

**COBALT STATISTICS<sup>1</sup>**  
**U.S. GEOLOGICAL SURVEY**

[All values are in metric tons (t) cobalt content unless otherwise noted]

Last modification: December 6, 2007

Year	Primary production	Secondary production	Mine shipments	Government shipments	Imports	Exports	Stocks	Reported consumption	Apparent consumption	Unit value (\$/t)	Unit value (98\$/t)	World mine production	World refinery production
1900					20				20	4,930	97,000		
1901					20				20	5,590	110,000	180	
1902					30				30	5,600	106,000	540	
1903					20				20	6,050	110,000	640	
1904					10				10	6,210	113,000	540	
1905					20				20	6,060	110,000	450	
1906					10				10	5,940	108,000	450	
1907					20				20	4,680	82,000	910	
1908					70				70	230	4,300	1,360	
1909					5				5	2,920	53,000	1,450	
1910	0				5				5	1,270	22,000	1,000	
1911	0				200				200	300	5,200	820	
1912	0				260				260	320	5,400	860	
1913	0				70				70	1,390	22,900	820	
1914	0				110				110	2,470	40,300	360	
1915	0				70				70	3,180	51,200	230	
1916	0				110				110	3,220	48,200	410	
1917	0				170				170	3,890	49,600	360	
1918					240				240	3,900	42,100	450	
1919					70				70	4,770	45,000	360	
1920					120				120	6,150	50,000	360	
1921					70				70	6,450	58,600	180	
1922					120				120	6,590	64,000	820	
1923	0				193				193	5,950	56,700	640	
1924	0				128				128	5,810	55,400	1,090	
1925	0				185				185	5,450	50,900	1,090	
1926	0				291				291	5,260	48,300	820	
1927	0				308				308	5,120	47,800	1,180	
1928	0				371				371	5,140	48,900	1,180	
1929	0				550				550	4,940	47,100	1,360	
1930	0				360				360	4,990	48,900	1,270	
1931					186				186	3,620	38,800	910	
1932	0				137				137	3,000	35,800	1,090	
1933					349				349	2,550	32,000	1,270	
1934					454				454	2,350	28,600	1,450	
1935					529				529	2,530	30,100	2,000	
1936					717				717	2,780	32,600	2,720	

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1937					787				787	3,140	35,500	3,800	
1938					567				567	3,030	35,000	4,500	
1939					1,210				1,210	3,100	36,400	4,500	
1940	40		40		1,910				1,940	2,620	30,600	5,000	
1941	150		150		2,120	20			2,250	2,600	28,800	4,000	
1942	210		190		1,940	40			2,100	2,220	22,200	3,500	
1943	210	20	220		2,050	160		1,780	2,140	2,920	27,600	4,200	
1944	240	21	160		1,710	180		1,810	1,710	4,200	38,900	3,900	
1945	320	14	380		2,090	10		1,680	2,470	3,660	33,200	4,700	
1946	150	4	150		1,570	5		1,860	1,710	3,400	28,300	3,500	
1947	187	2	198		3,720	0		1,880	3,920	2,920	21,400	5,000	
1948	198	9	170		4,000	1	852	2,280	3,330	3,040	20,500	6,100	
1949	150	7	197		3,380	10	621	2,130	3,810	3,550	24,300	5,900	
1950	232	57	193		4,130	10		3,760	4,990	3,670	24,800	7,170	
1951	267	406	221		4,690	5	438	4,510	4,870	4,420	27,600	8,440	
1952	438	621	254		6,820	25	491	4,910	7,620	5,000	30,700	10,100	
1953	398	699	577		7,820	20	545	4,880	9,020	5,070	30,900	11,300	
1954	652	358	733		7,650	140	538	3,330	8,610	5,470	33,200	13,100	
1955	842	233	787		8,500	170	589	4,420	9,300	5,460	33,300	13,300	
1956	1,150	179	1,200		7,070	140	564	4,340	8,330	5,570	33,400	14,400	
1957	1,500	165	1,490		7,880	70	443	4,150	9,590	4,410	25,600	14,400	
1958	1,820	161	1,820		6,870	80	396	3,420	8,820	4,360	24,600	12,600	
1959	1,060	118	1,050		9,640	30	636	4,490	10,500	3,930	22,000	14,800	
1960		109			5,520	80	842	4,050	5,340	3,390	18,600	14,200	
1961		81			4,760	90	820	4,350	4,770	3,280	17,900	14,400	
1962		94			5,640	90	671	5,110	5,790	3,210	17,400	17,100	
1963		112			4,770	90	498	4,780	4,970	3,180	16,900	14,500	
1964	492	67		332	5,640	49	644	4,830	6,340	3,190	16,800	17,800	
1965	538	39		1	6,990	53	1,630	6,170	6,520	3,480	18,000	19,000	
1966	551	22		346	8,540	45	2,900	6,440	8,140	3,420	17,200	21,800	
1967	530	54		2,810	3,730	91	2,970	6,340	6,960	4,370	21,300	20,500	
1968	533	65		2,250	4,110	644	2,670	5,900	6,620	4,500	21,100	19,600	17,100
1969	455	149		2,720	5,860	679	2,330	7,080	8,850	4,070	18,100	20,200	18,000
1970	316	31		2,340	5,630	670	2,600	6,060	7,380	4,880	20,500	24,200	21,300
1971	313	57		763	4,950	166	2,370	5,670	6,140	4,810	19,400	25,100	22,400
1972	0	89		2,700	6,310	586	2,060	6,410	8,830	5,230	20,400	24,800	20,300
1973	0	120	0	3,890	8,730	634	4,170	8,500	9,990	6,480	23,800	29,400	23,100

