

GALLIUM

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

Domestic Production and Use: No domestic primary gallium recovery was reported in 2003. One company in Oklahoma recovered and refined gallium from scrap and impure gallium metal, and one company in Oklahoma refined gallium from impure metal. Imports of gallium, which supplied most of U.S. gallium consumption, were valued at about \$4 million, most of which was low-purity material. Gallium arsenide (GaAs) and gallium nitride (GaN) components represented about 98% of domestic gallium consumption. About 42% of the gallium consumed was used in optoelectronic devices, which include light-emitting diodes (LEDs), laser diodes, photodetectors, and solar cells. Integrated circuits represented 49% of gallium demand. The remaining 9% was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial components, medical equipment, and telecommunications. Integrated circuits were used in defense applications, high-performance computers, and telecommunications.

Salient Statistics—United States:	1999	2000	2001	2002	2003^e
Production, primary	—	—	—	—	—
Imports for consumption	24,100	39,400	27,100	13,100	18,000
Exports	NA	NA	NA	NA	NA
Consumption:					
Reported	29,800	39,900	27,700	18,600	26,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure	640	640	640	¹ 530	¹ 530
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery, number ^e	20	20	20	20	20
Net import reliance ² as a percentage of apparent consumption	NA	NA	NA	NA	NA

Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of GaAs-base devices were reprocessed.

Import Sources (1999-2002): France, 43%; China, 19%; Kazakhstan, 12%; Russia, 8%; and other, 18%.

Tariff:	Item	Number	Normal Trade Relations
			12/31/03
	Gallium metal	8112.92.1000	3.0% ad val.
	Gallium arsenide wafers, undoped	2851.00.0010	2.8% ad val.
	Gallium arsenide wafers, doped	3818.00.0010	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: A management group from the gallium recovery facility in Oklahoma that was closed in 2002 purchased the company's gallium assets in 2003 and formed a spinoff. The new company's product lines were expected to remain the same (gallium trichloride and 99.99999%-pure gallium metal), but it would not be recovering gallium from GaAs or other scrap material. The new firm also was based in Oklahoma.

Imports continued to supply almost all U.S. demand for gallium and increased from those in 2002 because of a rebound in the wireless communications industry. Using partial-year data, China, Ukraine, Russia, and Hungary were the principal U.S. gallium suppliers in 2003. Although U.S. consumption of GaAs is increasing because of a rebound in the demand for cellular telephones, the quantity of imports of gallium metal into the United States has not increased as significantly. This is because a significant portion of the GaAs wafer manufacturing industry moved to areas such as the Republic of Korea and Taiwan. To compensate for the decrease in the quantity of metal imports, imports of GaAs wafers are increasing. By July 2003, the quantity of undoped GaAs wafers imported into the United States was higher than that for 2002.

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Gallium prices began to rise slowly in the second half of 2003, reflecting an increase in demand. The price of low-purity gallium from China was estimated to be about \$250 per kilogram at midyear, compared with about \$200 per kilogram at the beginning of 2003. Prices for 99.9999%-pure gallium in the United States were estimated to be about \$400 per kilogram.

Worldwide shipments of mobile phone handsets rose in the first half of 2003, compared with shipments in the same period of 2002. Global cellular telephone sales are split into two separate markets—mature markets like Western Europe and North America, where replacement growth is driving sales, and emerging markets like Africa, parts of Eastern Europe, and China, where new sales are fueling customer demand. As a result, the highest growth is in the emerging markets. In the mature markets, manufacturers are relying on customers to upgrade to more expensive, feature-rich, color phones with cameras and games to drive growth. Research and development work continued on GaN, primarily to commercialize blue and violet LEDs and laser diodes.

The company that purchased the 50-ton-per-year gallium extraction facility in Pinjarra, Western Australia, in 1999 chose to keep the facility dormant until there is improvement in the global market for gallium that would be sufficient to support the investment needed to operate the plant. The company also entered into a long-term contract with the owner of a nearby alumina extraction plant for the use of its Bayer liquor stream for the extraction of gallium.

World Production, Reserves, and Reserve Base: Data on world production of primary gallium are unavailable because data on the output of the few producers are considered to be proprietary. However, in 2003, world primary production was estimated to be about 64 metric tons, about the same as that in 2002. China, Germany, Japan, and Russia were the largest producers; countries with smaller output were Hungary, Kazakhstan, Slovakia, and Ukraine. Refined gallium production was estimated to be about 83 metric tons; this figure includes some scrap refining. France was the largest producer of refined gallium, using as feed material crude gallium produced in Germany. Japan and the United States were the other large gallium-refining countries. Gallium was recycled from new scrap in Germany, Japan, the United Kingdom, and the United States.

Gallium occurs in very small concentrations in many rocks and ores of other metals. Most gallium is produced as a byproduct of treating bauxite, and the remainder is produced from zinc-processing residues. Only part of the gallium present in bauxite and zinc ores is recoverable, and the factors controlling the recovery are proprietary. Therefore, an estimate of current reserves that is comparable to the definition of reserves of other minerals cannot be made. The world bauxite reserve base is so large that much of it will not be mined for many decades; hence, most of the gallium in the bauxite reserve base cannot be considered to be available in the short term.

World Resources:³ Assuming that the average content of gallium in bauxite is 50 parts per million (ppm), U.S. bauxite resources, which are mainly subeconomic deposits, contain approximately 15 million kilograms of gallium. About 2 million kilograms of this metal is present in the bauxite deposits in Arkansas. Some domestic zinc ores contain as much as 50 ppm gallium and, as such, could be a significant resource. World resources of gallium in bauxite are estimated to exceed 1 billion kilograms, and a considerable quantity could be present in world zinc reserves. The foregoing estimates apply to total gallium content; only a small percentage of this metal in bauxite and zinc ores is economically recoverable.

Substitutes: Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Researchers are also working to develop organic-base LEDs that may compete with GaAs in the future. Indium phosphide components can be substituted for GaAs-base infrared laser diodes in some specific-wavelength applications, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. GaAs-base integrated circuits are used in many defense-related applications because of their unique properties, and there are no effective substitutes for GaAs in these applications. GaAs in heterojunction bipolar transistors is being challenged in some applications by silicon-germanium.

⁰Estimated. NA Not available. — Zero.

¹Producer published price series was discontinued. The prices shown for 2002-3 are the estimated average values of U.S. imports for 99.9999%- and 99.99999%-pure gallium.

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

³See Appendix C for definitions.