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VISCOSITY OF THE HELIUM-NITROGEN SYSTEM FROM 133° TO 740° K FOR PRESSURES BETWEEN 1 AND 240 ATMOSPHERES

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

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By Robert E. Wood and W. J. Boone, Jr.

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VISCOSITY OF THE HELIUM-NITROGEN SYSTEM FROM 133° TO 740° K FOR PRESSURES BETWEEN 1 AND 240 ATMOSPHERES

by

Robert E. Wood[1] and W. J. Boone, Jr.[2]

ABSTRACT

The temperature dependency of the low-density viscosity coefficients, η_T°, of helium and of nitrogen, 100° to 1,000° K, is correlated with empirical equations, and the temperature and composition dependencies of the low-density viscosity coefficients, η_T°, of helium-nitrogen mixtures are correlated with the Chapman-Enskog expressions by using the Lennard-Jones (6:12) potential function. The residual viscosity, $\eta_{T,P} - \eta_T^\circ$ (the difference between the viscosity of a compressed gas and the dilute gas at a given temperature), was found to be a function of the thermal pressure coefficient, $(\partial P/\partial T)_V$, and two parameters, α and β, which are characteristic of gas composition.

The equation $\eta_{T,P} = \eta_T^\circ + \alpha\,[(\partial P/\partial T)_V]^\beta$ represented 1,340 higher pressure experimental viscosity values with a mean absolute deviation of 0.86 percent, and this equation was used to compute viscosities of the gaseous helium-nitrogen system for a range of temperatures and pressures including those encountered in Bureau of Mines helium purification processes and in a crude-helium conservation gas reservoir. Tabular viscosities for helium, nitrogen, and 13 helium-nitrogen mixtures are presented for 110 temperatures, 133° to 740° K, and 49 pressures in the range 1 to 240 atmospheres.

The accuracy of the tabulated viscosities varies because correlation parameters were obtained from experimental data of unequal reliability. It is estimated that uncertainties in the computed viscosity values are ±5 percent for the region 325° to 740° K, ±2 percent for the region 183° to 325° K, and ±5 percent for temperatures below 183° K. The latter uncertainty may rise to ±10 percent as critical conditions are approached.

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INTRODUCTION

An accurate knowledge of the shear viscosity behavior of the helium-nitrogen system, over a broad range of pressures and temperatures, is required in the design of equipment to carry out the various unit operations which are assembled into an integrated helium purification plant. The effects of pressure, temperature, and gas composition on the viscosity of helium-nitrogen mixtures are also of special importance to the Bureau of Mines in the prediction of the movement of crude helium being injected into a natural gas reservoir at the rate of 3.6 billion cubic feet per year. In addition to providing useful information for various direct engineering applications, the viscosity behavior of helium-nitrogen mixtures is of interest to the scientific community in the verification of hypotheses regarding intermolecular collisions and the intermolecular potential function, and in the applicability of statistical theories correlating microscopic properties with measurements.

This report presents a method for the prediction of the viscosities of gaseous helium, nitrogen, and helium-nitrogen mixtures over the practical range of pressures, temperatures, and gas compositions encountered in Bureau of Mines helium purification processes and in the gas reservoir where crude helium is being stored for future use. The temperature dependency of the low-density viscosity coefficients of helium and of nitrogen is correlated with empirical equations, and the temperature and composition dependencies of the low-density viscosity coefficients of mixtures are correlated with the Chapman-Enskog kinetic theory expressions (5, 27)[3] by the Lennard-Jones (6:12) potential function (27).

The Chapman-Enskog expressions are applicable only when the gas is dilute; that is, only when binary collisions are of consequence. Hence, the results of the theory are not applicable at densities sufficiently high that three-body collisions become important. There is no reliable or satisfactory theory for the prediction of the viscosities of real gases at higher pressures, and dense-gas momentum transport must be represented for the most part by empirical methods. In this report, the effect of pressure on the viscosity behavior of the helium-nitrogen system is correlated by the Golubev (20) relationship where the residual viscosity of a gas, $\eta_{T,P} - \eta^\circ_T$, is a function of the thermal pressure coefficient, $(\partial P/\partial T)_V$, and two parameters α and β which are characteristic of the gas composition. The residual viscosity is defined as the difference between the viscosity of a gas at a given temperature and high pressure, $\eta_{T,P}$, and the viscosity of the gas at the same temperature, η°_T, but at a pressure sufficiently low for the Chapman-Enskog kinetic theory to be applicable.

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[3] Underlined numbers in parentheses refer to items in the list of references at the end of this report.

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DILUTE-GAS TRANSPORT

The viscosity of dilute gases can be calculated from the Chapman-Enskog theory. However, there is no precise distinction between what is meant by a dilute or a dense gas. This theory is not applicable at densities sufficiently high that three-body collisions become important. An incomplete knowledge of the nature of such collisions limits to some degree the applicability of results from the Chapman-Enskog expressions to practical problems. According to this theory, the viscosity is independent of pressure. At sufficiently low temperatures, the use of classical mechanics must be excluded because of quantum effects, and the theory can be used only when the spatial dimensions of a container confining the gas are large compared to the molecular mean free path. The theory cannot be used when the mean free path is comparable to the diameter of the vessel (slip flow regime) or is much greater than the vessel diameter, when the gas exhibits properties of a discontinuous medium, Knudsen flow (free molecular flow regime). Therefore some criteria must be set by which the expressions derived from the Chapman-Enskog theory are applicable.

Childs and Hanley (6) have attempted to define a pressure range for several gases for which the kinetic theory viscosity expression,

$$\eta^\circ = \frac{5}{16}\left(\frac{(\pi mkT)^{\frac{1}{2}}}{\pi\sigma^2\Omega^{(2,2)\star}}\right), \qquad (1)$$

where η° = viscosity of a dilute gas,

m = mass of a molecule,

k = Boltzmann's constant,

σ = collision diameter,

T = absolute temperature,

and $\Omega^{(2,2)\star}$ = molecular collision integrals--a dimensionless function of temperature and molecular potential field,

may be applied to experimental low-pressure viscosity data by correlating η as a function of the mean free path, L. The mean free path is density, ρ, dependent in the elementary equation

$$L = \frac{3\eta^\circ}{\rho}\left(\frac{\pi m}{8kT}\right)^{\frac{1}{2}}. \qquad (2)$$

They select an upper pressure limit of dilution associated with the density, at a given temperature, where experimental data depart from equation 1 by more than the uncertainty in the experimental data, and a lower pressure boundary, rarefied conditions, by using a factor $\underline{a}/L \leq 10$, as a limit, where $\underline{a}$ is the radius of an apparatus used to determine the viscosity coefficient. The semi-quantitative results of Childs and Hanley indicate that the viscosity data for nitrogen at 1 atmosphere would be applicable in equation 1 over the temperature range 133° to 740° K, considered in this report. However, it should be pointed out that in the more rigorous theory for real gases the mean free path does not appear explicitly in the derivation of the transport properties (27). In this report, it is assumed that the Chapman-Enskog expressions, in the first approximation, describe completely the viscosity behavior of the helium-nitrogen system at pressures near 1 atmosphere for the temperature range 133° to 740° K.

According to the Chapman-Enskog theory (27), the first approximation to the viscosity of a pure gas is given by the equation

$$\eta^\circ \times 10^7 = \frac{266.93\sqrt{MT}}{\sigma^2\Omega^{(2,2)\star}}, \tag{3}$$

where η° = viscosity, g/cm sec,

T = temperature, °K,

M = molecular weight,

σ = collision diameter, A,

and $\Omega^{(2,2)\star}$ = collision integral values, reduced by rigid-sphere values, which are functions of the intermolecular potential and of the reduced temperature, $T^* = k\ T/\epsilon$. The correct functional form of the potential energy of molecular interaction is not known, and it is customary to use empirical potential energy functions. Three commonly used empirical potential functions are--

The Lennard-Jones (L-J) (6:12) potential, which has two adjustable parameters, force constants, which are evaluated from experimental data, is given by

$$\varphi(r) = 4\epsilon\left[(\sigma/r)^{12} - (\sigma/r)^6\right], \tag{4}$$

where $\varphi(r)$ is the interaction potential of two molecules separated by distance, r, and ϵ is the maximum energy of attraction. At $r = \sigma$ the potential energy is zero, $\varphi = 0$.

The modified Buckingham (Exp-6) potential has three adjustable parameters. This potential is given (27) by

$$\varphi(r) = \frac{\epsilon}{1 - \frac{6}{\alpha''}}\left[\frac{6}{\alpha''}e^{\alpha''\left(1 - \frac{r}{r_m}\right)} - \left(\frac{r_m}{r}\right)^6\right], \tag{5}$$

where r_m is the value of r at the energy minimum and α'' is a parameter which is a measure of the steepness of the repulsive part of the function.

The Kihara potential is given (7) by

$$\varphi(r) = 4\epsilon\left[\left(\frac{\sigma - \gamma}{r - \gamma}\right)^{12} - \left(\frac{\sigma - \gamma}{r - \gamma}\right)^{6}\right], \quad r > \gamma, \tag{6}$$

where $\varphi(r) = \infty$, for $r \leq \gamma$, and the finite size of the molecules is taken into account by a core diameter γ. If the core parameter γ is zero, this function reduces to the Lennard-Jones (6:12) potential function.

Low-Density Viscosity of Helium

Tables of collision integrals for the Lennard-Jones (6:12) potential as a function of T^* and force constants for helium and nitrogen are given by Hirschfelder, Curtiss, and Bird (27). The force constants given were derived principally from the viscosity data of Johnston and Grilly (31) and Johnston and McCloskey (33) for helium and nitrogen, respectively. Errors in viscosity data limit the accuracy of derived potential parameters, and Kestin has found fault with the work of Johnston and coworkers because they did not account for edge effects in the oscillating disk viscometer they used to obtain viscosity coefficients. Kestin's comments can be found in the "Discussion" section of a paper by Bonilla, Wang, and Weiner (2). Viscosity values of helium predicted from the L-J (6:12) potential are not always considered in satisfactory agreement with experimental results. Theoretical considerations indicate that helium atoms are less rigid than given by the inverse 12-power energy of repulsion term of this potential (57, 71). Shih and Ibele (71) have used the Lennard-Jones (6:9) potential, and Mason and Rice (57) have used the "Exp-6" potential for predicting the low-density viscosity behavior of helium for the temperature ranges 200° to 3,000° K and 200° to 1,090° K, respectively. Shih and Ibele obtained force constants for the L-J (6:9) potential from the experimental data of a number of investigators (31, 42, 64, 78), and Mason and Rice obtained force constants for the "Exp-6" by using an assigned value of $\alpha'' = 12.4$ from the experimental data contained in (31, 75-78, 80). The viscosity data of Trautz and coworkers (75-78) and of Wobser and Müller (80) were determined relative to air at a time when values for the viscosity of air were not known to ±1.5 percent. Mason corrected their values by using $\eta^\circ_{air} = 183.3\ \mu p$ at 23° C and by following the procedures of Johnston and McCloskey (33). The Kihara potential is not generally used for the prediction of the physical properties of helium because for $\gamma = 0$ this potential reduces to the L-J (6:12). Keesom (37) showed that the experimental low-density viscosity data of gaseous helium, available in 1941, in the temperature range 4° to 1,100° K could be represented within about ±1 percent by the empirical expression

$$\eta^\circ_{He} = 5.023\ T^{0.647},\ \mu p. \tag{7}$$

The simple form of this equation is much more attractive for engineering use than an empirical intermolecular potential to represent the dilute-gas behavior of helium because tables of collision integrals and an interpolation routine are not needed in a computer program. The low-density viscosity data for helium within the temperature range 100° to 1,090° K of a number of investigators (4, 12, 17, 21, 28, 30-31, 34, 39-43, 45-46, 55, 65, 72, 75-78, 80) were fitted to the form of equation 7 by a nonlinear least-squares procedure with the result

$$\eta^{\circ}_{He} = 4.2605563\ T^{0.67362904},\ \mu p. \qquad (8)$$

For the 108 data points in foregoing references, one standard error of estimate from values predicted from equation 8 is 1.53 μp. The standard error of estimate is defined as the square root of the quotient obtained from the sum of the squares of the residuals divided by the number of observations less the number of equation constants. Three data points (21, 46, 75) were not used in evaluating the constants in equation 8. Two points from Kestin (46) and Trautz (75) contribute 27 percent of the sum of the squares of the residuals. The point from Golubev (21) not used was inadvertently omitted in the data set.

Data from these sources were also compared with values computed from equation 3 by using the L-J (6:12), the L-J (6:9), and the "Exp-6" potentials with force constants for helium recommended for these potentials (27, 57, 71). No attempt was made to supply quantum corrections to the lower temperature data. Values of the viscosity coefficients used from Trautz and coworkers (75-78) and Wobser (80) contained corrections made by Mason (57). In all cases, equation 8 appeared to be superior to any one of the potentials.

Guevara and Wageman (23) measured what they considered Poiseuille flow of helium through a hole about 0.040 centimeter in diameter drilled through the wall of a tube with a wall thickness of 0.25 centimeter. Measurements were made at 24 temperatures ranging from 283° to 2,344° K. They considered the various sources of error in their measurements and applied corrections to their data, but they were unable to formulate a precise theory for the operability of their instrument. Results were presented as 23 viscosity ratios relative to their measurements at 283° K. Guevara and Wageman's data were fitted to the equation form of equation 8 by using η°_{He} = 191.01 μp at 283° K, obtained from equation 8, to convert viscosity ratios to viscosity. Very poor results were obtained; the standard error of estimate in the viscosity was 5.61 μp for 23 points, and no single point showed a large deviation. Viscosities of helium computed from the equation used to represent Guevara's data are from 5.17 to 0.8 percent larger than viscosities computed from equation 8 in the temperature range 280° to 1,000° K. The data of Guevara and Wageman (23) were not used in obtaining the coefficients of equation 8 because they considered their results inconclusive due to their inability to account in full for corrections relevant to their measurements.

The tabulated viscosity data of Tsederberg, Popov, and Morozova (79) for the temperature range 0° to 1,000° C were also fitted to the same equation form with a standard error of estimate of 1.37 μp for 101 points. Viscosities of helium computed from the equation used to represent Tsederberg's results are from 1.19 to 0.0 percent smaller than viscosities computed for equation 8 in the temperature range 270° to 980° K. The viscosities tabulated by Tsederberg and coworkers (79) have as a base some of the experimental data used to evaluate the coefficients of equation 8. To avoid giving undue weights to the data of certain investigators, the viscosity values they present were not considered in evaluating the coefficients of equation 8.

Viscosities computed from Keesom's equation (37, p. 107) are larger than those obtained from our equation 8 in the temperature region 100° to 480° K (4.28 to 0.02 percent larger). At 1,000° K, Keesom's equation gives a viscosity value 1.91 percent smaller than that predicted by equation 8.

At ambient temperature viscosity coefficients of helium obtained from capillary and oscillating disk viscometers are in satisfactory agreement. However, at high temperatures viscosity coefficients determined by these two methods are discordant, with those obtained by the oscillating disk method being higher than those obtained by the capillary method. The results from each type of instrument appear to be mutually consistent. DiPippo and Kestin (11) published atmospheric pressure viscosity data for helium (297.16° to 672.88° K) and nitrogen (294.90° to 773.73° K) after the constants for equation 8 were obtained. Their measurements, made with an oscillating disk viscometer, are in excellent agreement with the work of Kestin and Whitelaw (46), who used a similar type viscometer. Figure 1 summarizes the deviations in the low-density viscosity for helium when values obtained from equation 8 are compared with experimental values. Deviation, percent, in figure 1 is represented by

$$\text{Deviation, percent} = [(\text{Exp.} - \text{Calc.})/\text{Calc.}] \times 100, \tag{9}$$

where Exp. = the experimental value reported by an investigator,

and Calc. = the value computed in this work.

All percent deviation calculations in subsequent sections of this report are defined in this manner. Because of the superposition of points, only part of the data used to obtain equation 8 is plotted on figure 1. Selected points from the work of DiPippo and Kestin (11) are presented in figure 1 to show the marked disagreement between viscosity values obtained from their oscillating disk measurements and those from the capillary-flow viscometer measurements of Trautz and coworkers (75-76, 78) in the temperature range 500° to 700° K. Hanley and Childs (24) have presented evidence that new unpublished viscosity coefficients for several gases (1,100° to 2,200° K) determined by Guevara, McInteer, and Wageman at the Los Alamos Scientific Laboratory are more consistent with the trend of the higher temperature data of Kestin and coworkers (11, 46) than with the viscosity coefficients of Trautz and coworkers.

Unfortunately, the accuracy of viscosity values cannot be judged by an analysis of the principles of measurement alone. Therefore, further conclusions as to the proper values for the higher temperature viscosity values of helium must await the results of additional investigations.

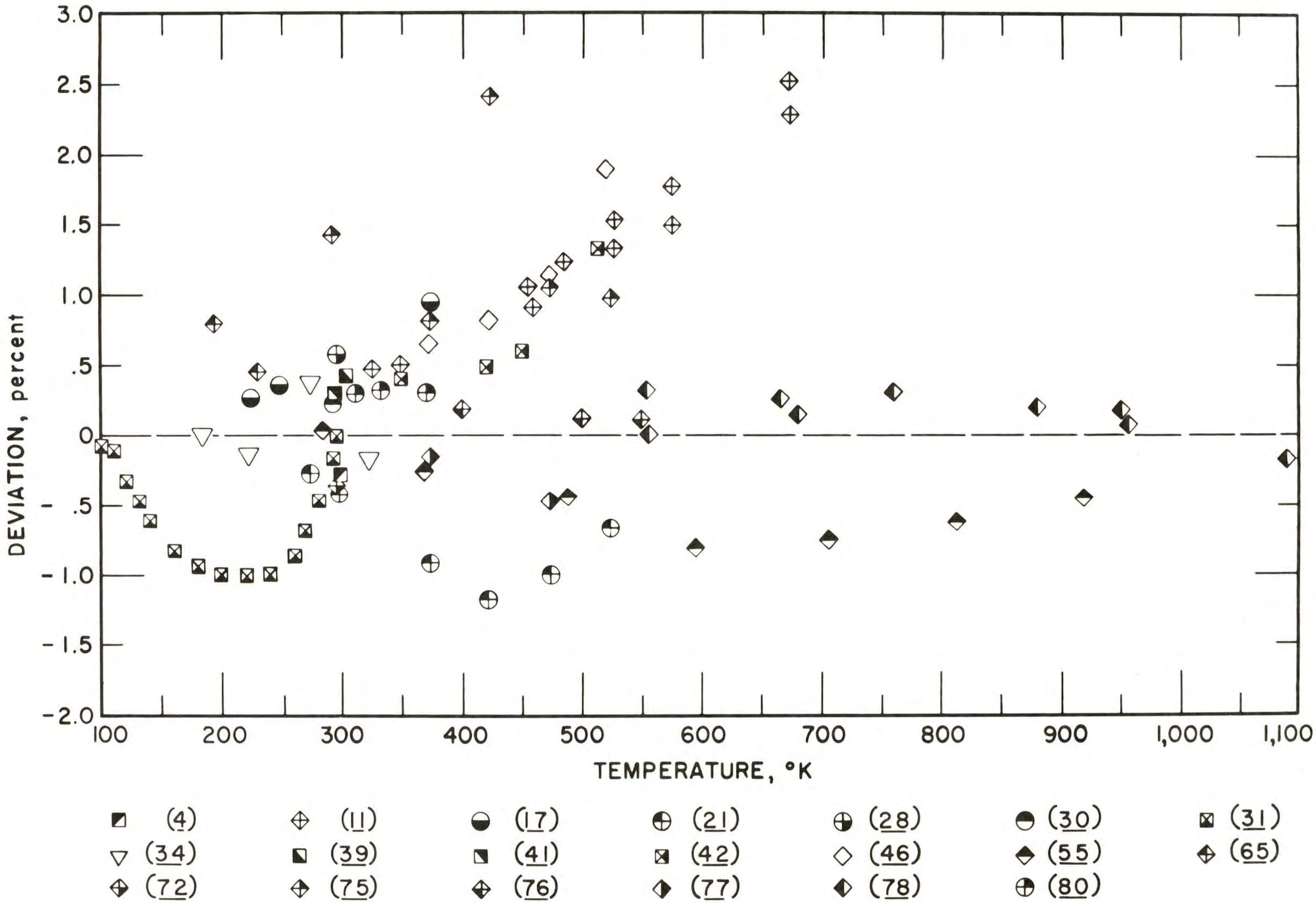

FIGURE 1. - Low-Density Viscosity Deviation Plot for Helium.

Low-Density Viscosity of Nitrogen

Childs and Hanley (7) found that the Kihara potential ($\gamma = 0.2$, $\varepsilon/k = 116.7^\circ$ K, and $\sigma = 3.55$ A) represented the low-density viscosity of nitrogen from 16 sources better than the Lennard-Jones (6:12), the "Exp-6," or the Morse potential, and they presented 91 viscosity values, computed from the Kihara potential, for the temperature range 100° to 1,000° K at 10° increments.

The Thermophysical Properties Research Center (74) correlated the low-density viscosity values of nitrogen from 20 sources with two polynomials in terms of T. Correlations, obtained by using third and fourth degree power series, were divided into the temperature regions 55° to 255° K and 172° to 1,811° K, respectively. The two equations do not give like results in the temperature range 172° to 255° K, common to both equations. In the present work, a polynomial of fourth degree in T seemed to represent nitrogen viscosity values computed from these sources (7, 74) for the temperature range 100° to 1,000° K, within the uncertainty of the experimental data from which the empirical equations were derived.

Data from sources (13, 34, 39-40, 46, 55-56), inaccessible or not considered in these previous correlations (7, 74), and the 91 tabulated viscosity values of Childs and Hanley (7) were fitted to a fourth degree polynomial to represent the temperature dependency of the viscosity of dilute nitrogen. The equation recommended is

$$\eta^\circ_{N_2} = -8.9188690 \times 10^{-1} + 7.7622418 \times 10^{-1}\, T - 7.2970066 \times 10^{-4}\, T^2 + 4.9473812 \times 10^{-7}\, T^3 - 1.3971248 \times 10^{-10}\, T^4, \quad (10)$$

where T = temperature, °K,

and $\eta^\circ_{N_2}$ = viscosity, μp.

Deviations of Childs and Hanley's (7) tabulated viscosity values from those computed from equation 10 range from -0.88 (100° K) to +0.27 (990° K) percent. Their deviation plot (7, p. 13) for nitrogen viscosity data from 16 sources relative to values computed from the Kihara function shows a deviation band of about ±1 percent. One standard error of estimate for their 91 tabulated points with respect to values computed from equation 10 is 0.94 μp. The standard error of estimate relevant to equation 10 increases to 1.8 μp when data from sources (13, 34, 39-40, 46, 55-56) are combined with Childs and Hanley's 91 computed points.

Figure 2 shows deviations of various investigators' experimental results from computed values. The data of Clarke and Smith (8) and of DiPippo and Kestin (11) shown in figure 2 were not available when the constants for equation 10 were obtained. It should be noted that the data of Clarke and Smith (8) and DiPippo and Kestin (11) differ from earlier measurements by more than what is considered as experimental uncertainty in their measurements. The departure of DiPippo and Kestin's (11) data from those of previous workers has

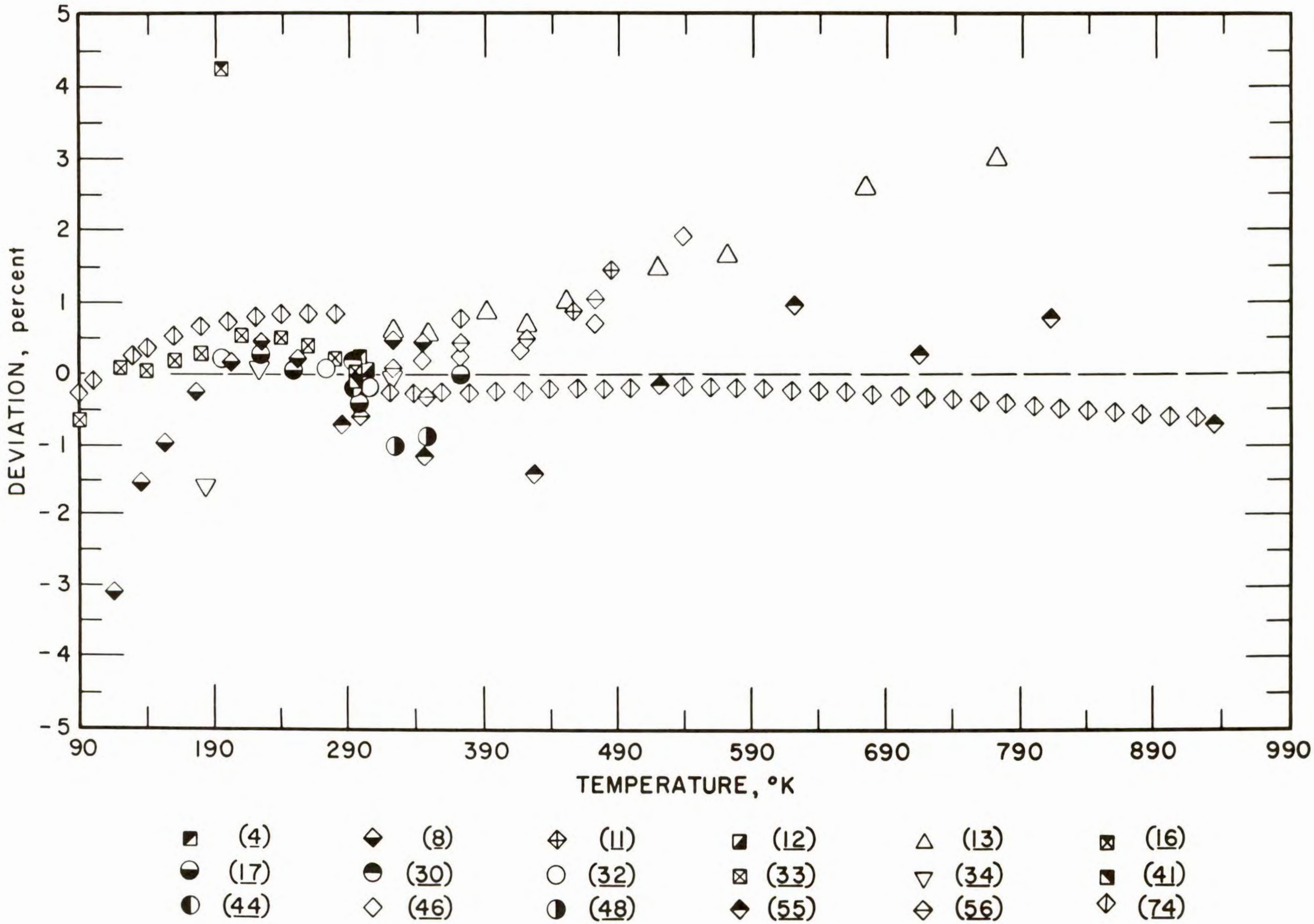

FIGURE 2. - Low-Density Viscosity Deviation Plot for Nitrogen.

the same trend as was noted in the case of helium. Below about 170° K the results of Johnston and coworkers (33), whose values are relevant to Childs and Hanley's (7) correlation and contributory in equation 10, are as much as 3 percent higher than the results of Clarke and Smith (8).

It will be recalled that Kestin criticized the work of Johnston and coworkers because their results were based on an inadequate theory for an oscillating-disk viscometer. The constants of equation 10 should probably be redetermined in light of the new work of Clarke and Smith (8) and DiPippo and Kestin (11). However, the present equation appears to be an acceptable interpolation equation to meet the engineering objectives of this work.

Low-Density Viscosity of Helium-Nitrogen Mixtures

Viscosity-composition isotherms for binary gas mixtures are often nonlinear, and sometimes the viscosity of a given mixture is greater than the viscosity of either pure component. Heath (25) first measured the viscosity of helium-nitrogen mixtures and observed that the viscosities of given mixtures exceeded the viscosity of either of the pure components. His measurements at 18° C and 70 centimeters of mercury pressure are presented in the form of a viscosity-composition diagram which suffers from scale-factor limitations, and viscosity values for the pure gases and nine mixtures cannot be read precisely from the graph.

Experimental viscosity data for helium-nitrogen mixtures (34, 39, 54) are scarce, and data of high precision are available only in the temperature range 183.15° to 323.15° K. The viscosity isotherms of Kao (34), 183.15°, 223.15°, 273.15°, and 323.15° K, terminate generally at 10 atmospheres, and the dilute-gas viscosity values he gives were obtained by extrapolation. Dilute-gas viscosity values derived from Kao's 183.15° K isotherm by a least-squares technique are compared, in the section Dense-Gas Transport, with his extrapolated results. Kao and Kobayashi (35) estimate the probable error in Kao's (34) data as 0.14 percent. Kestin, Kobayashi, and Wood (39) estimate an accuracy of ±0.1 percent for their viscosity measurements at 293.15° and 303.15° K. Makavetskas, Popov, and Tsederberg (54) estimated the maximum error in their viscosity measurements for mixtures in the temperature region 284.65° to 952.55° K to be not more than 4.5 percent. Makavetskas, Popov, and Tsederberg (55) indicate that the maximum error in their measurements of the viscosities of pure helium and nitrogen in the same apparatus did not exceed 3.5 percent. Large temperature gradients for the higher temperature measurements existed between the ring-balance manometer, used for differential-pressure measurements, and the capillary tube of the Rankine-type viscometer used by these investigators to measure mixture viscosities, and gas-phase separations by thermal diffusion could result in marked differences in gas compositions in various parts of their apparatus. Gas-phase separations may have resulted in a 10- to 12-percent change in gas compositions between the cold and hot parts of their apparatus.

In the literature, the simplest viscosity mixture rule which permits a maximum to exist for a viscosity-composition isotherm is the empirical equation of Buddenberg and Wilke (4),

$$\eta^{\circ}_{mix} = \frac{\eta^{\circ}_1}{1 + \left(\frac{x_2}{x_1}\right)\left(\frac{1.385}{D_{12}}\right)\left(\frac{\eta^{\circ}_1}{\rho_1}\right)} + \frac{\eta^{\circ}_2}{1 + \left(\frac{x_1}{x_2}\right)\left(\frac{1.385}{D_{12}}\right)\left(\frac{\eta^{\circ}_2}{\rho_2}\right)} , \quad (11)$$

where η°_1 and η°_2 = viscosities of pure components 1 and 2 at the temperature of the mixture,

ρ_1 and ρ_2 = densities of components 1 and 2 at the temperature and total pressure of the mixture,

x_1 and x_2 = mole fractions of components 1 and 2 in the mixture,

and D_{12} = the coefficient of binary diffusion.

This equation is useful only when binary diffusion coefficients are available. Low-pressure binary diffusion coefficients for helium-nitrogen are available in the literature for the temperature range 244.27° to over 1,000° K. The uncertainty in these coefficients very often exceeds 6 percent because of experimental difficulties, and the scattering of data and the lack of reproducibility of experimental points indicate that mixture-viscosity values computed from these results are questionable. The quantity $(1.385/D_{12})$ in equation 11 is equal to a constant for a gas pair at a given temperature and pressure, and values of this constant can be obtained from viscosity data by trial and error (4). However, there are no experimental data on mixtures in the temperature range 133° to 183° K for such an evaluation. Makavetskas, Popov, and Tsederberg (54) and Makaveckas (53) substituted the Chapman-Enskog expressions for the coefficients of binary and self-diffusion into Buddenberg and Wilke's (4) equation and used the empirical combining laws (27)

$$\sigma_{12} = 1/2\left(\sigma_1 + \sigma_2\right) \quad (12)$$

and

$$\epsilon_{12} = \left(\epsilon_1 \epsilon_2\right)^{1/2} , \quad (13)$$

in conjunction with the Lennard-Jones (6:12) potential, to estimate the viscosity of helium-nitrogen mixtures for the temperature range 0° to 1,000° C. Viscosities computed were within 2.5 percent of experimental results (54).

An equation for computing the low-density viscosity of a binary gas mixture must take into account differences in the molecular diameter of the molecules, differences in the masses, and the interaction forces between molecules.

Although Buddenberg and Wilke's equation has been widely used, it cannot satisfy all of these requirements. A more appropriate equation for computing the mixture viscosities is the Chapman-Enskog equation, wherein the viscosity of a mixture to the first approximation is given by

$$\frac{1}{\eta_m^\circ} = \frac{X_\eta + Y_\eta}{1 + Z_\eta}, \tag{14}$$

where

$$X_\eta = \frac{x_1^2}{\eta_1^\circ} + \frac{2x_1x_2}{\eta_{12}^\circ} + \frac{x_2^2}{\eta_2^\circ},$$

$$Y_\eta = \frac{3}{5} A_{12}^\star \left\{\frac{x_1^2}{\eta_1^\circ}\left(\frac{M_1}{M_2}\right) + \frac{2x_1x_2}{\eta_{12}^\circ}\left(\frac{(M_1 + M_2)^2}{4M_1M_2}\right)\left(\frac{\eta_{12}^{\circ 2}}{\eta_1^\circ\eta_2^\circ}\right) + \frac{x_2^2}{\eta_2^\circ}\left(\frac{M_2}{M_1}\right)\right\},$$

$$Z_\eta = \frac{3}{5} A_{12}^\star \left\{x_1^2\left(\frac{M_1}{M_2}\right) + 2x_1x_2\left[\left(\frac{(M_1 + M_2)^2}{4M_1M_2}\right)\left(\frac{\eta_{12}^\circ}{\eta_1^\circ} + \frac{\eta_{12}^\circ}{\eta_2^\circ}\right) - 1\right] + x_2^2\left(\frac{M_2}{M_1}\right)\right\},$$

x_1 and x_2 = mole fractions of components 1 and 2,

M_1 and M_2 = molecular weights of components 1 and 2,

$A_{12}^\star = \Omega^{(2,2)\star}/\Omega^{(1,1)\star}$,

$$\eta_{12}^\circ \times 10^7 = \frac{266.93\sqrt{2M_1M_2T/(M_1 + M_2)}}{\sigma_{12}^2\,\Omega_{12}^{(2,2)\star}},$$

T = temperature, °K,

η_{12}° = viscosity interaction parameter, g/cm sec,

σ_{12} = parameter characteristic of 1-2 interaction, A, and

$\Omega^{(1,1)\star}$ and $\Omega^{(2,2)\star}$ = reduced collision integral values which are functions of the potential model and reduced temperature, $T_{12}^* = k\,T/\varepsilon_{12}$.

Equation 14 is not strictly applicable to a gas mixture containing a diatomic gas because the theory from which this equation was derived is for molecules with symmetrical force fields and with no internal degrees of freedom. However, the viscosity, unlike thermal conductivity, is not appreciably affected by the presence of internal degrees of freedom, and equation 14 appears to give a good account of the viscosities of a gas mixture, provided molecules in the mixture are not too nonspherical.

For equation 14, Kestin, Kobayashi, and Wood (39) determined values of σ_{12} = 3.1198 A and ε_{12}/k = 36.18° K for the Lennard-Jones (6:12) potential by using their viscosity data on helium-nitrogen mixtures. Makaveckas (53) and Makavetskas, Popov, and Tsederberg (54) used σ_{12} = 3.1625 A and ε_{12}/k = 28.56° K as force constants for the Lennard-Jones (6:12) potential to estimate helium-nitrogen mixture viscosities for the temperature region 0° to 1,000° C. Kao (34) did not propose a mixing rule to represent his data. Force constants of helium and nitrogen for the Lennard-Jones (6:12) potential (27), based on the viscosity data of Johnston and coworkers (31, 33), and the mixing rules 12 and 13 yield values of σ_{12} = 3.1285 A and ε_{12}/k = 30.58° K.

Molecules of helium-nitrogen mixtures have a "soft" intermolecular force contribution, and the effective collision diameter of an unlike pair may not satisfy precisely the additivity rule, $\sigma_{12} = 1/2\ (\sigma_1 + \sigma_2)$. However, the arithmetic mean for σ_{12} is assumed to be reasonably accurate, whereas it is known from the London theory of dispersion forces that the geometric mean for ε_{12} is only a limiting relationship.

Imposing the requirement that η_1° and η_2° in equation 14 have values obtained from empirical equations 8 and 10 and σ_{12} = 3.12 A, a computer procedure was utilized to estimate the "best value" of ε_{12}/k to represent the mixture data (34, 39, 54). The viscosity depends more strongly on the parameter σ_{12} than on the energy well parameter ε_{12}, and other values of ε_{12}/k in the vicinity of $\sigma_{12} \approx 3.12$ were also tested. The "best results" obtained were close to the values of σ_{12} and ε_{12}/k derived by Kestin and coworkers (39), and their values of the force constants were used to compute the low-density viscosity behavior of helium-nitrogen mixtures.

Collision integrals $\Omega^{(1,1)\star}$ and $\Omega^{(2,2)\star}$ for the Lennard-Jones (6:12) potential tabulated by Hirschfelder (27) for the reduced temperature range 0.3° to 200° K were fitted by a least-squares technique to a multinomial of the form

$$\begin{aligned}\Omega^{(\ell,s)\star} &= P_0 + P_1T^* + P_2(T^*)^2 + P_3(T^*)^3 + P_4(T^*)^4 \\ &+ P_5(T^*)^5 + P_6(T^*)^6 + P_7(1/T^*) + P_8(1/T^*)^2 \\ &+ P_9(1/T^*)^3 + P_{10}(1/T^*)^4 + P_{11}(1/T^*)^5 \\ &+ P_{12}(1/T^*)^6, \qquad (15)\end{aligned}$$

where $T^* = k\ T/\varepsilon$,

and values for the constants are

	$\Omega^{(1,1)\star}$	$\Omega^{(2,2)\star}$
P_0	+7.6070438 (10^{-1})	+8.6881587 (10^{-1})
P_1	-1.0254183 (10^{-2})	-1.2672727 (10^{-2})
P_2	+2.7105188 (10^{-4})	+3.6256347 (10^{-4})
P_3	-4.6775042 (10^{-6})	-6.5768094 (10^{-6})
P_4	+4.6185077 (10^{-8})	+6.7033760 (10^{-8})
P_5	-2.3278934 (10^{-10})	-3.4490075 (10^{-10})
P_6	+4.5196819 (10^{-13})	+6.7846122 (10^{-13})
P_7	+5.9761505 (10^{-1})	+4.7185172 (10^{-1})
P_8	+1.9897294 (10^{-1})	+5.4259734 (10^{-1})
P_9	-1.3561679 (10^{-1})	-3.7823299 (10^{-1})
P_{10}	+2.9639310 (10^{-2})	+1.0882350 (10^{-1})
P_{11}	-1.9903389 (10^{-3})	-1.5367909 (10^{-2})
P_{12}	-8.4408981 (10^{-5})	+8.8652554 (10^{-4})

A comparison of computed and tabulated integrals $\Omega^{(\ell,s)\star}$ gave these results:

Maximum percent deviation for $\Omega^{(1,1)\star}$ = -0.05933 at T* = 90.

