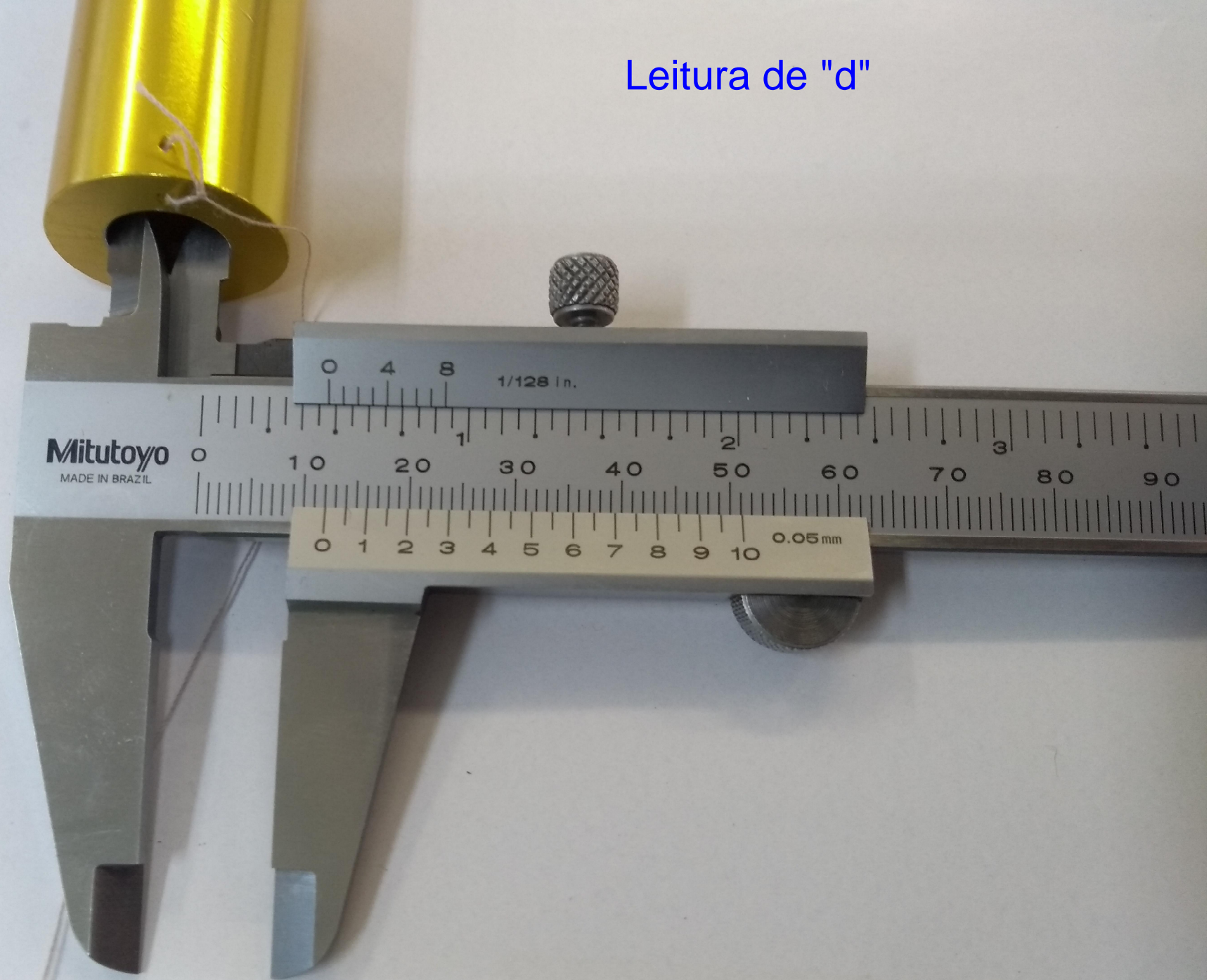
