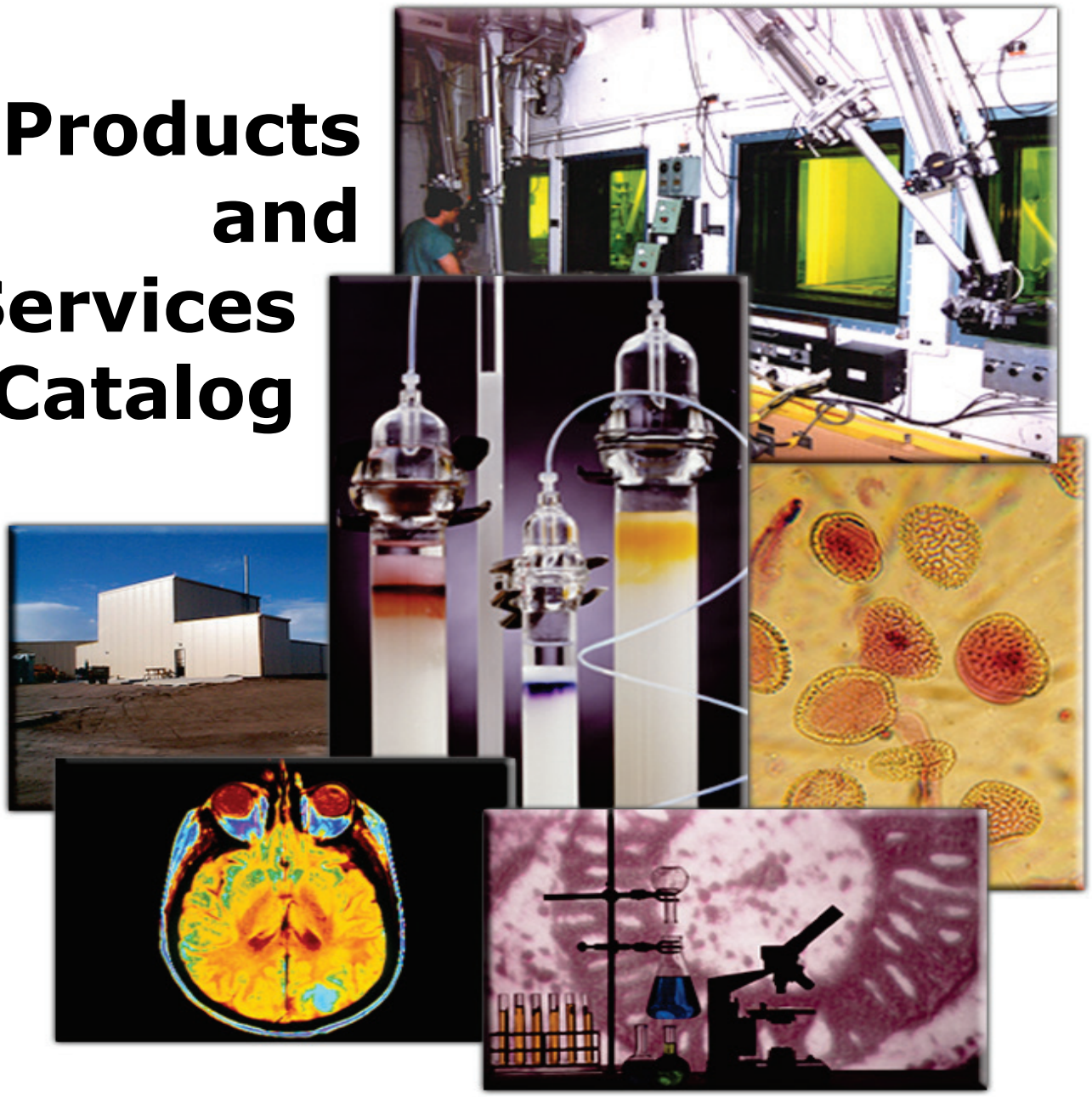
U.S. Department of Energy

Products and Services Catalog



The Department of Energy's (DOE) Isotope Development and Production for Research and Applications Program (IDPRA) is managed by the Office of Nuclear Physics and provides a wide range of isotope products and services to customers worldwide. Continuing a long tradition within the DOE and its predecessor organizations, it is committed to produce and distribute radioisotopes and enriched stable isotopes for research or development purposes, medical diagnoses and therapy, industrial, homeland security, agricultural, and other useful applications that are in the national interest. It is centrally managed from DOE Headquarters in Germantown, Maryland. Currently, DOE is maintaining isotope production facilities at Brookhaven National Laboratory, Idaho National Laboratory, Los Alamos National Laboratory, Pacific Northwest National Laboratory, and Oak Ridge National Laboratory. In addition, the DOE has established the National Isotope Development Center (NIDC) as a virtual service organization which interfaces with the user community and manages the coordination of isotope production across the program facilities. The Isotope Business Office (IBO) manages the business operations involved in the production, sale, and distribution of isotopes. For ordering isotopes or for additional information on isotopes and isotope services, contact the IBO at Oak Ridge National Laboratory. More detailed product information can be found in the online catalog at: www.isotopes.gov

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PRODUCTS that are offered for sale are listed in this catalog. Materials either exist in inventory or can be scheduled to be produced at one or more facilities. Isotopes are sold in forms suitable for incorporation by purchasers into diverse pharmaceuticals, generator kits, irradiation targets, radiation sources, or other finished products. Stable enriched isotopes in stock may be purchased or leased for non-consumptive use.

SERVICES are available based on the DOE's extensive expertise derived from many years of isotope research, development, and production operations. These services include chemical processing, target and source irradiations, research, development and testing capabilities, chemical form conversions, and source encapsulations.

