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TABLES FOR CONVERSION OF ATOMIC, WEIGHT, AND VOLUME PERCENTAGES

IN ALLOYS OF HEAVY METALS

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The accompanying tables have been compiled to facilitate prompt and accurate conversion of atomic and weight percentages in systems involving elements of widely differing atomic weights. They are based on a published paper¹⁾, but some typographical errors therein have been corrected and two tables²⁾ have been added.

Use of these tables depends on the following rearrangement of the common conversion formulae:

$$\frac{x}{100-x} = \frac{A}{B} \frac{y}{(100-y)}$$

PUBLICLY RELEASABLEPer MARK M. JONES FSS-16 Date: 12-1-95
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where x and y are the weight and atomic percentages respectively of the element of atomic weight A in a binary alloy with elements of atomic weight B . Tables I and II give values of the function $\log [x/(100-x)]$, and Tables III and IV, values of $\log (A/B)$ for various common combinations of elements.

The tables are used in exactly the same manner as ordinary log tables. To convert from a certain weight percentage to atomic percent, the value of $\log [x/(100-x)]$ corresponding to the known weight percentage is first read from Table I or II. From this value is subtracted the appropriate log atomic weight ratio from Table III or IV, giving a resultant value of $\log [y/(100-y)]$ corresponding to the atomic percentage directly read from Table I or II. Conversions in the reverse direction, i.e. from atomic to weight percentages, are done by adding the $\log (A/B)$ value.

- 1) American Institute of Mining and Metallurgical Engineers, Contribution 60, 1933. Copies obtainable from the writer.
- 2) Computations for Tables II and III were kindly made by the Computing Group.

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For conversions of amounts less than 0.01 percent (100 ppm), the simplified formula $x = (A/B)y$, worked on a slide rule, is sufficiently accurate, and in the case of elements not differing greatly in atomic weight, this may be used to higher values.

By the use of the appropriate log molecular weight ratios, Tables I and II also serve for rapid computation of molar fractions in any binary or pseudobinary system of compounds.

Conversion of Volume Percentages

By the use of log density ratios, these tables are equally good for conversions to or from volume percentages. In case of conversion from weight to volume percentage, the factor $\log \left[\frac{\text{density A}}{\text{density B}} \right]$ is subtracted from the appropriate $\log \left[\frac{x}{100-x} \right]$ from Table I or II, where A is the element whose percentage is being converted. Conversions from atomic to volume percentage are done by subtracting the function $\log \left(\frac{\text{density A}}{\text{density B}} \times \frac{\text{atomic weight B}}{\text{atomic weight A}} \right)$. In conversions from volume percentage to either weight or atomic percentages, these functions are added. These density functions have not been computed, but the reader may easily do so for any system of sufficient interest.

Conversions in Ternary Systems

Attention is called to a graphical method given in Ref. 1, permitting rapid conversion of percentages in ternary systems. The accuracy, however, is not great in systems of elements of greatly differing atomic weights.

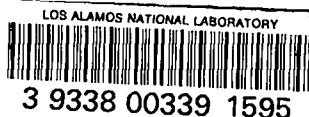
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TABLE I. Values of Log 100 - x + 10

TABLE I. Values of Log 100 - x + 10 (Continued)

Table with columns 0 to 0.9 and rows 0 to 49, containing logarithmic values for weight percentage conversion.

Subtract value of log 1/r (from table 2) if converting from weight to atomic percentage.

Table with columns 0 to 0.9 and rows 50 to 99, containing logarithmic values for weight percentage conversion.

Add value of log 1/b when converting from atomic to weight percentage.

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TABLE II. Values of $\log \frac{x}{100-x} + 10$

