

TUNGSTEN

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Summary

A tightness in the supply of tungsten products developed in 1994 as a result of increased demand from the major consuming economies and decreased production from traditional producers. The rise in consumption was a result of increased industrial activity, while the drop in production resulted from mine closures in China.

The reduced availability of tungsten products on the market resulted in significant price increases. The price for tungsten concentrates climbed 120% to close the year in the US\$47-\$60/mtu¹ range, while the price for ammonium paratungstate (APT) increased 160% to finish the year in the US\$100-\$105/mtu range.

A supply shortage is expected in 1995, despite production increases from the re-opening of mines and increased exports from the Commonwealth of Independent States (C.I.S.). Additional supplies may materialize from stockpiles in China, the United States or the C.I.S., and through a greater use of scrap.

Uses

Tungsten's properties include a very high density, the highest melting point of any metal at 3410°C, the hardest of the refractory metals and, in the compound tungsten carbide, is one of the hardest substances. It has a low coefficient of thermal expansion, high tensile strength at elevated temperatures, high corrosion resistance, and good thermal and electrical conductivity.

About 60% of tungsten concentrate consumption is for tungsten cemented carbide products such as tools and wear parts, while steel and metal products, including wire, electrical contacts and welding equipment, each account for 15%, nonferrous alloys and pigments/catalysts for 5%, and other uses for 5%.

APT is the most important intermediate in the production of tungsten metal powder, tungsten carbide, and for some chemical uses of tungsten. It is used to produce tungsten trioxide ("yellow oxide" and "blue oxide"), which can be converted into tungsten powder for use in the manufacture of cemented carbides, light bulb filaments, and other uses.

Because of tungsten's hardness, tungsten carbides have widespread applications where intense wear and abrasion are encountered. This product is the preferred metal-working material for the cutting edges of machine tools and as a metal surface in forming and shaping dies. It is produced by the chemical combination of tungsten metal powder and finely divided carbon. Tungsten carbide is compacted to the desired form, using cobalt as a binder, and sintered to produce cemented tungsten carbide. Other uses of tungsten carbide are in tire studs, spikes for golf shoes, armour-piercing projectiles, and welding electrodes.

As an alloy constituent, tungsten is used primarily in the production of high-speed steels, and tool and die steels. Tungsten-bearing steels are used for the same applications as carbides, especially where lower operating temperatures are encountered.

Tungsten is also used in superalloys and nonferrous alloys. Tungsten-containing superalloys are being used increasingly in high-temperature applications and in highly corrosive environments because of their high-temperature strength and oxidation resistance.

Tungsten wire is used for filaments in incandescent lamps, and for heating elements in both fluorescent lamps and vacuum tubes. Minor amounts of tungsten are also used to make chemicals and compounds for non-metallurgical applications. Some of the end uses include dyes, chemical reagents, catalysts, lubricants, paints and varnishes.

Canadian Developments

Until 1986, Canada was a major producer of tungsten ore and concentrate. Annual production reached a high of 3715 t (8% of world) tungsten content in 1984, after which prices collapsed as a result of increased exports from the People's Republic of China. The low-priced material from China eventually forced the closure of Canadian operations.

At the time, there were two mines in operation in Canada, the Cantung and Mount Pleasant mines.

The Cantung mine operated by Canada Tungsten Mining Corp. Ltd. (Cantung), Canada's leading tungsten company, was recognized as the largest producer of tungsten concentrate in the Western World. Located in the Northwest Territories, the Cantung mine was in operation between 1962 and 1986 at a rate of about 4450 t/y of tungsten trioxide (WO₃). Higher-grade concentrates were marketed directly while lower-grade concentrates were sent to the Fort Madison, Iowa plant for conversion to APT. At the end of 1984, underground mine reserves of scheelite ore stood at 2.8 Mt grading 1.39% WO₃.

In 1994, Aur Resources Inc. acquired control of Cantung by buying Cyprus Amax Minerals Co.'s 48.3% share in the company. The recent price rise for

¹ mtu = metric tonne unit. For example, the price per tonne of concentrate grading 65% WO₃ would be 65 x US\$47.00 = US\$3055.00/t.

APT has encouraged Cantung to consider re-opening its Cantung mine. In the event that prices continue to improve and stabilize, Cantung could rehabilitate its mine in four to six months.

