ZIRCONIUM AND HAFNIUM

(Data in metric tons unless otherwise specified)

Domestic Production and Use: In 2024, 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 a second company processed existing mineral sands tailings in California. Abrasive sands, monazite, and titanium mineral concentrates were coproducts of domestic heavy-mineral-sand operations. 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 50 to 1. Zirconium chemicals were produced from domestic and imported materials 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, and other end uses included abrasives, 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:	2020	2021	2022	2023	2024[e]
Production, zirconium ores and concentrates [zirconium oxide (ZrO_2) content]	<100,000	<100,000	<100,000	<100,000	<100,000
Imports:					
Zirconium ores and concentrates (ZrO_2 content)[1]	15,600	18,500	31,900	20,400	19,000
Zirconium, unwrought, powder, and waste and scrap	2,030	746	346	451	580
Zirconium, wrought	302	265	286	314	340
Hafnium, unwrought, including powders	16	23	43	70	50
Hafnium, wrought	NA	NA	2	6	10
Exports:					
Zirconium ores and concentrates (ZrO_2 content)[1, 2]	12,200	10,000	11,200	13,200	16,000
Zirconium, unwrought, powder, and waste and scrap	664	589	1,090	1,090	1,200
Zirconium, wrought	838	966	805	706	750
Hafnium, unwrought, including powders	--	--	15	58	10
Hafnium, wrought	NA	NA	3	3	5
Consumption, apparent,[3] zirconium ores and concentrates (ZrO_2 content)[1]	<100,000	<100,000	<100,000	<100,000	<100,000
Price:					
Zircon, dollars per metric ton (gross weight):					
Premium grade, cost, insurance, and freight, China[4]	1,490	1,580	2,170	2,160	2,000
Imported[5]	1,400	1,450	2,130	1,980	2,100
Zirconium, sponge, ex-works China,[6] dollars per kilogram	25	25	30	28	25
Hafnium, unwrought,[6] dollars per kilogram	778	781	1,590	6,150	4,600
Net import reliance[7] as a percentage of apparent consumption:					
Zirconium ores and concentrates	<25	<25	<50	<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 but could not be quantified. Hafnium metal recycling was limited.

Import Sources (2020–23): Zirconium ores and concentrates: South Africa, 46%; Australia, 35%; Senegal, 16%; and other, 3%. Zirconium, unwrought, including powder: China, 88%; Germany, 7%; and other, 5%. Zirconium, wrought: France, 46%; Germany, 19%; Canada, 16%; Belgium, 5%; and other, 14%. Hafnium, unwrought: Germany, 50%; China, 21%; France, 18%; United Kingdom, 5%; and other, 6%.

Tariff: Item	Number	Normal Trade Relations 12–31–24
Zirconium ores and concentrates	2615.10.0000	Free.
Ferrozirconium	7202.99.1000	4.2% ad valorem.
Zirconium, unwrought and powder	8109.21.0000, 8109.29.0000	4.2% ad valorem.
Zirconium waste and scrap	8109.31.0000, 8109.39.0000	Free.
Other zirconium articles	8109.91.0000, 8109.99.0000	3.7% ad valorem.
Hafnium, unwrought, including powders	8112.31.0000	Free.
Hafnium, other	8112.39.0000	4% ad valorem.

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

Government Stockpile:[8] Fiscal year 2025 potential acquisitions include 2,300 tons of zirconium.

Events, Trends, and Issues: Global mine production of zirconium mineral concentrates increased by 4% to an estimated 1.5 million tons gross weight in 2024. Several companies continued exploration and development projects with planned production of zirconium mineral concentrates in Australia, Mozambique, South Africa, Sri Lanka, Tanzania, and elsewhere. The leading global exporters of zirconium mineral concentrates were Australia and South Africa. China was the leading importer of zirconium mineral concentrates; China's imports included zircon in mixed and separated heavy-mineral concentrates. U.S. imports of zirconium mineral concentrates continued to decrease in 2024, whereas exports increased. Australia, Senegal, and South Africa were still the leading import sources of zirconium mineral concentrates. The United States was a net exporter of zirconium metal. U.S. exports of unwrought hafnium decreased by almost 80% in 2024 after a nearly fourfold increase in 2023, and imports decreased by almost 30%. The leading global exporters of unwrought hafnium were China, Germany, and the Netherlands.

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

	Zirconium mineral concentrates, mine production[e] (thousand metric tons, gross weight)		Zirconium reserves[9] (thousand metric tons, ZrO_2 content)[1]
	2023	2024	
United States	[10]100	[10]100	500
Australia	500	500	[11]55,000
China	100	100	72
Indonesia	95	95	NA
Kenya	[12]20	20	5
Madagascar	34	30	2,100
Mozambique	[12]144	160	1,500
Senegal	[12]48	60	2,600
Sierra Leone	[12]28	20	290
South Africa	[12]289	300	5,300
Other countries	86	110	5,700
World total (rounded)	1,440	1,500	>70,000

World Resources:[8] 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. Boron or cadmium-silver-indium alloys are sometimes used in lieu of hafnium metal in control rods at nuclear powerplants. Zirconium can be used interchangeably with hafnium in certain superalloys.

[e]Estimated. E Net exporter. NA Not available.

[1]Calculated ZrO_2 content as 65% of gross weight.

[2]Excludes zircon in mixed mineral concentrates.

[3]Defined as production + imports – exports.

[4]Source: Fastmarkets IM.

[5]Unit value based on landed-duty-paid United States imports for consumption from Australia, Senegal, and South Africa.

[6]Source: Argus Media Group, Argus Non-Ferrous Markets, annual average.

[7]Defined as imports – exports.

[8]See Appendix B for definitions.

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

[10]Data are rounded to the nearest hundred thousand tons to avoid disclosing company proprietary data.

[11]For Australia, Joint Ore Reserves Committee-compliant or equivalent reserves were 20 million tons, ZrO_2 content.

[12]Reported.