

TUNGSTEN

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Tungsten has a wide range of industrial uses, the largest of which is as tungsten carbide in cemented carbides. Cemented carbides (also called hardmetals) are wear-resistant materials used by the metalworking, mining, and construction industries. Tungsten metal wires, electrodes, and/or contacts are used in lighting, electronic, electrical, heating, and welding applications. Tungsten is also used to make heavy metal alloys for armaments, heat sinks, and high-density applications, such as weights and counterweights; superalloys for turbine blades; tool steels; and wear-resistant alloy parts and coatings. Chemical uses of tungsten include catalysts, inorganic pigments, and high-temperature lubricants.

In early 1998, demand for tungsten was strong, and supplies of raw materials were reportedly tightening (Ryan's Notes, 1998a). Concern for the future availability of stockpiled Russian tungsten led to forecasts of short supplies and increasing prices by summer. Instead, demand for tungsten decreased, at least in part resulting from the Asian financial crisis, the General Motors Corp. strike, a decline in oil drilling, and a seasonal decrease in industrial activity during the summer months. Consequently, prices decreased (Ryan's Notes, 1998b; Bunting, 1999).

U.S. tungsten mines remained closed in 1998. Domestic production of ammonium paratungstate decreased, while U.S. net production of primary tungsten products (tungsten carbide powder, tungsten chemicals, and tungsten metal powder) increased. In 1998, U.S. industries consumed more tungsten to make end-use products than in 1997.

China continued to be the largest supplier of tungsten imports to the United States. Russia was also a significant supplier. In 1998, 62% of all tungsten imports to the United States was from these two countries.

In October, the U.S. Congress authorized the sale of tungsten materials from the National Defense Stockpile (NDS). The last releases of tungsten from the NDS were during the ferroalloy upgrading program, which was completed in 1989. Tungsten ores and concentrates were released as payment in support of that program.

The important U.S. and world tungsten statistics for 1998 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.

Tungsten prices and many tungsten statistics are quoted in units of tungsten trioxide (WO_3). The short ton unit, 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 (15.86 pounds) of tungsten. The metric ton unit, used in most other countries, is 1% of a metric ton (10 kilograms). A metric ton unit of WO_3 , therefore, equals 10 kilograms of WO_3 and contains 7.93

kilograms (17.48 pounds) of tungsten.

Legislation and Government Programs

The antidumping duty on U.S. imports of tungsten ore concentrates from China, imposed in October 1991, remained at 151%. In March, the European Commission announced that it was terminating its antidumping duties on imports of tungsten materials from China under the following two categories: tungsten ores and concentrates and tungstic oxide and tungstic acid (Europa, March 21, 1998, Common commercial policy (11/21), Bulletin EU 3-1998, accessed July 27, 1999, at URL <http://europa.eu.int/abc/doc/off/bull/en/9803/p103030.htm>; Europa, March 21, 1998, Common commercial policy (12/21), Bulletin EU 3-1998, accessed July 27, 1999, at URL <http://europa.eu.int/abc/doc/off/bull/en/9803/p103031.htm>). In April, The Council of the European Union decided to reimpose an antidumping duty on imports of tungsten carbide and fused tungsten carbide originating in China (Eur-Lex, April 9, 1998, Community legislation in force, Document 398R0771, accessed July 27, 1999, at URL http://europa.eu.int/eur-lex/en/lif/dat/1998/en_398R0771.html).

In September, the NDS Market Impact Committee requested public comment on the potential impact of tungsten sales from the NDS in the event that disposal authority for tungsten was granted by Congress. The request for comments gave proposed annual disposal levels for the fiscal years beginning October 1, 1998, and October 1, 1999. For each year, the proposed maximum quantities of tungsten materials that could be sold were as follows, in metric tons (t) of contained tungsten: tungsten ores and concentrates, 680; tungsten carbide powder, 454; tungsten metal powder, 68; and ferrotungsten, 45 (Bureau of Export Administration, 1998a). Authorization for tungsten sales from the NDS was granted in October with the passage of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999 (Public Law 105-261). The act granted authority to dispose of all the tungsten materials in the NDS, but stated that disposals must not result in undue disruption of the usual markets of producers, processors, and consumers of the materials or avoidable loss to the United States. In November, the Market Impact Committee requested public comment on an increase in the Annual Materials Plan (AMP) for ferrotungsten to 181 t (Bureau of Export Administration, 1998b). In early 1999, final AMP levels for fiscal year 1999 were established as follows, in tons of contained tungsten: tungsten ores and concentrates, 1,360; tungsten carbide powder, 454; ferrotungsten, 136; and tungsten metal powder, 68 (Defense National Stockpile Center, 1999).

The NDS inventory of combined stockpile- and

nonstockpile-grade tungsten materials on December 31 was as follows, in tons of contained tungsten: tungsten ores and concentrates, 34,600; tungsten carbide powder, 922; ferrotungsten, 918; and tungsten metal powder, 861.

The U.S. Fish and Wildlife Service (FWS) gave temporary conditional approval to three tungsten-based shot products for the 1998-99 migratory bird hunting season. Approval for tungsten-iron shot was an extension of the temporary approval granted for the 1997-98 season. This shot, manufactured by Federal Cartridge Co. of Anoka, MN, is a two-phase alloy made by sintering tungsten and iron. The other two shot products were tungsten-polymer and tungsten-matrix. Tungsten-polymer shot, also manufactured by Federal Cartridge, comprised of approximately 95.5% elemental tungsten in a matrix of approximately 4.5% Nylon 6. Tungsten-matrix shot, manufactured by Kent Cartridge Manufacturing Co. of Kearneysville, WV, was made from a mixture of approximately 95.9% tungsten metal powder and 4.1% polymers. Use of the three shot materials was approved for all areas except the Yukon-Kuskokwim Delta in Alaska. Use in that area will depend on the results of chronic toxicity and reproductive tests being performed for the FWS (U.S. Fish and Wildlife Service, 1998a, b, c).

Production

Domestic production data for tungsten are based on data collected by the U.S. Geological Survey (USGS) by means of two separate voluntary surveys. Statistics resulting from these surveys are listed in tables 1 and 2.

The annual Tungsten Ore and Concentrate Survey covered the production, purchases, disposition, and stocks of tungsten ores and concentrates. No tungsten was mined in the United States in 1998. The Pine Creek Mine in Bishop, CA, owned equally by Avocet Mining PLC (Avocet) and Strategic Minerals Corp., remained under care and maintenance.

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 11 of the 12 processing operations on the survey; estimates were made for the nonresponding operation. Major U.S. processors of tungsten materials in 1998 included Avocet Tungsten Inc., Bishop, CA, Buffalo Tungsten Inc., Depew, NY, OM Group, Inc. (formerly The Dow Chemical Company), Midland, MI, General Electric Co., Euclid, OH, Kennametal Inc., Latrobe, PA, and Fallon, NV, Osram Sylvania, Inc., Towanda, PA, and Teledyne Metalworking Products, Huntsville, AL.

In 1998, U.S. processors consumed significantly less tungsten concentrate and 18% more tungsten-bearing scrap than in 1997. Domestic production of ammonium paratungstate decreased by 14% in 1998 compared with that of 1997. U.S. processors consumed nearly the same amount of ammonium paratungstate during both years. Total net production of all primary tungsten products (hydrogen-reduced metal powder, tungsten carbide powder, and tungsten chemicals) increased by 22% in 1998 compared with that of 1997.

