

Tables for Use in Aerosol Physics -- Unit Density

Spheres



Particle Diameter Micrometers μm	Slip Correction Factor (S.C.)	Sedimentation Velocity (cm/sec) v	Corrected Sedimentation Velocity (cm/sec) v (S.C.)	Reynolds Number Terminal Velocity Re	Diffusion Coefficient (cm^2/sec) D	Corrected Diffusion Coefficient (cm^2/sec) D (S.C.)	Mobility (sec/g) B	Corrected Mobility (sec/g) B (S.C.)	Relaxation Time (second) τ	Corrected Relaxation Time (second) τ (S.C.)
0.001	2.1697+02	3.0110-09	6.5330-07	2.0046-15	2.3545-04	5.1084-02	5.8620+09	1.2719+12	3.0694-12	6.6595-10
0.002	1.0877+02	1.2044-08	1.3100-06	1.6037-14	1.1772-04	1.2804-02	2.9310+09	3.1880+11	1.2277-11	1.3354-09
0.003	7.2700+01	2.7099-08	1.9701-06	5.4124-14	7.8482-05	5.7057-03	1.9540+09	1.4206+11	2.7624-11	2.0083-09
0.004	5.4668+01	4.8177-08	2.6337-06	1.2829-13	5.8861-05	3.2179-03	1.4655+09	8.0117+10	4.9110-11	2.6848-09
0.005	4.3850+01	7.5276-08	3.3009-06	2.5057-13	4.7089-05	2.0649-03	1.1724+09	5.1410+10	7.6734-11	3.3648-09
0.006	3.6638+01	1.0840-07	3.9715-06	4.3299-13	3.9241-05	1.4377-03	9.7701+08	3.5796+10	1.1050-10	4.0484-09
0.007	3.1488+01	1.4754-07	4.6457-06	6.8758-13	3.3635-05	1.0591-03	8.3744+08	2.6369+10	1.5040-10	4.7357-09
0.008	2.7625+01	1.9271-07	5.3235-06	1.0264-12	2.9431-05	8.1302-04	7.3276+08	2.0242+10	1.9644-10	5.4266-09
0.009	2.4621+01	2.4390-07	6.0050-06	1.4613-12	2.6161-05	6.4411-04	6.5134+08	1.6037+10	2.4862-10	6.1213-09
0.01	2.2218+01	3.0110-07	6.6901-06	2.0046-12	2.3545-05	5.2312-04	5.8620+08	1.3025+10	<3.0694-10	6.8197-09
0.02	1.1415+01	1.2044-06	1.3749-05	1.6037-11	1.1772-05	1.3438-04	2.9310+08	3.3458+09	1.2277-09	1.4015-08
0.03	7.8247+00	2.7099-06	2.1204-05	5.4124-11	7.8482-06	6.1409-05	1.9540+08	1.5290+09	2.7624-09	2.1615-08
0.04	6.0366+00	4.8177-06	2.9082-05	1.2829-10	5.8861-06	3.5532-05	1.4655+08	8.8466+08	2.7624-09	2.9645-08
0.05	4.9690+00	7.5276-06	3.7405-05	2.5057-10	4.7089-06	2.3399-05	1.1724+08	5.8257+08	4.9110-09	3.8129-08
0.06	4.2613+00	1.0840-05	4.6192-05	4.3299-10	3.9241-06	1.6722-05	9.7701+07	4.1634+08	7.6734-09	4.7087-08
0.07	3.7591+00	1.4754-05	5.5462-05	6.8758-10	3.3635-06	1.2644-05	8.3744+07	3.1480+08	1.1050-08	5.6536-08
0.08	3.3849+00	1.9271-05	6.5230-05	1.0264-09	2.9431-06	9.9621-06	7.3276+07	2.4803+08	1.5040-08	6.6493-08
0.09	3.0960+00	2.4390-05	7.5511-05	1.4613-09	2.6161-06	8.0994-06	6.5134+07	2.0166+08	1.9644-08	7.6973-08
0.1	2.8667+00	3.0110-05	8.6316-05	2.0046-09	2.3545-06	6.7494-06	5.8620+07	1.6804+08	3.0694-08	8.7988-08
0.2	1.8693+00	1.2044-04	2.2514-04	1.6037-08	1.1772-06	2.2006-06	2.9310+07	5.4789+07	1.2277-07	2.2950-07
0.3	1.5611+00	2.7099-04	4.2306-04	5.4124-08	7.8482-07	1.2252-06	1.9540+07	3.0505+07	2.7624-07	4.3125-07