Maximum percent deviation for $\Omega^{(2,2)\star}$ = 0.1157 at T* = 20.

Average absolute percent deviation for 80 values of $\Omega^{(1,1)\star}$ = 0.0177.

Average absolute percent deviation for 80 values of $\Omega^{(2,2)\star}$ = 0.0239.

Terms in equation 14 for the viscosity of binary mixtures were evaluated by using the multinomials for $\Omega^{(1,1)\star}$ and $\Omega^{(2,2)\star}$.

A comparison of the experimental viscosity data of Kao (34) and Kestin, Kobayashi, and Wood (39) with computed results is provided in figure 3. It will be seen that experimental values of η°_{mix} and values derived from equation 14 are in good agreement. The maximum difference between an experimental and computed value of figure 3 is 1.87 micropoises, and this occurs for Kao's nitrogen data at 183.15° K. The data of Makavetskas and coworkers (54) for mixtures scatter badly and were not plotted on a graph. The maximum deviation between an experimental and computed value was -4.27 percent for their mixture of 0.4350 mole fraction of helium at 952.55° K. The overall mean deviation

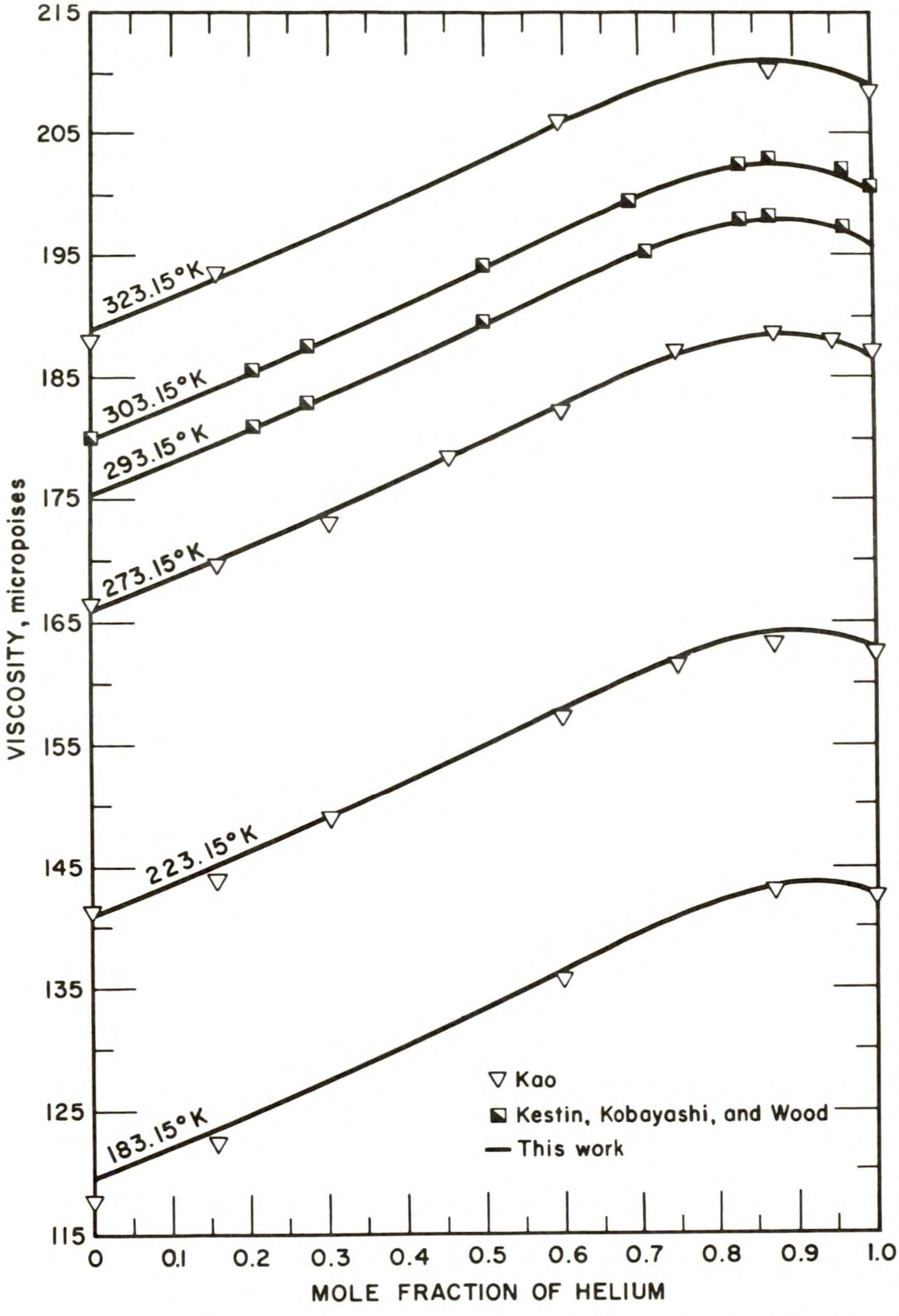

FIGURE 3. - Low-Density Viscosity of Helium-Nitrogen Mixtures From 183.15° to 323.15° K in Terms of Composition.

from the results of Makavetskas and coworkers (54) is about 1.66 percent, which is slightly better than the 2.5 percent they obtained by using Buddenberg and Wilke's (4) equation and equations 12 and 13 for σ_{12} and ϵ_{12} in conjunction with the Lennard-Jones (6:12) potential to represent their mixture viscosities.

DENSE-GAS TRANSPORT

No systematic approach to obtain transport coefficients of dense gases is known as yet, and there appears to be no accepted theory upon which to base estimation techniques. A number of empirical equations for correlation of viscosity values at higher pressures are given in the literature. A number of estimation methods commonly used by engineers are presented and discussed by Reid and Sherwood (62), and these authors provide an extensive list of references to the viscosity literature.

The following discussion is limited to a brief review of some of the more common dense-gas viscosity estimation and correlation techniques and some miscellaneous methods.

The Enskog theory, which is treated in detail by Chapman and Cowling (5), was the first theory developed to account for momentum transport in dense gases. Rigid spherical molecules with no intermolecular forces are assumed, and the treatment of the problem is more intuitive than rigorous. This method does not provide an accurate basis for dense-gas prediction, and values of viscosity computed from this method may differ from measurements by as much as 100 percent. The Enskog method also predicts that $\eta_{T,P}/\eta_T^\circ$ is a function only of the gas density.

More detailed theories arrive at a result which allows a separation of the viscosity into two terms (47). One term accounts for momentum transfer due to collisions in the absence of intermolecular force fields, which is congruent to the dilute-gas viscosity, η_T°. The other term accounts for momentum transfer due to intermolecular force fields encountered in a dense gas, $\eta_{T,P}$. The effect of these two contributions, kinetic and potential, suggests that the residual viscosity, $\eta_{T,P} - \eta_T^\circ$, is a monotonic function of density, ρ. Rogers and Brickwedde (66) have shown that nitrogen and several other gases do not obey this simple relationship, and that isometric viscosity values are temperature dependent.

Correlations based on viscosity ratios, $\eta_{T,P}/\eta_T^\circ$, and residual viscosity concepts using the principle of corresponding states have been widely used by engineers (62). However, no general scheme for defining reduced viscosity in terms of reduced properties or in terms of dimensionless functional groups has emerged from this principle. Because of the general nature of these correlations, predicted viscosities often deviate from measurements by more than 20 percent at ambient temperatures, and predicted viscosity values are particularly unreliable at low temperatures as critical conditions are approached.

A formal solution of the transport equations for moderately dense gases of molecules with repulsive forces only has yielded a viscosity expression analogous to the PV virial expansion

$$\eta_{T,P} = \tilde{A} + \tilde{B}\rho + \tilde{C}\rho^2 + \ldots, \qquad (16)$$

where $\tilde{A}$ = the low-density viscosity limit η_T°,

ρ = molar density,

$\tilde{B}$ = the second viscosity virial,

and $\tilde{C}$ ... = the third viscosity virial and subsequent higher viscosity virial coefficients.

The coefficients in this expansion have not been evaluated because the solutions of the equations of motion for three, four, etc., particles are required. The i-th virial coefficient involves dynamical events of (i + 1) particles. Kim and Ross (47) have presented a calculation of the contribution of triple collisions to the coefficient $\tilde{B}$, but more rigorous calculations are required to verify the results. Kim and Ross's account of repulsive interaction is inadequate. The $\widetilde{A}$ term in this density power series is generally assumed to be equivalent to the dilute-gas viscosity predicted by the Chapman-Enskog theory.

Kawasaki and Oppenheim (36) have concluded from the work of other investigators, cited in their paper, that the phase-space volume is not finite for dynamical events involving four or more particles and have suggested that the density expansion of viscosity should take the form

$$\eta_{T,P} = \widetilde{A} + \widetilde{B}_\rho + \widetilde{C}_\rho{}^2 \ell n\rho + \widetilde{D}_\rho{}^2 \ldots \tag{17}$$

for a classical or quantum gas. Fujita (18) has examined the results of Kawasaki and Oppenheim and has reached the conclusion that the divergence term, $\ell n\rho$, does not exist, and their results are due to the erroneous use of a real number in computations whereas a complex number is called for in analysis. At present, the accuracy of experimental viscosity data is not sufficient to give evidence to verify the existence of the divergence term in the density expansion of transport properties.

Hydrostatic pressure may be interpreted as the average rate of change of momentum due to the impact of molecules on a unit area of a wall containing a gas, and temperature may be correlated with the average kinetic energy of translation of molecules. Hydrostatic pressure can be regarded as the net effect of a kinetic pressure and a cohesive pressure or internal pressure which is due to the mutual attractions of molecules. Boyd (3) used the similarity between kinetic pressure and viscosity as a method for predicting the viscosity of a dense gas. His method is based on evaluating the kinetic pressure of a real gas from an equation of state. The temperature-dependent terms of the equation of state are used as a measure of the kinetic pressure. The ratio of the kinetic pressure of the real gas to that of an ideal gas, at a given temperature, is assumed to be equal to the ratio of the viscosity of a dense gas to that of the viscosity of the dilute gas at the given temperature; that is,

$$\frac{P_k}{P_i} = \frac{\eta_{T,P}}{\eta_T^\circ}, \tag{18}$$

where P_k = kinetic pressure of the real gas,

P_i = kinetic pressure of a perfect gas,

$\eta_{T,P}$ = viscosity of the dense gas,

and η_T° = viscosity of dilute gas.

Thus, if low-density viscosity data and a suitable equation of state are available for a gas, its viscosity at a high pressure can be estimated. Boyd used the Beattie-Bridgeman equation in conjunction with his low-precision viscosity data for nitrogen, hydrogen, and a mixture of these gases to test this theory. Boyd's method for computing the viscosities of gases at high pressures is not well substantiated from his results for nitrogen. The inability of the Beattie-Bridgeman equation of state to represent the properties of nitrogen at high pressures and the fact that his individual viscosity measurements differed from his mean viscosity values by as much as 7 percent undoubtedly contributed to his unsatisfactory results.

Irreversible thermodynamics, the description of kinetic systems by using thermodynamic variables, is one way to linearize equations of transport (27). The fundamental theorem of irreversible processes is due to Onsager (59-60). Unfortunately, the thermodynamic approach alone cannot lead to expressions for transport coefficients, irreversible thermodynamics provides few useful theorems, and its phenomenological formulation makes no claims to physical understanding. Some of the postulates of irreversible thermodynamics are that thermodynamic functions of state exist for each element of the system in which irreversible processes are taking place, that thermodynamic quantities for a nonequilibrium system are the same functions for local state variables as the corresponding equilibrium quantities, and that theorems are applicable for situations which are not removed too far from equilibrium. The last statement is vague because the question of how far from equilibrium these results will permit one to go cannot be answered. In an equilibrium situation, there is absolutely no ambiguity as to what is meant by the thermodynamic or hydrostatic pressure. Pressure is exerted equally in all directions at a particular point and is a scalar quantity. In a nonequilibrium state, this is not the case; the hydrodynamic equations of change derived from the Boltzmann equation show the pressure is a second-rank tensor, and the forces exerted across three mutually perpendicular planes at some point within the field are neither equal in magnitude nor, in general, normal to the planes. Therefore, there is a degree of arbitrariness with regard to what is meant by thermodynamic pressure in a nonequilibrium situation. Irreversible thermodynamics does not seem to provide any straightforward way for predicting momentum transport in dense gas. To the knowledge of the authors, this approach has not been used to correlate the viscosity of dense gases.

The thermodynamic equation

$$\left(\frac{\partial E}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P, \tag{19}$$

where E = internal energy,

P = hydrostatic pressure,

T = absolute temperature,

and V = molar volume,

has been used in predicting the viscosity behavior of dense gases. In the theory of liquids and regular solutions, Hildebrand and Scott (26) have defined $(\partial E/\partial V)_T$, $T\,(\partial P/\partial T)_V$, and P as the internal pressure, thermal pressure, and external pressure, respectively; this terminology is also used by

Hirschfelder, Curtiss, and Bird (27) in their discussions of the transport properties of dense gases and liquids. The internal pressure, $(\partial E/\partial V)_T$, represents the change in internal energy due to intermolecular forces, and it is supposed that in the interior of a dense gas there is a balance between attractive and repulsive forces which gives rise to this term in the thermodynamic equation of state. If there were no intermolecular attractions and repulsions, E would be independent of volume and pressure and would depend only on temperature, as in the simple kinetic theory of gases. Enskog, in formulating his theory of transport coefficients of a dense gas, supposed that a real gas is equivalent to a rigid sphere gas in which the external pressure has been replaced by the thermal pressure (27).

Golubev (20) in his book has shown through semitheoretical arguments that the residual viscosity, $\eta_{T,P} - \eta_T^\circ$, should be a unique function of the thermal pressure-temperature ratio or thermal pressure coefficient, $(\partial P/\partial T)_V$. Golubev plotted $\left(\eta_{T,P} - \eta_T^\circ\right)$ versus $(\partial P/\partial T)_V$ on log-log coordinates for a number of substances, and obtained linear plots.

From the relationship

$$\eta_{T,P} - \eta_T^\circ = \alpha \, [(\partial P/\partial T)_V]^\beta, \tag{20}$$

Golubev obtained values of β from the dense-gas viscosity behavior of hydrogen, nitrogen, carbon dioxide, ammonia, methane, ethane, propane, and ethylene which ranged from 1.10 to 1.12. The mean value of β derived from his results is 1.115. Values of α are characteristic of the substance.

Lennert and Thodos (50) used thermal pressure coefficients in a corresponding states approach to predict the dense-gas viscosity behavior of argon, krypton, xenon, nitrogen, oxygen, and carbon dioxide. Their dimensional analysis approach produced the relationship

$$\left(\eta_{T,P} - \eta_T^\circ\right) \xi = \frac{\alpha'}{R^{1/6}} Z_c^m \left(\frac{\partial P_r}{\partial T_r}\right)_{\rho_r}, \tag{21}$$

where ξ = viscosity parameter = $T_c^{1/6}/M^{1/2}P_c^{2/3}$,

M = molecular weight,

α' = constant,

Z = compressibility factor,

m = constant,

R = gas constant,

ρ = density,

T = absolute temperature,

P = pressure,

and the subscripts r and c refer to properties reduced by critical parameters of the substances and to the critical constant of a substance, respectively. Their log-log plots of $\left(\eta_{T,P} - \eta_T^\circ\right)\xi$ versus $\left(\frac{\partial P_r}{\partial T_r}\right)_{\rho_r}$ for argon, krypton, and xenon were essentially linear and identical in analytical detail, and they combined their results into a single expression,

$$\left(\eta_{T,P} - \eta_T^\circ\right)\xi = 6.195 \times 10^{-5}\left(\frac{\partial P_r}{\partial T_r}\right)_{\rho_r}^{1.075} . \tag{22}$$

Lo, Carroll, and Stiel (51) used the Golubev relationship to correlate the viscosity of gaseous air at moderate and high pressures. The results of their work will be discussed later in the report.

Lefrançois (49) used Boyd's (3) concept for computing the viscosity of a gas at high pressure but used the thermal pressure, $T\left(\frac{\partial P}{\partial T}\right)_V$, as being representative of kinetic pressure rather than eliminating nontemperature-dependent terms of an equation of state, such as the Beattie-Bridgeman, to evaluate the kinetic pressure. He correlated the high-pressure viscosity behavior of six gases in terms of reduced properties; his results are poor in comparison with those obtained from other correlation methods. For example, his correlation of the nitrogen viscosity data of Michels and Gibson (58) gives an average deviation of 4.5 percent, whereas results obtained in this work give an average percent deviation of less than 0.3 for the same ranges of temperature and pressure.

Kestin (38) has summarized other empirical relations for the prediction of the viscosity behavior of dense gases and commented on the performance of the various equation forms as predictive tools.

It is well known that empirical models differing greatly in detail can reproduce experimental data with acceptable accuracy for many engineering calculations, provided their parameters are determined from a given set of experimental data. However, the less theoretical the input to a predictive model is, the more likely the occurrence of unreliable extrapolations. On the other hand, a purely theoretical approach without regard to what is known from experiment is of little or no value. The high-pressure viscosity data for helium, nitrogen, and helium-nitrogen mixtures are of modest precision, the range of pressures covered is unimpressive, and the intensity of coverage is particularly poor at low temperatures. The virial expansion for describing the viscosity behavior of dense gases does not conflict in any essential way with general theoretical results, and efforts were made in this investigation to fit Kao's (34) data to this type of expansion. Experimental data cannot be fitted directly to a virial expansion and indirect methods for estimating virial coefficients must be used. A commonly used method consists of fitting polynomials to the experimental data by the method of least squares. The interdependence of the arbitrary constants in the least-squares treatment of a finite set of data precludes representing the coefficient of terms including

ρ as virials, where a number of such terms up to a higher degree in ρ are employed. There is no known relationship between the free parameters of least-squares polynomials and virial coefficients. Therefore, it is not possible, in practice, to obtain virial coefficients unambiguously from experimental results. This difficulty in giving unambiguous values to coefficients does not mean that it is not useful to express the viscosity coefficients as polynomials in density to represent experimental data.

Kao required densities for the calculation of differential pressures and kinetic corrections relevant to his experimental measurements. He used the eight equations presented by Pfenning, Canfield, and Kobayashi (61) for representing the PVT behavior of helium, nitrogen, and six helium-nitrogen mixtures (87.68, 75.23, 60.41, 44.56, 30.06, and 15.78 percent helium) from 240° to 560° R, for pressures between 14.696 and 7,500 psia, to compute densities and presented density values with his measured viscosities. Kao's gas compositions did not correspond exactly to those used by Pfenning and coworkers, and he had to make some interpolation of gas densities. The eight equations of Pfenning and coworkers are all of the same functional form, but combination rules for the constants of these equations in terms of gas composition have not been developed.

The Leiden form of the virial equation of state of Wood, Boone, Marshall, and Baer (82) for helium-nitrogen mixtures for temperatures from 133.15° to 748.15° K and for pressures to 300 atmospheres, relates pressure, volume, temperature, and gas composition by virials and interaction virials. Their equation is suitable for computing the PVTx properties of all possible helium-nitrogen mixtures in the pressure and temperature domain given for the equation of state. The equation of state of Wood and coworkers was used to check the density values Kao reported in conjunction with his viscosity data for pressures to 300 atmospheres, and a number of marked differences in density values were noted. Densities computed from Pfenning's eight equations and from the equation of state of Wood and coworkers, at PVTx conditions applicable to both works, are essentially in agreement, and density values tabulated by Kao were corrected to the results obtained from the equation of state of Wood and coworkers. The viscosity isotherms of Kao were then fitted by a least-squares procedure to polynomials of the following form, by employing successively higher degree terms of ρ to the fourth degree:

$$\eta_{T,P} = \hat{A} + \hat{B}\rho + \hat{C}\rho^2 + \dots \quad (23)$$

The superscript ^ is used to denote maximum likelihood estimators for the viscosity virial coefficients. Coefficients from those polynomials of the degree which exhibited minimum variance were plotted as functions of gas composition for given temperatures. Virial coefficients of pure gases and gaseous mixtures of fixed composition are rational functions of the absolute temperature only and independent of other state variables such as density and pressure. The same least-squares procedure was employed in using the residual viscosity concept because $\hat{A}$ values obtained from the least-squares equations were not always in accord with η_T° values used to represent the low-density gas behavior. The coefficient $\hat{A}$ for different degree polynomials for Kao's

183.15° K viscosity isotherm, his limiting viscosity values which he obtained by extrapolations, and values η_T° obtained in this work from equations 8, 10, and 14 are shown below.

Mole fraction of helium	Degree of polynomial			Kao's value	This work
	2d	3d	4th		
1.0000	142.34	142.55	142.91	142.5	142.48
.8717	142.94	142.88	143.06	143.0	143.39
.5972	135.46	135.56	136.25	135.7	136.57
.1588	122.43	121.88	122.34	122.4	123.62
.0000	117.60	116.91	114.47	117.8	119.67

Statistical-thermodynamic theory requires that the n-th virial coefficient of the complete expansion of the compressibility factor, Z, for a binary gas mixture be a polynomial of the n-th order in the mole fractions. If the viscosity virial expansion is analogous to the Z expansion and by inference the maximum likelihood estimators ($\hat{B}$, $\hat{C}$, etc.) are equivalent to virial coefficients (a doubtful postulate), then the rules for obtaining interaction virial coefficients in the Z expansion should be applicable to the viscosity expansion. Unfortunately, it was not possible to perceive satisfactory relationships with respect to gas composition and temperature from the free parameters obtained in the regression analysis. Also, there was no relationship between interaction virial coefficients of the equation of state, presented by Wood (81), and interaction viscosity virials.

Kestin, Kobayashi, and Wood (39) used the residual viscosity concept in representing their very precise low-pressure viscosity data for helium, nitrogen, and helium-nitrogen mixtures by second degree equations in terms of density and found that their $\hat{B}$ and $\hat{C}$ values were essentially independent of temperature for their measurements at 293.15° and 303.15° K. The density values they used are in excellent agreement with densities obtained from the equation of state of Wood and coworkers (82). Slight extrapolations of their equations using densities computed from the equation of state give inappropriate results. There are no high-pressure viscosity data for helium and helium-nitrogen mixtures in the temperature range 133.15° to 183.15° K, and one general shortcoming of the residual viscosity versus density correlation is that the correlation requires closely spaced viscosity data and highly accurate density data in order to interpolate the viscosities with accuracy. Therefore, this type of correlation did not appear to be very practical and the more empirical approach of relating residual viscosity values to thermal pressure coefficients was investigated.

Thermal pressure coefficients, $(\partial P/\partial T)_V$, derived from the equation of state of Wood and coworkers (82) and residual viscosities, $\Delta\eta = \left(\eta_{T,P} - \eta_T^\circ\right)$, obtained from experimental data were plotted on log-log coordinates. If an investigator gave η_T° values, these values were used in conjunction with his higher pressure data to obtain $\Delta\eta$ values; otherwise, applicable η_T° values computed from equations 8, 10, or 14 were used to compute residual viscosities. Large-scale graphs (constructed from 1 x 1 cycle logarithmic-coordinate sheets each with a grid of 9.85 x 9.85 inches) of $\left(\eta_{T,P} - \eta^{\circ}_{T}\right)$ versus $(\partial P/\partial T)_V$ showed that most of the data points for a gas of fixed composition clustered about a straight line. The concentration of points of an individual investigator about a line of regression of $\Delta\eta$ on $(\partial P/\partial T)_V$ for his points alone appeared to be within the experimental uncertainty claimed for his data. The envelope of all experimental points on the surface of a graph for a gas of fixed composition also indicated a linear relationship between $\Delta\eta$ and $(\partial P/\partial T)_V$ on log-log coordinates. However, on these graphs data points were more scattered and widely dispersed because of the marked discrepancies in experimental viscosity data of compressed helium and nitrogen obtained by various methods and investigators. Visual inspection of the graphs showed that the parameter β in the Golubev relationship, equation 20, increased in value as the helium concentration increased in the mixtures, and β for helium was about 1.6 times larger than β for nitrogen.

The equation of state (82) used to calculate thermal pressure coefficients, $(\partial P/\partial T)_V$, for helium, nitrogen, and binary mixtures of these gases is the virial power series in density truncated at the fifth virial coefficient:

$$Z = \frac{P}{\rho RT} = 1 + B\rho + C\rho^2 + D\rho^3 + E\rho^4, \tag{24}$$

where Z = compressibility factor,

P = pressure,

ρ = molal density, reciprocal of molal volume,

R = gas constant,

T = absolute temperature,

and B, C, D, and E = the second, third, fourth, and fifth virial coefficients, respectively.

The empirical equations used to represent the functional relationships of the virial coefficients with respect to temperature are (82)

$$B = a + b/T + c/T^2 + dT + eT^2, \tag{25}$$

$$C = f + g/T + h/T^2 + i/T^6, \tag{26}$$

$$D = j + k/T, \tag{27}$$

and

$$E = \ell + m/T. \tag{28}$$

The parameters a through m are related to the mole fraction of helium, x_1, where

$$a = \left[n_1 + n_2\ x_1\right], \tag{29}$$

$$b = \left[n_3 + n_4\ x_1 + n_5\ x_1^2\right] \times 10^2, \tag{30}$$

$$c = \left[n_6 + n_7\ x_1 + n_8\ x_1^2\right] \times 10^4, \tag{31}$$

$$d = \left[n_9 + n_{10}\ x_1 + n_{11}\ x_1^2\right] \times 10^{-2}, \tag{32}$$

$$e = \left[n_{12} + n_{13}\ x_1 + n_{14}\ x_1^2\right] \times 10^{-6}, \tag{33}$$

$$f = \left[n_{15} + n_{16}\ x_1\right], \tag{34}$$

$$g = \left[n_{17} + n_{18}\ x_1 + n_{19}\ x_1^2 + n_{20}\ x_1^3\right] \times 10^2, \tag{35}$$

$$h = \left[n_{21} + n_{22}\ x_1 + n_{23}\ x_1^2 + n_{24}\ x_1^3\right] \times 10^4, \tag{36}$$

$$i = \left[n_{25} + n_{26}\ x_1 + n_{27}\ x_1^2\right] \times 10^8, \tag{37}$$

$$j = \left[n_{28} + n_{29}\ x_1 + n_{30}\ x_1^2 + n_{31}\ x_1^3\right] \times 10^4, \tag{38}$$

$$k = \left[n_{32} + n_{33}\ x_1 + n_{34}\ x_1^2\right] \times 10^6, \tag{39}$$

$$\ell = \left[n_{35} + n_{36}\ x_1 + n_{37}\ x_1^2 + n_{38}\ x_1^3\right] \times 10^6, \tag{40}$$

and

$$m = \left[n_{39} + n_{40}\ x_1 + n_{41}\ x_1^2 + n_{42}\ x_1^3\right] \times 10^8. \tag{41}$$

Numerical values for n_1 through n_{42} are given in table 1.

The thermal pressure coefficient expressed in terms of the virial parameters of the equation of state 24 is

$$\left(\frac{\partial P}{\partial T}\right)_V = R\,\rho \left[1 + \rho\left(B + T\,\frac{dB}{dT}\right) + \rho^2\left(C + T\,\frac{dC}{dT}\right)\right.$$

$$\left. + \rho^3\left(D + T\,\frac{dD}{dT}\right) + \rho^4\left(E + T\,\frac{dE}{dT}\right)\right]. \tag{42}$$

TABLE 1. - Equation of state constants[1/]

($R = 82.0597$ cm^3 atm/g mole °K)

	Value		Value		Value
n_1	+43.55717061	n_{15}	+653.4350	n_{29}	-10.3168469978
n_2	-26.44142402	n_{16}	-593.8107	n_{30}	+6.7544135362
n_3	-113.93090540	n_{17}	+943.0050	n_{31}	-1.4213610130
n_4	+197.33531750	n_{18}	-2150.8043	n_{32}	-12.43854709
n_5	-87.91454650	n_{19}	+1507.8055	n_{33}	+28.45763019
n_6	-89.28053030	n_{20}	-173.3216	n_{34}	-16.49176184
n_7	+166.47036350	n_{21}	+3291.2149	n_{35}	+1.22067686
n_8	-77.18061130	n_{22}	-8040.7069	n_{36}	-2.69220173
n_9	+0.11947536	n_{23}	+6270.9306	n_{37}	+0.53500731
n_{10}	-1.88880885	n_{24}	-1462.0293	n_{38}	+0.95326739
n_{11}	+0.31910785	n_{25}	+4834983.16	n_{39}	+1.34284616
n_{12}	-3.53781356	n_{26}	-9702847.53	n_{40}	-1.14608807
n_{13}	+3.60178035	n_{27}	+4867864.37	n_{41}	-1.86210420
n_{14}	+6.72930720	n_{28}	+5.2624836522	n_{42}	+1.69131096

1/ These coefficients require that the units for ρ = g mole/cm^3, T = °K, and R = cm^3 atm/g mole °K.

The empirical equations, 25-28, used to represent the functional relationships of virial coefficients with respect to temperature, yield the following expressions for the terms in equation 42:

$$\left(B + T\frac{dB}{dT}\right) = a - cT^{-2} + 2dT + 3\,eT^{2}, \qquad (43)$$

$$\left(C + T\frac{dC}{dT}\right) = f - hT^{-2} - 5i\,T^{-6}, \qquad (44)$$

$$\left(D + T\frac{dD}{dT}\right) = j, \qquad (45)$$

and

$$\left(E + T\frac{dE}{dT}\right) = \ell. \qquad (46)$$

The equation of state, equation 24, cannot be solved explicitly for the molar density, ρ, as a function of temperature and pressure. Therefore, it is necessary to use an iterative process to solve for density when pressure and temperature are the independent variables. The Newton-Raphson method of iteration was used to compute densities, and convergence was assumed when

$$|Z_{(k+1)} - Z_{(k)}| \leq 10^{-6}, \tag{47}$$

where $Z_{(k)}$ = an approximation of the compressibility factor,

$Z = P/RT\rho$, at a given pressure and temperature,

and $Z_{(k+1)}$ = the next successive approximation of the compressibility factor at the same conditions of pressure and temperature.

For additional details regarding this method, the iteration process, and the recurrence relationship used, the reader is referred to Wood and coworkers (82).

The nonlinear Golubev equation, equation 20, can be readily reduced to a linear form for least-squares treatment by treating residuals, r, as

$$r = \log \alpha + \beta \log \left(\frac{\partial P}{\partial T}\right)_V - \log \left(\eta_{T,P} - \eta_T^\circ\right), \tag{48}$$

but this procedure of evaluating α and β so that Σr^2 is minimum is inappropriate and would be correct only for a constant absolute error in $\log\left(\eta_{T,P} - \eta_T^\circ\right)$; that is, for a constant percentage error in $\left(\eta_{T,P} - \eta_T^\circ\right)$, which is very unlikely. A general computer program for solving nonlinear regression problems written by Grout (22) was used to evaluate α and β in the Golubev relationship from high-pressure viscosity data. In this computer program weighting factors can be assigned to the dependent variables, and estimating parameters are improved by the Newton-Raphson or Gauss-Newton method of iteration. Twenty-two digit floating-point precision is used in program execution, and iterations are carried out for as long as the sum of the weighted squares of the residuals, Σr^2, continues to get smaller or until the relative change in Σr^2 becomes insignificant. Estimating parameters $\tilde{\alpha}$ and $\tilde{\beta}$ for this computer program were obtained from equation 48. Convergence was assumed when Σr^2 values of successive approximations differed by 10^{-16} or less in the nonlinear least-squares program.

High-pressure viscosity isotherms for nitrogen from 24 sources (1, 3, 12, 14, 16-17, 19, 29-30, 34, 39-41, 45-46, 48, 55-56, 58, 63, 67-70) in the temperature region 131.15° to 933.46° K were considered in computing α and β values for the Golubev equation. The nonlinear least-squares method of Grout (22) was used to compute α and β values from individual viscosity isotherms to see if α and β were temperature-dependent. No temperature dependency in either α or β was noted. Two-hundred eight data points for nitrogen, consisting of averaged data where a series of measurements had been made for a given isotherm, and individual points were used to obtain the "best" overall values of α and β for nitrogen. A standard error of estimate of 1.64 μp in the residual viscosity was obtained from the 208 points used. The regression analyses yielded $\alpha = 58.2659757$ and $\beta = 1.1160332$ when the residual viscosity values, $\left(\eta_{T,P} - \eta^{\circ}_{T}\right)$, are in micropoises.

Lo, Carroll, and Stiel (51) presented a viscosity correlation for air for the temperature region -70° to 600° C for pressures to 1,000 atmospheres, using the Golubev equation where $(\partial P/\partial T)_V$ values for nitrogen were computed from the derived data of Deming and Shupe (9). If residual viscosity values are expressed in micropoises, the coefficients obtained by Lo and coworkers are $\alpha = 57.6$ and $\beta = 1.126$. Golubev (20) obtained the relationship

$$\left(\eta_{T,P} - \eta^{\circ}_{T}\right) = 56.7\left[\left(\partial P/\partial T\right)_V\right]^{1.12} \qquad (49)$$

for nitrogen from the data of Golubev and Petrov (20); his $(\partial P/\partial T)_V$ values were obtained from the work of Deming and Shupe (9).

Makavetskas, Popov, and Tsederberg (55) used the Golubev relationship to correlate their higher pressure viscosity data for helium and nitrogen. The $(\partial P/\partial T)_V$ values they required for correlation were derived from helium data presented by Tsederberg, Popov, and Morozova (79) and nitrogen data presented principally by Din (10). The α and β values they obtained for nitrogen and helium depart markedly from α and β values obtained from either a linear or a nonlinear treatment of their viscosity data, when $(\partial P/\partial T)_V$ values used in analysis were derived from the equation of state of Wood and coworkers, equation 24. Values of α and β depend strongly on the values of the thermal pressure coefficient; it was assumed initially that the incongruous results obtained were due to marked variance in $(\partial P/\partial T)_V$ values from different sources. Fortunately, Makavetskas and coworkers tabulated the $(\partial P/\partial T)_V$ values they used. A comparison of $(\partial P/\partial T)_V$ values for helium computed from equation 24 and those tabulated (55) show deviations of less than 0.8 percent, except for one pair at 918.52° K and 490.9 atmospheres, where the tabulated and the computed value differed by 1.11 percent. In a like comparison of $(\partial P/\partial T)_V$ values for nitrogen, the agreement was not quite as good as that for helium; six out of 62 pairs of $(\partial P/\partial T)_V$ values diverged by more than 1.4 percent.

The equation of state of Wood and coworkers, equation 24, was not designed for pressures above 300 atmospheres or temperatures higher than 748.15° K. One would expect deviations to increase with increasing pressure and for the two isotherms of Makavetskas, 813.08° and 933.46° K, which were outside the range of the equation of state. The pattern in which the larger deviations, up to 5.26 percent, occurred was unexpected. Elimination of their higher pressure and temperature data from the regression analysis would not have resulted in agreement of the α and β values of Makavetskas and coworkers with those obtained by the nonlinear least-squares treatment of their data.

The α values obtained from Makavetskas and coworkers' data for helium and nitrogen departed so greatly from α values obtained from the viscosity isotherms of other investigators that their data for helium and nitrogen were not used in the regression analysis, wherein the data of a number of investigators were combined to obtain the "best" values of α and β. The shear viscosity data of Boyd (3) and kinematic viscosity values of Filippova and Ishkin (14) for nitrogen were also considered but not used in obtaining α and β values. Filippova and Ishkin's kinematic viscosity values were converted to dynamic values with densities taken from Strobridge (73); the results checked, in part, with densities obtained from equation 24. Boyd's data were rejected because his individual viscosity measurements, at a given temperature and pressure, often deviated from the arithmetical mean of these measurements by as much as 7 percent.

The reliability of Filippova and Ishkin's (14) data was considered doubtful because in several instances their results show a sharp rise or fall in isothermal viscosity values with increasing pressure. For example, on their 173.15° K isotherm, the viscosity increases 30.48 μp for a pressure increase of only 1.3 atmospheres, 139.0 to 140.3; on their 223.15° K isotherm, the viscosity drops 11.52 μp when the pressure is increased from 127.6 to 138.5 atmospheres.

However, it would not be prudent to reject all their experimental data on the basis of a few discrepancies. Proofreading and correction of tabular material before publication is apparently not a virtue in the Soviet literature. Filippova and Ishkin (15) claimed that the empirical formula

$$\eta_{T,P} = \eta_T^\circ + \left[c\rho^{4/3}/(1 - b\rho)\right], \tag{50}$$

where c and b = constants,

and ρ = density, g/cm^3,

gave a good description of their data when they used η_T° values obtained from Golubev's (20) book. Viscosity values were computed from equation 50 by using densities computed from equation 24 and η_T° values from equation 10. The computed viscosities were compared with the experimental data of Filippova and Ishkin (14), and deviations greater than 6 percent were encountered between the computed and experimental viscosity values. The magnitude of the differences encountered cannot be accounted for in terms of discrepancies between η_T° values taken from Golubev's book and results obtained from equation 10 or because of uncertainty in the density of nitrogen. In general, the overall results indicated that Filippova and Ishkin's data are erratic and should not be considered in a correlation of the viscosity data of compressed nitrogen.