Avocet Tungsten produced ammonium paratungstate and

ammonium metatungstate from imported concentrates at its tungsten processing plant in Bishop, CA. As part of an effort to produce and sell value-added products, the company commissioned a calciner with a capacity of approximately 4,500 metric ton units per month to convert ammonium paratungstate to blue oxide ($W_{20}O_{58}$), which can then be reduced to tungsten metal powder. Although ammonium paratungstate production at the Bishop plant has steadily increased in recent years, Avocet Tungsten planned to decrease its future output of ammonium paratungstate significantly in response to market conditions (Avocet Mining PLC, 1998a, p. 10).

In April, OM Group of Cleveland, OH, purchased The Dow Chemical Company's rapid carbothermal reduction technology for producing submicron-sized tungsten carbide powders. The submicron powders are used to produce circular magnetic tape slitters for video, audio, and computer memory magnetic tape; high-performance woodcutting drills and saw blades; microdrills for printed circuit boards; rotary cutting dies; and shear knives for cutting medical and industrial x-ray film. OM Group planned to continue operations at the Midland, MI, production facility (OM Group, Inc., 1998).

During the year, OM Group expanded its Apex cobalt facility in St. George, UT. The expansion will enable the recycling of soft and hard cemented carbide scrap to produce ammonium paratungstate (Magdics, 1998, p. 19, 22, and 31; OM Group, Inc., 1999, p. 3).

Nanodyne Inc. began construction of a full-scale plant in Laurinburg, NC, to produce composite metal powders with nanometer-sized grains. Nanodyne's proprietary spray-conversion process had been demonstrated at the company's pilot plant in New Brunswick, NJ, where it produced approximately 40 tons per year (t/yr) of nanocrystalline tungsten carbide-cobalt powder during the past 5 years. The Laurinburg plant, which will have a capacity of 500 t/yr of powder, was scheduled to open in early 1999. In addition to tungsten carbide-cobalt powders, Nanodyne was also developing tungsten-silver and tungsten-copper powders to be used as electrical contacts by the semiconductor industry (American Metal Market, 1998a). During the year, N.V. Union Minière S.A. of Brussels, Belgium, a nonferrous metals producer, increased its stake in Nanodyne from 27% to 100% (N.V. Union Minière S.A., 1999, p. 3).

Consumption

Data on U.S. consumption of tungsten in end-use categories were developed from the voluntary Consolidated Consumers Survey of U.S. metal consumers. For this survey, nearly 75 tungsten consumers were canvassed on a monthly or annual basis. Reported consumption and stocks data in tables 1 and 3 include estimates to account for nonrespondents. Total U.S. reported consumption of tungsten materials to make alloys; catalysts; cemented carbides; mill products, such as lamp filaments and electrodes; and pigments increased by 8% in 1998 compared with that of 1997. In 1998, U.S. metal consumers used more ferrotungsten, tungsten carbide powder, and tungsten metal powder, and less tungsten in chemicals and tungsten-bearing scrap. Producers of catalysts, cemented

carbides, and mill products for lighting and other industries reported increased tungsten consumption in 1998. Total tungsten consumption by steel manufacturers also increased in 1998 compared with that of 1997. Superalloy melters, producers of other alloys, and pigment manufacturers consumed less tungsten in 1998 than in 1997.

Weekly reports of the number of operating drilling rigs give an indication of the demand for cemented carbide components by the oil drilling industry. The number of rigs operating in the United States decreased steadily during 1998—from a high of 1,003 rigs in early January to a low of 621 rigs at the end of December. The average number of rigs operating in the United States during 1998 was 12% lower than that of 1997 (Baker Hughes, International Association of Drilling Contractors, 1998, IADC rotary rig report, accessed weekly at URL <http://www.iadc.org/rigcount.htm>). The decrease in drilling activity was attributed to a decrease in oil prices (Vine, 1998, p. 1).

Total U.S. consumption of tungsten scrap increased by 14% in 1998. Scrap consumption by U.S. tungsten processors and consumers was 3,350 t of contained tungsten in 1998 compared with 2,930 t in 1997.

Prices

Prices of tungsten materials, as published in Metal Bulletin and Platt's Metals Week, continued to decrease in 1998. Monthly and annual average prices of tungsten concentrates are listed in table 4. The average of tungsten concentrate prices reported by Metal Bulletin was \$44 per metric ton unit, 6% lower in 1998 than that of 1997. The average of U.S. spot tungsten ore concentrate prices reported by Platt's Metals Week was \$52 per metric ton unit (\$47 per short ton unit), 19% lower in 1998 than that of 1997.

Ammonium paratungstate prices also decreased during the year. The average of high and low prices of ammonium paratungstate in the U.S. market reported by Platt's Metals Week decreased from \$74 per metric ton unit (\$67 per short ton unit) in January to \$57 per metric ton unit (\$52 per short ton unit) in December. The average of U.S. ammonium paratungstate prices reported by Metal Bulletin decreased from \$71 per metric ton unit (\$64 per short ton unit) in January to \$55 per metric ton unit (\$50 per short ton unit) by yearend. Ammonium paratungstate prices quoted for the European and the Hong Kong markets also decreased during the year.

In 1996, mine executives at the Seventh International Tungsten Symposium stated that tungsten concentrate prices would need to increase to more than \$80 per metric ton unit and ammonium paratungstate prices would need to increase to more than \$100 per metric ton unit for it to be economic to bring back the more than 10,000 t/yr of capacity lost during the past 15 years (American Metal Market, 1996).

Foreign Trade

The United States exported 41% more tungsten in 1998 than in 1997. As shown in tables 5 through 9, in 1998, exports of ammonium paratungstate, ferrotungsten, tungsten carbide powder, tungsten compounds, tungsten metal powders, tungsten ores and concentrates, and unwrought tungsten and

waste and scrap were higher, while exports of tungsten wire, wrought tungsten other than wire, and other tungsten metal were lower compared with those of 1997.

In 1998, total U.S. imports of tungsten materials were slightly higher than those of 1997. China continued to be the largest supplier of tungsten to the United States, providing 40% of all tungsten imports in 1998. Imports from China increased by 24%, to 5,360 t of contained tungsten compared with 4,320 t imported in 1997. Of the imports from China, 36% was tungsten oxides; 35%, ammonium paratungstate; 13%, other tungstates; 5%, ferrotungsten; 5%, tungsten carbide powder; 2%, tungsten metal powders; 2%, tungsten waste and scrap; and the remainder was tungsten chloride and wrought tungsten.

Russia was the next largest supplier of tungsten materials to the United States, providing 21% of U.S. imports. In 1998, Russian imports were mainly tungsten ores and concentrates (77%), ferrotungsten (12%), and tungsten waste and scrap (10%). Total imports from Russia decreased by 5%, to 2,790 t of contained tungsten in 1998 compared with 2,930 t in 1997. Imports of Russian ferrotungsten and tungsten oxide decreased, while imports of tungsten ores and concentrates and waste and scrap increased in 1998 compared with those of 1997.