0.4	1.4149+00	4.8177-04	6.8166-04	1.2829-07	5.8861-07	8.3283-07	1.4655+07	2.0736+07	4.9110-07	6.9486-07
0.5	1.3299+00	7.5276-04	1.0011-03	2.5057-07	4.7089-07	6.2623-07	1.1724+07	1.5592+07	7.6734-07	1.0205-06
0.6	1.2742+00	1.0840-03	1.3812-03	4.3299-07	3.9241-07	4.9999-07	9.7701+06	1.2449+07	1.1050-06	1.4079-06
0.7	1.2347+00	1.4754-03	1.8217-03	6.8758-07	3.3635-07	4.1531-07	8.3744+06	1.0340+07	1.5040-06	1.8570-06
0.8	1.2053+00	1.9271-03	2.3227-03	1.0264-06	2.9431-07	3.5472-07	7.3276+06	8.8318+06	1.9644-06	2.3677-06
0.9	1.1824+00	2.4390-03	2.8839-03	1.4613-06	2.6161-07	3.0933-07	6.5134+06	7.7017+06	2.4862-06	2.9398-06
1	1.1642+00	3.0010-03	3.5054-03	2.0046-06	2.3545-07	2.7410-07	<5.8620+06	6.8245+06	3.0694-06	3.5733-06
2	1.0821+00	1.2044-02	1.3033-02	1.6037-05	1.1772-07	1.2739-07	2.9310+06	3.1716+06	1.2277-05	1.3285-05
3	1.0547+00	2.7099-02	2.8582-02	5.4124-05	7.8482-08	8.2777-08	1.9540+06	2.0609+06	2.7624-05	2.9136-05
4	1.0410+00	4.8177-02	5.0154-02	1.2829-04	5.8861-08	6.1277-08	1.4655+06	1.5257+06	4.9110-05	5.1125-05
5	1.0328+00	7.5276-02	7.7748-02	2.5057-04	4.7089-08	4.8635-08	1.1724+06	1.2109+06	7.6734-05	7.9265-05
6	1.0274+00	1.0840-01	1.1136-01	4.3299-04	3.9241-08	4.0315-08	9.7701+05	1.0037+06	1.1050-04	1.1352-04
7	1.0235+00	1.4754-01	1.5100-01	6.8758-04	3.3635-08	3.4424-08	8.3744+05	8.5707+05	1.5040-04	1.5393-04
8	1.0205+00	1.9271-01	1.9666-01	1.0264-03	2.9431-08	3.0035-08	7.3276+05	7.4779+05	1.9644-04	2.0047-04
9	1.0182+00	2.4390-01	2.4834-01	1.4613-03	2.6161-08	2.6638-08	6.5134+05	6.6322+05	2.4862-04	2.5315-04
10	1.0164+00	3.0110-01	3.0605-01	2.0046-03	2.3545-08	2.3931-08	5.8620+05	5.9583+05	3.0694-04	3.1198-04
20	1.0082+00	1.2018+00	1.2117+00	1.6002-02	1.1772-08	1.1869-08	2.9310+05	2.9551+05	1.2277-03	1.2378-03
30	1.0055+00	2.6904+00	2.7051+00	5.3734-02	7.8482-09	7.8911-09	1.9540+05	1.9647+05	2.7624-03	2.7775-03
40	1.0041+00	4.7367+00	4.7561+00	1.2614-01	5.8861-09	5.9103-09	1.4655+05	1.4715+05	4.9110-03	4.9311-03
50	1.0033+00	7.2867+00	7.3106+00	2.4255-01	4.7089-09	4.7244-09	1.1724+05	1.1763+05	7.6734-03	7.6986-03
60	1.0027+00	1.0263+01	1.0291+01	4.0994-01	3.9241-09	3.9348-09	9.7701+04	9.7968+04	1.1050-02	1.1080-02
70	1.0023+00	1.3572+01	1.3604+01	6.3250-01	3.3635-09	3.3714-09	8.3744+04	8.3940+04	1.5040-02	1.5075-02
80	1.0021+00	1.7127+01	1.7162+01	9.1217-01	2.9431-09	2.9491-09	7.3276+04	7.3426+04	1.9644-02	1.9684-02
90	1.0018+00	2.0870+01	2.0908+01	1.2505+00	2.6161-09	2.6208-09	6.5134+04	6.5253+04	2.4862-02	2.4907-02
100	1.0016+00	2.4803+01	2.4844+01	1.6512+00	2.3545-09	2.3583-09	5.8620+04	5.8717+04	3.0694-02	3.0744-02