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1974	0	122	0	4,050	7,310	611	4,290	8,560	10,700	7,520	24,900	30,900	24,800
1975	0	155	0	2,880	3,000	802	3,150	5,800	6,380	9,280	28,100	30,800	20,800
1976	0	149	0	3,040	7,480	794	4,020	7,480	9,000	9,410	27,000	21,400	18,800
1977	0	230	0	67	7,960	404	3,570	7,520	8,310	11,900	32,100	21,500	20,800
1978	0	470	0	0	8,630	702	2,730	9,070	9,240	22,000	54,900	26,800	24,700
1979	0	531	0	0	9,070	329	3,470	7,890	8,530	53,300	120,000	29,900	28,500
1980	0	537	0	0	7,390	264	3,400	6,950	7,740	51,600	102,000	31,300	30,200
1981	0	441	0	-1,060	7,070	378	3,800	5,300	5,680	36,900	66,100	30,700	25,800
1982	0	395	0	-1,300	5,840	270	3,390	4,290	5,070	25,300	42,700	24,600	19,300
1983	0	328	0	-120	7,810	374	4,050	5,130	6,980	14,900	24,300	37,900	18,100
1984	0	399	0	-2,450	11,500	304	5,110	5,870	8,060	19,000	29,800	40,900	23,700
1985	0	408	0	-721	8,030	292	5,480	5,620	7,060	23,800	36,100	47,400	27,500
1986	0	1,200	0	0	5,570	454	4,060	6,480	7,740	16,200	24,100	50,200	31,400
1987	0	1,030	0	0	8,830	366	5,560	6,670	7,990	14,700	21,100	41,200	28,000
1988	0	1,020	0	0	7,050	543	5,260	7,230	7,830	16,200	22,300	43,800	26,400
1989	0	1,180	0	0	5,790	889	4,550	7,030	6,800	17,300	22,700	42,900	26,400
1990	0	1,230	0	-108	6,530	1,340	3,220	7,560	7,640	18,200	22,700	42,300	27,300
1991	0	1,580	0	0	6,920	1,540	2,400	7,220	7,790	25,100	30,100	33,300	25,200
1992	0	1,620	0	0	5,760	1,420	1,760	6,400	6,590	47,400	55,100	28,000	21,500
1993	0	1,610	0	289	5,940	795	1,460	6,480	7,350	31,300	35,300	21,900	16,600
1994	0	1,840	0	1,500	6,780	1,360	1,490	7,500	8,730	42,200	46,400	18,000	20,000
1995	0	1,870	0	1,550	6,440	1,300	1,080	7,590	8,970	58,300	62,400	24,500	23,300
1996	0	2,280	0	2,050	6,710	1,660	1,070	7,990	9,380	56,400	58,600	26,200	25,600
1997	0	2,750	0	1,620	8,430	1,570	1,090	9,160	11,200	46,300	47,000	27,400	27,100
1998	0	3,080	0	2,310	7,670	1,680	1,000	9,380	11,500	44,200	44,200	35,300	31,400
1999	0	2,700	0	1,530	8,150	1,550	1,160	8,660	10,700	33,700	33,000	32,700	33,100
2000	0	2,590	0	2,960	8,770	2,630	1,120	8,980	11,700	29,700	28,100	37,900	36,000
2001	0	2,810	0	3,050	9,410	3,210	1,330	9,540	11,800	23,300	21,500	44,800	38,700
2002	0	2,750	0	524	8,450	2,080	1,140	8,270	9,830	17,100	15,500	52,200	40,800
2003	0	2,130	0	2,380	8,080	2,710	1,010	8,030	10,000	20,600	18,200	52,700	43,800
2004	0	2,300	0	1,630	8,720	2,500	1,210	8,990	9,950	43,400	37,400	58,400	49,100
2005	0	2,030	0	1,110	11,100	2,440	1,190	9,150	11,800	33,600	28,100	63,500	54,900
2006	0	2,010	0	260	11,600	2,850	1,150	9,270	11,100	30,700	24,800	67,500	55,000

