488	3,930	550	4,520
Rwanda	12	33	34	157
Thailand	39	214	--	--
Uganda	39	286	30	185
United Kingdom	5	46	--	--
Total	2,680	19,500	4,090	24,500

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 12  
U.S. IMPORTS FOR CONSUMPTION OF AMMONIUM PARATUNGSTATE,  
BY COUNTRY<sup>1</sup>

Country of origin	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
China	2,270	\$20,700	2,010	\$13,500
Germany	124	1,170	153	1,200
Hong Kong	159	1,250	33	223
Japan	15	147	90	860
Russia	157	1,240	42	173
United Kingdom	--	--	53	261
Vietnam	--	--	18	102
Total	2,720	24,500	2,400	16,300

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 13  
U.S. IMPORTS FOR CONSUMPTION OF FERROTUNGSTEN  
AND FERROSILICON TUNGSTEN, BY COUNTRY<sup>1</sup>

Country of origin	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
China	335	\$2,080	422	\$2,590
Germany	2	7	--	--
Hong Kong	--	--	15	95
India	15	82	--	--
Russia	--	--	43	248
Total	352	2,170	480	2,930

-- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 14  
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY<sup>1</sup>

Product and country of origin	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
<b>Tungsten metal powders:<sup>2</sup></b>				
Belgium	8	\$109	3	\$88
Canada	3	28	23	433
China	514	5,760	260	2,540
France	1	24	4	162
Germany	100	2,030	94	1,790
Hong Kong	4	52	--	--
Israel	57	994	32	580
Japan	33	1,720	9	588
Korea, Republic of	48	711	98	1,480
Pakistan	14	89	10	57
Sweden	--	--	10	40
United Kingdom	160	1,980	100	1,100
Other	4 <sup>r</sup>	65 <sup>r</sup>	1	23
Total	947	13,600	642	8,870
<b>Tungsten carbide powder:</b>				
Armenia	--	--	8	138
Austria	41	761	22	438
Belgium	2	41	--	--
Canada	414	3,030	345	4,470
China	215	3,100	192	2,480
France	7	567	5	383
Germany	95	2,060	99	1,880
Hong Kong	8	143	--	--
Israel	112	2,060	173	2,650
Japan	3	214	1	66
Korea, Republic of	14	247	38	571
Luxembourg	16	393	14	270
Russia	2	12	--	--
Sweden	2	58	1	37
Taiwan	--	--	2	18
Other	1	90 <sup>r</sup>	2	86
Total	932	12,800	901	13,500

See footnotes at end of table.

TABLE 14--Continued  
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY<sup>1</sup>

Product and country of origin	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
<b>Unwrought tungsten:</b> <sup>2, 3, 4</sup>				
Canada	6	\$25	--	--
China	5	110	56	\$479
Germany	1	53	1	75
Japan	(5)	3	2	191
Pakistan	--	--	15	61
Singapore	--	--	21	295
Other	(5)	55 <sup>r</sup>	1	44
Total	12	245	97	1,140
<b>Waste and scrap:</b>				
Austria	22	195	--	--
Canada	25	147	30	130
China	399	3,560	250	2,070
Czech Republic	3	41	31	218
Germany	150	658	141	717
Hong Kong	45	453	56	329
India	19	88	--	--
Israel	47	210	12	44
Japan	113	695	112	534
Korea, Republic of	2	22	17	43
Netherlands	21	145	2	7
Pakistan	--	--	53	241
Russia	49	294	17	90
Singapore	35	157	14	51
South Africa	87	483	56	272
Taiwan	8	54	--	--
United Kingdom	47	219	94	494
Uzbekistan	--	--	18	162
Other	6	32	--	--
Total	1,080	7,460	903	5,400
<b>Wrought tungsten wire, plate, sheet, strip, foil, other:</b> <sup>2, 3</sup>				
Austria	43	6,170	21	2,570
Belgium	2	86	2	119
Brazil	6	97	--	--
China	62	4,890	115	5,210
France	4	507	4	513
Germany	75	4,430	53	4,310
Hong Kong	6	232	6	450
Hungary	6	347	4	322
India	1	156	4	488
Israel	19	1,570	15	1,430
Japan	16	5,020	26	4,180
Russia	2	127	3	286
Singapore	1	147	1	36
South Africa	--	--	4	40
Taiwan	1	98	1	79
United Kingdom	3	355	2	301
Other	4 <sup>r</sup>	1,270 <sup>r</sup>	5	1,000
Total	251	25,500	266	21,300
<b>Tungsten oxides:</b>				
China	1,380	13,300	781	5,450
Germany	3	45	4	77
Japan	57	285	13	36
Russia	256	3,370	--	--
Other	(5)	13	(5)	8
Total	1,700	17,000	799	5,570

