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INVENTORY AND PRICE LIST
OF
ELECTROMAGNETICALLY ENRICHED
AND
OTHER STABLE ISOTOPES

Stable Isotope Research and Production Division
Keim, Director
April 1956

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UNION CARBIDE NUCLEAR COMPANY
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INVENTORY AND PRICE LIST

of

ELECTROMAGNETICALLY ENRICHED

and

OTHER STABLE ISOTOPES

CF-56-4-93

Photostat Price \$ 4.80

Microfilm Price \$ 2.70

Available from the
Office of Technical Services
Department of Commerce
Washington 25, D. C.

Stable Isotopes Research and Production Division

C. P. Keim, Director

April 1956

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THE INVENTORY

This price list includes all enriched isotopes which are distributed by the Stable Isotopes Research and Production Division, Oak Ridge National Laboratory. As an assistance to the user in his selection of isotopes, the range of isotopic purities for each isotope is listed, as well as the approximate quantity of the isotope ordinarily available, the product forms regularly stocked, and the unit price per milligram. Weights indicated are approximate element weights converted from compound weights by standard gravimetric factors. It is recognized that the use of the standard factors introduces some error, but the adjustment of these factors in accordance with isotopic abundances has been considered as unwarranted in most cases, both in this inventory and for weighing isotopes for shipment.

Since isotopic material is continually being allocated, the quantities listed as available are subject to change; in some instances, complete depletion is inevitable. However, in those cases, orders will be filled when new separations have been made.

All questions related to this inventory and to the information shown, as well as to that not shown in this inventory, such as complete isotopic-analysis data, spectrochemical-analysis data, the availability of product forms other than those shown, etc., should be directed to the supplier. The official address is given later under "Address of the Supplier."

PROCUREMENT AND SHIPPING INFORMATION

Stable Isotopes Are For Sale Or, In Some Cases, For Loan. - Isotopes listed in this catalog are for sale although the occasional loan of rare and expensive isotopes to domestic users will be considered.

Loan Conditions - The following are the conditions under which the Atomic Energy Commission has authorized loans of electromagnetically enriched isotopes:

- a. Loans will be made for research purposes only.
- b. Loans will be authorized only for "rare and expensive items."

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c. Isotopes not available for loan but only for sale are:

Ba-138	All enrichments
B-10	All enrichments
B-11	Any enrichment less than 90%
Cd-113	Any enrichment less than 26%
Cd-116	Any enrichment less than 25%
Ca-40	Any enrichment less than 99%
Cr-52	Any enrichment less than 97%
Hf-174	Any enrichment less than 0.5%
Hf-176	Any enrichment less than 11%
Hf-178	Any enrichment less than 35%
Hf-180	Any enrichment less than 50%
Fe-56	All enrichments
Pb-204	Any enrichment less than 0.6%
Li-6	All enrichments
Nd-142	Any enrichment less than 57%
Ni-58	All enrichments
Sn-116	Any enrichment less than 60%
Sn-118	Any enrichment less than 45%
Sn-120	All enrichments
Ti-48	Any enrichment less than 98%

d. All loans will be made to institutions and not to individuals.

e. The following are the criteria for making loans:

1. The loan must be deemed justifiable on the basis of the proposed research use and the qualifications of the individual and institution concerned. The proposed research must be of such a nature that there is little, if any, likelihood that the material will be destroyed, lost, or diluted.
2. The borrower must agree not to dilute or contaminate the loaned material during use and to return the loaned material in such form as to permit replacing the item in stock without chemical reworking. The borrower must also agree to be financially responsible for any fractional or complete loss incurred while the loaned item is in his possession.
3. The prospective loanee will negotiate a suitable loan period which should be sufficiently long to enable the completion of the proposed research and may include a reasonable contingency factor.

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f. The following charges are authorized for stable isotope loans and should be agreed to by the borrower in the loan arrangements.