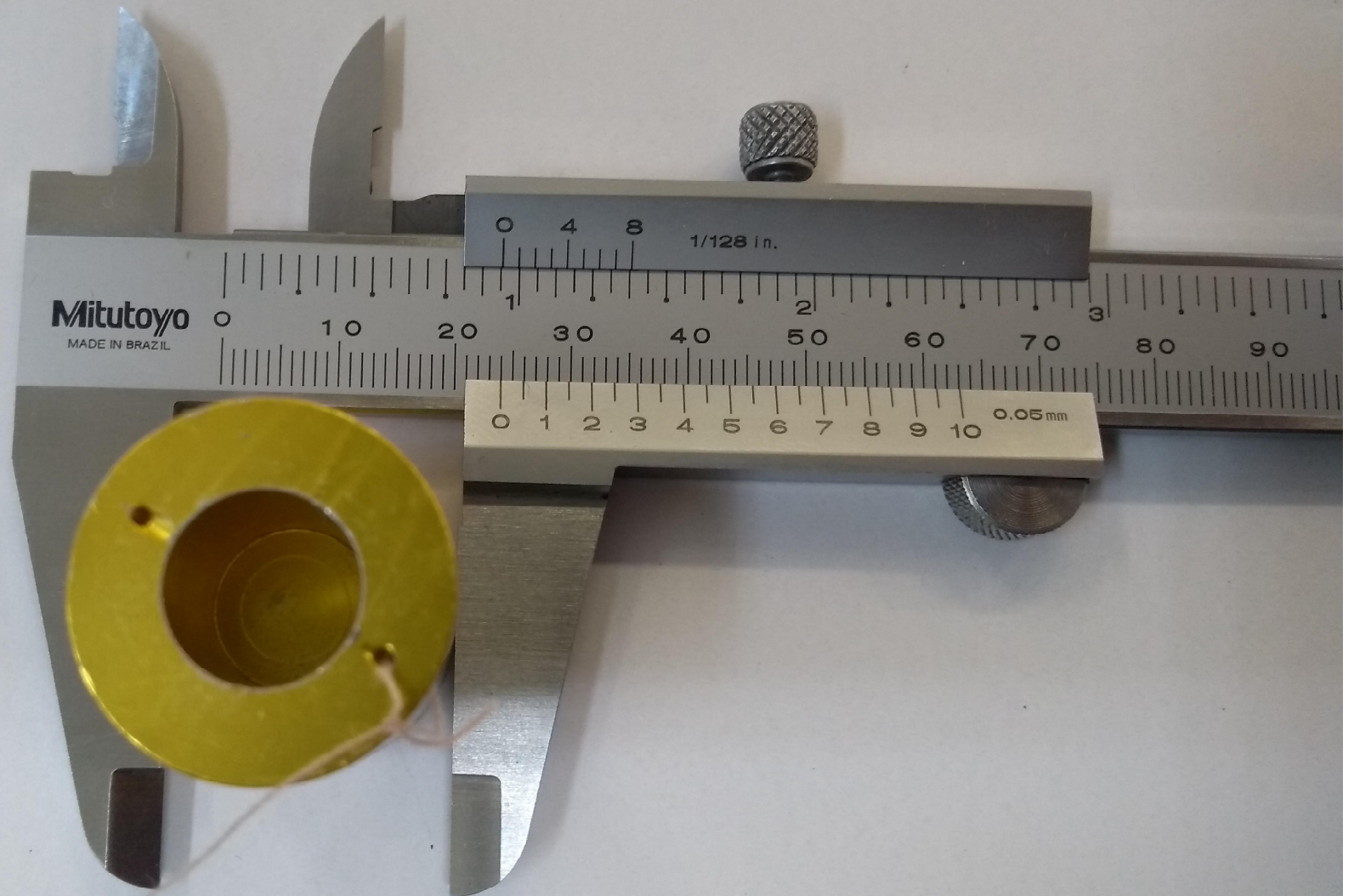