Note: Exponents are presented in computer format. Thus, 1.0291+01 = 1.0291 x 10¹ = 10.291 and 1.6002-02 = 1.6002 x 10⁻² = 0.016002.

Basis for the Table

Physical constants used in the making of the table:

$$\lambda = 6.53 \times 10^{-6} \text{ cm} = \text{mean free path of gas molecules in air}$$

$$\eta = 1.810 \times 10^{-4} \text{ poise} = \text{viscosity of air}$$

$$k = 1.3708 \times 10^{-16} \text{ erg/}^\circ\text{C} = \text{Boltzmann's constant}$$

$$T = 293^\circ\text{K} = \text{absolute temperature (20}^\circ\text{C)}$$

$$\rho = 1 \text{ g/cm}^3 = \text{particle density}$$

$$\rho' = 1.205 \times 10^{-3} \text{ g/cm}^3 = \text{density of air}$$

$$g = 981 \text{ cm/sec}^2 = \text{acceleration due to gravity}$$

Slip Correction Factor¹

$$\text{S.C.} = 1 + \frac{2A\lambda}{d}$$

$$A = 1.257 + 0.400 \exp(-1.10 d/2\lambda)$$

Mobility²

$$B = (3\pi \eta d)^{-1}$$

Diffusion Coefficient²

$$D = kBT$$

Relaxation Time³

$$\tau = d^2 \rho / 18\eta$$

Reynolds Number (Terminal Velocity)²

$$Re = C_D Re^2 / 24 = \rho \rho' g d^3 / 18\eta^2$$

Note: C_D = drag coefficient

Sedimentation Velocity²

1. For values of Re up to 0.05: $v = (\rho - \rho') g d^2 / 18\eta$

2. For values of Re from 0.05 to 4: $v = \left[C_D Re^2 / 24 - 2.3368 \cdot 10^{-4} (C_D Re^2)^2 + 2.0154 \cdot 10^{-6} (C_D Re^2)^3 - 6.9105 \cdot 10^{-9} (C_D Re^2)^4 \right] \eta / \rho' d$

1. Davies, C.N.: Definitive Equations for the Fluid Resistance of Spheres. The Proceedings of the Physical Society, Vol 57, Pt 4, No. 322 (1 July 1945).
2. Green, H.L. and Lane, W.R.: Particulate Clouds: Dusts, Smokes and Mists. E.&F.N. Spon Ltd., London, 1964 (2nd edition).
3. Davies, C.N. (ed.): Aerosol Science. Academic Press, London, 1966.