The 473.15° K viscosity isotherm of Reynes and Thodos (63) for nitrogen gave α and β values which departed appreciably from their other viscosity data, and three points out of eight higher pressure values on this isotherm were excluded from the regression analysis. Reynes and Thodos make no estimate of the accuracy of their viscosity data. The three points in question were not rejected from final computations because of a known lack of merit but were excluded because they were more than 3 standard error of estimate removed from the preliminary line of regression.

The data of Ross and Brown (67) for nitrogen depart appreciably from those of other investigators (17, 19, 30, 34, 41, 56, 58, 70), and hence they were not used in obtaining α and β values for nitrogen.

It appears that Makavetskas and coworkers (54-55) assumed from the start that β should have the value 1.12 for helium, nitrogen, and helium-nitrogen mixtures. Such a premise could explain, in part, the lack of agreement in α and β values obtained by the nonlinear least-squares treatment of their viscosity data, where both α and β were treated as variables, and their final results. Also, in the case of nitrogen, the higher pressure viscosity values from their 284.55° K isotherm delimit the upper boundary of points on the $\Delta\eta$ versus $(\partial P/\partial T)_V$ graph when Boyd's (3) data are not considered.

The only viscosity data for helium and helium-nitrogen mixtures of sufficient accuracy and at pressures sufficiently high to yield meaningful values of α and β, are those of Kao (34). Therefore, the α and β values for helium and helium-nitrogen mixtures used in this report are based solely on results derived from Kao's viscosity isotherms.

For computing the properties of all binary mixtures, Golubev recommended the formula

$$\alpha_m = \alpha_1 x_1^2 + \frac{2}{3}\left(\alpha_1 + \alpha_2\right) x_1 x_2 + \alpha_2 x_2^2, \qquad (51)$$

where α_m = coefficient for a mixture of fixed composition,

x_1 and x_2 = mole fractions of components 1 and 2 in the mixture,

and α_1 and α_2 = coefficients of the pure gas 1 and pure gas 2.

The α_m constants we obtained from the nonlinear least-squares procedure were not well represented by equation 51. It was found that a better representation of α_m values could be obtained from the expression

$$\alpha_m = \alpha_1 x_1^2 + 2x_1x_2 \alpha_{12} + \alpha_2 x_2^2. \qquad (52)$$

The values for constants of equation 52 are

$$\alpha_1 = 2.5254571,$$

$$\alpha_{12} = 24.4447980,$$

$$\alpha_2 = 58.2659757.$$

The subscripts 1 and 2 reference helium and nitrogen, respectively; and α_{12} is an artificial quantity characteristic of 1-2 interaction.

A comparison of α_m values obtained from experimental data with α_m values computed from equation 52 is provided in figure 4.

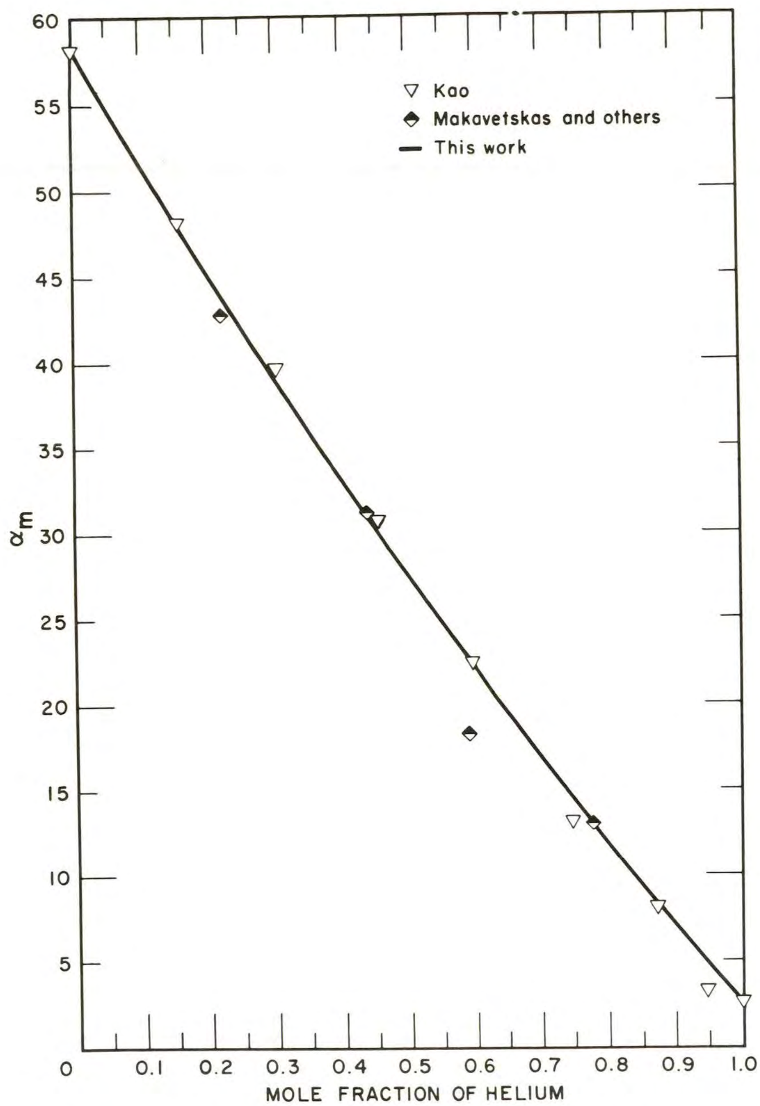

FIGURE 4. - The Dense-Gas Viscosity Parameter α_m as a Function of Composition.

The β values obtained for nitrogen, helium, and Kao's mixtures (0.9475, 0.8717, 0.7460, 0.5972, 0.4550, 0.3036, and 0.1588 mole fraction of helium) were fitted to polynomials in terms of the mole fraction of helium by a linear least-squares technique. As often happens in curve fitting, the normal equations were unstable or the equations were ill-conditioned. The procedures used to relate β's as a function of mole fraction were as follows:

1. A graph of β's versus mole fraction of helium was constructed and a visual "best-fit" curve was drawn.

2. A table of differences was formed from the "best-fit" curve.

3. Successive n differences of β were tabulated and the (n + 1)-th differences examined for approximate constancy.

These procedures indicated a suitable function to represent β's to be a polynomial of fourth degree in terms of the mole fraction of helium. The equation used to compute the thermal pressure coefficient exponent β as a function of composition is

$$\beta = 1.1160332 - 0.36651685\ x_1 + 2.78372553\ x_1^2 - 5.26596970\ x_1^3 + 3.602589636\ x_1^4, \tag{53}$$

where x_1 = mole fraction of helium in the mixture. Equation 53 was constrained so that the end points, β's for helium (1.8698618) and nitrogen (1.1160332), corresponded to β's obtained from the experimental data. The free parameters of the equation necessary to represent given mixtures were obtained by successive approximations. Figure 5 shows values of β computed from equation 53.

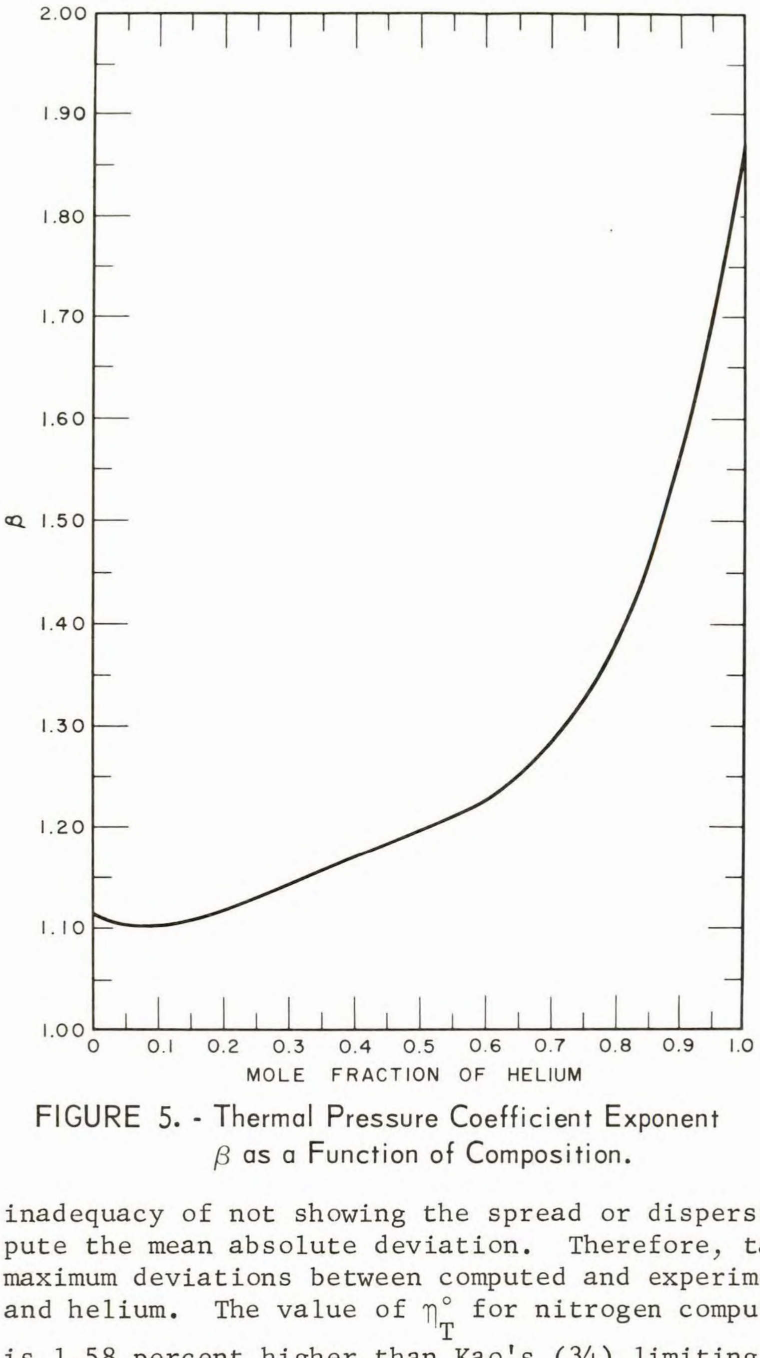

FIGURE 5. - Thermal Pressure Coefficient Exponent β as a Function of Composition.

The number of figures given for the coefficients of the various equations presented do not imply that virial coefficients, low-density viscosities, parameters α and β, and thermal pressure coefficients can be computed to 8- to 10-place accuracy. Just how many figures of any given coefficient are significant cannot be stated because of the lack of knowledge relevant to the reliability of the experimental data from which the coefficients were derived. However, it appears that in general the equations will give a better approximation of the experimental data if at least eight figures are used in calculations.

Table 2 shows the data distribution and the average absolute percentage deviations between the computed and experimental viscosity values of various investigators. In our opinion, in considering how representative the prediction equations are of the experimental data, the unreliable results of Boyd (3) and of Filippova and Ishkin (14) should be excluded from consideration. Table 2 has the inadequacy of not showing the spread or dispersion of quantities used to compute the mean absolute deviation. Therefore, table 3 is provided to show the maximum deviations between computed and experimental viscosities for nitrogen and helium. The value of η_T° for nitrogen computed in this work at 183.15° K is 1.58 percent higher than Kao's (34) limiting viscosity value. Discrepancies between computed and experimental higher pressure viscosity values on this isotherm are characteristic of the low-density result, except for the two measurements at 120 atmospheres which deviated from computed results by less than 0.3 percent. The very large deviations shown in table 3 are, in many cases, for viscosity values at pressures greater than 300 atmospheres. The accuracy of the thermal pressure coefficients derived from the equation of state for pressures greater than 300 atmospheres is probably not very good because it is known that the equation of state begins to depart from apparently reliable experimental compressibility factors at pressures greater than

300 atmospheres. However, the discrepancies between computed and experimental results at pressures greater than 300 atmospheres are not due solely to inadequacies in the prediction equation but in many cases result from lack of agreement between the experimental viscosity coefficients reported by investigators. The amount of variation between Kao's (34) experimental results and computed viscosity values for pressures greater than 300 atmospheres is not appreciably greater than the amount of variation for comparable lower pressure comparisons.

The 284.55° K viscosity isotherm of Makavetskas and coworkers (55) for nitrogen falls within the pressure and temperature domain of Kao's data but discrepancies between computed and experimental results increase sharply for pressures above 295 atmospheres. Table 2 shows the mean absolute percent deviation to be 2.58 for the 56 nitrogen points of Makavetskas and coworkers (55). However, the three highest pressure points on their 284.55° K isotherm, 5 percent of their data, account for 23 percent of the overall discrepancy between computed and experimental values. The penultimate point of their 284.55° K isotherm is given in table 3. Their points adjacent to this point have deviations greater than 10 percent.

A situation similar to that of Makavetskas and coworkers' nitrogen data exists in the case of Ross and Brown's (67) nitrogen data. The three highest pressure points on their 223.40° K viscosity isotherm, 11 percent of their data, account for 34 percent of the overall discrepancy between computed and experimental results. If all of Ross and Brown's 223.40° K viscosity data for nitrogen, about 25 percent of the data, were excluded from consideration, the mean absolute percent deviation for the remainder of their nitrogen data, 28 points at higher temperatures, would be 1.28.

Unfortunately, the experimental data of Shepeleva and Golubev (70) for nitrogen are at extremely large pressure intervals, and there is a lack of closely spaced data in the vicinity of their viscosity point at 132.15° K and 248.92 atmospheres, shown in table 3, which differs from the computed value by 7.59 percent. Therefore, it is not known if this large deviation is part of a trend or the result of a large error in an isolated point. Shepeleva's tabulated data show the viscosity of nitrogen to be 488.2 μp at 133.65° K and 98.99 atmospheres. This value appears to be a typographical error, and from figure 2 in his paper it is evident that the first significant figure should be a 3 rather than 4, and this change was made in using his data.

TABLE 2. - Data distribution and error analysis

Source of data	Temperature range, °K	Pressure range, atmospheres	No. of points	$\frac{\Sigma\|Pct\ Dev\|}{N}$ [1]
NITROGEN DATA				
Baron, Roof, and Wells (1)........	324.80-408.20	6.80-544.00	40	1.79
Boyd (3).........................	303.20-343.20	70.40-191.00	32	6.66
DiPippo, Kestin, and Oguchi (12)..	303.15	1.05- 23.08	5	.11
Filippova and Ishkin (14).........	133.15-273.15	46.50-141.20	17	6.11
Flynn (16).......................	298.15	149.57	1	.36
Flynn and others (17)............	194.65-373.15	6.77-176.58	34	.32
Goldman (19).....................	194.65-298.15	51.00-125.50	16	.75
Iwasaki (29).....................	298.15-423.15	20.60-187.80	25	.43
Iwasaki and Kestin (30)..........	293.04-297.89	1.00- 98.51	32	.11
Kao (34).........................	183.15-323.15	10.00-500.00	69	.79
Kestin, Kobayashi, and Wood (39)..	303.14-304.14	1.03- 25.35	19	.06
Kestin and Leidenfrost (40-41)....	293.20-298.20	.99-152.51	31	.16
Kestin and Wang (45).............	298.00	1.00- 70.00	10	.11
Kestin and Whitelaw (46).........	345.32-538.33	1.20-146.48	37	1.32
Lazarre and Vodar (48)...........	298.20-348.20	.96-483.90	6	.94
Makavetskas and others (55).......	284.55-933.46	15.10-507.40	56	2.58
Makita (56)......................	298.99-473.03	1.00-483.90	36	1.09
Michels and Gibson (58)..........	297.99-347.99	10.95-541.70	39	.28
Reynes and Thodos (63)...........	373.15-473.15	70.43-547.80	24	1.24
Ross and Brown (67)..............	223.40-298.20	35.02-545.40	37	2.44
Savino and Sibbitt (68)..........	298.00	69.00-271.80	9	1.14
Shepeleva and Golubev (70)........	131.15-277.55	9.08-499.40	50	1.56
Total, all observations nitrogen.	-	-	625	1.52
Total, excluding data of Boyd (3) and of Filippova and Ishkin (14)	-	-	576	1.09
HELIUM DATA				
DiPippo, Kestin, and Oguchi (12)..	303.15	1.04- 23.05	5	0.39
Flynn and others (17)............	223.15-373.15	22.24-175.48	23	.23
Golubev and Gnezdilov (21)........	273.15-523.15	9.70-483.90	45	.60
Kao (34).........................	183.15-323.15	10.00-500.00	65	.36
Kestin, Kobayashi, and Wood (39)..	303.14	1.03- 24.68	10	.32
Kestin and Leidenfrost (40-42)....	293.20-510.58	1.00-137.10	34	.42
Kestin and Nagashima (43).........	293.14-303.14	1.05- 63.40	17	.28
Kestin and Wang (45).............	298.00	1.00- 50.00	8	.41
Kestin and Whitelaw (46).........	296.27-520.78	1.34-117.02	34	.85
Luker and Johnson (52)...........	328.15-682.15	8.10-129.40	30	2.16
Makavetskas and others (55).......	283.75-918.52	39.70-507.00	35	1.07
Reynes and Thodos (63)...........	373.15-473.15	70.43-546.70	24	1.59
Ross and Brown (67)..............	223.10-298.20	69.05-545.40	24	1.01
Total, all observations helium...	-	-	354	.78
HELIUM-NITROGEN MIXTURES				
Kao (34).........................	183.15-323.15	10.00-500.00	273	0.48
Kestin, Kobayashi, and Wood (39)..	293.15-303.15	1.01- 25.76	65	.17
Makavetskas and others (54).......	284.65-952.55	11.32-226.86	72	1.49
Total, all observations mixtures.	-	-	410	.61
Total, all observations..........	-	-	1,389	1.06
Total, excluding data of Boyd (3) and of Filippova and Ishkin (14)	-	-	1,340	.86

[1] Mean absolute percent deviation.

TABLE 3. - Maximum deviations between computed and experimental viscosities for nitrogen and helium

Source of data	T, °K	P, atm	$\eta_{Exp.}$, μP	$\eta_{Comp.}$, μP	Deviation, percent
NITROGEN DATA					
Baron, Roof, and Wells (1)	408.20	544.00	348.10	332.20	4.78
Boyd (3)	303.20	176.90	272.50	224.10	21.59
DiPippo, Kestin, and Oguchi (12)	303.15	15.05	182.34	182.08	.14
Filippova and Ishkin (14)	173.15	139.00	209.59	256.63	-18.33
Flynn, Hanks, Lemaire, and Ross (17)	194.65	90.83	169.90	172.85	-1.70
Goldman (19)	194.65	125.50	212.40	204.87	3.67
Iwasaki (29)	423.15	162.70	249.50	253.09	-1.42
Iwasaki and Kestin (30)	297.89	98.51	199.73	198.67	.52
Kao (34)	183.15	10.00	118.88	122.15	-2.68
Kestin, Kobayashi, and Wood (39)	304.14	5.00	181.23	181.01	.11
Kestin and Leidenfrost (40)	298.20	69.04	191.64	191.09	.28
Kestin and Leidenfrost (41)	293.20	144.02	212.70	211.14	.73
Kestin and Wang (45)	298.00	10.00	179.30	178.96	.18
Kestin and Whitelaw (46)	538.33	133.69	292.90	284.18	3.06
Lazarre and Vodar (48)	298.20	483.90	348.00	341.01	2.04
Makavetskas and others (55)	284.55	396.30	350.20	312.43	12.08
Makita (56)	473.03	483.90	303.00	322.73	-6.11
Michels and Gibson (58)	347.99	212.40	240.80	243.51	-1.11
Reynes and Thodos (63)	473.15	479.40	310.00	321.92	-3.70
Ross and Brown (67)	223.40	545.40	422.80	472.03	-10.43
Savino and Sibbitt (68)	298.00	271.80	250.50	257.72	-2.80
Shepeleva and Golubev (70)	132.15	248.92	665.00	618.03	7.59
HELIUM DATA					
DiPippo, Kestin, and Oguchi (12)	303.15	5.00	200.93	200.07	0.42
Flynn, Hanks, Lemaire, and Ross (17)	248.15	174.25	174.77	176.10	-.76
Golubev and Gnezdilov (21)	273.15	483.90	197.00	193.50	1.80
Kao (34)	323.15	500.00	212.27	214.26	-.93
Kestin, Kobayashi, and Wood (39)	303.14	7.50	200.77	200.06	.35
Kestin and Leidenfrost (40)	293.20	4.39	196.19	195.62	.28
Kestin and Leidenfrost (41)	293.20	41.86	196.40	195.68	.36
Kestin and Leidenfrost (42)	506.00	137.09	287.20	282.74	1.57
Kestin and Nagashima (43)	303.14	14.54	200.88	200.07	.40
Kestin and Wang (45)	298.00	50.00	199.20	197.86	.67
Kestin and Whitelaw (46)	520.78	22.91	293.52	288.06	1.89
Luker and Johnson (52)	517.15	127.00	300.00	286.88	4.57
Makavetskas and others (55)	594.73	292.90	329.70	315.66	4.44
Reynes and Thodos (63)	473.15	546.70	279.60	273.14	2.36
Ross and Brown (67)	298.20	545.40	210.30	205.23	2.46

Figure 6 shows computed viscosities for nitrogen. A common characteristic of gases in the vicinity of the critical region is a sharp rise in the viscosity with increasing pressure. The computed results cannot be compared quantitatively for each isobar because of the lack of sufficient experimental data. However, the variation of viscosity along isobars conforms to this

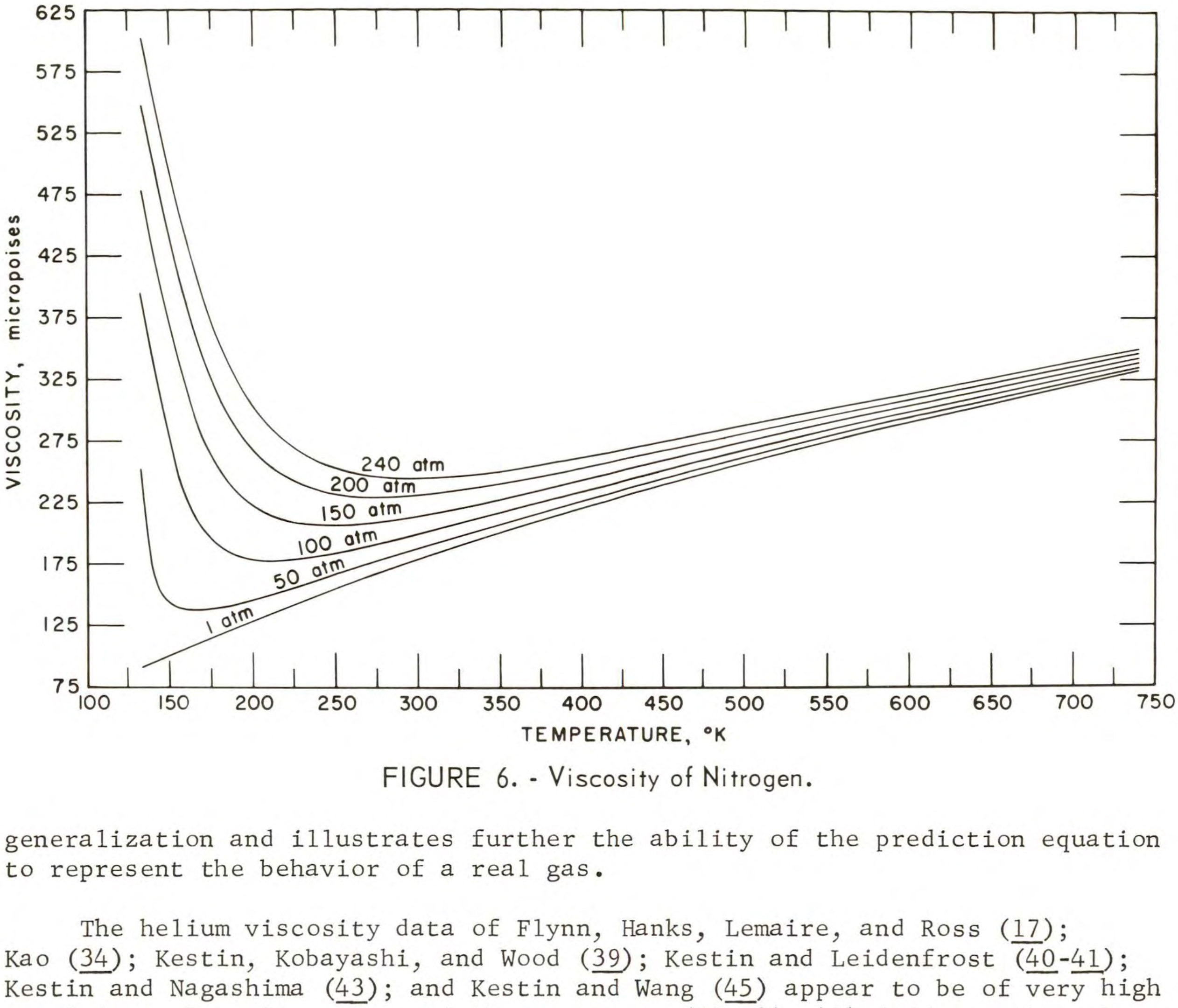

FIGURE 6. - Viscosity of Nitrogen.

generalization and illustrates further the ability of the prediction equation to represent the behavior of a real gas.

The helium viscosity data of Flynn, Hanks, Lemaire, and Ross (17); Kao (34); Kestin, Kobayashi, and Wood (39); Kestin and Leidenfrost (40-41); Kestin and Nagashima (43); and Kestin and Wang (45) appear to be of very high precision. Data from three of these sources (17, 34, 41) indicate that the isothermal viscosity of helium decreases very slightly from the dilute-gas value with increasing pressure, passes through a very superficial minimum, and then increases with increasing pressure. The thermal pressure method for computing residual viscosities is incompatible with such phenomena because the thermal pressure coefficients of helium are positive and increase monotonically with increasing pressure. Data from sources (12, 21, 42-43, 45-46) probably have uncertainties of 1 percent or less. However, the data of Luker and Johnson (52) are not in good agreement with the data of other investigators. Data from this source may have uncertainties up to 4 percent. Luker and Johnson's results show that the isothermal viscosity of helium increases by about 4 percent when the pressure is increased to 125 atmospheres. Their results are not substantiated by any other investigator. Makavetskas and coworkers (55) claim a maximum error of 3.5 percent in their viscosity coefficients. Their 918.52° K isotherm shows a marked decline in the viscosity of helium between 48.90 and 261.40 atmospheres and then a slight increase with increasing pressure.

The residual viscosity of helium is extremely small in the temperature and pressure region covered by precise experimental data, and there is high uncertainty in the numeric values for α and β obtained from these data. Unfortunately, there are no viscosity measurements at pressures greater than atmospheric in the temperature region 133° to 183° K where residual viscosity effects should be larger and the numerical values of α and β could be evaluated more precisely.

Figure 7 shows computed viscosities of helium at 1 and 240 atmospheres as a function of temperature. Typical values for the percentage increase in the isothermal viscosity of helium between 1 and 240 atmospheres are 26.16, 0.81, and 0.08 at 133°, 300°, and 740° K, respectively. For nitrogen under the same conditions, values are 562.78, 37.60, and 5.25 percent. The computed 26-percent increase in the viscosity of helium at 240 atmospheres, relative to the 1 atmosphere value at 133° K, appears too high because helium, more than any other gas, should more closely fit the assumptions of the elementary kinetic theory. A 26-percent increase in the viscosity of nitrogen between 1 and 240 atmospheres occurs at about 350° K.

A comparison of maximum deviations between computed and experimental viscosity coefficients for helium-nitrogen mixtures is provided in table 4. It will be seen that in general the larger deviations between computed and experimental results with respect to Kao's data (<u>34</u>) occur for pressures above

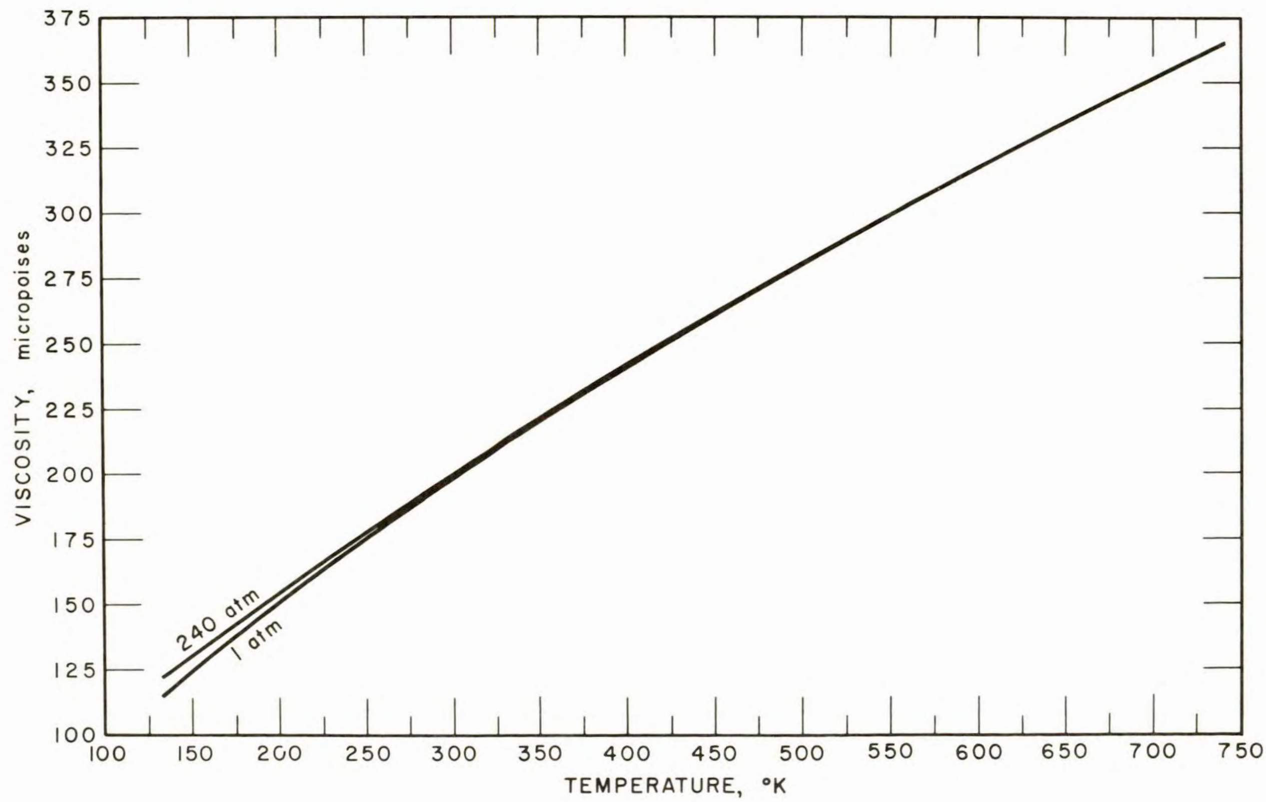

FIGURE 7. - Viscosity of Helium.

300 atmospheres. Duplicate measurements form a large part of Kao's results, and 12 out of his 18 data points given in table 4 have viscosity measurements of the same rank. Deviations of computed viscosity values from his duplicate measurements are all within about 1/2 percent of the deviations given in table 4. Also, the signs of these higher pressure deviations indicate that the equation has the tendency to give computed viscosity values slightly larger than experimental results at high pressures.

The data of Kestin, Kobayashi, and Wood (39) are for pressures less than 26 atmospheres, and residual viscosity effects are not apparent or very small in their work. Therefore, the deviations presented in table 4 are comparable to results obtained from the low-density viscosity expressions.

None of Makavetskas and coworkers' (54) points for mixtures deviated from computed results by as much as their estimated uncertainty of 4.5 percent.

Figures 8, 9, and 10 show typical graphs of the effect of temperature upon the isobaric viscosity coefficients of three mixtures.

The composition dependency of the viscosity of helium-nitrogen mixtures along isobars at 133°, 300°, and 740° K is shown in figures 11, 12, and 13.

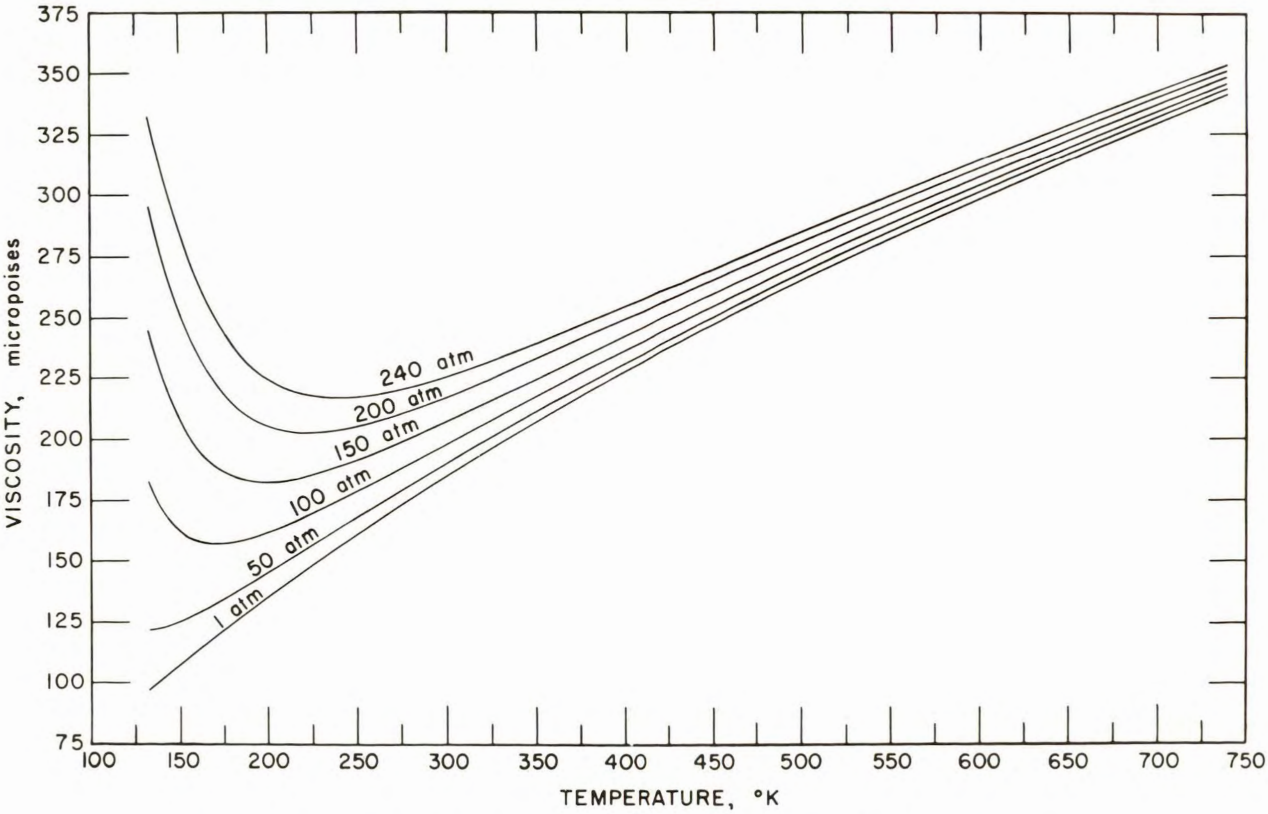

FIGURE 8. - Viscosity of a 0.2500 Helium-0.7500 Nitrogen Mixture.

