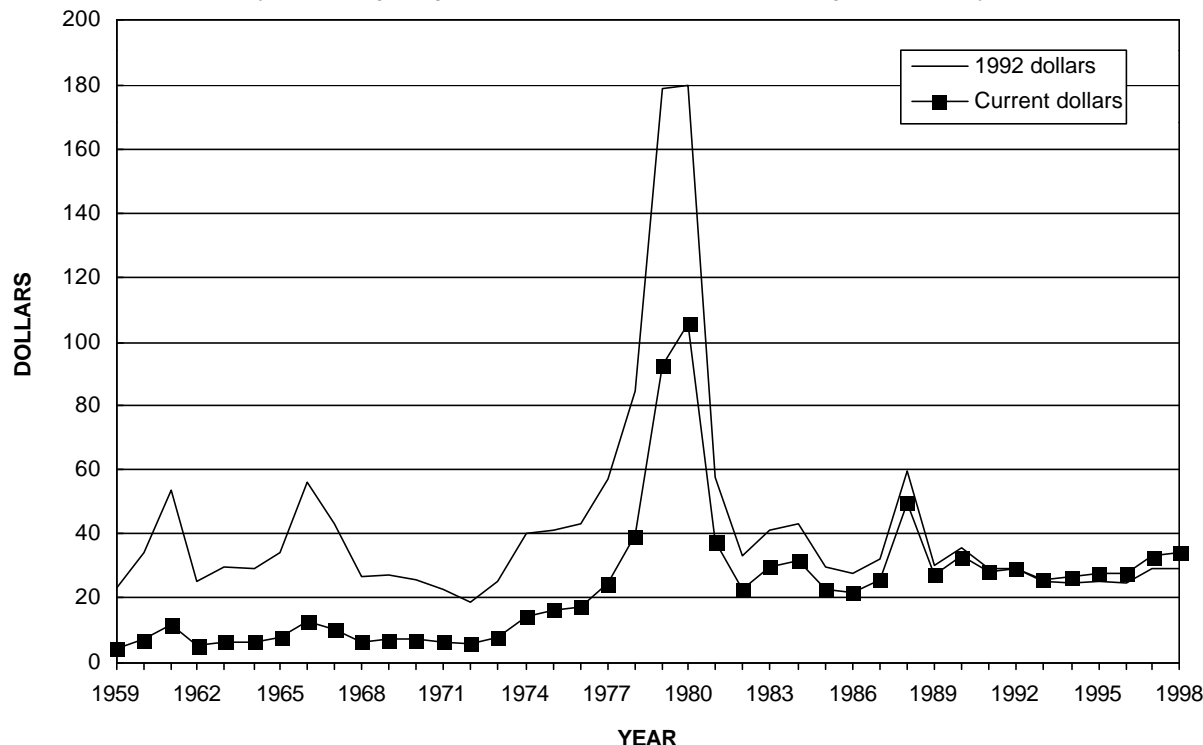


Yearend Average Tantalum Concentrate Price
(Dollars per pound contained tantalum pentoxide)



Significant events affecting tantalum prices since 1958

- 1979-80 Tantalum price accelerates to record levels
- 1982 Industry's accumulation of large tantalum material inventories
- 1988 Drawdown of tantalum material inventories by processors
- 1990 Purchase of tantalum materials for the National Defense Stockpile (NDS)
- 1991 Long-term tantalum supply contracts between major producer and processors
- 1998 Sales of tantalum minerals from the NDS

Tantalum is a refractory metal that is easily fabricated, has a high melting point, is highly resistant to corrosion by acids, and is a good conductor of heat and electricity. Tantalum's first commercial usage was as filament material in incandescent electric lamps in the early 1900's (Miller, 1959). Currently, the major use for tantalum, as tantalum metal powder, is in the production of electronic components, mainly tantalum capacitors. Alloyed with other metals, tantalum is also used in making carbide tools for metalworking equipment and in the production of superalloys for jet engine components. Substitutes, such as aluminum, rhenium,

titanium, tungsten, and zirconium, exist for tantalum but are usually made at either a performance or economic penalty.