The Mount Pleasant mine, located 60 km west of Saint John, New Brunswick, was operated at a rate of 1800 t/y of WO_3 by Billiton Metals Canada during the period 1983-85. The porphyry tin-molybdenum-tungsten deposit is estimated to contain reserves of 55 Mt in nine separate zones. However, the Fire Tower zone, the best tungsten zone of the deposit, has underground proven reserves of 9.0 Mt grading 0.40% tungsten, 0.2% molybdenum, 0.03% tin, and 1 oz/t indium. It closed as a result of depressed prices and technical problems. Piskahegan Resources, a private Canadian company that acquired the mine in early 1994, recently entered into a credit option agreement with Adex Mining Corp. under which the latter company will fund a \$525 000 exploration and metallurgical research program in exchange for a 10% interest in the property. The program will be completed by May 1995 at which time a feasibility study may be undertaken. If all goes well, production could re-start by the end of 1996.

A number of other deposits are also ready for production in Canada. To name one, the Mactung deposit located near the Cantung mine has reserves of 6.1 Mt grading 1.16% WO_3 suitable for underground mining, and reserves of 17.2 Mt at 0.78% WO_3 suitable for open-pit mining.

Canada's consumption of tungsten products in 1993, the latest year for which statistics have been compiled, was 334 t (tungsten content), down 1.6% compared to 1992. In comparison, consumption in the United States in 1993 was 9626 t. In 1994, Canadian imports, consisting mostly of tungsten carbides and intermediate products, were valued at \$19.85 million, up 26% from 1993, while exports consisting of intermediate products doubled to \$1.6 million.

World Developments

Using six-month statistics from the International Tungsten Industry Association, the supply of tungsten to the market economy countries (MEC) and China, in 1994, is estimated at 33 800 t (tungsten content), an increase of 19% from 1993. Similarly, consumption is estimated at 32 700 t (tungsten content), an increase of 15% relative to 1993. Excess supplies, resulting from increased exports from the C.I.S. in the second half of the year, were used to replenish exhausted consumer stock-piles.

The production of tungsten concentrates, including C.I.S. production, was estimated at 15 500 t metal content, down 15% from 1993. China produced around 68% of the total, Russia about 20%, and the balance was produced from various MEC, including Bolivia, Thailand, Uganda, Peru, Korea and Brazil.

Supplies of tungsten concentrates were estimated at 25 000 t (tungsten content) in 1994, up from 23 000 t in 1993.

China

China is the world's largest producer and exporter of tungsten ores and concentrates, and of intermediate and finished tungsten products. China's ore output was last reported coming from 28 mines located mostly in the Jiang Xi, Hu Nan, and Guandong provinces.

In 1994, Chinese exports of tungsten products to MEC are estimated at 19 000 t (tungsten content), an increase of 24% from 1993, while its consumption increased by about 10% to 11 000 t (tungsten content). China's production of ores and concentrates in 1994 is estimated at 10 500 t (tungsten content), up 2.4% from 1993, while exports remained very low at about 800 t (tungsten content). The low exports result from anti-dumping duties in the United States and the European Union, and the disappearance of Russia as a customer.

The decrease in the production of tungsten concentrates observed in China in the past few years is a result of mine closures due to the government's decision to stop subsidizing mines and to increase from 9% to 17% (later reduced to 13%) the value-added tax on ore and concentrate sales. The drop in production is also due to: a) a decline in ore grades, which fell from 0.8% to 0.5% tungsten content over the past 12 years; b) increasing production costs; and c) a lack of investment to keep mines operating efficiently.

Russia

Russia's 1994 production of tungsten concentrates, mostly from scheelite ore, is estimated at about 3000 t (tungsten content), down 45% from 1993. In 1995, production is expected to reach 60% of capacity, at 5400 t. However, reports of capacity reductions and closures, such as at the Lultinsky tungsten mining and enrichment complex in Chukotka in the Far East, and at the Lermontovskoe in the Promorye Territory, puts this in question.

Rushmore Hard Metals, a trading company based in the United Kingdom, signed an export agreement with Tverdospay and Gridrometallurg Nalchik. Tverdospay is a joint stock company that controls 10 plants in Russia, Uzbekistan and Ukraine involved in the processing of tungsten concentrates, semi-products and scrap to manufacture a variety of intermediate products. Nalchik is a hydrometallurgical plant producing APT, yellow and blue oxides, and molybdenum compounds. In 1994, the plant was closed between February and July because it could not secure feed from the nearby Tyrnaus mine, Russia's largest tungsten ore producer.

