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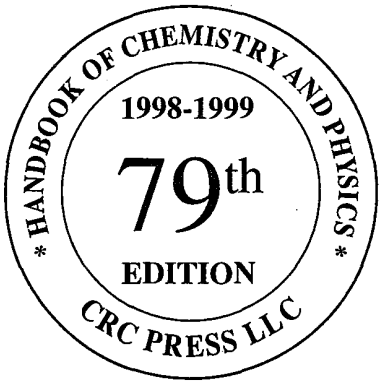

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CRC Press

Boca Raton Boston London New York Washington, D.C.

International Standard Book Number 0-8493-0479-2
Library of Congress Card Number 13-11056
Printed in the United States of America 1 2 3 4 5 6 7 8 9 0
Printed on acid-free paper

STRENGTHS OF CHEMICAL BONDS*

J. A. Kerr

The strength of a chemical bond, $D°$(R-X), often known as the bond dissociation energy, is defined as the standard enthalpy change of the reaction in which the bond is broken: RX → R + X. It is given by the thermochemical equation, $D°(R\text{-}X) = \Delta_f H°(R) + \Delta_f H°(X) - \Delta_f H°(RX)$. Some authors list bond strengths at a temperature of absolute zero but here the values at 298 K are given because more thermodynamic data are available for this temperature. Bond strengths or bond dissociation energies are not equal to, and may differ considerably from, mean bond energies determined solely from thermochemical data on atoms and molecules.

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES

These have usually been measured spectroscopically or by mass spectrometric analysis of hot gases effusing a Knudsen cell. Excellent accounts of these and other methods are given in (i) *Dissociation Energies and Spectra of Diatomic Molecules*, by A. G. Gaydon, 3rd. ed., Chapman & Hall, London, 1968 and (ii) "Mass Spectrometric Determination of Bond Energies of High-Temperature Molecules", K. A. Gingerich, *Chimia*, 26, 619, 1972. The errors quoted in the table are those given in the original paper or review article. The references have been chosen primarily as a key to the literature. It should not be assumed that the author referred to was responsible for the value quoted, as the reference may be to a review article.

Bond strengths reported at a temperature of absolute zero, $D°_0$, have been converted to $D°_{298}$ by the use of enthalpy functions taken mainly from the JANAF Thermochemical Tables, Third Edition, *J. Phys. Chem. Ref. Data*, 14, Suppl. 1, 1985, wherever possible. For most bonds, however, where these data are not available, the conversion has been made by the approximate relation:

$$D°_{298} = D°_0 + (3/2)RT$$

The list below does not include the increasing number of bond strengths of diatomic molecules now being calculated by *ab initio* methods. The Table has been arranged in an alphabetical order of the atoms.

