NASA TECHNICAL NOTE

NASA TN D-2525

c.1

NASA TN D-2525

NASA ENGINEERING MODELS OF THE MARS ATMOSPHERE FOR ENTRY VEHICLE DESIGN

Edited by George M. Levin, Dallas E. Evans, and Victor Stevens

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • NOVEMBER 1964

NASA ENGINEERING MODELS OF THE MARS ATMOSPHERE FOR ENTRY VEHICLE DESIGN

Edited by
George M. Levin, Dallas E. Evans,
and
Victor Stevens

NASA Headquarters
Washington, D. C.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

For sale by the Office of Technical Services, Department of Commerce, Washington, D.C. 20230 -- Price $1.50

This document was prepared by the

ad hoc Planetary Atmospheres Committee

of the

Office of Advanced Research and Technology

George M. Levin, Chairman
Goddard Space Flight Center

Fred DeMeritte
NASA Headquarters

Dallas E. Evans
Manned Spacecraft Center

Edwin Pounder
Jet Propulsion Laboratory

Robert E. Smith
Marshall Space Flight Center

Victor Stevens
Ames Research Center

SUMMARY

In an effort to standardize atmosphere models used in Mars mission analyses and thus facilitate interpretation of such analyses, tentative engineering models for the Mars atmosphere are proposed. The emphasis here is on the entry aspect of the mission. Three models having pressures at the planet's surface of 10, 25, and 40 mb are presented in both tabular and graphic form. An atmosphere model for use in terminal descent calculations is also presented. The atmosphere models are presented in both english and metric units in terms of eight variables as a function of altitude. These model atmospheres are based, insofar as possible, on experimentally obtained data and are not envelopes drawn around existing models of the Mars atmosphere.

INTRODUCTION

Uncertainties in the structure and chemical composition of the Mars atmosphere present a problem of growing importance in Mars mission analyses. Lack of definitive data has permitted construction of numerous equally plausible models of the atmosphere. As a result, various analyses of entry into the Mars atmosphere are often based upon widely differing atmosphere models. Since it is well known that important results of such analyses, e.g., heating, loads, landing techniques, are functions of the atmosphere structure and composition, interpretation of the results and comparison with results of other analyses are often clouded by the choice of atmosphere.

Obviously additional observations and direct measurements of the Mars atmosphere are badly needed to define the structure and composition with accuracy. Such data are required for intelligent interpretation and refinement of mission analyses and, ultimately, for the design of vehicles to enter the Mars atmosphere. Unfortunately, acquisition of the required observations takes time. Until better scientific data become available, considerable benefit can be derived from standardizing on certain atmosphere models for entry analyses.

It is the purpose of this report to present three tentative models - a maximum, a minimum, and a mean. An atmosphere model for terminal descent calculations is also presented in Appendix D. It is not the intent to present new scientific models of the Mars atmosphere, but rather to present reasonable standardized models which will be useful in engineering studies.

DEVELOPMENT OF ENGINEERING MODELS

Atmosphere Parameters Important in Entry Analysis

Before establishing atmosphere parameters important in entry analysis, it is instructive to examine some of the current models of the Mars atmosphere. Twelve current atmosphere models are shown in Figure 1. Although this is not a comprehensive presentation of all existing models of the Mars atmosphere, it is representative and demonstrates the extremely wide differences in temperature, pressure, density, and composition for the various models. Each of these parameters has an influence on the Mars mission; however, certain of them may exert a critical influence and thus deserve special attention. For example:

1. The density structure (or density scale height which is an increment in altitude required to produce a change in density by a factor of e) is important in determining the heating experienced by the entry body. Scale height also strongly influences the entry guidance requirements and the entry loads.

2. The density and pressure near the surface of the planet are vital factors in determining the terminal descent and landing. The configuration of the entry vehicle may also be dictated by these factors.

3. The chemical composition of the atmosphere determines to a large extent the radiative heating experienced by the entry body. It may also significantly affect radio communications during entry.

It is thus evident that (1) density structure, surface pressure, and composition are key factors in entry analysis and (2) values of these parameters are widely different for the models shown in Figure 1.

Since little reliable data exist on which to base a scientifically accurate model, most of the existing models differ due to varied interpretations of the limited data. It therefore becomes exceedingly difficult to settle on any one model for the Mars atmosphere. Until more definitive data become available, it seems appropriate to develop models which represent reasonable extremes and to conservatively design entry capsules to cope with these extremes. Accordingly, the atmosphere models presented herein were developed on the basis of current information to produce reasonable extremes in composition, surface pressure, and scale height. The development of these models was strongly influenced by the recent disclosures of Kaplan et al (Ref 1), and Kuiper (Ref 2) concerning the surface pressure and composition of the Mars atmosphere.

Calculation Procedure

Three models of the Mars atmosphere have been developed - two extremes and a mean. These models were generated by a computer program in use at the Manned Spacecraft Center. In principle, the temperature profile, the surface pressure, the composition, and the acceleration of gravity at the planet's surface were specified. The values of density, pressure, speed of sound, density scale height, mean free path, viscosity, and kinematic viscosity were calculated using the expressions in Appendix B.

The inputs to the computer program for the three models were as follows:

	Model 1	Model 2	Model 3
Surface Pressure, mb	40	25	10
Composition, % by mass CO_2	7 1/2	16	60
N_2	92 1/2	84	40
Surface Temp., ^{o}K	300	250	200
Troposphere Lapse Rate, $^{o}K/km$	-3.64	-3.89	-4.55
Stratosphere Temp., ^{o}K	260	180	100
Top of Stratosphere, km	150	150	150
Thermosphere Lapse Rate, $^{o}K/km$	2	2	---
Surface Gravity, cm/sec^2	375	375	375

It should be noted that the pressures and compositions* quoted were derived from the same set of scientific measurements (Ref 1); however, the values given for the temperature structure were

*The pressures of various constituents listed in Table 2 of Reference 1 are referred to in that paper as partial pressures even though it was made clear in the discussion of equation 11 of that paper that this partial pressure is the weight of a constituent in the atmosphere per unit area, and thus represents the mass density of the gas rather than the number density. For convenience both mass and volume compositions are listed in Table I of the present report.

derived independently from the literature. Combinations of pressure-composition data with temperature structure data were arbitrarily chosen to produce extreme models. For example, combining the highest surface pressure with the temperature structure giving the highest temperatures produces a model with the maximum pressure and density for any given altitude, and of course, a model with the maximum scale height--this is labeled maximum or model 1. It should be emphasized in choosing the inputs to the computer program that there is no physical basis for any correlation between surface temperature and surface pressure.

The surface pressures were based on the work of Kaplan, et al (Ref 1). Recent analysis by Kuiper (Ref 2) gives values of surface pressure in close agreement with the lower pressures published in Reference 1.

Although the evidence on chemical composition is not conclusive, it is generally agreed that carbon dioxide is the only gas detected in large quantities in the Mars atmosphere. The values given for carbon dioxide were taken from Reference 1. For the purposes of determining values of molecular weight and other constants required in the calculations, it is assumed the remainder of the gas is nitrogen. It is recognized that other gases such as argon (Ref 1), oxides of nitrogen (Refs 7 and 18), water vapor (Refs 1, 3, 8, 9, and 13), and oxygen (Ref 1), to name a few, may be present, but these quantities are probably small.

The surface temperatures chosen are representative of those given in the current literature and bracket known seasonal, diurnal, and latitudinal variations (Refs 4, 5, and 6). The lapse rates quoted for the troposphere are the dry adiabatic lapse rates for the compositions given for specific heats based on the average temperature in this region. The stratosphere temperatures given are representative values drawn from the current literature (for example, Refs 16 and 17). The height of the base of the thermosphere was based on values given by Goody in Reference 10. The thermosphere lapse rate was based on a representative value given by Vachon (Ref 11). The acceleration of gravity used is a representative value given in the literature (Refs 12 and 16).

PRESENTATION AND DISCUSSION OF

ENGINEERING MODELS

The proposed engineering models of the Mars atmosphere are presented in both tabular and graphical form. Summarized in Table I are the values of the primary parameters which characterize each model. The model atmospheres are presented in Tables II, III, and IV in both metric and english units. They are presented in terms of eight variables as a function of altitude in increments of one kilometer from the surface to one hundred kilometers; in increments of ten kilometers from one hundred to one thousand kilometers; and in increments of fifty kilometers above one thousand kilometers. Calculations and listings for these three tables were arbitrarily terminated at altitudes where the density fell to 10^{-14} gm/cm^3 since densities of this order or less are of little interest in entry analyses.

The values for the reduced collision integral $[\Omega^{(2,2)*}]$ (Ref. 19) used in the calculation of the viscosity and the kinematic viscosity are not valid above temperatures of 300°K; thus values of viscosity and kinematic viscosity do not appear in the tables for altitudes corresponding to temperatures above this ambient value.

Profiles of temperature, pressure, and density are illustrated in Figures 2a,b,c. Figure 2d shows the three density profiles normalized to earth sea level density.

Figure 3 shows how these three models compare with previous models of the Mars atmosphere. The major differences between these models and previous models of the Mars atmosphere are the surface pressures and atmospheric compositions that were assumed. These new lower surface pressures cause the density at any given altitude to be lower than those given in previous model atmospheres; however, it should be noted that a minimum surface density using the parameters selected is not included in these models. From Figure 3 it can be seen that the maximum and minimum scale heights remain essentially unchanged.

If a surface pressure of 10 millibars is combined with a 300°K surface temperature, a density of 50% less than that shown on model 3 would be derived. This atmosphere for use in terminal descent calculations is discussed in Appendix D and is shown in Figure 4.

It should be noted that in calculating the foregoing results the variation in gravity with altitude was included. When the atmosphere is relatively deep compared to the planet's radius, as it is in the case of Mars, then this variation of gravity can be important in determining the pressure and density structure over an extreme range of altitude. However, for many entry calculations it is only the lower atmosphere structure for a relatively small range of altitude that is important; hence assumptions of constant gravity for calculation of atmosphere structure should not introduce significant error. For this case, simple analytic expressions for the density structure in the troposphere and stratosphere regions can be derived from the basic equations of Appendix B. Since such expressions are often convenient to use in machine programmed entry calculations they are presented in Appendix C together with the pertinent constants for the three Mars atmospheres. Models were calculated using these expressions. When plotted to the scale of Figure 2c the results are essentially coincident with those obtained using variable gravity.

The proposed atmosphere models should be useful in mission analysis and design studies provided proper consideration is given to their limitations. As stated previously, it was assumed (primarily for the purpose of calculating pressure and density profiles) that the chemical composition was limited to CO_2-N_2 mixtures. Although argon has never been detected in the Mars atmosphere, Kaplan et al (Ref. 1) reason on the basis of abundance arguments that argon may be present in significant amounts. The presence of argon would have little effect on the density and pressure profile; however, it may importantly affect the plasma sheath surrounding a vehicle during entry, hence affect radiative heating and radio communications. In contrast, the assumed temperature profile directly affects the scale height and density profile. Temperatures near the surface of Mars are believed to be relatively accurate. Temperatures in the isothermal or even the assumption that an isothermal region exists are not so reliable. Due to these uncertainties quite extreme temperatures were chosen for the maximum and minimum profiles. It is reasonable to expect then that the density profiles and scale heights for the three atmosphere models will encompass the profile and scale height for the real Mars atmosphere. Despite these shortcomings, it is recommended that these models be accepted as a tentative standard until more definite data are available on the Mars atmosphere.

CONCLUDING REMARKS

The engineering models of the Mars atmosphere presented in this report are based on the latest data on the Mars atmosphere known to the authors. They have been developed to represent reasonable extremes of the Mars atmosphere for entry analysis. It is therefore recommended that these models be used in any further NASA-sponsored analyses of Mars atmosphere entry.

Designing entry vehicles to the worst combination of conditions described by these models unfortunately leads to design compromises and weight penalties. It is evident that additional scientific data on the Mars atmosphere are needed to eliminate the need for these compromises and the attendant weight penalties. When improved observational data are obtained that significantly reduce the Mars atmosphere uncertainties, the models presented herein should be revised.

REFERENCES

1. Kaplan, Lewis D., Munch, Guido, and Spinrad, Hyron: An Analysis of the Spectrum of Mars. Astrophysical Journal, Vol. 139, No. 1, Jan. 1964.

2. Kuiper, Gerard P.: Fifth Semiannual Status Report to National Aeronautics and Space Administration Lunar and Planetary Laboratory, University of Arizona Research Grant No. NsG 161-61, Dec. 1963.

3. Spinrad, Hyron, Munch, Guido, and Kaplan, Lewis D.: The Detection of Water Vapor on Mars. Astrophysical Journal, Vol. 137, No. 4, May 1963.

4. Gifford, F.: The Surface Temperature Climate of Mars. Astrophysical Journal, Vol. 123, 1956, pp. 154-161.

5. Kellogg, William W., and Sagan, Carl: The Atmospheres of Mars and Venus. National Academy of Sciences Publication 944, 1961.

6. Rasool, S. I., and Jastrow, Robert: The Atmospheres of Mars, Venus and Jupiter. Goddard Institute for Space Studies - NASA, 1963.

7. Kiess, C. C., Karrer, S., Kiess, H. K.: A New Interpretation of Martian Phenomena. Astronomical Society of the Pacific, Vol. 27, No. 427, Aug. 1960, pp. 256-267.

8. Sagan, Carl: The Abundance of Water Vapor on Mars. Astron. J., 66: 52, 1961a.

9. de Vaucouleurs, G.: Physics of the Planet Mars. Farber and Farber, London, 1954.

10. Goody, R. M.: The Atmosphere of Mars. Weather, Vol. 12, 1957, pp. 3-15.

11. Vachon, D. N.: The Density Structure of the Upper Atmosphere of Mars. General Electric TIS R62SD58, May 1962.

REFERENCES(Cont'd)

12. Zimmerman, R. H., and Jones, C. D.: Flight Environment Design Parameters for Mars and Venus. Prepared for USAF Wright-Patterson by the Ohio State University Research Foundation, Technical Documentary Report No. ASD-TDR-62-805, Sept. 1962.

13. Kellogg, W. S.: Mars, International Science and Technology, Feb. 1964, pp. 40-48.

14. Evans, D. C., and Wasko, P. E.: Model Atmospheres for the Planet Mars. Douglas Aircraft Company Report SM-44552, August 1963.

15. Schilling, Gerhard, F.: A Note on the Upper Atmosphere of Mars. Journal of Geophysical Res. Vol. 68, No. 16, August 1963, pp. 4875-4876.

16. Schilling, Gerhard F.: Limiting Model Atmospheres of Mars. Rand Corp. R-402-JPL, August 1962.

17. Schilling, Gerhard F.: Extreme Model Atmospheres of Mars. Rand Corp. RM-2782-JPL, June 1961.

18. Sinton, William W.: An Upper Limit to the Concentration of NO_2 and N_2O_4 in the Martian Atmosphere. Astronomical Society of the Pacific, Vol. 73, No. 431, April 1961, pp. 125-128.

19. Brokaw, Richard S.: Alignment Charts for Transport Properties Viscosity, Thermal Conductivity, and Diffusion Coefficient for Nonpolar Gases and Gas Mixtures at Low Density, NASA TR R-81, 1961.

APPENDIX A

LIST OF SYMBOLS

a	-	speed of sound
C_p	-	specific heat at constant pressure
C_v	-	specific heat at constant volume
g	-	local acceleration of gravity
H_ρ	-	density scale height
L	-	mean free path
m	-	molecular weight
N	-	Avagardro's number
p	-	pressure
r_o	-	planet radius
R	-	Universal gas constant
T	-	temperature
X	-	mole fractions of gas
Z	-	height above the surface
γ	-	ratio of specific heats
η	-	kinematic viscosity
μ	-	viscosity
ν	-	number of gas components
ρ	-	density
ρ_{ref}	-	reference density ($\rho = \rho_{ref}\, e^{-\frac{Z}{H_\rho}}$)
$\bar{\sigma}$	-	average effective collision diameter for gas mixture
σ	-	zero energy collision diameter for a gas
Φ	-	coefficients for calculating viscosity
$\Omega^{(2,2)*}$	-	reduced collisional integral

Subscripts

i,j	-	components i and j of a mixture
mix	-	entire mixture
o	-	denotes surface condition
strat	-	denotes stratosphere condition
$\oplus$	-	earth

APPENDIX B

SUMMARY OF METHOD OF COMPUTING MODEL ATMOSPHERE PARAMETERS

The results presented in Tables II, III and IV were calculated using the inputs from Table I and the equations presented here. The calculation of atmosphere parameters was based on a numerical integration of the hydrostatic equation:

$$dp = -g \rho dZ$$

The following assumptions were contained within the integration:

(1) Gravity varies as:

$$g = \left(\frac{r_o}{r_o + Z}\right)^2 g_o$$

(2) The gas mixture follows the perfect gas equation of state:

$$\rho = \frac{pm}{RT}$$

(3) The temperature varies with altitude by a series of constant lapse rates (depending on the altitude range) as illustrated by Figure 2A.

With p, ρ and T thus determined as functions of altitude, the following additional quantities may be computed:

Speed of Sound $$a = \left[\gamma \frac{R}{m} T\right]^{1/2}$$

Density Scale Height $$H_\rho = \frac{RT}{mg + R\frac{\partial T}{\partial Z}}$$

Mean Free Path
$$L = \frac{RT}{2^{1/2}\pi N\sigma^2 p}$$

Viscosity (for the mixture)
$$\mu_{mix} = \sum_{i=1}^{\nu} \frac{\mu_i}{1 + \sum_{\substack{j=1 \\ j\neq i}}^{\nu} \Phi_{i,j} \frac{x_j}{x_i}}$$

where
$$\Phi_{i,j} = \frac{\left[1 + \left(\frac{\mu_i}{\mu_j}\right)^{1/2} \left(\frac{m_j}{m_i}\right)^{1/4}\right]^2}{2\sqrt{2}\left(1 + \frac{m_i}{m_j}\right)^{1/2}}$$

$$\mu_i \times 10^6 = 26.693 \frac{\sqrt{mT}}{\sigma^2 \Omega^{(2,2)*}}$$

(Values of $\Omega^{(2,2)*}$ were obtained from ref. 19)

Kinematic Viscosity
$$\eta = \mu/\rho$$

APPENDIX C

ANALYTIC APPROXIMATIONS TO THE ENGINEERING MODELS

If the acceleration of gravity is assumed constant, then analytic expressions can be written for the density variation with altitude in the troposphere and the stratosphere regions. For the troposphere, the density is given by

$$\rho = \rho_o \left(1 + \frac{\Gamma Z}{T_o}\right)^{\frac{1}{\gamma - 1}}$$

where

$$\Gamma = -\frac{mg}{R}\left(\frac{\gamma - 1}{\gamma}\right)$$

For the stratosphere, the density is given by

$$\rho = \rho_{ref}\, e^{-Z/H_{\rho_{strat}}}$$

where

$$\rho_{ref} = \rho_o \left(\frac{T_{strat}}{T_o}\right)^{\frac{1}{\gamma - 1}} e^{\frac{\gamma}{\gamma - 1}\left(\frac{T_o}{T_{strat}} - 1\right)}$$

and

$$H_{\rho_{strat}} = \frac{RT_{strat}}{mg_{strat}}$$

Values of the parameters in the above expressions chosen to represent the engineering models are as follows:

APPENDIX C (Continued)

Parameter	Units	Model 1	Model 2	Model 3
Molecular wt., m	---	28.8	29.7	35.8
Acceleration of gravity, g				
Troposphere (Value @ surface)	cm/sec^2	375	375	375
Stratosphere (Value @ Z=75 km)		359	359	359
Universal gas constant, R	$m^2/sec^2\ {}^oK$	8315	8315	8315
Ratio of specific heats, γ	---	1.4	1.4	1.4
Troposphere lapse rate, Γ	$^oK/km$	-3.64	-3.89	-4.55
Surface density, ρ_o	gm/cm^3	4.62×10^{-5}	3.57×10^{-5}	2.15×10^{-5}
Reference density, ρ_{ref}	gm/cm^3	5.28×10^{-5}	5.69×10^{-5}	1.09×10^{-4}
Surface temperature, T_o	^oK	300	250	200
Stratosphere temperature, T_{strat}	^oK	260	180	100
Density scale height, $H_{\rho_{strat}}$	km	20.9	14.0	6.5

APPENDIX D

AN ATMOSPHERE MODEL FOR TERMINAL DESCENT CALCULATIONS

An alternate model atmosphere for use in the design of a retardation system for terminal descent may also be postulated. This model is generated by substituting a surface temperature of 300°K in place of the 200°K surface temperature in model 3 and keeping the same surface pressure and the same composition. The result is a model that has a higher atmosphere density at altitudes above 15 km, but at altitudes below 15 km the atmosphere density is lower than that of model 3 (see Figure 4). Equations are given below for the density in the troposphere and stratosphere regions in both metric and english units. These were obtained by substituting the appropriate values in the equations of Appendix C.