X	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	∞	6.0000	6.3011	6.4772	6.6022	6.6992	6.7784	6.8454	6.9034	6.9546
.1	7.0004	7.0419	7.0797	7.1145	7.1467	7.1767	7.2048	7.2312	7.2560	7.2796
.2	.3019	.3231	.3434	.3627	.3812	.3990	.4161	.4325	.4484	.4637
.3	.4784	.4927	.5065	.5200	.5330	.5456	.5579	.5698	.5814	.5928
.4	.6038	.6146	.6251	.6353	.6454	.6552	.6648	.6742	.6833	.6923
0.5	7.7012	7.7098	7.7183	7.7266	7.7347	7.7428	7.7506	7.7584	7.7660	7.7734
.6	.7808	.7880	.7951	.8021	.8090	.8157	.8224	.8290	.8355	.8419
.7	.8482	.8544	.8605	.8665	.8725	.8783	.8841	.8899	.8955	.9011
.8	.9066	.9120	.9174	.9227	.9279	.9331	.9382	.9433	.9483	.9534
.9	.9582	.9630	.9678	.9725	.9772	.9819	.9865	.9910	.9955	<u>8.0000</u>
1.0	8.0044	8.0087	8.0130	8.0173	8.0216	8.0258	8.0299	8.0340	8.0371	8.0422
.1	.0462	.0502	.0541	.0580	.0619	.0657	.0695	.0733	.0770	.0808
.2	.0844	.0881	.0917	.0953	.0988	.1024	.1059	.1094	.1128	.1162
.3	.1196	.1230	.1263	.1297	.1330	.1362	.1395	.1427	.1459	.1491
.4	.1522	.1554	.1585	.1616	.1647	.1677	.1707	.1738	.1767	.1797
1.5	8.1826	8.1856	8.1885	8.1914	8.1943	8.1971	8.2000	8.2028	8.2056	8.2084
.6	.2111	.2139	.2166	.2193	.2220	.2247	.2274	.2300	.2327	.2353
.7	.2379	.2405	.2431	.2456	.2482	.2507	.2532	.2557	.2582	.2607
.8	.2632	.2656	.2680	.2705	.2729	.2753	.2777	.2800	.2824	.2848
.9	.2871	.2894	.2917	.2940	.2963	.2986	.3009	.3031	.3054	.3076
2.0	8.3098	8.3120	8.3142	8.3164	8.3186	8.3208	8.3229	8.3250	8.3272	8.3293
.1	.3314	.3335	.3356	.3377	.3398	.3419	.3439	.3460	.3480	.3501
.2	.3521	.3541	.3561	.3581	.3601	.3621	.3640	.3660	.3680	.3699
.3	.3718	.3738	.3757	.3776	.3795	.3814	.3833	.3852	.3870	.3889
.4	.3908	.3926	.3945	.3963	.3981	.3999	.4018	.4036	.4054	.4072
2.5	8.4089	8.4107	8.4125	8.4142	8.4160	8.4178	8.4195	8.4212	8.4230	8.4247
.6	.4264	.4281	.4298	.4315	.4332	.4349	.4366	.4383	.4399	.4416
.7	.4432	.4449	.4466	.4482	.4498	.4514	.4531	.4547	.4563	.4579
.8	.4595	.4611	.4627	.4643	.4658	.4674	.4690	.4705	.4721	.4736
.9	.4752	.4767	.4782	.4798	.4813	.4828	.4843	.4858	.4874	.4888
3.0	8.4904	8.4918	8.4933	8.4948	8.4963	8.4978	8.4992	8.5007	8.5021	8.5036
.1	.5050	.5065	.5079	.5094	.5108	.5122	.5136	.5150	.5165	.5179
.2	.5193	.5207	.5221	.5235	.5248	.5262	.5276	.5290	.5304	.5317
.3	.5331	.5344	.5358	.5372	.5385	.5398	.5402	.5425	.5438	.5452
.4	.5465	.5478	.5491	.5504	.5518	.5531	.5544	.5557	.5570	.5583
3.5	8.5595	8.5608	8.5621	8.5634	8.5646	8.5659	8.5672	8.5685	8.5697	8.5710
.6	.5722	.5735	.5747	.5760	.5772	.5784	.5797	.5809	.5821	.5834
.7	.5846	.5858	.5870	.5882	.5894	.5906	.5918	.5930	.5942	.5954
.8	.5966	.5978	.5990	.6002	.6013	.6025	.6037	.6048	.6060	.6072
.9	.6083	.6095	.6107	.6118	.6130	.6141	.6152	.6164	.6175	.6186
4.0	8.6198	8.6209	8.6220	8.6232	8.6243	8.6254	8.6265	8.6276	8.6288	8.6299
.1	.6310	.6321	.6332	.6343	.6354	.6365	.6375	.6386	.6397	.6408
.2	.6419	.6430	.6440	.6451	.6462	.6472	.6483	.6494	.6504	.6515
.3	.6526	.6536	.6547	.6557	.6568	.6578	.6588	.6599	.6609	.6620
.4	.6630	.6640	.6650	.6661	.6671	.6681	.6691	.6702	.6712	.6722
4.5	8.6732	8.6742	8.6752	8.6762	8.6772	8.6782	8.6792	8.6802	8.6812	8.6822
.6	.6832	.6842	.6852	.6862	.6872	.6881	.6891	.6901	.6911	.6920
.7	.6930	.6940	.6949	.6959	.6969	.6978	.6988	.6998	.7007	.7017
.8	.7026	.7036	.7045	.7054	.7064	.7073	.7083	.7092	.7102	.7111
.9	.7120	.7130	.7139	.7148	.7157	.7167	.7176	.7185	.7194	.7203

