

## RHENIUM

(Data in kilograms of rhenium content, unless otherwise noted)

**Domestic Production and Use:** During 1997, ores containing rhenium were mined by nine operations. Rhenium compounds are included in molybdenum concentrates derived from porphyry copper deposits in the southwestern United States, and rhenium itself was recovered as a byproduct from roasting such molybdenum concentrates. Rhenium-containing products included ammonium perrhenate, perrhenic acid, and metal powder. The major uses of rhenium were in petroleum-reforming catalysts and in high-temperature superalloys used in jet engine components, representing about 20% and 60%, respectively, of the total demand. Rhenium was used in petroleum-reforming catalysts for the production of high-octane hydrocarbons, which are used in the production of lead-free gasoline. Bimetallic platinum-rhenium catalysts have replaced many of the monometallic catalysts. Rhenium is used in superalloys, improving the strength properties, at high temperatures (1,000° C), of nickel-based alloys. Some of the uses for rhenium alloys were in thermocouples, temperature controls, heating elements, ionization gauges, mass spectrographs, electron tubes and targets, electrical contacts, metallic coatings, vacuum tubes, crucibles, electromagnets, and semiconductors. The estimated value of rhenium consumed in 1997 was \$22 million.

<b>Salient Statistics—United States:</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997<sup>e</sup></b>
Production <sup>1</sup>	12,200	15,500	17,000	14,000	16,000
Imports for consumption	5,900	8,200	12,800	20,800	21,000
Exports			Small		
Consumption: Estimated	6,900	12,900	16,200	24,100	25,000
Apparent	W	W	W	W	W
Price, average value, dollars per kilogram:					
Metal powder, 99.99% pure	1,500	1,560	1,100	900	1,000
Ammonium perrhenate	1,100	1,100	700	500	750
Stocks, yearend, consumer, producer, dealer	W	W	W	W	W
Employment, number			Small		
Net import reliance <sup>2</sup> as a percent of apparent consumption	W	W	W	W	W

**Recycling:** Small amounts of molybdenum-rhenium and tungsten-rhenium scrap were processed during the past few years by several companies.

**Import Sources (1993-96):** Chile, 55%; Germany, 19%; the Netherlands, 8%; the United Kingdom, 5%; and other, 13%.

<b>Tariff: Item</b>	<b>Number</b>	<b>Most favored nation (MFN) 12/31/97</b>	<b>Non-MFN<sup>3</sup> 12/31/97</b>
Other inorganic acids, other—rhenium, etc.	2811.19.6050	4.2% ad val.	25% ad val.
Salts of peroxometallic acids, other— ammonium perrhenate	2841.90.2000	3.1% ad val.	25% ad val.
Rhenium, etc., (metals) waste and scrap	8112.91.0500	Free	Free.
Rhenium, (metals) unwrought; powders	8112.91.5000	3.3% ad val.	25% ad val.
Rhenium, etc., (metals) wrought; etc.	8112.99.0000	4.6% ad val.	45% ad val.

**Depletion Allowance:** 14% (Domestic), 14% (Foreign).

**Government Stockpile:** None.

## RHENIUM

**Events, Trends, and Issues:** During 1997, the rhenium metal price averaged \$1,000 per kilogram for rhenium metal and \$750 per kilogram for ammonium perrhenate. Imports of rhenium increased slightly for 1997 compared with those of 1996. Chile and Germany supplied the majority of the rhenium imported. The United States relies on imports for much of its supply of rhenium.

It is estimated that in 1998 U.S. consumption of rhenium will be about 26,000 kilograms.

Owing to the scarcity and minor output of rhenium, its production and processing pose no known threat to the environment. In areas where it is recovered, pollution control equipment for sulfur dioxide also prevents most of the rhenium from escaping into the atmosphere.

### **World Mine Production, Reserves, and Reserve Base:**

	Mine production <sup>e</sup>		Reserves <sup>4</sup>	Reserve base <sup>4</sup>
	1996	1997		
United States	14,000	16,000	390,000	4,500,000
Armenia	100	100	95,000	120,000
Canada	1,500	1,500	32,000	1,500,000
Chile	4,000	4,000	1,300,000	2,500,000
Kazakstan	200	200	190,000	250,000
Peru	2,000	2,000	45,000	550,000
Russia	500	500	310,000	400,000
Uzbekistan	300	300	59,000	400,000
Other countries	100	100	91,000	360,000
World total (may be rounded)	22,700	24,700	2,500,000	11,000,000

**World Resources:** Most rhenium occurs with molybdenum in porphyry copper deposits. Identified U.S. resources are estimated to be about 5 million kilograms, and the identified resources of the rest of the world are approximately 6 million kilograms. In Kazakstan, rhenium also exists in sedimentary copper deposits.

**Substitutes:** Substitutes for rhenium in platinum-rhenium catalysts are being evaluated continually. Iridium and tin have achieved commercial success in one such application. Other metals being evaluated for catalytic use include gallium, germanium, indium, selenium, silicon, tungsten, and vanadium. The use of these and other metals in bimetallic catalysts may decrease rhenium's share of the catalyst market. Materials that can substitute for rhenium in various end uses are as follows: cobalt and tungsten for coatings on copper X-ray targets, rhodium and rhodium-iridium for high-temperature thermocouples, tungsten and platinum-ruthenium for coatings on electrical contacts, and tungsten and tantalum for electron emitters.

<sup>e</sup>Estimated. W Withheld to avoid disclosing company proprietary data.

<sup>1</sup>Calculated rhenium contained in MoS<sub>2</sub> concentrates. Recovered quantities are considerably less and are withheld.

<sup>2</sup>Defined as imports - exports + adjustments for Government and industry stock changes.

<sup>3</sup>See Appendix B.

<sup>4</sup>See Appendix D for definitions.