Molecule	$D°_{298}$/kJ mol^{-1}	Ref.	Molecule	$D°_{298}$/kJ mol^{-1}	Ref.	Molecule	$D°_{298}$/kJ mol^{-1}	Ref.
Ag-Ag	160.3 ± 3.4	296	Al-Au	325.9 ± 6.3	116	As-F	410	192
Ag-Al	183.7 ± 9.2	71	Al-Br	429 ± 6	176	As-Ga	209.6 ± 1.2	75
Ag-Au	202.9 ± 9.2	3	Al-Cl	511.3 ± 0.8	294	As-H	274.0 ± 2.9	26
Ag-Bi	193 ± 42	230	Al-Cu	227.1 ± 9.8	19	As-I	296.6 ± 28.0	308
Ag-Br	293 ± 29	112	Al-D	290.8	230	As-In	201	281
Ag-Cl	341.4	151	Al-F	663.6 ± 6.3	72	As-N	489 ± 2	292
Ag-Cu	174.1 ± 9.2	128	Al-H	284.9 ± 6.3	72	As-O	481 ± 8	245
Ag-D	226.8	192	Al-I	369.9 ± 2.1	250	As-P	433.5 ± 12.6	129
Ag-Dy	130 ± 19	190	Al-Kr	5.89 ± 0.81	39	As-S	379.5 ± 6.3	245
Ag-Eu	129.7 ± 12.6	58	Al-Li	175.7 ± 14.6	152	As-Sb	330.5 ± 5.4	87
Ag-F	354.4 ± 16.3	112	Al-N	297 ± 96	112	As-Se	96	272
Ag-Ga	180 ± 15	40	Al-Ni	225 ± 5	18	As-Tl	198.3 ± 14.6	284
Ag-Ge	174.5 ± 20.9	127	Al-O	511 ± 3	49,66	At-At	~80	81
Ag-H	215.1 ± 8	202	Al-P	216.7 ± 12.6	72	Au-Au	224.7 ± 1.5	31,234
Ag-Ho	123.4 ± 16.7	54	Al-Pd	254.4 ± 12.1	56	Au-B	367.8 ± 10.5	137
Ag-I	234 ± 29	112	Al-S	373.6 ± 7.9	352	Au-Ba	254.8 ± 10.0	127
Ag-In	166.5 ± 4.9	11	Al-Sb	216.3 ± 5.9	277	Au-Be	285 ± 8	112
Ag-Li	177.4 ± 6.3	260	Al-Se	337.6 ± 10.0	352	Au-Bi	297 ± 8.4	127
Ag-Mn	100 ± 21	230	Al-Si	229.3 ± 30.1	44	Au-Ca	243	127
Ag-Na	138.1 ± 8.4	275,282	Al-Te	267.8 ± 10.0	352	Au-Ce	339 ± 21	127
Ag-Nd	<209	206	Al-U	326 ± 29	115	Au-Cl	343 ± 9.6	112
Ag-O	220.1 ± 20.9	271	Al-Xe	7.43 ± 0.69	39	Au-Co	222 ± 17	127
Ag-S	217.1	329	Ar-Ar	4.73 ± 0.04	172	Au-Cr	213 ± 17	127
Ag-Se	202.5	329	Ar-He	3.89	230	Au-Cs	255 ± 3.3	37
Ag-Si	177.8 ± 10.0	303	Ar-Hg	6.15	230	Au-Cu	228.0 ± 5.0	31,127
Ag-Sn	136.0 ± 20.9	2	Ar-I	10.0	36	Au-D	318.4	192
Ag-Te	195.8	329	Ar-K	4.2	192	Au-Dy	259 ± 21	190
Al-Al	133 ± 6	110	As-As	382.0 ± 10.5	231	Au-Eu	241.0 ± 10.5	58
Al-Ar	5.34 ± 0.78	39	As-Cl	448	72	Au-Fe	187.0 ± 16.7	205
Al-As	202.9 ± 7.1	278,286	As-D	270.3	192	Au-Ga	234 ± 38	127

* Revised to December 1995.