Metric Units

Troposphere region (below 46 km)

$$\rho = 1.44 \times 10^{-5} (1 - 0.0145 Z)^{2.50} \quad gm/cm^3$$

Stratosphere region (above 46 km)

$$\rho = 8.64 \times 10^{-4} e^{-\frac{Z}{6.5}} \quad gm/cm^3$$

(note Z is in km)

English Units

Troposphere region (below 150,900 ft)

$$\rho = 2.79 \times 10^{-5} (1 - 4.41 \times 10^{-6} Z)^{2.50} \quad slugs/ft^3$$

Stratosphere region (above 150,900 ft)

$$\rho = 2.0 \times 10^{-3} e^{\frac{-Z}{21,000}} \quad slugs/ft^3$$

(Note Z is in ft)

TABLE OF ATMOSPHERES FOR FIGURE 1

1. Rand Report, Rm-2782-JPL (June 1961) Model Atm. I (Max) (convective equilib. throughout atm.) — p_o = 132.6 mb

2. Manned Spacecraft Center Model II 9/25/63 — p_o = 132.6 mb

3. Rand Report, Rm-2782-JPL (June 1961 Model Atm. II (Max) (convective equilib. to tropopause + conductive equilib. above) — p_o = 132.6 mb

4. Rand Report, Rm-2782-JPL (June 1961) Model Atm. III (conjectural atm.) — p_o = 85.125 mb

5. Rand Report, Rm-2782-JPL (June 1961) Model Atm. I (Min) (convective equilib. through atm.) — p_o = 41.04 mb

6. Douglas Report, Sm-44552 (August 1963) Pressure Profile No. 8; M = 28.0 — p_o = 162 mb

7. Douglas Report, Sm-44552 (August 1963) Pressure Profile No. 6; M = 28.0 — p_o = 85 mb

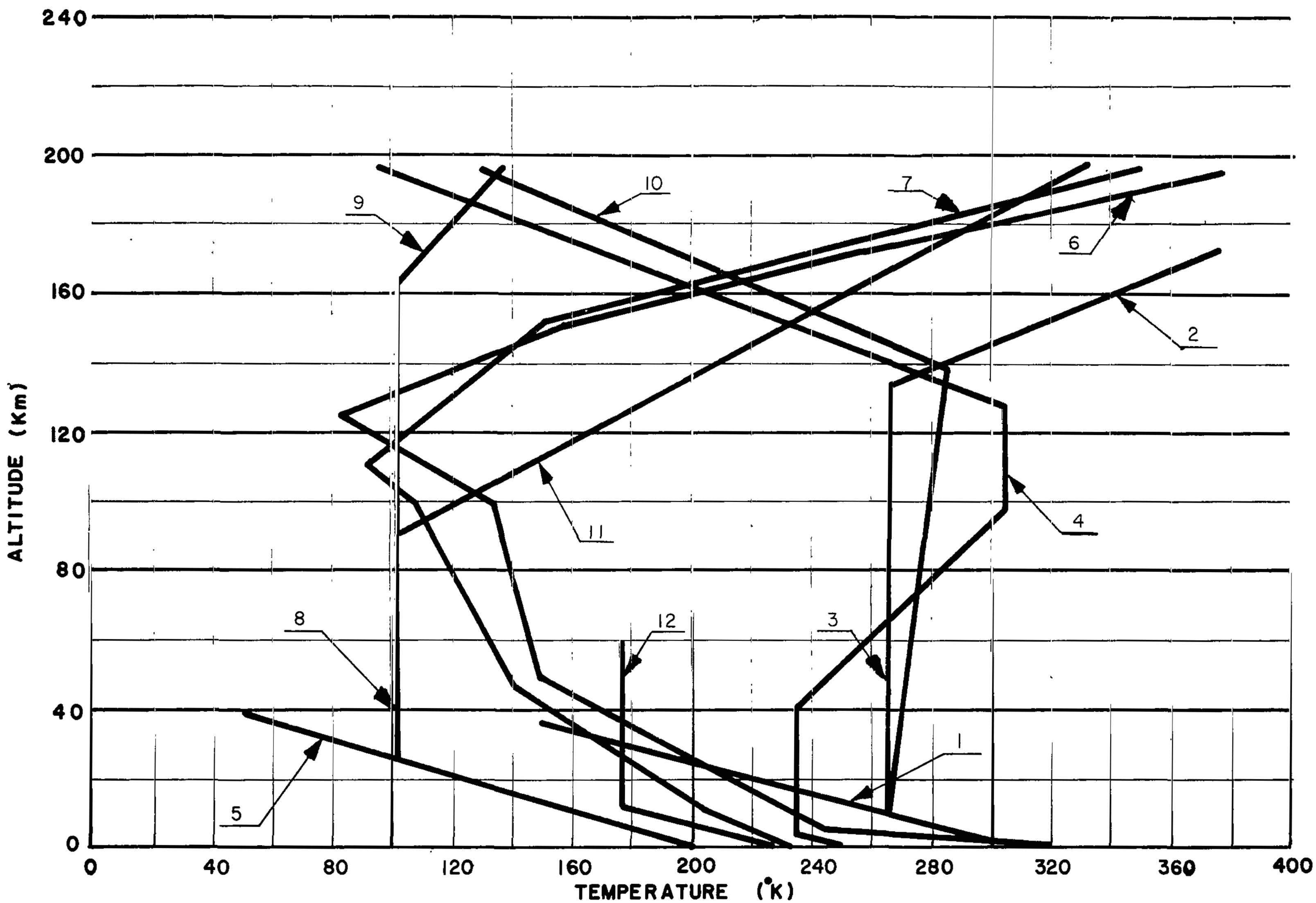
8. Rand Report, Rm-2782-JPL (June 1961) Model Atm. II (Min) (convective equilib. to tropopause & conductive equilib. above) — p_o = 41.04 mb

9. Manned Spacecraft Center Model II 9/25/63 Lower Limit 90%N_2-10%CO_2 — p_o = 41.04 mb

10. A Note on the Upper Atmos. of Mars (August 1963) J. of Geophysical Research (G. F. Schilling) Vol. 68, No. 16 Extension of Model II Atmos. (Max) — p_o = 132.6 mb

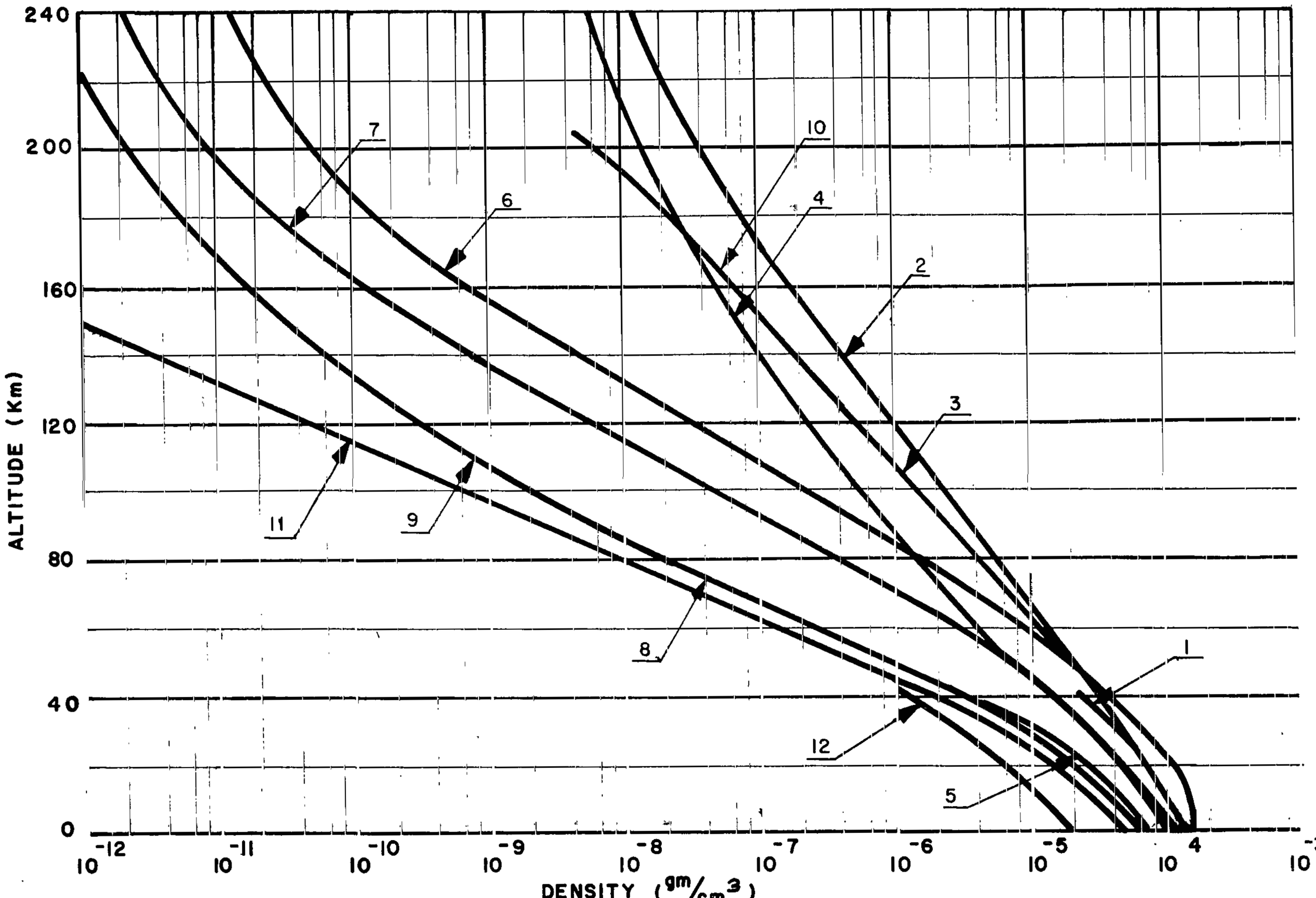
11. A Note on the Upper Atmos. of Mars (August 1963) J. of Geophysical Research (G. F. Schilling) Vol. 68, No. 16 Extension of Model II Atmos. (Min) — p_o = 41.04 mb

12. JPL Atmosphere "N" (Nov. 1963) 38.3% CO_2-61.7% N_2 — p_o = 15.0 mb



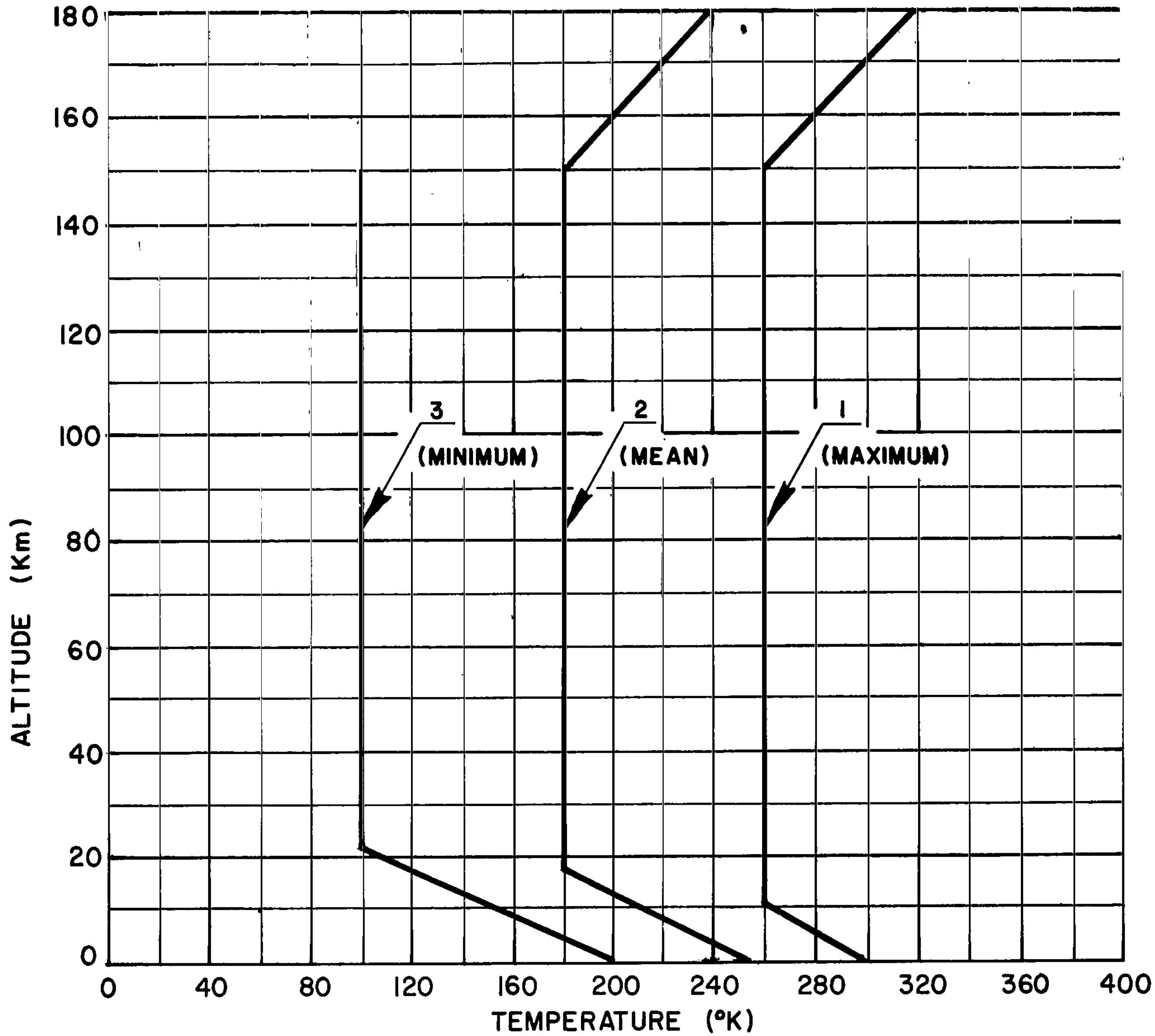
a - ALTITUDE Vs. TEMPERATURE

FIGURE 1 SOME CURRENT MODELS OF THE MARS ATMOSPHERE



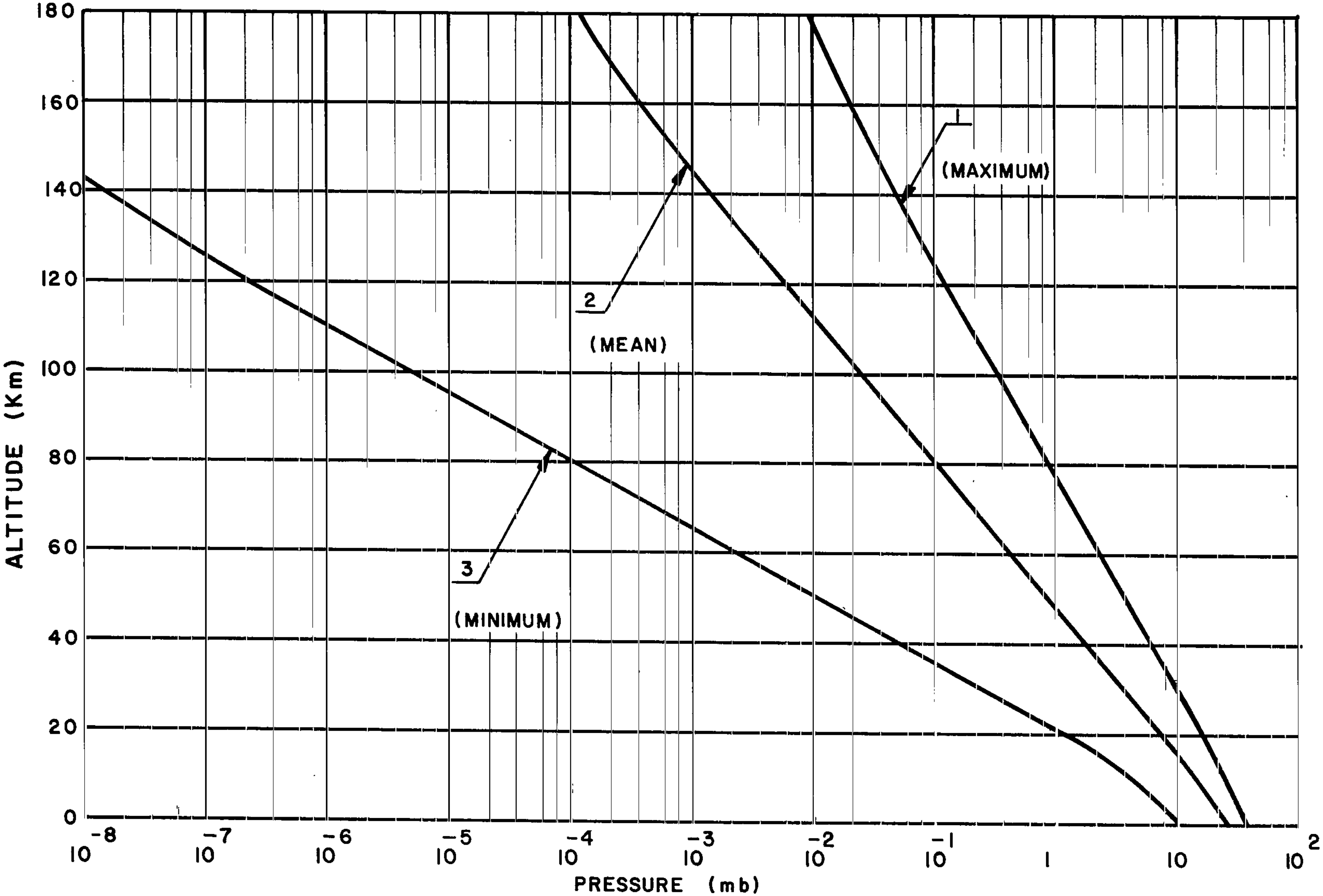
b - ALTITUDE Vs DENSITY

FIGURE I (CONCLUDED)

