

Acoustic Velocities for Pipe Solids at 25 deg. C (Shear velocity)

<u>Material</u>	<u>ft/sec</u>	<u>m/sec</u>
Acrylic*	8954	2730
Aluminum	10102	3080
Aluminum (rolled)	9971	3040
Aluminum (2024)	10365	3160
Asbestos Cement	7216	2200
Brass (Naval)	6724	2050
Carbon Steel	10516	3206
Cast Iron	10594	3230
Copper	7413	2260
Copper (annealed)	7626	2325
Copper (rolled)	7446	2270
Copper-Nickel (70-30)	8331	2540
Copper-Nickel (90-10)	6757	2060
Ductile Iron	9840	3000
FRP	8216	2505
Glass, Crown	9315	2840
Glass, Pyrex	10758	3280
Glass, Quartz	11546	3520
Gold	3936	1200
Inconel	9906	3020
Iron	10611	3235
Iron, Ductile	9840	3000
Lead	7118	2170
Lucite	4133	1260
Mild Steel	10611	3235
Monel	8922	2720
Mortar	8200	2500
Nickel	9709	2960
Nylon	7872	2400
Nylon, 6-6	3510	1070
Polyethylene (LD)*	6363	1940
Polyethylene (HD)*	7577	2310
PVC, CPVC*	7872	2400
Steel, 1% carbon	10562	3220
Steel, galvanized - standard	10590	3223
Steel, hardened 1% carbon	10332	3150
Stainless Steel - 302	10234	3120
Stainless Steel - 303	10234	3120
Stainless Steel - 304	10516	3206
Stainless Steel - 316	10414	3175
Stainless Steel - 347	10168	3100
Stainless Steel - 410	9807	2990
Stainless Steel - 430	11021	3360
Tar epoxy	6560	2000
Tin, rolled	5478	1670
Titanium	10250	3125
Tungsten, annealed	9479	2890
Tungsten, drawn	8659	2640
Tungsten, carbide	13054	3980
Zinc, rolled	8003	2440

*Longitudinal velocity used when friction coefficients is low

revised 10/20/2010

Longitudinal Acoustic Velocities for Common Liquids at 25 deg C or other temperature indicates

Substance	Specific Gravity	Ft/ Sec.	M./Sec.
Acetate, Ethyl	0.901	3560	1085
Acetate, Methyl	0.934	3973	1211
Acetic Anhydride (22)	1.082	3871	1180
Acetic Acid, Nitrile	0.783	4232	1290
Acetic Acid, Ethyl Ester (33)	0.901	3560	1085
Acetic Acid, Methyl Ester	0.934	3973	1211
Acetone	0.791	3852	1174
Acetonitrile	0.783	4232	1290
Acetonylacetone	0.729	4590	1399
Acetylen Dichloride	1.26	3330	1015
Acetylene Tetrabromide (47)	2.966	3369	1027
Acetylene Tetrachloride (47)	1.595	3763	1147
Alcohol	0.789	3960	1207
Alochol - Ethyl	0.83	3960	1207
Alcohol - Isopropyl		3839	1170
Alkazene-13	0.86	4321	1317
Alkazene-25	1.2	4288	1307
2-Amino-Ethanol	1.018	5656	1724
Aminobenzene	1.022	5376	1639
2-Aminotolidine (46)	0.999	5308	1618
4-Aminotolidine (46)	0.966	4856	1480
Ammonia (35)	0.771	5672	1729
Amorphous Polyolefin	0.98	3158	963
n-Amyl Alcohol		4015	1224
t-Amyl Alcohol	0.81	3950	1204
Aniline	10.2	5377	1639
Argon (45)	1.4	2799	853
Azine	0.982	4642	1415
Benzene	0.879	4285	1306
Benzol (29,40,41)	0.879	4285	1306
Bromine (21)	2.928	2917	889
Bromo-Benzene (46)	1.522	3839	1170
1-Bromo Butane (46)	1.276	3343	1.019
Bromo-Ethane (46)	1.46	2953	900
Bromoform (46,47)	2.89	3012	918
n-Butane (-5)	0.601	3560	1085
Sec-Butylalcohol	0.81	4068	1240
n-Butyl Bromide (46)	1.276	3343	1019
n-Butyl Chloride (22,46)	0.887	3740	1140
tert Butyl Chloride	0.84	3228	984
Butyl oleate	1.019	4869	1484
2,3,Butylene glycol	1.019	4869	1484

Longitudinal Acoustic Velocities for Common Liquids at 25 deg C or other temperature indicates

