GALLIUM

(Data in kilograms of gallium content unless otherwise noted)

Domestic Production and Use: No domestic primary gallium recovery was reported in 2004. One company in Utah 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) electronic components represented about 98% of domestic gallium consumption. About 41% of the gallium consumed was used in optoelectronic devices, which include light-emitting diodes (LEDs), laser diodes, photodetectors, and solar cells. Integrated circuits represented 40% of gallium demand. The remaining 19% was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial equipment, medical equipment, and telecommunications. Integrated circuits were used in defense applications, high-performance computers, and telecommunications.

Salient Statistics—United States:	**2000**	**2001**	**2002**	**2003**	**2004[e]**
Production, primary	—	—	—	—	—
Imports for consumption	39,400	27,100	13,100	14,300	18,000
Exports	NA	NA	NA	NA	NA
Consumption:					
Reported	39,900	27,700	18,600	20,100	25,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure	640	640	[1]530	[1]411	[1]550
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 reported consumption[e]	99	99	99	99	99

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

Import Sources (2000-03): France, 40%; China, 27%; Russia, 8%; Kazakhstan, 5%; and other, 20%.

Tariff: Item	**Number**	**Normal Trade Relations 12-31-04**
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: Imports of gallium and GaAs continued to supply almost all U.S. demand for gallium and increased from those in 2003 because of a rebound in the wireless communications industry. Using partial-year data, China and Ukraine were the principal U.S. gallium metal suppliers in 2004.

The owner of the gallium recovery plant in Germany and gallium refinery in France filed for Chapter 11 bankruptcy in March, but still continued to operate both facilities. Also in March, the company announced that it would continue to operate its Stade, Germany, plant at one-third of its rated capacity, which has been the operating rate since 2003. The extraction plant has an estimated capacity of 35 metric tons per year. The Kazakhstan gallium producer also closed its 25-ton-per-year plant in March citing a depressed market as the reason for the closure. In China, however, one of the large gallium producers announced that it would reopen its 20-ton-per-year plant in April, although the plant would operate only at about one-quarter of its capacity. The plant had been closed in mid-2003 because of low gallium prices. A purification plant in China, with a capacity of about 15 tons per year, announced that it was increasing production to between 6 and 7 tons in 2004, about three times production in 2003. The company also has the capacity to produce about 5 tons per year of crude gallium (99.99% pure).

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GALLIUM

At the beginning of 2004, the price of 99.99%-pure gallium from China was estimated to be about $250 per kilogram, and 99.9999%-pure material was about $350 per kilogram. By the end of the first quarter, the price of 99.99%-pure gallium had increased to $325 per kilogram, but by midyear, this had declined slightly and stabilized at about $300 per kilogram.

Market analysts were divided on their estimates of the world GaAs market in 2004, with estimates that ranged from $2.9 billion to $3.9 billion. They forecast that cellular telephone applications would remain the leading use for GaAs-base components, but applications such as automotive radar would begin to increase; automotive radar could have potential for double-digit annual growth until 2008.

Companies began introducing products for the commercial market that contain GaN-base laser diodes and LEDs. One Japanese electronics manufacturer introduced a range of televisions that feature GaN-base LED backlights for improved color reproduction, and another launched liquid crystal display monitors that were backlit by GaN-base LEDs. In addition, one of the manufacturers of video-game systems announced that it would use GaN-base laser diodes when it begins production of the next generation of the system.

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 2004, world primary production was estimated to be about 69 metric tons, about the same as that in 2003. China, Germany, Japan, Kazakhstan, and Ukraine were the leading producers; countries with smaller output were Hungary, Russia, and Slovakia. Refined gallium production was estimated to be about 86 metric tons; this figure includes some scrap refining. France was the leading 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. World primary gallium production capacity in 2004 was estimated to be 165 metric tons; refinery capacity, 140 tons; and recycling capacity, 68 tons.

Gallium occurs in very small concentrations in 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 also are 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.

[e]Estimated. NA Not available. — Zero.

[1]Producer published price series was discontinued. The prices shown for 2002-04 are the estimated average values of U.S. imports for 99.9999%- and 99.99999%-pure gallium.

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

[3]See Appendix C for definitions.