TUNGSTEN

By Kim B. Shedd

Domestic survey data and tables were prepared by Loren K. Duncan, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

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 Primorsky 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.

References Cited

American Metal Market, 1996, U.S. tungsten market expected to rebound: American Metal Market, v. 104, no. 192, October 3, p. 4.
———1998a, New Nanodyne plant to produce smallest tungsten grain: American Metal Market, v. 106, no. 165, August 27, p. 5.
———1998b, Rajasthan suspends tungsten operations: American Metal Market, v. 106, no. 211, November 3, p. 1.
———1999, China halts new mining permits for 8 minerals: American Metal Market, v. 107, no. 103, May 28, p. 5.
Avocet Mining PLC, 1998a, Avocet Mining PLC annual report and accounts 1998: London, Avocet Mining PLC, 38 p.
———1998b, Avocet Mining PLC interim results for the six months ended 30th September 1998: London, Avocet Mining PLC, 4 p.
Bunting, R.M., 1999, Tungsten: Engineering and Mining Journal, v. 200, no. 3, March, p. 43-46.
Bureau of Export Administration, 1998a, National Defense Stockpile Market Impact Committee request for public comments: Federal Register, v. 63, no. 184, September 23, p. 50865-50867.
———1998b, National Defense Stockpile Market Impact Committee request for public comments: Federal Register, v. 63, no. 218, November 12, p. 63286-63287.
Defense National Stockpile Center, 1999, Revised FY 1999 Annual Materials Plan: Fort Belvoir, VA, Defense National Stockpile Center news release, April 5, 3 p.
Ikar Mineral Corp., 1998a, Ikar Mineral Corp. announces 1998 work program update: North Vancouver, British Columbia, Ikar Mineral Corp. press release, October 19, 1 p.
———1998b, Ikar to meet with Chinese investors: North Vancouver, British Columbia, Ikar Mineral Corp. press release, December 21, 1 p.
Interfax International Ltd., 1998a, Kabardino-Balkaria takes control of Tuyrnyauz tungsten plant: Mining & Metals Report, v. 7, issue 38 (343), September 11-18, p. 10.
———1998b, Primorsky tungsten mine restarts after long break: Mining & Metals Report, v. 7, issue 5 (310), January 23-30, p. 11.
———1998c, Uzbek government to rejuvenate refractory metals plant: Mining & Metals Report, v. 7, issue 46 (351), November 6-13, p. 8.
———1999a, Russia to boost tungsten output: Mining & Metals Report, v. 8, issue 9 (364), February 26, p. 9-10.
———1999b, Tungsten producer closes 1998 with loss: Mining & Metals Report, v. 8, issue 23 (377), June 4, p. 9.
Magdics, Alex, 1998, Recycling cobalt and nickel battery waste at OMG, *in* International seminar on battery waste management, 10th, Deerfield Beach, FL, October 26-28, 1998, Proceedings: Boca Raton, Florida Educational Seminars, Inc., 33 p.
Metal Bulletin, 1998a, Demise of CNNC hastens new era in China's metals industry: Metal Bulletin, no. 8324, November 5, p. 5.
———1998b, Inmet sells its tungsten unit in Austria: Metal Bulletin, no. 8313, September 28, p. 13.
———1999a, China sets floor price for tungsten: Metal Bulletin, no. 8396, July 26, p. 8.
———1999b, China shakes up tungsten industry: Metal Bulletin, no. 8383, June 10, p. 8.
N.V. Union Minière S.A., 1999, Annual report 1998: Brussels, N.V. Union Minière S.A., 105 p.
OM Group, Inc., 1998, OMG to acquire technology from Dow Chemical: Cleveland, OH, OM Group, Inc., press release, April 21, 1 p.
———1999, 1998 annual report: Cleveland, OH, OM Group, Inc., 16 p.
Resource Information Unit, 1999, Register of Australian mining 1999/2000: Subiaco, Western Australia, Resource Information Unit, p. 304.
Ryan's Notes, 1998a, Tungsten supplies tighter—For real: Ryan's Notes, v. 4, no. 16, April 20, p. 2.
———1998b, W defies forecasts and slumps: Ryan's Notes, v. 4, no. 33, August 17, p. 2.
U.S. Fish and Wildlife Service, 1998a, Migratory bird hunting—Extension of temporary approval of tungsten-iron shot as nontoxic for the 1998-99 season: Federal Register, v. 63, no. 194, October 7, p. 54016-54019.
———1998b, Migratory bird hunting—Temporary approval of tungsten-polymer shot as nontoxic for the 1998-99 season: Federal Register, v. 63, no. 194, October 7, p. 54022-54026.
———1998c, Migratory bird hunting—Temporary conditional approval of tungsten-matrix shot as nontoxic for the 1998-99 season: Federal Register, v. 63, no. 235, December 8, p. 67619-67624.
Vine, D.R., 1998, U.S. tungsten industry update, *in* Annual General Meeting, 11th, Salzburg, Austria, October 20-22, 1998, Transcripts of Papers: London, International Tungsten Industry Association, 15 p.
Zairong, Gao, and Pugang, Peng, 1998, Current status of China's tungsten mines and resources prospect, *in* Annual General Meeting, 11th, Salzburg, Austria, October 20-22, 1998, Transcripts of Papers: London, International Tungsten Industry Association, 19 p.