As shown in table 10, the United States imported approximately the same amount of tungsten ores and concentrates during the past 2 years. In 1998, 88% of these imports were from Russia (45%), Kazakhstan (16%), Portugal (14%), and Bolivia (13%).

China continued to be the leading supplier of imported ammonium paratungstate to the United States (table 11). Total U.S. imports of this material decreased by 8% in 1998 as compared with those of 1997. Imports of ammonium paratungstate from China were approximately the same during the past 2 years, but were lower from other countries in 1998 compared with those of 1997.

In 1998, imports of other tungstates, tungsten carbide powder, tungsten metal powders, tungsten oxide, and unwrought tungsten increased, while imports of calcium tungstate, ferrotungsten, tungsten waste and scrap, and wrought tungsten decreased compared with those of 1997. (See tables 12 and 13.)

World Review

World consumption of primary tungsten was strong in early 1998, but demand decreased sharply beginning around May, particularly in Japan and the United States. As a result, world consumption for the year was 3% lower than that of 1997. World consumption continued to exceed world mine production, with the shortfall in supply being met by releases from stockpiles in Kazakhstan and Russia (Bunting, 1999).

Most of the world's tungsten mining occurs in China. As shown in table 14, in 1998, China produced more than three-quarters of the world's tungsten concentrates. Russia was the next largest producer at an estimated 9% of total production, followed by Austria at 4%.

Australia.—Tasmania Mines Ltd. produced 17 t of low- and high-grade scheelite concentrates from its Kara Mine at Hampshire, Tasmania. The concentrates were used by the specialty steel industry. This mine also produced magnetite,

much of which was used in coal beneficiation (Resource Information Unit, 1999).

Austria.—Inmet Mining Corp., of Toronto, Canada, sold its 100% interest in Wolfram Bergbau und Hutten GmbH Nfg KG to an unspecified European private holding company (Metal Bulletin, 1998b). Wolfram Bergbau owns the Mittersill scheelite mine in the Province of Salzburg and the Bergla tungsten processing plant in the Province of Steiermark.

China.—In April, the Chinese State Council disbanded China National Nonferrous Metals Corp. (CNNC) and established the State Bureau of Nonferrous Metals Industry. The new Bureau, under the State Economic and Trade Commission, is responsible for the administration of the nonferrous metals industry. After a transition period during which the Bureau will be responsible for managing the metals enterprises formerly run by CNNC, the Bureau will not have direct administrative control over the enterprises. Rather, its main responsibilities will be to prepare industrial plans and policies; formulate regulations and standards; collect, analyze, and publish economic, technical, and market information; and promote restructuring of the nonferrous metals industry (Metal Bulletin, 1998a; China Economic Information Network, 1998, State Bureau of Nonferrous Metals Industry, accessed July 29, 1999, at URL <http://ce.cei.gov.cn/echn/a1/ca102bnm.htm>).

An overview of the Chinese tungsten mining industry was presented at the 11th annual general meeting of the International Tungsten Industry Association in October 1998 (Zairong and Pugang, 1998, p. 2-5, 7 and 9). Production by state-owned mines decreased in 1997 compared with that of 1996. In contrast, the production by locally operated mines increased. As a result, the amount of tungsten in concentrates produced by locally operated mines was two times that of the state-owned mines. The state-owned mines are facing various problems—some mines are running out of resources, some are short of funds, and some have excessive operating costs. The average age of the state-owned mines is more than 40 years, and only half of the 18 former CNNC mines can maintain production for more than 10 years. The mines carry a heavy social burden to support schools, hospitals, and a large number of retired workers. The newly formed State Bureau of Nonferrous Metals Industry has prepared eight strategies to help improve the state-owned mining industry's situation.

India.—Late in the year, Rajasthan State Tungsten Development Corp. Ltd. decided to suspend mining operations at its tungsten mine at Degana in northwestern India. The suspension was attributed to low international tungsten prices (American Metal Market, 1998b).

Peru.—During the fiscal year ending March 1998, Minera Malaga Santolalla S.A., an Avocet subsidiary, produced concentrates containing 25,100 metric ton units of WO_3 from the Pasto Bueno Mine, a significant increase from the 10,310 mtu produced the previous fiscal year. As a result of continued low tungsten prices, lower-than-expected ore grades, diminishing ore reserves, and unresolved labor disputes, Avocet sold its 80% interest in Minera Malaga back to the Malaga family but retained an option to buy back a 67% interest (Avocet Mining PLC, 1998a).

The Palca Mine in southeastern Peru, operated by S.A. Minera Regina, an Avocet subsidiary, remained under care and maintenance in 1998. Lateral exploration at the mine did not yield high-grade ore. As a result, Avocet planned to close the mine permanently at the end of December (Avocet Mining PLC, 1998b).

Portugal.—During the fiscal year ending March 1998, Beralt Tin & Wolfram S.A., an Avocet subsidiary, produced concentrates containing 130,650 mtu of WO_3 , a 31% increase from the 100,070 mtu produced the previous fiscal year. In July, Beralt commissioned a subvertical hoisting shaft at the Panasqueria Mine. The shaft was intended to facilitate mining higher grade reserves at greater depths. As the year progressed, Beralt reduced its production to meet customer demand (Avocet Mining PLC, 1998a).

Russia.—Tungsten materials from stockpiles in Russia continued to contribute to world supply (Bunting, 1999). In 1998, Russian production of tungsten concentrates was reported to be only 56% of that of 1995 (Interfax International Ltd., 1999a).

In 1998, the Lermontov Mining Company sold 1,631 t of tungsten concentrates from its Lermontov Mine in Primorskiy Kray, a 39% decrease from sales in 1997. Approximately two-fifths of the concentrates were exported to the United States and Japan, and the remainder was sold in Russia. The company was considering a plan to build a tungsten-processing plant to upgrade its concentrates to an intermediate tungsten compound (Interfax International Ltd., 1999b).

The Primorskiy tungsten mine and mill complex in Primorskiy Kray resumed tungsten concentrate production in January after being idle for more than 6 months. The complex had raised funds to restart operations by selling stockpiled tungsten concentrate provided by the Government on credit in 1997 (Interfax International Ltd., 1998b).

In September, ownership of the Tyrnyauz tungsten and molybdenum mine and mill complex was transferred to the Republic of Kabardino-Balkaria. Production from the complex reportedly was very low during 1998 as a result of financial constraints (Interfax International Ltd., 1998a).

Tajikistan.—Ikar Mineral Corp. of Vancouver, British Columbia, began a prefeasibility study of the Ikar tungsten deposit in its 100%-owned Rushan concession in southeastern Tajikistan. As part of the study, Ikar planned to begin a drilling program to verify the resource in early 1999 (Ikar Mineral Corp., 1998a, b).

Uzbekistan.—Plans by the Government of Uzbekistan to privatize the Uzbek Refractory and High-Temperature Metals Plant in Chirchik, Tashkent region, were delayed indefinitely because of the plant's financial difficulties. The Government was considering a rejuvenation program that would provide money for working capital, deferred tax payments, exemptions from fines and penalties, and a 3-year reprieve on debt settlements for energy supplies. The plant processed tungsten and molybdenum concentrates to produce metal powders, hard alloys, and fabricated products. During 1998, it reportedly operated at one-third of its capacity as a result of reduced supplies of tungsten and molybdenum concentrates (Interfax International Ltd., 1998c).