TABLE 4. - Maximum deviations between computed and experimental viscosities for mixtures

T, °K	Mole fraction, helium	P, atm	$\eta_{Exp.}$, μP	$\eta_{Comp.}$, μP	Deviation, percent
		KAO (34)			
183.15	0.1588	10.00	124.30	125.65	-1.07
183.15	.5972	200.00	170.36	167.58	1.65
183.15	.8717	20.00	143.28	143.70	-.29
223.15	.1588	200.00	211.64	214.49	-1.32
223.15	.3036	80.00	162.05	163.72	-1.02
223.15	.5972	300.00	193.68	196.21	-1.29
223.15	.7460	400.00	193.79	196.66	-1.46
223.15	.8717	400.00	181.71	184.95	-1.75
273.15	.1588	200.00	219.04	216.43	1.20
273.15	.3036	500.00	284.44	282.09	.83
273.15	.4550	500.00	258.25	255.79	.96
273.15	.5972	300.00	211.43	210.78	.30
273.15	.7460	400.00	210.07	212.15	-.98
273.15	.8717	500.00	206.31	209.40	-1.47
273.15	.9475	500.00	198.75	201.22	-1.23
323.15	.1588	500.00	303.19	300.56	.87
323.15	.5972	200.00	217.18	218.92	-.79
323.15	.8717	400.00	220.18	222.71	-1.13
		KESTIN, KOBAYASHI, AND WOOD (39)			
293.15	0.2051	2.44	181.20	180.94	0.14
293.15	.2749	25.49	185.56	185.32	.12
293.15	.4995	22.91	190.90	190.69	.10
293.15	.7100	5.00	195.62	195.40	.11
293.15	.8318	5.03	198.00	197.59	.20
293.15	.8692	25.29	198.60	198.04	.28
293.15	.9639	5.01	197.44	196.88	.28
303.15	.2051	5.01	186.12	185.78	.17
303.15	.2749	24.87	190.19	189.74	.23
303.15	.4995	14.69	195.08	194.71	.18
303.15	.6871	4.16	199.73	199.40	.16
303.15	.8314	4.52	202.50	202.13	.18
303.15	.8318	25.16	203.01	202.40	.29
303.15	.8692	24.82	203.52	202.56	.47
303.15	.9639	4.99	202.06	201.37	.34
		MAKAVETSKAS AND OTHERS (54)			
284.65	0.4350	11.32	181.33	184.15	-1.53
285.55	.5880	200.73	202.02	204.49	-1.20
285.55	.7780	193.96	204.76	201.07	1.83
286.95	.2220	155.92	207.31	205.60	.83
588.75	.2220	218.93	313.32	309.86	1.11
590.15	.5880	15.10	301.06	309.01	-2.57
604.05	.7780	11.32	313.72	319.66	-1.86
604.75	.4350	11.32	295.77	308.14	-4.01
822.75	.7780	120.21	385.89	392.36	-1.65
873.15	.5880	226.09	394.42	402.04	-1.89
901.55	.2220	174.70	396.29	393.31	.75
952.55	.4350	12.49	394.33	411.70	-4.21

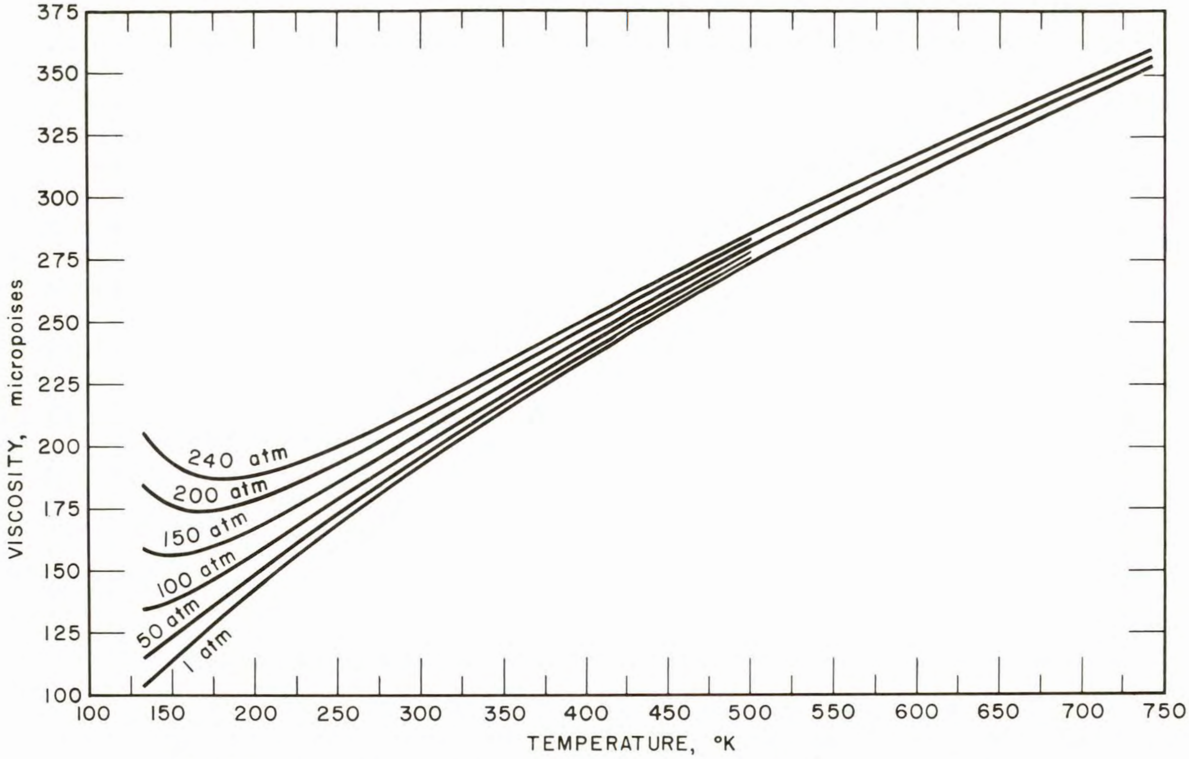

FIGURE 9. - Viscosity of a 0.5000 Helium-0.5000 Nitrogen Mixture.

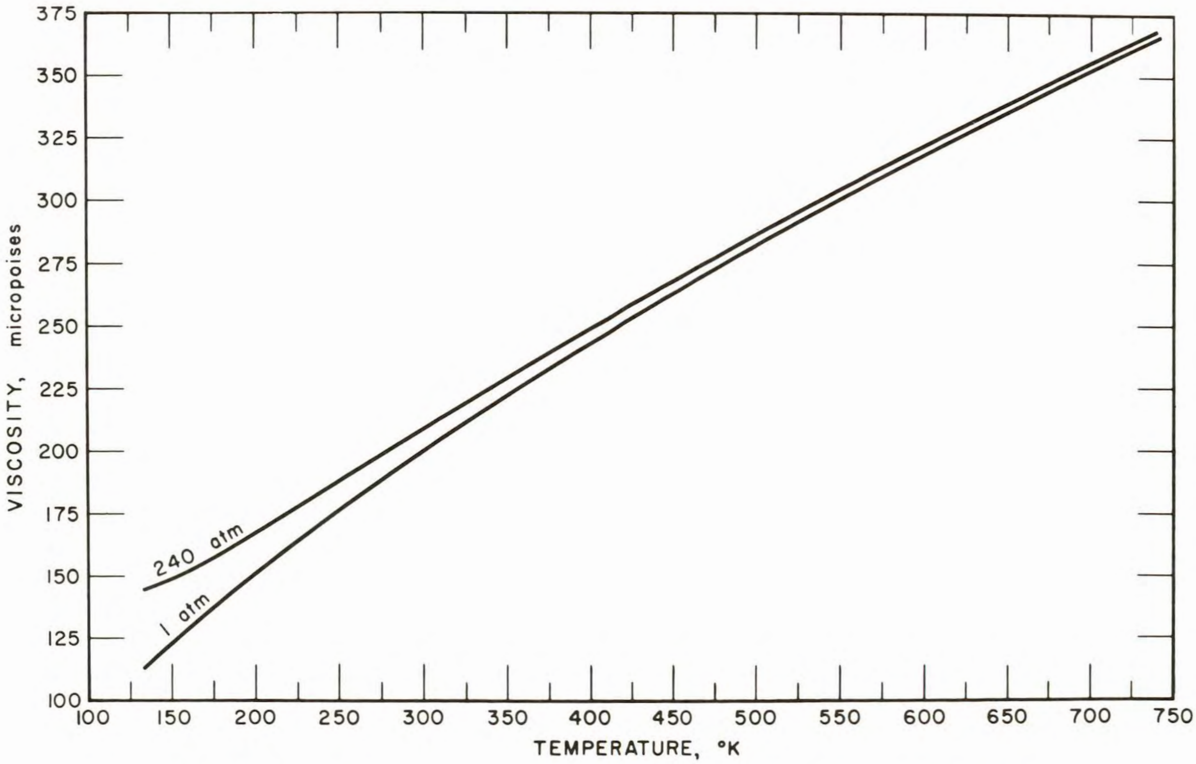

FIGURE 10. - Viscosity of a 0.8000 Helium-0.2000 Nitrogen Mixture.

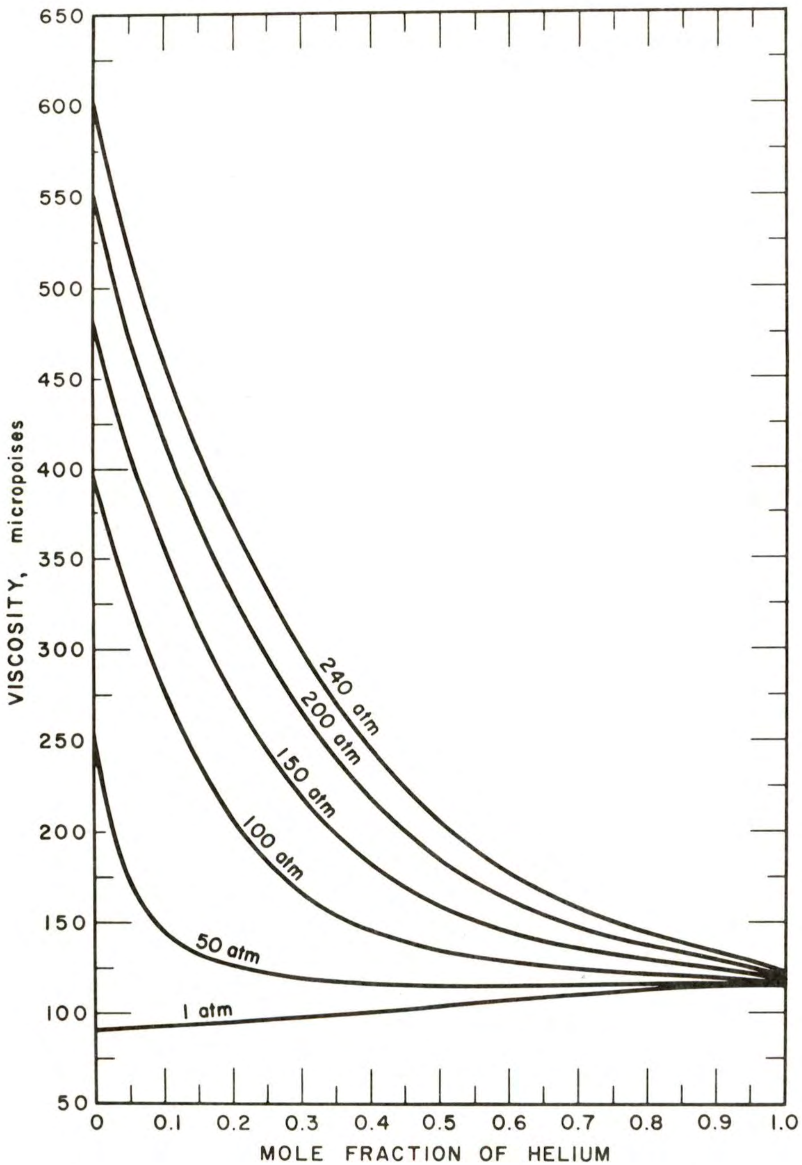

FIGURE 11. - Viscosity of the Helium-Nitrogen System at 133° K.

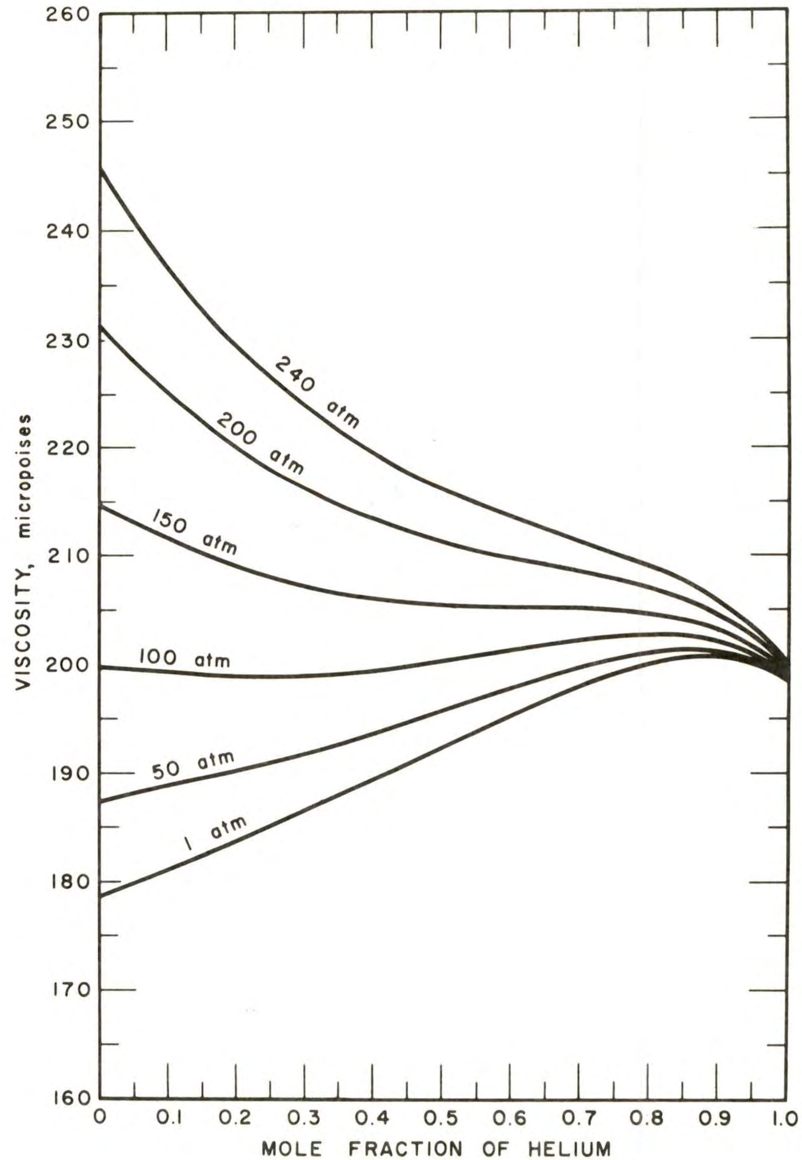

FIGURE 12. - Viscosity of the Helium-Nitrogen System at 300° K.

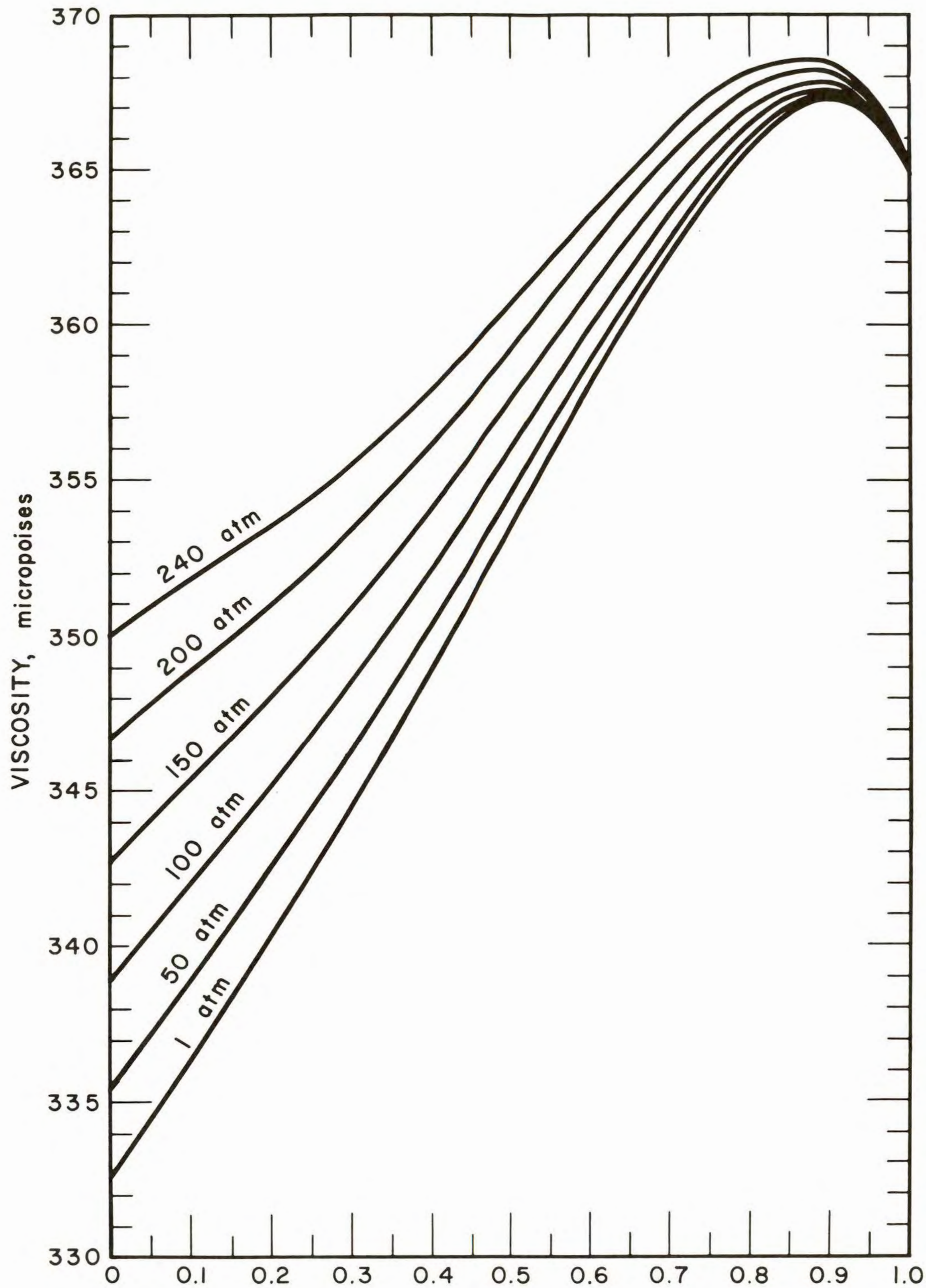

FIGURE 13. - Viscosity of the Helium-Nitrogen System at 740° K.

COMPUTER PROGRAM FOR CALCULATING VISCOSITY COEFFICIENT TABLES

Viscosity coefficients for helium, nitrogen, and 13 helium-nitrogen mixtures are presented in tables 5-19 for 110 temperatures in the region 133° to 740° K, and for 49 pressures from 1 to 240 atmospheres at increments of 5 atmospheres for pressures greater than 5 atmospheres.

Computing thermal pressure coefficients from the Leiden form of the virial equation of state is a labor laborious task because of the iteration methods required for solution. The computed viscosities are presented at temperature, pressure, and composition intervals in tables 5-19 to facilitate simple interpolation and should be adequate for most problems involving viscosity coefficients. However, for extensive heat transfer or pressure drop calculations, it is not always profitable to look up values from tables; it may be more expedient to solve certain problems with a digital computer.

The computer source program used in this work to produce tables 5-19 is presented, and with minor modifications, it can be used to compute viscosities and Reynolds numbers in more complex heat transfer and pressure drop problems. The computer program is written for an IBM 1620-II computer[4] (40,000 core storage) with the Fortran II programing system. The following definitions are required to locate input data and to modify the source program.

Dimension Statement

BN(14), CN(13), DN(7), and EN(8) allocate storage for the constants $n_1 - n_{42}$ in equations 29-41 used to compute the composition dependency of the second, third, fourth, and fifth virial coefficients which are subsequently used in equations 25-28 to compute the temperature dependency of the virial coefficients.

Numerical values for $n_1 - n_{42}$ are presented in table 1, and this ordered list of quantities is transmitted and stored for program execution. See READ 5001, list. X(21) provides storage for iterations in the Newton-Raphson DO loop. V(1127) is a 49 by 23 array for storage of 49 pressures, and the remaining elements of this two-dimensional array are for the storage of computed viscosity coefficients. TEMP(22) allocates storage for 22 temperatures for one page of output. See READ 901, XHE, MINT, INC. XHE, MINT, and INC are the mole fraction of helium, the minimum temperature on a given page of output, and the temperature increment on a given page of output, respectively. PP(49) allocates storage for 49 pressures, 1., 5., and so forth at intervals of 5. to 240. transmitted to the program in 16F5.0 format.

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[4] Reference to specific models of equipment is made for identification only and does not imply endorsement by the Bureau of Mines.

TABLE 5. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 1.0000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	114	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126
5	114	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126
10	114	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126
15	114	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126
20	114	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126
25	114	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126
30	115	115	116	116	117	117	118	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126
35	115	115	116	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126
40	115	115	116	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126
45	115	115	116	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	127
50	115	115	116	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	127
55	115	115	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	124	125	126	126	127
60	115	116	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127
65	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127
70	115	116	116	117	117	118	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127
75	115	116	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127
80	115	116	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	126	127
85	115	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	124	125	125	126	127	127
90	116	116	117	117	118	118	119	120	120	121	121	122	122	123	123	124	124	125	126	126	127	127
95	116	116	117	117	118	119	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127
100	116	116	117	118	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	127
105	116	117	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	126	127	128
110	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128
115	116	117	117	118	119	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128
120	116	117	118	118	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128
125	117	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	126	127	127	128
130	117	117	118	118	119	120	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128
135	117	118	118	119	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128
140	117	118	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	127	128	128
145	117	118	118	119	119	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	129
150	118	118	119	119	120	120	121	121	122	122	123	123	124	124	125	126	126	127	127	128	128	129
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165	118	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129
170	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129
175	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129
180	119	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128	129	129	130
185	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130
190	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130
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230	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132
235	122	122	123	123	124	124	125	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132
240	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132

TABLE 5. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 1.0000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	127	128	130	131	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150
5	127	128	130	131	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150
10	127	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150
15	127	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150
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25	127	129	130	131	132	133	134	135	136	137	138	139	140	141	142	144	145	146	147	148	149	150
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195	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
200	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
205	132	133	134	135	136	137	138	139	140	141	142	143	144	144	145	146	147	148	149	150	151	152
210	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	151	152
215	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
220	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
225	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
230	133	134	135	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
235	133	134	135	136	137	138	139	140	141	142	142	143	144	145	146	147	148	149	150	151	152	153
240	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	147	148	149	150	151	152	153

TABLE 5. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 1.0000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
5	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
10	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
15	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
20	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
25	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
30	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
35	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	191	194	196	198	200
40	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	191	194	196	198	200
45	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	191	194	196	198	200
50	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	200
55	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	200
60	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201
65	151	154	156	159	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201
70	151	154	156	159	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201
75	151	154	156	159	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201
80	151	154	156	159	161	164	166	168	171	173	176	178	180	183	185	187	189	192	194	196	198	201
85	151	154	156	159	161	164	166	168	171	173	176	178	180	183	185	187	189	192	194	196	198	201
90	151	154	156	159	161	164	166	168	171	173	176	178	180	183	185	187	189	192	194	196	198	201
95	151	154	156	159	161	164	166	168	171	173	176	178	180	183	185	187	189	192	194	196	198	201
100	151	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	198	201
105	151	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201
110	152	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201
115	152	154	157	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201
120	152	154	157	159	162	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201
125	152	154	157	159	162	164	166	169	171	174	176	178	181	183	185	187	190	192	194	196	199	201
130	152	154	157	159	162	164	166	169	171	174	176	178	181	183	185	187	190	192	194	196	199	201
135	152	154	157	159	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201
140	152	154	157	159	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201
145	152	155	157	159	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201
150	152	155	157	160	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201
155	152	155	157	160	162	164	167	169	172	174	176	179	181	183	185	188	190	192	194	197	199	201
160	152	155	157	160	162	164	167	169	172	174	176	179	181	183	185	188	190	192	194	197	199	201
165	152	155	157	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	195	197	199	201
170	153	155	157	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	195	197	199	201
175	153	155	158	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	195	197	199	201
180	153	155	158	160	162	165	167	170	172	174	177	179	181	183	186	188	190	192	195	197	199	201
185	153	155	158	160	163	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197	199	201
190	153	155	158	160	163	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197	199	201
195	153	155	158	160	163	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197	199	201
200	153	156	158	160	163	165	168	170	172	175	177	179	181	184	186	188	190	193	195	197	199	202
205	153	156	158	161	163	165	168	170	172	175	177	179	181	184	186	188	191	193	195	197	199	202
210	153	156	158	161	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	199	202
215	154	156	158	161	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	199	202
220	154	156	158	161	163	166	168	170	173	175	177	179	182	184	186	188	191	193	195	197	200	202
225	154	156	159	161	163	166	168	170	173	175	177	180	182	184	186	189	191	193	195	197	200	202
230	154	156	159	161	163	166	168	170	173	175	177	180	182	184	186	189	191	193	195	197	200	202
235	154	156	159	161	164	166	168	171	173	175	177	180	182	184	186	189	191	193	195	198	200	202
240	154	157	159	161	164	166	168	171	173	175	177	180	182	184	187	189	191	193	195	198	200	202

TABLE 5. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 1.0000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
5	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
10	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
15	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
20	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
25	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
30	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
35	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
40	203	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287
45	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	264	268	272	276	280	284	287
50	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	264	268	272	276	280	284	287
55	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
60	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
65	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
70	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
75	203	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
80	203	207	212	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
85	203	207	212	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
90	203	207	212	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
95	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
100	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
105	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
110	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287
115	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
120	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
125	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
130	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
135	203	207	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
140	203	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
145	203	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
150	203	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	288
155	203	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	288
160	203	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	288
165	203	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	288
170	203	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
175	203	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
180	203	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
185	204	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
190	204	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
195	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
200	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
205	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
210	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288
215	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	277	280	284	288
220	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	277	280	284	288
225	204	208	213	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	277	280	284	288
230	204	208	213	217	221	225	229	233	237	242	246	250	253	257	261	265	269	273	277	280	284	288
235	204	208	213	217	221	225	229	233	238	242	246	250	253	257	261	265	269	273	277	280	284	288
240	204	208	213	217	221	225	229	233	238	242	246	250	254	257	261	265	269	273	277	280	284	288

TABLE 5. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 1.0000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
5	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
10	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
15	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
20	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
25	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
30	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
35	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
40	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
45	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
50	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
55	291	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364
60	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	364
65	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
70	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
75	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
80	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
85	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
90	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
95	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	365
100	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	355	358	361	365
105	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	355	358	361	365
110	291	295	298	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	355	358	361	365
115	291	295	298	302	306	309	313	317	320	324	327	331	334	337	341	344	348	351	355	358	361	365
120	291	295	298	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
125	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
130	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
135	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
140	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
145	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
150	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
155	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
160	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
165	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
170	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
175	291	295	299	302	306	309	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
180	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
185	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
190	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365
195	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
200	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
205	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
210	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
215	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
220	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
225	291	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
230	292	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
235	292	295	299	302	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365
240	292	295	299	303	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365

TABLE 6. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9500

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	115	115	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127
5	115	115	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127
10	115	115	116	117	117	118	118	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127
15	115	116	116	117	117	118	118	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127
20	115	116	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127
25	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127	127
30	115	116	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127	127
35	115	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127	127
40	115	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	128
45	116	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	128
50	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	127	127	128
55	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	124	125	126	126	127	127	128
60	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128
65	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	128	128
70	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127	127	128	128
75	117	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128
80	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	128	128	129
85	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129
90	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128	129
95	118	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	128	128	129	129
100	118	118	119	120	120	121	121	122	122	123	123	124	124	125	126	126	127	127	128	128	129	129
105	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	127	128	128	129	130
110	118	119	119	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130
115	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	128	129	129	130
120	119	119	120	121	121	122	122	123	123	124	124	125	125	126	126	127	128	128	129	129	130	130
125	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130
130	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	128	128	129	129	130	130	131
135	120	120	121	121	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131
140	120	121	121	122	122	123	123	124	124	125	125	126	126	127	128	128	129	129	130	130	131	131
145	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131
150	121	121	122	122	123	123	124	124	125	126	126	127	127	128	128	129	129	130	130	131	131	132
155	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132
160	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132
165	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132
170	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133
175	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133
180	123	124	124	125	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133
185	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134
190	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	133	134
195	124	125	125	126	126	127	127	128	128	129	129	129	130	130	131	131	132	132	133	133	134	134
200	125	125	126	126	127	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134	134	135
205	125	126	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	133	134	134	135
210	126	126	126	127	127	128	128	129	129	130	130	131	131	132	132	132	133	133	134	134	135	135
215	126	126	127	127	128	128	129	129	130	130	130	131	131	132	132	133	133	134	134	135	135	136
220	126	127	127	128	128	129	129	130	130	130	131	131	132	132	133	133	134	134	135	135	135	136
225	127	127	128	128	129	129	129	130	130	131	131	132	132	133	133	134	134	134	135	135	136	136
230	127	128	128	129	129	129	130	130	131	131	132	132	133	133	133	134	134	135	135	136	136	137
235	128	128	129	129	129	130	130	131	131	132	132	133	133	133	134	134	135	135	136	136	137	137
240	128	129	129	130	130	130	131	131	132	132	132	133	133	134	134	135	135	136	136	136	137	137

TABLE 6. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9500

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	128	129	130	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150	151
5	128	129	130	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150	151
10	128	129	130	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150	151
15	128	129	130	132	133	134	135	136	137	138	139	140	141	142	144	145	146	147	148	149	150	151
20	128	129	131	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151
25	128	129	131	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151
30	128	130	131	132	133	134	135	136	137	138	139	140	142	143	144	145	146	147	148	149	150	151
35	129	130	131	132	133	134	135	136	137	138	139	141	142	143	144	145	146	147	148	149	150	151
40	129	130	131	132	133	134	135	136	137	138	140	141	142	143	144	145	146	147	148	149	150	151
45	129	130	131	132	133	134	135	136	137	139	140	141	142	143	144	145	146	147	148	149	150	151
50	129	130	131	132	133	134	135	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
55	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
60	129	130	131	132	133	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
65	129	130	131	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	152
70	129	130	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	148	149	150	151	152
75	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	146	147	148	149	150	151	152
80	130	131	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151	152
85	130	131	132	133	134	135	136	137	138	140	141	142	143	144	145	146	147	148	149	150	151	152
90	130	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
95	130	131	132	133	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
100	130	131	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
105	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
110	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	148	149	150	151	152	153
115	131	132	133	134	135	136	137	138	139	140	142	143	144	145	146	147	148	149	150	151	152	153
120	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
125	131	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
130	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
135	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
140	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
145	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
150	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
155	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
160	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
165	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
170	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	154
175	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
180	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
185	135	136	137	138	139	140	141	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
190	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	149	150	151	152	153	154	155
195	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	154	155
200	136	137	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
205	136	137	138	139	140	141	142	143	143	144	145	146	147	148	149	150	151	152	153	154	155	156
210	136	137	138	139	140	141	142	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156
215	137	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	153	154	155	156
220	137	138	139	140	141	142	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
225	137	138	139	140	141	142	143	144	145	146	146	147	148	149	150	151	152	153	154	155	156	157
230	138	138	139	140	141	142	143	144	145	146	147	148	149	150	150	151	152	153	154	155	156	157
235	138	139	140	141	142	142	143	144	145	146	147	148	149	150	151	152	153	153	154	155	156	157
240	138	139	140	141	142	143	144	145	145	146	147	148	149	150	151	152	153	154	155	156	156	157

TABLE 6. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9500

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	152	154	157	159	162	164	167	169	172	174	177	179	181	184	186	188	191	193	195	198	200	202
5	152	154	157	159	162	164	167	169	172	174	177	179	181	184	186	188	191	193	195	198	200	202
10	152	154	157	160	162	165	167	169	172	174	177	179	181	184	186	188	191	193	195	198	200	202
15	152	154	157	160	162	165	167	169	172	174	177	179	181	184	186	188	191	193	195	198	200	202
20	152	155	157	160	162	165	167	169	172	174	177	179	181	184	186	188	191	193	195	198	200	202
25	152	155	157	160	162	165	167	170	172	174	177	179	181	184	186	188	191	193	195	198	200	202
30	152	155	157	160	162	165	167	170	172	174	177	179	182	184	186	189	191	193	195	198	200	202
35	152	155	157	160	162	165	167	170	172	174	177	179	182	184	186	189	191	193	195	198	200	202
40	152	155	157	160	162	165	167	170	172	174	177	179	182	184	186	189	191	193	195	198	200	202
45	152	155	157	160	162	165	167	170	172	175	177	179	182	184	186	189	191	193	195	198	200	202
50	152	155	157	160	162	165	167	170	172	175	177	179	182	184	186	189	191	193	196	198	200	202
55	152	155	157	160	162	165	167	170	172	175	177	179	182	184	186	189	191	193	196	198	200	202
60	152	155	158	160	163	165	167	170	172	175	177	179	182	184	186	189	191	193	196	198	200	202
65	153	155	158	160	163	165	168	170	172	175	177	179	182	184	187	189	191	193	196	198	200	202
70	153	155	158	160	163	165	168	170	172	175	177	180	182	184	187	189	191	193	196	198	200	202
75	153	155	158	160	163	165	168	170	172	175	177	180	182	184	187	189	191	193	196	198	200	202
80	153	155	158	160	163	165	168	170	173	175	177	180	182	184	187	189	191	194	196	198	200	203
85	153	155	158	160	163	165	168	170	173	175	177	180	182	184	187	189	191	194	196	198	200	203
90	153	156	158	161	163	165	168	170	173	175	177	180	182	185	187	189	191	194	196	198	200	203
95	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200	203
100	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201	203
105	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201	203
110	154	156	159	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201	203
115	154	156	159	161	164	166	168	171	173	176	178	180	183	185	187	189	192	194	196	198	201	203
120	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201	203
125	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201	203
130	154	157	159	162	164	166	169	171	174	176	178	181	183	185	187	190	192	194	196	199	201	203
135	154	157	159	162	164	166	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201	203
140	154	157	159	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201	203
145	155	157	159	162	164	167	169	171	174	176	179	181	183	185	188	190	192	194	197	199	201	203
150	155	157	160	162	164	167	169	172	174	176	179	181	183	186	188	190	192	195	197	199	201	203
155	155	157	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	195	197	199	201	204
160	155	158	160	162	165	167	170	172	174	177	179	181	183	186	188	190	193	195	197	199	201	204
165	155	158	160	163	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197	199	201	204
170	155	158	160	163	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197	199	202	204
175	156	158	160	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	199	202	204
180	156	158	161	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	200	202	204
185	156	158	161	163	166	168	170	173	175	177	179	182	184	186	189	191	193	195	197	200	202	204
190	156	159	161	163	166	168	170	173	175	177	180	182	184	186	189	191	193	195	198	200	202	204
195	156	159	161	164	166	168	171	173	175	177	180	182	184	187	189	191	193	195	198	200	202	204
200	157	159	161	164	166	168	171	173	175	178	180	182	184	187	189	191	193	196	198	200	202	204
205	157	159	162	164	166	169	171	173	175	178	180	182	185	187	189	191	193	196	198	200	202	204
210	157	159	162	164	166	169	171	173	176	178	180	182	185	187	189	191	194	196	198	200	202	205
215	157	160	162	164	167	169	171	173	176	178	180	183	185	187	189	191	194	196	198	200	202	205
220	157	160	162	164	167	169	171	174	176	178	180	183	185	187	189	192	194	196	198	200	203	205
225	158	160	162	165	167	169	171	174	176	178	181	183	185	187	190	192	194	196	198	200	203	205
230	158	160	162	165	167	169	172	174	176	178	181	183	185	187	190	192	194	196	198	201	203	205
235	158	160	163	165	167	170	172	174	176	179	181	183	185	188	190	192	194	196	199	201	203	205
240	158	161	163	165	167	170	172	174	177	179	181	183	185	188	190	192	194	196	199	201	203	205

TABLE 6. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9500

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	204	209	213	217	222	226	230	234	238	242	247	251	255	259	262	266	270	274	278	282	285	289
5	204	209	213	217	222	226	230	234	238	243	247	251	255	259	262	266	270	274	278	282	285	289
10	204	209	213	217	222	226	230	234	238	243	247	251	255	259	262	266	270	274	278	282	285	289
15	204	209	213	217	222	226	230	234	238	243	247	251	255	259	262	266	270	274	278	282	285	289
20	204	209	213	217	222	226	230	234	238	243	247	251	255	259	262	266	270	274	278	282	285	289
25	204	209	213	217	222	226	230	234	238	243	247	251	255	259	263	266	270	274	278	282	286	289
30	204	209	213	217	222	226	230	234	238	243	247	251	255	259	263	266	270	274	278	282	286	289
35	204	209	213	217	222	226	230	234	238	243	247	251	255	259	263	266	270	274	278	282	286	289
40	204	209	213	218	222	226	230	234	239	243	247	251	255	259	263	266	270	274	278	282	286	289
45	204	209	213	218	222	226	230	234	239	243	247	251	255	259	263	266	270	274	278	282	286	289
50	204	209	213	218	222	226	230	234	239	243	247	251	255	259	263	266	270	274	278	282	286	289
55	205	209	213	218	222	226	230	234	239	243	247	251	255	259	263	266	270	274	278	282	286	289
60	205	209	213	218	222	226	230	234	239	243	247	251	255	259	263	267	270	274	278	282	286	289
65	205	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	270	274	278	282	286	289
70	205	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	270	274	278	282	286	289
75	205	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	270	274	278	282	286	289
80	205	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	270	274	278	282	286	289
85	205	209	214	218	222	226	230	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
90	205	209	214	218	222	226	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
95	205	209	214	218	222	226	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
100	205	209	214	218	222	226	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	290
105	205	209	214	218	222	226	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	290
110	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	290
115	205	210	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
120	205	210	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
125	205	210	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
130	205	210	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
135	205	210	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
140	205	210	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
145	206	210	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	282	286	290
150	206	210	214	219	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	282	286	290
155	206	210	214	219	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	282	286	290
160	206	210	214	219	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	282	286	290
165	206	210	214	219	223	227	231	235	239	244	248	252	255	259	263	267	271	275	279	282	286	290
170	206	210	215	219	223	227	231	235	240	244	248	252	256	259	263	267	271	275	279	282	286	290
175	206	210	215	219	223	227	231	236	240	244	248	252	256	260	263	267	271	275	279	282	286	290
180	206	210	215	219	223	227	231	236	240	244	248	252	256	260	263	267	271	275	279	283	286	290
185	206	211	215	219	223	227	232	236	240	244	248	252	256	260	263	267	271	275	279	283	286	290
190	206	211	215	219	223	227	232	236	240	244	248	252	256	260	264	267	271	275	279	283	286	290
195	206	211	215	219	223	228	232	236	240	244	248	252	256	260	264	267	271	275	279	283	286	290
200	206	211	215	219	223	228	232	236	240	244	248	252	256	260	264	267	271	275	279	283	286	290
205	207	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	271	275	279	283	286	290
210	207	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	271	275	279	283	287	290
215	207	211	215	220	224	228	232	236	240	244	248	252	256	260	264	268	271	275	279	283	287	290
220	207	211	215	220	224	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
225	207	211	215	220	224	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
230	207	211	216	220	224	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
235	207	211	216	220	224	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
240	207	212	216	220	224	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	290