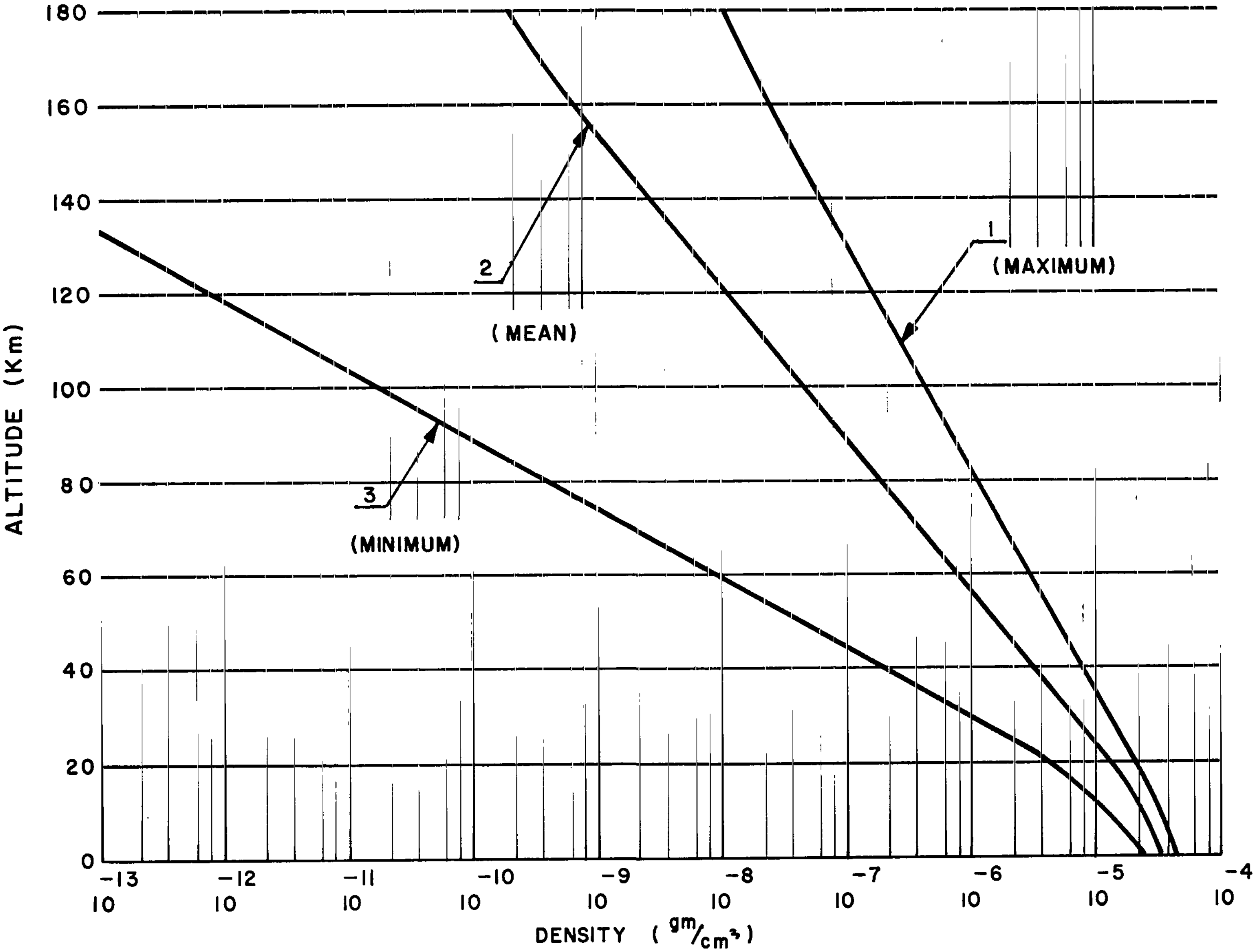


a - ALTITUDE Vs TEMPERATURE

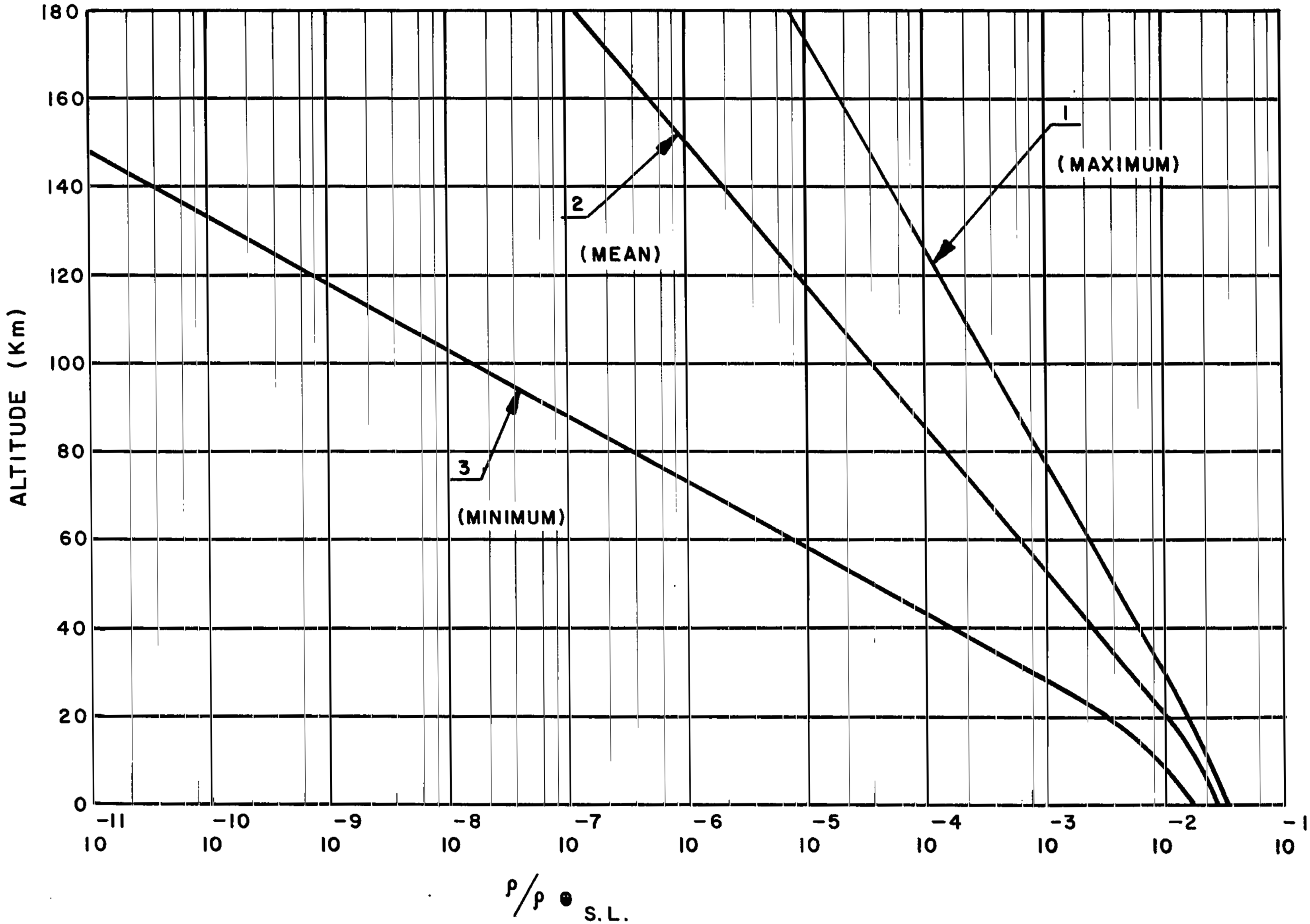
FIGURE 2 NASA ENGINEERING MODELS OF THE MARS ATMOSPHERE



b- ALTITUDE Vs PRESSURE
FIGURE 2 (CONTINUED)



c- ALTITUDE Vs DENSITY
FIGURE 2 (CONTINUED)



d- DENSITY PROFILE NORMALIZED TO EARTH SEA LEVEL DENSITY

FIGURE 2 (CONCLUDED)

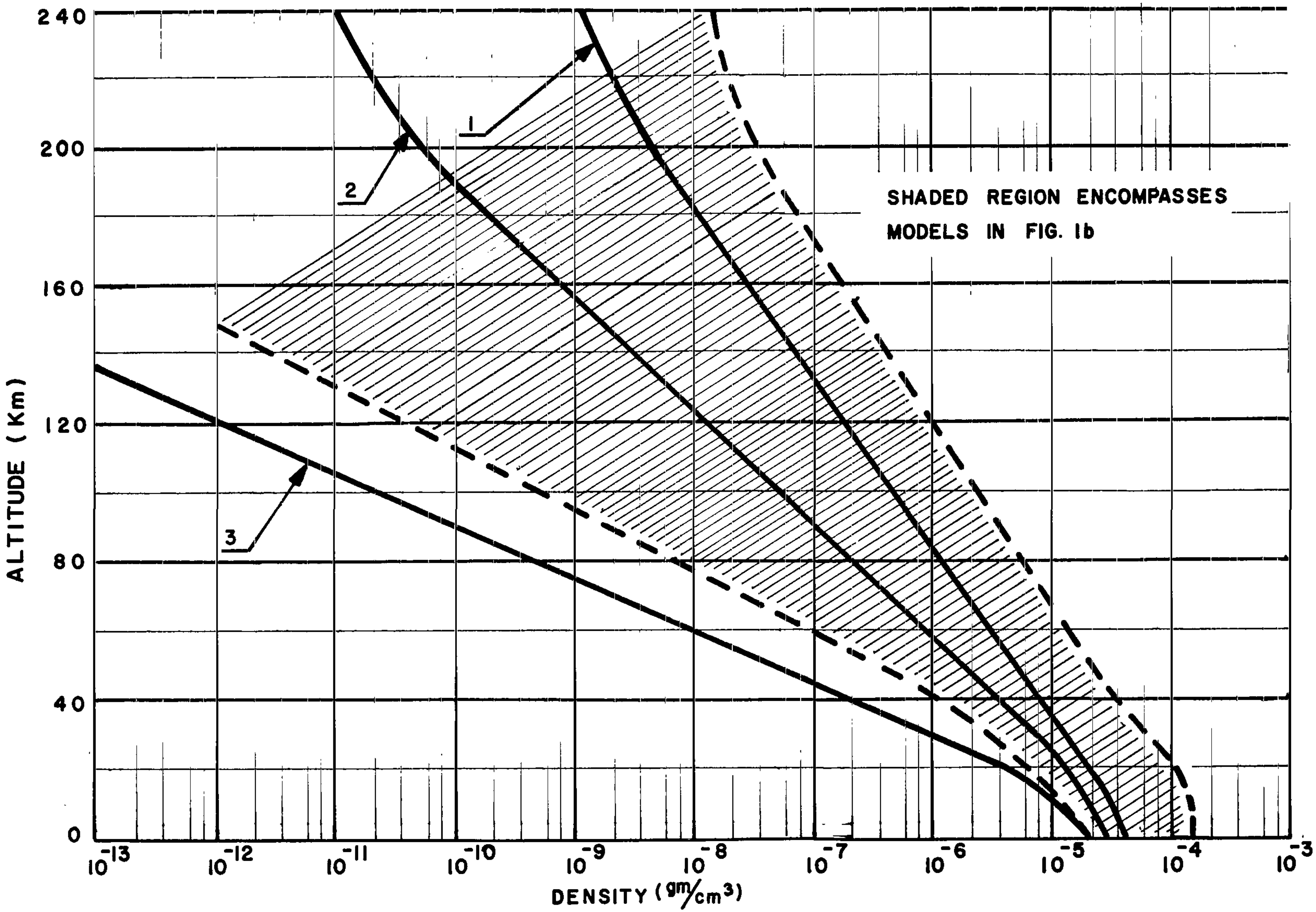
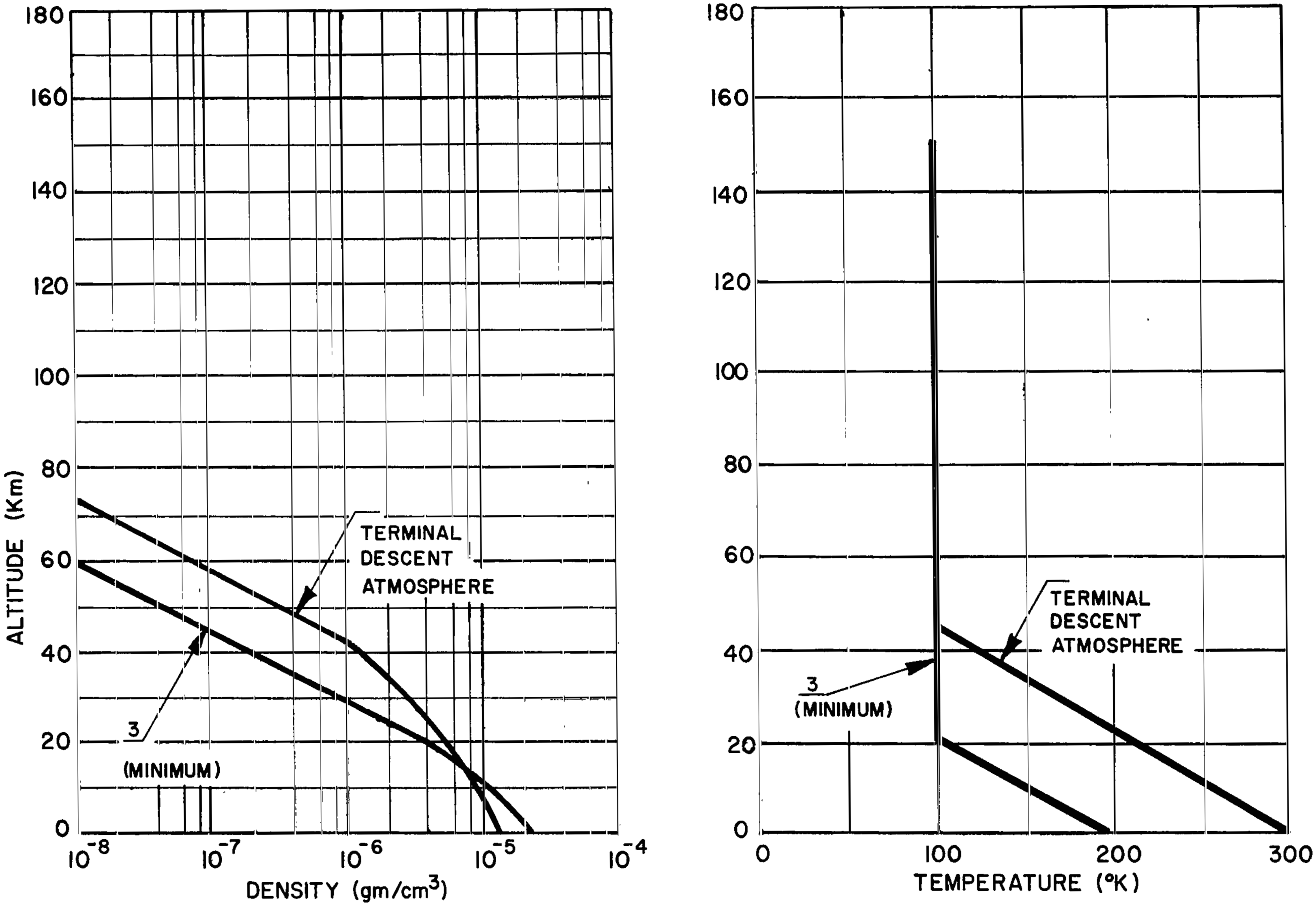


FIGURE 3 COMPARISON OF NASA ENGINEERING MODELS OF THE MARS ATMOSPHERE WITH OTHER MODELS (ALTITUDE Vs. DENSITY)



ALTITUDE Vs DENSITY

ALTITUDE Vs TEMPERATURE

FIGURE 4 COMPARISON OF TERMINAL DESCENT ATMOSPHERE WITH MODEL 3

TABLE I - SUMMARY OF STANDARD MODEL ATMOSPHERE PARAMETERS FOR MARS

Parameter	Units	Maximum (Model 1)	Mean (Model 2)	Minimum (Model 3)
Surface Pressure	mb	40	25	10
	lbs/sq.in.	0.58	0.363	0.145
Composition	CO_2% by Mass	7.5	16	60
	N_2% by Mass	92.5	84	40
	CO_2% by Volume	4.9	10.8	48.8
	N_2% by Volume	95.1	89.2	51.2
Molecular Weight	—	28.8	29.7	35.85
Acceleration of gravity at surface	cm/sec^2	375	375	375
	ft/sec^2	12.3	12.3	12.3
Surface Temp.	^oK	300	250	200
	^oR	540	450	360
Troposphere lapse rate	$^oK/km$	-3.636	-3.89	-4.55
	$^oR/10^3$ ft	-1.995	-2.134	-2.496
Tropopause altitude	km	11	18	22
	ft	36,100	59,100	72,200
Stratosphere temp.	^oK	260	180	100
	^oR	468	324	180
Top of stratosphere	km	150	150	150
	ft	492,100	492,100	492,100
Thermosphere lapse rate	$^oK/km$	2	2	—
	$^oR/10^3ft$	1.097	1.097	—
Surface density	gm/cm^3	4.62×10^{-5}	3.57×10^{-5}	2.16×10^{-5}
	$slugs/ft^3$	8.97×10^{-5}	6.94×10^{-5}	4.19×10^{-5}