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D°_{298}$/kJ mol^{-1}	Ref.
Au-Ge	274.1 ± 5.0	127
Au-H	292.0 ± 8	202
Au-Ho	267.4 ± 16.7	54,234
Au-In	286.0 ± 5.7	11
Au-La	336.4 ± 20.9	119
Au-Li	284.5 ± 6.7	260
Au-Lu	332.2 ± 16.7	124
Au-Mg	243 ± 42	230
Au-Mn	185.4 ± 12.6	322
Au-Na	215.1 ± 12.6	282
Au-Nd	299.2 ± 20.9	119
Au-Ni	255 ± 21	127
Au-O	221.8 ± 20.9	271
Au-Pb	130 ± 42	230
Au-Pd	155 ± 21	127
Au-Pr	310 ± 21	127
Au-Rb	243 ± 2.9	37
Au-Rh	231.0 ± 29	58
Au-S	418 ± 25	123
Au-Sc	280.3 ± 16.7	120
Au-Se	243.1	329
Au-Si	305.4 ± 5.9	131
Au-Sn	254.8 ± 7.1	217
Au-Sr	264 ± 42	230
Au-Tb	289.5 ± 33.5	144,234
Au-Te	317.6	329
Au-U	318 ± 29	115
Au-V	240.6 ± 12.1	165
Au-Y	307.1 ± 8.4	170
B-B	297 ± 21	72
B-Br	396	29
B-C	448 ± 29	230
B-Ce	305 ± 21	230
B-Cl	536	17
B-D	341.0 ± 6.3	230
B-F	757	240
B-H	340	287
B-I	220.5 ± 0.8	297
B-Ir	514.2 ± 17.2	357
B-La	339 ± 63	230
B-N	389 ± 21	72
B-O	808.8 ± 20.9	271
B-P	346.9 ± 16.7	139
B-Pd	329.3 ± 20.9	357
B-Pt	477.8 ± 16.7	251
B-Rh	475.7 ± 20.9	357
B-Ru	446.9 ± 20.9	357
B-S	580.7 ± 9.2	350
B-Sc	276 ± 63	230
B-Se	461.9 ± 14.6	350
B-Si	288.3	363
B-Te	354.4 ± 20.1	350
B-Th	297	132
B-Ti	276 ± 63	230
B-U	322 ± 33	230
B-Y	293 ± 63	230
Ba-Br	362.8 ± 8.4	97,186,214
Ba-Cl	436.0 ± 8.4	184,186
Ba-D	≤193.7	192
Ba-F	587.0 ± 6.7	94,183
Ba-H	176 ± 14.6	112
Ba-I	320.8 ± 6.3	178
Ba-O	561.9 ± 13.4	271
Ba-Pd	221.8 ± 5.0	117
Ba-Rh	259.4 ± 25.1	117
Ba-S	400.0 ± 18.8	62
Be-Be	59	32,79
Be-Br	381 ± 84	230
Be-Cl	388.3 ± 9.2	101,181,358
Be-D	203.05	192
Be-F	577 ± 42	72,101
Be-H	200.0 ± 1.3	59
Be-O	434.7 ± 13.4	271
Be-S	372 ± 59	112
Bi-Bi	200.4 ± 7.5	290,307
Bi-Br	267.4 ± 4.2	68
Bi-Cl	301 ± 4	70
Bi-D	283.7	249
Bi-F	367 ± 13	375
Bi-Ga	159 ± 17	280
Bi-H	≤283.3	249
Bi-I	218.0 ± 4.6	69
Bi-In	153.6 ± 1.7	304
Bi-Li	154.0 ± 5.0	262,288
Bi-O	337.2 ± 12.6	271
Bi-P	280 ± 13	129
Bi-Pb	141.8 ± 14.6	307
Bi-S	315.5 ± 4.6	351
Bi-Sb	251 ± 4	228
Bi-Se	280.3 ± 5.9	351
Bi-Sn	210.0 ± 8.4	127
Bi-Te	232.2 ± 11.3	351
Bi-Tl	121 ± 13	76
Br-Br	192.807	1
Br-C	280 ± 21	112
Br-Ca	310.9 ± 9.2	302
Br-Cd	159 ± 96	112
Br-Cl	217.53 ± 0.29	50
Br-Co	331 ± 42	230
Br-Cr	328.0 ± 24.3	112
Br-Cs	389.1 ± 4	269,341
Br-Cu	331 ± 25	112
Br-D	370.74	192
Br-F	280 ± 12	197
Br-Fe	247 ± 96	112
Br-Ga	444 ± 17	72
Br-Ge	255 ± 29	112
Br-H	366.35	192
Br-Hg	72.8 ± 4	72
Br-I	179.1 ± 0.4	112,291
Br-In	414 ± 21	72
Br-K	379.9 ± 0.8	341,354
Br-Li	418.8 ± 4	341
Br-Mg	≤327.2	192
Br-Mn	314.2 ± 9.6	112
Br-N	276 ± 21	112
Br-Na	367.4 ± 0.8	341,354
Br-Ni	360 ± 13	112
Br-O	235.1 ± 0.4	72
Br-Pb	247 ± 38	112
Br-Rb	380.7 ± 4	341
Br-Sb	314 ± 59	112
Br-Sc	444 ± 63	230
Br-Se	297 ± 84	230
Br-Si	367.8 ± 10.0	99
Br-Sn	≥552	270
Br-Sr	333.0 ± 9.2	186
Br-Th	364	177
Br-Ti	439	230
Br-Tl	333.9 ± 1.7	25
Br-U	377.4 ± 6.3	243
Br-V	439 ± 42	230
Br-W	329.3	208
Br-Y	485 ± 84	230
Br-Zn	142 ± 29	230
C-C	607 ± 21	72
C-Ce	444 ± 13	220
C-Cl	397 ± 29	267
C-D	341.4	192
C-F	552	182
C-Ge	460 ± 21	112
C-H	338.4 ± 1.2	192
C-Hf	540 ± 25	336
C-I	209 ± 21	112
C-Ir	632 ± 4	164
C-La	462 ± 20	274
C-Mo	481 ± 15.9	160
C-N	754.3 ± 10	38
C-Nb	569 ± 13.0	160
C-O	1076.5 ± 0.4	72
C-Os	≥594	118
C-P	513.4 ± 8	330
C-Pt	598 ± 5.9	164,355
C-Rh	580.0 ± 3.8	312
C-Ru	616.2 ± 10.5	313
C-S	714.1 ± 1.2	63,333
C-Sc	≤444 ± 21	140
C-Se	590.4 ± 5.9	323
C-Si	451.5	83,363
C-Tc	565 ± 29	305
C-Th	453 ± 17	159,336
C-Ti	423 ± 29	155,336
C-U	454.8 ± 15.1	158,162
C-V	427 ± 23.8	160
C-Y	418 ± 14	318
C-Zr	561 ± 25	336
Ca-Ca	≤46	371,373
Ca-Cl	409 ± 9	252

