

TABLE A-1
Properties of saturated water at atmospheric pressure

Temperature $T, ^\circ\text{C}$	Density $\rho, \text{kg/m}^3$	Viscosity $\mu, \text{mPa} \cdot \text{s}$	Surface tension [‡] $\mathcal{F}, \text{N/m}$	Vapor pressure p_v, kPa	Bulk modulus K, MPa
0	1000	1.792	0.0757	0.61	2062
20	998	1.002	0.0727	2.34	2230
40	992	0.653	0.0696	7.38	2304
60	983	0.467	0.0662	19.92	2301
80	972	0.355	0.0627	47.35	2235
100	958	0.282	0.0589	101.3	2120
150	915	0.182	0.0488	461	1692
200	863	0.136	0.0377	1580	1190
250	797	0.107	0.0261	3970	716
300	707	0.086	0.0144	8560	342
350	487	0.068	0.0038	16,500	82
374 [†]	315	0.019	0.0	22,100	0

[†] Critical point.

[‡] In contact with air.

TABLE A-2
Properties of air at atmospheric pressure

$T, ^\circ\text{C}$	$\rho, \text{kg/m}^3$	$\mu, \mu\text{Pa} \cdot \text{s}$	$k, \text{mW/m} \cdot \text{K}$	$c_p, \text{J/kg} \cdot \text{K}$	Pr
0	1.294	17.2	24.2	1003	0.71
50	1.093	19.5	27.6	1006	0.71
100	0.947	21.7	31.0	1010	0.71
150	0.835	23.8	34.4	1016	0.70
200	0.747	25.7	37.6	1024	0.70
250	0.675	27.6	40.8	1034	0.70
300	0.616	29.3	43.9	1045	0.70
400	0.525	32.5	49.7	1069	0.70
500	0.457	35.5	55.3	1093	0.70
600	0.405	38.3	60.9	1114	0.70
700	0.363	40.9	65.9	1135	0.70
800	0.329	43.4	70.3	1153	0.71
900	0.301	45.7	74.7	1170	0.72
1000	0.277	47.9	78.6	1184	0.72

Source: White (1988).

TABLE A-3
Properties of common liquids at 1 atm and 20°C (68°F)

Liquid	ρ , kg/m ³	μ , kg/(m · s)	\mathcal{F} , N/m*	p_{vs} , N/m ²	Bulk modulus, K, N/m ²
Ammonia	608	2.20E-4	2.13E-2	9.10E+5	—
Benzene	881	6.51E-4	2.88E-2	1.01E+4	1.4E+9
Carbon tetrachloride	1590	9.67E-4	2.70E-2	1.20E+4	9.65E+8
Ethanol	789	1.20E-3	2.28E-2	5.7E+3	9.0E+8
Ethylene glycol	1117	2.14E-2	4.84E-2	1.2E+1	—
Freon 12	1327	2.62E-4	—	—	—
Gasoline	680	2.92E-4	2.16E-2	5.51E+4	9.58E+8
Glycerin	1260	1.49	6.33E-2	1.4E-2	4.34E+9
Kerosene	804	1.92E-3	2.8E-2	3.11E+3	1.6E+9
Mercury	13,550	1.56E-3	4.84E-1	1.1E-3	2.55E+10
Methanol	791	5.98E-4	2.25E-2	1.34E+4	8.3E+8
SAE 10W oil	870	1.04E-1 [‡]	3.6E-2	—	1.31E+9
SAE 10W30 oil	876	1.7E-1 [‡]	—	—	—
SAE 30W oil	891	2.9E-1 [‡]	3.5E-2	—	1.38E+9
SAE 50W oil	902	8.6E-1 [‡]	—	—	—
Water	998	1.00E-3	7.28E-2	2.34E+3	2.19E+9
Seawater (30‰)	1025	1.07E-3	7.28E-2	2.34E+3	2.33E+9

*In contact with air.