1. A handling charge of \$78.00 will be billed at time of shipment, which includes a \$14.00 outgoing handling charge, a \$14.00 incoming handling charge, a \$25.00 incoming spectrographic analysis fee, and a \$25.00 incoming mass analysis fee. The two handling charges will include payment of shipping costs. Any one of the above services not actually performed will be refunded to the customer.
2. A use charge of four per cent per annum of the sales value of the item loaned will be billed by the supplier at time of shipment.
3. If an item out on loan has not been returned at the expiration date of the negotiated loan period, the loanee will be billed the full sales value of the loan and the matter will henceforth be treated as an ordinary sale. This does not preclude an extension of the original loan period prior to its expiration.

Procedures for Procuring Stable Isotopes - All users of the isotopes listed in this catalog may procure stable isotopes directly from the supplier without prior approval by the Atomic Energy Commission. All requests will be processed in the order in which they are received. Address all correspondence as directed under "Address of the Supplier."

Domestic Users - Atomic Energy Commission and other government laboratories should submit completed Form AEC-375 with the purchase order to the supplier at Oak Ridge National Laboratory. The user must submit two copies of the completed Form AEC-375 for each isotope requested. The user must indicate whether he is requesting the transaction to be on a sale or loan basis, although the final decision must be made by the supplier. A complete description of the proposed use must accompany the request for loan and the minimum usable quantity and enrichment should be requested.

All non-government laboratories should submit two completed Forms AEC-391 with the purchase order to the supplier; otherwise the procedures are the same as for government laboratories.

Foreign Users - Laboratories outside the United States may receive isotopes only on a sale basis. Two completed Forms AEC-391 must be submitted for each isotope requested. This completed form and the purchase order should be sent directly to the supplier at Oak Ridge National Laboratory. No export license is required.

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Packaging and Shipping - Stable isotopes are prepared for shipment on Thursday of each week.

How Shipped - All domestic shipments of stable isotopes are by registered mail, return receipt requested, unless air mail is requested. All foreign shipments are by air parcel post.

Sales Prices - The unit sales price of each isotope is listed for the form in which it is regularly stocked. The unit price is the price per milligram of contained element in the chemical form listed and includes all production and analysis costs. Total sales prices can be computed from these unit prices.

In addition to the sales price of each isotope, an additional charge of \$14.00 for each isotope ordered must be made to cover packaging, shipping, and clerical costs.

Isotope Request Forms - A supply of Forms AEC-375 (for all Federal agencies) or AEC-391 (for other than Federal agencies and for foreign users) will be sent by the supplier on request.

Mass and Chemical Analyses - A mass analysis and a spectrochemical analysis of the isotope production lot will be included with each shipment. Individual mass analysis data and spectrochemical data on a particular shipment can be obtained on special order. Questions about the data supplied or requests for additional analytical service of either kind should be addressed to the supplier. Estimates of the costs for services not available through the usual commercial channels will be furnished upon request.

Targets and Special Services - All isotopes will be shipped in the product form listed in this catalog unless special arrangements are made with the supplier for additional chemical processing or fabrication. A number of target shapes can now be provided and others could be made available. An estimate of the cost of additional services will be furnished by the supplier when requested. Standard solutions of specific isotopes for isotope dilution analysis will be available for purchase if sufficient demands develop.

The user is invited to contact the supplier regarding the latest detailed information concerning particular enriched stable isotopes, including their complete isotopic and chemical analyses. The supplier is also ready to assist in technical problems relative to using stable isotopes.

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Address of the Supplier - All correspondence and all returned isotopes should be to the following addressee:

Dr. C. P. Keim
Director, Stable Isotopes
Research and Production Division
Oak Ridge National Laboratory
Post Office Box Y
Oak Ridge, Tennessee

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UNIT PRICES OF ELECTROMAGNETICALLY-ENRICHED ISOTOPES

CF-56-4-93

Isotopes are listed by a class designation which indicates typical quantities which usually are available. Owing to prior allocations, however, the amounts on hand at any particular time may be considerably less than the maximum amount indicated for the class.

Class	I	Less than 50 milligrams.
Class	II	More than 50 milligrams, less than 100 milligrams.
Class	III	More than 100 milligrams, less than one gram.
Class	IV	More than one gram.

Numbers in parentheses refer to sources of abundance data. See Bibliography at end of catalog.