TABLE 6. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9500

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
5	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
10	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
15	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
20	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
25	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
30	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
35	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
40	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
45	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
50	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
55	293	297	300	304	308	311	315	318	322	325	329	332	336	339	343	346	350	353	356	360	363	366
60	293	297	300	304	308	311	315	318	322	326	329	333	336	339	343	346	350	353	356	360	363	366
65	293	297	300	304	308	311	315	318	322	326	329	333	336	339	343	346	350	353	356	360	363	366
70	293	297	300	304	308	311	315	318	322	326	329	333	336	339	343	346	350	353	356	360	363	366
75	293	297	300	304	308	311	315	318	322	326	329	333	336	339	343	346	350	353	356	360	363	366
80	293	297	300	304	308	311	315	319	322	326	329	333	336	339	343	346	350	353	356	360	363	366
85	293	297	301	304	308	311	315	319	322	326	329	333	336	339	343	346	350	353	356	360	363	366
90	293	297	301	304	308	311	315	319	322	326	329	333	336	340	343	346	350	353	356	360	363	366
95	293	297	301	304	308	311	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
100	293	297	301	304	308	311	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
105	293	297	301	304	308	311	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
110	293	297	301	304	308	311	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
115	293	297	301	304	308	311	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
120	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
125	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
130	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
135	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	346	350	353	357	360	363	367
140	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
145	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
150	293	297	301	304	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
155	294	297	301	304	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
160	294	297	301	305	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
165	294	297	301	305	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
170	294	297	301	305	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
175	294	297	301	305	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
180	294	297	301	305	308	312	315	319	322	326	329	333	336	340	343	347	350	353	357	360	363	367
185	294	297	301	305	308	312	315	319	323	326	330	333	336	340	343	347	350	353	357	360	363	367
190	294	297	301	305	308	312	315	319	323	326	330	333	336	340	343	347	350	353	357	360	364	367
195	294	297	301	305	308	312	315	319	323	326	330	333	336	340	343	347	350	354	357	360	364	367
200	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
205	294	298	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
210	294	298	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
215	294	298	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
220	294	298	301	305	309	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
225	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
230	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
235	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
240	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367

TABLE 7. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127
5	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127
10	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	124	124	125	125	126	126	127
15	115	115	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	127	127
20	115	115	116	117	117	118	118	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127
25	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127	127
30	115	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127	127
35	115	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	128
40	116	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	126	126	127	127	128
45	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128
50	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	128	128
55	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127	127	128	128
60	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	129
65	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127	128	128	129
70	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128	129
75	118	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127	128	128	129	129
80	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128	129	130
85	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130
90	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	128	129	130	130
95	119	119	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130	130
100	119	120	120	121	121	122	123	123	124	124	125	125	126	126	127	127	128	128	129	130	130	131
105	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128	129	129	130	130	131
110	120	121	121	122	122	123	123	124	124	125	125	126	126	127	128	128	129	129	130	130	131	131
115	120	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	131	131	132
120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132
125	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130	130	131	131	132	132
130	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	131	131	132	132	133
135	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133
140	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133
145	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134
150	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	133	134
155	124	125	125	126	126	127	127	128	128	128	129	129	130	130	131	131	132	132	133	133	134	134
160	125	125	126	126	127	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134	134	135
165	125	126	126	127	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134	134	135	135
170	126	126	127	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134	134	135	135	136
175	126	127	127	128	128	128	129	129	130	130	131	131	132	132	133	133	134	134	135	135	135	136
180	127	127	128	128	128	129	129	130	130	131	131	132	132	133	133	134	134	134	135	135	136	136
185	127	128	128	129	129	129	130	130	131	131	132	132	133	133	134	134	134	135	135	136	136	137
190	128	128	129	129	130	130	130	131	131	132	132	133	133	134	134	134	135	135	136	136	137	137
195	128	129	129	130	130	130	131	131	132	132	133	133	134	134	134	135	135	136	136	137	137	138
200	129	129	130	130	131	131	131	132	132	133	133	134	134	135	135	135	136	136	137	137	138	138
205	129	130	130	131	131	132	132	132	133	133	134	134	135	135	135	136	136	137	137	138	138	139
210	130	130	131	131	132	132	133	133	133	134	134	135	135	135	136	136	137	137	138	138	139	139
215	131	131	131	132	132	133	133	133	134	134	135	135	136	136	136	137	137	138	138	139	139	139
220	131	132	132	132	133	133	134	134	134	135	135	136	136	137	137	137	138	138	139	139	139	140
225	132	132	133	133	133	134	134	134	135	135	135	136	136	137	137	137	138	138	139	139	140	140
230	132	133	133	134	134	134	135	135	136	136	136	137	137	138	138	138	139	139	140	140	140	141
235	133	133	134	134	135	135	135	136	136	136	137	137	138	138	138	139	139	140	140	141	141	141
240	134	134	134	135	135	136	136	136	137	137	137	138	138	139	139	139	140	140	141	141	141	142

TABLE 7. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	128	129	130	131	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151
5	128	129	130	131	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151
10	128	129	130	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151
15	128	129	131	132	133	134	135	136	137	138	139	140	142	143	144	145	146	147	148	149	150	151
20	128	129	131	132	133	134	135	136	137	138	139	141	142	143	144	145	146	147	148	149	150	151
25	128	130	131	132	133	134	135	136	137	138	140	141	142	143	144	145	146	147	148	149	150	151
30	129	130	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151
35	129	130	131	132	133	134	135	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
40	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	150	151	152
45	129	130	131	132	134	135	136	137	138	139	140	141	142	143	144	145	146	148	149	150	151	152
50	129	130	131	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150	151	152
55	129	131	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151	152
60	130	131	132	133	134	135	136	137	138	139	141	142	143	144	145	146	147	148	149	150	151	152
65	130	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
70	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
75	130	131	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	151	152	153
80	131	132	133	134	135	136	137	138	139	140	141	142	143	144	146	147	148	149	150	151	152	153
85	131	132	133	134	135	136	137	138	139	140	142	143	144	145	146	147	148	149	150	151	152	153
90	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
95	131	132	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
100	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
105	132	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150	151	152	153	154
110	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
115	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
120	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
125	133	134	135	136	137	138	139	140	141	142	143	144	146	147	148	149	150	151	152	153	154	155
130	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
135	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
140	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
145	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	152	153	154	155
150	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
155	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
160	136	137	138	139	140	141	142	143	144	145	146	146	147	148	149	150	151	152	153	154	155	156
165	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	155	156
170	137	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
175	137	138	139	140	141	142	143	144	145	146	146	147	148	149	150	151	152	153	154	155	156	157
180	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	152	153	154	155	156	157
185	138	139	140	141	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	157
190	138	139	140	141	142	143	144	145	146	147	147	148	149	150	151	152	153	154	155	156	157	158
195	139	139	140	141	142	143	144	145	146	147	148	149	150	151	152	152	153	154	155	156	157	158
200	139	140	141	142	143	144	144	145	146	147	148	149	150	151	152	153	154	155	156	156	157	158
205	139	140	141	142	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156	157	158	159
210	140	141	142	143	143	144	145	146	147	148	149	150	151	152	153	153	154	155	156	157	158	159
215	140	141	142	143	144	145	146	147	147	148	149	150	151	152	153	154	155	156	156	157	158	159
220	141	142	143	143	144	145	146	147	148	149	150	150	151	152	153	154	155	156	157	158	159	160
225	141	142	143	144	145	146	146	147	148	149	150	151	152	153	154	154	155	156	157	158	159	160
230	142	143	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156	157	157	158	159	160
235	142	143	144	145	146	146	147	148	149	150	151	152	152	153	154	155	156	157	158	159	160	160
240	143	143	144	145	146	147	148	149	149	150	151	152	153	154	155	155	156	157	158	159	160	161

TABLE 7. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	200	203
5	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	200	203
10	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	200	203
15	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	200	203
20	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	201	203
25	152	155	157	160	163	165	168	170	172	175	177	180	182	184	187	189	191	194	196	198	201	203
30	152	155	158	160	163	165	168	170	173	175	177	180	182	185	187	189	191	194	196	198	201	203
35	153	155	158	160	163	165	168	170	173	175	177	180	182	185	187	189	192	194	196	198	201	203
40	153	155	158	160	163	165	168	170	173	175	178	180	182	185	187	189	192	194	196	198	201	203
45	153	155	158	160	163	165	168	170	173	175	178	180	182	185	187	189	192	194	196	199	201	203
50	153	155	158	161	163	166	168	170	173	175	178	180	182	185	187	189	192	194	196	199	201	203
55	153	156	158	161	163	166	168	171	173	175	178	180	183	185	187	190	192	194	196	199	201	203
60	153	156	158	161	163	166	168	171	173	175	178	180	183	185	187	190	192	194	196	199	201	203
65	153	156	158	161	163	166	168	171	173	176	178	180	183	185	187	190	192	194	197	199	201	203
70	153	156	159	161	164	166	168	171	173	176	178	180	183	185	187	190	192	194	197	199	201	203
75	154	156	159	161	164	166	169	171	173	176	178	181	183	185	188	190	192	194	197	199	201	203
80	154	156	159	161	164	166	169	171	174	176	178	181	183	185	188	190	192	195	197	199	201	204
85	154	156	159	161	164	166	169	171	174	176	178	181	183	185	188	190	192	195	197	199	201	204
90	154	157	159	162	164	167	169	171	174	176	179	181	183	186	188	190	192	195	197	199	201	204
95	154	157	159	162	164	167	169	172	174	176	179	181	183	186	188	190	193	195	197	199	202	204
100	154	157	159	162	164	167	169	172	174	176	179	181	183	186	188	190	193	195	197	199	202	204
105	155	157	160	162	165	167	169	172	174	177	179	181	184	186	188	191	193	195	197	200	202	204
110	155	157	160	162	165	167	170	172	174	177	179	181	184	186	188	191	193	195	197	200	202	204
115	155	158	160	162	165	167	170	172	174	177	179	182	184	186	188	191	193	195	198	200	202	204
120	155	158	160	163	165	167	170	172	175	177	179	182	184	186	189	191	193	195	198	200	202	204
125	155	158	160	163	165	168	170	172	175	177	180	182	184	186	189	191	193	196	198	200	202	204
130	156	158	161	163	165	168	170	173	175	177	180	182	184	187	189	191	193	196	198	200	202	205
135	156	158	161	163	166	168	170	173	175	177	180	182	184	187	189	191	194	196	198	200	202	205
140	156	159	161	163	166	168	171	173	175	178	180	182	185	187	189	191	194	196	198	200	203	205
145	156	159	161	164	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	200	203	205
150	157	159	161	164	166	169	171	173	176	178	180	183	185	187	189	192	194	196	198	201	203	205
155	157	159	162	164	166	169	171	174	176	178	180	183	185	187	190	192	194	196	199	201	203	205
160	157	160	162	164	167	169	171	174	176	178	181	183	185	187	190	192	194	196	199	201	203	205
165	157	160	162	165	167	169	172	174	176	179	181	183	185	188	190	192	194	197	199	201	203	205
170	158	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	194	197	199	201	203	205
175	158	160	163	165	167	170	172	174	177	179	181	183	186	188	190	192	195	197	199	201	203	206
180	158	161	163	165	168	170	172	174	177	179	181	184	186	188	190	193	195	197	199	201	204	206
185	158	161	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	199	202	204	206
190	159	161	163	166	168	170	173	175	177	179	182	184	186	188	191	193	195	197	199	202	204	206
195	159	161	164	166	168	171	173	175	177	180	182	184	186	189	191	193	195	197	200	202	204	206
200	159	162	164	166	168	171	173	175	178	180	182	184	187	189	191	193	195	198	200	202	204	206
205	160	162	164	166	169	171	173	176	178	180	182	185	187	189	191	193	196	198	200	202	204	206
210	160	162	164	167	169	171	174	176	178	180	182	185	187	189	191	194	196	198	200	202	204	207
215	160	162	165	167	169	171	174	176	178	180	183	185	187	189	192	194	196	198	200	202	205	207
220	160	163	165	167	169	172	174	176	178	181	183	185	187	190	192	194	196	198	200	203	205	207
225	161	163	165	167	170	172	174	176	179	181	183	185	188	190	192	194	196	198	201	203	205	207
230	161	163	166	168	170	172	174	177	179	181	183	186	188	190	192	194	196	199	201	203	205	207
235	161	164	166	168	170	172	175	177	179	181	184	186	188	190	192	194	197	199	201	203	205	207
240	162	164	166	168	171	173	175	177	179	182	184	186	188	190	192	195	197	199	201	203	205	207

TABLE 7. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
5	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
10	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
15	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
20	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
25	205	209	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
30	205	210	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	283	286	290
35	205	210	214	218	223	227	231	235	239	243	247	252	256	259	263	267	271	275	279	283	286	290
40	205	210	214	218	223	227	231	235	239	243	248	252	256	260	263	267	271	275	279	283	286	290
45	205	210	214	218	223	227	231	235	239	244	248	252	256	260	263	267	271	275	279	283	286	290
50	205	210	214	218	223	227	231	235	239	244	248	252	256	260	263	267	271	275	279	283	286	290
55	205	210	214	218	223	227	231	235	240	244	248	252	256	260	264	267	271	275	279	283	286	290
60	205	210	214	219	223	227	231	235	240	244	248	252	256	260	264	267	271	275	279	283	287	290
65	206	210	214	219	223	227	231	235	240	244	248	252	256	260	264	267	271	275	279	283	287	290
70	206	210	214	219	223	227	231	236	240	244	248	252	256	260	264	268	271	275	279	283	287	290
75	206	210	214	219	223	227	231	236	240	244	248	252	256	260	264	268	271	275	279	283	287	290
80	206	210	215	219	223	227	231	236	240	244	248	252	256	260	264	268	271	275	279	283	287	290
85	206	210	215	219	223	227	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
90	206	210	215	219	223	227	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
95	206	210	215	219	223	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
100	206	210	215	219	223	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	291
105	206	211	215	219	223	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	291
110	206	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	291
115	206	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	291
120	206	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	291
125	207	211	215	220	224	228	232	236	240	244	248	252	256	260	264	268	272	276	280	283	287	291
130	207	211	215	220	224	228	232	236	240	244	248	252	256	260	264	268	272	276	280	283	287	291
135	207	211	215	220	224	228	232	236	240	245	249	253	257	260	264	268	272	276	280	283	287	291
140	207	211	216	220	224	228	232	236	241	245	249	253	257	260	264	268	272	276	280	283	287	291
145	207	211	216	220	224	228	232	237	241	245	249	253	257	261	264	268	272	276	280	284	287	291
150	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287	291
155	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287	291
160	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287	291
165	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287	291
170	208	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	288	291
175	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288	291
180	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288	291
185	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288	291
190	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	277	280	284	288	291
195	208	213	217	221	225	229	233	237	242	246	250	253	257	261	265	269	273	277	280	284	288	291
200	208	213	217	221	225	229	234	238	242	246	250	254	257	261	265	269	273	277	280	284	288	292
205	209	213	217	221	225	230	234	238	242	246	250	254	258	261	265	269	273	277	280	284	288	292
210	209	213	217	221	226	230	234	238	242	246	250	254	258	262	265	269	273	277	281	284	288	292
215	209	213	217	221	226	230	234	238	242	246	250	254	258	262	265	269	273	277	281	284	288	292
220	209	213	217	222	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284	288	292
225	209	213	218	222	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284	288	292
230	209	214	218	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	285	288	292
235	209	214	218	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	285	288	292
240	210	214	218	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	285	288	292

TABLE 7. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.9000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
5	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
10	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
15	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
20	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
25	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
30	294	297	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
35	294	298	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
40	294	298	301	305	308	312	316	319	323	326	330	333	337	340	343	347	350	354	357	360	364	367
45	294	298	301	305	308	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
50	294	298	301	305	308	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
55	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
60	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
65	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
70	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
75	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
80	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	360	364	367
85	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	361	364	367
90	294	298	301	305	309	312	316	319	323	326	330	333	337	340	344	347	350	354	357	361	364	367
95	294	298	302	305	309	312	316	319	323	326	330	333	337	340	344	347	351	354	357	361	364	367
100	294	298	302	305	309	312	316	319	323	327	330	333	337	340	344	347	351	354	357	361	364	367
105	294	298	302	305	309	312	316	320	323	327	330	334	337	340	344	347	351	354	357	361	364	367
110	294	298	302	305	309	312	316	320	323	327	330	334	337	340	344	347	351	354	357	361	364	367
115	294	298	302	305	309	312	316	320	323	327	330	334	337	340	344	347	351	354	357	361	364	367
120	294	298	302	305	309	313	316	320	323	327	330	334	337	340	344	347	351	354	357	361	364	367
125	294	298	302	305	309	313	316	320	323	327	330	334	337	341	344	347	351	354	357	361	364	367
130	294	298	302	305	309	313	316	320	323	327	330	334	337	341	344	347	351	354	357	361	364	367
135	295	298	302	305	309	313	316	320	323	327	330	334	337	341	344	347	351	354	357	361	364	367
140	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	347	351	354	357	361	364	367
145	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	347	351	354	357	361	364	367
150	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	347	351	354	358	361	364	367
155	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	347	351	354	358	361	364	367
160	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364	368
165	295	298	302	306	309	313	316	320	323	327	330	334	337	341	344	348	351	354	358	361	364	368
170	295	299	302	306	309	313	316	320	324	327	331	334	337	341	344	348	351	354	358	361	364	368
175	295	299	302	306	309	313	317	320	324	327	331	334	337	341	344	348	351	354	358	361	364	368
180	295	299	302	306	309	313	317	320	324	327	331	334	337	341	344	348	351	354	358	361	364	368
185	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	354	358	361	364	368
190	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	354	358	361	364	368
195	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	364	368
200	295	299	302	306	310	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	364	368
205	295	299	303	306	310	313	317	320	324	327	331	334	338	341	344	348	351	355	358	361	365	368
210	295	299	303	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365	368
215	295	299	303	306	310	313	317	320	324	327	331	334	338	341	345	348	351	355	358	361	365	368
220	295	299	303	306	310	313	317	321	324	327	331	334	338	341	345	348	351	355	358	361	365	368
225	296	299	303	306	310	314	317	321	324	328	331	334	338	341	345	348	351	355	358	361	365	368
230	296	299	303	306	310	314	317	321	324	328	331	334	338	341	345	348	351	355	358	361	365	368
235	296	299	303	306	310	314	317	321	324	328	331	335	338	341	345	348	351	355	358	361	365	368
240	296	299	303	307	310	314	317	321	324	328	331	335	338	341	345	348	352	355	358	361	365	368

TABLE 8. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.8000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	113	113	114	114	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	125	125
5	113	113	114	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	124	124	125	125
10	113	113	114	115	115	116	117	117	118	118	119	120	120	121	121	122	123	123	124	124	125	125
15	113	114	114	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	124	125	126
20	113	114	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	124	124	125	125	126
25	114	114	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126
30	114	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	124	124	125	125	126	126
35	114	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127
40	115	115	116	117	117	118	118	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127
45	115	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126	127	127
50	116	116	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	126	126	127	127	128
55	116	117	117	118	119	119	120	120	121	121	122	123	123	124	124	125	125	126	127	127	128	128
60	117	117	118	118	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	129
65	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127	127	128	128	129
70	118	118	119	120	120	121	121	122	122	123	123	124	124	125	126	126	127	127	128	128	129	129
75	118	119	120	120	121	121	122	122	123	123	124	124	125	126	126	127	127	128	128	129	129	130
80	119	120	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130	130
85	120	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130	130	131
90	120	121	121	122	122	123	123	124	124	125	125	126	127	127	128	128	129	129	130	130	131	131
95	121	121	122	122	123	123	124	124	125	126	126	127	127	128	128	129	129	130	130	131	131	132
100	121	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132
105	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133
110	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133
115	124	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	134
120	124	125	125	126	126	127	127	128	128	129	129	129	130	130	131	131	132	132	133	133	134	134
125	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132	133	133	133	134	134	135
130	126	126	127	127	128	128	128	129	129	130	130	131	131	132	132	133	133	134	134	135	135	136
135	126	127	127	128	128	129	129	130	130	130	131	131	132	132	133	133	134	134	135	135	136	136
140	127	128	128	128	129	129	130	130	131	131	132	132	133	133	133	134	134	135	135	136	136	137
145	128	128	129	129	130	130	131	131	131	132	132	133	133	134	134	135	135	135	136	136	137	137
150	129	129	130	130	130	131	131	132	132	133	133	133	134	134	135	135	136	136	137	137	137	138
155	130	130	130	131	131	132	132	132	133	133	134	134	135	135	135	136	136	137	137	138	138	138
160	130	131	131	132	132	132	133	133	134	134	134	135	135	136	136	137	137	137	138	138	139	139
165	131	132	132	132	133	133	133	134	134	135	135	136	136	136	137	137	138	138	138	139	139	140
170	132	132	133	133	133	134	134	135	135	135	136	136	137	137	137	138	138	139	139	140	140	140
175	133	133	134	134	134	135	135	135	136	136	137	137	137	138	138	139	139	139	140	140	141	141
180	134	134	134	135	135	135	136	136	137	137	137	138	138	138	139	139	140	140	140	141	141	142
185	134	135	135	136	136	136	137	137	137	138	138	138	139	139	140	140	140	141	141	142	142	142
190	135	136	136	136	137	137	137	138	138	138	139	139	140	140	140	141	141	141	142	142	143	143
195	136	137	137	137	138	138	138	139	139	139	140	140	140	141	141	141	142	142	143	143	143	144
200	137	137	138	138	138	139	139	139	140	140	140	141	141	141	142	142	143	143	143	144	144	144
205	138	138	139	139	139	140	140	140	140	141	141	141	142	142	143	143	143	144	144	144	145	145
210	139	139	139	140	140	140	141	141	141	142	142	142	143	143	143	144	144	144	145	145	145	146
215	140	140	140	141	141	141	142	142	142	142	143	143	143	144	144	144	145	145	145	146	146	146
220	141	141	141	141	142	142	142	143	143	143	144	144	144	145	145	145	145	146	146	147	147	147
225	142	142	142	142	143	143	143	143	144	144	144	145	145	145	146	146	146	147	147	147	148	148
230	143	143	143	143	144	144	144	144	145	145	145	145	146	146	146	147	147	147	148	148	148	149
235	143	144	144	144	144	145	145	145	145	146	146	146	147	147	147	147	148	148	148	149	149	149
240	144	145	145	145	145	146	146	146	146	147	147	147	147	148	148	148	149	149	149	149	150	150

TABLE 8. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.8000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	126	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	147	148	149	150
5	126	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	146	147	148	149	150
10	127	128	129	130	131	132	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150
15	127	128	129	130	131	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150
20	127	128	129	130	132	133	134	135	136	137	138	139	141	142	143	144	145	146	147	148	149	150
25	127	128	130	131	132	133	134	135	136	137	139	140	141	142	143	144	145	146	147	148	149	150
30	128	129	130	131	132	133	134	135	137	138	139	140	141	142	143	144	145	146	147	149	150	151
35	128	129	130	131	132	134	135	136	137	138	139	140	141	142	143	144	146	147	148	149	150	151
40	128	129	130	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150	151
45	129	130	131	132	133	134	135	136	137	139	140	141	142	143	144	145	146	147	148	149	150	151
50	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	149	151	152
55	129	130	132	133	134	135	136	137	138	139	140	141	142	143	144	146	147	148	149	150	151	152
60	130	131	132	133	134	135	136	137	138	139	141	142	143	144	145	146	147	148	149	150	151	152
65	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
70	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	149	150	151	152	153
75	131	132	133	134	135	136	137	138	139	141	142	143	144	145	146	147	148	149	150	151	152	153
80	131	132	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
85	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	151	152	153	154
90	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
95	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
100	133	134	135	136	137	138	139	140	141	142	143	145	146	147	148	149	150	151	152	153	154	155
105	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
110	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
115	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
120	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156
125	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	151	152	153	154	155	156
130	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157
135	137	138	139	140	141	142	143	144	145	146	147	148	148	149	150	151	152	153	154	155	156	157
140	138	139	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	157
145	138	139	140	141	142	143	144	145	146	147	148	148	149	150	151	152	153	154	155	156	157	158
150	139	140	141	142	142	143	144	145	146	147	148	149	150	151	152	153	154	155	155	156	157	158
155	139	140	141	142	143	144	145	146	147	148	148	149	150	151	152	153	154	155	156	157	158	159
160	140	141	142	143	144	144	145	146	147	148	149	150	151	152	153	154	154	155	156	157	158	159
165	141	141	142	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156	157	158	159	160
170	141	142	143	144	145	146	146	147	148	149	150	151	152	153	154	154	155	156	157	158	159	160
175	142	143	144	144	145	146	147	148	149	150	151	151	152	153	154	155	156	157	158	159	159	160
180	143	143	144	145	146	147	148	148	149	150	151	152	153	154	155	155	156	157	158	159	160	161
185	143	144	145	146	146	147	148	149	150	151	152	152	153	154	155	156	157	158	159	159	160	161
190	144	145	145	146	147	148	149	150	150	151	152	153	154	155	156	156	157	158	159	160	161	162
195	144	145	146	147	148	148	149	150	151	152	153	154	154	155	156	157	158	159	160	160	161	162
200	145	146	147	147	148	149	150	151	152	152	153	154	155	156	157	157	158	159	160	161	162	163
205	146	147	147	148	149	150	151	151	152	153	154	155	155	156	157	158	159	160	160	161	162	163
210	147	147	148	149	150	150	151	152	153	154	154	155	156	157	158	158	159	160	161	162	163	163
215	147	148	149	149	150	151	152	153	153	154	155	156	157	157	158	159	160	161	161	162	163	164
220	148	149	149	150	151	152	152	153	154	155	155	156	157	158	159	159	160	161	162	163	164	164
225	149	149	150	151	151	152	153	154	154	155	156	157	158	158	159	160	161	162	162	163	164	165
230	149	150	151	151	152	153	154	154	155	156	157	157	158	159	160	161	161	162	163	164	165	165
235	150	151	151	152	153	154	154	155	156	156	157	158	159	160	160	161	162	163	163	164	165	166
240	151	151	152	153	153	154	155	156	156	157	158	159	159	160	161	162	162	163	164	165	166	166

TABLE 8. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.8000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	151	153	156	159	161	164	166	169	171	174	176	179	181	183	186	188	191	193	195	197	200	202
5	151	154	156	159	161	164	166	169	171	174	176	179	181	184	186	188	191	193	195	198	200	202
10	151	154	156	159	161	164	166	169	171	174	176	179	181	184	186	188	191	193	195	198	200	202
15	151	154	156	159	162	164	167	169	172	174	176	179	181	184	186	188	191	193	195	198	200	202
20	151	154	157	159	162	164	167	169	172	174	177	179	181	184	186	189	191	193	195	198	200	202
25	151	154	157	159	162	164	167	169	172	174	177	179	182	184	186	189	191	193	196	198	200	202
30	152	154	157	159	162	165	167	170	172	174	177	179	182	184	186	189	191	193	196	198	200	203
35	152	154	157	160	162	165	167	170	172	175	177	179	182	184	187	189	191	194	196	198	200	203
40	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	201	203
45	152	155	158	160	163	165	168	170	172	175	177	180	182	184	187	189	191	194	196	198	201	203
50	153	155	158	160	163	165	168	170	173	175	178	180	182	185	187	189	192	194	196	199	201	203
55	153	155	158	160	163	166	168	170	173	175	178	180	182	185	187	189	192	194	196	199	201	203
60	153	156	158	161	163	166	168	171	173	175	178	180	183	185	187	190	192	194	197	199	201	203
65	153	156	158	161	163	166	168	171	173	176	178	180	183	185	188	190	192	194	197	199	201	203
70	154	156	159	161	164	166	169	171	173	176	178	181	183	185	188	190	192	195	197	199	201	204
75	154	156	159	161	164	166	169	171	174	176	178	181	183	186	188	190	192	195	197	199	202	204
80	154	157	159	162	164	167	169	172	174	176	179	181	183	186	188	190	193	195	197	199	202	204
85	155	157	160	162	164	167	169	172	174	177	179	181	184	186	188	191	193	195	197	200	202	204
90	155	157	160	162	165	167	170	172	174	177	179	182	184	186	188	191	193	195	198	200	202	204
95	155	158	160	163	165	167	170	172	175	177	179	182	184	186	189	191	193	195	198	200	202	204
100	156	158	160	163	165	168	170	173	175	177	180	182	184	187	189	191	193	196	198	200	202	205
105	156	158	161	163	166	168	170	173	175	178	180	182	184	187	189	191	194	196	198	200	203	205
110	156	159	161	164	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201	203	205
115	157	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201	203	205
120	157	159	162	164	167	169	171	174	176	178	181	183	185	187	190	192	194	196	199	201	203	205
125	157	160	162	164	167	169	172	174	176	179	181	183	185	188	190	192	194	197	199	201	203	206
130	158	160	162	165	167	170	172	174	177	179	181	183	186	188	190	192	195	197	199	201	204	206
135	158	160	163	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197	199	202	204	206
140	158	161	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	200	202	204	206
145	159	161	163	166	168	170	173	175	177	180	182	184	186	189	191	193	195	198	200	202	204	206
150	159	162	164	166	168	171	173	175	178	180	182	184	187	189	191	193	196	198	200	202	204	207
155	160	162	164	167	169	171	173	176	178	180	182	185	187	189	191	194	196	198	200	202	205	207
160	160	162	165	167	169	171	174	176	178	181	183	185	187	189	192	194	196	198	200	203	205	207
165	160	163	165	167	170	172	174	176	179	181	183	185	188	190	192	194	196	199	201	203	205	207
170	161	163	165	168	170	172	174	177	179	181	183	186	188	190	192	194	197	199	201	203	205	207
175	161	164	166	168	170	173	175	177	179	181	184	186	188	190	192	195	197	199	201	203	205	208
180	162	164	166	168	171	173	175	177	180	182	184	186	188	191	193	195	197	199	201	204	206	208
185	162	164	167	169	171	173	175	178	180	182	184	186	189	191	193	195	197	199	202	204	206	208
190	163	165	167	169	171	174	176	178	180	182	185	187	189	191	193	195	198	200	202	204	206	208
195	163	165	167	170	172	174	176	178	181	183	185	187	189	191	194	196	198	200	202	204	206	208
200	163	166	168	170	172	174	176	179	181	183	185	187	190	192	194	196	198	200	202	205	207	209
205	164	166	168	170	173	175	177	179	181	183	186	188	190	192	194	196	198	201	203	205	207	209
210	164	166	169	171	173	175	177	179	182	184	186	188	190	192	194	197	199	201	203	205	207	209
215	165	167	169	171	173	175	178	180	182	184	186	188	190	193	195	197	199	201	203	205	207	209
220	165	167	169	172	174	176	178	180	182	184	186	189	191	193	195	197	199	201	203	205	208	210
225	166	168	170	172	174	176	178	180	183	185	187	189	191	193	195	197	199	202	204	206	208	210
230	166	168	170	172	175	177	179	181	183	185	187	189	191	193	196	198	200	202	204	206	208	210
235	167	169	171	173	175	177	179	181	183	185	187	190	192	194	196	198	200	202	204	206	208	210
240	167	169	171	173	175	177	179	182	184	186	188	190	192	194	196	198	200	202	204	207	209	211

TABLE 8. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.8000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	204	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
5	204	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
10	204	209	213	218	222	226	230	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
15	204	209	213	218	222	226	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
20	205	209	213	218	222	226	231	235	239	243	247	251	255	259	263	267	271	274	278	282	286	289
25	205	209	214	218	222	226	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
30	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
35	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	278	282	286	290
40	205	209	214	218	222	227	231	235	239	243	247	251	255	259	263	267	271	275	279	282	286	290
45	205	210	214	218	223	227	231	235	239	243	247	251	255	259	263	267	271	275	279	282	286	290
50	205	210	214	218	223	227	231	235	239	243	248	252	255	259	263	267	271	275	279	282	286	290
55	205	210	214	219	223	227	231	235	239	244	248	252	256	260	263	267	271	275	279	282	286	290
60	206	210	214	219	223	227	231	235	240	244	248	252	256	260	263	267	271	275	279	283	286	290
65	206	210	214	219	223	227	231	236	240	244	248	252	256	260	264	267	271	275	279	283	286	290
70	206	210	215	219	223	227	232	236	240	244	248	252	256	260	264	268	271	275	279	283	286	290
75	206	210	215	219	223	227	232	236	240	244	248	252	256	260	264	268	271	275	279	283	286	290
80	206	211	215	219	223	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
85	206	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	272	275	279	283	287	290
90	206	211	215	219	224	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	290
95	207	211	215	220	224	228	232	236	240	244	248	252	256	260	264	268	272	276	279	283	287	290
100	207	211	215	220	224	228	232	236	240	245	249	253	256	260	264	268	272	276	279	283	287	291
105	207	211	216	220	224	228	232	237	241	245	249	253	257	260	264	268	272	276	280	283	287	291
110	207	211	216	220	224	228	233	237	241	245	249	253	257	261	264	268	272	276	280	283	287	291
115	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	268	272	276	280	283	287	291
120	207	212	216	220	225	229	233	237	241	245	249	253	257	261	265	268	272	276	280	284	287	291
125	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287	291
130	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287	291
135	208	212	217	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	288	291
140	208	213	217	221	225	229	233	238	242	246	250	253	257	261	265	269	273	276	280	284	288	291
145	208	213	217	221	225	230	234	238	242	246	250	254	257	261	265	269	273	277	280	284	288	291
150	209	213	217	221	226	230	234	238	242	246	250	254	258	261	265	269	273	277	280	284	288	291
155	209	213	217	222	226	230	234	238	242	246	250	254	258	262	265	269	273	277	281	284	288	292
160	209	213	218	222	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284	288	292
165	209	214	218	222	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284	288	292
170	209	214	218	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	285	288	292
175	210	214	218	222	226	231	235	239	243	247	250	254	258	262	266	270	274	277	281	285	288	292
180	210	214	218	222	227	231	235	239	243	247	251	255	258	262	266	270	274	277	281	285	288	292
185	210	214	219	223	227	231	235	239	243	247	251	255	259	262	266	270	274	277	281	285	289	292
190	210	215	219	223	227	231	235	239	243	247	251	255	259	263	266	270	274	278	281	285	289	292
195	211	215	219	223	227	231	235	239	243	247	251	255	259	263	266	270	274	278	281	285	289	292
200	211	215	219	223	227	231	235	239	243	247	251	255	259	263	267	270	274	278	282	285	289	292
205	211	215	219	223	228	232	236	240	244	247	251	255	259	263	267	270	274	278	282	285	289	293
210	211	215	220	224	228	232	236	240	244	248	252	255	259	263	267	271	274	278	282	285	289	293
215	212	216	220	224	228	232	236	240	244	248	252	256	259	263	267	271	274	278	282	286	289	293
220	212	216	220	224	228	232	236	240	244	248	252	256	260	263	267	271	275	278	282	286	289	293
225	212	216	220	224	228	232	236	240	244	248	252	256	260	263	267	271	275	278	282	286	289	293
230	212	216	220	224	229	233	236	240	244	248	252	256	260	264	267	271	275	279	282	286	290	293
235	212	217	221	225	229	233	237	241	245	248	252	256	260	264	268	271	275	279	282	286	290	293
240	213	217	221	225	229	233	237	241	245	249	252	256	260	264	268	271	275	279	282	286	290	293

TABLE 8. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.8000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	293	297	300	304	308	311	315	318	322	325	329	332	335	339	342	346	349	352	356	359	362	365
5	293	297	300	304	308	311	315	318	322	325	329	332	335	339	342	346	349	352	356	359	362	365
10	293	297	300	304	308	311	315	318	322	325	329	332	335	339	342	346	349	352	356	359	362	365
15	293	297	300	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	365
20	293	297	300	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	365
25	293	297	301	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	365
30	293	297	301	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	365
35	293	297	301	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	366
40	293	297	301	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	366
45	293	297	301	304	308	311	315	318	322	325	329	332	336	339	342	346	349	352	356	359	362	366
50	294	297	301	304	308	312	315	319	322	325	329	332	336	339	343	346	349	353	356	359	362	366
55	294	297	301	304	308	312	315	319	322	326	329	332	336	339	343	346	349	353	356	359	362	366
60	294	297	301	304	308	312	315	319	322	326	329	332	336	339	343	346	349	353	356	359	362	366
65	294	297	301	305	308	312	315	319	322	326	329	333	336	339	343	346	349	353	356	359	363	366
70	294	297	301	305	308	312	315	319	322	326	329	333	336	339	343	346	349	353	356	359	363	366
75	294	297	301	305	308	312	315	319	322	326	329	333	336	339	343	346	349	353	356	359	363	366
80	294	298	301	305	308	312	315	319	322	326	329	333	336	339	343	346	350	353	356	359	363	366
85	294	298	301	305	308	312	315	319	322	326	329	333	336	340	343	346	350	353	356	359	363	366
90	294	298	301	305	308	312	316	319	322	326	329	333	336	340	343	346	350	353	356	359	363	366
95	294	298	301	305	309	312	316	319	323	326	329	333	336	340	343	346	350	353	356	360	363	366
100	294	298	301	305	309	312	316	319	323	326	330	333	336	340	343	346	350	353	356	360	363	366
105	294	298	302	305	309	312	316	319	323	326	330	333	336	340	343	346	350	353	356	360	363	366
110	294	298	302	305	309	312	316	319	323	326	330	333	336	340	343	347	350	353	356	360	363	366
115	294	298	302	305	309	312	316	319	323	326	330	333	337	340	343	347	350	353	356	360	363	366
120	295	298	302	305	309	312	316	319	323	326	330	333	337	340	343	347	350	353	357	360	363	366
125	295	298	302	305	309	313	316	320	323	326	330	333	337	340	343	347	350	353	357	360	363	366
130	295	298	302	306	309	313	316	320	323	326	330	333	337	340	343	347	350	353	357	360	363	366
135	295	298	302	306	309	313	316	320	323	327	330	333	337	340	343	347	350	353	357	360	363	366
140	295	299	302	306	309	313	316	320	323	327	330	333	337	340	344	347	350	353	357	360	363	367
145	295	299	302	306	309	313	316	320	323	327	330	334	337	340	344	347	350	354	357	360	363	367
150	295	299	302	306	309	313	316	320	323	327	330	334	337	340	344	347	350	354	357	360	363	367
155	295	299	302	306	309	313	316	320	323	327	330	334	337	340	344	347	350	354	357	360	363	367
160	295	299	302	306	310	313	317	320	323	327	330	334	337	340	344	347	350	354	357	360	364	367
165	295	299	303	306	310	313	317	320	324	327	330	334	337	341	344	347	351	354	357	360	364	367
170	295	299	303	306	310	313	317	320	324	327	330	334	337	341	344	347	351	354	357	360	364	367
175	296	299	303	306	310	313	317	320	324	327	331	334	337	341	344	347	351	354	357	360	364	367
180	296	299	303	306	310	313	317	320	324	327	331	334	337	341	344	347	351	354	357	361	364	367
185	296	299	303	306	310	314	317	320	324	327	331	334	337	341	344	347	351	354	357	361	364	367
190	296	299	303	307	310	314	317	321	324	327	331	334	338	341	344	348	351	354	357	361	364	367
195	296	300	303	307	310	314	317	321	324	327	331	334	338	341	344	348	351	354	357	361	364	367
200	296	300	303	307	310	314	317	321	324	328	331	334	338	341	344	348	351	354	358	361	364	367
205	296	300	303	307	310	314	317	321	324	328	331	334	338	341	344	348	351	354	358	361	364	367
210	296	300	303	307	310	314	317	321	324	328	331	335	338	341	345	348	351	354	358	361	364	367
215	296	300	304	307	311	314	318	321	324	328	331	335	338	341	345	348	351	354	358	361	364	367
220	297	300	304	307	311	314	318	321	324	328	331	335	338	341	345	348	351	355	358	361	364	368
225	297	300	304	307	311	314	318	321	325	328	331	335	338	341	345	348	351	355	358	361	364	368
230	297	300	304	307	311	314	318	321	325	328	331	335	338	342	345	348	351	355	358	361	364	368
235	297	300	304	307	311	314	318	321	325	328	332	335	338	342	345	348	352	355	358	361	365	368
240	297	301	304	308	311	315	318	321	325	328	332	335	338	342	345	348	352	355	358	361	365	368

