GALLIUM

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

Domestic Production and Use: No domestic primary gallium recovery was reported in 1999. Two companies in Oklahoma and Utah recovered and refined gallium from scrap and impure gallium metal. Imports of gallium, which supplied most of U.S. gallium consumption, were valued at about $11.2 million. Gallium arsenide (GaAs) components represented about 95% of domestic gallium consumption. About 44% of the gallium consumed was used in optoelectronic devices, which include light-emitting diodes (LED's), laser diodes, photodetectors, and solar cells. Integrated circuits represented 55% of gallium demand. The remaining 1% was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as consumer goods, medical equipment, industrial components, telecommunications, and aerospace applications. Integrated circuits were used in defense applications and high-performance computers.

Salient Statistics—United States:	1995	1996	1997	1998	1999[e]
Imports for consumption	18,100	30,000	19,100	26,300	26,000
Exports	NA	NA	NA	NA	NA
Consumption: Reported	16,900	21,900	23,600	26,900	27,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure	425	425	595	595	640
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery, number[e]	20	20	20	20	20
Net import reliance[1] as a percent of apparent consumption	NA	NA	NA	NA	NA

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

Import Sources (1995-98): France, 51%; Russia, 20%; Canada, 8%; Kazakhstan, 7%; and other, 14%.

Tariff: Item	Number	Normal Trade Relations 12/31/99
Gallium metal	8112.91.1000	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.

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Events, Trends, and Issues: The French gallium producer sold its operations in France and Germany to a U.S.-based specialty chemicals manufacturer for an undisclosed sum. These include a 20,000-kilogram-per-year refinery in Salindres, France, and a 20,000-kilogram-per-year production plant in Stade, Germany. Not included in the sale was the gallium recovery facility in Pinjarra, Western Australia, which has been mothballed since 1997. The U.S. firm announced that it would increase gallium production capacity at the Stade plant within the next 1 to 3 years, depending on market growth. A new gallium refinery in Japan began operation in July. The additional facility was expected to double the company's refinery capacity to 100,000 kilograms per year; the new facility will refine the company's impure gallium production, scrap GaAs and gallium phosphide, and imported crude gallium.

Several U.S. GaAs manufacturers either completed plant expansions during the year or announced plans to significantly increase their production capacities within the next 2 years. These expansions primarily are driven by increased demand for wireless communication products, particularly cellular telephone components. Many of the new facilities have been designed to handle 6-inch wafers, the next generation in size, compared to the current industry standard of 4-inch wafers.

Commercial shipments of blue and blue-violet gallium nitride (GaN)-based laser diodes and blue LED's began early in the year from a Japanese firm. Large-scale applications for the blue laser diodes include digital videodisk players, laser printers, and lithography systems, while the blue LED's can be used in full-color displays and serve as a springboard for the development of pure white LED's. In Europe, Japan, and the United States, electronics firms are forming joint ventures to develop and manufacture white LED's for lighting applications. The newly developed GaN technology can be used for making the white LED's.

World Production, Reserves, and Reserve Base: Data on world production of primary gallium were unavailable because data on the output of the few producers were considered to be proprietary. However, in 1999, world primary production was estimated to be about 75,000 kilograms, with Australia, Kazakhstan, and Russia as the largest producers. Countries with smaller output were China, Germany, Hungary, Japan, Slovakia, and Ukraine. Refined gallium production was estimated to be about 65,000 kilograms. France was the largest producer of refined gallium, using as feed material crude gallium produced in Australia. 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 was produced as a byproduct of treating bauxite, and the remainder was produced from zinc-processing residues. Significant reserves of gallium also occur in oxide minerals derived from surficial weathering of zinc-lead-copper ores. Only part of the gallium present in bauxite and zinc ores was recoverable, and the factors controlling the recovery were proprietary. Therefore, a meaningful estimate of current reserves could not 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 can be considered to have only long-term availability.

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 are 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 LED's. Indium phosphide components can be substituted for GaAs-based infrared laser diodes, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. Because of their enhanced properties, GaAs-based integrated circuits are used in place of silicon in many defense-related applications, and there are no effective substitutes for GaAs in these applications.

[e]Estimated. NA Not available.

[1]Defined as imports - exports + adjustments for Government and industry stock changes.