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Antimony (Sb) (32)					
121	57.25	97.7-99.4	\$ 6.25-6.75	Sb	II
123	42.75	95.6-96.7	4.40-4.75	Sb	II
Argon (A) (24)	Not yet available.				
Barium (Ba) (22)					
130	0.101	16.0-27.5	28.00-84.00	BaCO ₃	I
132	0.097	6.7-12.0	7.25-23.25	BaCO ₃	I
134	2.42	15.4-50.8	0.35-4.75	BaCO ₃	III
135	6.59	58.2-67.3	1.50-2.00	BaCO ₃	III
136	7.81	39.2-50.0	0.65-1.20	BaCO ₃	III
137	11.32	39.0-43.6	0.60-0.80	BaCO ₃	III
138	71.66	96.7-98.0	0.20-0.25	BaCO ₃	IV

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Boron (B)					
(30)					
10	See Appendix I to this Price List.				
11	81.02	89.0-97.8	\$ 0.05-16.50	BF ₃ ·CaF ₂ , B	IV
Bromine (Br)					
(33)					
79	50.52	87.0	26.00	KBr, AgBr	I
81	49.48	91.4-96.8	16.50-21.00	KBr, AgBr	I
Cadmium (Cd)					
(18)					
106	1.22	19.9-32.9	2.75-8.00	CdO	I
108	0.87	14.2-24.8	2.20-7.00	CdO	I
110	12.39	55.8-70.0	0.60-1.00	CdO	III
111	12.75	53.3-64.5	0.60-0.95	CdO	III
112	24.07	79.3-83.3	0.50-0.55	CdO	III
113	12.26	25.5-54.1	0.10-0.70	CdO	III
114	28.86	79.5-94.2	0.35-0.55	CdO	III
116	7.58	24.0-71.2	0.15-2.30	CdO	II
Calcium (Ca)					
(21)					
40	96.97	98.6-99.9	0.10-0.30	CaCO ₃	IV
42	0.64	28.3-82.5	5.75-50.00	CaCO ₃	I
43	0.15	37.6-72.1	23.00-88.00	CaCO ₃	I
44	2.06	85.4-98.0	7.00-9.00	CaCO ₃	II
46	0.003	0.7-10.2	2.90-703.00	CaCO ₃	I
48	0.18	7.5-75.5	1.10-114.00	CaCO ₃	I

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichment (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Carbon (C)					
(24)					
12	98.89	99.9-99.96	\$ 4.00-4.50	C	III
13	1.11	69.0	260.00	C	I
Cerium (Ce)					
(8)					
136	0.19	4.7-30.0	2.30-62.25	CeO ₂	I
138	0.25	4.4-13.1	2.20-20.50	CeO ₂	II
140	88.48	98.5-99.7	0.45-0.55	CeO ₂	IV
142	11.07	83.4-90.1	2.60-3.10	CeO ₂	III
Chlorine (Cl)					
(26)					
35	75.4	89.7-95.7	0.35-0.65	NaCl, AgCl	IV
37	24.6	60.5-66.3	1.10-1.50	NaCl, AgCl	III
Chromium (Cr)					
(32)					
50	4.31	41.2-94.5	1.10-6.25	Cr ₂ O ₃	III
52	83.76	96.3-99.1	0.20-0.30	Cr ₂ O ₃	IV
53	9.55	82.4-96.5	1.70-2.40	Cr ₂ O ₃	III
54	2.38	61.0-89.0	4.00-9.00	Cr ₂ O ₃	III
Copper (Cu)					
(1)					
63	69.1	96.0-99.7	0.35-0.45	CuO	III
65	30.9	90.6-98.2	0.70-0.85	CuO	IV
Dysprosium (Dy) Not yet available.					
(9) (10)					