TABLE 9. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.7000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	110	110	111	112	112	113	113	114	115	115	116	116	117	118	118	119	120	120	121	121	122	122
5	110	111	111	112	112	113	114	114	115	115	116	117	117	118	118	119	120	120	121	121	122	123
10	110	111	112	112	113	113	114	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123
15	111	111	112	113	113	114	114	115	116	116	117	117	118	119	119	120	120	121	122	122	123	123
20	111	112	112	113	114	114	115	115	116	117	117	118	118	119	120	120	121	121	122	123	123	124
25	112	112	113	114	114	115	115	116	117	117	118	118	119	120	120	121	121	122	122	123	124	124
30	112	113	114	114	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	125
35	113	114	114	115	115	116	116	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125
40	114	114	115	115	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126
45	114	115	115	116	117	117	118	118	119	119	120	121	121	122	122	123	123	124	125	125	126	126
50	115	116	116	117	117	118	118	119	120	120	121	121	122	122	123	123	124	125	125	126	126	127
55	116	116	117	117	118	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127
60	117	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125	125	126	126	127	127	128
65	117	118	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	128	128	129
70	118	119	119	120	120	121	121	122	122	123	124	124	125	125	126	126	127	127	128	128	129	129
75	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130
80	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131
85	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131
90	122	122	123	123	124	124	125	125	126	126	127	127	128	128	129	129	130	130	131	131	132	132
95	123	123	124	124	125	125	126	126	127	127	128	128	129	129	129	130	130	131	131	132	132	133
100	124	124	125	125	126	126	127	127	128	128	128	129	129	130	130	131	131	132	132	133	133	134
105	125	125	126	126	127	127	128	128	128	129	129	130	130	131	131	132	132	133	133	133	134	134
110	126	126	127	127	128	128	129	129	129	130	130	131	131	132	132	132	133	133	134	134	135	135
115	127	127	128	128	129	129	129	130	130	131	131	132	132	132	133	133	134	134	135	135	136	136
120	128	129	129	129	130	130	130	131	131	132	132	133	133	133	134	134	135	135	136	136	136	137
125	129	130	130	130	131	131	131	132	132	133	133	133	134	134	135	135	136	136	136	137	137	138
130	130	131	131	131	132	132	133	133	133	134	134	134	135	135	136	136	136	137	137	138	138	138
135	131	132	132	132	133	133	134	134	134	135	135	135	136	136	137	137	137	138	138	139	139	139
140	133	133	133	134	134	134	135	135	135	136	136	136	137	137	138	138	138	139	139	139	140	140
145	134	134	134	135	135	135	136	136	136	137	137	137	138	138	138	139	139	140	140	140	141	141
150	135	135	136	136	136	136	137	137	137	138	138	138	139	139	139	140	140	141	141	141	142	142
155	136	136	137	137	137	138	138	138	138	139	139	139	140	140	140	141	141	141	142	142	143	143
160	137	138	138	138	138	139	139	139	140	140	140	140	141	141	141	142	142	142	143	143	143	144
165	139	139	139	139	140	140	140	140	141	141	141	142	142	142	142	143	143	143	144	144	144	145
170	140	140	140	140	141	141	141	141	142	142	142	143	143	143	143	144	144	144	145	145	145	146
175	141	141	141	142	142	142	142	143	143	143	143	144	144	144	144	145	145	145	146	146	146	147
180	142	142	143	143	143	143	143	144	144	144	144	145	145	145	146	146	146	146	147	147	147	148
185	143	144	144	144	144	144	145	145	145	145	146	146	146	146	147	147	147	147	148	148	148	149
190	145	145	145	145	145	146	146	146	146	146	147	147	147	147	148	148	148	148	149	149	149	150
195	146	146	146	146	147	147	147	147	147	148	148	148	148	148	149	149	149	149	150	150	150	151
200	147	147	148	148	148	148	148	148	149	149	149	149	149	150	150	150	150	150	151	151	151	152
205	149	149	149	149	149	149	149	150	150	150	150	150	150	151	151	151	151	152	152	152	152	153
210	150	150	150	150	150	150	151	151	151	151	151	151	152	152	152	152	152	153	153	153	153	154
215	151	151	151	151	152	152	152	152	152	152	152	152	153	153	153	153	153	154	154	154	154	155
220	152	153	153	153	153	153	153	153	153	153	153	154	154	154	154	154	155	155	155	155	155	156
225	154	154	154	154	154	154	154	154	154	155	155	155	155	155	155	155	156	156	156	156	156	157
230	155	155	155	155	155	155	155	156	156	156	156	156	156	156	156	157	157	157	157	157	157	158
235	156	156	156	156	157	157	157	157	157	157	157	157	157	157	158	158	158	158	158	158	158	159
240	158	158	158	158	158	158	158	158	158	158	158	158	158	159	159	159	159	159	159	159	160	160

TABLE 9. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.7000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	124	125	126	127	128	130	131	132	133	134	135	136	137	139	140	141	142	143	144	145	146	147
5	124	125	126	127	129	130	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147
10	124	125	126	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	146	147	148
15	124	126	127	128	129	130	131	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148
20	125	126	127	128	129	131	132	133	134	135	136	137	138	140	141	142	143	144	145	146	147	148
25	125	126	128	129	130	131	132	133	134	135	137	138	139	140	141	142	143	144	145	146	147	149
30	126	127	128	129	130	131	133	134	135	136	137	138	139	140	141	142	144	145	146	147	148	149
35	126	127	129	130	131	132	133	134	135	136	137	138	140	141	142	143	144	145	146	147	148	149
40	127	128	129	130	131	132	133	135	136	137	138	139	140	141	142	143	144	145	146	147	148	150
45	127	128	130	131	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149	150
50	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
55	128	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	146	147	148	149	150	151
60	129	130	131	132	133	134	135	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
65	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	150	151	152
70	130	131	132	133	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
75	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
80	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
85	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
90	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
95	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	148	149	150	151	152	153	154
100	135	136	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155
105	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	152	153	154	155
110	136	137	138	139	140	141	142	143	144	145	145	146	147	148	149	150	151	152	153	154	155	156
115	137	138	139	140	141	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	155	156
120	138	139	139	140	141	142	143	144	145	146	147	148	149	150	150	151	152	153	154	155	156	157
125	139	139	140	141	142	143	144	145	146	147	147	148	149	150	151	152	153	154	155	156	157	157
130	139	140	141	142	143	144	145	145	146	147	148	149	150	151	152	153	153	154	155	156	157	158
135	140	141	142	143	144	144	145	146	147	148	149	150	151	151	152	153	154	155	156	157	158	159
140	141	142	143	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156	157	157	158	159
145	142	143	143	144	145	146	147	148	148	149	150	151	152	153	154	154	155	156	157	158	159	160
150	143	144	144	145	146	147	148	148	149	150	151	152	153	153	154	155	156	157	158	159	159	160
155	144	144	145	146	147	148	148	149	150	151	152	152	153	154	155	156	157	157	158	159	160	161
160	145	145	146	147	148	148	149	150	151	152	152	153	154	155	156	156	157	158	159	160	161	162
165	145	146	147	148	148	149	150	151	151	152	153	154	155	155	156	157	158	159	160	160	161	162
170	146	147	148	148	149	150	151	151	152	153	154	155	155	156	157	158	159	159	160	161	162	163
175	147	148	149	149	150	151	152	152	153	154	155	155	156	157	158	158	159	160	161	162	163	163
180	148	149	150	150	151	152	152	153	154	155	155	156	157	158	158	159	160	161	162	162	163	164
185	149	150	150	151	152	152	153	154	155	155	156	157	158	158	159	160	161	161	162	163	164	165
190	150	151	151	152	153	153	154	155	155	156	157	158	158	159	160	161	161	162	163	164	164	165
195	151	152	152	153	154	154	155	156	156	157	158	158	159	160	161	161	162	163	164	164	165	166
200	152	153	153	154	154	155	156	156	157	158	158	159	160	161	161	162	163	163	164	165	166	167
205	153	154	154	155	155	156	157	157	158	159	159	160	161	161	162	163	163	164	165	166	166	167
210	154	155	155	156	156	157	157	158	159	159	160	161	161	162	163	163	164	165	166	166	167	168
215	155	156	156	157	157	158	158	159	160	160	161	161	162	163	163	164	165	166	166	167	168	169
220	156	156	157	158	158	159	159	160	160	161	162	162	163	164	164	165	166	166	167	168	168	169
225	157	157	158	158	159	160	160	161	161	162	162	163	164	164	165	166	166	167	168	168	169	170
230	158	158	159	159	160	160	161	162	162	163	163	164	164	165	166	166	167	168	168	169	170	171
235	159	159	160	160	161	161	162	162	163	164	164	165	165	166	167	167	168	168	169	170	171	171
240	160	160	161	161	162	162	163	163	164	164	165	166	166	167	167	168	169	169	170	171	171	172

TABLE 9. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.7000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	148	151	154	156	159	161	164	167	169	172	174	176	179	181	184	186	188	191	193	195	198	200
5	149	151	154	156	159	162	164	167	169	172	174	177	179	181	184	186	189	191	193	196	198	200
10	149	151	154	157	159	162	164	167	169	172	174	177	179	182	184	186	189	191	193	196	198	200
15	149	152	154	157	159	162	165	167	170	172	174	177	179	182	184	186	189	191	193	196	198	200
20	149	152	155	157	160	162	165	167	170	172	175	177	180	182	184	187	189	191	194	196	198	201
25	150	152	155	157	160	162	165	168	170	172	175	177	180	182	185	187	189	192	194	196	198	201
30	150	153	155	158	160	163	165	168	170	173	175	178	180	182	185	187	189	192	194	196	199	201
35	150	153	155	158	161	163	166	168	171	173	175	178	180	183	185	187	190	192	194	197	199	201
40	151	153	156	158	161	163	166	168	171	173	176	178	180	183	185	188	190	192	194	197	199	201
45	151	154	156	159	161	164	166	169	171	174	176	178	181	183	185	188	190	192	195	197	199	201
50	151	154	156	159	161	164	166	169	171	174	176	179	181	183	186	188	190	193	195	197	199	202
55	152	154	157	159	162	164	167	169	172	174	176	179	181	184	186	188	191	193	195	197	200	202
60	152	155	157	160	162	165	167	170	172	174	177	179	182	184	186	189	191	193	195	198	200	202
65	153	155	158	160	163	165	167	170	172	175	177	179	182	184	186	189	191	193	196	198	200	202
70	153	156	158	160	163	165	168	170	173	175	177	180	182	184	187	189	191	194	196	198	200	203
75	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189	192	194	196	198	201	203
80	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196	199	201	203
85	154	157	159	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201	203
90	155	157	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	195	197	199	201	204
95	155	158	160	163	165	167	170	172	174	177	179	181	184	186	188	191	193	195	197	199	202	204
100	156	158	161	163	165	168	170	172	175	177	179	182	184	186	189	191	193	195	198	200	202	204
105	156	159	161	163	166	168	171	173	175	177	180	182	184	187	189	191	193	196	198	200	202	204
110	157	159	162	164	166	169	171	173	176	178	180	182	185	187	189	191	194	196	198	200	202	205
115	157	160	162	164	167	169	171	174	176	178	181	183	185	187	190	192	194	196	198	201	203	205
120	158	160	163	165	167	169	172	174	176	179	181	183	185	188	190	192	194	197	199	201	203	205
125	158	161	163	165	168	170	172	174	177	179	181	184	186	188	190	192	195	197	199	201	203	205
130	159	161	164	166	168	170	173	175	177	179	182	184	186	188	191	193	195	197	199	201	204	206
135	160	162	164	166	169	171	173	175	178	180	182	184	186	189	191	193	195	197	200	202	204	206
140	160	162	165	167	169	171	174	176	178	180	182	185	187	189	191	193	196	198	200	202	204	206
145	161	163	165	167	170	172	174	176	178	181	183	185	187	189	192	194	196	198	200	202	205	207
150	161	163	166	168	170	172	174	177	179	181	183	185	188	190	192	194	196	198	201	203	205	207
155	162	164	166	168	171	173	175	177	179	181	184	186	188	190	192	194	197	199	201	203	205	207
160	162	165	167	169	171	173	175	178	180	182	184	186	188	191	193	195	197	199	201	203	205	208
165	163	165	167	169	172	174	176	178	180	182	184	187	189	191	193	195	197	199	202	204	206	208
170	164	166	168	170	172	174	176	178	181	183	185	187	189	191	193	196	198	200	202	204	206	208
175	164	166	168	170	173	175	177	179	181	183	185	187	190	192	194	196	198	200	202	204	206	209
180	165	167	169	171	173	175	177	179	182	184	186	188	190	192	194	196	198	201	203	205	207	209
185	165	167	169	172	174	176	178	180	182	184	186	188	190	193	195	197	199	201	203	205	207	209
190	166	168	170	172	174	176	178	180	182	185	187	189	191	193	195	197	199	201	203	205	207	209
195	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	200	202	204	206	208	210
200	167	169	171	173	175	177	179	181	183	185	188	190	192	194	196	198	200	202	204	206	208	210
205	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210
210	169	171	172	174	176	178	180	182	184	186	188	190	193	195	197	199	201	203	205	207	209	211
215	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207	209	211
220	170	172	174	176	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207	210	212
225	171	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212
230	171	173	175	177	179	181	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212
235	172	174	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207	209	211	213
240	173	174	176	178	180	182	184	185	187	189	191	193	195	197	199	201	203	205	207	209	211	213

TABLE 9. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.7000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	202	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	283	287
5	202	207	211	216	220	224	228	233	237	241	245	249	253	257	261	265	268	272	276	280	283	287
10	202	207	211	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	283	287
15	203	207	212	216	220	224	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
20	203	207	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	272	276	280	284	287
25	203	207	212	216	220	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	287
30	203	208	212	216	221	225	229	233	237	241	245	249	253	257	261	265	269	273	276	280	284	287
35	203	208	212	216	221	225	229	233	237	242	246	250	254	257	261	265	269	273	277	280	284	288
40	203	208	212	217	221	225	229	234	238	242	246	250	254	258	261	265	269	273	277	280	284	288
45	204	208	212	217	221	225	230	234	238	242	246	250	254	258	262	265	269	273	277	280	284	288
50	204	208	213	217	221	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284	288
55	204	209	213	217	221	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284	288
60	204	209	213	217	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	284	288
65	205	209	213	218	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	285	288
70	205	209	214	218	222	226	230	234	239	243	247	251	254	258	262	266	270	274	277	281	285	288
75	205	209	214	218	222	226	231	235	239	243	247	251	255	259	262	266	270	274	277	281	285	288
80	205	210	214	218	222	227	231	235	239	243	247	251	255	259	263	266	270	274	278	281	285	289
85	206	210	214	218	223	227	231	235	239	243	247	251	255	259	263	266	270	274	278	281	285	289
90	206	210	214	219	223	227	231	235	239	243	247	251	255	259	263	267	270	274	278	282	285	289
95	206	210	215	219	223	227	231	235	239	243	247	251	255	259	263	267	271	274	278	282	285	289
100	206	211	215	219	223	227	232	236	240	244	248	252	255	259	263	267	271	274	278	282	285	289
105	207	211	215	219	224	228	232	236	240	244	248	252	256	259	263	267	271	275	278	282	286	289
110	207	211	215	220	224	228	232	236	240	244	248	252	256	260	263	267	271	275	278	282	286	289
115	207	211	216	220	224	228	232	236	240	244	248	252	256	260	264	267	271	275	279	282	286	289
120	207	212	216	220	224	228	232	236	240	244	248	252	256	260	264	268	271	275	279	282	286	290
125	208	212	216	220	224	229	233	237	241	245	249	252	256	260	264	268	271	275	279	283	286	290
130	208	212	216	221	225	229	233	237	241	245	249	253	256	260	264	268	272	275	279	283	286	290
135	208	212	217	221	225	229	233	237	241	245	249	253	257	260	264	268	272	275	279	283	286	290
140	208	213	217	221	225	229	233	237	241	245	249	253	257	261	264	268	272	276	279	283	287	290
145	209	213	217	221	225	229	234	238	241	245	249	253	257	261	265	268	272	276	279	283	287	290
150	209	213	217	222	226	230	234	238	242	246	250	253	257	261	265	269	272	276	280	283	287	290
155	209	214	218	222	226	230	234	238	242	246	250	254	257	261	265	269	272	276	280	283	287	291
160	210	214	218	222	226	230	234	238	242	246	250	254	258	261	265	269	273	276	280	284	287	291
165	210	214	218	222	226	230	234	238	242	246	250	254	258	262	265	269	273	276	280	284	287	291
170	210	214	219	223	227	231	235	239	243	246	250	254	258	262	266	269	273	277	280	284	287	291
175	211	215	219	223	227	231	235	239	243	247	251	254	258	262	266	269	273	277	280	284	288	291
180	211	215	219	223	227	231	235	239	243	247	251	255	258	262	266	270	273	277	281	284	288	291
185	211	215	219	223	227	231	235	239	243	247	251	255	259	262	266	270	273	277	281	284	288	292
190	212	216	220	224	228	232	236	240	243	247	251	255	259	263	266	270	274	277	281	285	288	292
195	212	216	220	224	228	232	236	240	244	248	251	255	259	263	266	270	274	277	281	285	288	292
200	212	216	220	224	228	232	236	240	244	248	252	255	259	263	267	270	274	278	281	285	288	292
205	213	217	221	225	229	232	236	240	244	248	252	256	259	263	267	271	274	278	281	285	289	292
210	213	217	221	225	229	233	237	241	244	248	252	256	260	263	267	271	274	278	282	285	289	292
215	213	217	221	225	229	233	237	241	245	248	252	256	260	264	267	271	275	278	282	285	289	292
220	214	218	221	225	229	233	237	241	245	249	252	256	260	264	267	271	275	278	282	286	289	293
225	214	218	222	226	230	234	237	241	245	249	253	256	260	264	268	271	275	279	282	286	289	293
230	214	218	222	226	230	234	238	242	245	249	253	257	260	264	268	271	275	279	282	286	289	293
235	215	218	222	226	230	234	238	242	246	249	253	257	261	264	268	272	275	279	282	286	290	293
240	215	219	223	227	231	234	238	242	246	250	253	257	261	265	268	272	275	279	283	286	290	293

TABLE 9. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.7000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	291	294	298	302	305	309	312	316	319	322	326	329	333	336	339	343	346	349	352	356	359	362
5	291	294	298	302	305	309	312	316	319	322	326	329	333	336	339	343	346	349	352	356	359	362
10	291	294	298	302	305	309	312	316	319	322	326	329	333	336	339	343	346	349	352	356	359	362
15	291	295	298	302	305	309	312	316	319	323	326	329	333	336	339	343	346	349	352	356	359	362
20	291	295	298	302	305	309	312	316	319	323	326	329	333	336	339	343	346	349	352	356	359	362
25	291	295	298	302	305	309	312	316	319	323	326	329	333	336	339	343	346	349	353	356	359	362
30	291	295	298	302	305	309	312	316	319	323	326	330	333	336	340	343	346	349	353	356	359	362
35	291	295	298	302	306	309	312	316	319	323	326	330	333	336	340	343	346	349	353	356	359	362
40	291	295	299	302	306	309	313	316	319	323	326	330	333	336	340	343	346	349	353	356	359	362
45	291	295	299	302	306	309	313	316	320	323	326	330	333	336	340	343	346	350	353	356	359	362
50	292	295	299	302	306	309	313	316	320	323	326	330	333	336	340	343	346	350	353	356	359	362
55	292	295	299	302	306	309	313	316	320	323	327	330	333	337	340	343	346	350	353	356	359	363
60	292	295	299	302	306	309	313	316	320	323	327	330	333	337	340	343	347	350	353	356	359	363
65	292	295	299	303	306	310	313	316	320	323	327	330	333	337	340	343	347	350	353	356	359	363
70	292	296	299	303	306	310	313	317	320	323	327	330	333	337	340	343	347	350	353	356	360	363
75	292	296	299	303	306	310	313	317	320	324	327	330	334	337	340	343	347	350	353	356	360	363
80	292	296	299	303	306	310	313	317	320	324	327	330	334	337	340	344	347	350	353	357	360	363
85	292	296	299	303	306	310	313	317	320	324	327	330	334	337	340	344	347	350	353	357	360	363
90	292	296	300	303	307	310	314	317	320	324	327	331	334	337	340	344	347	350	353	357	360	363
95	293	296	300	303	307	310	314	317	321	324	327	331	334	337	341	344	347	350	354	357	360	363
100	293	296	300	303	307	310	314	317	321	324	327	331	334	337	341	344	347	350	354	357	360	363
105	293	296	300	303	307	310	314	317	321	324	327	331	334	337	341	344	347	351	354	357	360	363
110	293	297	300	304	307	311	314	317	321	324	328	331	334	338	341	344	347	351	354	357	360	363
115	293	297	300	304	307	311	314	318	321	324	328	331	334	338	341	344	347	351	354	357	360	363
120	293	297	300	304	307	311	314	318	321	324	328	331	334	338	341	344	348	351	354	357	360	364
125	293	297	300	304	307	311	314	318	321	325	328	331	335	338	341	344	348	351	354	357	360	364
130	293	297	301	304	308	311	314	318	321	325	328	331	335	338	341	344	348	351	354	357	361	364
135	294	297	301	304	308	311	315	318	321	325	328	331	335	338	341	345	348	351	354	357	361	364
140	294	297	301	304	308	311	315	318	321	325	328	332	335	338	341	345	348	351	354	358	361	364
145	294	297	301	304	308	311	315	318	322	325	328	332	335	338	342	345	348	351	354	358	361	364
150	294	298	301	305	308	312	315	318	322	325	328	332	335	338	342	345	348	351	355	358	361	364
155	294	298	301	305	308	312	315	318	322	325	329	332	335	338	342	345	348	351	355	358	361	364
160	294	298	301	305	308	312	315	319	322	325	329	332	335	339	342	345	348	352	355	358	361	364
165	294	298	302	305	308	312	315	319	322	325	329	332	335	339	342	345	348	352	355	358	361	364
170	295	298	302	305	309	312	315	319	322	326	329	332	336	339	342	345	349	352	355	358	361	364
175	295	298	302	305	309	312	316	319	322	326	329	332	336	339	342	345	349	352	355	358	361	365
180	295	298	302	305	309	312	316	319	322	326	329	332	336	339	342	346	349	352	355	358	361	365
185	295	299	302	306	309	312	316	319	323	326	329	333	336	339	342	346	349	352	355	358	362	365
190	295	299	302	306	309	313	316	319	323	326	329	333	336	339	343	346	349	352	355	359	362	365
195	295	299	302	306	309	313	316	319	323	326	329	333	336	339	343	346	349	352	355	359	362	365
200	296	299	303	306	309	313	316	320	323	326	330	333	336	339	343	346	349	352	356	359	362	365
205	296	299	303	306	310	313	316	320	323	326	330	333	336	340	343	346	349	352	356	359	362	365
210	296	299	303	306	310	313	316	320	323	327	330	333	336	340	343	346	349	353	356	359	362	365
215	296	299	303	306	310	313	317	320	323	327	330	333	337	340	343	346	350	353	356	359	362	365
220	296	300	303	307	310	313	317	320	323	327	330	333	337	340	343	346	350	353	356	359	362	365
225	296	300	303	307	310	314	317	320	324	327	330	334	337	340	343	347	350	353	356	359	362	366
230	296	300	303	307	310	314	317	320	324	327	330	334	337	340	343	347	350	353	356	359	363	366
235	297	300	304	307	310	314	317	321	324	327	330	334	337	340	344	347	350	353	356	359	363	366
240	297	300	304	307	311	314	317	321	324	327	331	334	337	340	344	347	350	353	356	360	363	366

TABLE 10. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.6000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	107	107	108	108	109	110	110	111	112	112	113	113	114	115	115	116	116	117	118	118	119	119
5	107	108	108	109	109	110	111	111	112	112	113	114	114	115	116	116	117	117	118	119	119	120
10	107	108	109	109	110	111	111	112	112	113	114	114	115	115	116	117	117	118	118	119	120	120
15	108	109	109	110	111	111	112	112	113	114	114	115	115	116	117	117	118	118	119	120	120	121
20	109	109	110	111	111	112	112	113	114	114	115	115	116	117	117	118	118	119	120	120	121	121
25	110	110	111	111	112	113	113	114	114	115	116	116	117	117	118	118	119	120	120	121	121	122
30	110	111	112	112	113	113	114	115	115	116	116	117	117	118	119	119	120	120	121	121	122	123
35	111	112	113	113	114	114	115	115	116	117	117	118	118	119	119	120	120	121	122	122	123	123
40	112	113	113	114	115	115	116	116	117	117	118	119	119	120	120	121	121	122	122	123	123	124
45	113	114	114	115	116	116	117	117	118	118	119	119	120	120	121	122	122	123	123	124	124	125
50	114	115	116	116	117	117	118	118	119	119	120	120	121	121	122	122	123	124	124	125	125	126
55	116	116	117	117	118	118	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	127
60	117	117	118	118	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127
65	118	118	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126	127	127	128	128
70	119	120	120	121	121	122	122	123	123	123	124	124	125	125	126	126	127	127	128	128	129	129
75	121	121	121	122	122	123	123	124	124	125	125	126	126	126	127	127	128	128	129	129	130	130
80	122	122	123	123	124	124	124	125	125	126	126	127	127	128	128	128	129	129	130	130	131	131
85	123	124	124	125	125	125	126	126	127	127	127	128	128	129	129	130	130	130	131	131	132	132
90	125	125	125	126	126	127	127	127	128	128	129	129	129	130	130	131	131	132	132	132	133	133
95	126	127	127	127	128	128	128	129	129	130	130	130	131	131	132	132	132	133	133	134	134	134
100	128	128	128	129	129	129	130	130	130	131	131	132	132	132	133	133	133	134	134	135	135	136
105	129	130	130	130	130	131	131	131	132	132	132	133	133	134	134	134	135	135	135	136	136	137
110	131	131	131	132	132	132	133	133	133	133	134	134	135	135	135	136	136	136	137	137	137	138
115	132	133	133	133	133	134	134	134	135	135	135	136	136	136	136	137	137	138	138	138	139	139
120	134	134	134	135	135	135	135	136	136	136	137	137	137	137	138	138	138	139	139	139	140	140
125	136	136	136	136	136	137	137	137	137	138	138	138	139	139	139	139	140	140	140	141	141	141
130	137	137	138	138	138	138	138	139	139	139	139	140	140	140	140	141	141	141	142	142	142	143
135	139	139	139	139	140	140	140	140	140	141	141	141	141	142	142	142	142	143	143	143	144	144
140	141	141	141	141	141	141	142	142	142	142	142	143	143	143	143	143	144	144	144	145	145	145
145	142	142	143	143	143	143	143	143	143	144	144	144	144	144	145	145	145	145	146	146	146	146
150	144	144	144	144	144	145	145	145	145	145	145	145	146	146	146	146	146	147	147	147	147	148
155	146	146	146	146	146	146	146	146	146	147	147	147	147	147	147	148	148	148	148	148	149	149
160	148	148	148	148	148	148	148	148	148	148	148	148	149	149	149	149	149	149	150	150	150	150
165	149	149	149	149	149	149	150	150	150	150	150	150	150	150	150	151	151	151	151	151	151	152
170	151	151	151	151	151	151	151	151	151	151	151	151	152	152	152	152	152	152	152	153	153	153
175	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153	153	154	154	154	154	154	154
180	155	155	155	155	154	154	154	154	154	154	155	155	155	155	155	155	155	155	155	155	156	156
185	157	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	156	157	157	157	157	157
190	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158
195	160	160	160	160	160	160	160	159	159	159	159	159	159	159	159	159	159	160	160	160	160	160
200	162	162	162	162	161	161	161	161	161	161	161	161	161	161	161	161	161	161	161	161	161	161
205	164	164	164	163	163	163	163	163	163	163	163	163	162	162	162	162	162	162	163	163	163	163
210	166	166	165	165	165	165	165	164	164	164	164	164	164	164	164	164	164	164	164	164	164	164
215	168	167	167	167	167	167	166	166	166	166	166	166	166	166	166	166	165	165	165	165	165	166
220	169	169	169	169	168	168	168	168	168	168	167	167	167	167	167	167	167	167	167	167	167	167
225	171	171	171	170	170	170	170	170	169	169	169	169	169	169	169	169	169	168	168	168	168	168
230	173	173	173	172	172	172	172	171	171	171	171	171	170	170	170	170	170	170	170	170	170	170
235	175	175	174	174	174	174	173	173	173	173	172	172	172	172	172	172	172	172	171	171	171	171
240	177	177	176	176	176	175	175	175	175	174	174	174	174	174	173	173	173	173	173	173	173	173

TABLE 10. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.6000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	121	122	123	124	125	126	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144
5	121	122	123	124	126	127	128	129	130	131	132	134	135	136	137	138	139	140	141	142	144	145
10	121	123	124	125	126	127	128	129	131	132	133	134	135	136	137	138	139	141	142	143	144	145
15	122	123	124	125	126	128	129	130	131	132	133	134	135	137	138	139	140	141	142	143	144	145
20	122	124	125	126	127	128	129	130	132	133	134	135	136	137	138	139	140	141	142	144	145	146
25	123	124	125	126	128	129	130	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146
30	124	125	126	127	128	129	130	132	133	134	135	136	137	138	139	140	141	142	143	144	146	147
35	124	126	127	128	129	130	131	132	133	134	135	136	138	139	140	141	142	143	144	145	146	147
40	125	126	127	128	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	146	147	148
45	126	127	128	129	130	131	132	133	135	136	137	138	139	140	141	142	143	144	145	146	147	148
50	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	143	144	145	146	147	148	149
55	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149
60	128	129	130	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
65	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
70	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
75	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
80	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	148	149	150	151	152
85	133	134	135	136	137	138	139	140	141	142	143	143	144	145	146	147	148	149	150	151	152	153
90	134	135	136	137	138	139	140	141	141	142	143	144	145	146	147	148	149	150	151	152	153	154
95	135	136	137	138	139	140	141	141	142	143	144	145	146	147	148	149	150	151	152	153	153	154
100	136	137	138	139	140	141	142	142	143	144	145	146	147	148	149	150	150	151	152	153	154	155
105	137	138	139	140	141	142	142	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156
110	139	139	140	141	142	143	143	144	145	146	147	148	149	149	150	151	152	153	154	155	156	157
115	140	140	141	142	143	144	144	145	146	147	148	149	149	150	151	152	153	154	155	155	156	157
120	141	142	142	143	144	145	145	146	147	148	149	149	150	151	152	153	154	155	155	156	157	158
125	142	143	143	144	145	146	146	147	148	149	150	150	151	152	153	154	155	155	156	157	158	159
130	143	144	145	145	146	147	147	148	149	150	151	151	152	153	154	155	155	156	157	158	159	160
135	144	145	146	146	147	148	149	149	150	151	152	152	153	154	155	155	156	157	158	159	159	160
140	146	146	147	148	148	149	150	150	151	152	152	153	154	155	156	156	157	158	159	159	160	161
145	147	148	148	149	149	150	151	151	152	153	153	154	155	156	156	157	158	159	160	160	161	162
150	148	149	149	150	150	151	152	152	153	154	154	155	156	157	157	158	159	160	160	161	162	163
155	149	150	151	151	152	152	153	154	154	155	155	156	157	158	158	159	160	161	161	162	163	164
160	151	151	152	152	153	153	154	155	155	156	157	157	158	159	159	160	161	161	162	163	164	164
165	152	152	153	153	154	155	155	156	156	157	158	158	159	160	160	161	162	162	163	164	164	165
170	153	154	154	155	155	156	156	157	157	158	159	159	160	160	161	162	163	163	164	165	165	166
175	155	155	155	156	156	157	157	158	158	159	160	160	161	161	162	163	163	164	165	165	166	167
180	156	156	157	157	158	158	159	159	160	160	161	161	162	162	163	164	164	165	166	166	167	168
185	157	158	158	158	159	159	160	160	161	161	162	162	163	164	164	165	165	166	167	167	168	169
190	159	159	159	160	160	160	161	161	162	162	163	163	164	165	165	166	166	167	168	168	169	170
195	160	160	161	161	161	162	162	163	163	163	164	164	165	166	166	167	167	168	168	169	170	170
200	161	162	162	162	163	163	163	164	164	165	165	166	166	167	167	168	168	169	169	170	171	171
205	163	163	163	164	164	164	165	165	165	166	166	167	167	168	168	169	169	170	170	171	172	172
210	164	164	165	165	165	165	166	166	166	167	167	168	168	169	169	170	170	171	171	172	172	173
215	166	166	166	166	166	167	167	167	168	168	168	169	169	170	170	171	171	172	172	173	173	174
220	167	167	167	167	168	168	168	168	169	169	170	170	170	171	171	172	172	173	173	174	174	175
225	168	169	169	169	169	169	169	170	170	170	171	171	171	172	172	173	173	174	174	175	175	176
230	170	170	170	170	170	170	171	171	171	171	172	172	173	173	173	174	174	175	175	176	176	177
235	171	171	171	171	172	172	172	172	172	173	173	173	174	174	174	175	175	176	176	177	177	178
240	173	173	173	173	173	173	173	173	174	174	174	174	175	175	175	176	176	177	177	178	178	179

TABLE 10. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.6000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	145	148	151	153	156	159	161	164	166	169	171	174	176	179	181	183	186	188	190	193	195	197
5	146	148	151	154	156	159	161	164	166	169	171	174	176	179	181	184	186	188	191	193	195	197
10	146	149	151	154	157	159	162	164	167	169	172	174	177	179	181	184	186	188	191	193	195	198
15	146	149	152	154	157	159	162	164	167	169	172	174	177	179	182	184	186	189	191	193	196	198
20	147	149	152	155	157	160	162	165	167	170	172	175	177	179	182	184	187	189	191	194	196	198
25	147	150	152	155	158	160	163	165	168	170	173	175	177	180	182	185	187	189	191	194	196	198
30	148	150	153	155	158	161	163	166	168	170	173	175	178	180	182	185	187	189	192	194	196	199
35	148	151	153	156	158	161	163	166	168	171	173	176	178	180	183	185	187	190	192	194	197	199
40	149	151	154	156	159	161	164	166	169	171	174	176	178	181	183	185	188	190	192	195	197	199
45	149	152	154	157	159	162	164	167	169	172	174	176	179	181	183	186	188	190	193	195	197	199
50	150	152	155	157	160	162	165	167	170	172	174	177	179	181	184	186	188	191	193	195	198	200
55	150	153	155	158	160	163	165	168	170	172	175	177	180	182	184	186	189	191	193	196	198	200
60	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194	196	198	200
65	151	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	189	192	194	196	198	201
70	152	155	157	159	162	164	167	169	171	174	176	178	181	183	185	188	190	192	194	197	199	201
75	153	155	158	160	162	165	167	169	172	174	177	179	181	183	186	188	190	192	195	197	199	201
80	153	156	158	161	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195	197	200	202
85	154	156	159	161	163	166	168	170	173	175	177	180	182	184	187	189	191	193	195	198	200	202
90	155	157	159	162	164	166	169	171	173	176	178	180	182	185	187	189	191	194	196	198	200	202
95	155	158	160	162	165	167	169	172	174	176	178	181	183	185	187	190	192	194	196	198	201	203
100	156	158	161	163	165	167	170	172	174	177	179	181	183	186	188	190	192	194	197	199	201	203
105	157	159	161	164	166	168	170	173	175	177	179	182	184	186	188	190	193	195	197	199	201	203
110	157	160	162	164	166	169	171	173	175	178	180	182	184	187	189	191	193	195	197	200	202	204
115	158	160	163	165	167	169	171	174	176	178	180	183	185	187	189	191	194	196	198	200	202	204
120	159	161	163	165	168	170	172	174	176	179	181	183	185	187	190	192	194	196	198	200	203	205
125	160	162	164	166	168	170	173	175	177	179	181	184	186	188	190	192	194	197	199	201	203	205
130	160	163	165	167	169	171	173	175	178	180	182	184	186	188	191	193	195	197	199	201	203	205
135	161	163	165	167	170	172	174	176	178	180	182	185	187	189	191	193	195	197	200	202	204	206
140	162	164	166	168	170	172	174	177	179	181	183	185	187	189	192	194	196	198	200	202	204	206
145	163	165	167	169	171	173	175	177	179	181	184	186	188	190	192	194	196	198	200	202	205	207
150	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	195	197	199	201	203	205	207
155	164	166	168	170	172	174	176	178	181	183	185	187	189	191	193	195	197	199	201	203	205	207
160	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	196	198	200	202	204	206	208
165	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208
170	167	169	171	172	174	176	178	180	182	184	186	188	190	192	195	197	199	201	203	205	207	209
175	168	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207	209
180	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210
185	169	171	173	175	177	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210
190	170	172	174	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	206	208	210
195	171	173	174	176	178	180	182	184	185	187	189	191	193	195	197	199	201	203	205	207	209	211
200	172	174	175	177	179	181	182	184	186	188	190	192	194	196	198	200	202	204	205	207	209	211
205	173	174	176	178	180	181	183	185	187	189	191	192	194	196	198	200	202	204	206	208	210	212
210	174	175	177	179	180	182	184	186	187	189	191	193	195	197	199	201	203	205	206	208	210	212
215	175	176	178	179	181	183	185	186	188	190	192	194	196	197	199	201	203	205	207	209	211	213
220	176	177	179	180	182	184	185	187	189	191	192	194	196	198	200	202	204	206	207	209	211	213
225	176	178	179	181	183	184	186	188	189	191	193	195	197	199	200	202	204	206	208	210	212	214
230	177	179	180	182	183	185	187	188	190	192	194	195	197	199	201	203	205	207	208	210	212	214
235	178	180	181	183	184	186	187	189	191	193	194	196	198	200	202	203	205	207	209	211	213	215
240	179	181	182	183	185	187	188	190	191	193	195	197	198	200	202	204	206	208	209	211	213	215