Element A			Log atomic weight ratios		
Ato- mic No.	Sym- bol	Atomic Wt.	B=238.06 Uranium	B=235.90 75% 25	B=239.07 Plutonium
1	H	1.008	3.6268	3.6307	3.6249
2	He	4.003	2.2257	2.2297	2.2239
3	Li	6.940	.4647	.4686	.4628
4	Be	9.02	2.5785	2.5825	2.5767
5	B	10.82	.6575	.6615	.6557
6	C	12.010	.7029	.7068	.7010
7	N	14.008	2.7697	2.7737	2.7679
8	O	16.000	.8274	.8314	.8256
9	F	19.00	.9021	.9060	.9002
10	Ne	20.183	2.9283	2.9323	2.9265
11	Na	22.997	.9850	.9889	.9832
12	Mg	24.32	1.0093	1.0132	1.0074
13	Al	26.97	1.0542	1.0582	1.0524
14	Si	28.06	.0714	.0754	.0696
15	P	30.98	.1144	.1184	.1126
16	S	32.06	1.1293	1.1332	1.1274
17	Cl	35.457	.1730	.1770	.1712
18	A	39.944	.2248	.2287	.2229
19	K	39.096	1.2155	1.2194	1.2136
20	Ca	40.08	.2262	.2302	.2244
21	Sc	45.10	.2775	.2815	.2757
22	Ti	47.90	1.3037	1.3076	1.3018
23	V	50.95	.3305	.3344	.3286
24	Cr	52.01	.3394	.3434	.3376
25	Mn	54.93	1.3631	1.3671	1.3613
26	Fe	55.85	.3703	.3743	.3685
27	Co	58.94	.3937	.3977	.3919
28	Ni	58.69	1.3919	1.3958	1.3900
29	Cu	63.57	.4266	.4305	.4247
30	Zn	65.38	.4388	.4427	.4369
31	Ga	69.72	1.4667	1.4706	1.4648
32	Ge	72.60	.4843	.4882	.4824
33	As	74.91	.4979	.5018	.4960
34	Se	78.96	1.5207	1.5247	1.5189
35	Br	79.916	.5260	.5299	.5241
36	Kr	83.7	.5460	.5500	.5442
37	Rb	85.48	1.5552	1.5591	1.5533
38	Sr	87.63	.5660	.5699	.5641
39	Y	88.92	.5723	.5763	.5705
40	Zr	91.22	1.5834	1.5874	1.5816
41	Nb	92.91	.5914	.5953	.5895
42	Mo	95.95	.6054	.6093	.6035
44	Ru	101.7	1.6306	1.6346	1.6288
45	Rh	102.91	.6358	.6397	.6339
46	Pd	106.7	.6515	.6554	.6496

Element A			Log atomic weight ratios		
Ato- mic No.	Sym- bol	Atomic Wt.	B=238.06 Uranium	B=235.90 75% 25	B=239.07 Plutonium
47	Ag	107.880	1.6563	1.6602	1.6544
48	Cd	112.41	.6741	.6781	.6723
49	In	114.76	.6831	.6871	.6813
50	Sn	118.70	1.6978	1.7017	1.6959
51	Sb	121.76	.7088	.7128	.7070
52	Te	127.61	.7292	.7332	.7274
53	I	126.92	1.7268	1.7308	1.7250
54	Xe	131.3	.7416	.7455	.7397
55	Cs	132.91	.7469	.7508	.7450
56	Ba	137.36	1.7612	1.7651	1.7593
57	La	138.92	.7661	.7700	.7642
58	Ce	140.13	.7698	.7738	.7680
59	Pr	140.92	1.7723	1.7762	1.7705
60	Nd	144.27	.7825	.7865	.7807
62	Sm	150.43	.8007	.8046	.7988
63	Eu	152.0	1.8052	1.8091	1.8033
64	Gd	156.9	.8189	.8229	.8171
65	Tb	159.2	.8253	.8292	.8234
66	Dy	162.46	1.8341	1.8380	1.8322
67	Ho	164.94	.8406	.8446	.8388
68	Er	167.2	.8466	.8505	.8447
69	Tm	169.4	1.8522	1.8562	1.8504
70	Yb	173.04	.8615	.8654	.8596
71	Lu	174.99	.8663	.8703	.8645
72	Hf	178.6	1.8752	1.8792	1.8734
73	Ta	180.88	.8807	.8847	.8789
74	W	183.92	.8879	.8919	.8861
75	Re	186.31	1.8936	1.8975	1.8917
76	Os	190.2	.9025	.9065	.9007
77	Ir	193.1	.9091	.9131	.9073
78	Pt	195.23	1.9139	1.9178	1.9120
79	Au	197.2	.9182	.9222	.9164
80	Hg	200.61	.9257	.9296	.9238
81	Tl	204.39	1.9338	1.9377	1.9319
82	Pb	207.21	.9397	.9437	.9379
83	Bi	209.00	.9435	.9474	.9416
84	Po	210.01	1.9455	1.9495	1.9437
86	Rn	222	.9697	.9736	.9678
88	Ra	226.05	.9775	.9815	.9757
90	Th	232.12	1.9890	1.9930	1.9872
91	Pa	231	.9869	.9909	.9851
92	U	238.06	0.0000	0.0040	1.998