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Erbium (Er) (2)	Not yet available.				
Europium (Eu) (3) (17)					
151	47.77	78.7-91.9	\$ 0.55-1.10	Eu ₂ O ₃	IV
153	52.23	86.5-95.0	0.50-1.00	Eu ₂ O ₃	IV
Gadolinium (Gd) (3) (17)					
152	0.20	15.0	21.25	Gd ₂ O ₃	I
154	2.15	33.2	4.80	Gd ₂ O ₃	II
155	14.73	72.3	1.10	Gd ₂ O ₃	III
156	20.47	80.2	0.70	Gd ₂ O ₃	IV
157	15.68	69.7	0.85	Gd ₂ O ₃	III
158	24.87	92.9	1.25	Gd ₂ O ₃	III
160	21.90	95.4	1.10	Gd ₂ O ₃	III
Gallium (Ga) (14)					
69	60.2	98.4	0.75	Ga ₂ O ₃	IV
71	39.8	98.1	1.30	Ga ₂ O ₃	III
Germanium (Ge) (9)					
70	20.55	88.1-91.4	0.60-0.65	GeO ₂	IV
72	27.37	89.2-94.9	0.40-0.45	GeO ₂	IV
73	7.61	68.9-78.0	1.50-2.00	GeO ₂	III
74	36.74	95.2-95.8	0.40	GeO ₂	IV
76	7.67	79.3-81.0	1.30-1.40	GeO ₂	III

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Hafnium (Hf)					
(6)					
174	0.18	7.8-10.1	\$16.00-26.00	HfO ₂	I
176	5.15	10.3-59.5	0.10-7.00	HfO ₂	II
177	18.39	59.1-62.2	2.30-2.70	HfO ₂	III
178	27.08	33.0-84.8	0.05-2.00	HfO ₂	III
179	13.78	31.1-53.3	0.75-3.90	HfO ₂	III
180	35.44	49.6-93.3	0.10-1.60	HfO ₂	III
Helium (He)					
	Contact Radioisotopes Sales Department, Oak Ridge National Laboratory.				
Hydrogen (H)					
	Contact commercial suppliers.				
Indium (In)					
(32)					
113	4.23	14.2-65.4	0.45-16.75	In ₂ O ₃	II
115	95.77	99.6-99.9	0.50-0.60	In ₂ O ₃	IV
Iridium (Ir)					
(27)					
191	37.3	85.9	25.00	Ir	II
193	62.7	89.1	21.00	Ir	II
Iron (Fe)					
(31)					
54	5.84	34.5-96.7	0.40-3.75	Fe ₂ O ₃	III
56	91.68	98.3-99.6	0.05-0.15	Fe ₂ O ₃	IV
57	2.17	31.9-87.3	1.10-8.50	Fe ₂ O ₃	III
58	0.31	10.3-81.5	0.85-55.00	Fe ₂ O ₃	II

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Krypton (Kr) (25)	Not yet available.				
Lanthanum (La) (8)					
138	0.09	0.6- 1.7	\$ 3.10-32.25	La ₂ O ₃	III
139	99.91	99.96-99.995	0.35-1.00	La ₂ O ₃	IV
Lead (Pb) (23)					
204	1.48	5.3-27.0	0.15-4.60	PbO, PbCrO ₄	III
206	23.6	35.0-81.0	0.45-1.80	PbO, PbCrO ₄	III
207	22.6	26.8-66.8	0.30-1.75	PbO, PbCrO ₄	III
208	52.3	75.4-96.6	0.25-0.95	PbO, PbCrO ₄	IV
Lithium (Li) (13)					
6	7.52	90.0-99.3	0.02-0.03	Li, Li ₂ SO ₄	IV
7	92.48	98.4-99.9	0.15-0.30	Li ₂ SO ₄	IV
Lutetium (Lu) (2)	Not yet available.				
Magnesium (Mg) (32)					
24	78.60	98.4-99.6	0.80-0.90	MgO	III
25	10.11	32.8-92.3	0.30-3.75	MgO	III
26	11.29	95.9-98.1	4.00-4.25	MgO	III