TABLE 10. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.6000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	200	204	209	213	217	221	226	230	234	238	242	246	250	254	258	262	265	269	273	277	280	284
5	200	204	209	213	217	222	226	230	234	238	242	246	250	254	258	262	266	269	273	277	280	284
10	200	204	209	213	217	222	226	230	234	238	242	246	250	254	258	262	266	269	273	277	281	284
15	200	205	209	213	218	222	226	230	234	238	242	246	250	254	258	262	266	270	273	277	281	284
20	200	205	209	214	218	222	226	230	235	239	243	247	251	254	258	262	266	270	273	277	281	284
25	201	205	209	214	218	222	226	231	235	239	243	247	251	255	258	262	266	270	274	277	281	285
30	201	205	210	214	218	223	227	231	235	239	243	247	251	255	259	262	266	270	274	277	281	285
35	201	206	210	214	219	223	227	231	235	239	243	247	251	255	259	263	266	270	274	278	281	285
40	201	206	210	214	219	223	227	231	235	239	243	247	251	255	259	263	267	270	274	278	281	285
45	202	206	210	215	219	223	227	231	236	240	244	248	251	255	259	263	267	270	274	278	281	285
50	202	206	211	215	219	223	228	232	236	240	244	248	252	255	259	263	267	271	274	278	282	285
55	202	207	211	215	219	224	228	232	236	240	244	248	252	256	260	263	267	271	274	278	282	285
60	203	207	211	216	220	224	228	232	236	240	244	248	252	256	260	263	267	271	275	278	282	286
65	203	207	212	216	220	224	228	232	236	240	244	248	252	256	260	264	267	271	275	278	282	286
70	203	208	212	216	220	224	229	233	237	241	245	249	252	256	260	264	268	271	275	279	282	286
75	204	208	212	216	221	225	229	233	237	241	245	249	253	256	260	264	268	272	275	279	282	286
80	204	208	212	217	221	225	229	233	237	241	245	249	253	257	261	264	268	272	275	279	283	286
85	204	209	213	217	221	225	229	233	237	241	245	249	253	257	261	264	268	272	276	279	283	286
90	205	209	213	217	221	226	230	234	238	242	246	249	253	257	261	265	268	272	276	279	283	287
95	205	209	213	218	222	226	230	234	238	242	246	250	254	257	261	265	269	272	276	280	283	287
100	205	210	214	218	222	226	230	234	238	242	246	250	254	258	261	265	269	272	276	280	283	287
105	206	210	214	218	222	226	230	234	238	242	246	250	254	258	262	265	269	273	276	280	284	287
110	206	210	214	219	223	227	231	235	239	243	247	250	254	258	262	266	269	273	277	280	284	287
115	206	211	215	219	223	227	231	235	239	243	247	251	254	258	262	266	269	273	277	280	284	287
120	207	211	215	219	223	227	231	235	239	243	247	251	255	258	262	266	270	273	277	281	284	288
125	207	211	215	220	224	228	232	236	240	243	247	251	255	259	262	266	270	274	277	281	284	288
130	208	212	216	220	224	228	232	236	240	244	248	251	255	259	263	266	270	274	277	281	284	288
135	208	212	216	220	224	228	232	236	240	244	248	252	255	259	263	267	270	274	278	281	285	288
140	208	212	217	221	225	229	233	236	240	244	248	252	256	259	263	267	271	274	278	281	285	288
145	209	213	217	221	225	229	233	237	241	245	248	252	256	260	263	267	271	274	278	282	285	289
150	209	213	217	221	225	229	233	237	241	245	249	252	256	260	264	267	271	275	278	282	285	289
155	209	214	218	222	226	230	233	237	241	245	249	253	256	260	264	268	271	275	278	282	285	289
160	210	214	218	222	226	230	234	238	242	245	249	253	257	260	264	268	271	275	279	282	286	289
165	210	214	218	222	226	230	234	238	242	246	249	253	257	261	264	268	272	275	279	282	286	289
170	211	215	219	223	227	231	234	238	242	246	250	254	257	261	265	268	272	275	279	283	286	290
175	211	215	219	223	227	231	235	239	242	246	250	254	258	261	265	269	272	276	279	283	286	290
180	212	216	219	223	227	231	235	239	243	247	250	254	258	261	265	269	272	276	279	283	287	290
185	212	216	220	224	228	232	235	239	243	247	251	254	258	262	265	269	273	276	280	283	287	290
190	212	216	220	224	228	232	236	240	243	247	251	255	258	262	266	269	273	276	280	283	287	290
195	213	217	221	225	228	232	236	240	244	247	251	255	259	262	266	269	273	277	280	284	287	291
200	213	217	221	225	229	233	236	240	244	248	251	255	259	263	266	270	273	277	280	284	287	291
205	214	218	221	225	229	233	237	241	244	248	252	255	259	263	266	270	274	277	281	284	288	291
210	214	218	222	226	230	233	237	241	245	248	252	256	259	263	267	270	274	277	281	284	288	291
215	215	218	222	226	230	234	237	241	245	249	252	256	260	263	267	270	274	278	281	285	288	291
220	215	219	223	226	230	234	238	242	245	249	253	256	260	264	267	271	274	278	281	285	288	292
225	215	219	223	227	231	234	238	242	246	249	253	257	260	264	267	271	275	278	282	285	288	292
230	216	220	223	227	231	235	239	242	246	250	253	257	261	264	268	271	275	278	282	285	289	292
235	216	220	224	228	231	235	239	243	246	250	254	257	261	264	268	272	275	279	282	286	289	292
240	217	221	224	228	232	236	239	243	247	250	254	257	261	265	268	272	275	279	282	286	289	293

TABLE 10. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.600

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	288	291	295	298	302	305	309	312	315	319	322	326	329	332	335	339	342	345	348	351	355	358
5	288	291	295	298	302	305	309	312	316	319	322	326	329	332	335	339	342	345	348	351	355	358
10	288	291	295	298	302	305	309	312	316	319	322	326	329	332	335	339	342	345	348	352	355	358
15	288	291	295	298	302	305	309	312	316	319	322	326	329	332	336	339	342	345	348	352	355	358
20	288	292	295	299	302	306	309	312	316	319	322	326	329	332	336	339	342	345	348	352	355	358
25	288	292	295	299	302	306	309	313	316	319	323	326	329	332	336	339	342	345	349	352	355	358
30	288	292	295	299	302	306	309	313	316	319	323	326	329	333	336	339	342	345	349	352	355	358
35	288	292	295	299	302	306	309	313	316	319	323	326	329	333	336	339	342	346	349	352	355	358
40	289	292	296	299	303	306	309	313	316	320	323	326	330	333	336	339	342	346	349	352	355	358
45	289	292	296	299	303	306	310	313	316	320	323	326	330	333	336	339	343	346	349	352	355	358
50	289	292	296	299	303	306	310	313	316	320	323	326	330	333	336	339	343	346	349	352	355	358
55	289	293	296	300	303	306	310	313	317	320	323	327	330	333	336	340	343	346	349	352	355	359
60	289	293	296	300	303	307	310	313	317	320	323	327	330	333	336	340	343	346	349	352	356	359
65	289	293	296	300	303	307	310	314	317	320	324	327	330	333	337	340	343	346	349	353	356	359
70	289	293	296	300	303	307	310	314	317	320	324	327	330	333	337	340	343	346	349	353	356	359
75	290	293	297	300	304	307	310	314	317	320	324	327	330	334	337	340	343	346	350	353	356	359
80	290	293	297	300	304	307	311	314	317	321	324	327	330	334	337	340	343	347	350	353	356	359
85	290	293	297	300	304	307	311	314	317	321	324	327	331	334	337	340	344	347	350	353	356	359
90	290	294	297	301	304	307	311	314	318	321	324	327	331	334	337	340	344	347	350	353	356	359
95	290	294	297	301	304	308	311	314	318	321	324	328	331	334	337	341	344	347	350	353	356	359
100	290	294	297	301	304	308	311	315	318	321	324	328	331	334	337	341	344	347	350	353	356	360
105	291	294	298	301	304	308	311	315	318	321	325	328	331	334	338	341	344	347	350	353	357	360
110	291	294	298	301	305	308	311	315	318	321	325	328	331	335	338	341	344	347	350	354	357	360
115	291	294	298	301	305	308	312	315	318	322	325	328	331	335	338	341	344	347	351	354	357	360
120	291	295	298	302	305	308	312	315	318	322	325	328	332	335	338	341	344	348	351	354	357	360
125	291	295	298	302	305	309	312	315	319	322	325	328	332	335	338	341	345	348	351	354	357	360
130	292	295	298	302	305	309	312	315	319	322	325	329	332	335	338	341	345	348	351	354	357	360
135	292	295	299	302	305	309	312	316	319	322	325	329	332	335	338	342	345	348	351	354	357	360
140	292	295	299	302	306	309	312	316	319	322	326	329	332	335	339	342	345	348	351	354	357	361
145	292	296	299	302	306	309	313	316	319	323	326	329	332	336	339	342	345	348	351	354	358	361
150	292	296	299	303	306	309	313	316	319	323	326	329	332	336	339	342	345	348	351	355	358	361
155	292	296	299	303	306	310	313	316	320	323	326	329	333	336	339	342	345	348	352	355	358	361
160	293	296	300	303	306	310	313	316	320	323	326	330	333	336	339	342	345	349	352	355	358	361
165	293	296	300	303	307	310	313	317	320	323	326	330	333	336	339	342	346	349	352	355	358	361
170	293	297	300	303	307	310	313	317	320	323	327	330	333	336	339	343	346	349	352	355	358	361
175	293	297	300	304	307	310	314	317	320	323	327	330	333	336	340	343	346	349	352	355	358	361
180	293	297	300	304	307	310	314	317	320	324	327	330	333	337	340	343	346	349	352	355	358	362
185	294	297	301	304	307	311	314	317	321	324	327	330	334	337	340	343	346	349	352	356	359	362
190	294	297	301	304	307	311	314	317	321	324	327	330	334	337	340	343	346	349	353	356	359	362
195	294	298	301	304	308	311	314	318	321	324	327	331	334	337	340	343	346	350	353	356	359	362
200	294	298	301	304	308	311	314	318	321	324	328	331	334	337	340	343	347	350	353	356	359	362
205	295	298	301	305	308	311	315	318	321	324	328	331	334	337	340	344	347	350	353	356	359	362
210	295	298	302	305	308	312	315	318	321	325	328	331	334	337	341	344	347	350	353	356	359	362
215	295	298	302	305	308	312	315	318	322	325	328	331	334	338	341	344	347	350	353	356	359	362
220	295	299	302	305	309	312	315	318	322	325	328	331	335	338	341	344	347	350	353	356	360	363
225	295	299	302	305	309	312	315	319	322	325	328	332	335	338	341	344	347	350	354	357	360	363
230	296	299	302	306	309	312	316	319	322	325	329	332	335	338	341	344	348	351	354	357	360	363
235	296	299	303	306	309	312	316	319	322	326	329	332	335	338	341	345	348	351	354	357	360	363
240	296	299	303	306	309	313	316	319	322	326	329	332	335	338	342	345	348	351	354	357	360	363

TABLE 11. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.5000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	103	104	105	105	106	107	107	108	108	109	110	110	111	111	112	113	113	114	114	115	116	116
5	104	105	105	106	106	107	108	108	109	109	110	111	111	112	112	113	114	114	115	115	116	117
10	105	105	106	107	107	108	108	109	110	110	111	111	112	113	113	114	114	115	116	116	117	117
15	106	106	107	107	108	109	109	110	110	111	112	112	113	113	114	115	115	116	116	117	117	118
20	107	107	108	108	109	110	110	111	111	112	112	113	114	114	115	115	116	116	117	118	118	119
25	108	108	109	109	110	111	111	112	112	113	113	114	115	115	116	116	117	117	118	119	119	120
30	109	109	110	111	111	112	112	113	113	114	114	115	116	116	117	117	118	118	119	119	120	121
35	110	111	111	112	112	113	113	114	114	115	116	116	117	117	118	118	119	119	120	120	121	122
40	112	112	113	113	114	114	115	115	116	116	117	117	118	118	119	119	120	120	121	122	122	123
45	113	113	114	114	115	115	116	116	117	117	118	119	119	120	120	121	121	122	122	123	123	124
50	115	115	115	116	116	117	117	118	118	119	119	120	120	121	121	122	122	123	123	124	124	125
55	116	117	117	117	118	118	119	119	120	120	121	121	122	122	123	123	124	124	125	125	126	126
60	118	118	119	119	120	120	120	121	121	122	122	123	123	124	124	124	125	125	126	126	127	127
65	120	120	120	121	121	122	122	122	123	123	124	124	125	125	125	126	126	127	127	128	128	129
70	122	122	122	123	123	123	124	124	124	125	125	126	126	126	127	127	128	128	129	129	129	130
75	123	124	124	124	125	125	125	126	126	127	127	127	128	128	128	129	129	130	130	130	131	131
80	125	126	126	126	127	127	127	128	128	128	129	129	129	130	130	130	131	131	131	132	132	133
85	128	128	128	128	129	129	129	129	130	130	130	131	131	131	132	132	132	133	133	133	134	134
90	130	130	130	130	131	131	131	131	132	132	132	132	133	133	133	134	134	134	135	135	135	136
95	132	132	132	132	133	133	133	133	133	134	134	134	134	135	135	135	136	136	136	137	137	137
100	134	134	134	134	135	135	135	135	135	136	136	136	136	136	137	137	137	138	138	138	138	139
105	136	136	137	137	137	137	137	137	137	138	138	138	138	138	139	139	139	139	140	140	140	140
110	139	139	139	139	139	139	139	139	139	140	140	140	140	140	140	141	141	141	141	141	142	142
115	141	141	141	141	141	141	141	141	141	142	142	142	142	142	142	142	143	143	143	143	143	144
120	144	143	143	143	143	143	143	143	143	144	144	144	144	144	144	144	144	145	145	145	145	145
125	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	146	147	147	147	147
130	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	148	149	149	149
135	151	151	151	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	151	151
140	153	153	153	153	153	153	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152	152
145	156	156	155	155	155	155	155	155	154	154	154	154	154	154	154	154	154	154	154	154	154	154
150	159	158	158	158	157	157	157	157	157	156	156	156	156	156	156	156	156	156	156	156	156	156
155	161	161	160	160	160	160	159	159	159	159	159	158	158	158	158	158	158	158	158	158	158	158
160	164	163	163	163	162	162	162	161	161	161	161	161	160	160	160	160	160	160	160	160	160	160
165	166	166	165	165	165	164	164	164	163	163	163	163	163	162	162	162	162	162	162	162	162	162
170	169	168	168	168	167	167	166	166	166	165	165	165	165	165	164	164	164	164	164	164	164	164
175	171	171	170	170	170	169	169	168	168	168	167	167	167	167	167	166	166	166	166	166	166	166
180	174	174	173	173	172	172	171	171	170	170	170	169	169	169	169	168	168	168	168	168	168	168
185	177	176	176	175	174	174	174	173	173	172	172	172	171	171	171	171	170	170	170	170	170	169
190	179	179	178	177	177	176	176	175	175	175	174	174	174	173	173	173	172	172	172	172	172	171
195	182	181	181	180	179	179	178	178	177	177	177	176	176	175	175	175	175	174	174	174	174	173
200	184	184	183	182	182	181	181	180	180	179	179	178	178	178	177	177	177	176	176	176	176	175
205	187	186	186	185	184	184	183	183	182	182	181	181	180	180	179	179	179	178	178	178	178	177
210	190	189	188	187	187	186	186	185	184	184	183	183	182	182	182	181	181	181	180	180	180	179
215	192	191	191	190	189	189	188	187	187	186	186	185	185	184	184	183	183	183	182	182	182	181
220	195	194	193	192	192	191	190	190	189	189	188	187	187	186	186	186	185	185	184	184	184	183
225	197	197	196	195	194	193	193	192	191	191	190	190	189	189	188	188	187	187	186	186	186	185
230	200	199	198	197	197	196	195	194	194	193	193	192	191	191	190	190	189	189	189	188	188	187
235	203	202	201	200	199	198	198	197	196	195	195	194	194	193	193	192	192	191	191	190	190	189
240	205	204	203	202	202	201	200	199	199	198	197	197	196	195	195	194	194	193	193	192	192	191

TABLE 11. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.5000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	117	119	120	121	122	123	124	126	127	128	129	130	131	132	134	135	136	137	138	139	140	141
5	118	119	120	121	123	124	125	126	127	128	129	131	132	133	134	135	136	137	138	139	140	142
10	118	120	121	122	123	124	125	127	128	129	130	131	132	133	134	135	137	138	139	140	141	142
15	119	120	121	123	124	125	126	127	128	129	131	132	133	134	135	136	137	138	139	140	141	143
20	120	121	122	123	124	126	127	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143
25	121	122	123	124	125	126	127	129	130	131	132	133	134	135	136	137	138	139	140	142	143	144
30	122	123	124	125	126	127	128	129	130	132	133	134	135	136	137	138	139	140	141	142	143	144
35	123	124	125	126	127	128	129	130	131	132	133	134	136	137	138	139	140	141	142	143	144	145
40	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	142	143	144	145	146
45	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146
50	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147
55	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148
60	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149
65	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	148	149
70	131	132	133	133	134	135	136	137	138	139	140	141	142	143	144	145	146	146	147	148	149	150
75	132	133	134	135	136	136	137	138	139	140	141	142	143	144	145	146	146	147	148	149	150	151
80	133	134	135	136	137	138	138	139	140	141	142	143	144	145	146	147	147	148	149	150	151	152
85	135	136	136	137	138	139	140	141	141	142	143	144	145	146	147	148	148	149	150	151	152	153
90	136	137	138	139	139	140	141	142	143	143	144	145	146	147	148	149	149	150	151	152	153	154
95	138	139	139	140	141	141	142	143	144	145	145	146	147	148	149	150	150	151	152	153	154	155
100	139	140	141	141	142	143	144	144	145	146	147	147	148	149	150	151	151	152	153	154	155	156
105	141	142	142	143	143	144	145	146	146	147	148	149	149	150	151	152	153	153	154	155	156	157
110	143	143	144	144	145	146	146	147	148	148	149	150	151	151	152	153	154	154	155	156	157	158
115	144	145	145	146	146	147	148	148	149	150	150	151	152	152	153	154	155	155	156	157	158	159
120	146	146	147	147	148	148	149	150	150	151	152	152	153	154	154	155	156	157	157	158	159	160
125	147	148	148	149	149	150	150	151	152	152	153	154	154	155	156	156	157	158	158	159	160	161
130	149	150	150	150	151	151	152	152	153	154	154	155	155	156	157	157	158	159	160	160	161	162
135	151	151	152	152	152	153	153	154	154	155	156	156	157	157	158	159	159	160	161	161	162	163
140	153	153	153	154	154	154	155	155	156	156	157	157	158	159	159	160	160	161	162	162	163	164
145	154	155	155	155	156	156	156	157	157	158	158	159	159	160	160	161	162	162	163	164	164	165
150	156	156	157	157	157	158	158	158	159	159	160	160	161	161	162	162	163	164	164	165	165	166
155	158	158	158	159	159	159	159	160	160	161	161	162	162	163	163	164	164	165	165	166	167	167
160	160	160	160	160	160	161	161	161	162	162	162	163	163	164	164	165	165	166	166	167	168	168
165	162	162	162	162	162	162	163	163	163	164	164	164	165	165	166	166	167	167	168	168	169	169
170	164	164	164	164	164	164	164	164	165	165	165	166	166	167	167	167	168	168	169	169	170	171
175	165	165	165	165	165	166	166	166	166	167	167	167	168	168	168	169	169	170	170	171	171	172
180	167	167	167	167	167	167	167	168	168	168	168	169	169	169	170	170	170	171	171	172	172	173
185	169	169	169	169	169	169	169	169	169	170	170	170	170	171	171	171	172	172	173	173	174	174
190	171	171	171	171	171	171	171	171	171	171	171	171	171	172	172	172	173	173	174	174	175	175
195	173	173	173	172	172	172	172	172	172	173	173	173	173	173	174	174	174	175	175	176	176	176
200	175	175	174	174	174	174	174	174	174	174	174	174	175	175	175	175	176	176	176	177	177	178
205	177	177	176	176	176	176	176	176	176	176	176	176	176	176	177	177	177	177	178	178	178	179
210	179	178	178	178	178	177	177	177	177	177	177	177	178	178	178	178	178	179	179	179	180	180
215	181	180	180	180	179	179	179	179	179	179	179	179	179	179	179	180	180	180	180	181	181	181
220	183	182	182	181	181	181	181	181	180	180	180	180	181	181	181	181	181	181	182	182	182	183
225	185	184	184	183	183	183	182	182	182	182	182	182	182	182	182	182	183	183	183	183	184	184
230	187	186	186	185	185	184	184	184	184	184	184	184	184	184	184	184	184	184	184	185	185	185
235	189	188	187	187	187	186	186	186	185	185	185	185	185	185	185	185	185	185	186	186	186	186
240	191	190	189	189	188	188	188	187	187	187	187	187	187	187	187	187	187	187	187	187	187	188

TABLE 11. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.5000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	142	145	148	150	153	156	158	161	163	166	168	171	173	176	178	180	183	185	187	190	192	194
5	143	145	148	151	153	156	158	161	163	166	168	171	173	176	178	181	183	185	188	190	192	195
10	143	146	148	151	154	156	159	161	164	166	169	171	174	176	179	181	183	186	188	190	193	195
15	144	146	149	152	154	157	159	162	164	167	169	172	174	176	179	181	184	186	188	191	193	195
20	144	147	149	152	155	157	160	162	165	167	170	172	174	177	179	182	184	186	189	191	193	195
25	145	147	150	153	155	158	160	163	165	168	170	172	175	177	180	182	184	187	189	191	193	196
30	145	148	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	192	194	196
35	146	149	151	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194	196
40	147	149	152	154	157	159	162	164	167	169	171	174	176	179	181	183	185	188	190	192	195	197
45	147	150	152	155	157	160	162	165	167	170	172	174	177	179	181	184	186	188	190	193	195	197
50	148	151	153	156	158	160	163	165	168	170	172	175	177	179	182	184	186	189	191	193	195	198
55	149	151	154	156	159	161	163	166	168	171	173	175	178	180	182	185	187	189	191	194	196	198
60	150	152	154	157	159	162	164	166	169	171	174	176	178	180	183	185	187	190	192	194	196	198
65	150	153	155	158	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	194	197	199
70	151	154	156	158	161	163	165	168	170	172	175	177	179	182	184	186	188	190	193	195	197	199
75	152	154	157	159	161	164	166	168	171	173	175	178	180	182	184	187	189	191	193	195	198	200
80	153	155	158	160	162	164	167	169	171	174	176	178	180	183	185	187	189	191	194	196	198	200
85	154	156	158	161	163	165	167	170	172	174	176	179	181	183	185	188	190	192	194	196	198	201
90	155	157	159	161	164	166	168	170	173	175	177	179	182	184	186	188	190	192	195	197	199	201
95	156	158	160	162	164	167	169	171	173	175	178	180	182	184	186	189	191	193	195	197	199	202
100	157	159	161	163	165	167	170	172	174	176	178	181	183	185	187	189	191	194	196	198	200	202
105	157	160	162	164	166	168	170	172	175	177	179	181	183	185	188	190	192	194	196	198	200	202
110	158	161	163	165	167	169	171	173	175	178	180	182	184	186	188	190	192	195	197	199	201	203
115	159	161	163	166	168	170	172	174	176	178	180	182	185	187	189	191	193	195	197	199	201	203
120	160	162	164	166	168	171	173	175	177	179	181	183	185	187	189	192	194	196	198	200	202	204
125	161	163	165	167	169	171	173	175	178	180	182	184	186	188	190	192	194	196	198	200	202	204
130	162	164	166	168	170	172	174	176	178	180	182	184	187	189	191	193	195	197	199	201	203	205
135	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	206
140	165	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206
145	166	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207
150	167	168	170	172	174	176	178	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207
155	168	169	171	173	175	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208
160	169	170	172	174	176	177	179	181	183	185	187	189	191	193	194	196	198	200	202	204	206	208
165	170	172	173	175	177	178	180	182	184	186	187	189	191	193	195	197	199	201	203	205	207	209
170	171	173	174	176	177	179	181	183	185	186	188	190	192	194	196	198	200	202	203	205	207	209
175	172	174	175	177	178	180	182	184	185	187	189	191	193	195	196	198	200	202	204	206	208	210
180	173	175	176	178	179	181	183	184	186	188	190	192	193	195	197	199	201	203	205	207	208	210
185	175	176	177	179	180	182	184	185	187	189	191	192	194	196	198	200	202	203	205	207	209	211
190	176	177	178	180	181	183	185	186	188	190	191	193	195	197	199	200	202	204	206	208	210	212
195	177	178	179	181	182	184	185	187	189	190	192	194	196	197	199	201	203	205	207	208	210	212
200	178	179	181	182	183	185	186	188	190	191	193	195	196	198	200	202	204	205	207	209	211	213
205	179	180	182	183	184	186	187	189	190	192	194	195	197	199	201	202	204	206	208	210	211	213
210	180	182	183	184	185	187	188	190	191	193	195	196	198	200	201	203	205	207	208	210	212	214
215	182	183	184	185	186	188	189	191	192	194	195	197	199	200	202	204	206	207	209	211	213	214
220	183	184	185	186	187	189	190	192	193	195	196	198	199	201	203	204	206	208	210	211	213	215
225	184	185	186	187	188	190	191	192	194	195	197	199	200	202	204	205	207	209	210	212	214	216
230	185	186	187	188	189	191	192	193	195	196	198	199	201	203	204	206	208	209	211	213	214	216
235	187	187	188	189	190	192	193	194	196	197	199	200	202	203	205	207	208	210	212	213	215	217
240	188	189	189	190	192	193	194	195	197	198	199	201	203	204	206	207	209	211	212	214	216	217

TABLE 11. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.5000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	197	201	206	210	214	219	223	227	231	235	239	243	247	251	255	259	262	266	270	273	277	281
5	197	201	206	210	214	219	223	227	231	235	239	243	247	251	255	259	262	266	270	273	277	281
10	197	202	206	210	215	219	223	227	231	235	239	243	247	251	255	259	263	266	270	274	277	281
15	197	202	206	211	215	219	223	227	232	236	240	244	247	251	255	259	263	266	270	274	277	281
20	198	202	207	211	215	219	224	228	232	236	240	244	248	252	255	259	263	267	270	274	278	281
25	198	202	207	211	215	220	224	228	232	236	240	244	248	252	256	259	263	267	270	274	278	281
30	198	203	207	211	216	220	224	228	232	236	240	244	248	252	256	260	263	267	271	274	278	281
35	199	203	207	212	216	220	224	228	233	237	241	244	248	252	256	260	263	267	271	274	278	282
40	199	203	208	212	216	221	225	229	233	237	241	245	249	252	256	260	264	267	271	275	278	282
45	199	204	208	212	217	221	225	229	233	237	241	245	249	253	256	260	264	268	271	275	278	282
50	200	204	208	213	217	221	225	229	233	237	241	245	249	253	257	260	264	268	271	275	279	282
55	200	205	209	213	217	221	226	230	234	238	242	245	249	253	257	261	264	268	272	275	279	282
60	201	205	209	213	218	222	226	230	234	238	242	246	250	253	257	261	265	268	272	276	279	283
65	201	205	210	214	218	222	226	230	234	238	242	246	250	254	257	261	265	269	272	276	279	283
70	201	206	210	214	218	222	227	231	235	239	242	246	250	254	258	261	265	269	272	276	280	283
75	202	206	210	215	219	223	227	231	235	239	243	247	250	254	258	262	265	269	273	276	280	283
80	202	207	211	215	219	223	227	231	235	239	243	247	251	254	258	262	266	269	273	276	280	284
85	203	207	211	215	219	224	228	232	236	239	243	247	251	255	258	262	266	270	273	277	280	284
90	203	207	212	216	220	224	228	232	236	240	244	247	251	255	259	262	266	270	273	277	280	284
95	204	208	212	216	220	224	228	232	236	240	244	248	252	255	259	263	266	270	274	277	281	284
100	204	208	212	217	221	225	229	233	237	240	244	248	252	256	259	263	267	270	274	277	281	284
105	205	209	213	217	221	225	229	233	237	241	245	248	252	256	260	263	267	271	274	278	281	285
110	205	209	213	217	221	225	229	233	237	241	245	249	252	256	260	264	267	271	274	278	281	285
115	206	210	214	218	222	226	230	234	238	241	245	249	253	256	260	264	267	271	275	278	282	285
120	206	210	214	218	222	226	230	234	238	242	246	249	253	257	260	264	268	271	275	278	282	285
125	207	211	215	219	223	227	231	234	238	242	246	250	253	257	261	264	268	272	275	279	282	286
130	207	211	215	219	223	227	231	235	239	242	246	250	254	257	261	265	268	272	275	279	282	286
135	208	212	216	220	223	227	231	235	239	243	247	250	254	258	261	265	269	272	276	279	283	286
140	208	212	216	220	224	228	232	236	239	243	247	251	254	258	262	265	269	272	276	279	283	286
145	209	213	217	220	224	228	232	236	240	244	247	251	255	258	262	266	269	273	276	280	283	287
150	209	213	217	221	225	229	233	236	240	244	248	251	255	259	262	266	269	273	276	280	283	287
155	210	214	217	221	225	229	233	237	240	244	248	252	255	259	263	266	270	273	277	280	284	287
160	210	214	218	222	226	230	233	237	241	245	248	252	256	259	263	266	270	274	277	281	284	287
165	211	215	218	222	226	230	234	238	241	245	249	252	256	260	263	267	270	274	277	281	284	288
170	211	215	219	223	227	230	234	238	242	245	249	253	256	260	264	267	271	274	278	281	285	288
175	212	216	219	223	227	231	235	238	242	246	249	253	257	260	264	267	271	274	278	281	285	288
180	212	216	220	224	227	231	235	239	242	246	250	253	257	261	264	268	271	275	278	282	285	288
185	213	217	220	224	228	232	235	239	243	246	250	254	257	261	264	268	272	275	278	282	285	289
190	213	217	221	225	228	232	236	240	243	247	251	254	258	261	265	268	272	275	279	282	286	289
195	214	218	221	225	229	233	236	240	244	247	251	254	258	262	265	269	272	276	279	282	286	289
200	215	218	222	226	229	233	237	240	244	248	251	255	258	262	265	269	272	276	279	283	286	290
205	215	219	222	226	230	233	237	241	244	248	252	255	259	262	266	269	273	276	280	283	286	290
210	216	219	223	227	230	234	238	241	245	248	252	256	259	263	266	270	273	277	280	283	287	290
215	216	220	223	227	231	234	238	242	245	249	252	256	259	263	266	270	273	277	280	284	287	290
220	217	220	224	228	231	235	238	242	246	249	253	256	260	263	267	270	274	277	281	284	287	291
225	217	221	225	228	232	235	239	242	246	250	253	257	260	264	267	271	274	277	281	284	288	291
230	218	222	225	229	232	236	239	243	246	250	254	257	261	264	267	271	274	278	281	285	288	291
235	219	222	226	229	233	236	240	243	247	250	254	257	261	264	268	271	275	278	281	285	288	291
240	219	223	226	230	233	237	240	244	247	251	254	258	261	265	268	272	275	278	282	285	288	292

TABLE 11. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.5000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	284	288	291	295	298	302	305	308	312	315	318	322	325	328	331	334	338	341	344	347	350	353
5	284	288	291	295	298	302	305	308	312	315	318	322	325	328	331	334	338	341	344	347	350	353
10	284	288	291	295	298	302	305	308	312	315	318	322	325	328	331	335	338	341	344	347	350	353
15	285	288	292	295	298	302	305	309	312	315	319	322	325	328	331	335	338	341	344	347	350	353
20	285	288	292	295	299	302	305	309	312	315	319	322	325	328	332	335	338	341	344	347	350	353
25	285	288	292	295	299	302	306	309	312	316	319	322	325	329	332	335	338	341	344	347	351	354
30	285	289	292	295	299	302	306	309	312	316	319	322	325	329	332	335	338	341	344	348	351	354
35	285	289	292	296	299	302	306	309	313	316	319	322	326	329	332	335	338	341	345	348	351	354
40	285	289	292	296	299	303	306	309	313	316	319	323	326	329	332	335	338	342	345	348	351	354
45	286	289	293	296	299	303	306	310	313	316	319	323	326	329	332	335	339	342	345	348	351	354
50	286	289	293	296	300	303	306	310	313	316	320	323	326	329	332	336	339	342	345	348	351	354
55	286	289	293	296	300	303	307	310	313	316	320	323	326	329	333	336	339	342	345	348	351	354
60	286	290	293	297	300	303	307	310	313	317	320	323	326	330	333	336	339	342	345	348	351	354
65	286	290	293	297	300	304	307	310	314	317	320	323	327	330	333	336	339	342	345	348	352	355
70	287	290	294	297	300	304	307	310	314	317	320	323	327	330	333	336	339	342	346	349	352	355
75	287	290	294	297	301	304	307	311	314	317	320	324	327	330	333	336	339	343	346	349	352	355
80	287	290	294	297	301	304	307	311	314	317	321	324	327	330	333	337	340	343	346	349	352	355
85	287	291	294	298	301	304	308	311	314	318	321	324	327	330	334	337	340	343	346	349	352	355
90	287	291	294	298	301	305	308	311	314	318	321	324	327	331	334	337	340	343	346	349	352	355
95	288	291	295	298	301	305	308	311	315	318	321	324	328	331	334	337	340	343	346	349	352	355
100	288	291	295	298	302	305	308	312	315	318	321	325	328	331	334	337	340	343	346	350	353	356
105	288	292	295	298	302	305	308	312	315	318	321	325	328	331	334	337	340	344	347	350	353	356
110	288	292	295	299	302	305	309	312	315	318	322	325	328	331	334	338	341	344	347	350	353	356
115	289	292	295	299	302	306	309	312	315	319	322	325	328	331	335	338	341	344	347	350	353	356
120	289	292	296	299	302	306	309	312	316	319	322	325	328	332	335	338	341	344	347	350	353	356
125	289	293	296	299	303	306	309	313	316	319	322	325	329	332	335	338	341	344	347	350	353	356
130	289	293	296	299	303	306	309	313	316	319	322	326	329	332	335	338	341	344	347	350	354	357
135	290	293	296	300	303	306	310	313	316	319	323	326	329	332	335	338	341	345	348	351	354	357
140	290	293	297	300	303	307	310	313	316	320	323	326	329	332	335	339	342	345	348	351	354	357
145	290	293	297	300	304	307	310	313	317	320	323	326	329	332	336	339	342	345	348	351	354	357
150	290	294	297	300	304	307	310	314	317	320	323	326	330	333	336	339	342	345	348	351	354	357
155	291	294	297	301	304	307	311	314	317	320	323	327	330	333	336	339	342	345	348	351	354	357
160	291	294	298	301	304	307	311	314	317	320	324	327	330	333	336	339	342	345	348	351	355	358
165	291	294	298	301	304	308	311	314	317	321	324	327	330	333	336	339	343	346	349	352	355	358
170	291	295	298	301	305	308	311	314	318	321	324	327	330	333	337	340	343	346	349	352	355	358
175	292	295	298	302	305	308	311	315	318	321	324	327	331	334	337	340	343	346	349	352	355	358
180	292	295	299	302	305	308	312	315	318	321	324	328	331	334	337	340	343	346	349	352	355	358
185	292	295	299	302	305	309	312	315	318	321	325	328	331	334	337	340	343	346	349	352	355	358
190	292	296	299	302	306	309	312	315	318	322	325	328	331	334	337	340	343	346	350	353	356	359
195	293	296	299	303	306	309	312	316	319	322	325	328	331	334	338	341	344	347	350	353	356	359
200	293	296	300	303	306	309	313	316	319	322	325	328	332	335	338	341	344	347	350	353	356	359
205	293	296	300	303	306	310	313	316	319	322	325	329	332	335	338	341	344	347	350	353	356	359
210	293	297	300	303	307	310	313	316	319	323	326	329	332	335	338	341	344	347	350	353	356	359
215	294	297	300	304	307	310	313	316	320	323	326	329	332	335	338	341	344	347	350	353	356	359
220	294	297	301	304	307	310	313	317	320	323	326	329	332	335	338	342	345	348	351	354	357	360
225	294	298	301	304	307	311	314	317	320	323	326	329	333	336	339	342	345	348	351	354	357	360
230	294	298	301	304	308	311	314	317	320	323	327	330	333	336	339	342	345	348	351	354	357	360
235	295	298	301	305	308	311	314	317	321	324	327	330	333	336	339	342	345	348	351	354	357	360
240	295	298	302	305	308	311	314	318	321	324	327	330	333	336	339	342	345	348	351	354	357	360