TO ORDER, contact the IBO. Buyers will be required to provide complete but brief documentation. Purchasers can obtain the order forms, instructions, and assistance necessary for a transaction from the IBO at Oak Ridge National Laboratory. Order forms are also available as part of the online catalog. The DOE Headquarters office is available to coordinate among production sites or to receive and direct inquiries.

AVAILABILITY of products and services described in this catalog varies, and DOE distribution of some products may not be feasible at some times. However, the DOE is eager to work with its current and potential customers to establish new means of production and new products as warranted by demand and national need. If specific products and services are not listed, inquiries are welcomed and encouraged.

PRICES, terms and other conditions of purchase are established by the DOE. Price changes may be necessary at any time. However, confirming a purchase order assures that prices stated therein will apply for the term of the order. Estimates of prices can be obtained from the IBO. Firm quotations are developed during the ordering process.

Radioisotopes

Actinium-225
Decay: 10.0 days to bismuth-213, multiple alpha and beta emission to stable ^{209}Bi
Major Radiation: α-8.38 MeV, β^-_{max}-1.42 MeV
Form: dried nitrate, 5.80 x 10^4 Ci/g; carrier free, >98% ^{225}Ac radiopurity
Also available as a Ac-225/Bi-213 generator.

Aluminum-26
Decay: 7.17 x 10^5 years to magnesium-26
Major Radiation: β^+_{max}-1.17 MeV, γ-1,809 keV
Form: aluminum (III) in 1 M HCl, >0.01 µCi/ml, >99% radiopurity

Americium-243
Decay: 7.37 x 10^3 years to neptunium-239
Major Radiation: α-5.27 MeV
Form: oxide powder, 0.2 Ci/g, >99.9% radiopurity

Arsenic-73
Decay: 80.3 days to germanium-73
Major Radiation: γ-53.4 keV
Form: arsenic (V) in <0.1M HCl
Source: by proton in rubidium chloride targets

Bismuth-207
Decay: 32.2 years to lead-207
Major Radiation: γ-1.7702 MeV
Form: bismuth (III) in > 4.0 M HNO_3, > 20 µCi/ml, >99% radiopurity

Cadmium-109
Decay: 462.6 days to silver-109
Major Radiation: γ-88 keV
Form: cadmium (II) in 1 M HCl, >10 mCi/ml, >99.9% radiopurity (excluding Cd-113m)

Californium-252
Decay; 2.645 years to curium-248
Major Radiation: α particles and fission neutrons
Form: solution or custom forms, >80-85 atom % radiopurity

Cobalt-60
Decay: 5.27 years to nickel-60
Major Radiation: β^-_{max}-318 keV, γ-1.333 MeV
Form: nickel-plated pellets (1mm x 1 mm), wire, or cobalt rods, up to 250-300 Ci/g, >99% radiopurity

Copper-67
Decay: 2.580 days to zinc-67
Major Radiation: β^-_{max}-580 keV, γ-184.6 keV
Form: copper (II) in 0.1-1.0 M HCl, >10-20 mCi/ml, >99% radiopurity (excluding Cu-64)