<sup>1</sup>Compiled by D.A. Buckingham and K.B. Shedd.

Data are calculated, estimated, or reported. See notes for more information.

## Cobalt Worksheet Notes

### Data Sources

The sources of data for the cobalt worksheet are the mineral statistics publications of the U.S. Bureau of Mines and the U.S. Geological Survey—Minerals Yearbooks (MYB) and its predecessor, Mineral Resources of the United States (MR); Mineral Commodity Summaries (MCS) and its predecessor, Commodity Data Summaries (CDS); and Mineral Facts and Problems (MFP). In addition, some data came from U.S. Bureau of Mines Information Circular 8103 (IC 8103), Cobalt—A Materials Survey, (U.S. Bureau of Mines, 1962). The years of publication and corresponding years of data coverage are listed in the References section below. Blank cells in the worksheet indicate that data were either not available or were withheld in order to avoid disclosing proprietary data.

### Primary Production

The data are U.S. mine production. Prior to 1940, U.S. cobalt mine production was intermittent and, with some exceptions, generally very low in volume; a consistent data series is not available. Data are not available for the years 1900–09, 1918–22, 1931, and 1933–39. Data for the years 1940–46 represent estimated recoverable cobalt content derived by using an estimated average recovery rate of 63.5% for cobalt. This average was calculated from recoverable cobalt and cobalt content for the years 1947–50. Data for the years 1947–59 are published recoverable cobalt content from the MYB. Production data are withheld for the years 1960–63 in order to avoid disclosing proprietary data. Data for the years 1964–71 are mine production from the 1975 MFP. After 1971, there was no mine production; the data are “0.”

### Secondary Production

U.S. scrap consumption was used to estimate secondary cobalt production. Prior to 1943, data are not available. Data for the years 1943–45 are from IC 8103. Data for the years 1946–2006 are from the MYB, but include unpublished revisions for 1988, 1992–96, and 1999–2002.

### Shipments

Shipments data are not available prior to 1940. Data for the years 1940–59 are mine shipments. Data for the years 1940–46 represent estimated recoverable cobalt content derived by using an estimated average recovery rate of 64.6% for cobalt. This average was calculated from the cobalt content and recoverable cobalt content of mine shipments for the years 1947–50. Data for 1947–59 are recoverable cobalt content. All mine shipments data are from the MYB. Data for the years 1960–61 are withheld in order to avoid disclosing proprietary data. For the years 1962–72 mine shipments data are not available. The U.S. Government began stockpiling cobalt in the early 1940s. Data for the years 1964–2006 are net U.S. Government stockpile shipments. Negative numbers for these shipments indicate net U.S. Government acquisitions. Data for the years 1964–77 are from the 1975 and 1980 MFP. Data for the years 1978–89 and 1991–2006 are from the MCS. Datum for 1990 is from the MYB.

### Imports

Data are cobalt imports for consumption. Imports data include various types of cobalt materials, such as alloys, matte, oxides, ores and concentrates, salts and compounds, unwrought metal, waste and scrap, and other. These data are reported in gross weight for the years 1900–22 and cobalt content for the years 1923–2006. By using gross weights and cobalt contents reported for the years 1923–30, an estimated weighted average cobalt content of 73.1% was calculated and used to estimate the cobalt content of imports for the years 1900–22. Data for the years 1964–2006 exclude cobalt alloys, ores, and concentrates. Imports data for the years 1989–2006 exclude matte, waste, and scrap. Data for 1984–85 and 1990 include cobalt destined for the National Defense Stockpile. Data are from the MR and the MYB.