Substance	Specific Gravity	Ft/ Sec.	M./Sec.
Cadmium (7)		7342	2238
Carbinol (40,41)	0.791	3530	1076
Carbitol	0.988	4784	1458
Carbon Dioxide	1.101	2757	839
Carbon Disulphide	1.261	3770	1149
Carbon Tetrachloride	1.595	3038	926
Carbon Tetraflouride (-150)	1.75	2872	875
Cetane (23)	0.773	4390	1338
Chloro-benezene	0.887	3740	1140
Chloroform (20)		3054	931
1-Chloro-propane (47)	0.892	3471	1058
Chloro-diFluoromethane (3)	1.491	2933	894
Cinnamaldehyde	1.112	5098	1554
Colamine	1.018	5656	1724
o-Cresol (46)	1.047	5056	1541
m-Cresol (46)	1.034	4921	1500
Cyanomethane	0.783	4232	1290
Cyclohexane (15)	0.779	4095	1284
Cyclohexanol	0.962	4770	1454
Cyclohexanone	0.948	4669	1423
Decane (46)	0.73	4108	1252
1-Decene (27)	0.746	4052	1235
Diacetyl	0.99	4055	1236
Diamylamine		4121	1256
1,2 Dibromo-ethane (47)	2.18	3264	995
trans-1,2-Dibromoethene (47)	2.231	3068	935
Dibutyl phthalate		4619	1408
Dichloro-t-butyl alcohol		4278	1304
2,3,Dichlorodioxane		4564	1391
Dichlorodifluoromethane(3)Freon(12)	1.516	2540	774
1,2 Dichloro ethane (47)	1.253	3914	1193
cis 1,2-Dichloro-ethene (3, 47)	1.284	3481	1061
trans1,2-Dichloro-ethene (3,47)	1.257	3314	1010
1-2-Dichlorohexafluorocyclobutane (47)	1.65	2195	669
1-3-Dichloro-isobutane	1.14	4003	1220
Dichloro methane (3)	1.327	3511	1070
1,1-Dichloro-1,2,2,2,tetra fluroethane	1.455	21853	665
Diesel fuel		4100	1250
Diethyl ether	0.713	3232	985
Diethylene glycol	1.116	5203	1586
Diethylene glycol, monoethyl ether	0.988	4784	1458
Diethylenimide oxide	1	4731	1442
1,2-bis (DiFluoramino) butane (43)	1.216	3281	1000
1,2-bis(diFluoramino) 2-methylpropane	1.213	2953	900

Longitudinal Acoustic Velocities for Common Liquids at 25 deg C or other temperature indicates

Substance	Specific Gravity	Ft/ Sec.	M./Sec.
1,2-bis(diFlouramino) propane (43)	1.265	3150	960
2,2-Dihydroxydiethyl ether	1.116	5203	1586
Dihydroxyethane	1.113	5440	1658
1,3-Dimethyl-benzene (46)	0.868	4406	1343
1,4-Dimehyl-benzene (46)		4377	1334
2,2-Dimethyl-butane (29,33)	0.649	3540	1079
Dimethyl Ketone	0.0791	3852	1174
Dimethyl pentane (47)	0.674	3488	1063
Dimethyl phthalate	1.2	4800	1463
Diiodo-methane	3.24	3215	980
Dimethyl Silocan (Dow Corning 200)		2991	912
Dioxane	1.033	4514	1376
Dodecane (23)	0.749	4196	1279
1,2-Ethanediol	1.113	5440	1658
Ethanenitrile	0.783	4232	1290
Ethanoic anhydride (22)	1.082	3871	1180
Ethanol	0.789	3960	1207
Ethanol amide	1.018	5656	1724
Ethoxyethane	0.713	3232	985
Ethyl acetate (33)	901	3560	1085
Ethyl alcohol	0.789	3960	1207
Ethyl benzene (46)	0.867	4390	1338
Ethyl Bromide (46)	1.461	2953	900
Ethyl iodide (460)	1.95	2874	876
Ether	0.713	3232	985
Ethyl ether	0.713	3232	985
Ethylene bromide	2.18	3264	995
Ethylene Chloride	1.253	3914	1193
Ethyle glycol	1113	5440	1658
d-2-Fenechanone	0.947	4331	1320
Fluorine	0.0545	1322	403
Fluoro-benzene (46)	1.024	3901	1189
Formaldehyde, methyl ester	0.974	3698	1127
Formamide	1.134	5322	1622
Freon R12		2540	774
Furfural	1.157	4738	1444
Furfuryl alcohol	1.135	4757	1450
Fural	1.157	4738	1444
2-Furancarboxaldehyde	1.157	4738	1444
2-Furyl-Methanol	1.135	4757	1450
Gallium	6.095	9416	2870
Glycerin	1.26	6247	1904
Glycol	1.113	5440	1658