Curium-244
Decay: 18.11 years to plutonium-240
Major Radiation: α-5.81 MeV, fission neutrons
Form: oxide or nitrate, variable radiopurity

Curium-248
Decay: 3.4 x 10^5 years to plutonium-244
Major Radiation: α-5.08 MeV
Form: solid nitrate or chloride, ~97% radiopurity

Germanium-68
Decay: 270.8 days to gallium-68
Major Radiation: β^+_{max}-1899 keV, annihilation γ-511 keV
Form: germanium (IV) in <1.0M HCl

Holmium-166
Decay: 26.8 hours to erbium-166
Major Radiation: γ-80 keV, β^-_{max}- 666 keV
Form: holmium chloride in 0.1 M HCl, >99% radiopurity

Holmium-166m
Decay: 1,200 years, to erbium-166M
Major Radiation: β^-_{max}- 65 keV
Form: oxide, 1 mCi/g; variable radiopurity

Iridium-192
Decay: 73.83 days to platinum-192
Major Radiation: β^-_{max}-672 keV, γ-468 keV
Form: thin wires only

Iron-55
Decay: 2.7 years to magnesium-55
Major Radiation: X-ray-5.89 keV
Form: metal, ~120 Ci/g, variable radiopurity

Nickel-63
Decay: 101 years to copper-63
Major Radiation: β^-_{max}-66.9 keV
Form: chloride solution or dried chloride solid, >10 C/g, >99% radiopurity

Plutonium-238
Decay: 87.7 years to uranium-234
Major Radiation: α-5.49 MeV
Form: oxide powder, 80-97% radiopurity

Plutonium-239
Decay: 24,100 years to uranium-235
Major Radiation: α-5.15 MeV
Form: oxide powder, 99.00-99.99% radiopurity

Plutonium-240
Decay: 6,560 years to uranium-236
Major Radiation: α-5.16 MeV
Form: oxide powder, 75-95% radiopurity

Plutonium-241
Decay: 14.4 years to uranium-237
Major Radiation: α-4.9 MeV
Form: oxide powder, 80-93% radiopurity

Plutonium-242
Decay: 3.76 x 10^5 years to uranium-238
Major Radiation: α-4.9 MeV
Form: oxide powder, >99% radiopurity

Polonium-209
Decay: 102 years to lead-205
Major Radiation: α-4.9 MeV
Form: 5 M nitric acid, ~5µCi/ml, >99% radiopurity (<1% Po-210)

Radium-223
Decay: 11.4 days through decay chain of six short-lived members
Major Radiation: α-5.6 to 5.7 MeV
Form: dry solid, carrier-free, >99.99%

Selenium-75
Decay: 119.78 days to arsenic-75
Major Radiation: γ-279.5 keV
Form: selenium (VI) in 6.0 M HCl, >1.0 mCi/ml, >99% radiopurity (excluding 8.5 day Se-72)

Silicon-32
Decay: ~100 years to phosphorus-32
Major Radiation: β^-_{max}-221 keV
Form: silicates in 0.1 M NaOH, ~11.8 µCi/ml, >99.9% radiopurity

Sodium-22
Decay: 2.605 years to neon-22
Major Radiation: β^+_{max}-546 keV, γ-1274.5 keV
Form: Na (I) in 0.1 M HCl, >10 mCi/ml, >99.9% radiopurity

Strontium-82
Decay: 25.55 days to rubidium-82
Major Radiation: β^+_{max}-511 keV
Form: Strontium chloride in 0.1-0.5 M HCl, >10 mCi/ml, >99% radiopurity (excluding Sr-85)

Strontium-85
Decay: 64.84 days to rubidium-85
Major Radiation: γ-514.0 keV
Form: Strontium (II) in 0.1 M HCl, >1 mCi/ml, >99% radiopurity (excluding <0.5% Sr-82)
Source: by protons in natural molybdenum targets

Technetium-99
Decay: 2.13 x 10^5 years to ruthenium-99
Major Radiation: β^-_{max}-293.6 keV
Form: solid ammonium pertechnetate, typically 17 mCi/g, >99% radiopurity

Thorium-227
Decay: 18.7 days to 11.4 day radium-223
Major Radiation: α-5.7 to 6.0 MeV
Form: dry solid, carrier-free, >99.99%

Thorium-229
Decay: 7.3 x 103 years to radium-225
Major Radiation: α-4.8453 MeV
Form: dried nitrate, α-4.8453 MeV, ~0.213 Ci/g, >99% radiopurity (α pulse activity 36%)