Portugal and Peru

Avocet Ventures Inc. (Avocet) is preparing to re-open two past producing mines. Avocet, a Canadian company, announced that production at its 80.55%-owned Panasqueira mine, located near Fundao in central Portugal, will start up in January 1995 at a rate of 1440 t/y of tungsten concentrate grading 70% WO₃. The mine, which had been shut down at the end of 1993 by its previous owner, Minorco S.A. of Luxembourg, will be rehabilitated at a cost of between \$2 million and \$3 million.

Avocet also raised its equity position in Peruvian tungsten producers S.A. Minera Regina and Fermin Malaga Santolalla to 80% and 72% respectively, after the conclusion of a private placement of \$16.25 million. A US\$2 million program to increase the productivity of Minera Regina's Palca XI mine, located near Juliaca in southern Peru, is scheduled to be completed by January 1995 at which time the mine will have a monthly capacity of 150 t of tungsten concentrates grading 67% WO₃. Meanwhile, a US\$1 million investment program realized at Malaga's Pasta Bueno mine, located in the Pallasca province 655 km north of Lima, should be completed in six months and lead to a monthly production of 80 t of tungsten concentrates.

United States

In the United States, Strategic Metals Corp. has done preliminary work to re-open its Pine Creek tungsten mine located near Bishop, California, but no production decision has yet been taken. Ore from Pine Creek would be concentrated and converted into APT on site. Lead time to reactivate the mine would be about six months.

In contrast to this, General Electric Co. pursued reclamation plans for its Springer tungsten mine in northwestern Nevada, which are to be completed by mid-1996.

In March, Kazakhstan and Ukraine were granted Generalized System of Preference trade status by the United States, joining Russia which was granted the same status in October 1993. Accordingly, tungsten concentrates, ferrotungsten, carbide powder blends, and certain forms of waste and scrap from these countries can now be imported into the United States duty-free.

The Defense Logistics Agency reported that, as of January 1, 1994, uncommitted inventories of tungsten totalled 37 347 t metal content. The stockpile consists of carbide powder, ferrotungsten, metal powder, and ores and concentrates.

Other Developments

The European Commission (EC) imposed provisional anti-dumping duties on tungsten products originat-

ing from China. A duty of 37% was imposed on imports of Chinese tungsten ores and concentrates, 35% on tungstic oxide and acid, and 33% on tungsten carbide and fused tungsten carbide. The decision to implement the duties came after CNIEC and Minmetals, China's sole tungsten products exporter, withdrew from a minimum price undertaking that was negotiated with the EC when the duties were first imposed in September 1990.

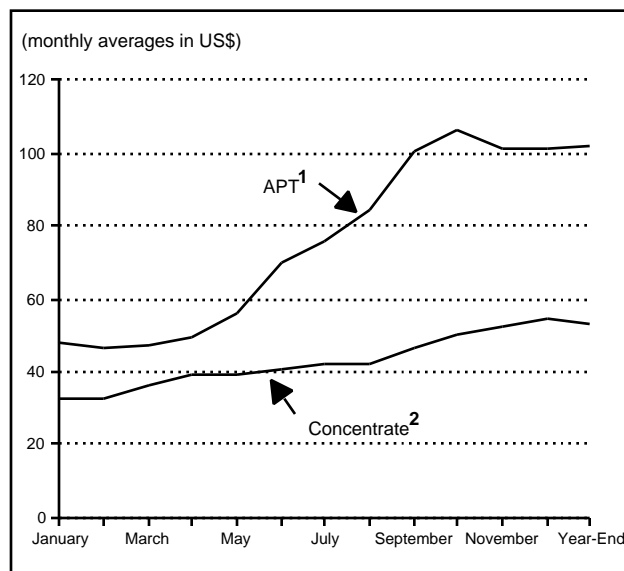
Sandvik AB, the Swedish producer of cemented carbide and high-speed steel tools, purchased Krupp Widia of Essen, Germany, a cemented carbide and magnet manufacturer, and acquired a controlling interest in Russia's largest cemented carbide company, Moskovskiy Kombinat Tverdih Splavov.

Prices

In 1994, the tungsten market was somewhat unstable in response to increased demand from the booming North American economies, from European countries, and from Japan coming out of recession. The hike in demand, coupled with a decrease in the production of tungsten concentrates in China, which provides the MEC with about 75% of their supplies, pushed prices up.

Prices for tungsten concentrates gradually increased from a low of US\$27/mtu at the start of the year, and peaked at a high of US\$60/mtu in mid-November. Prices stabilized in the range of US\$47-\$60/mtu

Figure 1
Tungsten Price Variations, 1994



Source: *Metal Bulletin*.