TABLE II

NASA MARS ATMOSPHERE
MODEL 1
(Maximum)
English Units

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.0000	540.0	5.80E-01	8.97E-05	1138.	0.105	5.6E-06	3.98	4.4E-03
0.0033	533.5	5.56E-01	8.70E-05	1131.	0.104	5.8E-06	3.93	4.5E-03
0.0066	526.9	5.32E-01	8.43E-05	1124.	0.103	6.0E-06	3.87	4.6E-03
0.0098	520.4	5.09E-01	8.16E-05	1117.	0.102	6.2E-06	3.82	4.7E-03
0.0131	513.8	4.86E-01	7.90E-05	1110.	0.100	6.4E-06	3.76	4.8E-03
0.0164	507.3	4.64E-01	7.64E-05	1103.	0.099	6.6E-06	3.71	4.9E-03
0.0197	500.7	4.43E-01	7.39E-05	1096.	0.098	6.8E-06	3.65	4.9E-03
0.0230	494.2	4.23E-01	7.15E-05	1089.	0.097	7.0E-06	3.60	5.0E-03
0.0262	487.6	4.04E-01	6.91E-05	1082.	0.096	7.3E-06	3.55	5.1E-03
0.0295	481.1	3.85E-01	6.67E-05	1074.	0.094	7.5E-06	3.49	5.2E-03
0.0328	474.6	3.66E-01	6.44E-05	1067.	0.093	7.8E-06	3.44	5.3E-03
0.0361	468.0	3.49E-01	6.22E-05	1060.	0.092	8.1E-06	3.39	5.5E-03
0.0394	468.0	3.32E-01	5.92E-05	1060.	0.066	8.5E-06	3.39	5.7E-03
0.0427	468.0	3.16E-01	5.63E-05	1060.	0.066	8.9E-06	3.39	6.0E-03
0.0459	468.0	3.00E-01	5.36E-05	1060.	0.066	9.4E-06	3.39	6.3E-03
0.0492	468.0	2.86E-01	5.10E-05	1060.	0.066	9.9E-06	3.39	6.7E-03
0.0525	468.0	2.72E-01	4.85E-05	1060.	0.066	1.0E-05	3.39	7.0E-03
0.0558	468.0	2.59E-01	4.62E-05	1060.	0.066	1.1E-05	3.39	7.4E-03
0.0591	468.0	2.46E-01	4.40E-05	1060.	0.066	1.1E-05	3.39	7.7E-03
0.0623	468.0	2.35E-01	4.19E-05	1060.	0.066	1.2E-05	3.39	8.1E-03
0.0656	468.0	2.23E-01	3.98E-05	1060.	0.066	1.3E-05	3.39	8.5E-03
0.0689	468.0	2.13E-01	3.79E-05	1060.	0.066	1.3E-05	3.39	9.0E-03
0.0722	468.0	2.02E-01	3.61E-05	1060.	0.066	1.4E-05	3.39	9.4E-03
0.0755	468.0	1.93E-01	3.44E-05	1060.	0.067	1.5E-05	3.39	9.9E-03
0.0787	468.0	1.83E-01	3.27E-05	1060.	0.067	1.5E-05	3.39	1.0E-02
0.0820	468.0	1.74E-01	3.11E-05	1060.	0.067	1.6E-05	3.39	1.1E-02
0.0853	468.0	1.66E-01	2.96E-05	1060.	0.067	1.7E-05	3.39	1.1E-02
0.0886	468.0	1.58E-01	2.82E-05	1060.	0.067	1.8E-05	3.39	1.2E-02
0.0919	468.0	1.51E-01	2.69E-05	1060.	0.067	1.9E-05	3.39	1.3E-02
0.0951	468.0	1.43E-01	2.56E-05	1060.	0.067	2.0E-05	3.39	1.3E-02
0.0984	468.0	1.35E-01	2.43E-05	1060.	0.067	2.1E-05	3.39	1.4E-02
0.1017	468.0	1.30E-01	2.32E-05	1060.	0.067	2.2E-05	3.39	1.5E-02
0.1050	468.0	1.24E-01	2.21E-05	1060.	0.067	2.3E-05	3.39	1.5E-02
0.1083	468.0	1.1[illegible]E-01	2.10E-05	1060.	0.067	2.[illegible]E-05	3.39	1.6E-02

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density $slugs/ft^3$	Speed of sound ft/sec	Density scale height ft x 10^{-5}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.1116	468.0	1.12E-01	2.00E-05	1060.	0.067	2.5E-05	3.39	1.7E-02
0.1148	468.0	1.07E-01	1.91E-05	1060.	0.067	2.6E-05	3.39	1.8E-02
0.1181	468.0	1.02E-01	1.81E-05	1060.	0.067	2.8E-05	3.39	1.9E-02
0.1214	468.0	9.68E-02	1.73E-05	1060.	0.067	2.9E-05	3.39	2.0E-02
0.1247	468.0	9.22E-02	1.65E-05	1060.	0.067	3.1E-05	3.39	2.1E-02
0.1280	468.0	8.76E-02	1.57E-05	1060.	0.067	3.2E-05	3.39	2.2E-02
0.1312	468.0	8.36E-02	1.49E-05	1060.	0.067	3.4E-05	3.39	2.3E-02
0.1345	468.0	7.97E-02	1.42E-05	1060.	0.067	3.5E-05	3.39	2.4E-02
0.1378	468.0	7.59E-02	1.35E-05	1060.	0.067	3.7E-05	3.39	2.5E-02
0.1411	468.0	7.23E-02	1.29E-05	1060.	0.067	3.9E-05	3.39	2.6E-02
0.1444	468.0	6.88E-02	1.23E-05	1060.	0.067	4.1E-05	3.39	2.8E-02
0.1476	468.0	6.55E-02	1.17E-05	1060.	0.067	4.3E-05	3.39	2.9E-02
0.1509	468.0	6.24E-02	1.11E-05	1060.	0.067	4.5E-05	3.39	3.0E-02
0.1542	468.0	5.95E-02	1.06E-05	1060.	0.067	4.7E-05	3.39	3.2E-02
0.1575	468.0	5.66E-02	1.01E-05	1060.	0.068	5.0E-05	3.39	3.4E-02
0.1608	468.0	5.40E-02	9.63E-06	1060.	0.068	5.2E-05	3.39	3.5E-02
0.1640	468.0	5.14E-02	9.17E-06	1060.	0.068	5.5E-05	3.39	3.7E-02
0.1673	468.0	4.90E-02	8.74E-06	1060.	0.068	5.8E-05	3.39	3.9E-02
0.1706	468.0	4.67E-02	8.32E-06	1060.	0.068	6.0E-05	3.39	4.1E-02
0.1739	468.0	4.44E-02	7.93E-06	1060.	0.068	6.3E-05	3.39	4.3E-02
0.1772	468.0	4.23E-02	7.55E-06	1060.	0.068	6.7E-05	3.39	4.5E-02
0.1805	468.0	4.03E-02	7.20E-06	1060.	0.068	7.0E-05	3.39	4.7E-02
0.1837	468.0	3.84E-02	6.86E-06	1060.	0.068	7.3E-05	3.39	5.0E-02
0.1870	468.0	3.66E-02	6.53E-06	1060.	0.068	7.7E-05	3.39	5.2E-02
0.1903	468.0	3.49E-02	6.23E-06	1060.	0.068	8.1E-05	3.39	5.5E-02
0.1936	468.0	3.33E-02	5.93E-06	1060.	0.068	8.5E-05	3.39	5.7E-02
0.1969	468.0	3.17E-02	5.65E-06	1060.	0.068	8.9E-05	3.39	6.0E-02
0.2001	468.0	3.02E-02	5.39E-06	1060.	0.068	9.3E-05	3.39	6.3E-02
0.2034	468.0	2.88E-02	5.13E-06	1060.	0.068	9.8E-05	3.39	6.6E-02
0.2067	468.0	2.74E-02	4.89E-06	1060.	0.068	1.0E-04	3.39	6.9E-02
0.2100	468.0	2.61E-02	4.66E-06	1060.	0.068	1.1E-04	3.39	7.3E-02
0.2133	468.0	2.49E-02	4.44E-06	1060.	0.068	1.1E-04	3.39	7.6E-02
0.2165	468.0	2.37E-02	4.23E-06	1060.	0.068	1.2E-04	3.39	8.0E-02
0.2198	468.0	2.26E-02	4.04E-06	1060.	0.068	1.2E-04	3.39	8.4E-02
0.2231	468.0	2.16E-02	3.85E-06	1060.	0.068	1.3E-04	3.39	8.8E-02
0.2264	468.0	2.05E-02	3.67E-06	1060.	0.068	1.4E-04	3.39	9.3E-02
0.2297	468.0	1.96E-02	3.49E-06	1060.	0.068	1.4E-04	3.39	9.7E-02
0.2330	468.0	1.87E-02	3.33E-06	1060.	0.068	1.5E-04	3.39	1.0E-01
0.2362	468.0	1.78E-02	3.17E-06	1060.	0.068	1.6E-04	3.39	1.1E-01
0.2395	468.0	1.70E-02	3.03E-06	1060.	0.068	1.7E-04	3.39	1.1E-01
0.2428	468.0	1.62E-02	2.88E-06	1060.	0.069	1.7E-04	3.39	1.2E-01
0.2461	468.0	1.54E-02	2.75E-06	1060.	0.069	1.8E-04	3.39	1.2E-01
0.2494	468.0	1.47E-02	2.62E-06	1060.	0.069	1.9E-04	3.39	1.3E-01
0.2526	468.0	1.40E-02	2.50E-06	1060.	0.069	2.0E-04	3.39	1.4E-01
0.2559	468.0	1.34E-02	2.38E-06	1060.	0.069	2.1E-04	3.39	1.4E-01
0.2592	468.0	1.27E-02	2.27E-06	1060.	0.069	2.2E-04	3.39	1.5E-01
0.2625	468.0	1.21E-02	2.17E-06	1060.	0.069	2.3E-04	3.39	1.6E-01
0.2658	468.0	1.16E-02	2.06E-06	1060.	0.069	2.4E-04	3.39	1.6E-01
0.2690	468.0	1.10E-02	1.97E-06	1060.	0.069	2.6E-04	3.39	1.7E-01
0.2723	468.0	1.05E-02	1.88E-06	1060.	0.069	2.7E-04	3.39	1.8E-01
0.2756	468.0	1.00E-02	1.79E-06	1060.	0.069	2.8E-04	3.39	1.9E-01
0.2789	468.0	9.57E-03	1.71E-06	1060.	0.069	2.9E-04	3.39	2.0E-01
0.2822	468.0	9.12E-03	1.63E-06	1060.	0.069	3.1E-04	3.39	2.1E-01
0.2854	468.0	8.70E-03	1.55E-06	1060.	0.069	3.2E-04	3.39	2.2E-01
0.2887	468.0	8.30E-03	1.48E-06	1060.	0.069	3.4E-04	3.39	2.3E-01
0.2920	468.0	7.91E-03	1.41E-06	1060.	0.069	3.6E-04	3.39	2.4E-01
0.2953	468.0	7.55E-03	1.35E-06	1060.	0.069	3.7E-04	3.39	2.5E-01
0.2986	468.0	7.20E-03	1.28E-06	1060.	0.069	3.9E-04	3.39	2.6E-01
0.3019	468.0	[illegible]	1.22E-06	1060.	0.069	4.1E-04	3.39	2.8E-01
0.3051	468.0	[illegible]	1.17E-06	1060.	0.069	4.3E-04	3.39	2.9E-01

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.3084	468.0	5.24E-03	1.11E-06	1060.	0.067	4.5E-04	3.39	3.0E-01
0.3117	468.0	5.35E-03	1.06E-06	1050.	0.067	4.7E-04	3.39	3.2E-01
0.3150	468.0	5.08E-03	1.01E-06	1060.	0.069	5.0E-04	3.39	3.4E-01
0.3183	468.0	5.42E-03	9.66E-07	1060.	0.069	5.2E-04	3.39	3.5E-01
0.3215	468.0	5.17E-03	9.22E-07	1060.	0.069	5.5E-04	3.39	3.7E-01
0.3248	468.0	4.93E-03	8.79E-07	1060.	0.070	5.7E-04	3.39	3.9E-01
0.3281	468.0	4.70E-03	8.39E-07	1060.	0.070	6.0E-04	3.39	4.0E-01
0.3609	468.0	2.94E-03	5.24E-07	1060.	0.070	9.6E-04	3.39	6.5E-01
0.3937	468.0	1.84E-03	3.29E-07	1060.	0.070	1.5E-03	3.39	1.0E 00
0.4265	468.0	1.16E-03	2.06E-07	1060.	0.071	2.4E-03	3.39	1.6E 00
0.4593	468.0	7.29E-04	1.30E-07	1060.	0.071	3.9E-03	3.39	2.6E 00
0.4921	468.0	4.60E-04	8.21E-08	1060.	0.072	6.1E-03	3.39	4.1E 00
0.5250	504.0	2.96E-04	4.91E-08	1100.	0.066	1.0E-02	3.68	7.5E 00
0.5578	540.0	1.97E-04	3.05E-08	1138.	0.071	1.6E-02	3.98	1.3E 01
0.5906	576.0	1.35E-04	1.96E-08	1176.	0.077	2.6E-02		
0.6234	612.0	9.47E-05	1.29E-08	1212.	0.082	3.9E-02		
0.6562	648.0	6.80E-05	8.76E-09	1247.	0.087	5.7E-02		
0.6890	684.0	4.97E-05	6.07E-09	1281.	0.092	8.3E-02		
0.7218	720.0	3.71E-05	4.30E-09	1314.	0.098	1.2E-01		
0.7546	756.0	2.80E-05	3.10E-09	1347.	0.103	1.6E-01		
0.7874	792.0	2.15E-05	2.27E-09	1379.	0.108	2.2E-01		
0.8202	828.0	1.67E-05	1.69E-09	1410.	0.114	3.0E-01		
0.8531	864.0	1.32E-05	1.27E-09	1440.	0.119	3.9E-01		
0.8859	900.0	1.05E-05	9.74E-10	1470.	0.125	5.2E-01		
0.9187	936.0	8.44E-06	7.53E-10	1499.	0.130	6.7E-01		
0.9515	972.0	6.85E-06	5.89E-10	1527.	0.136	8.5E-01		
0.9843	1008.0	5.61E-06	4.65E-10	1555.	0.142	1.1E 00		
1.0171	1044.0	4.63E-06	3.70E-10	1583.	0.147	1.4E 00		
1.0499	1080.0	3.85E-06	2.98E-10	1610.	0.153	1.7E 00		
1.0827	1116.0	3.23E-06	2.41E-10	1637.	0.159	2.1E 00		
1.1155	1152.0	2.72E-06	1.97E-10	1663.	0.165	2.6E 00		
1.1483	1188.0	2.31E-06	1.62E-10	1688.	0.171	3.1E 00		
1.1812	1224.0	1.97E-06	1.34E-10	1714.	0.177	3.7E 00		
1.2140	1260.0	1.69E-06	1.12E-10	1739.	0.183	4.5E 00		
1.2468	1296.0	1.46E-06	9.38E-11	1764.	0.189	5.4E 00		
1.2796	1332.0	1.26E-06	7.90E-11	1788.	0.195	6.4E 00		
1.3124	1368.0	1.10E-06	6.70E-11	1812.	0.201	7.5E 00		
1.3452	1404.0	9.59E-07	5.70E-11	1836.	0.207	8.5E 00		
1.3780	1440.0	8.42E-07	4.88E-11	1859.	0.214	1.0E 01		
1.4108	1476.0	7.42E-07	4.20E-11	1882.	0.220	1.2E 01		
1.4436	1512.0	6.56E-07	3.62E-11	1905.	0.226	1.4E 01		
1.4764	1548.0	5.82E-07	3.14E-11	1927.	0.233	1.6E 01		
1.5093	1584.0	5.18E-07	2.73E-11	1950.	0.239	1.8E 01		
1.5421	1620.0	4.63E-07	2.39E-11	1972.	0.246	2.1E 01		
1.5749	1656.0	4.15E-07	2.09E-11	1994.	0.252	2.4E 01		
1.6077	1692.0	3.73E-07	1.84E-11	2015.	0.259	2.7E 01		
1.6405	1728.0	3.35E-07	1.62E-11	2036.	0.265	3.1E 01		
1.6733	1764.0	3.04E-07	1.44E-11	2057.	0.272	3.5E 01		
1.7061	1800.0	2.75E-07	1.28E-11	2078.	0.279	3.9E 01		
1.7389	1836.0	2.50E-07	1.14E-11	2099.	0.286	4.4E 01		
1.7717	1872.0	2.27E-07	1.01E-11	2120.	0.293	5.0E 01		
1.8045	[illegible]	[illegible]	[illegible]	2140.	0.299	5.5E 01		
1.8374	1944.0	1.90E-07	8.15E-12	2160.	0.306	6.2E 01		
1.8702	[illegible]	1.74E-07	7.33E-12	2180.	0.313	6.9E 01		
1.9030	2016.0	[illegible]	[illegible]	2200.	0.320	7.6E 01		
1.9358	2052.0	1.47E-07	[illegible]	2219.	0.327	8.4E 01		
1.9686	2088.0	1.35E-07	5.41E-12	2238.	0.335	9.3E 01		
2.0014	2124.0	1.25E-07	4.91E-12	2258.	0.342	1.0E 02		
2.0342	2160.0	1.15E-07	4.46E-12	2277.	0.349	1.1E 02		
2.0670	2196.0	1.07E-07	4.07E-12	2296.	0.356	1.2E 02		