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Mercury (Hg)					
(25)					
196	0.15	1.5- 8.4	\$15.00-480.00	Hg(NO ₃) ₂	I
198	10.02	53.4-79.1	4.10-10.50	Hg(NO ₃) ₂	III
199	16.84	62.5-73.1	12.00-18.25	Hg(NO ₃) ₂	I
200	23.13	64.7-91.4	2.30-6.25	Hg(NO ₃) ₂	III
201	13.22	51.5-71.8	13.25-31.00	Hg(NO ₃) ₂	I
202	29.80	75.8-98.3	2.10-4.60	Hg(NO ₃) ₂	III
204	6.85	30.1-89.2	1.50-18.25	Hg(NO ₃) ₂	II
Molybdenum (Mo)					
(33)					
92	15.86	87.6-95.5	1.10-1.40	MoO ₃	III
94	9.12	74.7-84.9	1.75-2.30	MoO ₃	II
95	15.70	80.8-91.3	0.90-1.25	MoO ₃	III
96	16.50	85.9-92.0	0.75-0.90	MoO ₃	III
97	9.45	73.5-89.6	1.10-1.70	MoO ₃	III
98	23.75	89.9-96.3	0.75-0.95	MoO ₃	III
100	9.62	86.7-90.2	1.50-1.75	MoO ₃	II
Neodymium (Nd)					
(13)					
142	27.13	56.6-93.0	0.15-0.60	Nd ₂ O ₃	IV
143	12.20	49.7-83.9	0.65-2.40	Nd ₂ O ₃	IV
144	23.87	62.6-95.7	0.25-0.80	Nd ₂ O ₃	IV
145	8.30	70.0-78.6	1.40-1.80	Nd ₂ O ₃	III
146	17.18	86.9-95.6	0.95-1.20	Nd ₂ O ₃	IV
148	5.72	64.3-89.9	2.10-4.30	Nd ₂ O ₃	III
150	5.60	83.6-94.8	4.25-5.50	Nd ₂ O ₃	III

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Neon (Ne) (25)	Not yet available.				
Nickel (Ni) (32)					
58	67.76	98.4-99.9	\$ 0.15-0.20	N10	IV
60	26.16	87.1-99.1	0.30-0.50	N10	IV
61	1.25	34.4-83.1	1.90-11.75	N10	II
62	3.66	68.0-96.8	1.25-3.00	N10	III
64	1.16	64.2-97.4	7.25-17.00	N10	II
Nitrogen (N) (24)	Contact commercial suppliers.				
Osmium (Os) (20)	Not yet available.				
Oxygen (O) (24)	Contact commercial suppliers.				
Palladium (Pd) (29)					
102	0.96	35.2	18.25	Pd	I
104	10.97	63.2	3.60	Pd	II
105	22.23	78.2	5.75	Pd	II
106	27.33	82.3	2.25	Pd	III
108	26.71	94.2	1.75	Pd	III
110	11.81	91.4	3.75	Pd	II

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Platinum (Pt) (15)					
190	0.01	0.8	\$ 32.00	Pt	I
192	0.78	7.6-13.9	5.75-21.00	Pt	II
194	32.8	65.1	0.95	Pt	IV
195	33.7	60.1	3.50	Pt	III
196	25.4	65.9	1.60	Pt	III
198	7.23	58.3-61.0	7.00-7.75	Pt	II
Potassium (K) (24)					
39	93.08	99.5-99.9	0.90-1.10	KCl, KClO ₄	IV
40	0.012	6.2	485.00	KCl	II
41	6.91	86.8-99.2	10.00-13.50	KCl, KClO ₄	II
Rhenium (Re) (32)					
185	37.07	85.4	1.40	Re	III
187	62.93	98.2	1.70	Re	III
Rubidium (Rb) (25)					
85	72.15	96.0-99.1	0.85-1.10	RbCl	IV
87	27.85	89.6-95.9	3.50-4.25	RbCl	III
Ruthenium (Ru) (28)					
96	5.47	74.1-95.5	12.25-18.00	Ru	I
98	1.84	34.2-65.5	12.50-48.00	Ru	I
99	12.77	86.9-91.2	13.00-14.50	Ru	I
100	12.56	73.0-88.9	10.00-16.00	Ru	I
101	17.10	91.1	8.50	Ru	I
102	31.20	94.2	2.50-2.75	Ru	I
104	18.56	95.1-98.2	4.25-4.50	Ru	II