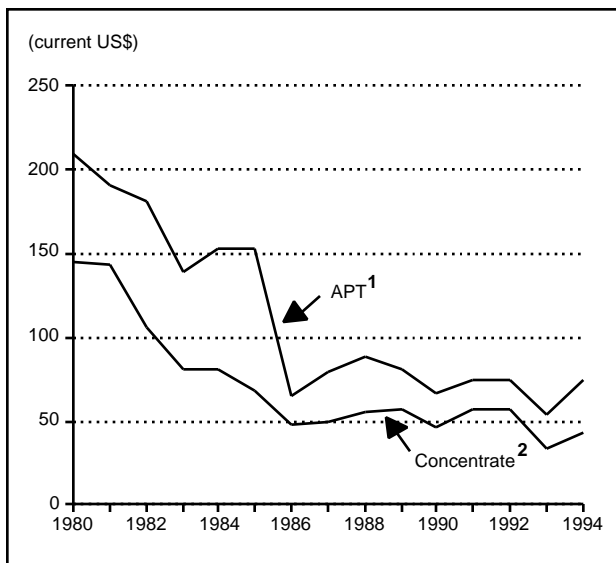
¹ Price per mtu WO₃, U.S. free market, c.i.f.

² Price per mtu WO₃ minimum 65% WO₃ c.i.f. Europe.

following a steady flow of material from the C.I.S. Prices for APT reacted faster to the market situation. APT started the year at a low of US\$42/mtu, peaked at US\$110/mtu in early October, and stabilized at year-end in the range of US\$100-\$105/mtu.

In the short term, supplies of tungsten concentrates and intermediate tungsten products should remain fairly tight with concentrate prices increasing to around US\$60-\$70/mtu and APT stabilizing at the US\$80-\$100/mtu level. An improvement in exports from China, coupled with increased supplies from the C.I.S. and from re-opened mines in the MEC, should balance the market.

Figure 2
Tungsten Price Variations in the Past Fifteen Years, 1980-94



Source: *Metal Bulletin*.

¹ Price per mtu WO_3 , U.S. free market, c.i.f.

² Price per mtu WO_3 minimum 65% WO_3 c.i.f. Europe.

Outlook

Recent changes in the production pattern in China will affect the world's tungsten supply for a number of years. Because of an increase in domestic consumption and a push to downstream products, Chinese exports of ore, concentrates and APT probably will not be allowed to return to levels experienced in the past. Russia, a major producer of tungsten products, could partly replace China as a major supplier of tungsten ore, concentrates and APT, but recent drops in production levels may limit its exports.

Estimates for 1995 identify MEC supplies from primary sources at 21 500 t metal content, and consumption at 28 000 t metal content, up 29% from 1994. This supply estimate factors in a production level from China equal to 1994, a maximum production increase from the MEC to a level of 5000 t, and exports from the C.I.S. equal to the 1994 level of 3500 t. The supply gap outlined above may, in the end, be filled by an increase in production in China, and by sourcing more tungsten from scrap and from stockpiles in Russia, China and the United States. However, recent reports indicate that stocks in China are fairly depleted following drawdowns in recent years to make up for lower production levels. Supplies from that source may, therefore, be limited.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2611.00	Tungsten ores and concentrates	Free	Free	Free	Free
2841.80	Tungstates (wolframates)	8.5%	6%	Free	Free
2849.90.00.10	Tungsten carbide	Free	Free	Free	Free
7202.80	Ferrotungsten and ferro-silico-tungsten	9.5%	6.5%	Free	Free
8101.10.10	Tungsten powders, not alloyed	3.7%	Free	Free	Free
8101.10.20	Tungsten powders, alloyed	8.8%	6.5%	Free	Free
8101.91.10	Sintered bars and rods, not alloyed	Free	Free	Free	Free
8101.91.91	Unwrought tungsten, not alloyed	3.7%	Free	Free	Free
8101.91.92	Unwrought tungsten, alloyed; waste and scrap	8.8%	6.5%	Free	Free
8101.92.10	Tungsten bars and rods, not alloyed, other than those obtained simply by sintering	Free	Free	Free	Free
8101.92.20	Tungsten bars and rods, alloyed; profiles, plates, sheet, strip and foil	8.8%	6.5%	Free	Free
8101.93.10	Tungsten wire, not alloyed	Free	Free	Free	Free
8101.93.21	Tungsten wire, alloyed, not coated or covered	7%	5%	Free	Free
8101.93.22	Tungsten wire, alloyed, coated or covered	8.8%	6.5%	Free	Free
8101.99	Tungsten (wolfram) and articles thereof, n.e.s.	8.8%	6.5%	Free	Free

Sources: Customs Tariff, effective January 1995, Revenue Canada; Harmonized Tariff Schedule of the United States, 1995.

n.e.s. Not elsewhere specified.