SOURCES OF INFORMATION

U.S. Geological Survey Publications

International Strategic Mineral Issues summary report—Tungsten. U.S. Geological Survey Circular 930-O, 1998.

Recycling—Metals. Ch. in Minerals Yearbook, annual.[1]

Tungsten. Ch. in Mineral Commodity Summaries, annual.[1]

Tungsten. Ch. in Minerals Yearbook, annual.[1]

Tungsten. Ch. in United States mineral resources, U.S. Geological Survey Professional Paper 820, 1973.

Tungsten. Mineral Industry Surveys, monthly.[1]

Other

American Metal Market, daily.

Company annual reports.

Defense Logistics Agency, Defense National Stockpile

[1]Prior to January 1996, published by the U.S. Bureau of Mines.

Center.
Engineering and Mining Journal, monthly.
Federal Register, daily.
Interfax International Ltd., Mining & Metals Report, weekly.
International Tungsten Industry Association [United Kingdom].
Materials flow of tungsten in the United States, U.S. Bureau of Mines Information Circular 9388, 1994.
Metal Bulletin [London], semiweekly and monthly.
Mining Journal [London], weekly, Metals & Minerals Annual Review, Mining Annual Review.
Platt's Metals Week, weekly.
Roskill Information Services Ltd. [London].
Ryan's Notes, weekly.
Strategic and Critical Materials Report to the Congress, Department of Defense.
The tungsten industry of the U.S.S.R., U.S. Bureau of Mines Mineral Issues, 1988.
Tungsten. Ch. in Metal Prices in the United States through 1991. U.S. Bureau of Mines Special Publication, 1993.
Tungsten. Ch. in Mineral facts and problems. U.S. Bureau of Mines Bulletin 675, 1985.

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	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

	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
Month	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 WO_3 of all semiweekly low and high prices was $44 in 1998. The average equivalent price per short ton unit of WO_3 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 WO_3 of all weekly low and high prices was $47 in 1998. The average equivalent price per metric ton unit of WO_3 was $52 in 1998.

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

	1997		1998	
Country of destination	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 WO_3.
2/ Calculated based upon an estimated value of $48 per metric ton unit WO_3.
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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Gross weight (metric tons)	1997 Tungsten content 3/ (metric tons)	1997 Value (thousands)	1998 Gross weight (metric tons)	1998 Tungsten content 3/ (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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 Tungsten content (metric tons)	1997 Value (thousands)	1998 Tungsten content (metric tons)	1998 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.