BISMUTH

(Data in metric tons gross weight unless otherwise noted)

Domestic Production and Use: The United States ceased production of primary refined bismuth in 1997 and is highly import dependent for its supply. Bismuth is contained in some lead ores mined domestically. However, the last domestic primary lead smelter closed at yearend 2013; since then all lead concentrates have been exported for smelting.

About two-thirds of domestic bismuth consumption was for chemicals used in cosmetic, industrial, laboratory, and pharmaceutical applications. Bismuth use in pharmaceuticals included bismuth salicylate (the active ingredient in over-the-counter stomach remedies) and other compounds used to treat burns, intestinal disorders, and stomach ulcers. Bismuth is also used in the manufacture of ceramic glazes, crystalware, and pearlescent pigments.

Bismuth has a wide variety of metallurgical applications, including use as an additive to enhance metallurgical quality in the foundry industry and as a nontoxic replacement for lead in brass, free-machining steels, and solders. The use of bismuth in brass for pipe fittings, fixtures, and water meters increased after 2014 when the definition of “lead-free” under the Safe Drinking Water Act was modified to reduce the maximum lead content of “lead free” pipes and plumbing fixtures to 0.25% from 8%. The melting point of bismuth is relatively low at 271 °C, and it is an important component of various fusible alloys, some of which have melting points below that of boiling water. These bismuth-containing alloys can be used in holding devices for grinding optical lenses, as a temporary filler to prevent damage to tubes in bending operations, as a triggering mechanism for fire sprinklers, and in other applications in which a low melting point is ideal. Bismuth-tellurium-oxide alloy film paste is used in the manufacture of semiconductor devices.

Salient Statistics—United States:	**2015**	**2016**	**2017**	**2018**	**2019[e]**
Production:					
Refinery	—	—	—	—	—
Secondary (scrap)[e]	80	80	80	80	80
Imports for consumption, metal, alloys, and scrap	1,950	2,190	2,820	2,510	2,400
Exports, metal, alloys, and scrap	519	431	392	653	580
Consumption:					
Apparent[1]	1,490	1,780	2,520	1,900	1,900
Reported	621	710	756	566	600
Price, average, dollars per pound[2]	6.43	4.53	4.93	4.64	3.40
Stocks, yearend, consumer	456	512	494	533	500
Net import reliance[3] as a percentage of apparent consumption	95	96	97	96	96

Recycling: Bismuth-containing alloy scrap was recycled and thought to compose less than 5% of U.S. bismuth apparent consumption.

Import Sources (2015–18): China, 76%; Belgium, 6%; Mexico, 6%; Republic of Korea, 5%; and other, 7%.

Tariff: Item	**Number**	**Normal Trade Relations 12–31–19**
Bismuth and articles thereof, including waste and scrap	8106.00.0000	Free.

Depletion Allowance: 22% (Domestic), 14% (Foreign).

Government Stockpile: None.

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BISMUTH

Events, Trends, and Issues: Bismuth prices continued a significant downward trend that began in 2014, when the annual average domestic dealer price was $11.14 per pound. Bismuth was one of the metals held in significant quantities by the defunct Fanya Nonferrous Metals Exchange in China, which closed in 2015. In 2019, sales of the exchange's assets began, and though bismuth was not among the limited initial offerings the potential sale was a factor on the price of bismuth throughout the year.

In 2019, a stable bismuth-based perovskite oxide semiconductor was discovered that could potentially be used in thin-film solar technology. The discovery was the product of a National Science Foundation grant for development of high-performance semiconductors that could replace lead-halide perovskites in applications such as perovskite solar cells, the commercial production of which was not feasible because of stability issues as well as the toxicity of the lead-based perovskite material. Additional research to improve the photovoltaic efficiency of the bismuth-based perovskites is needed before their use would be feasible.

World Refinery Production and Reserves: Available information was inadequate to make reliable estimates for mine production and reserves data.

	Refinery production		Reserves[4]
	2018	2019[e]	
United States	—	—	Quantitative estimates of reserves are not available.
Bulgaria	50	50	
Canada	25	25	
China	14,000	14,000	
Japan	571	540	
Kazakhstan	290	270	
Korea, Republic of	900	900	
Laos	3,010	3,000	
Mexico	333	400	
World total (rounded)	19,200	19,000	

World Resources: Bismuth ranks 65th in elemental abundance in the Earth's continental crust, at an estimated 85 parts per billion by weight, constituting much less than 0.001%. World reserves of bismuth are usually estimated based on the bismuth content of lead resources because bismuth production is most often a byproduct of processing lead ores. In China and Vietnam, bismuth production is a byproduct or coproduct of tungsten and other metal ore processing. Bismuth minerals rarely occur in sufficient quantities to be mined as principal products; the Tasna Mine in Bolivia and a mine in China are the only mines where bismuth has been the primary product. The Tasna Mine in Bolivia has been inactive since 1996.

Substitutes: Bismuth compounds can be replaced in pharmaceutical applications by alumina, antibiotics, calcium carbonate, and magnesia. Titanium dioxide-coated mica flakes and fish-scale extracts are substitutes in pigment uses. Cadmium, indium, lead, and tin can partially replace bismuth in low-temperature solders. Resins can replace bismuth alloys for holding metal shapes during machining, and glycerine-filled glass bulbs can replace bismuth alloys in triggering devices for fire sprinklers. Free-machining alloys can contain lead, selenium, or tellurium as a replacement for bismuth. Bismuth is an environmentally friendly substitute for lead in plumbing and many other applications, including fishing weights, hunting ammunition, lubricating greases, and soldering alloys.

[e]Estimated. — Zero.

[1]Defined as secondary production + imports – exports + adjustments for industry stock changes.

[2]Price in 2015 is based on New York dealer price for 99.99%-purity metal in minimum lots of 1 ton; source: Platts Metals Week. Prices in 2016–19 are based on 99.99%-purity metal at warehouse (Rotterdam) in minimum lots of 1 ton; source: American Metal Market (Fastmarkets AMM).

[3]Defined as imports – exports + adjustments for industry stock changes.

[4]See Appendix C for resource and reserve definitions and information concerning data sources.