TABLE 1. CANADA, TUNGSTEN PRODUCTION AND TRADE, 1992-94

Item No.		1992		1993		1994P	
		(kilograms)	(\$000)	(kilograms)	(\$000)	(kilograms)	(\$000)
	Production¹ (WO₃)	-	-	-	-	-	-
	Imports						
2611.00	Tungsten ores and concentrates						
	United States	-	-	1 494	19	286	4
	Total	-	-	1 494	19	286	4
2841.80	Tungstates (wolframates)						
	United States	1 628	7	13 906	62	8 352	32
	United Kingdom	-	-	-	-	183	...
	Total	1 628	7	13 906	62	8 535	31
2849.90.00.10	Tungsten carbide						
	United States	316 110	8 292	374 452	9 763	412 273	12 571
	People's Republic of China	16 700	77	8 067	202	4 522	116
	Germany	3 209	84	-	-	2 169	90
	France	2 632	103	2 106	85	1 323	58
	Other countries	9 473	319	3 461	116	643	36
	Total	348 124	8 875	388 086	10 167	420 930	12 874
7202.80	Ferrotungsten and ferro-silicotungsten						
	People's Republic of China	66 726	342	80 822	396	80 928	438
	United States	1 825	18	997	12	1 858	26
	Total	68 551	361	81 819	408	82 786	465
8101.10.10	Tungsten powders, not alloyed						
	United States	32 692	759	25 651	598	34 423	874
	Other countries	17 000	82	244	13	2 612	118
	Total	49 692	842	25 895	612	37 035	994
8101.10.20	Tungsten powders, alloyed						
	United States	7 518	389	10 602	421	9 765	397
	Germany	100	4	1 021	28	100	2
	Total	7 618	393	11 623	450	9 865	400
8101.91.10	Unwrought tungsten, sintered bars and rods, not alloyed						
	United States	434	24	1 964	76	5 709	446
	Other countries	45	3	50	3	182	9
	Total	479	27	2 014	80	5 891	455
8101.91.91	Unwrought tungsten, not alloyed						
	United States	4 568	94	1 089	34	4 004	94
	Total	4 568	94	1 089	34	4 004	94
8101.91.92.10	Unwrought tungsten, alloyed						
	People's Republic of China	-	-	4 731	182	12 855	324
	Other countries	2 200	47	3 984	95	5 208	133
	Total	2 200	47	8 715	278	18 063	458
8101.91.92.20	Unwrought tungsten, waste and scrap						
	United States	1 984	39	3 136	64	4 874	96
	People's Republic of China	-	-	-	-	1 331	26
	Total	1 984	39	3 136	64	6 205	122
8101.92.10	Tungsten not alloyed, other than those obtained simply by sintering						
	United States	4 478	164	5 005	263	3 213	173
	Other countries	1 097	75	952	65	1 356	54
	Total	5 575	240	5 957	329	4 569	228
8101.92.20.10	Tungsten bars and rods, not alloyed; profiles, plates, sheets, strip and foil						
	United States	1 101	68	1 822	81	2 659	119
	Total	1 101	68	1 822	81	2 659	119
8101.92.20.20	Tungsten bars and rods, alloyed other than those obtained simply by sintering; profiles, plates, sheets, strip and foil						
	United States	33 278	1 185	36 494	1 313	56 396	2 180
	Denmark	4 736	347	6 247	466	8 157	615
	People's Republic of China	9 979	64	-	-	-	-
	Other countries	539	43	509	26	352	26
	Total	48 532	1 639	43 250	1 806	64 905	2 823

TABLE 1 (cont'd)

