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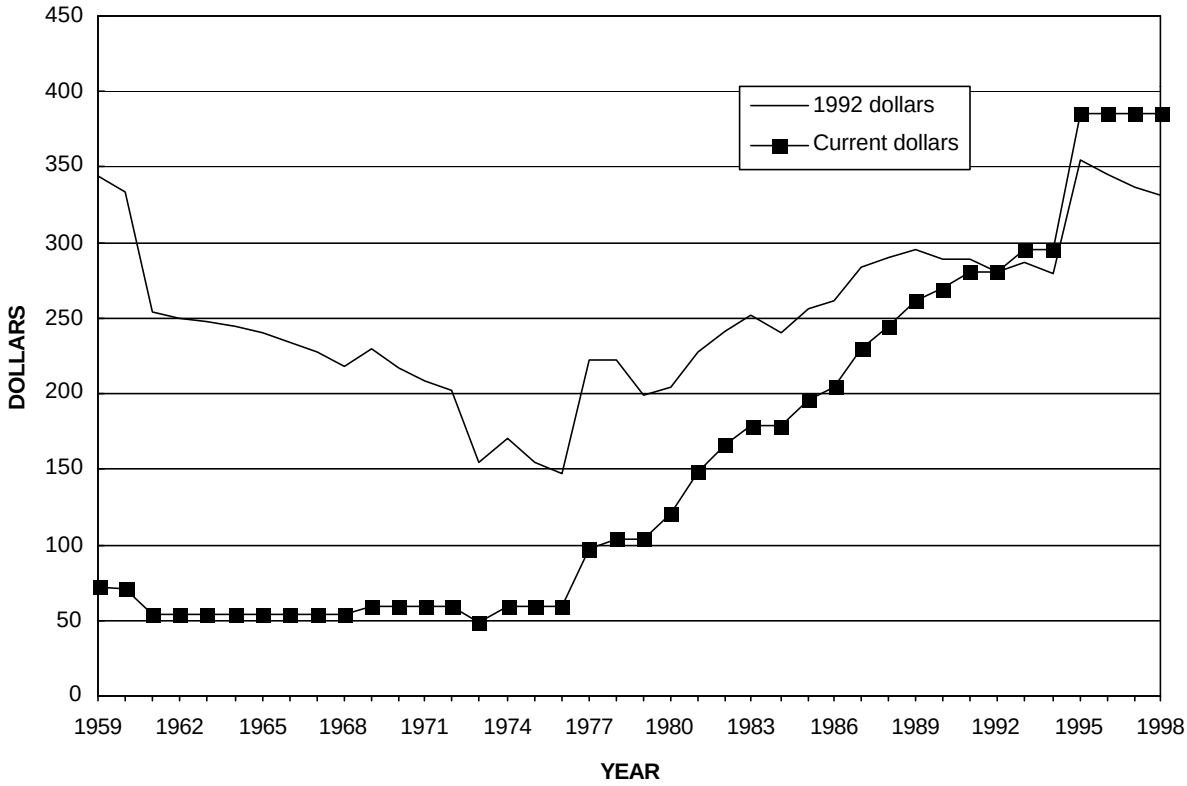
Beryllium

by Larry D. Cunningham

Yearend Average Beryllium Metal Price

(Dollars per pound)



Significant events affecting beryllium prices since 1958

1969	Bertrandite mine established in the United States providing a significant raw materials source
1977	Effects of inflation rates, increased energy costs, and additional costs associated with complying with air emission standards results in increased prices
1979	Beryllium metal price set by one producer
1988	Purchase of beryllium metal for the National Defense Stockpile (NDS)
1990	Conversion of NDS beryl ore to beryllium metal for the NDS
1991	Recession, dissolution of the Soviet Union

Beryllium is one of the lightest of all metals and has one of the highest melting points of any light metal. Beryllium has physical and chemical properties, such as its stiffness, high resistance to corrosion from acids, and high thermal conductivity, that make it useful for various applications in its alloy, oxide, and metallic forms. Beryllium metal is used principally in aerospace and defense applications because of its stiffness, light weight, and dimensional stability over a wide temperature range. Beryllium-copper alloys are used in a wide variety of applications because of their electrical and thermal conductivity, high strength and hardness, good corrosion and fatigue resistance, and nonmagnetic properties. Beryllium oxide is an excellent heat conductor, with high strength and hardness, and acts as an electrical insulator in some applications. The United States, one of only three countries that process beryllium ores and concentrates into

beryllium products, supplies most of the rest of the world with these products (Cunningham, 1997). Because of its use in aerospace and defense applications, beryllium is classified as "critical and strategic," and over the years, various beryllium materials have been purchased for the NDS. Steel, titanium, phosphor bronze, and aluminum nitride can be substituted for beryllium in some applications but usually at a performance penalty. The quoted price for beryllium metal during most of the 1980's and 1990's, as presented in the table and graph, may not reflect true transaction prices for the material. The quoted prices reflect the more high-end/high-purity form of the material.

In 1956, the Atomic Energy Commission awarded 5-year contracts to two domestic companies for each to produce about 45 metric tons (t) of beryllium annually (Eilertsen, 1958). Beryllium metal was also considered for aircraft structural components and components in inertial guidance systems for advanced missiles. These new applications increased beryllium metal demand, which led to improvements in beryllium processing and a reduction in price.

Prior to 1970, the United States was nearly 100% import dependent for its beryl ore needs. In 1969, however, a bertrandite mine opened in Utah that provided a large secure source of domestic raw material supply (Petkof, 1985). During most of the 1960's, the price for beryllium metal remained stable.