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
2.0998	2232.0	9.92E-08	3.71E-12	2314.	0.364	1.4E 02		
2.1326	2268.0	9.22E-08	3.39E-12	2333.	0.371	1.5E 02		
2.1655	2304.0	8.58E-08	3.11E-12	2351.	0.378	1.6E 02		
2.1983	2340.0	8.00E-08	2.85E-12	2370.	0.386	1.6E 02		
2.2311	2376.0	7.47E-08	2.62E-12	2388.	0.393	1.9E 02		
2.2639	2412.0	6.98E-08	2.42E-12	2406.	0.401	2.1E 02		
2.2967	2448.0	6.53E-08	2.23E-12	2424.	0.409	2.3E 02		
2.3295	2484.0	6.12E-08	2.06E-12	2442.	0.416	2.4E 02		
2.3623	2520.0	5.74E-08	1.90E-12	2459.	0.424	2.6E 02		
2.3951	2556.0	5.40E-08	1.76E-12	2477.	0.432	2.9E 02		
2.4279	2592.0	5.08E-08	1.63E-12	2494.	0.440	3.1E 02		
2.4607	2628.0	4.78E-08	1.52E-12	2511.	0.447	3.3E 02		
2.4936	2664.0	4.50E-08	1.41E-12	2528.	0.455	3.6E 02		
2.5264	2700.0	4.25E-08	1.31E-12	2545.	0.463	3.9E 02		
2.5592	2736.0	4.02E-08	1.23E-12	2562.	0.471	4.1E 02		
2.5920	2772.0	3.80E-08	1.14E-12	2579.	0.479	4.4E 02		
2.6248	2808.0	3.59E-08	1.07E-12	2596.	0.488	4.7E 02		
2.6576	2844.0	3.41E-08	10.00E-13	2612.	0.496	5.0E 02		
2.6904	2880.0	3.23E-08	9.36E-13	2629.	0.504	5.4E 02		
2.7232	2916.0	3.07E-08	8.78E-13	2645.	0.512	5.7E 02		
2.7560	2952.0	2.91E-08	8.24E-13	2662.	0.520	6.1E 02		
2.7888	2988.0	2.77E-08	7.74E-13	2678.	0.529	6.5E 02		
2.8217	3024.0	2.64E-08	7.27E-13	2694.	0.537	6.9E 02		
2.8545	3060.0	2.51E-08	6.85E-13	2710.	0.546	7.3E 02		
2.8873	3096.0	2.39E-08	6.45E-13	2726.	0.554	7.8E 02		
2.9201	3132.0	2.28E-08	6.08E-13	2742.	0.563	8.3E 02		
2.9529	3168.0	2.18E-08	5.74E-13	2757.	0.571	8.8E 02		
2.9857	3204.0	2.08E-08	5.42E-13	2773.	0.580	9.3E 02		
3.0185	3240.0	1.99E-08	5.13E-13	2738.	0.589	9.8E 02		
3.0513	3276.0	1.90E-08	4.85E-13	2804.	0.598	1.0E 03		
3.0841	3312.0	1.82E-08	4.59E-13	2819.	0.606	1.1E 03		
3.1169	3348.0	1.75E-08	4.35E-13	2835.	0.615	1.2E 03		
3.1498	3384.0	1.67E-08	4.13E-13	2850.	0.624	1.2E 03		
3.1826	3420.0	1.61E-08	3.92E-13	2865.	0.633	1.3E 03		
3.2154	3456.0	1.54E-08	3.72E-13	2880.	0.642	1.4E 03		
3.2482	3492.0	1.48E-08	3.54E-13	2895.	0.651	1.4E 03		
3.2810	3528.0	1.42E-08	3.37E-13	2910.	0.660	1.5E 03		
3.4450	3708.0	1.18E-08	2.65E-13	2983.	0.707	1.9E 03		
3.6091	3888.0	9.85E-09	2.11E-13	3055.	0.754	2.4E 03		
3.7731	4068.0	8.34E-09	1.71E-13	3124.	0.803	2.9E 03		
3.9372	4248.0	7.15E-09	1.40E-13	3193.	0.853	3.6E 03		
4.1012	4428.0	6.18E-09	1.17E-13	3260.	0.904	4.3E 03		
4.2653	4608.0	5.39E-09	9.77E-14	3325.	0.957	5.1E 03		
4.4293	4788.0	4.74E-09	8.27E-14	3390.	1.010	6.1E 03		
4.5934	4968.0	4.20E-09	7.06E-14	3453.	1.065	7.1E 03		
4.7574	5148.0	3.75E-09	6.08E-14	3515.	1.122	8.3E 03		
4.9215	5328.0	3.36E-09	5.27E-14	3576.	1.179	9.5E 03		
5.0855	5508.0	3.03E-09	4.60E-14	3636.	1.238	1.1E 04		
5.2496	5688.0	2.75E-09	4.04E-14	3695.	1.298	1.2E 04		
5.4136	5868.0	2.51E-09	3.57E-14	3753.	1.359	1.4E 04		
5.5777	6048.0	2.30E-09	3.17E-14	3810.	1.422	1.6E 04		
5.7417	6228.0	2.12E-09	2.84E-14	3866.	1.485	1.8E 04		
5.9058	6408.0	1.95E-09	2.54E-14	3921.	1.550	2.0E 04		
6.0698	6588.0	1.81E-09	2.29E-14	3976.	1.616	2.2E 04		
6.2339	6768.0	1.68E-09	2.08E-14	4030.	1.634	2.4E 04		
6.3979	6948.0	1.57E-09	1.89E-14	4083.	1.752	2.7E 04		
6.5620	7128.0	1.47E-09	1.72E-14	4136.	1.822	2.9E 04		
6.7260	7128.0	1.38E-09	1.62E-14	4136.	2.580	3.1E 04		
6.8901	7128.0	1.30E-09	1.52E-14	4136.	2.628	3.3E 04		
7.0541	7128.0	1.22E-09	1.43E-14	4135.	2.676	3.5E 04		

TABLE II

NASA MARS ATMOSPHERE
MODEL 1
(Maximum)
Metric Units

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
0	300.0	4.00E 01	4.62E-05	347.	32.0	1.7E-04	1.90
1	296.4	3.83E 01	4.48E-05	345.	31.7	1.8E-04	1.88
2	292.7	3.66E 01	4.34E-05	343.	31.3	1.8E-04	1.85
3	289.1	3.50E 01	4.20E-05	341.	31.0	1.9E-04	1.83
4	285.5	3.35E 01	4.07E-05	338.	30.6	1.9E-04	1.80
5	281.8	3.20E 01	3.93E-05	336.	30.2	2.0E-04	1.77
6	278.2	3.06E 01	3.80E-05	334.	29.9	2.1E-04	1.75
7	274.5	2.92E 01	3.68E-05	332.	29.5	2.1E-04	1.72
8	270.9	2.79E 01	3.56E-05	330.	29.1	2.2E-04	1.70
9	267.3	2.65E 01	3.43E-05	327.	28.8	2.3E-04	1.67
10	263.6	2.52E 01	3.32E-05	325.	28.4	2.4E-04	1.65
11	260.0	2.40E 01	3.20E-05	323.	28.0	2.5E-04	1.62
12	260.0	2.29E 01	3.05E-05	323.	20.1	2.6E-04	1.62
13	260.0	2.18E 01	2.90E-05	323.	20.2	2.7E-04	1.62
14	260.0	2.07E 01	2.76E-05	323.	20.2	2.9E-04	1.62
15	260.0	1.97E 01	2.63E-05	323.	20.2	3.0E-04	1.62
16	260.0	1.88E 01	2.50E-05	323.	20.2	3.2E-04	1.62
17	260.0	1.78E 01	2.38E-05	323.	20.2	3.3E-04	1.62
18	260.0	1.70E 01	2.26E-05	323.	20.2	3.5E-04	1.62
19	260.0	1.62E 01	2.15E-05	323.	20.2	3.7E-04	1.62
20	260.0	1.54E 01	2.05E-05	323.	20.2	3.8E-04	1.62
21	260.0	1.46E 01	1.95E-05	323.	20.3	4.0E-04	1.62
22	260.0	1.39E 01	1.86E-05	323.	20.3	4.2E-04	1.62
23	260.0	1.33E 01	1.77E-05	323.	20.3	4.5E-04	1.62
24	260.0	1.26E 01	1.68E-05	323.	20.3	4.7E-04	1.62
25	260.0	1.20E 01	1.60E-05	323.	20.3	4.9E-04	1.62
26	260.0	1.14E 01	1.53E-05	323.	20.3	5.2E-04	1.62
27	260.0	1.09E 01	1.45E-05	323.	20.3	5.4E-04	1.62
28	260.0	1.04E 01	1.38E-05	323.	20.3	5.7E-04	1.62
29	260.0	[illegible] 00	1.32E-05	323.	20.3	6.0E-04	1.62
30	260.0	9.40E 00	1.25E-05	323.	20.4	6.3E-04	1.62
31	260.0	[illegible] 00	1.19E-05	323.	20.4	6.6E-04	1.62
32	260.0	[illegible].52E 00	1.14E-05	323.	20.4	6.9E-04	1.62
33	260.0	[illegible].12E 00	1.08E-05	323.	20.4	7.3E-04	1.62

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
34	260.0	7.73E 00	1.03E-05	323.	20.4	7.7E-04	1.62
35	260.0	7.36E 00	9.80E-06	323.	20.4	8.0E-04	1.62
36	260.0	7.01E 00	9.34E-06	323.	20.4	8.4E-04	1.62
37	260.0	6.67E 00	8.89E-06	323.	20.4	8.9E-04	1.62
38	260.0	6.35E 00	8.47E-06	323.	20.5	9.3E-04	1.62
39	260.0	6.05E 00	8.06E-06	323.	20.5	9.8E-04	1.62
40	260.0	5.76E 00	7.68E-06	323.	20.5	1.0E-03	1.62
41	260.0	5.49E 00	7.31E-06	323.	20.5	1.1E-03	1.62
42	260.0	5.23E 00	6.96E-06	323.	20.5	1.1E-03	1.62
43	260.0	4.98E 00	6.63E-06	323.	20.5	1.2E-03	1.62
44	260.0	4.74E 00	6.32E-06	323.	20.5	1.2E-03	1.62
45	260.0	4.52E 00	6.02E-06	323.	20.5	1.3E-03	1.62
46	260.0	4.30E 00	5.73E-06	323.	20.6	1.4E-03	1.62
47	260.0	4.10E 00	5.46E-06	323.	20.6	1.4E-03	1.62
48	260.0	3.90E 00	5.20E-06	323.	20.6	1.5E-03	1.62
49	260.0	3.72E 00	4.95E-06	323.	20.6	1.6E-03	1.62
50	260.0	3.54E 00	4.72E-06	323.	20.6	1.7E-03	1.62
51	260.0	3.37E 00	4.50E-06	323.	20.6	1.8E-03	1.62
52	260.0	3.21E 00	4.28E-06	323.	20.6	1.8E-03	1.62
53	260.0	3.06E 00	4.08E-06	323.	20.6	1.9E-03	1.62
54	260.0	2.92E 00	3.89E-06	323.	20.6	2.0E-03	1.62
55	260.0	2.78E 00	3.70E-06	323.	20.7	2.1E-03	1.62
56	260.0	2.65E 00	3.53E-06	323.	20.7	2.2E-03	1.62
57	260.0	2.52E 00	3.36E-06	323.	20.7	2.3E-03	1.62
58	260.0	2.40E 00	3.20E-06	323.	20.7	2.5E-03	1.62
59	260.0	2.29E 00	3.05E-06	323.	20.7	2.6E-03	1.62
60	260.0	2.18E 00	2.91E-06	323.	20.7	2.7E-03	1.62
61	260.0	2.08E 00	2.77E-06	323.	20.7	2.8E-03	1.62
62	260.0	1.98E 00	2.64E-06	323.	20.7	3.0E-03	1.62
63	260.0	1.89E 00	2.52E-06	323.	20.8	3.1E-03	1.62
64	260.0	1.80E 00	2.40E-06	323.	20.8	3.3E-03	1.62
65	260.0	1.72E 00	2.29E-06	323.	20.8	3.4E-03	1.62
66	260.0	1.64E 00	2.18E-06	323.	20.8	3.6E-03	1.62
67	260.0	1.56E 00	2.08E-06	323.	20.8	3.8E-03	1.62
68	260.0	1.49E 00	1.98E-06	323.	20.8	4.0E-03	1.62
69	260.0	1.42E 00	1.89E-06	323.	20.8	4.2E-03	1.62
70	260.0	1.35E 00	1.80E-06	323.	20.8	4.4E-03	1.62
71	260.0	1.29E 00	1.71E-06	323.	20.9	4.6E-03	1.62
72	260.0	1.23E 00	1.63E-06	323.	20.9	4.8E-03	1.62
73	260.0	1.17E 00	1.56E-06	323.	20.9	5.1E-03	1.62
74	260.0	1.11E 00	1.48E-06	323.	20.9	5.3E-03	1.62
75	260.0	1.06E 00	1.42E-06	323.	20.9	5.6E-03	1.62
76	260.0	1.01E 00	1.35E-06	323.	20.9	5.8E-03	1.62
77	260.0	9.65E-01	1.29E-06	323.	20.9	6.1E-03	1.62
78	260.0	9.20E-01	1.23E-06	323.	20.9	6.4E-03	1.62
79	260.0	8.77E-01	1.17E-06	323.	20.9	6.7E-03	1.62
80	260.0	8.37E-01	1.11E-06	323.	21.0	7.1E-03	1.62
81	260.0	7.98E-01	1.06E-06	323.	21.0	7.4E-03	1.62
82	260.0	7.60E-01	1.01E-06	323.	21.0	7.8E-03	1.62
83	260.0	7.25E-01	9.66E-07	323.	21.0	8.2E-03	1.62
84	260.0	6.91E-01	9.21E-07	323.	21.0	8.6E-03	1.62
85	260.0	6.59E-01	8.78E-07	323.	21.0	9.0E-03	1.62
86	260.0	6.29E-01	8.38E-07	323.	21.0	9.4E-03	1.62
87	260.0	6.00E-01	7.99E-07	323.	21.0	9.9E-03	1.62
88	260.0	5.72E-01	7.62E-07	323.	21.1	1.0E-02	1.62
89	260.0	5.45E-01	7.26E-07	323.	21.1	1.1E-02	1.62
90	260.0	5.20E-01	6.93E-07	323.	21.1	1.1E-02	1.62
91	260.0	4.96E-01	6.61E-07	323.	21.1	1.2E-02	1.62
92	260.0	4.73E-01	6.30E-07	323.	21.1	1.3E-02	1.62
93	260.0	4.51E-01	6.01E-07	323.	21.1	1.3E-02	1.62

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
94	260.0	4.30E-01	5.73E-07	323.	21.1	1.4E-02	1.62
95	260.0	4.10E-01	5.47E-07	323.	21.1	1.4E-02	1.62
96	260.0	3.91E-01	5.21E-07	323.	21.2	1.5E-02	1.62
97	260.0	3.73E-01	4.97E-07	323.	21.2	1.6E-02	1.62
98	260.0	3.56E-01	4.74E-07	323.	21.2	1.7E-02	1.62
99	260.0	3.40E-01	4.53E-07	323.	21.2	1.7E-02	1.62
100	260.0	3.24E-01	4.32E-07	323.	21.2	1.8E-02	1.62
110	260.0	2.03E-01	2.70E-07	323.	21.3	2.9E-02	1.62
120	260.0	1.27E-01	1.69E-07	323.	21.4	4.7E-02	1.62
130	260.0	7.97E-02	1.06E-07	323.	21.6	7.4E-02	1.62
140	260.0	5.02E-02	6.69E-08	323.	21.7	1.2E-01	1.62
150	260.0	3.17E-02	4.23E-08	323.	21.8	1.9E-01	1.62
160	280.0	2.04E-02	2.53E-08	335.	20.2	3.1E-01	1.76
170	300.0	1.36E-02	1.57E-08	347.	21.8	5.0E-01	1.91
180	320.0	9.30E-03	1.01E-08	358.	23.3	7.8E-01	
190	340.0	6.53E-03	6.65E-09	369.	24.9	1.2E 00	
200	360.0	4.68E-03	4.51E-09	380.	26.5	1.7E 00	
210	380.0	3.43E-03	3.12E-09	390.	28.1	2.5E 00	
220	400.0	2.55E-03	2.21E-09	401.	29.7	3.6E 00	
230	420.0	1.93E-03	1.59E-09	411.	31.4	4.9E 00	
240	440.0	1.48E-03	1.17E-09	420.	33.0	6.8E 00	
250	460.0	1.15E-03	8.69E-10	430.	34.7	9.1E 00	
260	480.0	9.09E-04	6.56E-10	439.	36.3	1.2E 01	
270	500.0	7.23E-04	5.01E-10	448.	38.0	1.6E 01	
280	520.0	5.82E-04	3.68E-10	457.	39.7	2.0E 01	
290	540.0	4.72E-04	3.03E-10	465.	41.5	2.6E 01	
300	560.0	3.87E-04	2.39E-10	474.	43.2	3.3E 01	
310	580.0	3.19E-04	1.91E-10	482.	44.9	4.1E 01	
320	600.0	2.65E-04	1.53E-10	491.	46.7	5.1E 01	
330	620.0	2.22E-04	1.24E-10	499.	48.5	6.3E 01	
340	640.0	1.87E-04	1.01E-10	507.	50.3	7.8E 01	
350	660.0	1.59E-04	8.34E-11	515.	52.1	9.5E 01	
360	680.0	1.36E-04	6.91E-11	522.	53.9	1.1E 02	
370	700.0	1.16E-04	5.76E-11	530.	55.7	1.4E 02	
380	720.0	1.00E-04	4.83E-11	538.	57.6	1.6E 02	
390	740.0	8.69E-05	4.07E-11	545.	59.4	1.9E 02	
400	760.0	7.56E-05	3.45E-11	552.	61.3	2.3E 02	
410	780.0	6.61E-05	2.94E-11	559.	63.2	2.7E 02	
420	800.0	5.80E-05	2.51E-11	567.	65.1	3.1E 02	
430	820.0	5.11E-05	2.16E-11	574.	67.1	3.7E 02	
440	840.0	4.52E-05	1.86E-11	581.	69.0	4.2E 02	
450	860.0	4.01E-05	1.62E-11	587.	70.9	4.9E 02	
460	880.0	3.57E-05	1.41E-11	594.	72.9	5.6E 02	
470	900.0	3.19E-05	1.23E-11	601.	74.9	6.4E 02	
480	920.0	2.86E-05	1.08E-11	608.	76.9	7.3E 02	
490	940.0	2.57E-05	9.47E-12	614.	78.9	8.3E 02	
500	960.0	2.32E-05	8.36E-12	621.	80.9	9.4E 02	
510	980.0	2.09E-05	7.40E-12	627.	83.0	1.1E 03	
520	1000.0	1.90E-05	6.57E-12	633.	85.0	1.2E 03	
530	1020.0	1.72E-05	5.85E-12	640.	87.1	1.3E 03	
540	1040.0	1.57E-05	5.22E-12	646.	89.2	1.5E 03	
550	1060.0	1.43E-05	4.67E-12	652.	91.3	1.7E 03	
560	1080.0	1.31E-05	4.19E-12	658.	93.4	1.9E 03	
570	1100.0	1.20E-05	3.77E-12	664.	95.5	2.1E 03	
580	1120.0	1.10E-05	3.40E-12	670.	97.7	2.3E 03	
590	1140.0	1.01E-05	3.07E-12	676.	99.8	2.6E 03	
600	1160.0	9.32E-06	2.78E-12	682.	102.0	2.8E 03	
610	1180.0	8.60E-06	2.53E-12	688.	104.2	3.1E 03	
620	1200.0	7.96E-06	2.30E-12	694.	106.4	3.4E 03	
630	1220.0	7.37E-06	2.09E-12	700.	108.6	3.8E 03	