Tin-117m
Decay: 14 days to stable tin-117
Major Radiation: γ-158.56 keV
Form: tin metal in quartz tube of tin (IV) in 0.1 M HCl, 4-8 Ci/g, > 99% radiopurity

Tungsten-188/Rhenium-188 Generator
Decay: W-188 parent, 69 days to rhenium-188; Re-188 daughter, 16.9 hours to osmium-188
Major Radiation: W-188: γ-220 and 290 keV; Re-188: γ-155 keV, β^-_{max}-764 keV
Form: W-188 as tungstic acid absorbed on alumina in glass column; Re-188 eluted as sodium perrhenate with saline solution, 4-5 mCi/mg W-188, 75-85% Re-188/bolus, based on W-188 parent
Also available as a W-188 solution

Uranium-234
Decay: 2.46 x 10^5 years to thorium-230
Major Radiation: α-4.77 MeV
Form: oxide, 6.25 mCi/g, >95% radiopurity

Uranium-235
Decay: 7.04 x 10^8 years to thorium-231
Major Radiation: α-4.39 MeV
Form: oxide, ~2.16 µCi/g, >98% radiopurity

Uranium-238
Decay: 4.47 x 10^9 years to uranium-234
Major Radiation: α-4.20 MeV
Form: oxide, ~0.336 µCi/g, >99.9% radiopurity

Yttrium-88
Decay: 106.6 days to strontium-88
Major Radiation: β^+_{max}-760 keV, γ-1,836 keV
Form: yttrium (III) in 0.1 M HC1, >1.0 mCi/ml, >99% radiopurity

Zinc-65
Decay: 243.8 days to copper-65
Major Radiation: γ-1115.5 keV, β^+_{max}-325 keV
Form: zinc (II) in 0.1-0.5 M HCl, >1 mCi/ml, >99% radiopurity

Zirconium-88
Decay: 84.3 days to yttrium-88
Major Radiation: γ-392.9 keV
Form: Zirconium (IV) in 2.0M HCl >99% radiopurity
Source: by protons in molybdenum targets

Stable Isotopes

The DOE has a large supply of many stable isotopes at various isotopic enrichments. Below is a list of these isotopes, including the isotopic enrichments, standard form and alternate form (in italics). Isotopes are listed alphabetically by common name.

Antimony
Form: metal, *oxide*, *sulfide*

Sb-121	Isotopic enrichment	>99%
Sb-123	Isotopic enrichment	>99%

Argon
Form: gas

Ar-36	Isotopic enrichment	>99.9%
Ar-40	Isotopic enrichment	>99.95%

Barium
Form: carbonate, *nitrate*, *chloride*, *metal, oxide*

Ba-130	Isotopic enrichment	8-37%
Ba-132	Isotopic enrichment	21-28%
Ba-134	Isotopic enrichment	73%
Ba-135	Isotopic enrichment	79-93%
Ba-136	Isotopic enrichment	92-95%
Ba-137	Isotopic enrichment	81-89%
Ba-138	Isotopic enrichment	>97%

Bromine
Form: sodium and ammonium bromide*, bromides of magnesium, potassium, silver*

Br-79	Isotopic enrichment	90-99%
Br-81	Isotopic enrichment	>97%

Cadmium
Form: oxide, *chloride*, *bromide*, *iodide*, *sulfide*, *metal, nitrate, sulfate*

Cd-106	Isotopic enrichment	79-88%
Cd-108	Isotopic enrichment	68-69%
Cd-110	Isotopic enrichment	93-97%
Cd-111	Isotopic enrichment	92-96%
Cd-112	Isotopic enrichment	>97%
Cd-113	Isotopic enrichment	91-95%
Cd-114	Isotopic enrichment	>98%
Cd-116	Isotopic enrichment	93-98%

Calcium
Form: carbonate, *chloride, oxide*, *nitrate*, *metal*, *gluconate, iodide, fluoride*

Ca-40	Isotopic enrichment	>99.8%
Ca-42	Isotopic enrichment	92-94%
Ca-43	Isotopic enrichment	61-83%
Ca-44	Isotopic enrichment	79-98%
Ca-46	Isotopic enrichment	4-30%
Ca-48	Isotopic enrichment	66-97%