Tantalum mineral concentrates (tantallite) are the main primary source of tantalum, and the price for tantalum products is affected most by events in the supply of and demand for tantallite. The price for tantalum metal products generally follows the pattern for that of tantalum concentrates. The price for tantalum metal products is also affected by the size of the order/contract and material specification. The yearend 1998 price for tantalum concentrates was about \$41.50 per pound of contained tantalum compared with the

most recent industry source for the selling price for the following tantalum metal products (per pound of contained tantalum)—vacuum-grade metal for superalloys, \$75 to \$95; sheet, \$100 to \$150; capacitor-grade metal powder, \$135 to \$240; and capacitor-grade wire, \$180 to \$250.

Australia is the major producer of tantalum mineral concentrates. U.S. tantalum-mining has not been significant since 1959. The United States satisfies its tantalum requirements primarily by importing tantalum concentrates from Australia and Brazil and quantities of metal and powders from various countries. Many of the applications for tantalum are either directly or indirectly defense related because of its use in the aerospace, communications, energy, and transportation industries. Thus, tantalum is classified as critical and strategic, and over the years, various tantalum materials have been purchased for the NDS.

A significant activity during the 1950's was the U.S. Government's worldwide program for the purchase of about 6,800 metric tons (t) of combined columbium and tantalum oxides contained in columbium-tantalum ores and concentrates. The purchase program was terminated in 1958 (Cunningham, 1985a, b). The program, which was initiated to encourage increased production of columbium-tantalum ores and concentrates of domestic and foreign origin, largely governed the market price for tantalum ores and concentrates. It also resulted in the discovery of large low-grade domestic and foreign deposits of tantalum minerals. The program, however, was less successful in developing domestic tantalum mineral production. The low grade of the discoveries precluded their development at current or expected future prices.

By 1960, tantalum demand for use in capacitors, high-temperature alloys, corrosion-resistant chemical and nuclear applications, machine cutting tools, and aerospace applications had increased substantially. Price peaks in 1961 and 1966 were occasioned by a sudden increase in demand for tantalum, which outstripped the supply, thus driving prices up. Increased demand stimulated tantalum production. After a leveling off of demand, however, overproduction ensued, resulting in a decline in tantalum prices. The higher cost operations, which had opened in response to the increased demand, closed down, and supply reverted back to customary levels.

The 1970's was a decade of increasing tantalum demand, ore shortages, escalating prices, and substitution. The record price levels during this period were attributed, in part, to a state of panic buying influenced by anticipated increases in tantalum demand amidst concerns of shrinking world tantalum supply. As demand for tantalum increased, some processors foresaw the coming production shortfall and began to stockpile inventories. The net effect was very competitive buying of tantalum feed materials to meet customer needs with associated spiraling prices. The high prices brought about substitution for tantalum and more-widespread search for and development of new tantalum supply sources.

In 1979 to 1980, the price for tantalum source materials exploded. Tantalum source material production could not meet market demand, resulting in sustained inventory reduction. With optimistic forecasts of market growth, processors found themselves locked into a bidding contest for available tantalum source materials. By yearend 1982, large high-cost inventories of tantalum source materials were accumulated as a hedge against perceived future shortages.

During the late 1970's and early 1980's, processors, faced with runaway source material prices, were forced to pass along a large part of the price increases to end users, which had the effect of a decrease in the use of tantalum. Because of escalating tantalum prices, consumers began to substitute alternate products, to decrease tantalum content in products, and to increase recycling to substitute for virgin tantalum products. These demand-reducing activities were accelerated by the price volatility and resulted in increased stock inventories. In the consumer electronics sector, tantalum was designed out of some circuits and replaced primarily with aluminum-bearing electronic components.