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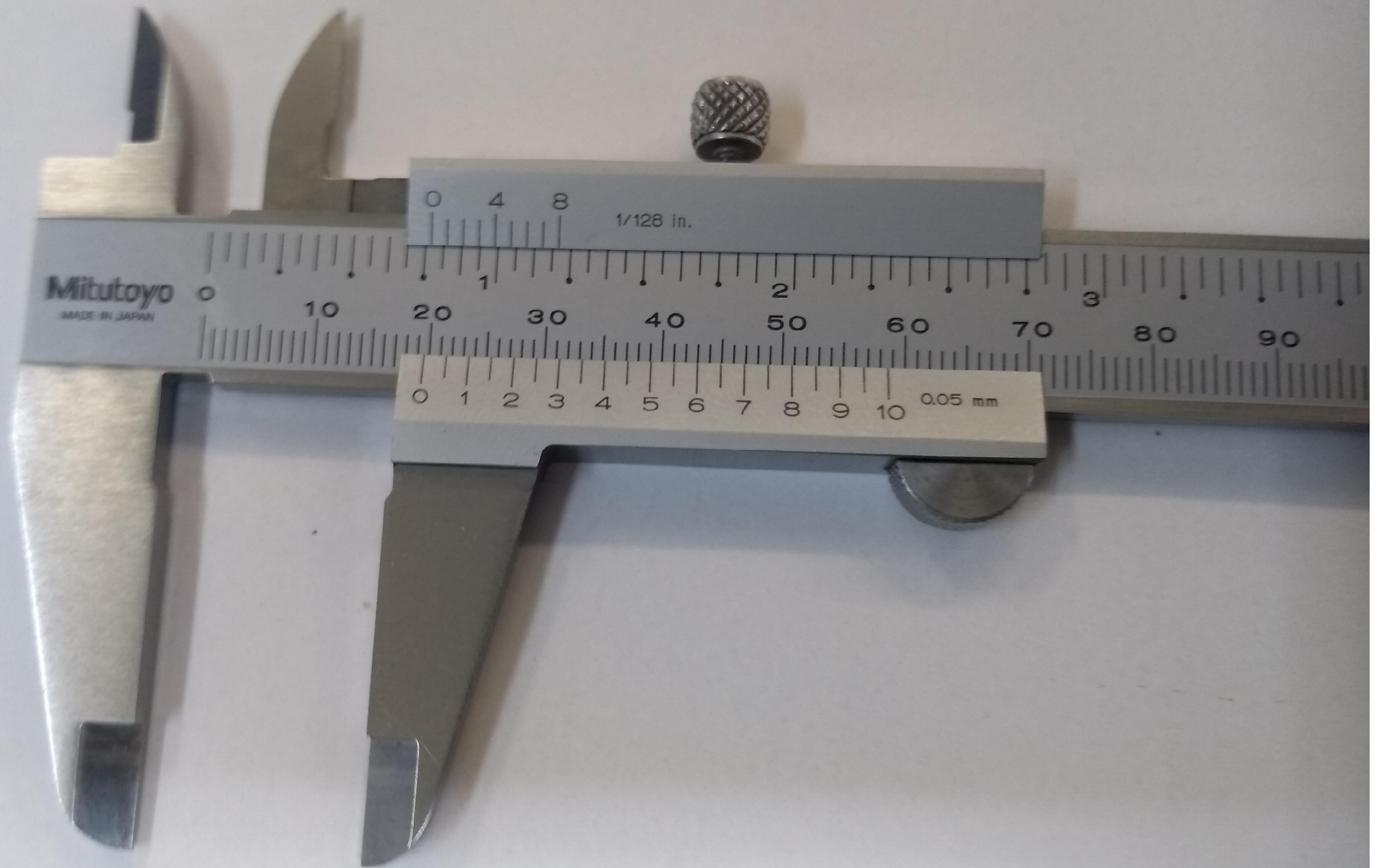
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Leitura de "h"