Outlook

Demand for tungsten tends to follow general economic conditions and is expected to increase when world market conditions improve. Future consumption of tungsten in cemented carbides, the largest end-use sector, will depend on the performance of the following industries: automotive and aircraft production, construction, mining, oil and gas drilling, and semiconductor and other manufacturing.

World tungsten supply will continue to be dominated by Chinese production and exports. In an effort to control its output, the Chinese Government stopped issuing new permits for tungsten mines (American Metal Market, 1999) and reduced the number of export licences for tungsten materials (Metal Bulletin, 1999b) during the first half of 1999. Also, in an effort to bring the prices of tungsten materials closer to the costs of production, the China Tungsten Industry Association set minimum prices for ammonium paratungstate, tungsten concentrates, and tungsten oxide in July (Metal Bulletin, 1999a).

In 1999, a "new" supply of tungsten materials will become available to the market when the U.S. Government resumes sales of stockpiled tungsten after a 10-year hiatus. The tungsten industry will be watching closely to see how the Defense National Stockpile Center enters a market characterized by oversupply and historically low prices. The amount of tungsten materials released from stockpiles has been an ongoing concern for the tungsten industry. In the mid to late 1990's, releases of stockpiled tungsten from Kazakhstan and Russia sustained the oversupply situation, kept prices low, and resulted in further hardship for the remaining tungsten mining industry. In recent years, approximately one-quarter of the world's tungsten supply has been from Government stockpile releases (Bunting, 1999). At some point, stockpiles will be depleted, and world mine production will have to increase to meet demand. World mine capacity is currently estimated to be less than world demand (Bunting, 1999). How quickly mines can be brought back online and whether mine production can meet demand once stockpiles are depleted will determine the future tungsten supply-demand balance.

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TABLE 1
SALIENT TUNGSTEN STATISTICS 1/

(Metric tons of tungsten content unless otherwise specified)

| | 1994 | 1995 | 1996 | 1997 | 1998 |
|--|-----------|-----------|-----------|-----------|-----------|
| United States: | | | | | |
| Concentrate: | | | | | |
| Production | W | (2/) | (2/) | (2/) | -- |
| Shipments | NA | NA | NA | NA | NA |
| Value | thousands | NA | NA | NA | NA |
| Consumption | 3,630 3/ | 5,890 | 5,260 | 6,590 | 3,210 4/ |
| Exports | 44 | 20 | 72 | 40 | 49 |
| Imports for consumption | 2,960 | 4,660 | 4,190 | 4,850 | 4,750 |
| Stocks, December 31: | | | | | |
| Producer | NA | NA | NA | NA | NA |
| Consumer | 911 r/ | 627 | 569 | 658 | 514 |
| U.S. Government 5/ | 34,600 | 34,600 | 34,600 | 34,600 | 34,600 |
| Ammonium paratungstate: | | | | | |
| Production | 536 6/ | 2,580 7/ | 4,450 8/ | 5,380 8/ | 838 6/ |
| Consumption | 7,080 | 7,920 | 7,790 | 9,300 | 9,210 |
| Stocks, December 31: Producer and consumer | 179 r/ | 727 | 558 | W | 603 |
| Primary products: | | | | | |
| Net production | 7,410 | 8,060 | 7,810 | 8,300 | 9,630 |
| Consumption 9/ | 8,110 | 8,800 | 7,830 | 8,390 | 9,100 |
| Stocks, December 31: | | | | | |
| Producer 10/ | 1,050 r/ | 1,300 | 1,400 | 1,210 | 1,340 |
| Consumer 9/ | 849 | 570 | 413 r/ | 610 r/ | 536 |
| U.S. Government 5/ | 2,700 | 2,380 | 2,700 | 2,700 | 2,700 |
| World: | | | | | |
| Concentrate: | | | | | |
| Production | 34,000 r/ | 38,500 r/ | 34,700 r/ | 33,200 r/ | 32,200 e/ |
| Consumption 11/ | 31,600 | 31,000 e/ | (12/) | (12/) | (12/) |

e/ Estimated. r/ Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.

1/ Data are rounded to three significant digits.

2/ Revised to zero.

3/ Excludes 3 months of "Withheld" data.

4/ Excludes 6 months of "Withheld" data.

5/ Defense Logistics Agency.

6/ Excludes 11 months of "Withheld" data.

7/ Excludes 7 months of "Withheld" data.

8/ Excludes 4 months of "Withheld" data.

9/ Includes scrap.

10/ Excludes cast and crystalline tungsten carbide powder.

11/ Based on data received from United Nations Conference on Trade and Development, January 1996.

12/ The United Nations is no longer collecting and publishing this information.

TABLE 2
NET PRODUCTION AND STOCKS OF TUNGSTEN PRODUCTS IN THE UNITED STATES 1/ 2/

(Metric tons of tungsten content)

| | Hydrogen reduced metal powder | Tungsten carbide powder | | Chemicals | Total |
|------------------------------------|--|---------------------------|-------------------------|-----------|-------|
| | | Made from metal powder | Cast and crystalline | | |
| Net production 1998 | 4,600 | 5,040 | W | W | 9,630 |
| Net production 1997 | 3,410 | 4,890 | W | W | 8,300 |
| Producer stocks, December 31, 1998 | 719 | 576 | W | 46 | 1,340 |
| Producer stocks, December 31, 1997 | 710 | 405 | W | 95 | 1,210 |

W Withheld to avoid disclosing company proprietary data.

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

2/ Data are rounded to three significant digits; may not add to totals shown.

TABLE 3
REPORTED CONSUMPTION AND STOCKS OF TUNGSTEN PRODUCTS
IN THE UNITED STATES 1/ 2/ 3/

(Metric tons of tungsten content)

| | 1997 | 1998 |
|--------------------------------------|----------|--------|
| Consumption by end use: | | |
| Steel: | | |
| Tool | 361 | (4/) |
| Other | 151 | 532 5/ |
| Superalloys | 366 r/ | 333 |
| Other alloys 6/ | 277 r/ | 219 |
| Cemented carbides 7/ | 6,280 r/ | 6,640 |
| Mill products made from metal powder | 828 | 1,270 |
| Chemical uses | 123 r/ | 97 |
| Total | 8,390 | 9,100 |
| Consumption by form: | | |
| Ferrotungsten | 473 | 527 |
| Tungsten metal powder | 962 r/ | 1,370 |
| Tungsten carbide powder | 6,270 | 6,560 |
| Tungsten scrap | 525 r/ | 516 |
| Other tungsten materials 8/ | 165 r/ | 121 |
| Total | 8,390 | 9,100 |
| Consumer stocks, December 31: | | |
| Ferrotungsten | 28 | 26 |
| Tungsten metal powder | 24 r/ | 17 |
| Tungsten carbide powder | 488 | 431 |
| Tungsten scrap | 45 | 38 |
| Other tungsten materials 8/ | 25 r/ | 24 |
| Total | 610 r/ | 536 |

r/ Revised.

1/ Data are rounded to three significant digits; may not add to totals shown.

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

3/ Includes estimates.

4/ Included with "Other Steel."

5/ Includes "Tool Steel."