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
640	1240.0	[illegible]	1.91E-12	705.	110.6	4.1E 03	
650	1260.0	5.35E-06	1.75E-12	711.	113.1	4.5E 03	
660	1280.0	[illegible]	1.60E-12	717.	115.3	4.9E 03	
670	1300.0	5.51E-06	1.47E-12	722.	117.6	5.4E 03	
680	1320.0	5.15E-06	1.35E-12	728.	119.9	5.8E 03	
690	1340.0	4.91E-06	1.24E-12	733.	122.2	6.3E 03	
700	1360.0	4.50E-06	1.15E-12	737.	124.5	6.9E 03	
710	1380.0	4.22E-06	1.06E-12	744.	126.9	7.4E 03	
720	1400.0	3.96E-06	9.79E-13	750.	129.2	8.1E 03	
730	1420.0	3.72E-06	9.07E-13	755.	131.6	8.7E 03	
740	1440.0	3.50E-06	8.41E-13	760.	134.0	9.4E 03	
750	1460.0	3.29E-06	7.81E-13	765.	136.4	1.0E 04	
760	1480.0	3.10E-06	7.27E-13	771.	138.8	1.1E 04	
770	1500.0	2.93E-06	6.77E-13	776.	141.2	1.2E 04	
780	1520.0	2.77E-06	6.31E-13	781.	143.7	1.3E 04	
790	1540.0	2.62E-06	5.89E-13	786.	146.1	1.3E 04	
800	1560.0	2.48E-06	5.50E-13	791.	148.6	1.4E 04	
810	1580.0	2.35E-06	5.14E-13	796.	151.1	1.5E 04	
820	1600.0	2.23E-06	4.82E-13	801.	153.6	1.6E 04	
830	1620.0	2.11E-06	4.52E-13	805.	156.1	1.7E 04	
840	1640.0	2.01E-06	4.24E-13	811.	158.6	1.9E 04	
850	1660.0	1.91E-06	3.98E-13	815.	161.2	2.0E 04	
860	1680.0	1.82E-06	3.74E-13	821.	163.7	2.1E 04	
870	1700.0	1.73E-06	3.52E-13	826.	166.3	2.2E 04	
880	1720.0	1.65E-06	3.32E-13	831.	168.9	2.4E 04	
890	1740.0	1.57E-06	3.13E-13	836.	171.5	2.5E 04	
900	1760.0	1.50E-06	2.95E-13	840.	174.2	2.7E 04	
910	1780.0	1.43E-06	2.79E-13	845.	176.8	2.8E 04	
920	1800.0	1.37E-06	2.64E-13	850.	179.4	3.0E 04	
930	1820.0	1.31E-06	2.50E-13	855.	182.1	3.2E 04	
940	1840.0	1.26E-06	2.36E-13	859.	184.8	3.3E 04	
950	1860.0	1.20E-06	2.24E-13	864.	187.5	3.5E 04	
960	1880.0	1.15E-06	2.13E-13	869.	190.2	3.7E 04	
970	1900.0	1.11E-06	2.02E-13	873.	192.9	3.9E 04	
980	1920.0	1.06E-06	1.92E-13	878.	195.7	4.1E 04	
990	1940.0	1.02E-06	1.82E-13	882.	198.5	4.3E 04	
1000	1960.0	9.80E-07	1.73E-13	887.	201.2	4.6E 04	
1050	2060.0	8.10E-07	1.36E-13	909.	215.3	5.8E 04	
1100	2160.0	6.79E-07	1.09E-13	931.	229.8	7.2E 04	
1150	2260.0	5.75E-07	8.51E-14	952.	244.7	8.9E 04	
1200	2360.0	4.93E-07	7.23E-14	973.	259.9	1.1E 05	
1250	2460.0	4.26E-07	6.00E-14	994.	275.6	1.3E 05	
1300	2560.0	3.72E-07	5.03E-14	1014.	291.6	1.6E 05	
1350	2660.0	3.27E-07	4.26E-14	1033.	308.0	1.9E 05	
1400	2760.0	2.90E-07	3.63E-14	1052.	324.7	2.2E 05	
1450	2860.0	2.59E-07	3.13E-14	1071.	341.9	2.5E 05	
1500	2960.0	2.32E-07	2.71E-14	1090.	359.4	2.9E 05	
1550	3060.0	2.09E-07	2.37E-14	1108.	377.3	3.3E 05	
1600	3160.0	1.90E-07	2.08E-14	1126.	395.6	3.8E 05	
1650	3260.0	1.73E-07	1.84E-14	1144.	414.3	4.3E 05	
1700	3360.0	1.58E-07	1.63E-14	1161.	433.3	4.8E 05	
1750	3460.0	1.46E-07	1.46E-14	1178.	452.7	5.4E 05	
1800	3560.0	1.35E-07	1.31E-14	1195.	472.5	6.0E 05	
1850	3660.0	1.25E-07	1.18E-14	1212.	492.7	6.7E 05	
1900	3760.0	1.16E-07	1.07E-14	1228.	513.2	7.4E 05	

TABLE III

NASA MARS ATMOSPHERE

MODEL 2
(Mean)
English Units

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.0000	450.0	3.63E-01	6.94E-05	1027	0.086	7.4E-06	3.19	4.6E-03
0.0033	443.0	3.44E-01	6.68E-05	1019.	0.085	7.7E-06	3.14	4.7E-03
0.0066	436.0	3.25E-01	6.43E-05	1011.	0.084	8.0E-06	3.09	4.8E-03
0.0098	429.0	3.08E-01	6.18E-05	1003.	0.082	8.3E-06	3.04	4.9E-03
0.0131	422.0	2.91E-01	5.93E-05	995.	0.081	8.7E-06	2.99	5.0E-03
0.0164	415.0	2.75E-01	5.70E-05	987.	0.080	9.0E-06	2.94	5.2E-03
0.0197	408.0	2.59E-01	5.47E-05	978.	0.079	9.4E-06	2.89	5.3E-03
0.0230	401.0	2.44E-01	5.24E-05	970.	0.077	9.8E-06	2.84	5.4E-03
0.0262	394.0	2.30E-01	5.02E-05	961.	0.076	1.0E-05	2.79	5.6E-03
0.0295	387.0	2.16E-01	4.81E-05	953.	0.075	1.1E-05	2.74	5.7E-03
0.0328	380.0	2.03E-01	4.60E-05	944.	0.073	1.1E-05	2.69	5.9E-03
0.0361	373.0	1.90E-01	4.40E-05	935.	0.072	1.2E-05	2.64	6.0E-03
0.0394	366.0	1.78E-01	4.20E-05	926.	0.071	1.2E-05	2.59	6.2E-03
0.0427	359.0	1.67E-01	4.01E-05	913.	0.070	1.3E-05	2.55	6.4E-03
0.0459	352.0	1.56E-01	3.82E-05	909.	0.068	1.3E-05	2.50	6.5E-03
0.0492	345.0	1.46E-01	3.64E-05	900.	0.067	1.4E-05	2.45	6.7E-03
0.0525	338.0	1.36E-01	3.46E-05	890.	0.066	1.5E-05	2.40	7.0E-03
0.0558	331.0	1.27E-01	3.29E-05	881.	0.064	1.6E-05	2.36	7.2E-03
0.0591	324.0	1.18E-01	3.13E-05	872.	0.063	1.6E-05	2.31	7.4E-03
0.0623	324.0	1.09E-01	2.91E-05	872.	0.045	1.8E-05	2.31	8.0E-03
0.0656	324.0	1.02E-01	2.70E-05	872.	0.045	1.9E-05	2.31	8.6E-03
0.0689	324.0	9.44E-02	2.51E-05	872.	0.045	2.0E-05	2.31	9.2E-03
0.0722	324.0	8.77E-02	2.33E-05	872.	0.045	2.2E-05	2.31	9.9E-03
0.0755	324.0	8.15E-02	2.17E-05	872.	0.045	2.4E-05	2.31	1.1E-02
0.0787	324.0	7.57E-02	2.01E-05	872.	0.045	2.6E-05	2.31	1.2E-02
0.0820	324.0	7.04E-02	1.87E-05	872.	0.045	2.7E-05	2.31	1.2E-02
0.0853	324.0	6.54E-02	1.74E-05	872.	0.045	3.0E-05	2.31	1.3E-02
0.0886	324.0	6.08E-02	1.61E-05	872.	0.045	3.2E-05	2.31	1.4E-02
0.0919	324.0	5.65E-02	1.50E-05	872.	0.045	3.4E-05	2.31	1.5E-02
0.0951	324.0	5.25E-02	1.39E-05	872.	0.045	3.7E-05	2.31	1.7E-02
0.0984	324.0	4.88E-02	1.30E-05	872.	0.045	4.0E-05	2.31	1.8E-02
0.1017	324.0	4.53E-02	1.20E-05	872.	0.045	4.3E-05	2.31	1.9E-02
0.1050	324.0	4.21E-02	1.12E-05	872.	0.045	4.6E-05	2.31	2.1E-02
0.1083	324.0	3.92E-02	1.04E-05	872.	0.045	4.9E-05	2.31	2.2E-02

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.1116	324.0	3.64E-02	9.68E-06	872.	0.045	5.3E-05	2.31	2.4E-02
0.1148	324.0	3.39E-02	9.00E-06	872.	0.045	5.7E-05	2.31	2.6E-02
0.1181	324.0	3.15E-02	8.36E-06	872.	0.045	6.1E-05	2.31	2.8E-02
0.1214	324.0	2.93E-02	7.78E-06	872.	0.045	6.6E-05	2.31	3.0E-02
0.1247	324.0	2.72E-02	7.23E-06	872.	0.045	7.1E-05	2.31	3.2E-02
0.1280	324.0	2.53E-02	6.72E-06	872.	0.045	7.6E-05	2.31	3.4E-02
0.1312	324.0	2.35E-02	6.25E-06	872.	0.045	8.2E-05	2.31	3.7E-02
0.1345	324.0	2.19E-02	5.81E-06	872.	0.045	8.8E-05	2.31	4.0E-02
0.1378	324.0	2.03E-02	5.41E-06	872.	0.045	9.5E-05	2.31	4.3E-02
0.1411	324.0	1.89E-02	5.03E-06	872.	0.045	1.0E-04	2.31	4.6E-02
0.1444	324.0	1.76E-02	4.67E-06	872.	0.045	1.1E-04	2.31	5.0E-02
0.1476	324.0	1.64E-02	4.35E-06	872.	0.045	1.2E-04	2.31	5.3E-02
0.1509	324.0	1.52E-02	4.04E-06	872.	0.045	1.3E-04	2.31	5.7E-02
0.1542	324.0	1.42E-02	3.76E-06	872.	0.045	1.4E-04	2.31	6.2E-02
0.1575	324.0	1.32E-02	3.50E-06	872.	0.045	1.5E-04	2.31	6.6E-02
0.1608	324.0	1.22E-02	3.25E-06	872.	0.045	1.6E-04	2.31	7.1E-02
0.1640	324.0	1.14E-02	3.03E-06	872.	0.045	1.7E-04	2.31	7.7E-02
0.1673	324.0	1.06E-02	2.82E-06	872.	0.045	1.8E-04	2.31	8.2E-02
0.1706	324.0	9.86E-03	2.62E-06	872.	0.045	2.0E-04	2.31	8.8E-02
0.1739	324.0	9.17E-03	2.44E-06	872.	0.045	2.1E-04	2.31	9.5E-02
0.1772	324.0	8.53E-03	2.27E-06	872.	0.045	2.3E-04	2.31	1.0E-01
0.1805	324.0	7.94E-03	2.11E-06	872.	0.046	2.4E-04	2.31	1.1E-01
0.1837	324.0	7.39E-03	1.96E-06	872.	0.046	2.6E-04	2.31	1.2E-01
0.1870	324.0	6.87E-03	1.83E-06	872.	0.046	2.8E-04	2.31	1.3E-01
0.1903	324.0	6.40E-03	1.70E-06	872.	0.046	3.0E-04	2.31	1.4E-01
0.1936	324.0	5.95E-03	1.58E-06	872.	0.046	3.2E-04	2.31	1.5E-01
0.1969	324.0	5.54E-03	1.47E-06	872.	0.046	3.5E-04	2.31	1.6E-01
0.2001	324.0	5.16E-03	1.37E-06	872.	0.046	3.8E-04	2.31	1.7E-01
0.2034	324.0	4.80E-03	1.28E-06	872.	0.046	4.0E-04	2.31	1.8E-01
0.2067	324.0	4.47E-03	1.19E-06	872.	0.046	4.3E-04	2.31	2.0E-01
0.2100	324.0	4.16E-03	1.10E-06	872.	0.046	4.7E-04	2.31	2.1E-01
0.2133	324.0	3.87E-03	1.03E-06	872.	0.046	5.0E-04	2.31	2.3E-01
0.2165	324.0	3.60E-03	9.57E-07	872.	0.046	5.4E-04	2.31	2.4E-01
0.2198	324.0	3.35E-03	8.91E-07	872.	0.046	5.8E-04	2.31	2.6E-01
0.2231	324.0	3.12E-03	8.30E-07	872.	0.046	6.2E-04	2.31	2.8E-01
0.2264	324.0	2.91E-03	7.72E-07	872.	0.046	6.7E-04	2.31	3.0E-01
0.2297	324.0	2.71E-03	7.19E-07	872.	0.046	7.2E-04	2.31	3.2E-01
0.2330	324.0	2.52E-03	6.69E-07	872.	0.046	7.7E-04	2.31	3.5E-01
0.2362	324.0	2.35E-03	6.23E-07	872.	0.046	8.2E-04	2.31	3.7E-01
0.2395	324.0	2.18E-03	5.80E-07	872.	0.046	8.9E-04	2.31	4.0E-01
0.2428	324.0	2.03E-03	5.40E-07	872.	0.046	9.5E-04	2.31	4.3E-01
0.2461	324.0	1.89E-03	5.03E-07	872.	0.046	1.0E-03	2.31	4.6E-01
0.2494	324.0	1.76E-03	4.69E-07	872.	0.046	1.1E-03	2.31	4.9E-01
0.2526	324.0	1.64E-03	4.36E-07	872.	0.046	1.2E-03	2.31	5.3E-01
0.2559	324.0	1.53E-03	4.06E-07	872.	0.046	1.3E-03	2.31	5.7E-01
0.2592	324.0	1.42E-03	3.79E-07	872.	0.046	1.4E-03	2.31	6.1E-01
0.2625	324.0	1.33E-03	3.53E-07	872.	0.046	1.5E-03	2.31	6.6E-01
0.2658	324.0	1.24E-03	3.28E-07	872.	0.046	1.6E-03	2.31	7.1E-01
0.2690	324.0	1.15E-03	3.06E-07	872.	0.046	1.7E-03	2.31	7.6E-01
0.2723	324.0	1.07E-03	2.85E-07	872.	0.046	1.8E-03	2.31	8.1E-01
0.2756	324.0	9.99E-04	2.65E-07	872.	0.046	1.9E-03	2.31	8.7E-01
0.2789	324.0	9.30E-04	2.47E-07	872.	0.046	2.1E-03	2.31	9.4E-01
0.2822	324.0	8.67E-04	2.30E-07	872.	0.046	2.2E-03	2.31	1.0E 00
0.2854	324.0	8.08E-04	2.15E-07	872.	0.046	2.4E-03	2.31	1.1E 00
0.2887	324.0	7.52E-04	2.00E-07	872.	0.046	2.6E-03	2.31	1.2E 00
0.2920	324.0	7.01E-04	1.86E-07	872.	0.046	2.8E-03	2.31	1.2E 00
0.2953	324.0	6.53E-04	1.74E-07	872.	0.046	3.0E-03	2.31	1.3E 00
0.2986	324.0	6.09E-04	1.62E-07	872.	0.046	3.2E-03	2.31	1.4E 00
0.3019	324.0	5.67E-04	1.51E-07	872.	0.046	3.4E-03	2.31	1.5E 00
0.3051	324.0	5.29E-04	1.40E-07	872.	0.047	3.7E-03	2.31	1.6E 00

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.3084	324.0	4.93E-04	1.31E-07	872.	0.047	3.9E-03	2.31	1.8E 00
0.3117	324.0	4.59E-04	1.22E-07	872.	0.047	4.2E-03	2.31	1.9E 00
0.3150	324.0	4.26E-04	1.14 -07	872.	0.047	4.5E-03	2.31	2.0E 00
0.3183	324.0	3.99E-04	1.06E-07	872.	0.047	4.9E-03	2.31	2.2E 00
0.3215	324.0	3.72E-04	9.88E-08	872.	0.047	5.2E-03	2.31	2.3E 00
0.3248	324.0	3.46E-04	9.21E-08	872.	0.047	5.6E-03	2.31	2.5E 00
0.3281	324.0	3.23E-04	8.53E-08	872.	0.047	6.0E-03	2.31	2.7E 00
0.3609	324.0	1.60E-04	4.26E-08	872.	0.047	1.2E-02	2.31	5.4E 00
0.3937	324.0	7.99E-05	2.12E-08	872.	0.047	2.4E-02	2.31	1.1E 01
0.4265	324.0	4.00E-05	1.06E-08	872.	0.048	4.8E-02	2.31	2.2E 01
0.4593	324.0	2.01E-05	5.34E-09	872.	0.048	9.6E-02	2.31	4.3E 01
0.4921	324.0	1.01E-05	2.69E-09	872.	0.048	1.9E-01	2.31	8.6E 01
0.5250	360.0	5.31E-06	1.27E-09	913.	0.045	4.0E-01	2.55	2.0E 02
0.5578	396.0	2.97E-06	6.46E-10	964.	0.051	8.0E-01	2.80	4.3E 02
0.5906	432.0	1.75E-06	3.50E-10	1007.	0.056	1.5E 00	3.06	8.8E 02
0.6234	468.0	1.08E-06	1.99E-10	1048.	0.061	2.6E 00	3.34	1.7E 03
0.6562	504.0	6.95E-07	1.19E-10	1087.	0.066	4.3E 00	3.62	3.1E 03
0.6890	540.0	4.61E-07	7.35E-11	1125.	0.071	7.0E 00	3.93	5.3E 03
0.7218	576.0	3.14E-07	4.70E-11	1162.	0.076	1.1E 01		
0.7546	612.0	2.20E-07	3.10E-11	1198.	0.081	1.7E 01		
0.7874	648.0	1.57E-07	2.09E-11	1233.	0.086	2.5E 01		
0.8202	684.0	1.15E-07	1.45E-11	1267.	0.092	3.6E 01		
0.8531	720.0	8.54E-08	1.02E-11	1299.	0.097	5.0E 01		
0.8859	756.0	6.44E-08	7.34E-12	1332.	0.102	7.0E 01		
0.9187	792.0	4.94E-08	5.37E-12	1363.	0.107	9.6E 01		
0.9515	828.0	3.83E-08	3.98E-12	1394.	0.113	1.3E 02		
0.9843	864.0	3.01E-08	3.00E-12	1424.	0.118	1.7E 02		
1.0171	900.0	2.39E-08	2.29E-12	1453.	0.124	2.2E 02		
1.0499	936.0	1.92E-08	1.77E-12	1482.	0.129	2.9E 02		
1.0827	972.0	1.56E-08	1.38E-12	1510.	0.135	3.7E 02		
1.1155	1008.0	1.27E-08	1.09E-12	1538.	0.141	4.7E 02		
1.1483	1044.0	1.05E-08	8.64E-13	1565.	0.146	6.0E 02		
1.1812	1080.0	8.69E-09	6.93E-13	1592.	0.152	7.4E 02		
1.2140	1116.0	7.27E-09	5.61E-13	1618.	0.158	9.2E 02		
1.2468	1152.0	6.12E-09	4.57E-13	1644.	0.164	1.1E 03		
1.2796	1188.0	5.18E-09	3.76E-13	1669.	0.170	1.4E 03		
1.3124	1224.0	4.41E-09	3.11E-13	1694.	0.175	1.7E 03		
1.3452	1260.0	3.78E-09	2.58E-13	1719.	0.181	2.0E 03		
1.3780	1296.0	3.26E-09	2.16E-13	1743.	0.187	2.4E 03		
1.4108	1332.0	2.82E-09	1.82E-13	1768.	0.193	2.8E 03		
1.4436	1368.0	2.45E-09	1.54E-13	1791.	0.200	3.3E 03		
1.4764	1404.0	2.14E-09	1.31E-13	1815.	0.206	3.9E 03		
1.5093	1440.0	1.87E-09	1.12E-13	1838.	0.212	4.6E 03		
1.5421	1476.0	1.65E-09	9.61E-14	1861.	0.218	5.3E 03		
1.5749	1512.0	1.46E-09	8.29E-14	1883.	0.224	6.2E 03		
1.6077	1548.0	1.29E-09	7.18E-14	1905.	0.231	7.2E 03		
1.6405	1584.0	1.15E-09	6.24E-14	1927.	0.237	8.2E 03		
1.6733	1620.0	1.02E-09	5.44E-14	1949.	0.244	9.4E 03		
1.7061	1656.0	9.16E-10	4.76E-14	1971.	0.250	1.1E 04		
1.7389	1692.0	8.23E-10	4.19E-14	1992.	0.257	1.2E 04		
1.7717	1728.0	7.41E-10	3.69E-14	2013.	0.263	1.4E 04		
1.8045	1764.0	6.68E-10	3.26E-14	2034.	0.270	1.6E 04		
1.8374	1800.0	6.05E-10	2.89E-14	2055.	0.277	1.8E 04		
1.8702	1836.0	5.49E-10	2.57E-14	2075.	0.283	2.0E 04		
1.9030	1872.0	4.99E-10	2.30E-14	2095.	0.290	2.2E 04		
1.9358	1908.0	4.55E-10	2.05E-14	2115.	0.297	2.5E 04		
1.9686	1944.0	4.15E-10	1.84E-14	2135.	0.304	2.8E 04		
2.0014	1980.0	3.80E-10	1.65 -14	2155.	0.311	3.1E 04		
2.0342	2016.0	3.47E-10	1.49E-14	2174.	0.313	3.5E 04		
2.0670	2052.0	3.21E-10	1.34E-14	2194.	0.325	3.3E 04		