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D°_{298}$/kJ mol^{-1}	Ref.
Ca-D	≤169.9	192
Ca-F	527 ± 21	94,180
Ca-H	167.8	112
Ca-I	284.7 ± 8.4	178
Ca-Li	84.9 ± 8.4	371
Ca-O	402.1 ± 16.7	271
Ca-S	337.6 ± 18.8	62,192
Cd-Cd	7.36	235
Cd-Cl	208.4	192
Cd-F	305 ± 21	28
Cd-H	69.0 ± 0.4	112
Cd-I	97.23	200
Cd-In	138	230
Cd-O	235.6 ± 83.7	149,271
Cd-S	208.4 ± 20.9	149
Cd-Se	127.6 ± 25.1	149
Cd-Te	100.0 ± 15.1	149
Ce-Ce	245.2	119
Ce-F	582 ± 42	230
Ce-Ir	586	141
Ce-N	519 ± 21	138
Ce-O	795 ± 8	88
Ce-Os	506 ± 33	118
Ce-Pd	322.2	55
Ce-Pt	556	141
Ce-Rh	548	141
Ce-Ru	531 ± 25	118
Ce-S	569	21
Ce-Se	494.5 ± 14.6	255
Ce-Te	189.4 ± 12.8	236
Cl-Cl	242.580 ± 0.004	192
Cl-Co	389	238
Cl-Cr	366.1 ± 24.3	112
Cl-Cs	448 ± 8	269,342
Cl-Cu	382.8 ± 4.6	154
Cl-D	436.47	192
Cl-Eu	~326	107
Cl-F	256.23	192,264
Cl-Fe	~351	112
Cl-Ga	481 ± 13	72
Cl-Ge	~431	192
Cl-H	431.62	192
Cl-Hg	100 ± 8	112
Cl-I	211.3 ± 0.4	112
Cl-In	439 ± 8	72
Cl-K	433.0 ± 8	342
Cl-Li	469 ± 13	72
Cl-Mg	327.6 ± 2.1	98,184,358
Cl-Mn	360.7 ± 9.6	112
Cl-N	333.9 ± 9.6	47
Cl-Na	412.1 ± 8	342
Cl-Ni	372 ± 21	112
Cl-O	269.1	192,301
Cl-P	289 ± 42	230
Cl-Pb	301 ± 29	112
Cl-Ra	343 ± 75	112
Cl-Rb	427.6 ± 8	342
Cl-S	277.0	209
Cl-Sb	360 ± 50	112
Cl-Sc	331	362
Cl-Se	322	230
Cl-Si	406	361
Cl-Sm	≥423 ± 13	374
Cl-Sn	414 ± 17	230
Cl-Sr	406 ± 13	184,186
Cl-Ta	544	20
Cl-Th	489	244
Cl-Ti	494	230
Cl-Tl	372.8 ± 2.1	25
Cl-U	452 ± 8	242
Cl-V	477 ± 63	230
Cl-W	423 ± 42	230
Cl-Xe	6.7	192
Cl-Y	527 ± 84	230
Cl-Yb	~322	107
Cl-Zn	228.9 ± 19.7	65
Cm-O	736	321
Co-Co	167 ± 25	203
Co-Cu	167 ± 17	127
Co-F	435 ± 63	230
Co-Ge	234 ± 21	127
Co-H	226 ± 42	347
Co-I	285 ± 21	230
Co-O	384.5 ± 13.4	271
Co-S	331	329
Co-Si	276 ± 17	356
Cr-Cr	142.9 ± 5.4	188
Cr-Cu	155 ± 21	207
Cr-F	444.8 ± 19.7	211
Cr-Ge	154 ± 7	189
Cr-H	190.3 ± 7.0	46
Cr-I	287.0 ± 24.3	112
Cr-N	377.8 ± 18.8	144,334
Cr-O	429.3 ± 29.3	271
Cr-Pb	105 ± 2	189
Cr-S	331	85
Cr-Sn	141 ± 3	189
Cs-Cs	43.919 ± 0.010	368
Cs-F	519 ± 8	269
Cs-H	175.364	376
Cs-Hg	8	192
Cs-I	337.2 ± 2.1	269,340
Cs-Na	63.2 ± 1.3	78
Cs-O	295.8 ± 62.8	271
Cs-Rb	49.57 ± 0.01	167
Cu-Cu	176.52 ± 2.38	127,306
Cu-D	270.3	192
Cu-Dy	142 ± 21	190
Cu-F	413.4 ± 13	92
Cu-Ga	215.9 ± 15.1	40
Cu-Ge	208.8 ± 21	257
Cu-H	277.8	202,300
Cu-Ho	142 ± 21	190
Cu-I	197 ± 21	112
Cu-In	187.4 ± 7.9	11
Cu-Li	192.9 ± 8.8	260
Cu-Mn	158.6 ± 17	207
Cu-Na	176.1 ± 16.7	283
Cu-Ni	205.9 ± 17	207
Cu-O	269.0 ± 20.9	271
Cu-S	276	329
Cu-Se	251	329
Cu-Si	221.3 ± 6.3	303
Cu-Sn	169.5 ± 6.7	2,221
Cu-Tb	193 ± 19	190
Cu-Te	278.7	1
D-D	443.533	192
D-F	576.6	192
D-Ga	<272.8	237
D-Ge	≤322	192
D-H	439.433	192
D-Hg	42.05	192
D-In	246.0	192
D-Li	240.1892 ± 0.0046	194,339
D-Mg	135.1	192
D-Ni	≤302.9	192
D-Pt	≤350.2	192
D-S	351	192
D-Si	302.5	192
D-Sr	≥275.7	192
D-Zn	88.7	192
Dy-F	531	381
Dy-O	607 ± 17	88
Dy-S	414 ± 42	230
Dy-Se	322 ± 42	230
Dy-Te	234 ± 42	230
Er-F	565 ± 17	381
Er-O	615 ± 13	88
Er-S	418 ± 42	230
Er-Se	326 ± 42	230
Er-Te	238 ± 42	230
Eu-Eu	33.5 ± 17	58
Eu-F	544	226
Eu-Li	66.9 ± 2.9	259
Eu-O	479 ± 10	88
Eu-Rh	233.9 ± 33	58
Eu-S	362.3 ± 13.0	255,327
Eu-Se	301 ± 14.6	22,171,255
Eu-Te	243 ± 14.6	22,255
F-F	158.78	192
F-Ga	577 ± 14.6	254
F-Gd	590.4 ± 27.2	378
F-Ge	485 ± 21	91
F-H	569.87 ± 0.06	377
F-Hf	650 ± 15	14
F-Hg	~180	192
F-Ho	540	381
F-I	≤271.5	6,30,51,67