Leitura de "h" (zoom)



Leitura de "H"



Leitura de "m"

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HANDBOOK OF CHEMISTRY AND PHYSICS

A READY-REFERENCE BOOK OF
CHEMICAL AND PHYSICAL DATA
FORTY-THIRD EDITION

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IN COLLABORATION WITH A LARGE NUMBER OF PROFESSIONAL
CHEMISTS AND PHYSICISTS WHOSE ASSISTANCE IS ACKNOWLEDGED IN THE LIST OF GENERAL COLLABORATORS AND IN CONNECTION WITH THE PARTICULAR TABLES OR SECTIONS INVOLVED.

Depto. de Física e Ciência dos Materiais
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UNITED STATES OF AMERICA

DENSITY OF ELEMENTS

The density is given in grams per cubic centimeter and pounds per cubic foot at the temperature stated. Where no temperature is given ordinary atmospheric temperature is understood.

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Aluminum, hard drawn	20	2.690	168.5	Edwards, 1925
liquid	659	2.382	148.7	Moorman, 1921
Antimony, vacuo-distilled	20	6.618	413.1	Kahlbaum, 1902
compressed	20	6.691	417.7	Kahlbaum, 1902
amorphous	6.22	388.3	Herard	
Argon, liquid	-183	1.3845	86.4	Baly-Donnan
	-189	1.4233	88.9	Baly-Donnan
Arsenic, metallic	15	5.73	357.7	Lashchenko, 1922
amorphous, brown-black	3.70	231.0	Guenther [1908	
yellow	18	2.0	124.9	Erdmann & Reppert,
Barium	3.78	236.0	Guntz	
	25	3.5	218.5	Biltz & Hüttig, 1920
Beryllium	20	1.84	114.9	Fichter & Jablczynski,
Bismuth, electrolytic	9.747	603.5	Classen, 1890 [1912	
	20	9.80	611.8	Johnston & Adams,
vacuo-distilled	20	9.781	610.6	Kahlbaum, 1902
liquid	271	10.00	624.3	Vincentini-Omodei
	271	10.24	639.25	Plüss, 1915
solid	271	9.67	603.7	Vincentini-Omodei
Boron, crystal	2.53	158.3	Wigand	
amorphous	2.45	152.9	Moissan	
Bromine, liquid	3.12	194.8	Richards-Stull	
Cadmium, cast	20	8.648	539.9	Egerton & Lee, 1923
wrought	8.67	541.2		
vacuo-distilled	20	8.648	539.9	Kahlbaum, 1902
solid	318	8.37	522.5	Vincentini-Omodei
liquid	318	7.99	498.8	Vincentini-Omodei
	349	7.94	495.7	Arpi, 1914
Calcium	1.54	96.1	Brink	
Carbon, crystal	3.52	219.7	Wigand	
graphite	2.25	140.5	Wigand	
Cerium, electrolytic	6.79	423.9	Muthmann-Weiss	
pure	6.9	430.7	Muthmann-Weiss	
Cesium	20	1.873	116.9	Richards-Brink
Chlorine, liquid	-33.6	1.507	94.1	Drugman-Ramsay
Chromium	6.52-73	407.0-420.1		
pure	20	6.92	432.0	Moissan
	28	7.20	449.5	Brenner, 1948
	21	8.71	543.7	Tilden [1915
Cobalt	8.9	555.6	Kalmus & Harper.	
	15	8.4	524.4	Muthmann-Weiss
Columbium	8.30-95	518.1-558.7		
Copper, cast	20	8.89	555.0	Dellinger, 1911
annealed	20	8.85-95	552.5-558.7	
wrought	20	8.89	555.0	Dellinger, 1911
hard-drawn	20	8.89	555.0	Kahlbaum, 1902
vacuo-distilled	20	8.9326	557.6	Kahlbaum, 1902
compressed	20	8.9376	558.0	

