

ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise noted)

Domestic Production and Use: In 2022, 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 were 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:	2018	2019	2020	2021	2022^e
Production, zirconium ores and concentrates (ZrO ₂ content) ¹	² 100,000	<100,000	<100,000	<100,000	<100,000
Imports:					
Zirconium ores and concentrates (ZrO ₂ content) ¹	26,400	22,600	15,600	18,500	35,000
Zirconium, unwrought, powder, and waste and scrap	1,880	1,820	2,030	746	290
Zirconium, wrought	282	289	302	265	300
Hafnium, unwrought, powder, and waste and scrap	42	32	16	23	33
Hafnium, wrought	NA	NA	NA	NA	2
Exports:					
Zirconium ores and concentrates (ZrO ₂ content) ¹	77,500	40,500	12,200	10,000	14,000
Zirconium, unwrought, powder, and waste and scrap	556	897	664	589	1,200
Zirconium, wrought	1,150	816	838	966	820
Consumption, apparent, ³ zirconium ores and concentrates (ZrO ₂ content) ¹	² 100,000	<100,000	<100,000	<100,000	<100,000
Price:					
Zirconium, dollars per metric ton (gross weight):					
Premium grade, cost, insurance, and freight, China ⁴	1,948	1,933	1,843	2,025	2,270
Imported ⁵	1,290	1,490	1,380	1,380	1,950
Zirconium, sponge, ex-works China, ⁴ dollars per kilogram	35	33	21	31	29
Hafnium, unwrought, ⁴ dollars per kilogram	838	775	750	950	1,900
Net import reliance ⁶ as a percentage of apparent consumption:					
Zirconium ores and concentrates	E	E	<25	<25	<50
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 limited but could not be quantified.

Import Sources (2018–21): Zirconium ores and concentrates: South Africa, 51%; Senegal, 25%; Australia, 21%; Russia, 2%; and other, 1%. Zirconium, unwrought, including powder: China, 89%; Germany, 8%; France, 1%; Japan, 1%, and other, 1%. Zirconium, wrought: France, 62%; Germany, 19%; Belgium, 6%; Canada, 4%; and other, 9%. Hafnium, unwrought: Germany, 36%; France, 30%; China, 26%; Russia, 3%; and other, 5%.

Tariff:	Item	Number	Normal Trade Relations 12–31–22
	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	8112.31.0000	Free.
	Hafnium, other	8112.39.0000	4% ad valorem.

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

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Government Stockpile: None.

Events, Trends, and Issues: Global mine production of zirconium mineral concentrates increased slightly in 2022 compared with that in 2021. 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 at incorporated mobile mining units. Near Camden, TN, a pilot facility was commissioned at the Titan heavy-mineral-sands project to demonstrate mineral separations. U.S. imports and exports of zirconium ores and concentrates increased significantly in 2022. Australia, Senegal, and South Africa continued to be the leading import sources of zirconium ores and mineral 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 zirconium metal including waste and scrap under the Harmonized System code 8109 were China, France, Germany, South Africa, and the United States. Vietnam and the United States led the global importers of zirconium metal.

World Mine Production and Reserves: World primary hafnium production data were not available, and quantitative estimates of hafnium reserves were not available. Zirconium reserves for Australia, Senegal and "Other countries" were revised based on company and Government reports.

	Zirconium ores and zircon concentrates, mine production ^e (thousand metric tons, gross weight)		Zirconium reserves ⁷ (thousand metric tons, ZrO ₂ content) ¹
	2021	2022	
United States	<100	<100	500
Australia	500	500	⁸ 48,000
China	140	140	500
Indonesia	55	60	NA
Mozambique	100	100	1,800
Senegal	64	70	2,600
South Africa	320	320	5,900
Other countries	150	160	8,500
World total (rounded)	⁹ 1,300	⁹ 1,400	68,000

World Resources:⁷ 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 the nearest hundred thousand tons to avoid disclosing company proprietary data.

³Defined as production + imports – exports.

⁴Source: Argus Media group, Argus Metals International, average of yearend price.

⁵Unit value based on annual United States imports for consumption from Australia, Senegal, and South Africa.

⁶Defined as imports – exports.

⁷See Appendix C for resource and reserve definitions and information concerning data sources.

⁸For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 24 million tons, gross weight.

⁹Excludes U.S. production.