Longitudinal Acoustic Velocities for Common Liquids at 25 deg C or other temperature indicates

Substance	Specific Gravity	Ft/ Sec.	M./Sec.
Heptane (22, 23)	0.684	3711	1131
n-Heptane (29,33)	0.684	3871	1180
Hexachloro-Cyclopentadiene (47)	1.718	3773	1150
Hexadecane (23)	0.773	4390	1338
Hexalin	0.962	4770	1454
Hexane (16,22,23)	0.659	3540	1079
n-Hexane (29,33)	0.649	3540	1079
2,5-Hexanedione	0.729	4590	1399
n-Hexanol	0.819	4265	1300
Hexahydrobenzene (15)	0.779	4095	1248
Hexahydrophenol	0.962	4770	1454
Hydrogen (45)	0.071	3894	1187
2-Hydroxy-toluene (46)	1.047	5056	1541
3-Hydroxy-toluene (46)	1.034	4921	1500
Iodo-benzene (46)	1.823	3655	1114
Iodo-ethane (46)	1.95	2874	876
Iodo-methane	2.28	3209	978
Isobutyl acetate (22)		3871	1180
Isobutanol	0.81	3976	1212
Iso-Butane		4002	1220
Isopentane (36)	0.62	3215	980
Isopropanol (46)	0.785	3839	1170
Isopropyl alcohol (46)	0.785	3839	1170
Kerosene	0.81	4343	1324
Ketohexamethylene	0.948	4669	1423
Lithium fluoride (42)		8153	2485
Mercury (45)	13.6	4754	1449
Mesityloxide	0.85	4298	1310
Methane (25,28,38,39)	0.162	1329	405
Methanol (40,41)	0.791	3530	1076
Methyl acetate	0.934	3973	1211
o-Methylaniline (46)	0.999	5308	1618
4-Methylaniline (46)	0.966	4856	1480
Methyl alcohol (40,44)	0.791	3530	1076
Methyl benzene (16,52)	0.867	4357	1328
2-Methyl-butane (36)	0.62	3215	980
Methyl carbinol	0.789	3960	1207
Methyl-chloroform (47)	1.33	3232	985
Methyl-cyanide	0.783	4232	1290
3-Methyl cyclohexanol	0.92	4593	1400
Methylene chloride (3)	1.327	3511	1070

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<u>Substance</u>	<u>Specific Gravity</u>	<u>Ft/ Sec.</u>	<u>M./Sec.</u>
Methylene iodide	3.235	3215	980
Methyl formate (22)	0.974	3698	1127
Methyl iodide	2.28	3209	978
a-Methyl naphthalene	1.09	4954	1510
2-Methylphenol (46)	1.047	5056	1541
3-Methylphenol (46)	1.034	4921	1500
Milk, homogenized		1548	5080
Morpholine	1	4731	1442
Naphtha	0.76	4019	1225
Natural Gas (37)	0.316	2471	753
Neon (45)	1.207	1952	595
Nitrobenzene (46)	1.204	4642	1415
Nitrogen (45)	0.808	3156	962
Nitromethane (43)	1.135	4265	1300
Nonane (23)	0.718	3960	1207
1-Nonene (27)	0.736	3960	1207
Octane	0.703	3845	1172
n-Octane	0.704	3978	1213
l-Octene	0.723	3857	1176
Oil, Auto crankcase - SAE 20		2854	870
Oil of Camphor Sassafrassy		4560	1390
Oil, Car (SAE 20a.30)	1.74	2854	870
Oil,Castor	0.969	4849	1477
Oil, Fuel AA gravity	0.99	4872	1485
Oil, Diesel	0.8	4101	1250
Oil, Lube - X200		5020	1530
Oil (Olive)	0.912	4695	1431
Oil (Peanut)	0.936	4784	1458
Oil (Sperm)	0.88	4724	1440
Oil, 6		4951	1509
2,2-Oxydiethanol	1.116	5203	1586
Oxygen (45)	1.155	3123	952
Pentachloro-ethane (47)	1.687	3550	1082
Pentalin (47)	1.687	3550	1082
Pentane (36)	0.626	3347	1020
n-Pentane (47)	0.557	3301	1006
Perchlorocyclopentadiene (47)	1.718	3773	1150
Perchloro-ethylene (47)	1.632	3399	1036
Perfluoro-1-Hepten (47)	1.67	1913	583
Perfluoro-n-Hexane (47)	1.672	1667	508
Phene (29,40,41)	0.879	4285	1306
b-Phenyl acrolein	1.112	5098	1554
Phenylamine (41)	1.022	5377	1639