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Samarium (Sm) (12)					
144	3.16	58.9-81.5	\$ 2.40-7.75	Sm ₂ O ₃	II
147	15.07	78.4-85.1	1.15-1.40	Sm ₂ O ₃	III
148	11.27	62.4-76.0	0.90-1.50	Sm ₂ O ₃	III
149	13.84	71.5-81.5	0.90-1.25	Sm ₂ O ₃	III
150	7.47	64.8-74.1	1.50-2.10	Sm ₂ O ₃	III
152	26.63	89.9-93.9	0.40-0.45	Sm ₂ O ₃	IV
154	22.53	92.1-99.1	0.55-0.70	Sm ₂ O ₃	III
Selenium (Se) (32)					
74	0.87	6.5-18.0	2.50-23.00	Se	I
76	9.02	41.5-88.5	1.50-9.00	Se	III
77	7.58	49.4-91.7	2.75-10.75	Se	II
78	23.52	72.3-96.6	1.30-3.00	Se	III
80	49.82	86.7-98.4	0.90-1.60	Se	III
82	9.19	44.4-89.9	2.40-12.25	Se	II
Silicon (Si) (33)					
28	92.27	98.1-99.4	0.75-1.10	SiO ₂	IV
29	4.68	63.6-81.2	10.00-16.75	SiO ₂	II
30	3.05	49.6-72.6	12.25-27.00	SiO ₂	I
Silver (Ag) (32)					
107	51.35	89.0-96.1	1.60-2.25	Ag, AgCl	III
109	48.65	92.2-99.5	1.00-1.40	Ag, AgCl	III

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Strontium (Sr) (22)					
84	0.56	27.2-63.7	\$ 6.75-37.50	SrO, SrCO ₃ , Sr(NO ₃) ₂	I
86	9.86	69.9-89.0	1.90-3.25	SrO, SrCO ₃ , Sr(NO ₃) ₂	III
87	7.02	42.8-73.1	1.25-4.25	SrO, SrCO ₃ , Sr(NO ₃) ₂	III
88	82.56	98.9-99.7	0.55-0.60	SrO, SrCO ₃ , Sr(NO ₃) ₂	IV
Sulfur (S) (21)					
32	95.06	97.9-99.7	1.70-2.50	S, CdS	III
33	0.75	5.5-22.1	1.90-38.50	S, CdS	II
34	4.18	5.4-37.2	0.02-13.25	S, CdS	II
36	0.016	0.3- 2.4	9.00-600.00	CdS	I
Tantalum (Ta)					
180	0.0001	0.0018-0.0025	6.25-12.50	Ta ₂ O ₅	II
Tellurium (Te) (32) (33)					
120	0.09	11.5-22.3	25.50-95.00	Te	I
122	2.46	77.8-86.3	10.25-12.75	Te	I
123	0.87	34.9-60.9	8.00-25.00	Te	I
124	4.61	21.8-83.9	0.25-5.25	Te	II
125	6.99	40.5-87.9	0.60-3.50	Te	III
126	18.71	79.0-95.4	0.70-1.10	Te	III
128	31.79	82.3-96.5	0.45-0.75	Te	III
130	34.49	78.2-97.8	0.40-0.80	Te	III

<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Thallium (Tl)					
(6) (32)					
203	29.50	34.1-86.0	\$ 0.35-52.00	Tl ₂ O ₃	III
205	70.50	86.1-98.7	1.40-4.60	Tl ₂ O ₃	III
Tin (Sn)					
(6) (7) (32)					
112	0.95	30.8-72.5	4.25-24.50	Sn, SnO ₂	I
114	0.65	19.2-50.0	5.00-34.50	Sn, SnO ₂	I
115	0.34	4.5-17.6	1.00-18.25	Sn, SnO ₂	I
116	14.24	43.2-92.6	0.10-0.70	Sn, SnO ₂	III
117	7.57	61.8-83.8	0.60-1.40	Sn, SnO ₂	III
118	24.01	69.3-96.2	0.15-0.35	Sn, SnO ₂	IV
119	8.58	64.4-83.5	0.40-0.70	Sn, SnO ₂	IV
120	32.97	53.6-98.2	0.05-0.20	Sn, SnO ₂	IV
122	4.71	42.9-88.9	0.40-2.00	Sn, SnO ₂	III
124	5.98	52.0-95.0	0.55-2.10	Sn, SnO ₂	III
Titanium (Ti)					
(21)					
46	7.95	82.7-84.4	2.20-2.30	TiO ₂	III
47	7.75	63.1-82.8	0.80-1.50	TiO ₂	III
48	73.45	96.8-99.2	0.20-0.25	TiO ₂	IV
49	5.51	27.5-79.4	0.35-3.75	TiO ₂	III
50	5.34	71.4-84.7	2.10-3.10	TiO ₂	III