6/ Includes welding and hard-facing rods and materials, wear- and corrosion-resistant alloys, and nonferrous alloys.

7/ Includes diamond bit matrices, cemented and sintered carbides, and cast carbide dies or parts.

8/ Includes tungsten chemicals.

TABLE 4
MONTHLY PRICE QUOTATIONS OF TUNGSTEN CONCENTRATE IN 1998

| Month | Metal Bulletin (London), European market, 65% WO ₃ basis, c.i.f. 1/ | | | Platt's Metals Week, U.S. spot quotations, 65% WO ₃ basis, c.i.f. U.S. ports, including duty 2/ | | | | |
|-----------|---|------|---------|---|----------------------------|------|---------|--------------------------------|
| | Dollars per metric ton unit | | | Dollars per short ton unit | Dollars per short ton unit | | | Dollars per metric ton unit |
| | Low | High | Average | Average | Low | High | Average | Average |
| January | 40 | 52 | 46 | 42 | 45 | 55 | 50 | 55 |
| February | 40 | 52 | 46 | 42 | 40 | 55 | 48 | 52 |
| March | 40 | 52 | 46 | 42 | 40 | 50 | 45 | 50 |
| April | 40 | 52 | 46 | 42 | 46 | 50 | 48 | 53 |
| May | 40 | 52 | 46 | 42 | 46 | 50 | 48 | 53 |
| June | 40 | 52 | 46 | 42 | 46 | 50 | 48 | 53 |
| July | 38 | 52 | 45 | 41 | 46 | 50 | 48 | 53 |
| August | 38 | 48 | 43 | 39 | 44 | 50 | 47 | 52 |
| September | 38 | 48 | 43 | 39 | 44 | 50 | 47 | 52 |
| October | 38 | 48 | 43 | 39 | 44 | 50 | 47 | 52 |
| November | 38 | 48 | 43 | 39 | 40 | 50 | 45 | 50 |
| December | 32 | 42 | 37 | 34 | 40 | 45 | 43 | 47 |

1/ Combined wolframite and scheelite quotations. Low and high prices are reported semiweekly. Monthly averages are arithmetic averages of semiweekly low and high prices. The average annual price per metric ton unit of WO₃ of all semiweekly low and high prices was \$44 in 1998. The average equivalent price per short ton unit of WO₃ was \$40 in 1998.

2/ Low and high prices are reported weekly. Monthly averages are arithmetic averages of weekly low and high prices. The average annual price per short ton unit of WO₃ of all weekly low and high prices was \$47 in 1998. The average equivalent price per metric ton unit of WO₃ was \$52 in 1998.

TABLE 5
U.S. EXPORTS OF TUNGSTEN ORE AND CONCENTRATE, BY COUNTRY

| Country of destination | 1997 | | 1998 | |
|------------------------|---|----------------------|---|----------------------|
| | Tungsten content 1/ (metric tons) | Value (thousands) | Tungsten content 2/ (metric tons) | Value (thousands) |
| Belgium | -- | -- | 1 | \$6 |
| Bolivia | 3 | \$19 | -- | -- |
| Brazil | -- | -- | 1 | 4 |
| China | 13 | 91 | -- | -- |
| Colombia | -- | -- | 1 | 5 |
| Germany | 1 | 6 | 6 | 36 |
| Hong Kong | 1 | 8 | -- | -- |
| India | 1 | 10 | -- | -- |
| Ireland | 1 | 8 | 15 | 89 |
| Italy | 4 | 28 | 6 | 37 |
| Japan | 12 | 86 | (3/) | 3 |
| Mexico | -- | -- | (3/) | 3 |
| Qatar | (3/) | 3 | -- | -- |
| United Kingdom | 3 | 21 | 19 | 117 |
| Vietnam | (3/) | 3 | -- | -- |
| Total 4/ | 40 | 282 | 49 | 300 |

1/ Calculated based upon an estimated value of \$56 per metric ton unit WO₃.

2/ Calculated based upon an estimated value of \$48 per metric ton unit WO₃.

3/ Less than 1/2 unit.

4/ Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

TABLE 6
U.S. EXPORTS OF AMMONIUM PARATUNGSTATE, BY COUNTRY 1/

| Country of destination | 1997 | | 1998 | |
|------------------------|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Belgium | 42 | \$519 | 72 | \$744 |
| Denmark | 3 | 33 | -- | -- |
| France | -- | -- | 1 | 8 |
| Germany | -- | -- | 37 | 194 |
| Hungary | -- | -- | 1 | 9 |
| Japan | 62 | 464 | -- | -- |
| Korea, Republic of | (2/) | 6 | -- | -- |
| Netherlands | 11 | 145 | -- | -- |
| Sweden | 4 | 41 | 95 | 708 |
| United Kingdom | -- | -- | 82 | 535 |
| Total | 121 | 1,210 | 287 | 2,200 |

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 7
U.S. EXPORTS OF TUNGSTEN METAL POWDERS, BY COUNTRY 1/ 2/

| Country of destination | 1997 | | | 1998 | | |
|------------------------|----------------------------|-----------------------------------|-------------------|----------------------------|-----------------------------------|-------------------|
| | Gross weight (metric tons) | Tungsten content 3/ (metric tons) | Value (thousands) | Gross weight (metric tons) | Tungsten content 3/ (metric tons) | Value (thousands) |
| Australia | 5 | 4 | \$154 | 5 | 4 | \$139 |
| Belgium | 11 | 8 | 365 | 12 | 10 | 124 |
| Brazil | 11 | 8 | 447 | 17 | 14 | 415 |
| Canada | 74 | 59 | 2,120 | 59 | 47 | 1,930 |
| China | (4/) | (4/) | 17 | 5 | 4 | 114 |
| Colombia | 2 | 2 | 50 | (4/) | (4/) | 29 |
| France | 13 | 11 | 295 | 15 | 12 | 513 |
| Germany | 195 | 156 | 5,880 | 408 | 326 | 12,900 |
| Guatemala | 7 | 5 | 9 | -- | -- | -- |
| Hong Kong | 6 | 5 | 102 | 3 | 2 | 84 |
| India | (4/) | (4/) | 10 | 83 | 66 | 1,160 |
| Israel | 54 | 43 | 735 | 38 | 30 | 466 |
| Italy | 4 | 3 | 100 | 14 | 12 | 700 |
| Japan | 6 | 5 | 62 | 75 | 60 | 565 |
| Korea, Republic of | 1 | 1 | 36 | 5 | 4 | 197 |
| Mexico | 6 | 5 | 145 | 9 | 7 | 224 |
| Netherlands | 14 | 11 | 63 | 19 | 15 | 421 |
| Panama | -- | -- | -- | 11 | 9 | 13 |
| Singapore | 2 | 2 | 72 | 4 | 3 | 273 |
| South Africa | (4/) | (4/) | 6 | 3 | 2 | 111 |
| Spain | 5 | 4 | 56 | 1 | 1 | 40 |
| Sweden | 1 | 1 | 44 | 3 | 2 | 50 |
| Switzerland | 47 | 37 | 1,290 | 59 | 48 | 2,420 |
| Taiwan | 1 | 1 | 58 | 16 | 13 | 482 |
| Trinidad and Tobago | 7 | 6 | 45 | 1 | (4/) | 15 |
| United Kingdom | 36 | 29 | 513 | 193 | 154 | 2,140 |
| Other | 6 r/ | 5 r/ | 207 r/ | 7 | 5 | 182 |
| Total | 512 | 410 | 12,900 | 1,060 | 851 | 25,700 |

r/ Revised.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ May include tungsten alloy powders.