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D°_{298}$/kJ mol^{-1}	Ref.
F-In	506 ± 14.6	254
F-K	497.5 ± 2.5	15
F-La	598 ± 42	230
F-Li	577 ± 21	72
F-Lu	333.5	195
F-Mg	461.9 ± 5.0	94,183
F-Mn	423.4 ± 14.6	212
F-Mo	464.8	185
F-N	343	192
F-Na	519	192
F-Nd	545.2 ± 12.6	379
F-Ni	430 ± 20	77
F-O	222 ± 17	52
F-P	439 ± 96	112
F-Pb	356 ± 8	383
F-Pm	540 ± 42	230
F-Pr	582 ± 46	230
F-Pu	538.5 ± 29	213
F-Rb	494 ± 21	72
F-Ru	402	175
F-S	342.7 ± 5.0	27,187,215
F-Sb	439 ± 96	112
F-Sc	589.1 ± 13	380
F-Se	339 ± 42	230
F-Si	552.7 ± 2.1	102
F-Sm	565	226
F-Sn	466.5 ± 13	383
F-Sr	541.8 ± 6.7	94,183
F-Ta	573 ± 13	239
F-Tb	561 ± 42	230
F-Th	652	246
F-Ti	569 ± 33	382
F-Tl	445.2 ± 19.2	25
F-Tm	510	226
F-U	659.0 ± 10.5	148,241
F-V	590 ± 63	230
F-W	548 ± 63	230
F-Xe	15.77	299,346
F-Y	605.0 ± 20.9	380
F-Yb	≥521.3 ± 9.6	16,107,374
F-Zn	368 ± 63	230
F-Zr	616 ± 15	14
Fe-Fe	75 ± 17	310
Fe-Ge	210.9 ± 29	204
Fe-H	180 ± 25	347
Fe-O	390.4 ± 17.2	271
Fe-S	322	85
Fe-Si	297 ± 25	356
Ga-Ga	112.1 ± 7	317
Ga-H	<274.1	237
Ga-I	339 ± 9.6	112
Ga-Li	133.1 ± 14.6	152
Ga-O	353.5 ± 41.8	271
Ga-P	229.7 ± 12.6	122
Ga-Sb	192.0 ± 12.6	279
Ga-Te	251 ± 25	353
Gd-O	719 ± 10	88
Gd-S	526.8 ± 10.5	109,325
Gd-Se	431 ± 14.6	22
Gd-Te	343 ± 14.6	22
Ge-Ge	263.6 ± 7.1	222
Ge-H	≤321.7	227
Ge-Ni	290.3 ± 10.9	315
Ge-O	659.4 ± 12.6	271
Ge-Pd	254.7 ± 10.5	314
Ge-S	551.0 ± 2.5	80,86
Ge-Sc	271.0 ± 11	218
Ge-Se	489 ± 4	266
Ge-Si	301 ± 21	112
Ge-Te	456 ± 13	106
Ge-Y	279.8 ± 11.4	219
H-H	435.990	192
H-Hg	39.844	192
H-I	298.407	192
H-In	243.1	192
H-K	174.576	193,376
H-Li	238.049 ± 0.004	367
H-Mg	126.4 ± 2.9	12,13,93
H-Mn	234 ± 29	112
H-N	≤339	192
H-Na	185.69 ± 0.25	258,298
H-Ni	252.3 ± 8	202
H-O	427.6	192
H-P	297	192
H-Pb	≤157	192
H-Pd	234 ± 25	347
H-Pt	≤335	192
H-Rb	167 ± 21	112
H-Rh	247 ± 21	347
H-Ru	234 ± 21	347
H-S	344.3 ± 12.1	198
H-Sc	~180	309
H-Se	314.47 ± 0.96	114
H-Si	≤299.2	192
H-Sn	264 ± 17	112
H-Sr	163 ± 8	112
H-Te	268 ± 2.1	111
H-Ti	204.6 ± 8.8	45
H-Tl	188 ± 8	112
H-V	208.7 ± 7.0	46
H-Yb	159 ± 38	112
H-Zn	85.8 ± 2.1	112
He-He	3.8	192
He-Hg	6.61	230
Hf-C	548 ± 63	230
Hf-N	536 ± 29	144,229
Hf-O	801.7 ± 13.4	271
Hg-Hg		190,191
Hg-I	34.69 ± 0.96	365
Hg-K	8.24 ± 0.21	230
Hg-Li	13.8	192
Hg-Na	9.2	192,386
Hg-O	220.9 ± 33.1	149
Hg-Rb	8.4	192
Hg-S	217.1 ± 22.2	149
Hg-Se	144.3 ± 30.1	149
Hg-Te	≤142	230
Hg-Tl	4	174
Ho-Ho	84 ± 17	54
Ho-O	611 ± 17	88
Ho-S	428.4 ± 14.6	325
Ho-Se	335 ± 17	22
Ho-Te	259 ± 17	22
I-I	151.088	192,348
I-In	331	360
I-K	325.1 ± 0.8	340,354
I-Li	345.2 ± 4.2	340
I-Mg	~285	23
I-Mn	282.8 ± 9.6	112
I-N	159 ± 17	230
I-Na	304.2 ± 2.1	340,354
I-Ni	293 ± 21	112
I-O	249.0 ± 1.3	301
I-Pb	193 ± 4	320
I-Rb	318.8 ± 2.1	340
I-Si	293	192
I-Sn	234 ± 42	230
I-Sr	269.9 ± 5.9	223
I-Te	192 ± 42	230
I-Ti	310 ± 42	230
I-Tl	272 ± 8	23
I-Zn	108.29	200
I-Zr	305	225
In-In	100 ± 8	230
In-Li	92.5 ± 14.6	152
In-O	<320.1 ± 41.8	271
In-P	197.9 ± 8.4	278
In-S	289 ± 17	61
In-Sb	151.9 ± 10.5	73
In-Se	247 ± 17	61
In-Te	218 ± 17	61
Ir-La	577 ± 13	169
Ir-O	414.6 ± 42.3	271
Ir-Si	462.8 ± 20.9	357
Ir-Th	573	125
Ir-Ti	422 ± 13	273
Ir-Y	456.1 ± 16.7	170
K-K	54.63 ± 0.02	5,248
K-Kr	4.6	192
K-Li	82.0 ± 4.2	96,385
K-Na	65.994 ± 0.008	33,385
K-O	277.8 ± 20.9	271
K-Xe	5.0	192
Kr-Kr	5.23	42,192
Kr-O	<8	230
Kr-Xe	5.505 ± 0.002	7
La-La	247 ± 21	362
La-N	519 ± 42	230