Cerium
Form: oxide, *hydrated nitrate*, *metal, chloride*

Ce-136	Isotopic enrichment	21-50%
Ce-138	Isotopic enrichment	17-26%
Ce-140	Isotopic enrichment	>99%
Ce-142	Isotopic enrichment	83-92%

Chlorine
Form: chloride of sodium, *potassium*, *silver*, *barium*, magnesium, or *lead, calcium, ammonium*

Cl-35	Isotopic enrichment	>99%
Cl-37	Isotopic enrichment	95-98%

Chromium
Form: oxide, *metal powder*

Cr-50	Isotopic enrichment	75-97%
Cr-52	Isotopic enrichment	>99.7%
Cr-53	Isotopic enrichment	95-98%
Cr-54	Isotopic enrichment	90-96%

Copper
Form: oxide, *metal powder, metal, nitrate, sulfate, chloride*

Cu-63	Isotopic enrichment	>99.6%
Cu-65	Isotopic enrichment	>99.4%

Dysprosium
Form: oxide, *metal*, *nitrate, chloride*

Dy-156	Isotopic enrichment	20-21%
Dy-158	Isotopic enrichment	20-32%
Dy-160	Isotopic enrichment	69-78%
Dy-161	Isotopic enrichment	90-95%
Dy-162	Isotopic enrichment	92-96%
Dy-163	Isotopic enrichment	89-96%
Dy-164	Isotopic enrichment	92-98%

Erbium
Form: oxide, *metal*, *nitrate, chloride*

Er-162	Isotopic enrichment	27-34%
Er-164	Isotopic enrichment	67-92%
Er-166	Isotopic enrichment	96%
Er-167	Isotopic enrichment	91%
Er-168	Isotopic enrichment	95-97%
Er-170	Isotopic enrichment	95-96%

Europium
Form: oxide, *metal*, *nitrate, chloride*

Eu-151	Isotopic enrichment	91-96%
Eu-153	Isotopic enrichment	98%

Gadolinium
Form: oxide, *metal*, *nitrate, chloride*

Gd-152	Isotopic enrichment	32-42%
Gd-154	Isotopic enrichment Second pass 92.2% (special product)	65-66%
Gd-155	Isotopic enrichment Second pass 99.8% (special product)	84-94%
Gd-156	Isotopic enrichment	82-99%
Gd-157	Isotopic enrichment	79-88%
Gd-158	Isotopic enrichment	81-97%
Gd-160	Isotopic enrichment Second pass 99.9% (special product)	95-98%

Gallium
Form: oxide, *metal*

Ga-69	Isotopic enrichment	>99%
Ga-71	Isotopic enrichment	>99%

Germanium
Form: oxide, *metal*

Ge-70	Isotopic enrichment	84-98%
Ge-72	Isotopic enrichment	90-98%
Ge-73	Isotopic enrichment	83-94%
Ge-74	Isotopic enrichment	94-98%
Ge-76	Isotopic enrichment	73-92%

Hafnium
Form: oxide, *metal*, *crystal bar*

Hf-174	Isotopic enrichment	6-19%
Hf-176	Isotopic enrichment	63-77%
Hf-177	Isotopic enrichment	84-91%
Hf-178	Isotopic enrichment	87-94%
Hf-179	Isotopic enrichment	81-86%
Hf-180	Isotopic enrichment	93-98%

Helium
Form: compressed gas

He-3	Isotopic enrichment	>99.99%

Indium
Form: oxide, *metal*

In-113	Isotopic enrichment	>59-96%
In-115	Isotopic enrichment	>99.9%

Iridium
Form: metal powder

Ir-191	Isotopic enrichment	95-98%
Ir-193	Isotopic enrichment	>98%

Iron
Form: oxide, *metal, nitrate* (+3)*, sulfate* (+2)*, chloride* (+3)

Fe-54	Isotopic enrichment	95-98%
Fe-56	Isotopic enrichment	>99%
Fe-57	Isotopic enrichment	72-92%
Fe-58	Isotopic enrichment	65-82%

Krypton
Form: gas

Kr-78	Isotopic enrichment	8-20%
		50%
		96%
		99%
Kr-80	Isotopic enrichment	71-77%
		90-97 %
Kr-82	Isotopic enrichment	71-77%
		92%
Kr-84	Isotopic enrichment	90-92%
Kr-86	Isotopic enrichment	50-52%
		99-99.99%

Lanthanum
Form: oxide, *nitrate, chloride*

La-138	Isotopic enrichment	6-7%
La-139	Isotopic enrichment	99.99%

Lead
Form: carbonate, *chloride*, *nitrate*, *oxide*, acetate, sulfide, sulfate, *metal pellets*, or *single piece*