Item No.	1992		1993		1994 P		
	(kilograms)	(\$000)	(kilograms)	(\$000)	(kilograms)	(\$000)	
Imports (cont'd)							
8101.93.10	Tungsten wire, not alloyed						
	Japan	1 281	54	1 526	68	2 939	106
	United States	11 441	1 062	4 383	235	579	36
	France	55	1	72	2	118	4
	United Kingdom	1 849	110	—	—	73	5
	Total	14 626	1 228	5 981	306	3 709	153
8101.93.21	Tungsten wire, alloyed, not coated or covered						
	United States	1 120	69	491	29	779	59
	Other countries	—	—	70	5	160	12
	Total	1 120	69	561	35	939	72
8101.93.22	Tungsten wire, alloyed, coated or covered						
	Japan	5 860	375	6 714	289	2 439	162
	United States	2 013	206	1 657	187	481	30
	Total	7 873	581	8 371	477	2 920	193
8101.99	Tungsten (wolfram) and articles thereof, n.e.s.						
	United States	6 560	330	12 427	566	6 362	337
	People's Republic of China	9 100	48	—	—	41	3
	Other countries	55	3	317	8	412	22
	Total	15 715	382	12 744	574	6 815	364
Exports							
2611.00	Tungsten ores and concentrates						
	People's Republic of China	—	—	—	—	17 012	43
	United States	41 539	165	—	—	—	—
	Total	41 539	165	—	—	17 012	43
2841.80	Tungstates (wolframates)						
	Germany	—	—	—	—	5 200	39
	Total	—	—	—	—	5 200	39
7202.80	Ferrotungsten and ferro-silicotungsten						
		—	—	—	—	—	—
8101.10	Tungsten (wolfram) powders						
	United States	21 542	681	16 265	472	14 934	508
	United Kingdom	550	37	545	35	1 025	69
	Sweden	1 000	52	550	28	824	44
	Other countries	3 350	162	3 108	133	6 314	225
	Total	26 442	932	20 468	675	23 097	853
8101.91	Unwrought tungsten; including bars and rods obtained simply by sintering; waste and scrap						
	United States	21 758	122	7 274	36	19 883	109
	Total	21 758	122	7 274	36	19 883	109
8101.92	Tungsten profiles, plate, sheet, strip and foil, including bars and rods not simply sintered						
	United States	—	—	197	9	15	10
	Total	—	—	197	9	15	10
8101.93	Tungsten (wolfram) wire						
	United States	—	—	74	3	—	—
	Total	—	—	74	3	—	—
8101.99	Tungsten (wolfram) and articles thereof, n.e.s.						
	United States	—	—	136	32	6 070	523
	Other countries	1 460	168	50	1	—	—
	Total	1 460	168	186	33	6 070	523

Sources: Natural Resources Canada; Statistics Canada.

— Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; P Preliminary.

1 Producers' shipments.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, TUNGSTEN PRODUCTION, TRADE AND CONSUMPTION, 1975 AND 1980-94

	Production ¹	Imports		Consumption ⁴
		Tungsten Ore ²	Ferrotungsten ³	
(kilograms)				
1975	1 477 731	1 000	45 359	451 336
1980	4 007 000	6 000	7 000	290 479
1981	2 515 000	14 000	6 000	401 447
1982	3 029 730	7 620	4 536	485 606
1983	1 125 558	12 000	3 000	503 651
1984	4 195 785	6 000	5 000	659 665
1985	4 030 547	12 000	2 000	707 271
1986	2 469 990	11 000	6 000	655 982
1987	—	1 000	11 000	729 776
1988	—	205	53 052	385 917
1989	—	194	31 103	345 018 ^r
1990	—	—	10 287	326 216
1991	—	—	42 518	256 597
1992	—	—	68 551	340 040
1993	—	1 494	81 819	334 458
1994 ^p	—	286	82 786	..

Sources: Natural Resources Canada; Statistics Canada.

¹ Producers' shipments of scheelite (WO₃ content). ² Tungsten content. ³ Gross weight.

⁴ Available data as reported by consumers.

— Nil; .. Not available; ^p Preliminary; ^r Revised.

TABLE 3. TUNGSTEN ORES AND CONCENTRATES, WORLD MINE PRODUCTION AND CONSUMPTION, 1985-94

	Production	Consumption	Imports	Exports
(tonnes of contained tungsten)				
1985	46 741	44 968	25 136	26 592
1986	44 767	43 456	20 899	23 392
1987	40 492	43 382	19 889	22 017
1988	50 445	51 720	23 594	23 360
1989	52 426	51 049	23 645	25 467
1990	50 866	50 763	18 759	16 544
1991	40 815	40 428	14 358	11 460
1992	35 270	36 024	6 293	6 383
1993	30 063	33 301	4 540	3 770
1994	32 824	28 550

Source: Committee on Tungsten, United Nations Conference on Trade and Development (UNCTAD).

.. Not available.