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
liquid	.....	8.217	513.0	Roberts-Wrightson
Erbium	.....	4.77(?)	298.0	St. Meyer
Fluorine, liquid	-200	1.14	71.2	Moissan-Dewar
Gallium	25	5.903	369.1	Bur. of Stand., 1934
Germanium	20	5.46	340.9	Winkler [1913]
Gold, cast	.....	19.3	1204.8	
cold rolled	20	19.296	1204.6	Rose, 1912
wrought	.....	19.33	1206.7	[1905]
drawn annealed	20	19.26	1202.3	Kahlbaum & Sturm,
vacuo-distilled	20	18.88	1178.6	Kahlbaum, 1902
compressed	20	19.27	1203.0	Kahlbaum, 1902
Helium, liquid	-269	0.15	9.4	Onnes
Hydrogen, liquid	-252	0.07	4.4	Dewar, 1904
Indium	.....	7.28	454.5	Richards
Iridium	17	22.42	1399.6	Deville-Debray
Iodine	20	4.94	308.4	Richards-Stull
Iron, pure	.....	7.85-88	490.1-491.9	[1924]
electrolytic, rolled	20	7.90	493.2	Tritton & Hanson,
gray cast	.....	7.03-13	438.9-445.1	
white cast	.....	7.58-73	473.2-482.6	
wrought	.....	7.80-90	486.9-493.2	
liquid	.....	6.88	429.5	Roberts-Austen
steel	.....	7.60-80	474.4-486.9	
Krypton, liquid	-146	2.16	134.8	Ramsay-Travers
Lanthanum	.....	6.15	383.9	Muthmann-Weiss
Lead, vacuo-distilled	20	11.342	708.0	Kahlbaum, 1902
compressed	20	11.347	708.4	Kahlbaum, 1902
solid	325	11.005	687.0	Vincentini-Omodei
liquid	325	10.645	664.5	Vincentini-Omodei
	400	10.597	661.5	Day, Sosman, 1914
	850	10.078	629.1	Day, Sosman, 1914
Lithium	20	0.534	33.3	Richards-Brink, 1907
Magnesium	.....	1.741	108.7	Voigt
Manganese	.....	7.42	463.2	Prelinger
Mercury, liquid	0	13.596	848.8	Regnault, Volkmann
	20	13.546	845.6	
	-38.8	13.690	854.6	Vincentini-Omodei
solid	-38.8	14.193	886.0	Vincentini-Omodei
	-188	14.383	897.9	Dewar, 1902
Molybdenum	.....	9.01	562.5	Moissan
	.....	10.2	636.8	Fink, 1910
Neodymium	.....	6.96	434.5	Muthmann-Weiss
Nickel	.....	8.60-90	536.9-555.6	
Nitrogen, liquid	-195	0.81	50.6	Baly-Donnan, 1902
	-205	0.854	53.3	Baly-Donnan, 1902
Osmium	.....	22.5	1404.6	Deville-Debray
Oxygen, liquid	-184	1.14	71.2	
Palladium	.....	12.16	759.1	Richards-Stull
Phosphorus, white	.....	1.83	114.2	
red	.....	2.20	137.3	
metallic	15	2.34	146.1	Hittorf
Platinum	20	21.37	1334.1	Richards-Stull
Potassium	20	0.87	54.3	Richards-Brink, 1907
solid	62.1	0.851	53.1	Vincentini-Omodei
liquid	62.1	0.83	51.8	Vincentini-Omodei
Praseodymium	.....	6.475	404.2	Muthmann-Weiss
Rhodium	.....	12.44	776.6	Holborn-Henning
Rubidium	20	1.532	95.6	Richards-Brink, 1907
Ruthenium	0	12.06	752.9	Toby
Samarium	.....	7.7-8	480.7-486.9	Muthmann-Weiss

DENSITY OF ELEMENTS (Continued)

Element	Temp. °C.	Density gm./c.c.	Lbs. per cu. ft.	Observer
Selenium	.....	4.3-8	268.4-299.6	
Silicon, crystal	20	2.42	151.1	Richards-Stull-Bray
amorphous	15	2.35	146.7	Vigoroux
Silver, cast	.....	10.42-53	650.5-657.4	
wrought	.....	10.6	661.7	
vacuo-distilled	20	10.492	655.0	Kahlbaum, 1902
compressed	20	10.503	655.7	Kahlbaum, 1902
liquid	.....	9.51	593.7	Wrightson
Sodium	20	0.9712	60.6	Richards-Brink, 1907
solid	97.6	0.9519	59.4	Vincentini-Omodei
liquid	97.6	0.9287	58.0	Vincentini-Omodei
solid	-188	1.0066	62.8	Dewar
Strontium	.....	2.50-58	156.1-161.1	Matthiessen
Sulfur	.....	2.0-1	124.9-131.1	
liquid	.....	1.811	112.1	Vincentini-Omodei
Tantalum	.....	16.6	1036.3	
Tellurium, crystal	.....	6.25	390.2	
amorphous	20	6.02	375.8	Beljankin
Thallium	.....	11.86	740.4	Richards-Stull [1924]
Thorium	.....	11.3-11.7	705.4-730.4	Rentschler, Mardes
Tin, white cast	.....	7.29	455.1	Matthiessen
wrought	.....	7.30	455.7	
crystallized	.....	6.97-7.18	435.1-448.2	
solid	226	7.184	448.5	Vincentini-Omodei
liquid	226	6.99	436.4	Vincentini-Omodei
gray	.....	5.8	362.1	
Titanium	18	4.5	280.9	Mixer
Tungsten	.....	18.6-19.1	1161.1-1192.4	
Uranium	13	18.7	1167.4	Zimmermann
Vanadium	.....	5.69	355.3	Ruff-Martin
	20	5.96	372.1	Hull, 1922
Xenon, liquid	-109	3.52	219.7	Ramsay-Travers
Yttrium	.....	5.51	237.2	St. Meyer
Zinc, cast	.....	7.04-16	439.5-447.0	
wrought	.....	7.19	448.9	
vacuo-distilled	20	6.92	432.0	Kahlbaum, 1902
compressed	20	7.13	445.1	Kahlbaum, 1902
liquid	.....	6.48	404.5	Roberts-Wrightson
Zirconium	.....	6.44	402.0	

DENSITY OF ALLOYS

The density is given in grams per cubic centimeter at ordinary atmospheric temperatures.