3/ Content estimated from reported gross weight.

4/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 8
U.S. EXPORTS OF TUNGSTEN CARBIDE POWDER, BY COUNTRY 1/

| Country of destination | 1997 | | 1998 | |
|------------------------|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Argentina | (2/) | \$30 | 1 | \$46 |
| Australia | 6 | 142 | 7 | 157 |
| Austria | 52 | 971 | 22 | 463 |
| Belgium | 2 | 140 | 8 | 291 |
| Brazil | 6 | 161 | 7 | 264 |
| Canada | 323 | 8,530 | 224 | 5,680 |
| Denmark | 3 | 153 | (2/) | 4 |
| France | 54 | 651 | 10 | 234 |
| Germany | 177 | 3,380 | 272 | 4,620 |
| Hong Kong | 1 | 74 | (2/) | 3 |
| India | 3 | 136 | 2 | 72 |
| Ireland | 4 | 271 | 2 | 170 |
| Israel | (2/) | 13 | 106 | 1,370 |
| Italy | 80 | 2,380 | 96 | 2,490 |
| Japan | 38 | 1,440 | 28 | 1,040 |
| Korea, Republic of | 24 | 1,020 | 6 | 256 |
| Luxembourg | (2/) | 15 | 2 | 38 |
| Malaysia | -- | -- | 1 | 40 |
| Mexico | 9 | 380 | 13 | 491 |
| Netherlands | 7 | 171 | 240 | 3,780 |
| Peru | 2 | 56 | (2/) | 6 |
| Portugal | 3 | 15 | 17 | 254 |
| Singapore | 47 | 1,020 | 4 | 272 |
| South Africa | 58 | 878 | 35 | 459 |
| Spain | (2/) | 3 | 1 | 49 |
| Sweden | 83 | 4,090 | 25 | 338 |
| Switzerland | (2/) | 5 | 3 | 126 |
| Taiwan | 29 | 840 | 15 | 455 |
| United Arab Emirates | (2/) | 13 | 1 | 22 |
| United Kingdom | 31 | 640 | 80 | 1,310 |
| Venezuela | 22 | 465 | 13 | 292 |
| Other | 2 | 110 r/ | 1 | 58 |
| Total | 1,070 | 28,200 | 1,240 | 25,200 |

r/ Revised.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 9
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY 1/

| Product and country of destination | 1997 | | 1998 | |
|---|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Ferrotungsten and ferrosilicon tungsten: | | | | |
| Canada | 1 | \$23 | 4 | \$62 |
| China | 3 | 42 | -- | -- |
| India | (2/) | 5 | -- | -- |
| Israel | -- | -- | (2/) | 4 |
| Korea, Republic of | -- | -- | 9 | 394 |
| Mexico | 7 | 28 | 14 | 407 |
| Netherlands | -- | -- | 5 | 222 |
| Venezuela | -- | -- | 9 | 367 |
| Total | 10 | 98 | 40 | 1,460 |
| Unwrought tungsten and waste and scrap: 3/ 4/ 5/ | | | | |
| Australia | 5 | 26 | 6 | 33 |
| Brazil | 11 | 98 | (2/) | 12 |
| Canada | 43 | 417 | 49 | 422 |
| China | -- | -- | 2 | 11 |
| Colombia | 13 | 78 | 2 | 13 |
| Denmark | -- | -- | 12 | 68 |
| France | -- | -- | 31 | 177 |
| Germany | 318 | 1,990 | 319 | 1,650 |
| Hong Kong | 4 | 21 | 1 | 12 |
| Hungary | -- | -- | 3 | 15 |
| India | 3 | 30 | 10 | 169 |
| Ireland | -- | -- | 3 | 17 |
| Israel | 1 | 8 | 19 | 106 |
| Italy | 1 | 3 | 18 | 82 |
| Japan | 3 | 31 | 39 | 222 |
| Korea, Republic of | -- | -- | 4 | 25 |
| Malaysia | -- | -- | 10 | 75 |
| Mexico | 17 | 129 | 27 | 169 |
| Netherlands | -- | -- | 22 | 159 |
| Norway | -- | -- | 3 | 18 |
| Philippines | -- | -- | 13 | 74 |
| Singapore | (2/) | 6 | 3 | 34 |
| Sweden | -- | -- | 19 | 160 |
| Taiwan | 11 | 62 | 95 | 757 |
| United Kingdom | 61 | 348 | 82 | 475 |
| Venezuela | 12 | 54 | -- | -- |
| Other | 3 r/ | 23 r/ | 1 | 14 |
| Total | 507 | 3,320 | 794 | 4,970 |
| Wrought tungsten--wire: 3/ 4/ | | | | |
| Belgium | 1 | 103 | 10 | 653 |
| Brazil | 1 | 96 | 10 | 741 |
| Canada | 31 | 1,040 | 21 | 749 |
| France | 3 | 422 | 8 | 576 |
| Germany | 4 | 409 | 3 | 480 |
| Hong Kong | 7 | 903 | 1 | 64 |
| Hungary | 11 | 624 | 5 | 223 |
| India | 26 | 1,640 | 19 | 1,360 |
| Indonesia | (2/) | 21 | 3 | 207 |
| Italy | 5 | 473 | 6 | 366 |
| Japan | 11 | 1,490 | 7 | 897 |
| Mexico | 15 | 1,320 | 17 | 1,250 |
| Spain | 11 | 557 | 3 | 130 |
| Sweden | 3 | 262 | 3 | 249 |
| Taiwan | 3 | 223 | 4 | 232 |
| United Kingdom | 1 | 149 | 2 | 340 |
| Other | 5 r/ | 764 r/ | 3 | 626 |
| Total | 136 | 10,500 | 125 | 9,140 |

See footnotes at end of table.

TABLE 9--Continued
U.S. EXPORTS OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY 1/