Pb-204	Isotopic enrichment	63-99%
Pb-206	Isotopic enrichment	>98%
Pb-207	Isotopic enrichment	92%
Pb-208	Isotopic enrichment	>98%
	Second pass	
	99.9% (special product)	

Lithium
Form: metal, hydroxide monohydrate, *fluoride*, *chloride*, *sulfate*, *carbonate*

Li-6	Isotopic enrichment	95-96%
Li-7	Isotopic enrichment	98-99.9+%

Lutetium
Form: oxide, *metal*, *nitrate, chloride*

Lu-175	Isotopic enrichment	>99.8%
Lu-176*	Isotopic enrichment	44-83%

***NOTE**: Radioactive; half-life 3.73E10 years, theoretical specific activity 5.5E-8 Ci/g.*

Magnesium
Form: oxide, *metal, chloride, sulfate*

Mg-24	Isotopic enrichment	>99.6%
Mg-25	Isotopic enrichment	97-98%
Mg-26	Isotopic enrichment	>98%

Mercury
Form: oxide, *sulfide*, *metal, chloride*

Hg-196	Isotopic enrichment	13-73%
Hg-198	Isotopic enrichment	82-93%
Hg-199	Isotopic enrichment	85-91%
Hg-200	Isotopic enrichment	88-93%
Hg-201	Isotopic enrichment	74-96%
Hg-202	Isotopic enrichment	95-99%
Hg-204	Isotopic enrichment	85-98%

Molybdenum
Form: metal powder, metal, oxide

Mo-92	Isotopic enrichment	90-98%
Mo-94	Isotopic enrichment	82-92%
Mo-95	Isotopic enrichment	89-96%
Mo-96	Isotopic enrichment	91-96%
Mo-97	Isotopic enrichment	83-94%
Mo-98	Isotopic enrichment	95-98%
Mo-100	Isotopic enrichment	91-99%

Neodymium
Form: oxide, *nitrate*, *metal*, *chloride*

Nd-142	Isotopic enrichment	84-98%
Nd-143	Isotopic enrichment	90-91%
Nd-144	Isotopic enrichment	97%
Nd-145	Isotopic enrichment	73-91%
Nd-146	Isotopic enrichment	63-97%
Nd-148	Isotopic enrichment	87-95%
Nd-150	Isotopic enrichment	68-97%

Neon
Form: gas

Ne-22	Isotopic enrichment	71%

Nickel
Form: metal powder, metal, *oxide*, *chloride, carbonate*

Ni-58	Isotopic enrichment	>99.6%
Ni-60	Isotopic enrichment	>98%
Ni-61	Isotopic enrichment	84-99%
Ni-62	Isotopic enrichment	86-96%
Ni-64	Isotopic enrichment	90-99%

Nitrogen
Form: ammonium sulfate

N-15	Isotopic enrichment	67-69%

Osmium
Form: metal, *oxide*

Os-184	Isotopic enrichment	5%
Os-186	Isotopic enrichment	67-79%
Os-187	Isotopic enrichment	34-73%
Os-188	Isotopic enrichment	86-94%
Os-189	Isotopic enrichment	81-95%
Os-190	Isotopic enrichment	95-97%
Os-192	Isotopic enrichment	>98%

Oxygen
Form: water, oxygen gas

O-16	Isotopic enrichment	>99.99%

Palladium
Form: metal, *oxide, chloride*

Pd-102	Isotopic enrichment	73-78%
Pd-104	Isotopic enrichment	86-95%
Pd-105	Isotopic enrichment	90-97%
Pd-106	Isotopic enrichment	96-98%
Pd-108	Isotopic enrichment	96-98%
Pd-110	Isotopic enrichment	97-98%

Platinum
Form: metal sponge, metal powder, metal

Pt-190	Isotopic enrichment	1-4%
Pt-192	Isotopic enrichment	41-56%
Pt-194	Isotopic enrichment	91-96%
Pt-195	Isotopic enrichment	93-97%
Pt-196	Isotopic enrichment	94-97%
Pt-198	Isotopic enrichment	91-95%

Potassium
Form: chloride, *carbonate*, *iodide, nitrate*

K-39	Isotopic enrichment	>99.9%
K-40*	Isotopic enrichment	3.15%
K-41	Isotopic enrichment	>98%