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D°_{298}$/kJ mol^{-1}	Ref.
La-O	799 ± 4	88
La-Pt	502 ± 21	256
La-Rh	527 ± 17	57
La-S	573.2 ± 1.7	199,338
La-Se	477 ± 17	22,255
La-Te	381 ± 17	22,145
La-Y	202.1	362
Li-Li	110.21 ± 4	359,372
Li-Mg	67.4 ± 6.3	370
Li-Na	87.181 ± 0.001	95,104
Li-O	333.5 ± 8.4	271
Li-Pb	78.7 ± 7.9	262
Li-S	312.5 ± 7.5	216
Li-Sb	172.8 ± 10.0	263
Li-Sm	49.0 ± 4.2	259
Li-Tm	69.0 ± 3.3	259
Li-Yb	37.2 ± 2.9	259
Lu-Lu	142 ± 33	230
Lu-O	678 ± 8	88
Lu-Pt	402 ± 33	133
Lu-S	507.1 ± 14.6	108,325
Lu-Se	418 ± 17	22
Lu-Te	326 ± 17	22
Mg-Mg	8.552 ± 0.004	247,371
Mg-O	363.2 ± 12.6	271
Mg-S	234	62
Mn-Mn	25.9	206
Mn-O	402.9 ± 41.8	210,271
Mn-S	301 ± 17	369
Mn-Se	239.3 ± 9.2	331
Mo-Mo	406 ± 21	161
Mo-Nb	456 ± 25	156
Mo-O	560.2 ± 20.9	271
N-N	945.33 ± 0.59	192
N-O	630.57 ± 0.13	192
N-P	617.1 ± 20.9	64,143
N-Pu	473 ± 63	230
N-S	464 ± 21	230
N-Sb	301 ± 50	112
N-Sc	469 ± 84	230
N-Se	370 ± 11	333
N-Si	470 ± 15	293
N-Ta	611 ± 84	230
N-Th	577.4 ± 33.1	136,144
N-Ti	476.1 ± 33.1	144,335
N-U	531.4 ± 2.1	134
N-V	477.4 ± 17.2	100,144
N-Xe	23.0	173
N-Y	481 ± 63	230
N-Zr	564.8 ± 25.1	135,144
Na-Na	73.60 ± 0.25	364
Na-O	256.1 ± 16.7	271
Na-Rb	63.25	366
Nb-Nb	510 ± 10.0	157
Nb-O	771.5 ± 25.1	271
Nd-Nd	<163	230
Nd-O	703 ± 13	88
Nd-S	471.5	22
Nd-Se	385 ± 17	22,147,255
Nd-Te	305 ± 17	22
Ne-Ne	3.93	344
Ni-Ni	203.26 ± 0.96	253
Ni-O	382.0 ± 16.7	271
Ni-Pt	273.7 ± 0.3	345
Ni-S	344.3	85
Ni-Si	318 ± 17	356
Ni-V	206.3 ± 0.2	332
Np-O	718.4 ± 41.8	271
O-O	498.36 ± 0.17	35,192
O-Os	575	179
O-P	599.1 ± 12.6	271
O-Pa	788.3 ± 17.2	224
O-Pb	382.0 ± 12.6	271
O-Pd	380.7 ± 83.7	271
O-Pm	674 ± 63	230
O-Pr	753 ± 13	88
O-Pt	391.6 ± 41.8	271
O-Pu	715.9 ± 33.9	271
O-Rb	255 ± 84	34
O-Re	626.8 ± 83.7	271
O-Rh	405.0 ± 41.8	271