### Exports

Data are not available prior to 1941. Cobalt exports data include alloys, oxides, ores and concentrates, salts and compounds, waste and scrap, and unwrought metal, and exclude semifabricated, wrought cobalt, and cobalt articles. Cobalt content data for the years 1942–48 and 1951–52 are estimated based on the estimated cobalt content of each material, alloys, metal, and scrap (estimated to be mostly metal), 90%; ores and concentrates, 2%; oxides, 70%; and salts and compounds, 30%. Exports for the years 1949–50 and 1953–63 are estimated to be mostly scrap with a cobalt content of about 10%. Gross weight data for the years 1941–63 came from the MYB. Exports for the years 1964–79 are estimated cobalt content from the 1975 and 1980 MFP. Exports for the years 1980–2006 are estimated cobalt content from the MYB.

### Stocks

Stocks data are not available prior to 1948 and for the year 1950. All stocks data are for the end of the calendar year, so beginning stocks are defined as the previous year stocks, and ending stocks are defined as the current year stocks. Stocks data for the years 1948–49 and 1951–64 are consumer stocks; data for the years 1965–2006 are industry stocks. Data are from the following sources: 1948–53, CDS; 1954–64, MYB; 1965–72, MFP (1975); 1973–82, MCS; 1983–85, and 2000, previously unpublished revisions; and 1986–99, 2001–06, MCS.

### **Reported Consumption**

Data represent reported cobalt consumption in the United States to make products such as alloys, cemented carbides, and a variety of chemical applications. Data are based on company reports to the U.S. Bureau of Mines and the U.S. Geological Survey and may include estimates for non-respondents. Reported consumption data are not available prior to 1943. Cobalt materials included during various time periods are as follows: 1943–45, metal, chemical compounds (oxide and cobalt-nickel compound only), purchased scrap, and ore used directly in magnets and other industrial applications; 1946–53, metal, chemical compounds (organic and inorganic), purchased scrap, and ore and alloy; 1954–2006, metal, chemical compounds (organic and inorganic), and purchased scrap. Data for the years the 1943–87 and 1992–2006 are from the MYB. Data for the years 1988–91 are previously unpublished revisions.

### **Apparent Consumption**

Cobalt apparent consumption data prior to 1940 are cobalt imports data only. Prior to 1940, U.S. cobalt mine production was intermittent and, with some exceptions, generally very low in volume; secondary production, exports, and U.S. government shipments were assumed to be negligible or zero; and there is no information available to assess changes in stocks levels. Apparent consumption for the years 1940–63 was estimated using the following equation:

$$\text{APPARENT CONSUMPTION} = \text{MINE SHIPMENTS} + \text{SECONDARY PRODUCTION} + \text{IMPORTS} - \text{EXPORTS} \pm \text{STOCK CHANGES} + \text{GOVERNMENT SHIPMENTS.}$$

Because primary cobalt production and mine shipments data for the years 1960–61 were withheld and were not available for the years 1962–63, an estimate of 500 metric tons (t) was used for calculating apparent consumption and rounded to three significant figures. This estimate reflects a contraction of the domestic cobalt industry during this time period. Apparent consumption for the years 1964–2006 was estimated using the following equation:

$$\text{APPARENT CONSUMPTION} = \text{PRIMARY (MINE) PRODUCTION} + \text{SECONDARY PRODUCTION} + \text{IMPORTS} - \text{EXPORTS} \pm \text{STOCK CHANGES} + \text{GOVERNMENT SHIPMENTS.}$$

### **Unit Value (\$/t)**

Unit value is defined as the value of 1 t of cobalt apparent consumption. For the years 1900–2006, estimation of the cobalt unit value is calculated on an annual basis from the U.S. dollar (expressed as current dollars) value of imports divided by cobalt content of those imports. Estimation of unit value is based on import data because the greatest part of apparent consumption is imported. U.S. cobalt import quantity and value data are from the MR and the MYB.

### **Unit Value (98\$/t)**

The Consumer Price Index conversion factor, with 1998 as the base year, is used to adjust unit value in current U.S. dollars to the unit value in constant 1998 U.S. dollars.

### **World Mine Production**

Data represent the cobalt content of refined products or the cobalt content, recoverable cobalt content, or recovered cobalt content of mined ores, concentrates, or intermediate products depending on the producing country and year. The blank cell in the worksheet indicates that data for the year 1900 were not available. Production estimates for the former Soviet Union are not included prior to 1961. Data for the years 1901–36 are from IC 8103. Data for the years 1937–2006 are from the MYB.

### **World Refinery Production**

Blank cells in the worksheet indicate that data were not available for the years 1900–67. Data for the years 1968–2006 are from the MYB and represent the cobalt content of refined cobalt products. U.S. production data are included in the total for the years 1969–71, and 1975–83. No U.S. production data are reported for the years 1968, 1972–74 and after 1983.

### **References**

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**For more information, please contact:**

[USGS Cobalt Commodity Specialist](#)