TABLE III

NASA MARS ATMOSPHERE

MODEL 2
(Mean)
Metric Units

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
0	250.1	2.50E 01	3.57E-05	314.	26.3	2.2E-04	1.54
1	246.1	2.37E 01	3.44E-05	311.	25.9	2.3E-04	1.51
2	242.2	2.24E 01	3.31E-05	308.	25.5	2.4E-04	1.48
3	238.3	2.12E 01	3.18E-05	306.	25.1	2.5E-04	1.46
4	234.4	2.00E 01	3.05E-05	303.	24.7	2.6E-04	1.43
5	230.5	1.89E 01	2.93E-05	301.	24.3	2.8E-04	1.41
6	226.7	1.78E 01	2.81E-05	298.	23.9	2.9E-04	1.38
7	222.8	1.68E 01	2.70E-05	296.	23.6	3.0E-04	1.36
8	218.9	1.58E 01	2.58E-05	293.	23.2	3.1E-04	1.33
9	215.0	1.49E 01	2.47E-05	290.	22.8	3.3E-04	1.31
10	211.1	1.40E 01	2.37E-05	288.	22.4	3.4E-04	1.29
11	207.2	1.31E 01	2.26E-05	285.	22.0	3.6E-04	1.26
12	203.3	1.23E 01	2.16E-05	282.	21.6	3.7E-04	1.24
13	199.4	1.15E 01	2.06E-05	280.	21.2	3.9E-04	1.22
14	195.5	1.08E 01	1.97E-05	277.	20.8	4.1E-04	1.20
15	191.6	1.00E 01	1.87E-05	274.	20.4	4.3E-04	1.17
16	187.5	9.37E 00	1.78E-05	271.	20.0	4.5E-04	1.15
17	183.9	8.72E 00	1.70E-05	269.	19.6	4.8E-04	1.13
18	180.0	8.11E 00	1.61E-05	266.	19.2	5.0E-04	1.11
19	180.0	7.54E 00	1.50E-05	266.	13.6	5.4E-04	1.11
20	180.0	7.00E 00	1.39E-05	266.	13.6	5.8E-04	1.11
21	180.0	6.50E 00	1.29 -05	266.	13.6	6.2E-04	1.11
22	180.0	6.04E 00	1.20E-05	266.	13.6	6.7E-04	1.11
23	180.0	5.62E 00	1.11E-05	266.	13.6	7.2E-04	1.11
24	180.0	5.22E 00	1.04E-05	266.	13.6	7.8E-04	1.11
25	180.0	4.85E 00	9.62E-06	266.	13.6	8.4E-04	1.11
26	180.0	4.51 00	8.94E-06	266.	13.6	9.0E-04	1.11
27	180.0	4.19E 00	8.31E-06	266.	13.6	9.7E-04	1.11
28	180.0	3.89E 00	7.72E-06	266.	13.7	1.0E-03	1.11
29	180.0	3.62 00	7.18E-06	266.	13.7	1.1E-03	1.11
30	180.0	3.36E 00	6.67E-06	266.	13.7	1.2E-03	1.11
31	180.0	3.12E 00	6.20E-06	266.	13.7	1.3E-03	1.11
32	180.0	2.90E 00	5.76E-06	266.	13.7	1.4E-03	1.11
33	180.0	2.70E 00	5.36 -06	266.	13.7	1.5E-03	1.11

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
34	180.0	2.51E 00	4.98E-06	266.	13.7	1.6E-03	1.11
35	180.0	2.33E 00	4.63E-06	266.	13.7	1.7E-03	1.11
36	180.0	2.17E 00	4.30E-06	266.	13.7	1.9E-03	1.11
37	180.0	2.02E 00	4.00E-06	266.	13.7	2.0E-03	1.11
38	180.0	1.87E 00	3.72E-06	266.	13.7	2.2E-03	1.11
39	180.0	1.74E 00	3.46E-06	266.	13.7	2.3E-03	1.11
40	180.0	1.62E 00	3.22E-06	266.	13.7	2.5E-03	1.11
41	180.0	1.51E 00	2.99E-06	266.	13.8	2.7E-03	1.11
42	180.0	1.40E 00	2.76E-06	266.	13.8	2.9E-03	1.11
43	180.0	1.30E 00	2.59E-06	266.	13.8	3.1E-03	1.11
44	180.0	1.21E 00	2.41E-06	266.	13.8	3.4E-03	1.11
45	180.0	1.13E 00	2.24E-06	266.	13.8	3.6E-03	1.11
46	180.0	1.05E 00	2.08E-06	266.	13.8	3.9E-03	1.11
47	180.0	9.75E-01	1.94E-06	266.	13.8	4.2E-03	1.11
48	180.0	9.07E-01	1.80E-06	266.	13.8	4.5E-03	1.11
49	180.0	8.44E-01	1.67E-06	266.	13.8	4.8E-03	1.11
50	180.0	7.85E-01	1.56E-06	266.	13.8	5.2E-03	1.11
51	180.0	7.30E-01	1.45E-06	266.	13.8	5.6E-03	1.11
52	180.0	6.79E-01	1.35E-06	266.	13.8	6.0E-03	1.11
53	180.0	6.32E-01	1.25E-06	266.	13.9	6.4E-03	1.11
54	180.0	5.88E-01	1.17E-06	266.	13.9	6.9E-03	1.11
55	180.0	5.47E-01	1.09E-06	266.	13.9	7.4E-03	1.11
56	180.0	5.09E-01	1.01E-06	266.	13.9	8.0E-03	1.11
57	180.0	4.74E-01	9.40E-07	266.	13.9	8.6E-03	1.11
58	180.0	4.41E-01	8.75E-07	266.	13.9	9.2E-03	1.11
59	180.0	4.10E-01	8.14E-07	266.	13.9	9.9E-03	1.11
60	180.0	3.82E-01	7.58E-07	266.	13.9	1.1E-02	1.11
61	180.0	3.55E-01	7.05E-07	266.	13.9	1.1E-02	1.11
62	180.0	3.31E-01	6.56E-07	266.	13.9	1.2E-02	1.11
63	180.0	3.08E-01	6.11E-07	266.	13.9	1.3E-02	1.11
64	180.0	2.86E-01	5.69E-07	266.	13.9	1.4E-02	1.11
65	180.0	2.67E-01	5.29E-07	266.	13.9	1.5E-02	1.11
66	180.0	2.48E-01	4.93E-07	266.	14.0	1.6E-02	1.11
67	180.0	2.31E-01	4.59E-07	266.	14.0	1.8E-02	1.11
68	180.0	2.15E-01	4.27E-07	266.	14.0	1.9E-02	1.11
69	180.0	2.00E-01	3.97E-07	266.	14.0	2.0E-02	1.11
70	180.0	1.86E-01	3.70E-07	266.	14.0	2.2E-02	1.11
71	180.0	1.74E-01	3.45E-07	266.	14.0	2.3E-02	1.11
72	180.0	1.62E-01	3.21E-07	266.	14.0	2.5E-02	1.11
73	180.0	1.50E-01	2.99E-07	266.	14.0	2.7E-02	1.11
74	180.0	1.40E-01	2.78E-07	266.	14.0	2.9E-02	1.11
75	180.0	1.30E-01	2.59E-07	266.	14.0	3.1E-02	1.11
76	180.0	1.22E-01	2.41E-07	266.	14.0	3.3E-02	1.11
77	180.0	1.13E-01	2.25E-07	266.	14.0	3.6E-02	1.11
78	180.0	1.05E-01	2.09E-07	266.	14.1	3.9E-02	1.11
79	180.0	9.82E-02	1.95E-07	266.	14.1	4.1E-02	1.11
80	180.0	9.14E-02	1.81E-07	266.	14.1	4.4E-02	1.11
81	180.0	8.52E-02	1.69E-07	266.	14.1	4.8E-02	1.11
82	180.0	7.93E-02	1.57E-07	266.	14.1	5.1E-02	1.11
83	180.0	7.39E-02	1.47E-07	266.	14.1	5.5E-02	1.11
84	180.0	6.88E-02	1.37E-07	266.	14.1	5.9E-02	1.11
85	180.0	6.41E-02	1.27E-07	266.	14.1	6.3E-02	1.11
86	180.0	5.97E-02	1.19E-07	266.	14.1	6.8E-02	1.11
87	180.0	5.57E-02	1.10E-07	266.	14.1	7.3E-02	1.11
88	180.0	5.19E-02	1.03E-07	266.	14.1	7.8E-02	1.11
89	180.0	4.83E-02	9.59E-08	266.	14.1	8.4E-02	1.11
90	180.0	4.50E-02	8.94E-08	266.	14.2	9.0E-02	1.11
91	180.0	4.19E-02	8.33E-08	266.	14.2	9.7E-02	1.11
92	180.0	3.91E-02	7.76E-08	266.	14.2	1.0E-01	1.11
93	180.0	3.64E-02	7.23E-08	266.	14.2	1.1E-01	1.11

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
94	180.0	3.39E-02	6.74E-08	266.	14.2	1.2E-01	1.11
95	180.0	3.16E-02	6.28E-08	266.	14.2	1.3E-01	1.11
96	130.0	2.95E-02	5.85E-08	266.	14.2	1.4E-01	1.11
97	180.0	2.75E-02	5.45E-08	266.	14.2	1.5E-01	1.11
98	180.0	2.56E-02	5.08E-08	266.	14.2	1.6E-01	1.11
99	180.0	2.39E-02	4.74E-08	266.	14.2	1.7E-01	1.11
100	180.0	2.23E-02	4.42E-08	266.	14.2	1.8E-01	1.11
110	180.0	1.10E-02	2.19E-08	266.	14.3	3.7E-01	1.11
120	180.0	5.51E-03	1.09E-08	266.	14.4	7.4E-01	1.11
130	180.0	2.76E-03	5.47E-09	266.	14.5	1.5E 00	1.11
140	180.0	1.38E-03	2.75E-09	266.	14.6	2.9E 00	1.11
150	180.0	6.98E-04	1.39E-09	266.	14.6	5.8E 00	1.11
160	200.0	3.66E-04	6.54E-10	280.	14.1	1.2E 01	1.22
170	220.0	2.05E-04	3.33E-10	294.	15.5	2.4E 01	1.34
180	240.0	1.21E-04	1.80E-10	307.	17.0	4.5E 01	1.47
190	260.0	7.47E-05	1.03E-10	319.	18.5	7.9E 01	1.60
200	280.0	4.79E-05	6.11E-11	331.	20.1	1.3E 02	1.73
210	300.0	3.18E-05	3.78E-11	343.	21.6	2.1E 02	1.88
220	320.0	2.17E-05	2.42E-11	354.	23.2	3.3E 02	
230	340.0	1.52E-05	1.59E-11	365.	24.7	5.1E 02	
240	360.0	1.08E-05	1.08E-11	376.	26.3	7.5E 02	
250	380.0	7.92E-06	7.44E-12	386.	27.9	1.1E 03	
260	400.0	5.88E-06	5.25E-12	396.	29.5	1.5E 03	
270	420.0	4.44E-06	3.78E-12	406.	31.1	2.1E 03	
280	440.0	3.40E-06	2.76E-12	415.	32.8	2.9E 03	
290	460.0	2.64E-06	2.05E-12	425.	34.4	3.9E 03	
300	480.0	2.07E-06	1.54E-12	434.	36.1	5.2E 03	
310	500.0	1.65E-06	1.18E-12	443.	37.7	6.8E 03	
320	520.0	1.32E-06	9.09E-13	452.	39.4	8.9E 03	
330	540.0	1.07E-06	7.09E-13	460.	41.1	1.1E 04	
340	560.0	8.76E-07	5.59E-13	469.	42.9	1.4E 04	
350	580.0	7.22E-07	4.45E-13	477.	44.6	1.8E 04	
360	600.0	5.99E-07	3.57E-13	485.	46.3	2.3E 04	
370	620.0	5.01E-07	2.89E-13	493.	48.1	2.8E 04	
380	640.0	4.22E-07	2.35E-13	501.	49.9	3.4E 04	
390	660.0	3.57E-07	1.93E-13	509.	51.7	4.2E 04	
400	680.0	3.04E-07	1.60E-13	516.	53.5	5.0E 04	
410	700.0	2.61E-07	1.33E-13	524.	55.3	6.1E 04	
420	720.0	2.24E-07	1.11E-13	531.	57.1	7.2E 04	
430	740.0	1.94E-07	9.37E-14	539.	59.0	8.6E 04	
440	760.0	1.69E-07	7.93E-14	546.	60.8	1.0E 05	
450	780.0	1.47E-07	6.74E-14	553.	62.7	1.2E 05	
460	800.0	1.29E-07	5.76E-14	560.	64.6	1.4E 05	
470	820.0	1.14E-07	4.95E-14	567.	66.5	1.6E 05	
480	840.0	1.00E-07	4.27E-14	574.	68.4	1.9E 05	
490	860.0	8.39E-08	3.69E-14	581.	70.3	2.2E 05	
500	880.0	7.91E-08	3.21E-14	587.	72.3	2.5E 05	
510	900.0	7.06E-08	2.80E-14	594.	74.3	2.9E 05	
520	920.0	6.32E-08	2.45E-14	601.	76.2	3.3E 05	
530	940.0	5.67E-08	2.15E-14	607.	78.2	3.7E 05	
540	960.0	5.10E-08	1.90E-14	614.	80.2	4.2E 05	
550	980.0	4.61E-08	1.68E-14	620.	82.2	4.8E 05	
560	1000.0	4.17E-08	1.49E-14	626.	84.3	5.4E 05	
570	1020.0	3.78E-08	1.32E-14	632.	86.3	6.1E 05	
580	1040.0	3.44E-08	1.18E-14	639.	88.4	6.8E 05	
590	1060.0	3.13E-08	1.06E-14	645.	90.5	7.6E 05	

TABLE IV

NASA MARS ATMOSPHERE
MODEL 3
(Minimum)
English Units

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.0000	360.0	1.45E-01	-4.19E-05	834.	0.056	1.4E-05	2.30	5.5E-03
0.0033	351.8	1.34E-01	3.95E-05	824.	0.055	1.5E-05	2.24	5.7E-03
0.0066	343.6	1.23E-01	3.72E-05	814.	0.054	1.6E-05	2.18	5.9E-03
0.0098	335.4	1.13E-01	3.50E-05	804.	0.053	1.7E-05	2.13	6.1E-03
0.0131	327.2	1.03E-01	3.28E-05	795.	0.051	1.8E-05	2.08	6.4E-03
0.0164	319.0	9.45E-02	3.08E-05	785.	0.050	1.9E-05	2.03	6.6E-03
0.0197	310.9	8.62E-02	2.88E-05	774.	0.049	2.0E-05	1.98	6.9E-03
0.0230	302.7	7.84E-02	2.69E-05	764.	0.048	2.2E-05	1.94	7.2E-03
0.0262	294.5	7.12E-02	2.51E-05	754.	0.046	2.3E-05	1.89	7.5E-03
0.0295	286.3	6.44E-02	2.34E-05	743.	0.045	2.5E-05	1.84	7.9E-03
0.0328	278.1	5.81E-02	2.17E-05	732.	0.044	2.7E-05	1.79	8.3E-03
0.0361	269.9	5.23E-02	2.01E-05	722.	0.043	2.9E-05	1.75	8.7E-03
0.0394	261.7	4.69E-02	1.86E-05	711.	0.041	3.2E-05	1.70	9.1E-03
0.0427	253.5	4.19E-02	1.72E-05	699.	0.040	3.4E-05	1.65	9.6E-03
0.0459	245.3	3.74E-02	1.58E-05	688.	0.039	3.7E-05	1.61	1.0E-02
0.0492	237.1	3.31E-02	1.45E-05	676.	0.038	4.0E-05	1.56	1.1E-02
0.0525	229.0	2.93E-02	1.33E-05	665.	0.036	4.4E-05	1.52	1.1E-02
0.0558	220.8	2.58E-02	1.21E-05	653.	0.035	4.8E-05	1.47	1.2E-02
0.0591	212.6	2.26E-02	1.10E-05	640.	0.034	5.3E-05	1.43	1.3E-02
0.0623	204.4	1.96E-02	9.79E-06	628.	0.033	5.9E-05	1.38	1.4E-02
0.0656	196.2	1.70E-02	9.01E-06	615.	0.031	6.5E-05	1.34	1.5E-02
0.0689	188.0	1.46E-02	8.10E-06	602.	0.030	7.3E-05	1.30	1.6E-02
0.0722	179.8	1.25E-02	7.24E-06	589.	0.029	8.1E-05	1.25	1.7E-02
0.0755	179.8	1.07E-02	6.17E-06	589.	0.021	9.5E-05	1.25	2.0E-02
0.0787	179.8	9.10E-03	5.26E-06	589.	0.021	1.1E-04	1.25	2.4E-02
0.0820	179.8	7.76E-03	4.48E-06	589.	0.021	1.3E-04	1.25	2.8E-02
0.0853	179.8	6.62E-03	3.82E-06	589.	0.021	1.5E-04	1.25	3.3E-02
0.0886	179.8	5.64E-03	3.26E-06	589.	0.021	1.8E-04	1.25	3.9E-02
0.0919	179.8	4.81E-03	2.78E-06	589.	0.021	2.1E-04	1.25	4.5E-02
0.0951	179.8	4.10E-03	2.37E-06	589.	0.021	2.5E-04	1.25	5.3E-02
0.0984	179.8	3.50E-03	2.02E-06	589.	0.021	2.9E-04	1.25	6.2E-02
0.1017	179.8	2.98E-03	1.72E-06	589.	0.021	3.4E-04	1.25	7.3E-02
0.1050	179.8	2.55E-03	1.47E-06	589.	0.021	4.0E-04	1.25	8.5E-02
0.1083	179.8	2.17E-03	1.26E-06	589.	0.021	4.7E-04	1.25	1.0E-01