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<u>Isotope</u>	<u>Per cent Natural Abundance</u>	<u>Range of Enrichments (Isotope %)</u>	<u>Cost per mg. of Element</u>	<u>Usual Form</u>	<u>Class</u>
Tungsten (W) (33)					
180	0.14	5.0- 9.0	\$ 51.00-175.00	WO ₃	I
182	26.4	91.6-94.3	1.10-1.20	WO ₃	IV
183	14.4	82.0-86.2	1.40-1.60	WO ₃	III
184	30.6	91.1-95.7	0.85-1.00	WO ₃	III
186	28.4	97.2-97.9	1.00	WO ₃	IV
Xenon (Xe) (25)					
Not yet available.					
Ytterbium (Yb) (17)					
Not yet available.					
Vanadium (V) (4) (16)					
50	0.24	22.8	65.00	V ₂ O ₅	I
51	99.76	99.95-99.98	0.55-0.70	V ₂ O ₅	IV
Zinc (Zn) (5)					
64	48.89	83.8-93.1	0.40-0.65	ZnO	III
66	27.82	76.1-93.8	0.50-0.90	ZnO	III
67	4.14	56.0-62.6	2.40-3.00	ZnO	III
68	18.54	72.6-95.5	0.45-0.85	ZnO	III
70	0.62	32.0-48.4	4.50-10.50	ZnO	I
Zirconium (Zr) (32)					
90	51.46	91.7-98.7	0.45-0.65	ZrO ₂	IV
91	11.23	54.4-88.0	0.75-2.25	ZrO ₂	III
92	17.11	85.6-95.8	1.40-1.80	ZrO ₂	III
94	17.40	80.9-97.9	1.20-1.90	ZrO ₂	III
96	2.80	43.6-89.5	3.75-16.25	ZrO ₂	I

APPENDIX I

BORON-10 - TRIFLUORIDE COMPLEX

Item: SS 1(b) - Trifluoride Complex ($B^{10}F_3 \cdot CaF_2$)

Price: \$2.00 per gram of complex

The B^{10} complex contains 6.9% elemental boron. Of the boron present, 96% is B^{10} , corresponding to an enrichment of about 4.8 times normal.

Approximately 6.5 g of $BF_3 \cdot CaF_2$ is needed to obtain 1 liter of BF_3 at STP (assuming 100% liberation). The boron trifluoride may easily be released as a gas by heating to temperatures above $260^\circ C$ in a vacuum. Organic vapors and air released from the complex during heating will be present in the BF_3 and will have to be removed when material is being processed for use in neutron counters.

The B^{10} complex is packaged in quantities of 1 g or more.

BORON-10 - BORIC ACID

Item: SS 1(ac) - Boric Acid ($H_3B^{10}O_3$)

Price: \$7.50 per gram of H_3BO_3

The boric acid contains 16.5% boron. Of the boron, approximately 96% is B^{10} .

BORON-10 - ELEMENTAL BORON

Item: SS 1(a) - Elemental B^{10}

Price: \$15.00 per gram for the first 49 grams and \$7.00 per gram over 49 grams.

Elemental B^{10} is in the form of a powder with a particle size of the order of 200 mesh. It is composed of 94-98% boron with impurities of iron, magnesium, and silicon. The B^{10} content varies between 92 and 96%.

Only a limited quantity of elemental B^{10} is available. It is packaged in quantities of 1 g or more.

BORON-11 - TRIFLUORIDE COMPLEX

Item: SS 2(b) - Trifluoride Complex ($B^{11}F_3 \cdot CaF_2$)

Price: \$1.00 per gram of complex

The B^{11} is packaged for shipment in the form of the solid complex: boron trifluoride-calcium fluoride. The complex contains 10% or less elemental boron. Approximately 89% of the boron present is B^{11} , corresponding to a B^{10} content which is 60% of its normal abundance.

This item is packaged in quantities of 1 g or more.

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