| Product and country of destination | 1997 | | 1998 | |
|--|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Wrought tungsten, excluding wire: 3/ 4/ | | | | |
| Argentina | -- | -- | 1 | \$27 |
| Australia | 4 | \$180 | (2/) | 9 |
| Belgium | 1 | 26 | (2/) | 80 |
| Brazil | 1 | 72 | 5 | 246 |
| Canada | 21 | 658 | 22 | 822 |
| Chile | (2/) | 34 | 1 | 47 |
| China | (2/) | 247 | 1 | 162 |
| France | 3 | 305 | 2 | 203 |
| Germany | 154 | 3,540 | 112 | 2,780 |
| India | 4 | 109 | 28 | 590 |
| Ireland | 5 | 221 | 1 | 24 |
| Israel | 1 | 105 | (2/) | 173 |
| Italy | 2 | 166 | 1 | 122 |
| Japan | 9 | 904 | 12 | 1,360 |
| Korea, Republic of | 1 | 75 | (2/) | 29 |
| Lithuania | 2 | 41 | -- | -- |
| Mexico | 3 | 189 | 5 | 299 |
| Netherlands | 1 | 54 | 1 | 53 |
| Singapore | 2 | 121 | 1 | 108 |
| Spain | 7 | 292 | 4 | 151 |
| Sweden | (2/) | 33 | 1 | 128 |
| Taiwan | 8 | 658 | 7 | 453 |
| United Kingdom | 2 | 238 | 2 | 213 |
| Other | 5 | 274 r/ | 1 | 99 |
| Total | 237 | 8,540 | 207 | 8,180 |
| Other tungsten metal: 3/ 4/ | | | | |
| Australia | 2 | 301 | 1 | 147 |
| Belgium | 1 | 107 | -- | -- |
| Brazil | 2 | 313 | 1 | 111 |
| Canada | 9 | 617 | 12 | 760 |
| France | 1 | 218 | 1 | 75 |
| Germany | 3 | 972 | 3 | 706 |
| Hong Kong | 3 | 116 | 4 | 174 |
| India | 6 | 493 | 2 | 137 |
| Israel | 1 | 226 | 7 | 1,170 |
| Japan | 9 | 3,400 | 5 | 2,280 |
| Korea, Republic of | 7 | 704 | 4 | 285 |
| Mexico | 11 | 1,290 | 5 | 707 |
| Netherlands | 1 | 291 | 2 | 288 |
| Singapore | 1 | 391 | 1 | 362 |
| Taiwan | 7 | 840 | 8 | 714 |
| Thailand | 1 | 504 | (2/) | 198 |
| United Kingdom | 11 | 1,010 | 6 | 495 |
| Other | 5 r/ | 1,350 r/ | 4 | 559 |
| Total | 80 | 13,100 | 64 | 9,170 |
| Tungsten compounds: 6/ | | | | |
| Canada | 5 | 16 | 11 | 28 |
| El Salvador | -- | -- | 19 | 27 |
| United Kingdom | 1 | 64 | -- | -- |
| Other | (2/) | 10 | (2/) | 7 |
| Total | 6 | 90 | 31 | 62 |

r/ Revised.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

3/ May include alloys.

4/ Content estimated from reported gross weight.

5/ Includes bars and rods obtained simply by sintering.

6/ Includes only other tungstates. Formerly called "Other tungsten compounds."

Source: Bureau of the Census.

TABLE 10
U.S. IMPORTS FOR CONSUMPTION OF TUNGSTEN ORE AND CONCENTRATE, BY COUNTRY 1/

| Country of origin | 1997 | | 1998 | |
|-------------------|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Australia | 23 | \$127 | 72 | \$308 |
| Bolivia | 635 | 3,230 | 619 | 3,000 |
| Canada | 1 | 5 | -- | -- |
| Chile | 46 | 255 | 12 | 57 |
| China | 71 | 349 | -- | -- |
| Germany | 52 | 240 | 52 | 238 |
| Japan | 11 | 57 | 10 | 54 |
| Kazakhstan | 626 | 2,450 | 782 | 3,570 |
| Mexico | 176 | 652 | 132 | 490 |
| Mongolia | 22 | 90 | 24 | 74 |
| Netherlands | 3 | 25 | 33 | 152 |
| Peru | 212 | 1,220 | 85 | 451 |
| Portugal | 1,010 | 6,100 | 643 | 3,770 |
| Russia | 1,880 | 9,020 | 2,140 | 9,070 |
| Rwanda | 51 | 248 | 82 | 302 |
| Thailand | 37 | 221 | 12 | 70 |
| United Kingdom | -- | -- | 49 | 270 |
| Total | 4,850 | 24,300 | 4,750 | 21,900 |

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 11
U.S. IMPORTS FOR CONSUMPTION OF AMMONIUM PARATUNGSTATE, BY COUNTRY 1/

| Country of origin | 1997 | | 1998 | |
|-------------------|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| China | 1,920 | \$12,100 | 1,900 | \$10,900 |
| Germany | 52 | 649 | 3 | 137 |
| Hong Kong | 45 | 293 | -- | -- |
| Japan | 25 | 281 | (2/) | 1 |
| Russia | 4 | 145 | -- | -- |
| Sweden | 52 | 287 | 18 | 91 |
| Total | 2,100 | 13,700 | 1,920 | 11,100 |

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF FERROTUNGSTEN
AND FERROSILICON TUNGSTEN, BY COUNTRY 1/

| Country of origin | 1997 | | 1998 | |
|-------------------|--------------------------------|-------------------|--------------------------------|-------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| China | 76 | \$410 | 261 | \$1,770 |
| Germany | 2 | 30 | 1 | 13 |
| Russia | 725 | 4,000 | 324 | 2,000 |
| United Kingdom | -- | -- | 14 | 100 |
| Total | 803 | 4,440 | 599 | 3,890 |

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 13
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY 1/

| Product and country of origin | 1997 | | 1998 | |
|-------------------------------------|-----------------------------------|----------------------|-----------------------------------|----------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Tungsten metal powders: 2/ | | | | |
| Belgium | 26 | \$751 | 4 | \$132 |
| Canada | 7 | 237 | 6 | 164 |
| China | 126 | 1,790 | 122 | 1,850 |
| Czech Republic | 28 | 456 | 17 | 277 |
| France | 9 | 56 | 10 | 95 |
| Germany | 51 | 1,520 | 79 | 1,780 |
| Israel | 22 | 287 | 20 | 201 |
| Japan | 16 | 1,950 | 24 | 1,760 |
| Latvia | 31 | 142 | -- | -- |
| Netherlands | -- | -- | 17 | 277 |
| Sweden | 18 | 724 | -- | -- |
| South Africa | 1 | 4 | 15 | 79 |
| United Kingdom | 93 | 933 | 145 | 1,330 |
| Other | 5 r/ | 146 r/ | (3/) | 8 |
| Total | 432 | 8,990 | 459 | 7,950 |
| Tungsten carbide powder: | | | | |
| Austria | 20 | 352 | 62 | 1,030 |
| Canada | 38 | 571 | 432 | 7,510 |
| China | 356 | 5,310 | 286 | 4,410 |
| France | 14 | 273 | 2 | 84 |
| Germany | 125 | 2,810 | 43 | 1,150 |
| Hong Kong | 7 | 102 | 3 | 49 |
| India | 11 | 198 | 16 | 245 |
| Israel | 14 | 266 | 84 | 1,420 |
| Korea, Republic of | 16 | 317 | 4 | 77 |
| Luxembourg | -- | -- | 8 | 122 |
| Switzerland | 2 | 119 | (3/) | 5 |
| United Kingdom | 43 | 457 | 2 | 41 |
| Other | 3 | 155 r/ | 3 | 147 |
| Total | 650 | 10,900 | 944 | 16,300 |
| Unwrought tungsten: 2/ 4/ 5/ | | | | |
| Austria | 1 | 120 | 4 | 319 |
| Canada | 3 | 14 | 3 | 35 |
| Germany | 13 | 212 | 4 | 190 |
| Russia | -- | -- | 10 | 111 |
| Switzerland | 3 | 334 | -- | -- |
| United Kingdom | (3/) | 5 | 4 | 67 |
| Other | (3/) | 3 | (3/) | 9 |
| Total | 20 | 689 | 24 | 730 |
| Waste and scrap: | | | | |
| Austria | 8 | 51 | 15 | 148 |
| Belgium | 14 | 140 | -- | -- |
| Bermuda | -- | -- | 12 | 59 |
| Canada | 24 | 121 | 23 | 167 |
| China | 93 | 825 | 98 | 887 |
| Estonia | -- | -- | 11 | 69 |
| France | 13 | 94 | 21 | 154 |
| Germany | 285 | 2,350 | 241 | 1,810 |
| Hong Kong | 6 | 51 | 9 | 83 |
| India | 48 | 240 | 48 | 272 |
| Israel | 105 | 483 | 74 | 370 |
| Japan | 349 | 2,100 | 240 | 1,670 |
| Korea, Republic of | 14 | 95 | 15 | 112 |
| Mexico | 2 | 10 | 9 | 44 |
| Netherlands | 5 | 21 | 53 | 395 |
| Pakistan | 15 | 72 | -- | -- |
| Russia | 166 | 1,040 | 280 | 1,500 |
| Singapore | 29 | 179 | 33 | 168 |
| South Africa | 81 | 411 | 69 | 543 |
| Sweden | 64 | 433 | -- | -- |