***NOTE**: Radioactive; half-life 1.25E9 years, theoretical specific activity 7.2E-6 Ci/g.*

Rhenium
Form: metal

Re-185	Isotopic enrichment	96%
Re-187*	Isotopic enrichment	96-99%

***NOTE**: Radioactive; half-life 4.5E10 years, theoretical specific activity 4.3E-8 Ci/g.*

Rubidium
Form: chloride, *carbonate*

Rb-85	Isotopic enrichment	>99%
Rb-87*	Isotopic enrichment	97-99%

***NOTE:** Radioactive; half-life 4.89E10 years, theoretical specific activity 8.4E-8 Ci/g.*

Ruthenium
Form: metal powder, *oxide*

Ru-98	Isotopic enrichment	82-89%
Ru-99	Isotopic enrichment	96-97%
Ru-100	Isotopic enrichment	95-97%
Ru-101	Isotopic enrichment	96-97%
Ru-102	Isotopic enrichment	>98%
Ru-104	Isotopic enrichment	>98%

Samarium
Form: oxide, *nitrate*, *metal, chloride*

Sm-144	Isotopic enrichment	85%
Sm-147*	Isotopic enrichment	97-98%
Sm-148	Isotopic enrichment	90-96%
Sm-149	Isotopic enrichment	91-97%
Sm-150	Isotopic enrichment	87-99%
Sm-152	Isotopic enrichment	>97%
Sm-154	Isotopic enrichment	98%

***NOTE:** * Radioactive; half-life 1.06E10 years, theoretical specific activity 2.3E-8 Ci/g.*

Selenium
Form: elemental, *oxide*

Se-74	Isotopic enrichment	55-77%
Se-76	Isotopic enrichment	93-97%
Se-77	Isotopic enrichment	91-94%
Se-78	Isotopic enrichment	97-98%
Se-80	Isotopic enrichment	>99%
Se-82	Isotopic enrichment	87-97%

Silicon
Form: oxide, *elemental powder*, *elemental crystal bar*

Si-28	Isotopic enrichment	>99%
Si-29	Isotopic enrichment	88-95%
Si-30	Isotopic enrichment	83-96%

Silver
Form: metal, *bromide*, chloride, *nitrate*

Ag-107	Isotopic enrichment	>98%
Ag-109	Isotopic enrichment	>97%

Strontium
Form: carbonate, *nitrate*, *metal*, *chloride, oxide*

Sr-84	Isotopic enrichment Second Pass 99.6% (special product)	80-82%
Sr-86	Isotopic enrichment	95-97%
Sr-87	Isotopic enrichment	84-91%
Sr-88	Isotopic enrichment	>99.8%

Sulfur
Form: elemental sulfur hexafluoride, disulfide or powder, sulfides of calcium, iron, potassium, sodium, and zinc

S-32	Isotopic enrichment	>99%
S-33	Isotopic enrichment	17.5%
		88.4%
S-34	Isotopic enrichment	9.8%
		50-52%
		50%
		89-92%
		90-97%
S-36	Isotopic enrichment	1.5-3.5%
		5.9%
		10%
		15-16%
		30%

Tantalum
Form: oxide

Ta-180	Isotopic enrichment	5.7%

Tellurium
Form: elemental, *oxide*

Te-120	Isotopic enrichment	41-56%
Te-122	Isotopic enrichment	94-97%
Te-123	Isotopic enrichment	77-90%
Te-124	Isotopic enrichment	93-98%
Te-125	Isotopic enrichment	93-95%
Te-126	Isotopic enrichment	98%
Te-128	Isotopic enrichment	98-99%
Te-130	Isotopic enrichment	>99%

Thallium
Form: oxide, *metal, chloride, nitrate, sulfide*

Tl-203	Isotopic enrichment	92-97%
Tl-205	Isotopic enrichment	>99%

Tin
Form: oxide, *metal*

Sn-112	Isotopic enrichment	68%
Sn-114	Isotopic enrichment	51-69%
Sn-115	Isotopic enrichment	17-40%
Sn-116	Isotopic enrichment	95-96%
Sn-117	Isotopic enrichment	84-92%
Sn-118	Isotopic enrichment	95-97%
Sn-119	Isotopic enrichment	84-89%
Sn-120	Isotopic enrichment	97-98%
Sn-122	Isotopic enrichment	90-92%
Sn-124	Isotopic enrichment	92-96%