Alloy	Composition	g./cm. ³	Pounds per cu. ft.
Aluminum and copper	10 Al, 90 Cu	7.69	480.06
	5 Al, 95 Cu	8.37	522.51
	3 Al, 97 Cu	8.69	542.49
Aluminum and zinc	91 Al, 9 Zn	2.80	174.80
	78 Cu, 22 Sn	8.70	543.11
Bismuth, lead and tin	53 Bi, 40 Pb, 7 Sn	10.56	659.23

DENSITY OF ALLOYS (Continued)

Alloy.	Composition.	g/cm. ³	Pounds per cu. ft.	
Brass, yellow....	70 Cu, 30 Zn cast	8.44	526.88	
	rolled	8.56	534.38	
	drawn	8.70	543.11	
red.....	90 Cu, 10 Zn.....	8.60	536.87	
white.....	50 Cu, 50 Zn.....	8.20	511.01	
Bronze.....	90 Cu, 10 Sn (gun metal)	8.78	548.11	
	85 Cu, 15 Sn	8.89	554.98	
	80 Cu, 20 Sn	8.74	545.61	
	75 Cu, 25 Sn	8.83	551.23	
Cadmium and tin	32 Cd, 68 Sn	7.70	480.66	
	60 Cu, 40 Ni	8.88	554.35	
	Constantan.....	8.30	518.14	
German silver....	26.3 Cu, 36.6 Zn, 36.8 Ni	8.45	527.51	
	52 Cu, 26 Zn, 22 Ni	8.34	520.64	
	63 Cu, 30 Zn, 6 Ni	8.30	518.14	
Gold and copper	98 Au, 2 Cu	18.84	1176.12	
	96 Au, 4 Cu	18.36	1146.16	
	94 Au, 6 Cu	17.95	1120.56	
	92 Au, 8 Cu	17.52	1093.72	
	90 Au, 10 Cu	17.16	1071.25	
	88 Au, 12 Cu	16.81	1049.40	
	86 Au, 14 Cu	16.47	1028.17	
	Invar.....	63.8 Fe, 36 Ni, 0.2 C	8.00	499.42
	Lead and tin.....	87.5 Pb, 12.5 Sn	10.60	661.73
84 Pb, 16 Sn		10.33	644.87	
77.8 Pb, 22.2 Sn		10.05	627.39	
63.7 Pb, 36.3 Sn		9.43	588.69	
46.7 Pb, 53.3 Sn		8.73	544.99	
30.5 Pb, 69.5 Sn		8.24	514.40	
Magnalium.....		90 Al, 10 Mg	2.50	156.07
	70 Al, 30 Mg	2.00	124.85	
Manganese bronze	95 Cu, 5 Mn	8.80	549.36	
Manganin.....	84 Cu, 12 Mn, 4 Ni	8.50	530.63	
Monel metal.....	71 Ni, 27 Cu, 2 Fe	8.90	555.60	
Nickelin.....		8.77	547.48	
Phosphor bronze	79.7 Cu, 10 Sn, 9.5 Sb, 0.8 P	8.80	549.36	
Platinum and iridium.....	90 Pt, 10 Ir	21.62	1349.67	
	85 Pt, 15 Ir	21.62	1349.67	
	66.67 Pt, 33.33 Ir	21.87	1365.28	
	5 Pt, 95 Ir	22.38	1397.12	
Speculum metal..	67 Cu, 33 Sn	8.60	536.87	
Steel.....	99 Fe, 1 C	7.83	488.80	
	manganese	86 Fe, 13 Mn, 1 C	7.81	487.55
Wood's metal....	50 Bi, 25 Pb, 12.5 Cd, 12.5 Sn	9.70	659.23	

DENSITY OF VARIOUS SOLIDS

The approximate density of various solids at ordinary atmospheric temperature.
In the case of substances with voids such as paper or leather the bulk density is indicated rather than the density of the solid portion.