Longitudinal Acoustic Velocities for Common Liquids at 25 deg C or other temperature indicates

Substance	Specific Gravity	Ft/ Sec.	M./Sec.
Phenyl bromide (46)	1.522	3839	1170
Phenyl chloride	1.106	4177	1273
Phenyl iodide (46)	1.823	3655	1114
Phenyl methane (16,52)	0.867	4357	1328
3-Phenyl propenal	1.112	5098	1554
Phthalardione		3691	1125
Phthalic acid, anhydride		3691	1125
Pimelic ketone	0.948	4669	1423
Polyterpene Resin	0.77	3608	1100
Potassium bromide (42)		3835	1169
Potassium fluoride (42)		5879	1792
Potassium iodide (42)		3232	985
Potassium nitrate (48)	1.859	5709	1740
Propane (2,13)	0.585	3291	1003
1,2,3-Propanetriol	1.26	6247	1904
1-Propanol (46)	0.78	4009	1222
2-Propanol (46)	0.78	3839	1170
2-Propanone	0.791	3852	1174
Propene (17,18, 35)	0.563	3159	963
n-Propyl acetate (22)		4199	1280
n-Propyl-alcohol	0.78	4009	1222
Propylchloride (47)	0.892	3471	1058
Propylene (17,18, 35)	0.563	-3159	963
Pyridine	0.982	4642	1415
Refrigerant 11	1.49	2718	828
Refrigerant 12 (-40)	1.52	2540	774
Refrigerant 14 (-150)	1.75	2872	875
Refrigerant 21	1.43	2923	891
Refrigerant 22	1.49	2933	894
Refrigerant 113	1.56	2571	784
Refrigerant 114	1.46	2183	665
Refrigerant 115		2153	656
Refrigerant C318	1.62	1883	574
Selenium (8)		3717	1072
Silicone (30 cp)	0.993	3248	990
Sodium fluoride (42)	0.877	6831	2082
Sodium nitrate (48)	1.884	5785	1763
Sodium nitrite (48)	1.805	6158	1877
Solvesso #3	0.877	4495	1370
Spirit of wine	0.789	3960	1207
Sulfur		3862	1177
Sufuric Acid	1.841	4126	1258
Tellurium		3251	991

Longitudinal Acoustic Velocities for Common Liquids at 25 deg C or other temperature indicates

<u>Substance</u>	<u>Specific Gravity</u>	<u>Ft/ Sec.</u>	<u>M./Sec.</u>
1,1,2,2-Tetrabromo-ethane (47)	2.966	3369	1027
Tetrachloroethane (46)	1.553	3839	1170
Tetrachloro-ethene (47)	1.632	3399	1036
Tetrachloro-Methane (33, 47)	1.595	3038	926
Tetradecane (46)	0.763	4367	1331
Tetraethylene glycol	1.123	5203	1586
Tetrafluoro-methane (14) (Freon 14)	1.75	2872	875
Tetrahydro-1,4-isoxazine	1	4731	1442
Toluene (16,52)	0.867	4357	1328
o-Toluidine (46)	0.999	5308	1618
p-Toluidine (46)	0.966	4856	1480
Toluol	0.866	4291	1308
Tribromo-methane	2.89	3019	918
Trichloro-ethene	1.33	3232	985
Trifluorotrichlorethene - Freon 113	1.464	3373	1028
Trichloro-fluoromethane (3) (Freon 11)	1.49	2718	828
Trichloro-methane (47)	1.489	3212	979
1,1,2-Trichloro-Trifluoro-Etham	1.563	2571	784
Triethyl-amine (33)	0.726	3684	1123
Triethylene glycol	1.123	5276	1608
1,1,1-Trifluoro-2-Chloro-2-Bromo-Ethane	1.869	2274	693
d-1,3,3-Trimethylnorcamphor	0.947	4331	1320
Trinitrotoluene	1.64	5282	1610
Unisis 800	0.87	4416	1346
Water, distilled	0.996	4915	1498
Water, heavy		4593	1400
Water, sea	1.025	5023	1531
Wood Alcohol	0.791	3530	1076
Xenon		2067	630
m-Xylene	0.868	4406	1343
o-Xylene	0.897	4368	1332
p-Xylene		4377	1334
Xylene hexafluoride	1.37	2884	879
Zinc		10820	3298

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Sound Speeds in Water at Selected Temperatures

