

GALLIUM

(Data in kilograms of gallium content unless otherwise noted)

Domestic Production and Use: No domestic primary gallium recovery was reported in 2005. 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. Gallium arsenide (GaAs) and gallium nitride (GaN) electronic components represented about 98% of domestic gallium consumption. About 46% of the gallium consumed was used in integrated circuits. Optoelectronic devices, which include light-emitting diodes (LEDs), laser diodes, photodetectors, and solar cells, represented 36% of gallium demand. The remaining 18% 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:	2001	2002	2003	2004	2005^e
Production, primary	—	—	—	—	—
Imports for consumption	27,100	13,100	14,300	19,400	16,000
Exports	NA	NA	NA	NA	NA
Consumption:					
Reported	27,700	18,600	20,100	21,500	21,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure ¹	² 640	530	411	494	512
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery, number ^e	20	20	20	20	20
Net import reliance ³ 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 (2001-04): China, 39%; France, 19%; Japan, 9%; Russia, 9%; and other, 24%.

Tariff: Item	Number	Normal Trade Relations 12-31-05
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 were slightly lower than those in 2004.

Japan's supply of gallium was expected to increase slightly from 134 metric tons in 2004 to 136 metric tons in 2005. Production was estimated to be 9 metric tons; recycled scrap, 82 metric tons; and imports, 45 metric tons. Included in the imports was 11.5 metric tons of 99%-pure gallium from the Republic of Korea and Taiwan; this is most likely recycled scrap. Imports have been declining since 2001 when an overestimation of demand led to a buildup in stocks. China, with 13 metric tons, was projected to be the largest gallium supplier to Japan. A small (1%) growth in demand for gallium from 2004 to 2005 was expected to be from higher demand for GaAs at the expense of gallium phosphide (GaP). Although LEDs represent 50% of the market for compound semiconductors in Japan, the mix has shifted away from GaP-base LEDs to GaAs-base LEDs.

Gallium prices increased during 2005. At the beginning of the year, 99.99%-pure gallium was estimated to be selling at \$275 to \$325 per kilogram. This price range rose to \$300 to \$350 per kilogram in April. By midyear, the price had risen to about \$400 per kilogram. The high-purity gallium (99.9999% to 99.99999%) price range was estimated to be \$500 to \$600 per kilogram, which had been stable though most of 2005.

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Consolidation of companies continued in GaAs device and LED production sectors. Several large U.S. firms divested themselves of their GaAs device manufacturing operations. In addition, two of the leading LED producers in Taiwan merged to create the largest LED producer in the country. Research in academia, government, and private industry continued to develop GaN production methods that would reduce costs and yield high-quality products.

Market analysts predicted that the world market for semi-insulating GaAs substrates would increase from 14 million square inches in 2004 to 20 million square inches in 2009. Although many companies had planned to switch GaAs substrate production from 4-inch diameter to 6-inch diameter in 2003, 4-inch-diameter material sales still accounted for about 50% of the market in 2005. The cellular telephone market was expected to continue to remain the dominant application for GaAs-base components.

The market for high-brightness LEDs was expected to nearly double from 2004 to 2009. Growth was expected to be in automotive headlamps, backlights for liquid crystal displays and television monitors, and general illumination (the interior and exterior lighting of homes and buildings). High-brightness LEDs, however, were not expected to achieve significant use in general illumination applications until costs are reduced.

World Production, Reserves, and Reserve Base:⁴ 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 2005, world primary production was estimated to be about 63 metric tons, about 5% higher than that in 2004. China, Germany, Japan, and Ukraine were the leading producers; countries with smaller output were Hungary, Russia, and Slovakia. Refined gallium production was estimated to be about 91 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 2005 was estimated to be 160 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: 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.

⁰Estimated. NA Not available. — Zero.

¹Estimated average values of U.S. imports for 99.9999%- and 99.99999%-pure gallium.

²Source: American Metal Market.

³Defined as imports – exports + adjustments for Government and industry stock changes.

⁴[See Appendix C for definitions.](#)