O-Ru	528.4 ± 41.8	271
O-S	521.7 ± 4.2	271
O-Sb	434.3 ± 41.8	271
O-Sc	681.6 ± 11.3	271
O-Se	464.8 ± 21.3	271,324
O-Si	799.6 ± 13.4	271
O-Sm	565 ± 13	88
O-Sn	531.8 ± 12.6	271
O-Sr	425.5 ± 16.7	271
O-Ta	799.1 ± 12.6	271
O-Tb	711 ± 13	88
O-Te	376.1 ± 20.9	271
O-Th	878.6 ± 12.1	271
O-Ti	672.4 ± 9.2	271
O-Tm	502 ± 13	88
O-U	759.4 ± 13.4	271
O-V	626.8 ± 18.8	10,271
O-W	672.0 ± 41.8	271
O-Xe	36.4	230
O-Y	719.6 ± 11.3	196,271
O-Yb	397 ± 17	88
O-Zn	159 ± 4	48
O-Zr	776.1 ± 13.4	271
P-P	489.5 ± 10.5	143
P-Pt	≤416.7 ± 17	328
P-Rh	353.1 ± 17	328
P-S	444 ± 8	84
P-Sb	356.9	233
P-Se	363.6 ± 10.0	84
P-Si	363.6	326
P-Te	297.9 ± 10.0	84
P-Th	550.2 ± 42	127
P-Tl	209 ± 13	277
P-U	297 ± 21	230
P-W	305 ± 4	142
Pb-Pb	86.6 ± 0.8	130,288
Pb-S	346.0 ± 1.7	351
Pb-Sb	161.5 ± 10.5	384
Pb-Se	302.9 ± 4	351
Pb-Te	251 ± 13	351
Pd-Pd	100 ± 15	311
Pd-Si	261 ± 12	316
Pd-Y	238 ± 17	295
Pm-S	423 ± 63	230
Pm-Se	339 ± 63	230
Pm-Te	255 ± 63	230
Po-Po	187.0	192
Pr-S	492.5 ± 4.6	105
Pr-Se	446.4 ± 23.0	146,255
Pr-Te	326 ± 42	230
Pt-Pt	357.3 ± 15.1	163
Pt-Si	501.2 ± 18.0	357
Pt-Th	552	125
Pt-Ti	397 ± 13	166
Pt-Y	474.0 ± 12.1	163
Rb-Rb	48.898 ± 0.005	4
Rh-Rh	285.3 ± 20.9	53,285
Rh-Sc	443.9 ± 10.5	168
Rh-Si	395.0 ± 18.0	357
Rh-Th	515 ± 21	121
Rh-Ti	390.8 ± 14.6	53
Rh-U	519 ± 17	121
Rh-V	364 ± 29	127
Rh-Y	445.2 ± 10.5	168
Ru-Si	397.1 ± 20.9	357
Ru-Th	591.6 ± 42	126
Ru-V	414 ± 29	127
S-S	425.30	192
S-Sb	378.7	103
S-Sc	477 ± 13	338,349
S-Se	371.1 ± 6.7	82
S-Si	623	192
S-Sm	389	105
S-Sn	464 ± 3.3	80
S-Sr	339	41
S-Tb	515 ± 42	230
S-Te	339 ± 21	80
S-Ti	418 ± 3	89,276
S-Tm	368 ± 42	230
S-U	522.6 ± 9.6	338
S-V	450	90,192
S-Y	528.4 ± 10.5	337
S-Yb	167	230
S-Zn	205 ± 13	74,149
S-Zr	575.3 ± 16.7	338
Sb-Sb	299.2 ± 6.3	73,232
Sb-Te	277.4 ± 3.8	289,343