See footnotes at end of table.



TABLE 14--Continued  
 U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY<sup>1</sup>

Product and country of origin	2001		2002	
	Tungsten content (metric tons)	Value (thousands)	Tungsten content (metric tons)	Value (thousands)
<b>Calcium tungstate:</b>				
China	104	\$666	--	--
Japan	(5)	28	(5)	\$8
United Kingdom	13	73	--	--
Total	117	766	(5)	8
<b>Other tungstates:</b>				
Australia	--	--	(5)	62
China	(5)	8	--	--
Germany	17	153	(5)	48
India	--	--	(5)	8
Japan	--	--	(5)	4
Total	17	160	1	122
<b>Other tungsten compounds:<sup>6</sup></b>				
Belgium	(5)	8	--	--
China	20	319	20	258
Germany	(5)	53	(5)	184
Japan	(5)	78	2	372
Korea, Republic of	--	--	(5)	10
Total	21	458	23	824

<sup>1</sup>Revised. -- Zero.

<sup>1</sup>Data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>May include alloys.

<sup>3</sup>Content estimated from reported gross weight.

<sup>4</sup>Includes bars and rods obtained by sintering; excludes powders and waste and scrap.

<sup>5</sup>Less than 1/2 unit.

<sup>6</sup>Includes tungsten chlorides.

Source: U.S. Census Bureau.

TABLE 15  
TUNGSTEN: WORLD CONCENTRATE PRODUCTION, BY COUNTRY<sup>1,2</sup>

(Metric tons, tungsten content)

Country	1998	1999	2000	2001	2002 <sup>c</sup>
Austria	1,423	1,610	1,600 <sup>e</sup>	1,237 <sup>r</sup>	1,400
Bolivia	497	334	382	533 <sup>r</sup>	500
Brazil	--	13	14	31 <sup>r</sup>	30
Burma <sup>3</sup>	178	87	74	71	70
Canada	--	--	--	--	2,550
China <sup>e</sup>	30,000	31,100	37,000	38,500 <sup>r</sup>	49,500
Korea, North <sup>e</sup>	500 <sup>r</sup>	500 <sup>r</sup>	500 <sup>r</sup>	500 <sup>r</sup>	600
Mexico	130	11	--	--	--
Mongolia <sup>e</sup>	35	27	52	63	60
Peru	76	--	--	--	--
Portugal	831	434	743	700 <sup>r, e</sup>	700
Russia <sup>e</sup>	3,000	3,500	3,500	3,500	3,400
Rwanda	109 <sup>r</sup>	41 <sup>r</sup>	108 <sup>r</sup>	148 <sup>r</sup>	150
Thailand <sup>e</sup>	35	30	30	30	30
Uganda	--	( <sup>4</sup> )	--	17	90
Uzbekistan <sup>e</sup>	200	--	--	--	--
Total	37,000 <sup>r</sup>	37,700 <sup>r</sup>	44,000 <sup>r</sup>	45,300 <sup>r</sup>	59,100

<sup>c</sup>Estimated. <sup>r</sup>Revised. -- Zero.

<sup>1</sup>World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

<sup>2</sup>Tungsten concentrates are believed to be produced in Nigeria and may be produced from tin-tungsten ores in Kyrgyzstan, but information is inadequate for making production estimates. Table includes data available through May 30, 2003.

<sup>3</sup>Includes tungsten content of tin-tungsten concentrate produced by state-owned mining enterprises under the Ministry of Mines.

<sup>4</sup>Less than 1/2 unit.