By 1977 and continuing through the 1990's, the effects of inflation rates and rising operating costs were reflected in increased beryllium prices. Energy requirements for producing beryllium metal are high. Processing requires the use of induction furnaces that consume large quantities of energy. Also, because of the toxic nature of beryllium, the industry must maintain careful control over the quantity of beryllium dust and fumes in the workplace. Under the Clean Air Act, the U.S. Environmental Protection Agency issues standards for certain hazardous air pollutants, including beryllium, and the Occupational Safety and Health Administration issues standards for airborne beryllium particles. To comply with these standards, plants are required to install and maintain pollution control equipment. Beryllium dust and fumes have been recognized as the cause of beryllosis, a serious chronic lung disease. Although the exact cause of the disease is uncertain, the problem appears to be controlled when established preventative measures are exercised. In beryllium-processing plants, harmful effects are prevented by maintaining clean workplaces; requiring the use of safety equipment, such as personal respirators; collection of dust, fumes, and mists at the source of deposition in dust collectors; medical programs; and other procedures to provide safe working conditions (Rossman, Preuss, and Powers, 1991; Kramer, 1994). This control of potential health hazards adds to the cost of beryllium metal and other beryllium products. The additional costs are ultimately passed on to the consumer in the form of increased prices.

In 1979, one of two domestic beryllium producers discontinued beryllium metal production, leaving the price of the metal to be set by one company (Petkof, 1980). In 1988, the U.S. Government purchased about 27 t of "vacuum hot-pressed beryllium billets" worth an estimated $19 million; the metal was delivered to the NDS by yearend 1989 (Kramer, 1990). The average unit value for the NDS metal was about $317 per pound. The quoted price for beryllium metal powder at yearend 1988 and yearend 1989 was $244 per pound and $261 per pound, respectively. In 1990, the Defense Logistics Agency awarded a contract to convert some of the beryl ore contained in the NDS to vacuum hot-pressed beryllium billets. The contract was extended through 1992 for a combined total of 73 t of beryllium metal, valued at about $46 million, recovered from about 2,940 t of NDS beryl ore (Kramer, 1993, 1994). The overall unit value of the NDS metal, about $287 per pound, was comparable to the price being quoted for beryllium metal powder from yearend 1990 to yearend 1994, which ranged from $269 per pound to $295 per pound. Deliveries of the metal to the NDS were completed in the second quarter of 1994.

The beryllium metal purchase and beryl ore conversion came at a time of declining beryllium metal consumption, caused by reduced spending for strategic defense programs. The jump in price in 1995, shown in the graph, reflects a change in the nature of the price quotation, not any single causal event. Beryllium metal currently averages about 10% of annual U.S. beryllium demand compared with about 20% in the early 1990's. With applications primarily in the aerospace and defense sectors, the dissolution of the U.S.S.R. in 1991 contributed most to the decline in beryllium metal demand as defense strategic plans changed. The sole U.S. beryllium metal producer, however, continues to develop purer metal with improved physical properties for its customers.

The major end use for beryllium—in beryllium-copper alloys for springs, connectors, and switches for use in such applications as automobiles, aerospace, and computers—averages about 75% of total annual U.S. consumption of beryllium on a beryllium metal equivalent basis. For comparison purposes with metal, the quoted price for beryllium-copper master alloy (BCMA) has remained unchanged since August 1987 at $160 per pound of contained beryllium. In 1998, the U.S. Department of Defense (DOD) initiated the sale of BCMA from the NDS. From May through November, the DOD sold about 1,190 t of BCMA valued at about $6.71 million (Defense National Stockpile Center, 1998a, b, c). The overall unit price for the BCMA sales was about $2.55 per pound.

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Yearend Average Beryllium Metal Price
(Dollars per pound[1])

Year	Price	Year	Price	Year	Price	Year	Price
1947	95.00	1960	70.00	1973	49.00	1986	204.00
1948	95.00	1961	54.00	1974	59.75	1987	229.00
1949	95.00	1962	54.00	1975	59.50	1988	244.00
1950	95.00	1963	54.00	1976	59.50	1989	261.00
1951	95.00	1964	54.00	1977	96.00	1990	269.00
1952	95.00	1965	54.00	1978	103.00	1991	280.00
1953	71.50	1966	54.00	1979	103.00	1992	280.00
1954	71.50	1967	54.00	1980	120.00	1993	295.00
1955	71.50	1968	54.00	1981	148.00	1994	295.00
1956	71.50	1969	60.00	1982	166.00	1995	385.00
1957	71.50	1970	60.00	1983	178.00	1996	385.00
1958	71.50	1971	60.00	1984	178.00	1997	385.00
1959	71.50	1972	60.00	1985	196.00	1998	385.00

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

Note:
1947-52, beryllium, technical grade, *in* E&MJ Metal and Mineral Markets.
1953-59, beryllium, lumps and beads, 97% beryllium, *in* American Metal Market (AMM).
1960-68, beryllium, powder or powder blend, 97% beryllium, *in* AMM.
1969-80, beryllium, powder or powder blend, *in* U.S. Bureau of Mines, Minerals Yearbook, origin and/or beryllium content unknown.
1981-85, beryllium, powder blend, 97% beryllium, *in* AMM.
1986-89, beryllium, powder blend, 98.5% beryllium, *provided by* Brush Wellman, Inc.
1990-94, beryllium, powder blend, 98.5% beryllium, *in* AMM.
1995-98, beryllium, powder, 99% beryllium, *in* AMM.