[‡]Representative values. The SAE oil classifications allow a viscosity variation of up to ± 50 percent.

TABLE A-4
Properties of common gases at 1 atm and 20°C (68°F)

Gas	Molecular weight	R , m ² /(s ² · K)	ρ_g , N/m ³	μ , N · s/m ²	Specific-heat ratio
H ₂	2.016	4124	0.822	9.05E-6	1.41
He	4.003	2077	1.63	1.97E-5	1.66
H ₂ O	18.02	461	7.35	1.02E-5	1.33
Ar	39.944	208	16.3	2.24E-5	1.67
Dry air	28.97	287	11.8	1.80E-5	1.40
CO ₂	44.01	189	17.9	1.48E-5	1.30
CO	28.01	297	11.4	1.82E-5	1.40
N ₂	28.02	297	11.4	1.76E-5	1.40
O ₂	32.00	260	13.1	2.00E-5	1.40
NO	30.01	277	12.1	1.90E-5	1.40
N ₂ O	44.02	189	17.9	1.45E-5	1.31
Cl ₂	70.91	117	28.9	1.03E-5	1.34
CH ₄	16.04	518	6.54	1.34E-5	1.32

TABLE A-5
Critical-point constants for common fluids

Substance	Molecular weight	T_c , °R	p_c , atm	μ_c , $\mu\text{Pa}\cdot\text{s}$	k_c , $\text{mW}/(\text{m}\cdot\text{K})$
H ₂	2.016	60.0	12.8	3.47	90.0
He	4.003	9.47	2.26	2.54	20.8
Ar	39.944	272	48.0	26.4	29.8
Air	28.97 [†]	238 [†]	36.4 [†]	19.3 [†]	38.1 [†]
CO ₂	44.01	548	72.9	34.3	51.1
CO	28.01	239	34.5	19.0	36.2
N ₂	28.02	227	33.5	18.0	36.3
O ₂	32.00	278	49.7	25.0	44.1
NO	30.01	324	64	25.8	49.5
N ₂ O	44.02	557	71.7	33.2	54.9
Cl ₂	70.91	751	76.1	42.0	40.7
CH ₄	16.04	343	45.8	15.9	66.1

[†] Values for air are pseudocritical properties computed for the average composition of sea-level dry air.

TABLE A-6
Sutherland and power-law constants for gas viscosity

Gas	T_0 , °R	μ_0 , slugs/ft·h	S , °R	n
Ammonia	491.6	0.000722	679	0.981
Chlorine	491.6	0.000970	585	1.00
Deuterium	545.7	0.000974		0.699
Ethylene	491.6	0.000722	407	
Helium	491.6	0.001406	143	0.666
Hydrogen chloride	491.6	0.001030	643	1.03
Hydrogen sulfide	491.6	0.000880	596	
Krypton	491.6	0.001744	338	
Methane	491.6	0.000902	356	0.873
Methyl chloride	491.6	0.000743	817	
Neon	491.6	0.002233	110	0.657
Nitric oxide	491.6	0.001346	230	0.78
Nitrous oxide	491.6	0.001015	493	0.89
Sulfur dioxide	491.6	0.000880	749	
Xenon	491.6	0.001579	454	

Source: Chapman and Cowling (1970).

TABLE A-7
Molecular parameters for dilute-gas transport
properties, Eqs. (1-33) and (1-41)

Gas	$\sigma, \text{\AA}$	T_e, K
H ₂	2.827	59.7
He	2.551	10.22
Ar	3.542	93.3
Air	3.711	78.6
CO ₂	3.941	195.2
CO	3.690	91.7
O ₂	3.467	106.7
N ₂	3.798	71.4
NO	3.492	116.7
N ₂ O	3.828	232.4
Cl ₂	4.217	316.0
CH ₄	3.758	148.6

Source: R.A. Svehla, *NASA Tech. Rep. R-132*, 1962.