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.1116	179.8	1.85E-03	1.07E-06	589.	0.021	5.5E-04	1.25	1.2E-01
0.1148	179.8	1.58E-03	9.14E-07	589.	0.021	6.4E-04	1.25	1.4E-01
0.1181	179.8	1.35E-03	7.80E-07	589.	0.021	7.5E-04	1.25	1.6E-01
0.1214	179.8	1.15E-03	6.65E-07	589.	0.021	8.8E-04	1.25	1.9E-01
0.1247	179.8	9.83E-04	5.68E-07	589.	0.021	1.0E-03	1.25	2.2E-01
0.1280	179.8	8.39E-04	4.85E-07	589.	0.021	1.2E-03	1.25	2.6E-01
0.1312	179.8	7.16E-04	4.14E-07	589.	0.021	1.4E-03	1.25	3.0E-01
0.1345	179.8	6.11E-04	3.53E-07	589.	0.021	1.7E-03	1.25	3.6E-01
0.1378	179.8	5.22E-04	3.02E-07	589.	0.021	1.9E-03	1.25	4.2E-01
0.1411	179.8	4.46E-04	2.58E-07	589.	0.021	2.3E-03	1.25	4.9E-01
0.1444	179.8	3.81E-04	2.20E-07	589.	0.021	2.7E-03	1.25	5.7E-01
0.1476	179.8	3.25E-04	1.88E-07	589.	0.021	3.1E-03	1.25	6.7E-01
0.1509	179.8	2.76E-04	1.61E-07	589.	0.021	3.7E-03	1.25	7.8E-01
0.1542	179.8	2.37E-04	1.37E-07	589.	0.021	4.3E-03	1.25	9.2E-01
0.1575	179.8	2.03E-04	1.17E-07	589.	0.021	5.0E-03	1.25	1.1E 00
0.1608	179.8	1.73E-04	1.00E-07	589.	0.021	5.9E-03	1.25	1.3E 00
0.1640	179.8	1.48E-04	8.55E-08	589.	0.021	6.9E-03	1.25	1.5E 00
0.1673	179.8	1.26E-04	7.31E-08	589.	0.021	8.0E-03	1.25	1.7E 00
0.1706	179.8	1.08E-04	6.25E-08	589.	0.021	9.4E-03	1.25	2.0E 00
0.1739	179.8	9.24E-05	5.34E-08	589.	0.021	1.1E-02	1.25	2.4E 00
0.1772	179.8	7.90E-05	4.56E-08	589.	0.021	1.3E-02	1.25	2.8E 00
0.1805	179.8	6.75E-05	3.90E-08	589.	0.021	1.5E-02	1.25	3.2E 00
0.1837	179.8	5.77E-05	3.34E-08	589.	0.021	1.8E-02	1.25	3.8E 00
0.1870	179.8	4.93E-05	2.85E-08	589.	0.021	2.1E-02	1.25	4.4E 00
0.1903	179.8	4.22E-05	2.44E-08	589.	0.021	2.4E-02	1.25	5.2E 00
0.1936	179.8	3.61E-05	2.09E-08	589.	0.021	2.8E-02	1.25	6.0E 00
0.1969	179.8	3.09E-05	1.78E-08	589.	0.021	3.3E-02	1.25	7.0E 00
0.2001	179.8	2.64E-05	1.53E-08	589.	0.021	3.9E-02	1.25	8.2E 00
0.2034	179.8	2.26E-05	1.30E-08	589.	0.021	4.5E-02	1.25	9.6E 00
0.2067	179.8	1.93E-05	1.12E-08	589.	0.021	5.3E-02	1.25	1.1E 01
0.2100	179.8	1.65E-05	9.55E-09	589.	0.021	6.2E-02	1.25	1.3E 01
0.2133	179.8	1.41E-05	8.17E-09	589.	0.021	7.2E-02	1.25	1.5E 01
0.2165	179.8	1.21E-05	6.99E-09	589.	0.021	8.4E-02	1.25	1.8E 01
0.2198	179.8	1.04E-05	5.98E-09	589.	0.021	9.8E-02	1.25	2.1E 01
0.2231	179.8	8.86E-06	5.12E-09	589.	0.021	1.1E-01	1.25	2.5E 01
0.2264	179.8	7.59E-06	4.38E-09	589.	0.021	1.3E-01	1.25	2.9E 01
0.2297	179.8	6.49E-06	3.75E-09	589.	0.021	1.6E-01	1.25	3.3E 01
0.2330	179.8	5.56E-06	3.21E-09	589.	0.021	1.8E-01	1.25	3.9E 01
0.2362	179.8	4.76E-06	2.75E-09	589.	0.021	2.1E-01	1.25	4.6E 01
0.2395	179.8	4.08E-06	2.36E-09	589.	0.021	2.5E-01	1.25	5.3E 01
0.2428	179.8	3.49E-06	2.02E-09	589.	0.021	2.9E-01	1.25	6.2E 01
0.2461	179.8	2.99E-06	1.73E-09	589.	0.021	3.4E-01	1.25	7.3E 01
0.2494	179.8	2.56E-06	1.48E-09	589.	0.021	4.0E-01	1.25	8.5E 01
0.2526	179.8	2.19E-06	1.27E-09	589.	0.021	4.6E-01	1.25	9.9E 01
0.2559	179.8	1.88E-06	1.09E-09	589.	0.021	5.4E-01	1.25	1.2E 02
0.2592	179.8	1.61E-06	9.30E-10	589.	0.021	6.3E-01	1.25	1.4E 02
0.2625	179.8	1.38E-06	7.97E-10	589.	0.021	7.4E-01	1.25	1.6E 02
0.2658	179.8	1.18E-06	6.83E-10	589.	0.021	8.6E-01	1.25	1.8E 02
0.2690	179.8	1.01E-06	5.85E-10	589.	0.021	1.0E 00	1.25	2.1E 02
0.2723	179.8	8.68E-07	5.02E-10	589.	0.021	1.2E 00	1.25	2.5E 02
0.2756	179.8	7.44E-07	4.30E-10	589.	0.021	1.4E 00	1.25	2.9E 02
0.2789	179.8	6.38E-07	3.68E-10	589.	0.021	1.6E 00	1.25	3.4E 02
0.2822	179.8	5.47E-07	3.16E-10	589.	0.021	1.9E 00	1.25	4.0E 02
0.2854	179.8	4.69E-07	2.71E-10	589.	0.021	2.2E 00	1.25	4.6E 02
0.2887	179.8	4.02E-07	2.32E-10	589.	0.021	2.5E 00	1.25	5.4E 02
0.2920	179.8	3.44E-07	1.99E-10	589.	0.021	3.0E 00	1.25	6.3E 02
0.2953	179.8	2.95E-07	1.71E-10	589.	0.021	3.4E 00	1.25	7.4E 02
0.2986	179.8	2.53E-07	1.46E-10	589.	0.021	4.0E 00	1.25	8.6E 02
0.3019	179.8	2.17E-07	1.26E-10	589.	0.021	4.7E 00	1.25	1.0E 03
0.3051	179.8	1.86E-07	1.08E-10	589.	0.021	5.5E 00	1.25	1.2E 03

Altitude ft x 10^{-6}	Temperature °R	Pressure lbs/in^2	Density slugs/ft^3	Speed of sound ft/sec	Density scale height ft x 10^{-6}	Mean free path ft	Viscosity slugs/ft sec x 10^7	Kinematic viscosity ft^2/sec
0.3084	179.8	1.60E-07	9.24E-11	589.	0.021	6.4E 00	1.25	1.4E 03
0.3117	179.8	1.37E-07	7.93E-11	589.	0.021	7.4E 00	1.25	1.6E 03
0.3150	179.8	1.15E-07	6.80E-11	589.	0.021	8.6E 00	1.25	1.8E 03
0.3183	179.8	1.01E-07	5.84E-11	589.	0.021	1.0E 01	1.25	2.2E 03
0.3215	179.8	8.67E-08	5.01E-11	589.	0.021	1.2E 01	1.25	2.5E 03
0.3248	179.8	7.44E-08	4.30E-11	589.	0.021	1.4E 01	1.25	2.9E 03
0.3281	179.8	6.39E-08	3.69E-11	589.	0.021	1.6E 01	1.25	3.4E 03
0.3609	179.8	1.39E-08	8.05E-12	589.	0.022	7.3E 01	1.25	1.6E 04
0.3937	179.8	3.06E-09	1.77E-12	589.	0.022	3.3E 02	1.25	7.1E 04
0.4265	179.8	6.79E-10	3.93E-13	589.	0.022	1.5E 03	1.25	3.2E 05
0.4593	179.8	1.52E-10	8.79E-14	589.	0.022	6.7E 03	1.25	1.4E 06
0.4921	179.8	3.43E-11	1.98E-14	589.	0.022	3.0E 04	1.25	6.3E 06

TABLE IV

NASA MARS ATMOSPHERE

MODEL 3

(Minimum)

Metric Units

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
0	200.0	1.00E 01	2.14E-05	254.	17.2	4.2E-04	1.10
1	195.4	9.21E 00	2.03E-05	251.	16.8	4.5E-04	1.07
2	190.9	8.48E 00	1.91E-05	248.	16.4	4.8E-04	1.05
3	186.3	7.78E 00	1.80E-05	245.	16.1	5.1E-04	1.02
4	181.8	7.13E 00	1.69E-05	242.	15.7	5.5E-04	1.00
5	177.2	6.51E 00	1.58E-05	239.	15.3	5.8E-04	0.97
6	172.7	5.94E 00	1.48E-05	236.	14.9	6.2E-04	0.95
7	168.1	5.40E 00	1.39E-05	233.	14.5	6.6E-04	0.93
8	163.6	4.90E 00	1.29E-05	230.	14.2	7.1E-04	0.90
9	159.0	4.44E 00	1.20E-05	227.	13.8	7.7E-04	0.88
10	154.5	4.01E 00	1.12E-05	223.	13.4	8.2E-04	0.86
11	149.9	3.60E 00	1.04E-05	220.	13.0	8.9E-04	0.84
12	145.4	3.23E 00	9.59E-06	217.	12.6	9.6E-04	0.81
13	140.8	2.89E 00	8.85E-06	213.	12.2	1.0E-03	0.79
14	136.3	2.57E 00	8.14E-06	210.	11.9	1.1E-03	0.77
15	131.7	2.28E 00	7.47E-06	206.	11.5	1.2E-03	0.75
16	127.2	2.02E 00	6.84E-06	203.	11.1	1.3E-03	0.73
17	122.6	1.78E 00	6.24E-06	199.	10.7	1.5E-03	0.71
18	118.1	1.55E 00	5.67E-06	195.	10.3	1.6E-03	0.68
19	113.5	1.35E 00	5.14E-06	191.	9.9	1.8E-03	0.66
20	109.0	1.17E 00	4.64E-06	188.	9.5	2.0E-03	0.64
21	104.4	1.01E 00	4.17E-06	184.	9.1	2.2E-03	0.62
22	99.9	8.63E-01	3.73E-06	180.	8.7	2.5E-03	0.60
23	99.9	7.36E-01	3.18E-06	180.	6.3	2.9E-03	0.60
24	99.9	6.27E-01	2.71E-06	180.	6.3	3.4E-03	0.60
25	99.9	5.35E-01	2.31E-06	180.	6.3	4.0E-03	0.60
26	99.9	4.56E-01	1.97E-06	180.	6.3	4.7E-03	0.60
27	99.9	3.89E-01	1.68E-06	180.	6.3	5.5E-03	0.60
28	99.9	3.31E-01	1.43E-06	180.	6.3	6.4E-03	0.60
29	99.9	2.83E-01	1.22E-06	180.	6.3	7.6E-03	0.60
30	99.9	2.41E-01	1.04E-06	180.	6.3	8.9E-03	0.60
31	99.9	2.06E-01	8.88E-07	180.	6.3	1.0E-02	0.60
32	99.9	1.75E-01	7.57E-07	180.	6.3	1.2E-02	0.60
33	99.9	1.50E-01	6.46E-07	180.	6.3	1.4E-02	0.60

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity $kg/m\ sec \times 10^5$
34	99.9	1.28E-01	5.51E-07	180.	6.3	1.7E-02	0.60
35	99.9	1.09E-01	4.70E-07	180.	6.3	2.0E-02	0.60
36	99.9	9.30E-02	4.01E-07	180.	6.3	2.3E-02	0.60
37	99.9	7.94E-02	3.43E-07	180.	6.3	2.7E-02	0.60
38	99.9	6.77E-02	2.92E-07	180.	6.3	3.2E-02	0.60
39	99.9	5.78E-02	2.50E-07	180.	6.3	3.7E-02	0.60
40	99.9	4.94E-02	2.13E-07	180.	6.3	4.3E-02	0.60
41	99.9	4.21E-02	1.82E-07	180.	6.3	5.1E-02	0.60
42	99.9	3.60E-02	1.55E-07	180.	6.3	5.9E-02	0.60
43	99.9	3.07E-02	1.33E-07	180.	6.3	6.9E-02	0.60
44	99.9	2.62E-02	1.13E-07	180.	6.3	8.1E-02	0.60
45	99.9	2.24E-02	9.67E-08	180.	6.3	9.5E-02	0.60
46	99.9	1.91E-02	8.26E-08	180.	6.3	1.1E-01	0.60
47	99.9	1.64E-02	7.06E-08	180.	6.3	1.3E-01	0.60
48	99.9	1.40E-02	6.03E-08	180.	6.4	1.5E-01	0.60
49	99.9	1.19E-02	5.15E-08	180.	6.4	1.8E-01	0.60
50	99.9	1.02E-02	4.40E-08	180.	6.4	2.1E-01	0.60
51	99.9	8.71E-03	3.76E-08	180.	6.4	2.4E-01	0.60
52	99.9	7.45E-03	3.21E-08	180.	6.4	2.9E-01	0.60
53	99.9	6.37E-03	2.75E-08	180.	6.4	3.4E-01	0.60
54	99.9	5.44E-03	2.35E-08	180.	6.4	3.9E-01	0.60
55	99.9	4.65E-03	2.01E-08	180.	6.4	4.6E-01	0.60
56	99.9	3.98E-03	1.72E-08	180.	6.4	5.4E-01	0.60
57	99.9	3.40E-03	1.47E-08	180.	6.4	6.3E-01	0.60
58	99.9	2.91E-03	1.26E-08	180.	6.4	7.3E-01	0.60
59	99.9	2.49E-03	1.07E-08	180.	6.4	8.6E-01	0.60
60	99.9	2.13E-03	9.18E-09	180.	6.4	1.0E 00	0.60
61	99.9	1.82E-03	7.85E-09	180.	6.4	1.2E 00	0.60
62	99.9	1.56E-03	6.72E-09	180.	6.4	1.4E 00	0.60
63	99.9	1.33E-03	5.75E-09	180.	6.4	1.6E 00	0.60
64	99.9	1.14E-03	4.92E-09	180.	6.4	1.9E 00	0.60
65	99.9	9.74E-04	4.21E-09	180.	6.4	2.2E 00	0.60
66	99.9	8.34E-04	3.60E-09	180.	6.4	2.6E 00	0.60
67	99.9	7.14E-04	3.08E-09	180.	6.4	3.0E 00	0.60
68	99.9	6.11E-04	2.64E-09	180.	6.4	3.5E 00	0.60
69	99.9	5.23E-04	2.26E-09	180.	6.4	4.1E 00	0.60
70	99.9	4.48E-04	1.93E-09	180.	6.4	4.8E 00	0.60
71	99.9	3.83E-04	1.65E-09	180.	6.4	5.6E 00	0.60
72	99.9	3.28E-04	1.42E-09	180.	6.4	6.5E 00	0.60
73	99.9	2.81E-04	1.21E-09	180.	6.4	7.6E 00	0.60
74	99.9	2.41E-04	1.04E-09	180.	6.4	8.9E 00	0.60
75	99.9	2.06E-04	8.89E-10	180.	6.5	1.0E 01	0.60
76	99.9	1.76E-04	7.61E-10	180.	6.5	1.2E 01	0.60
77	99.9	1.51E-04	6.52E-10	180.	6.5	1.4E 01	0.60
78	99.9	1.29E-04	5.59E-10	180.	6.5	1.6E 01	0.60
79	99.9	1.11E-04	4.79E-10	180.	6.5	1.9E 01	0.60
80	99.9	9.50E-05	4.10E-10	180.	6.5	2.2E 01	0.60
81	99.9	8.14E-05	3.51E-10	180.	6.5	2.6E 01	0.60
82	99.9	6.98E-05	3.01E-10	180.	6.5	3.1E 01	0.60
83	99.9	5.98E-05	2.58E-10	180.	6.5	3.6E 01	0.60
84	99.9	5.13E-05	2.21E-10	180.	6.5	4.2E 01	0.60
85	99.9	4.39E-05	1.90E-10	180.	6.5	4.9E 01	0.60
86	99.9	3.77E-05	1.63E-10	180.	6.5	5.7E 01	0.60
87	99.9	3.23E-05	1.39E-10	180.	6.5	6.6E 01	0.60
88	99.9	2.77E-05	1.19E-10	180.	6.5	7.7E 01	0.60
89	99.9	2.37E-05	1.02E-10	180.	6.5	9.0E 01	0.60
90	99.9	2.04E-05	8.79E-11	180.	6.5	1.0E 02	0.60
91	99.9	1.75E-05	7.54E-11	180.	6.5	1.2E 02	0.60
92	99.9	1.50E-05	6.46E-11	180.	6.5	1.4E 02	0.60
93	99.9	1.28E-05	5.54E-11	180.	6.5	1.7E 02	0.60

Altitude km.	Temperature °K	Pressure mb	Density gm/cm^3	Speed of sound m/sec	Density scale height km	Mean free path cm	Viscosity kg/m sec x 10^5
94	99.9	1.10E-05	4.76E-11	180.	6.5	1.9E 02	0.60
95	99.9	9.45E-06	4.08E-11	180.	6.5	2.3E 02	0.60
96	99.9	8.11E-06	3.50E-11	180.	6.5	2.6E 02	0.60
97	99.9	6.96E-06	3.00E-11	180.	6.5	3.1E 02	0.60
98	99.9	5.97E-06	2.58E-11	180.	6.5	3.6E 02	0.60
99	99.9	5.13E-06	2.21E-11	180.	6.5	4.2E 02	0.60
100	99.9	4.40E-06	1.90E-11	180.	6.5	4.9E 02	0.60
110	99.9	9.52E-07	4.14E-12	180.	6.6	2.2E 03	0.60
120	99.9	2.11E-07	9.11E-13	180.	6.6	1.0E 04	0.60
130	99.9	4.68E-08	2.02E-13	180.	6.7	4.6E 04	0.60
140	99.9	1.05E-08	4.52E-14	180.	6.7	2.0E 05	0.60
150	99.9	2.36E-09	1.02E-14	180.	6.7	9.0E 05	0.60

2 ! : . / (
 ! , T

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Technical information generated in connection with a NASA contract or grant and released under NASA auspices.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

TECHNICAL REPRINTS: Information derived from NASA activities and initially published in the form of journal articles.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities but not necessarily reporting the results of individual NASA-programmed scientific efforts. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546