Titanium
Form: oxide, metal, *crystal bar*

Ti-46	Isotopic enrichment	73-96%
Ti-47	Isotopic enrichment	80-94%
Ti-48	Isotopic enrichment	>99%
Ti-49	Isotopic enrichment	66-96%
Ti-50	Isotopic enrichment	67-83%

Tungsten
Form: oxide, *metal powder, ammonium tungstate*

W-180	Isotopic enrichment	6-11%
W-182	Isotopic enrichment	92-94%
W-183	Isotopic enrichment	73-87%
W-184	Isotopic enrichment	93-95%
W-186	Isotopic enrichment	96-99%

Vanadium
Form: oxide

V-50	Isotopic enrichment	36-44%

Xenon
Form: gas

Xe-124	Isotopic enrichment	5-41%
		50-89%
		98.40%
		99.95%
Xe-126	Isotopic enrichment	99%
Xe-129	Isotopic enrichment	88%
Xe-131	Isotopic enrichment	81-87%
Xe-134	Isotopic enrichment	51%
Xe-136	Isotopic enrichment	62-94%

Ytterbium
Form: oxide, *metal*, *nitrate, chloride*

Yb-168	Isotopic enrichment	13-33%
Yb-170	Isotopic enrichment	64-78%
Yb-171	Isotopic enrichment	87-95%
Yb-172	Isotopic enrichment	92-97%
Yb-173	Isotopic enrichment	89-94%
Yb-174	Isotopic enrichment	95-98%
Yb-176	Isotopic enrichment	96-97%

Zinc
Form: oxide, *metal flakes*, *metal, chloride, sulfate, sulfide*

Zn-64	Isotopic enrichment	97-99%
Zn-66	Isotopic enrichment	>98%
Zn-67	Isotopic enrichment	88-94%
Zn-68	Isotopic enrichment	>98%
Zn-70	Isotopic enrichment	65-88%
	Second pass	
	99.7% (special)	

Zirconium
Form: oxide, *crystal bar, metal*

Zr-90	Isotopic enrichment	95-99%
Zr-91	Isotopic enrichment	88-94%
Zr-92	Isotopic enrichment	94-98%
Zr-94	Isotopic enrichment	96-98%
Zr-96	Isotopic enrichment	57-95%

Isotope Services

DOE's isotope production sites offer a wide variety of special custom-order isotope services to complement its radioactive and stable isotope offerings.

Stable Isotope Services

- ***Inorganic compound synthesis and metallurgical, ceramic, and high vacuum processing methods*** are available to process stable isotopes into the desired chemical physical forms to meet customer needs that may be different from the forms listed in the catalog.
- ***Pyrochemical conversion techniques*** (reduction/distillation) to convert rare earth and Group IIA element oxides to high purity metal.
- ***Arc melting casting and alloying*** to prepare metal ingots and to recycle materials, such as foil trimmings and scrap, for further processing and casting shapes.
- ***Hot and cold rolling*** to produce metal foils from the mm to micron range thickness.
- ***Preparation of cold-rolled foils from air-reactive metals*** in micron range thickness.
- ***Wire rolling*** and ***swaging*** processes to prepare metal rods and wires for a variety of applications.
- ***Metal and ceramic powder consolidation*** techniques using cold pressing or cold pressing and sintering to prepare materials. Vacuum hot pressing equipment is available also.
- ***Vanadium-encapsulated neutron dosimeters*** are prepared by sealing very accurately known quantities of well-characterized, enriched stable isotopes or natural elements into small, vanadium capsules for use in making in-core neutron flux measurements.
- ***High vacuum evaporation***-using resistance, radio frequency or electron beam heating techniques is available to prepare thin films and coatings from enriched or natural stable metals, oxides, and other compounds.
- ***Ion beam and plasma sputtering*** equipment is available to produce thin films and coatings from stable, enriched or natural metals, or compounds.
- ***Crystal bar reduction*** process for the preparation of Si, Ti, Zr, and Hf metals is being restored.
- ***Custom targets*** for cyclotrons and accelerators can be fabricated to customer specifications.

Radioisotope Services

- Target Irradiations. Irradiated targets may be supplied to the customer without processing.
- Preparation of custom chemical and physical forms from a variety of radioisotopes may be possible.
- Nuclear Medicine. In addition to Ac-225 and W-188/Re-188 generators, the nuclear medicine staff can provide other radioisotopes and support for development of diagnostic and therapeutic radioisotopes and clinical trials.

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