

ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In 2021, one company recovered zircon (zirconium silicate) from surface-mining operations in Florida and Georgia as a coproduct from the mining of heavy-mineral sands and the processing of titanium and zirconium mineral concentrates, and a second company processed existing mineral sands tailings in Florida. Zirconium metal and hafnium metal were produced from zirconium chemical intermediates by one producer in Oregon and one in Utah. Zirconium and hafnium are typically contained in zircon at a ratio of about 36 to 1. Zirconium chemicals were produced by the metal producer in Oregon and by at least 10 other companies. Ceramics, foundry sand, opacifiers, and refractories are the leading end uses for zircon. Other end uses of zircon include abrasives, chemicals (predominantly, zirconium basic sulfate and zirconium oxychloride octohydrate as intermediate chemicals), metal alloys, and welding rod coatings. The leading consumers of zirconium metal are the chemical process and nuclear energy industries. The leading use of hafnium metal is in superalloys.

Salient Statistics—United States:	2017	2018	2019	2020	2021^e
Production, zirconium ores and concentrates (ZrO ₂ content) ¹	² 50,000	³ 100,000	² 20,000	² 20,000	² 20,000
Imports:					
Zirconium ores and concentrates (ZrO ₂ content) ¹	24,300	26,400	22,600	15,600	18,000
Zirconium, unwrought, powder, and waste and scrap	899	1,880	1,820	2,030	560
Zirconium, wrought	282	282	289	302	250
Hafnium, unwrought, powder, and waste and scrap	113	42	32	16	16
Exports:					
Zirconium ores and concentrates (ZrO ₂ content) ¹	31,500	77,500	40,500	12,200	12,000
Zirconium, unwrought, powder, and waste and scrap	627	556	897	664	550
Zirconium, wrought	972	1,150	816	830	770
Consumption, apparent, ⁴ zirconium ores and concentrates (ZrO ₂ content) ¹	² 50,000	³ 100,000	² 10,000	² 30,000	² 30,000
Price:					
Zircon, dollars per metric ton (gross weight):					
Australia, free on board ⁵	975	NA	NA	NA	NA
China, cost, insurance, and freight ⁶	1,295	1,625	1,585	1,415	1,780
Imported ⁷	916	1,290	1,490	1,380	1,340
Zirconium, unwrought, imports, China, ⁸ dollars per kilogram	12	13	14	6	8
Hafnium, unwrought, ⁶ dollars per kilogram	900	840	780	750	830
Net import reliance ⁹ as a percentage of apparent consumption:					
Zirconium ores and concentrates	E	E	E	<25	<25
Hafnium	NA	NA	NA	NA	NA

Recycling: Companies in Oregon and Utah recycled zirconium from new scrap generated during metal production and fabrication and (or) from post-commercial old scrap. Zircon foundry mold cores and spent or rejected zirconia refractories are often recycled. Hafnium metal recycling was insignificant.

Import Sources (2017–20): Zirconium ores and concentrates: South Africa, 54%; Senegal, 25%; Australia, 19%; Russia, 2%; and other, <1%. Zirconium, unwrought, including powder: China, 89%; Germany, 8%; and other, 3%. Zirconium, wrought: France, 64%; Germany, 18%; Belgium, 5%; and other, 13%. Hafnium, unwrought: Germany, 42%; France, 29%; China, 24%; the United Kingdom, 2%; and other, 3%.

Tariff:	Item	Number	Normal Trade Relations 12–31–21
	Zirconium ores and concentrates	2615.10.0000	Free.
	Ferrozirconium	7202.99.1000	4.2% ad valorem.
	Zirconium, unwrought and powder	8109.20.0000	4.2% ad valorem.
	Zirconium waste and scrap	8109.30.0000	Free.
	Other zirconium articles	8109.90.0000	3.7% ad valorem.
	Hafnium, unwrought, powder, and waste and scrap	8112.92.2000	Free.

Depletion Allowance: 22% (domestic), 14% (foreign).

Government Stockpile: None.

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Events, Trends, and Issues: Global production of zirconium mineral concentrates was essentially unchanged in 2021 compared with that in 2020. Advanced exploration and development projects with planned production of zircon concentrates were ongoing in Australia, Madagascar, Mozambique, Senegal, Tanzania, and elsewhere. In the United States, mining and heavy-mineral-processing operations were expanded near Starke, FL, and prefeasibility studies were underway at the Titan heavy-mineral-sands project near Camden, TN. U.S. exports of zirconium ores and concentrates were essentially unchanged, whereas imports increased by 15% from those in 2020 but remained lower than those in previous years. Australia, Senegal, and South Africa continued to be the leading import sources of zirconium ores and concentrates. The leading global exporters of zirconium mineral concentrates were Australia, Senegal, and South Africa. The leading global importers were China, India, and Spain.

Global producers of zirconium sponge included China, France, India, Russia, and the United States. The leading global exporters of unwrought zirconium metal under Harmonized System Code 8109.20 were China, Germany, and the United States. France and Russia led the global importers of unwrought zirconium.

World Mine Production and Reserves: World primary hafnium production data were not available, and quantitative estimates of hafnium reserves are not available. Zirconium reserves for Australia were revised on the basis of Government reports. Zirconium reserves for Kenya and South Africa were revised on the basis of company reports.

	Zirconium ores and zircon concentrates, mine production (thousand metric tons, gross weight)		Zirconium reserves ¹⁰ (thousand metric tons, ZrO ₂ content) ¹
	2020	2021 ^e	
United States	² 30	² 30	500
Australia	400	400	¹¹ 50,000
China	140	140	500
Indonesia	64	55	NA
Kenya	29	30	50
Mozambique	110	110	1,800
Senegal	60	70	NA
South Africa	280	270	5,900
Other countries	117	110	11,000
World total (rounded)	1,200	1,200	70,000

World Resources:¹⁰ Resources of zircon in the United States included about 14 million tons associated with titanium resources in heavy-mineral-sand deposits. Phosphate rock and sand and gravel deposits could potentially yield substantial amounts of zircon as a byproduct. World resources of hafnium are associated with those of zircon and baddeleyite. Quantitative estimates of hafnium resources were not available.

Substitutes: Chromite and olivine can be used instead of zircon for some foundry applications. Dolomite and spinel refractories can also substitute for zircon in certain high-temperature applications. Niobium (columbium), stainless steel, and tantalum provide limited substitution in nuclear applications, and titanium and synthetic materials may substitute in some chemical processing plant applications. Silver-cadmium-indium control rods are used in lieu of hafnium at numerous nuclear powerplants. Zirconium can be used interchangeably with hafnium in certain superalloys.

^eEstimated. E Net exporter. NA Not available.

¹Calculated ZrO₂ content as 65% of gross production.

²Data are rounded to one significant digit to avoid disclosing company proprietary data.

³Data are rounded to the nearest hundred thousand tons to avoid disclosing company proprietary data.

⁴Defined as production + imports – exports.

⁵Source: Industrial Minerals, average of yearend price. Prices of zircon from Australia were discontinued at yearend 2017.

⁶Source: Argus Media group—Argus Metals International, average of yearend price.

⁷Unit value based on annual United States imports for consumption from Australia, Senegal, and South Africa.

⁸Unit value based on annual United States imports for consumption from China.

⁹Defined as imports – exports.

¹⁰See Appendix C for resource and reserve definitions and information concerning data sources.

¹¹For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 22.1 million tons, gross weight.