(Selected principally from the Smithsonian Tables.)

Substance	Grams per cu. cm	Pounds per cu. ft.	Substance	Grams per cu. cm	Pounds per cu. ft.
Agate.....	2.5-2.7	156-168	Garnet.....	3.15-4.3	197-268
Alabaster, carbon-ate.....	2.69-2.78	168-173	Gas carbon.....	1.88	117
sulfate.....	2.26-2.32	141-145	Gelatin.....	1.27	79
Albite.....	2.62-2.65	163-165	Glass, common... flint.....	2.4-2.8	150-175
Amber.....	1.06-1.11	66-69	.....	2.9-5.9	180-370
Amphiboles.....	2.9-3.2	180-200	Glue.....	1.27	79
Anorthite.....	2.74-2.76	171-172	Granite.....	2.64-2.76	165-172
Asbestos.....	2.0-2.8	125-175	Graphite.....	2.30-2.72	144-170
Asbestos slate....	1.8	112	Gum arabic.....	1.3-1.4	81-87
Asphalt.....	1.1-1.5	69-94	Gypsum.....	2.31-2.33	144-145
Basalt.....	2.4-3.1	150-190	Hematite.....	4.9-5.3	306-330
Beeswax.....	0.96-0.97	60-61	Hornblende.....	3.0	187
Beryl.....	2.69-2.7	168-169	Ice.....	0.917	57.2
Biotite.....	2.7-3.1	170-190	Ivory.....	1.83-1.92	114-120
Bone.....	1.7-2.0	106-125	Leather, dry.....	0.86	54
Brick.....	1.4-2.2	87-137	Lime, slaked....	1.3-1.4	81-87
Butter.....	0.86-0.87	53-54	Limestone.....	2.68-2.76	167-171
Calamine.....	4.1-4.5	255-280	Linoleum.....	1.18	74
Calcsp.	2.6-2.8	162-175	Magnetite.....	4.9-5.2	306-324
Camphor.....	0.99	62	Malachite.....	3.7-4.1	231-256
Caoutchouc.....	0.92-0.99	57-62	Marble.....	2.6-2.84	160-177
Cardboard.....	0.69	43	Meerschaum....	0.99-1.28	62-80
Celluloid.....	1.4	87	Mica.....	2.6-3.2	165-200
Cement, set.....	2.7-3.0	170-190	Muscovite.....	2.76-3.00	172-187
Chalk.....	1.9-2.8	118-175	Ochre.....	3.5	218
Charcoal, oak....	0.57	35	Opal.....	2.2	137
pine.....	0.28-0.44	18-28	Paper.....	0.7-1.15	44-72
Cinnabar.....	8.12	507	Paraffin.....	0.87-0.91	54-57
Clay.....	1.8-2.6	112-162	Peat blocks.....	0.84	52
Coal, anthracite..	1.4-1.8	87-112	Pitch.....	1.07	67
bituminous....	1.2-1.5	75-94	Porcelain.....	2.3-2.5	143-156
Cocoa butter.....	0.89-0.91	56-57	Porphyry.....	2.6-2.9	162-181
Coke.....	1.0-1.7	62-105	Pressed wood pulp board.....	0.19	12
Copal.....	1.04-1.14	65-71	Pyrite.....	4.95-5.1	309-318
Cork.....	0.22-0.26	14-16	Quartz.....	2.65	165
Cork linoleum....	0.54	34	Resin.....	1.07	67
Corundum.....	3.9-4.0	245-250	Rock salt.....	2.18	136
Diamond.....	3.01-3.52	188-220	Rubber, hard... board.....	1.19	74
Dolomite.....	2.84	177	Rubber, soft commercial.....	1.1	69
Ebonite.....	1.15	72	pure gum.....	0.91-0.93	57-58
Emery.....	4.0	250	Sandstone.....	2.14-2.36	134-147
Epidote.....	3.25-3.50	203-218	Serpentine.....	2.50-2.65	156-165
Feldspar.....	2.55-2.75	159-172	Silica, fused trans-parent.....	2.21	138
Flint.....	2.63	164	translucent..	2.07	129
Fluorite.....	3.18	198	Slag.....	2.0-3.9	125-240
Galena.....	7.3-7.6	460-470			
Gamboge.....	1.2	75			