See footnotes at end of table.

TABLE 13--Continued
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TUNGSTEN-BEARING MATERIALS, BY COUNTRY 1/

| Product and country of origin | 1997 | | 1998 | |
|---|-----------------------------------|----------------------|-----------------------------------|----------------------|
| | Tungsten content (metric tons) | Value (thousands) | Tungsten content (metric tons) | Value (thousands) |
| Waste and scrap--Continued: | | | | |
| Taiwan | 18 | \$115 | 2 | \$25 |
| United Kingdom | 138 | 1,280 | 155 | 1,080 |
| Uzbekistan | 27 | 307 | 36 | 361 |
| Other | 3 | 26 | 12 | 81 |
| Total | 1,510 | 10,400 | 1,450 | 10,000 |
| Wrought tungsten wire, plate, sheet, strip, foil, and other: 2/ 4/ | | | | |
| Austria | 20 | 3,020 | 16 | 3,260 |
| Canada | 4 | 107 | 2 | 62 |
| China | 41 | 2,060 | 31 | 1,360 |
| France | 2 | 474 | 4 | 234 |
| Germany | 102 | 9,020 | 26 | 3,410 |
| Hungary | 7 | 802 | 6 | 558 |
| India | (3/) | 45 | 12 | 138 |
| Israel | 19 | 1,340 | 28 | 2,060 |
| Japan | 32 | 6,600 | 30 | 5,950 |
| Mexico | 8 | 848 | 3 | 840 |
| Netherlands | 7 | 675 | (3/) | 184 |
| Russia | 2 | 119 | 25 | 191 |
| Switzerland | 9 | 989 | 16 | 1,450 |
| United Kingdom | 2 | 470 | 3 | 392 |
| Uzbekistan | 17 | 103 | -- | -- |
| Other | 2 r/ | 300 r/ | 5 | 303 |
| Total | 277 | 27,000 | 206 | 20,400 |
| Tungsten oxides: | | | | |
| China | 1,190 | 8,020 | 1,940 | 12,600 |
| Germany | 43 | 452 | 3 | 63 |
| Hong Kong | 117 | 727 | -- | -- |
| Japan | -- | -- | 39 | 298 |
| Russia | 152 | 929 | 14 | 69 |
| Sweden | 4 | 32 | -- | -- |
| United Kingdom | 220 | 1,900 | 140 | 866 |
| Other | (3/) | 5 | 1 | 15 |
| Total | 1,720 | 12,100 | 2,130 | 13,900 |
| Calcium tungstate: | | | | |
| China | 29 | 169 | -- | -- |
| Japan | 2 | 108 | 1 | 127 |
| Total | 31 | 277 | 1 | 127 |
| Other tungstates: | | | | |
| China | 426 | 2,400 | 723 | 3,290 |
| Germany | (3/) | 52 | 2 | 75 |
| India | -- | -- | (3/) | 6 |
| Japan | (3/) | 14 | (3/) | 2 |
| Mongolia | -- | -- | 11 | 45 |
| Total | 426 | 2,470 | 736 | 3,420 |
| Other tungsten compounds: 6/ | | | | |
| Belgium | (3/) | 2 | -- | -- |
| China | -- | -- | (3/) | 10 |
| Germany | 4 | 147 | 1 | 81 |
| Japan | (3/) | 13 | 1 | 257 |
| Total | 4 | 162 | 2 | 348 |

r/ Revised.

1/ Data are rounded to three significant digits; may not add to totals shown.

2/ May include alloys.

3/ Less than 1/2 unit.

4/ Content estimated from reported gross weight.

5/ Includes bars and rods obtained simply by sintering; excludes powders, waste and scrap.

6/ Includes tungsten chlorides.

Source: Bureau of the Census.

TABLE 14
TUNGSTEN: WORLD CONCENTRATE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons of tungsten content)

| Country | 1994 | 1995 | 1996 | 1997 | 1998 e/ |
|-----------------|-----------|-----------|-----------|-----------|---------|
| Australia | 11 e/ | -- | -- | -- | -- |
| Austria | -- | 738 | 1,413 | 1,400 e/ | 1,400 |
| Bolivia | 462 | 655 | 582 | 513 r/ | 497 3/ |
| Brazil | 196 r/ | 98 r/ | 98 r/ | 51 r/ | 50 |
| Burma 4/ | 544 | 531 | 334 | 272 r/ | 200 |
| Burundi e/ | -- | 22 | 16 | 16 | 10 |
| China e/ 5/ | 27,000 | 27,400 | 26,500 | 25,000 | 24,700 |
| India | 2 | 4 | 2 | 3 e/ | 3 |
| Kazakhstan | 122 r/ | 249 r/ | -- r/ | -- r/ | -- |
| Korea, North e/ | 900 | 900 | 900 | 900 | 900 |
| Mexico | -- | 287 | 188 | 179 | 130 3/ |
| Mongolia e/ | -- r/ | 34 r/ | 17 r/ | 26 r/ | 36 |
| Peru | 259 | 728 | 332 | 279 r/ | 76 3/ |
| Portugal | 59 r/ | 875 r/ | 776 | 1,036 | 831 |
| Russia e/ | 4,000 | 5,400 | 3,000 | 3,000 | 3,000 |
| Rwanda e/ | 30 | 47 3/ | 40 | 40 | 40 |
| Tajikistan e/ | 100 | 75 | 50 | -- r/ | -- |
| Thailand e/ | 40 | 60 | 30 | 25 | 20 |
| Uganda | 12 | 17 | -- | -- e/ | -- |
| United States | W | -- r/ | -- r/ | -- r/ | -- |
| Uzbekistan e/ | 300 | 300 | 300 | 250 | 200 |
| Vietnam | -- | 50 | 130 | 210 | 60 |
| Total | 34,000 r/ | 38,500 r/ | 34,700 r/ | 33,200 r/ | 32,200 |

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total."

1/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Production of tungsten concentrates is believed to occur in Kyrgyzstan, but information is inadequate for making production estimates. Table includes data available through July 22, 1999.

3/ Reported figure.

4/ Includes content of tin-tungsten concentrate.

5/ Based upon data published in the Yearbook of Nonferrous Industry of China, 1995-97.