Temperature		Sound Speed in Water	
°C	°F	m/s	ft/s
0	32.0	1,402	4,600
1	33.8	1,407	4,616
2	35.6	1,412	4,633
3	37.4	1,417	4,649
4	39.2	1,421	4,662
5	41.0	1,426	4,679
6	42.8	1,430	4,692
7	44.6	1,434	4,705
8	46.4	1,439	4,721
9	48.2	1,443	4,734
10	50.0	1,447	4,748
11	51.8	1,451	4,761
12	53.6	1,455	4,774
13	55.4	1,458	4,784
14	57.2	1,462	4,797
15	59.0	1,465	4,807
16	60.8	1,469	4,820
17	62.6	1,472	4,830
18	64.4	1,476	4,843
19	66.2	1,479	4,853
20	68.0	1,482	4,862
21	69.8	1,485	4,872
22	71.6	1,488	4,882
23	73.4	1,491	4,892
24	75.2	1,493	4,899
25	77.0	1,496	4,908
26	78.8	1,499	4,918
27	80.6	1,501	4,925
28	82.4	1,504	4,935
29	84.2	1,506	4,941
30	86.0	1,509	4,951
31	87.8	1,511	4,958
32	89.6	1,513	4,964
33	91.4	1,515	4,971
34	93.2	1,517	4,977
35	95.0	1,519	4,984
36	96.8	1,521	4,990
37	98.6	1,523	4,997
38	100.4	1,525	5,004
39	102.2	1,527	5,010
40	104.0	1,528	5,013
41	105.8	1,530	5,020
42	107.6	1,532	5,026
43	109.4	1,534	5,033
44	111.2	1,535	5,036
45	113.0	1,536	5,040
46	114.8	1,538	5,046
47	116.6	1,539	5,049

Temperature		Sound Speed in Water	
°C	°F	m/s	ft/s
48	118.4	1,540	5,053
49	120.2	1,541	5,056
50	122.0	1,543	5,063
51	123.8	1,543	5,063
52	125.6	1,544	5,066
53	127.4	1,545	5,069
54	129.2	1,546	5,072
55	131.0	1,547	5,076
56	132.8	1,548	5,079
57	134.6	1,548	5,079
58	136.4	1,549	5,082
59	138.2	1,550	5,086
60	140.0	1,550	5,086
61	141.8	1,551	5,089
62	143.6	1,552	5,092
63	145.4	1,552	5,092
64	147.2	1,553	5,095
65	149.0	1,553	5,095
66	150.8	1,553	5,095
67	152.6	1,554	5,099
68	154.4	1,554	5,099
69	156.2	1,554	5,099
70	158.0	1,554	5,099
71	159.8	1,554	5,099
72	161.6	1,555	5,102
73	163.4	1,555	5,102
74	165.2	1,555	5,102
75	167.0	1,555	5,102
76	168.8	1,555	5,102
77	170.6	1,554	5,099
78	172.4	1,554	5,099
79	174.2	1,554	5,099
80	176.0	1,554	5,099
81	177.8	1,554	5,099
82	179.6	1,553	5,095
83	181.4	1,553	5,095
84	183.2	1,553	5,095
85	185.0	1,552	5,092
86	186.8	1,552	5,092
87	188.6	1,552	5,092
88	190.4	1,551	5,089
89	192.2	1,551	5,089
90	194.0	1,550	5,086
91	195.8	1,549	5,082
92	197.6	1,549	5,082
93	199.4	1,548	5,079
94	201.2	1,547	5,076
95	203.0	1,547	5,076

Temperature		Sound Speed in Water	
°C	°F	m/s	ft/s
96	204.8	1,546	5,072
97	206.6	1,545	5,069
98	208.4	1,544	5,066
99	210.2	1,543	5,063
100	212.0	1,543	5,063
104	220.0	1,538	5,046
110	230.0	1,532	5,026
116	140.0	1,524	5,000
121	250.0	1,526	5,007
127	260.0	1,507	4,944
132	270.0	1,497	4,912
138	280.0	1,487	4,879
143	290.0	1,479	4,843
149	300.0	1,465	4,807
154	310.0	1,453	4,767
160	320.0	1,440	4,725
166	330.0	1,426	4,679
171	340.0	1,412	4,633
177	350.0	1,398	4,587
182	360.0	1,383	4,538
188	370.0	1,368	4,488
193	380.0	1,353	4,439
199	390.0	1,337	4,387
204	400.0	1,320	4,331
210	410.0	1,320	4,272
216	420.0	1,283	4,210
221	430.0	1,264	4,147
227	440.0	1,244	4,082
232	450.0	1,220	4,003
238	460.0	1,200	3,937
243	470.0	1,180	3,872
249	480.0	1,160	3,806
254	490.0	1,140	3,740
260	500.0	1,110	3,642