The tantalum concentrate price was at its highest level at midyear 1980, about \$118 per pound of contained tantalum oxide. By yearend 1980, prices began declining and, by yearend 1986, were the lowest since yearend 1976. The downturn in prices was hastened by weak tantalum demand and the overhang of the large inventories of tantalum source materials built up during the early 1980's. Industry sources estimated that these inventories were as high as about 5,000 t of contained tantalum oxide in 1982 (Tantalum-Niobium International Study Center, 1986). By 1988, price increases for tantalum source materials were again of major concern in the tantalum industry. The yearend 1988 price for tantalite ore, \$50 per pound of contained tantalum oxide, nearly doubled the yearend 1987 price. The price escalation was attributed to increased demand for tantalum source materials following a drawdown of the tantalum inventories that had been built up.

The price for tantalum ore continued its cyclic pattern through 1993; thereafter, the price was steady with some moderate increases. From 1990 to 1998, the demand for tantalum remained strong, with increased consumption in most years. Demand was robust in the electronics sector for tantalum capacitors in such products as portable telephones, pagers, video cameras, personal computers, and automotive electronics. Overall growth in this sector, however, was slowed owing to the industry's continued emphasis on the miniaturization of electronic components, resulting in less tantalum used per unit.

In 1990, the Defense Logistics Agency (DLA) purchased about 91 t of tantalum oxide contained in tantalum minerals for the NDS. The price of the material purchased ranged from about \$36.62 to \$37 per pound of contained tantalum oxide. At about the time of material purchase, the price quote for tantalite ore ranged from about \$27 to \$28.50 per pound of contained tantalum oxide (Cunningham, 1993).

In 1991, Australia's largest tantalum minerals producer entered into contracts with the world's two largest tantalum processors for the long-term supply of tantalum ore. Under the terms of the contracts, tantalum ore would be supplied to the processors at fixed volumes and prices for a period of 5 years (Gwalia Consolidated Ltd., 1991). Subsequently, the producer contracted with the processors for the sale of all its budgeted production of tantalite ore through 2003 (Sons of Gwalia Ltd., 1998).

In 1998, the DLA initiated the sale of tantalum minerals from the NDS. In September and December, the DLA sold about 90 t of tantalum contained in tantalum minerals valued at about \$11.6 million (Defense National Stockpile Center, 1998a, b). The overall average unit price for the sales, about \$48 per pound of contained tantalum oxide, was significantly higher than that being quoted for tantalum minerals, about \$34 per pound of contained oxide.

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(Dollars per pound contained tantalum pentoxide¹)

Year	Price	Year	Price	Year	Price	Year	Price
1940	2.50	1955	3.40	1970	7.13	1985	22.75
1941	2.25	1956	3.40	1971	6.50	1986	21.75
1942	1.93	1957	3.40	1972	5.63	1987	26.00
1943	2.50	1958	3.40	1973	8.00	1988	50.00
1944	2.50	1959	4.80	1974	14.00	1989	27.00
1945	2.50	1960	7.25	1975	16.00	1990	33.00
1946	NA	1961	11.50	1976	17.63	1991	28.25
1947	2.50	1962	5.50	1977	24.63	1992	29.00
1948	2.38	1963	6.50	1978	39.50	1993	26.00
1949	2.25	1964	6.50	1979	92.50	1994	26.25
1950	2.25	1965	7.75	1980	105.50	1995	27.75
1951	2.25	1966	13.00	1981	37.50	1996	27.75
1952	3.40	1967	10.25	1982	22.50	1997	33.00
1953	3.40	1968	6.50	1983	29.50	1998	34.00
1954	3.40	1969	7.13	1984	32.00		

NA Not available

¹ To convert to dollars per kilogram, multiply by 2.20462.

Sources: E&MJ Metal and Mineral Markets (E&MJ M&MM) (1940-41), U.S. Government purchase (1942-43), E&MJ M&MM (1944-51) U.S. Government purchase (1952-58), E&MJ M&MM (1963-66), Metals Week (1967-92), and Platt's Metals Week (1993-98). Prices for the period 1959-62 were published by the U.S. Bureau of Mines, but origin is unknown.