

GALLIUM

(Data in kilograms, gallium content, unless otherwise specified)

Domestic Production and Use: No domestic primary (low-purity, unrefined) gallium has been recovered since 1987. Globally, primary gallium is recovered as a byproduct of processing bauxite and zinc ores. One company in New York recovered and refined high-purity gallium from imported primary low-purity gallium metal and new scrap. In 2024, the value of imports of gallium metal was an estimated \$4 million, and the value of gallium arsenide (GaAs) wafer imports was an estimated \$140 million, increases in value of 33% and 24%, respectively, from those in 2023. GaAs was used to manufacture compound semiconductor wafers used in integrated circuits (ICs) and optoelectronic devices, which include laser diodes, light-emitting diodes (LEDs), photodetectors, and solar cells. Gallium nitride (GaN) was used to manufacture ICs and optoelectronic devices; ICs accounted for 79% of domestic gallium consumption, optoelectronic devices accounted for 20%, and research and development accounted for 1%. About 83% of the gallium consumed in the United States was in GaAs, GaN, and gallium phosphide wafers. Gallium metal, triethyl gallium, and trimethyl gallium, used in the epitaxial layering process to fabricate epiwafers for the production of ICs and LEDs, accounted for most of the remainder. Optoelectronic devices were used in aerospace applications, consumer goods, industrial equipment, medical equipment, and telecommunications equipment. Uses of ICs included defense applications, high-performance computers, and telecommunications equipment.

Salient Statistics—United States:	<u>2020</u>	<u>2021</u>	<u>2022</u>	<u>2023</u>	<u>2024^e</u>
Production, primary	—	—	—	—	—
Imports for consumption:					
Metal	4,430	8,890	11,350	11,400	11,000
Gallium arsenide wafers (gross weight)	208,000	306,000	424,000	163,000	180,000
Exports	NA	NA	NA	NA	NA
Consumption, reported	15,700	17,100	19,700	19,200	19,000
Price, average unit value of imports, dollars per kilogram:					
High-purity, refined ¹	596	625	560	450	500
Low-purity, primary ²	163	254	394	288	220
Stocks, consumer, yearend	2,920	2,810	2,780	2,760	2,700
Net import reliance ³ as a percentage of reported consumption	100	100	100	100	100

Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of GaAs-based devices were reprocessed to recover high-purity gallium at one facility in New York. An Australian company plans to open an industrial electronic scrap recycling plant in the United States with an initial focus on gallium recovery.

Import Sources (2020–23): Metal: Japan, 24%; China, 19%; Germany, 19%; Canada, 17%; and other, 21%.

Tariff:	Item	Number	Normal Trade Relations 12-31-24
	Gallium arsenide wafers, undoped	2853.90.9010	2.8% ad valorem.
	Gallium arsenide wafers, doped	3818.00.0010	Free.
	Gallium metal	8112.92.1000	3% ad valorem.

Depletion Allowance: 14% (domestic and foreign).

Government Stockpile: Not available.

Events, Trends, and Issues: Imports of gallium metal, GaAs wafers, and GaN wafers and domestic production of GaAs and GaN wafers continued to account for all U.S. consumption of gallium. In 2024, gallium metal imports decreased by 4% owing to decreased imports from China, Japan, Russia, and Slovakia. In August 2023, China's Government implemented gallium export controls, requiring licensing procedures to be carried out by China's gallium exporters. After a decrease in exports for the remainder of 2023, China's gallium exports have recovered in 2024 as export licenses have been granted. In December 2024, China banned all exports of gallium to the United States.

Primary low-purity (99.99%-pure) gallium prices in China averaged \$380 per kilogram in June 2024, an increase of 17% from \$325 per kilogram in January 2024, and an increase of 58% from \$240 per kilogram in June 2023. China's gallium prices increased in the first half of 2024 owing to global concern about reduced gallium availability following China's implementation of gallium export controls. The controls required all exports have a committed end which made rebuilding limited stock outside of China difficult. By October, primary low-purity gallium prices in China increased by 11% to \$420 per kilogram as stocks outside of China depleted further.

GALLIUM

China accounted for 99% of worldwide primary low-purity gallium production. The remaining primary low-purity gallium producers outside of China included Japan, the Republic of Korea, and Russia. Germany, Hungary, and Kazakhstan ceased primary production in 2016, 2015, and 2013, respectively. Ukraine most likely ceased primary production in 2022 because of the conflict with Russia. Owing to China's 2023 gallium export controls, the United States and other countries are pursuing the start or restart of domestic primary gallium production. At least one company is exploring the feasibility of producing domestic primary gallium.

World high-purity refined gallium production in 2024 was estimated to be about 320,000 kilograms, unchanged from the estimate for 2023. Canada, China, Japan, Slovakia, and the United States were the known principal producers of high-purity refined gallium. The United Kingdom ceased high-purity refined gallium production in 2018. Gallium was recovered from new scrap in Canada, China, Japan, Slovakia, and the United States. World high-purity refined gallium production capacity was an estimated 340,000 kilograms per year, and secondary high-purity gallium production capacity was an estimated 280,000 kilograms per year.

World Low-Purity Production and Production Capacity:

	Primary production		Production capacity
	2023	2024 ^e	2024
United States	—	—	—
China	⁴ 621,000	⁴ 750,000	1,000,000
Japan ^e	3,000	3,000	10,000
Korea, Republic of ^e	3,000	3,000	16,000
Russia ^e	6,000	6,000	10,000
Other countries ⁵	—	—	^e 88,000
World total (rounded)	633,000	760,000	^e 1,100,000

World Resources:⁶ Gallium occurs in very small concentrations in ores of other metals. Most gallium is produced as a byproduct of processing bauxite, and the remainder is produced from zinc-processing residues. The average gallium content of bauxite is 50 parts per million. U.S. bauxite deposits consist mainly of subeconomic resources that are not generally suitable for alumina production owing to their high silica content. Some domestic zinc ores contain up to 50 parts per million gallium and could be a significant resource, although no gallium is currently recovered from domestic ores. Gallium contained in world resources of bauxite is estimated to exceed 1 million tons, and a considerable quantity could be contained in world zinc resources. However, less than 10% of the gallium in bauxite and zinc resources is potentially recoverable.

Substitutes: Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Silicon-based complementary metal-oxide semiconductor power amplifiers compete with GaAs power amplifiers in midtier third-generation (3G) cellular handsets. Indium phosphide components can be substituted for GaAs-based infrared laser diodes in some specific-wavelength applications, and helium-neon lasers compete with GaAs in visible laser diode applications. Silicon is the principal competitor with GaAs in solar-cell applications. In many defense-related applications, GaAs- and GaN-based ICs are used because of their unique properties, and no effective substitutes exist for GaAs and GaN in these applications. In heterojunction bipolar transistors, GaAs is being replaced in some applications by silicon-germanium.

^eEstimated. NA Not available. — Zero.

¹Estimated based on the average unit values of U.S. imports for 99.999%- and 99.99999%-pure gallium.

²Estimated based on the average unit values of U.S. imports for 99.99%-pure gallium.

³Defined as imports – exports. Excludes gallium arsenide wafers.

⁴Estimated from China Nonferrous Metals Industry Association article. Source: Argus Media Group, Argus Non-Ferrous Markets.

⁵Other countries estimated to still have primary low-purity gallium production capacity include Germany, Hungary, Kazakhstan, and Ukraine.

⁶See Appendix C for resource and reserve definitions and information concerning data sources.