

RHENIUM

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

Domestic Production and Use: During 1999, ores containing rhenium were mined by eight operations. Rhenium compounds are included in molybdenum concentrates derived from porphyry copper deposits in the southwestern United States, and rhenium is 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 35% and 55%, 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 1999 was \$20 million.

Salient Statistics—United States:	1995	1996	1997	1998	1999^e
Production ¹	17,000	14,000	15,400	14,000	11,900
Imports for consumption	12,800	20,800	15,100	25,200	15,600
Exports	NA	NA	NA	NA	NA
Consumption: Estimated	16,200	24,100	17,900	28,600	19,900
Apparent	NA	NA	NA	NA	NA
Price, average value, dollars per kilogram:					
Metal powder, 99.99% pure	1,100	900	900	1,100	1,100
Ammonium perrhenate	700	500	300	400	750
Stocks, yearend, consumer, producer, dealer	NA	NA	NA	NA	NA
Employment, number			Small		
Net import reliance ² as a percent of apparent consumption	NA	NA	NA	NA	NA

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

Import Sources (1995-98): Chile, 52%; Germany, 19%; Kazakhstan, 8%; Russia, 7%; and other, 14%.

Tariff: Item	Number	Normal Trade Relations 12/31/99
Other inorganic acids, other—rhenium, etc.	2811.19.6050	4.2% ad val.
Salts of peroxometallic acids, other— ammonium perrhenate	2841.90.2000	3.1% ad val.
Rhenium, etc., (metals) waste and scrap	8112.91.0500	Free.
Rhenium, (metals) unwrought; powders	8112.91.5000	3% ad val.
Rhenium, etc., (metals) wrought; etc.	8112.99.0000	4% ad val.

Depletion Allowance: 15% (Domestic and foreign).

Government Stockpile: None.

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Events, Trends, and Issues: During 1999, the average rhenium prices were \$1,100 per kilogram for metal and \$750 per kilogram for ammonium perrhenate. The supply decreased by 11,700 kilograms, while the consumption decreased by 8,700 kilograms, leaving a shortfall of 3,000 kilograms. The shortfall in supply was reflected by prices increasing about 100% over those of 1998. Imports of rhenium decreased by about 38% for 1999 compared with those of 1998. Chile and Germany supplied the majority of the rhenium imported. The United States relies on imports for much of its supply of rhenium. The decreased estimated consumption was in the areas of catalysts for petroleum refining and superalloys for jet engines.

It is estimated that U.S. consumption of rhenium in 2000 will be about 25,000 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 ^e		Reserves ³	Reserve base ³
	1998	1999		
United States	14,000	11,900	390,000	4,500,000
Armenia	1,000	700	95,000	120,000
Canada	2,200	1,300	—	1,500,000
Chile	13,600	13,000	1,300,000	2,500,000
Kazakhstan	2,400	2,400	190,000	250,000
Mexico	5,500	6,300	NA	NA
Peru	2,300	4,800	45,000	550,000
Russia	900	700	310,000	400,000
Uzbekistan	NA	NA	59,000	400,000
Other countries	3,200	3,300	91,000	360,000
World total (may be rounded)	45,100	44,400	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 Kazakhstan, 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.

^eEstimated. NA Not available.

¹Calculated rhenium contained in MoS₂ concentrates. Recovered quantities are considerably less and are withheld.

²Defined as imports - exports + adjustments for Government and industry stock changes.

³See Appendix C for definitions.