Table 1
BOND STRENGTHS IN DIATOMIC MOLECULES (continued)

Molecule	$D°_{298}$/kJ mol^{-1}	Ref.	Molecule	$D°_{298}$/kJ mol^{-1}	Ref.	Molecule	$D°_{298}$/kJ mol^{-1}	Ref.
Sb-Tl	126.8 ± 10.5	9,277	Se-V	347 ± 21	230	Te-Tm	276 ± 42	230
Sc-Sc	162.8 ± 21	128	Se-Y	435 ± 13	230	Te-Y	339 ± 13	230
Sc-Se	385 ± 17	230	Se-Zn	170.7 ± 25.9	74,149	Te-Zn	117.6 ± 18.0	149
Sc-Si	228.7 ± 14	218	Si-Si	326.8 ± 10.0	44	Th-Th	≤289	132
Sc-Te	289 ± 17	230	Si-Te	452 ± 8	192,265	Ti-Ti	141.4 ± 21	201
Se-Se	332.6 ± 0.4	82,351	Si-Y	258.8 ± 17.3	219	Tl-Tl	64.4 ± 17	8
Se-Si	548	192	Sm-Te	272.4 ± 14.6	255	U-U	222 ± 21	230
Se-Sm	331.0 ± 14.6	255	Sn-Sn	187.1 ± 0.3	268	V-V	269.2 ± 0.2	332
Se-Sn	401.2 ± 5.9	60	Sn-Te	359.8	192	Xe-Xe	6.53 ± 0.29	43
Se-Sr	~285	24	Sr-Sr	15.5 ± 0.4	113	Y-Y	159 ± 21	230
Se-Tb	423 ± 42	230	Tb-Tb	131.4 ± 25.1	234	Yb-Yb	20.5 ± 17	153
Se-Te	291.6 ± 4	80,82,150	Tb-Te	339 ± 42	230	Zn-Zn	29	319
Se-Ti	381 ± 42	230	Te-Te	259.8 ± 5.0	261			
Se-Tm	276 ± 42	230	Te-Ti	289 ± 17	230			

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Table 1
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