TABLE 12. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.4000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	100	101	102	102	103	104	104	105	105	106	107	107	108	108	109	110	110	111	111	112	113	113
5	101	102	102	103	104	104	105	105	106	107	107	108	108	109	110	110	111	111	112	113	113	114
10	102	103	103	104	104	105	106	106	107	107	108	109	109	110	110	111	112	112	113	113	114	115
15	103	104	104	105	106	106	107	107	108	109	109	110	110	111	111	112	113	113	114	114	115	115
20	105	105	106	106	107	107	108	109	109	110	110	111	111	112	113	113	114	114	115	115	116	117
25	106	107	107	108	108	109	109	110	110	111	112	112	113	113	114	114	115	115	116	117	117	118
30	108	108	109	109	110	110	111	111	112	112	113	114	114	115	115	116	116	117	117	118	118	119
35	109	110	110	111	111	112	112	113	113	114	114	115	116	116	117	117	118	118	119	119	120	120
40	111	112	112	113	113	114	114	115	115	116	116	117	117	118	118	119	119	120	120	121	121	122
45	113	114	114	115	115	116	116	116	117	117	118	118	119	119	120	120	121	121	122	122	123	123
50	116	116	116	117	117	118	118	118	119	119	120	120	121	121	121	122	122	123	123	124	124	125
55	118	118	119	119	119	120	120	121	121	121	122	122	122	123	123	124	124	125	125	125	126	126
60	121	121	121	121	122	122	122	123	123	123	124	124	124	125	125	126	126	126	127	127	128	128
65	123	124	124	124	124	124	125	125	125	126	126	126	127	127	127	128	128	128	129	129	129	130
70	126	126	126	127	127	127	127	127	128	128	128	128	129	129	129	130	130	130	131	131	131	132
75	129	129	129	129	129	130	130	130	130	130	131	131	131	131	132	132	132	132	133	133	133	134
80	132	132	132	132	132	132	132	133	133	133	133	133	133	134	134	134	134	134	135	135	135	136
85	135	135	135	135	135	135	135	135	135	135	136	136	136	136	136	136	137	137	137	137	137	138
90	139	138	138	138	138	138	138	138	138	138	138	138	138	138	139	139	139	139	139	139	140	140
95	142	142	142	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	142	142	142
100	145	145	145	145	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144
105	149	149	148	148	148	147	147	147	147	147	146	146	146	146	146	146	146	146	146	146	146	147
110	153	152	152	151	151	151	150	150	150	150	149	149	149	149	149	149	149	149	149	149	149	149
115	156	156	155	155	154	154	153	153	153	153	152	152	152	152	152	152	151	151	151	151	151	151
120	160	159	159	158	158	157	157	156	156	156	155	155	155	155	154	154	154	154	154	154	154	154
125	163	163	162	162	161	160	160	159	159	159	158	158	158	157	157	157	157	157	157	156	156	156
130	167	166	166	165	164	164	163	163	162	162	161	161	161	160	160	160	160	159	159	159	159	159
135	171	170	169	169	168	167	167	166	165	165	164	164	164	163	163	163	162	162	162	162	161	161
140	175	174	173	172	171	171	170	169	169	168	168	167	167	166	166	165	165	165	165	164	164	164
145	178	177	176	176	175	174	173	173	172	171	171	170	170	169	169	168	168	168	167	167	167	166
150	182	181	180	179	178	177	177	176	175	174	174	173	173	172	172	171	171	170	170	170	169	169
155	186	185	184	183	182	181	180	179	178	178	177	176	176	175	175	174	174	173	173	172	172	172
160	189	188	187	186	185	184	183	182	182	181	180	179	179	178	178	177	177	176	176	175	175	174
165	193	192	191	190	189	188	187	186	185	184	183	183	182	181	181	180	179	179	178	178	177	177
170	197	195	194	193	192	191	190	189	188	187	186	186	185	184	184	183	182	182	181	181	180	180
175	200	199	198	197	195	194	193	192	191	190	190	189	188	187	187	186	185	185	184	183	183	182
180	204	202	201	200	199	198	197	196	195	194	193	192	191	190	190	189	188	187	187	186	186	185
185	207	206	205	203	202	201	200	199	198	197	196	195	194	193	192	192	191	190	190	189	188	188
190	211	210	208	207	206	204	203	202	201	200	199	198	197	196	195	195	194	193	192	192	191	191
195	214	213	212	210	209	208	207	205	204	203	202	201	200	199	198	198	197	196	195	195	194	193
200	218	217	215	214	212	211	210	209	208	206	205	204	203	202	201	201	200	199	198	197	197	196
205	221	220	219	217	216	214	213	212	211	210	208	207	206	205	204	203	203	202	201	200	199	199
210	225	223	222	220	219	218	216	215	214	213	212	210	209	208	207	206	206	205	204	203	202	201
215	228	227	225	224	222	221	220	218	217	216	215	214	212	211	210	209	208	207	207	206	205	204
220	232	230	229	227	226	224	223	222	220	219	218	217	215	214	213	212	211	210	209	209	208	207
225	235	234	232	230	229	227	226	225	223	222	221	220	218	217	216	215	214	213	212	211	210	210
230	239	237	235	234	232	231	229	228	227	225	224	223	221	220	219	218	217	216	215	214	213	212
235	242	240	239	237	235	234	232	231	230	228	227	226	224	223	222	221	220	219	218	217	216	215
240	245	244	242	240	239	237	236	234	233	231	230	229	227	226	225	224	223	222	221	220	219	218

TABLE 12. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.4000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	114	116	117	118	119	120	121	123	124	125	126	127	128	129	131	132	133	134	135	136	137	138
5	115	116	117	118	120	121	122	123	124	125	126	128	129	130	131	132	133	134	135	136	138	139
10	116	117	118	119	120	121	123	124	125	126	127	128	129	130	132	133	134	135	136	137	138	139
15	117	118	119	120	121	122	123	125	126	127	128	129	130	131	132	133	134	136	137	138	139	140
20	118	119	120	121	122	123	124	125	127	128	129	130	131	132	133	134	135	136	137	138	140	141
25	119	120	121	122	123	124	125	126	127	129	130	131	132	133	134	135	136	137	138	139	140	141
30	120	121	122	123	124	125	126	127	128	130	131	132	133	134	135	136	137	138	139	140	141	142
35	121	122	123	124	125	126	127	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
40	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
45	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145
50	126	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146
55	127	128	129	130	131	132	133	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147
60	129	130	130	131	132	133	134	135	136	137	138	138	139	140	141	142	143	144	145	146	147	148
65	130	131	132	133	134	135	135	136	137	138	139	140	141	142	142	143	144	145	146	147	148	149
70	132	133	134	135	135	136	137	138	139	139	140	141	142	143	144	145	145	146	147	148	149	150
75	134	135	136	136	137	138	138	139	140	141	142	142	143	144	145	146	147	148	148	149	150	151
80	136	137	137	138	139	139	140	141	142	142	143	144	145	146	146	147	148	149	150	150	151	152
85	138	139	139	140	140	141	142	142	143	144	145	145	146	147	148	148	149	150	151	152	153	153
90	140	141	141	142	142	143	144	144	145	145	146	147	148	148	149	150	151	151	152	153	154	155
95	142	143	143	144	144	145	145	146	146	147	148	148	149	150	151	151	152	153	153	154	155	156
100	145	145	145	146	146	147	147	148	148	149	149	150	151	151	152	153	153	154	155	156	156	157
105	147	147	147	148	148	148	149	149	150	150	151	152	152	153	153	154	155	155	156	157	158	158
110	149	149	149	150	150	150	151	151	152	152	153	153	154	154	155	156	156	157	158	158	159	160
115	151	151	152	152	152	152	153	153	154	154	154	155	155	156	157	157	158	158	159	160	160	161
120	154	154	154	154	154	154	155	155	155	156	156	157	157	158	158	159	159	160	160	161	162	162
125	156	156	156	156	156	156	157	157	157	158	158	158	159	159	160	160	161	161	162	162	163	164
130	159	158	158	158	158	159	159	159	159	159	160	160	161	161	161	162	162	163	163	164	165	165
135	161	161	161	161	161	161	161	161	161	161	162	162	162	163	163	163	164	164	165	165	166	167
140	163	163	163	163	163	163	163	163	163	163	163	164	164	164	165	165	166	166	166	167	167	168
145	166	166	165	165	165	165	165	165	165	165	165	166	166	166	166	167	167	168	168	168	169	169
150	169	168	168	167	167	167	167	167	167	167	167	167	168	168	168	168	169	169	170	170	170	171
155	171	171	170	170	170	169	169	169	169	169	169	169	169	170	170	170	170	171	171	172	172	172
160	174	173	173	172	172	172	171	171	171	171	171	171	171	171	172	172	172	172	173	173	173	174
165	176	176	175	175	174	174	174	173	173	173	173	173	173	173	173	174	174	174	174	175	175	175
170	179	178	178	177	176	176	176	176	175	175	175	175	175	175	175	175	176	176	176	176	177	177
175	181	181	180	179	179	178	178	178	177	177	177	177	177	177	177	177	177	177	178	178	178	178
180	184	183	182	182	181	181	180	180	180	179	179	179	179	179	179	179	179	179	179	180	180	180
185	187	186	185	184	184	183	182	182	182	181	181	181	181	181	181	181	181	181	181	181	181	182
190	189	188	187	187	186	185	185	184	184	183	183	183	183	183	183	183	183	183	183	183	183	183
195	192	191	190	189	188	188	187	186	186	186	185	185	185	185	184	184	184	184	184	185	185	185
200	195	194	192	192	191	190	189	189	188	188	187	187	187	186	186	186	186	186	186	186	186	186
205	197	196	195	194	193	192	192	191	190	190	189	189	189	188	188	188	188	188	188	188	188	188
210	200	199	198	196	195	195	194	193	192	192	191	191	191	190	190	190	190	190	190	190	190	190
215	203	201	200	199	198	197	196	195	195	194	194	193	193	192	192	192	192	191	191	191	191	191
220	205	204	203	201	200	199	198	198	197	196	196	195	195	194	194	194	193	193	193	193	193	193
225	208	206	205	204	203	202	201	200	199	198	198	197	197	196	196	196	195	195	195	195	195	195
230	211	209	208	206	205	204	203	202	201	200	200	199	199	198	198	197	197	197	197	196	196	196
235	213	212	210	209	208	206	205	204	203	203	202	201	201	200	200	199	199	199	198	198	198	198
240	216	214	213	211	210	209	208	207	206	205	204	203	203	202	202	201	201	200	200	200	200	200

TABLE 12. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.4000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	139	142	145	147	150	153	155	158	160	163	165	168	170	173	175	177	180	182	184	187	189	191
5	140	142	145	148	150	153	155	158	161	163	166	168	170	173	175	178	180	182	185	187	189	192
10	140	143	146	148	151	153	156	158	161	163	166	168	171	173	176	178	180	183	185	187	190	192
15	141	144	146	149	151	154	156	159	161	164	166	169	171	174	176	178	181	183	185	188	190	192
20	142	144	147	149	152	155	157	160	162	165	167	169	172	174	177	179	181	184	186	188	190	193
25	142	145	148	150	153	155	158	160	163	165	168	170	172	175	177	179	182	184	186	189	191	193
30	143	146	148	151	153	156	158	161	163	166	168	170	173	175	178	180	182	185	187	189	191	194
35	144	147	149	152	154	157	159	161	164	166	169	171	173	176	178	180	183	185	187	190	192	194
40	145	147	150	152	155	157	160	162	165	167	169	172	174	176	179	181	183	186	188	190	192	195
45	146	148	151	153	156	158	160	163	165	168	170	172	175	177	179	182	184	186	188	191	193	195
50	147	149	152	154	156	159	161	164	166	168	171	173	175	178	180	182	184	187	189	191	193	195
55	148	150	152	155	157	160	162	164	167	169	171	174	176	178	180	183	185	187	189	192	194	196
60	149	151	153	156	158	160	163	165	167	170	172	174	177	179	181	183	186	188	190	192	194	197
65	150	152	154	157	159	161	164	166	168	170	173	175	177	179	182	184	186	188	191	193	195	197
70	151	153	155	158	160	162	164	167	169	171	173	176	178	180	182	185	187	189	191	193	195	198
75	152	154	156	159	161	163	165	167	170	172	174	176	179	181	183	185	187	190	192	194	196	198
80	153	155	157	160	162	164	166	168	171	173	175	177	179	182	184	186	188	190	192	194	197	199
85	154	156	158	161	163	165	167	169	171	174	176	178	180	182	184	187	189	191	193	195	197	199
90	155	157	159	162	164	166	168	170	172	174	177	179	181	183	185	187	189	191	194	196	198	200
95	157	159	161	163	165	167	169	171	173	175	177	179	182	184	186	188	190	192	194	196	198	200
100	158	160	162	164	166	168	170	172	174	176	178	180	182	184	187	189	191	193	195	197	199	201
105	159	161	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	196	198	200	202
110	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202
115	162	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203
120	163	165	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204
125	164	166	168	169	171	173	175	177	179	181	182	184	186	188	190	192	194	196	198	200	202	204
130	166	167	169	171	172	174	176	178	180	181	183	185	187	189	191	193	195	197	199	201	203	205
135	167	169	170	172	173	175	177	179	181	182	184	186	188	190	192	194	196	198	200	202	204	206
140	168	170	171	173	175	176	178	180	182	183	185	187	189	191	193	195	197	198	200	202	204	206
145	170	171	173	174	176	177	179	181	183	184	186	188	190	192	194	195	197	199	201	203	205	207
150	171	173	174	175	177	179	180	182	184	185	187	189	191	192	194	196	198	200	202	204	206	208
155	173	174	175	177	178	180	181	183	185	186	188	190	192	193	195	197	199	201	203	204	206	208
160	174	175	177	178	179	181	182	184	186	187	189	191	192	194	196	198	200	201	203	205	207	209
165	176	177	178	179	181	182	183	185	187	188	190	192	193	195	197	199	200	202	204	206	208	210
170	177	178	179	181	182	183	185	186	188	189	191	193	194	196	198	199	201	203	205	207	208	210
175	179	180	181	182	183	184	186	187	189	190	192	194	195	197	199	200	202	204	206	207	209	211
180	180	181	182	183	184	186	187	188	190	191	193	194	196	198	199	201	203	205	206	208	210	212
185	182	183	183	184	186	187	188	189	191	192	194	195	197	199	200	202	204	205	207	209	211	212
190	183	184	185	186	187	188	189	191	192	193	195	196	198	200	201	203	205	206	208	210	211	213
195	185	186	186	187	188	189	190	192	193	194	196	197	199	200	202	204	205	207	209	210	212	214
200	187	187	188	189	189	191	192	193	194	196	197	198	200	201	203	205	206	208	210	211	213	215
205	188	189	189	190	191	192	193	194	195	197	198	199	201	202	204	205	207	209	210	212	214	215
210	190	190	191	191	192	193	194	195	196	198	199	200	202	203	205	206	208	209	211	213	214	216
215	191	192	192	193	193	194	195	196	198	199	200	201	203	204	206	207	209	210	212	214	215	217
220	193	193	194	194	195	196	197	198	199	200	201	202	204	205	207	208	210	211	213	214	216	218
225	195	195	195	196	196	197	198	199	200	201	202	203	205	206	208	209	210	212	214	215	217	218
230	196	196	197	197	197	198	199	200	201	202	203	204	206	207	208	210	211	213	214	216	217	219
235	198	198	198	198	199	200	200	201	202	203	204	206	207	208	209	211	212	214	215	217	218	220
240	199	199	199	200	200	201	202	202	203	204	205	207	208	209	210	212	213	215	216	218	219	221

TABLE 12. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.4000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	194	198	203	207	211	215	220	224	228	232	236	240	244	248	251	255	259	263	266	270	274	277
5	194	198	203	207	211	216	220	224	228	232	236	240	244	248	252	255	259	263	266	270	274	277
10	194	199	203	207	212	216	220	224	228	232	236	240	244	248	252	256	259	263	267	270	274	277
15	195	199	203	208	212	216	220	225	229	233	237	241	244	248	252	256	260	263	267	270	274	278
20	195	199	204	208	212	217	221	225	229	233	237	241	245	249	252	256	260	263	267	271	274	278
25	195	200	204	208	213	217	221	225	229	233	237	241	245	249	253	256	260	264	267	271	275	278
30	196	200	205	209	213	217	221	226	230	234	237	241	245	249	253	257	260	264	268	271	275	278
35	196	201	205	209	213	218	222	226	230	234	238	242	246	249	253	257	261	264	268	271	275	279
40	197	201	205	210	214	218	222	226	230	234	238	242	246	250	253	257	261	264	268	272	275	279
45	197	202	206	210	214	218	223	227	231	235	238	242	246	250	254	257	261	265	268	272	275	279
50	198	202	206	211	215	219	223	227	231	235	239	243	246	250	254	258	261	265	269	272	276	279
55	198	202	207	211	215	219	223	227	231	235	239	243	247	251	254	258	262	265	269	272	276	280
60	199	203	207	211	216	220	224	228	232	236	240	243	247	251	255	258	262	266	269	273	276	280
65	199	203	208	212	216	220	224	228	232	236	240	244	247	251	255	259	262	266	269	273	277	280
70	200	204	208	212	216	221	225	229	232	236	240	244	248	252	255	259	263	266	270	273	277	280
75	200	205	209	213	217	221	225	229	233	237	241	244	248	252	256	259	263	267	270	274	277	281
80	201	205	209	213	217	221	225	229	233	237	241	245	249	252	256	260	263	267	270	274	277	281
85	201	206	210	214	218	222	226	230	234	238	241	245	249	253	256	260	264	267	271	274	278	281
90	202	206	210	214	218	222	226	230	234	238	242	246	249	253	257	260	264	267	271	274	278	281
95	203	207	211	215	219	223	227	231	235	238	242	246	250	253	257	261	264	268	271	275	278	282
100	203	207	211	215	219	223	227	231	235	239	243	246	250	254	257	261	265	268	272	275	279	282
105	204	208	212	216	220	224	228	232	235	239	243	247	250	254	258	261	265	268	272	275	279	282
110	204	208	212	216	220	224	228	232	236	240	243	247	251	254	258	262	265	269	272	276	279	283
115	205	209	213	217	221	225	229	232	236	240	244	247	251	255	258	262	266	269	273	276	279	283
120	206	210	213	217	221	225	229	233	237	240	244	248	252	255	259	262	266	269	273	276	280	283
125	206	210	214	218	222	226	230	233	237	241	245	248	252	256	259	263	266	270	273	277	280	283
130	207	211	215	219	222	226	230	234	238	241	245	249	252	256	260	263	267	270	274	277	280	284
135	207	211	215	219	223	227	231	234	238	242	245	249	253	256	260	263	267	270	274	277	281	284
140	208	212	216	220	223	227	231	235	238	242	246	249	253	257	260	264	267	271	274	278	281	284
145	209	213	216	220	224	228	232	235	239	243	246	250	254	257	261	264	268	271	275	278	281	285
150	209	213	217	221	225	228	232	236	239	243	247	250	254	257	261	265	268	271	275	278	282	285
155	210	214	218	221	225	229	233	236	240	244	247	251	254	258	261	265	268	272	275	279	282	285
160	211	214	218	222	226	229	233	237	240	244	248	251	255	258	262	265	269	272	276	279	282	286
165	211	215	219	223	226	230	234	237	241	244	248	252	255	259	262	266	269	273	276	279	283	286
170	212	216	219	223	227	230	234	238	241	245	248	252	256	259	263	266	269	273	276	280	283	286
175	213	216	220	224	227	231	235	238	242	245	249	252	256	259	263	266	270	273	277	280	283	287
180	213	217	221	224	228	232	235	239	242	246	249	253	256	260	263	267	270	274	277	280	284	287
185	214	218	221	225	228	232	236	239	243	246	250	253	257	260	264	267	271	274	277	281	284	287
190	215	218	222	226	229	233	236	240	243	247	250	254	257	261	264	268	271	274	278	281	284	288
195	216	219	223	226	230	233	237	240	244	247	251	254	258	261	265	268	271	275	278	281	285	288
200	216	220	223	227	230	234	237	241	244	248	251	255	258	262	265	268	272	275	278	282	285	288
205	217	220	224	227	231	234	238	241	245	248	252	255	259	262	265	269	272	275	279	282	285	289
210	218	221	225	228	231	235	238	242	245	249	252	256	259	262	266	269	273	276	279	282	286	289
215	218	222	225	229	232	235	239	242	246	249	253	256	259	263	266	270	273	276	280	283	286	289
220	219	223	226	229	233	236	239	243	246	250	253	257	260	263	267	270	273	277	280	283	286	290
225	220	223	227	230	233	237	240	243	247	250	254	257	260	264	267	270	274	277	280	284	287	290
230	221	224	227	231	234	237	241	244	247	251	254	257	261	264	267	271	274	277	281	284	287	290
235	221	225	228	231	234	238	241	245	248	251	255	258	261	265	268	271	275	278	281	284	288	291
240	222	225	229	232	235	238	242	245	248	252	255	258	262	265	268	272	275	278	281	285	288	291

TABLE 12. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.4000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	281	284	288	291	294	298	301	304	308	311	314	317	321	324	327	330	333	336	339	342	346	349
5	281	284	288	291	295	298	301	305	308	311	314	318	321	324	327	330	333	336	340	343	346	349
10	281	284	288	291	295	298	301	305	308	311	315	318	321	324	327	330	333	337	340	343	346	349
15	281	285	288	291	295	298	302	305	308	311	315	318	321	324	327	331	334	337	340	343	346	349
20	281	285	288	292	295	298	302	305	308	312	315	318	321	324	328	331	334	337	340	343	346	349
25	282	285	288	292	295	299	302	305	309	312	315	318	321	325	328	331	334	337	340	343	346	349
30	282	285	289	292	295	299	302	305	309	312	315	318	322	325	328	331	334	337	340	343	346	349
35	282	285	289	292	296	299	302	306	309	312	315	319	322	325	328	331	334	337	340	343	346	349
40	282	286	289	293	296	299	303	306	309	312	316	319	322	325	328	331	334	338	341	344	347	350
45	282	286	289	293	296	299	303	306	309	313	316	319	322	325	328	332	335	338	341	344	347	350
50	283	286	290	293	296	300	303	306	310	313	316	319	322	325	329	332	335	338	341	344	347	350
55	283	286	290	293	297	300	303	306	310	313	316	319	323	326	329	332	335	338	341	344	347	350
60	283	287	290	293	297	300	303	307	310	313	316	320	323	326	329	332	335	338	341	344	347	350
65	284	287	290	294	297	300	304	307	310	313	317	320	323	326	329	332	335	338	341	344	347	350
70	284	287	291	294	297	301	304	307	310	314	317	320	323	326	329	332	336	339	342	345	348	351
75	284	287	291	294	298	301	304	307	311	314	317	320	323	326	330	333	336	339	342	345	348	351
80	284	288	291	294	298	301	304	308	311	314	317	320	324	327	330	333	336	339	342	345	348	351
85	285	288	291	295	298	301	305	308	311	314	317	321	324	327	330	333	336	339	342	345	348	351
90	285	288	292	295	298	302	305	308	311	315	318	321	324	327	330	333	336	339	342	345	348	351
95	285	289	292	295	299	302	305	308	312	315	318	321	324	327	330	333	337	340	343	346	349	352
100	285	289	292	295	299	302	305	309	312	315	318	321	324	328	331	334	337	340	343	346	349	352
105	286	289	292	296	299	302	306	309	312	315	318	322	325	328	331	334	337	340	343	346	349	352
110	286	289	293	296	299	303	306	309	312	315	319	322	325	328	331	334	337	340	343	346	349	352
115	286	290	293	296	300	303	306	309	313	316	319	322	325	328	331	334	337	340	343	346	349	352
120	287	290	293	297	300	303	306	310	313	316	319	322	325	328	331	335	338	341	344	347	350	352
125	287	290	294	297	300	303	307	310	313	316	319	322	326	329	332	335	338	341	344	347	350	353
130	287	291	294	297	300	304	307	310	313	316	320	323	326	329	332	335	338	341	344	347	350	353
135	287	291	294	297	301	304	307	310	313	317	320	323	326	329	332	335	338	341	344	347	350	353
140	288	291	294	298	301	304	307	311	314	317	320	323	326	329	332	335	338	341	344	347	350	353
145	288	291	295	298	301	304	308	311	314	317	320	323	326	330	333	336	339	342	345	348	351	353
150	288	292	295	298	302	305	308	311	314	317	321	324	327	330	333	336	339	342	345	348	351	354
155	289	292	295	299	302	305	308	311	315	318	321	324	327	330	333	336	339	342	345	348	351	354
160	289	292	296	299	302	305	308	312	315	318	321	324	327	330	333	336	339	342	345	348	351	354
165	289	293	296	299	302	306	309	312	315	318	321	324	327	330	334	337	340	343	345	348	351	354
170	290	293	296	299	303	306	309	312	315	318	322	325	328	331	334	337	340	343	346	349	352	354
175	290	293	296	300	303	306	309	312	316	319	322	325	328	331	334	337	340	343	346	349	352	355
180	290	294	297	300	303	306	310	313	316	319	322	325	328	331	334	337	340	343	346	349	352	355
185	291	294	297	300	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346	349	352	355
190	291	294	297	301	304	307	310	313	316	319	323	326	329	332	335	338	341	344	347	350	352	355
195	291	294	298	301	304	307	310	314	317	320	323	326	329	332	335	338	341	344	347	350	353	356
200	292	295	298	301	304	308	311	314	317	320	323	326	329	332	335	338	341	344	347	350	353	356
205	292	295	298	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347	350	353	356
210	292	295	299	302	305	308	311	314	317	321	324	327	330	333	336	339	342	345	347	350	353	356
215	293	296	299	302	305	308	312	315	318	321	324	327	330	333	336	339	342	345	348	351	354	356
220	293	296	299	302	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348	351	354	357
225	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348	351	354	357
230	294	297	300	303	306	309	312	316	319	322	325	328	331	334	337	340	343	345	348	351	354	357
235	294	297	300	303	307	310	313	316	319	322	325	328	331	334	337	340	343	346	349	352	354	357
240	294	297	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346	349	352	355	357

TABLE 13. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.3000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	98	98	99	99	100	101	101	102	103	103	104	104	105	106	106	107	107	108	109	109	110	110
5	98	99	100	100	101	101	102	103	103	104	104	105	106	106	107	107	108	109	109	110	110	111
10	100	100	101	102	102	103	103	104	104	105	106	106	107	107	108	109	109	110	110	111	111	112
15	101	102	102	103	104	104	105	105	106	106	107	108	108	109	109	110	110	111	112	112	113	113
20	103	104	104	105	105	106	106	107	107	108	109	109	110	110	111	111	112	112	113	113	114	115
25	105	105	106	107	107	108	108	109	109	110	110	111	111	112	112	113	113	114	114	115	116	116
30	107	108	108	109	109	110	110	111	111	112	112	113	113	114	114	115	115	116	116	117	117	118
35	110	110	111	111	111	112	112	113	113	114	114	115	115	116	116	116	117	117	118	118	119	119
40	112	113	113	114	114	114	115	115	116	116	116	117	117	118	118	119	119	119	120	120	121	121
45	116	116	116	116	117	117	117	118	118	118	119	119	120	120	120	121	121	122	122	122	123	123
50	119	119	119	120	120	120	120	121	121	121	121	122	122	122	123	123	123	124	124	125	125	125
55	123	123	123	123	123	123	123	124	124	124	124	125	125	125	125	126	126	126	127	127	127	128
60	127	126	126	126	127	127	127	127	127	127	127	127	128	128	128	128	129	129	129	129	130	130
65	131	131	130	130	130	130	130	130	130	130	130	130	131	131	131	131	131	132	132	132	132	133
70	135	135	135	134	134	134	134	134	134	134	134	134	134	134	134	134	134	134	135	135	135	135
75	140	140	139	139	138	138	138	138	138	138	137	137	137	137	137	137	137	137	138	138	138	138
80	145	144	144	143	143	142	142	142	142	141	141	141	141	141	141	141	141	141	141	141	141	141
85	150	149	149	148	147	147	146	146	146	145	145	145	145	144	144	144	144	144	144	144	144	144
90	155	154	154	153	152	151	151	150	150	149	149	149	148	148	148	148	147	147	147	147	147	147
95	161	160	159	158	157	156	155	155	154	154	153	153	152	152	152	151	151	151	151	150	150	150
100	166	165	164	163	162	161	160	159	159	158	157	157	156	156	155	155	155	154	154	154	154	153
105	172	170	169	168	167	166	165	164	163	162	162	161	160	160	159	159	158	158	158	157	157	157
110	177	176	174	173	172	171	170	169	168	167	166	165	165	164	163	163	162	162	161	161	160	160
115	183	181	180	178	177	176	174	173	172	171	170	170	169	168	167	167	166	165	165	164	164	164
120	188	186	185	183	182	180	179	178	177	176	175	174	173	172	171	171	170	169	169	168	168	167
125	193	192	190	188	187	185	184	183	181	180	179	178	177	176	175	175	174	173	173	172	171	171
130	199	197	195	193	192	190	189	187	186	185	184	183	182	181	180	179	178	177	176	176	175	174
135	204	202	200	198	197	195	194	192	191	189	188	187	186	185	184	183	182	181	180	179	179	178
140	209	207	205	203	202	200	198	197	195	194	193	191	190	189	188	187	186	185	184	183	182	182
145	214	212	210	208	206	205	203	201	200	198	197	196	194	193	192	191	190	189	188	187	186	185
150	219	217	215	213	211	209	208	206	204	203	201	200	199	197	196	195	194	193	192	191	190	189
155	224	222	220	218	216	214	212	211	209	207	206	204	203	202	200	199	198	197	196	195	194	193
160	229	227	225	223	221	219	217	215	213	212	210	209	207	206	204	203	202	201	199	198	197	196
165	234	232	229	227	225	223	221	220	218	216	214	213	211	210	208	207	206	205	203	202	201	200
170	239	236	234	232	230	228	226	224	222	220	219	217	215	214	212	211	210	208	207	206	205	204
175	243	241	239	236	234	232	230	228	226	225	223	221	220	218	217	215	214	212	211	210	209	207
180	248	246	243	241	239	237	235	233	231	229	227	225	224	222	221	219	218	216	215	214	212	211
185	252	250	248	245	243	241	239	237	235	233	231	230	228	226	225	223	221	220	219	217	216	215
190	257	255	252	250	248	245	243	241	239	237	235	234	232	230	228	227	225	224	222	221	220	218
195	261	259	257	254	252	250	248	245	243	241	240	238	236	234	232	231	229	228	226	225	223	222
200	266	263	261	259	256	254	252	250	248	246	244	242	240	238	236	235	233	231	230	228	227	226
205	270	268	265	263	260	258	256	254	252	250	248	246	244	242	240	238	237	235	234	232	231	229
210	274	272	269	267	265	262	260	258	256	254	252	250	248	246	244	242	241	239	237	236	234	233
215	279	276	274	271	269	267	264	262	260	258	256	254	252	250	248	246	244	243	241	239	238	236
220	283	280	278	275	273	271	268	266	264	262	260	257	255	254	252	250	248	246	245	243	241	240
225	287	285	282	279	277	275	272	270	268	266	263	261	259	257	255	254	252	250	248	247	245	243
230	291	289	286	284	281	279	276	274	272	269	267	265	263	261	259	257	255	254	252	250	248	247
235	295	293	290	288	285	283	280	278	276	273	271	269	267	265	263	261	259	257	255	254	252	250
240	299	297	294	292	289	287	284	282	279	277	275	273	271	269	267	265	263	261	259	257	255	254

TABLE 13. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.3000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	112	113	114	115	116	117	119	120	121	122	123	124	125	126	128	129	130	131	132	133	134	135
5	112	113	115	116	117	118	119	120	121	123	124	125	126	127	128	129	130	131	133	134	135	136
10	113	114	116	117	118	119	120	121	122	123	125	126	127	128	129	130	131	132	133	134	135	137
15	114	116	117	118	119	120	121	122	123	124	126	127	128	129	130	131	132	133	134	135	136	137
20	116	117	118	119	120	121	122	123	124	125	127	128	129	130	131	132	133	134	135	136	137	138
25	117	118	119	120	121	122	123	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139
30	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
35	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
40	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	139	140	141	142
45	124	125	126	127	128	129	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
50	126	127	128	129	129	130	131	132	133	134	135	136	137	137	138	139	140	141	142	143	144	145
55	128	129	130	131	131	132	133	134	135	135	136	137	138	139	140	141	142	142	143	144	145	146
60	131	131	132	133	133	134	135	136	136	137	138	139	140	141	141	142	143	144	145	146	147	147
65	133	134	134	135	135	136	137	138	138	139	140	141	141	142	143	144	145	145	146	147	148	149
70	136	136	137	137	138	138	139	140	140	141	142	142	143	144	145	145	146	147	148	149	149	150
75	138	139	139	139	140	141	141	142	142	143	144	144	145	146	146	147	148	149	149	150	151	152
80	141	141	142	142	142	143	143	144	144	145	146	146	147	147	148	149	149	150	151	152	152	153
85	144	144	144	145	145	145	146	146	147	147	148	148	149	149	150	151	151	152	153	153	154	155
90	147	147	147	147	147	148	148	148	149	149	150	150	151	151	152	152	153	154	154	155	156	156
95	150	150	150	150	150	150	150	151	151	151	152	152	153	153	154	154	155	155	156	157	157	158
100	153	153	153	153	153	153	153	153	153	154	154	154	155	155	156	156	157	157	158	158	159	160
105	156	156	156	156	155	155	156	156	156	156	156	157	157	157	158	158	159	159	160	160	161	161
110	160	159	159	158	158	158	158	158	158	158	159	159	159	159	160	160	161	161	161	162	162	163
115	163	162	162	161	161	161	161	161	161	161	161	161	161	162	162	162	163	163	163	164	164	165
120	166	166	165	165	164	164	164	163	163	163	163	163	164	164	164	164	165	165	165	166	166	167
125	170	169	168	168	167	167	166	166	166	166	166	166	166	166	166	166	167	167	167	168	168	168
130	173	172	171	171	170	170	169	169	169	168	168	168	168	168	168	169	169	169	169	170	170	170
135	177	176	175	174	173	173	172	172	171	171	171	171	171	171	171	171	171	171	171	172	172	172
140	180	179	178	177	176	176	175	174	174	174	173	173	173	173	173	173	173	173	173	173	174	174
145	184	183	181	180	179	179	178	177	177	176	176	176	175	175	175	175	175	175	175	176	176	176
150	187	186	185	184	182	182	181	180	179	179	179	178	178	178	178	177	177	177	177	178	178	178
155	191	189	188	187	186	185	184	183	182	182	181	181	180	180	180	180	180	180	180	180	180	180
160	195	193	191	190	189	188	187	186	185	184	184	183	183	183	182	182	182	182	182	182	182	182
165	198	196	195	193	192	191	190	189	188	187	187	186	185	185	185	184	184	184	184	184	184	184
170	202	200	198	197	195	194	193	192	191	190	189	189	188	188	187	187	186	186	186	186	186	186
175	205	203	201	200	198	197	196	195	194	193	192	191	191	190	190	189	189	188	188	188	188	188
180	209	207	205	203	202	200	199	198	196	195	195	194	193	192	192	191	191	191	190	190	190	190
185	212	210	208	206	205	203	202	200	199	198	197	196	196	195	194	194	193	193	193	192	192	192
190	216	214	212	210	208	206	205	203	202	201	200	199	198	198	197	196	196	195	195	195	194	194
195	219	217	215	213	211	209	208	206	205	204	203	202	201	200	199	199	198	198	197	197	196	196
200	223	221	218	216	214	212	211	209	208	207	206	204	203	203	202	201	200	200	199	199	199	198
205	226	224	222	219	217	216	214	212	211	209	208	207	206	205	204	204	203	202	202	201	201	200
210	230	227	225	223	221	219	217	215	214	212	211	210	209	208	207	206	205	205	204	203	203	203
215	233	231	228	226	224	222	220	218	217	215	214	212	211	210	209	208	208	207	206	206	205	205
220	237	234	232	229	227	225	223	221	219	218	216	215	214	213	212	211	210	209	209	208	207	207
225	240	238	235	232	230	228	226	224	222	221	219	218	217	215	214	213	212	212	211	210	210	209
230	244	241	238	236	233	231	229	227	225	224	222	221	219	218	217	216	215	214	213	212	212	211
235	247	244	241	239	236	234	232	230	228	226	225	223	222	221	219	218	217	216	215	215	214	213
240	251	248	245	242	240	237	235	233	231	229	227	226	224	223	222	221	220	219	218	217	216	216

TABLE 13. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.3000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	136	139	142	144	147	150	152	155	157	160	162	165	167	170	172	174	177	179	182	184	186	188
5	137	140	142	145	147	150	153	155	158	160	163	165	168	170	172	175	177	180	182	184	186	189
10	138	140	143	146	148	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187	189
15	138	141	144	146	149	151	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187	190
20	139	142	144	147	150	152	155	157	160	162	164	167	169	172	174	176	179	181	183	186	188	190
25	140	143	145	148	150	153	155	158	160	163	165	168	170	172	175	177	179	182	184	186	188	191
30	141	144	146	149	151	154	156	159	161	164	166	168	171	173	175	178	180	182	184	187	189	191
35	142	145	147	150	152	155	157	159	162	164	167	169	171	174	176	178	181	183	185	187	190	192
40	143	146	148	151	153	156	158	160	163	165	167	170	172	174	177	179	181	183	186	188	190	192
45	145	147	149	152	154	156	159	161	164	166	168	171	173	175	177	180	182	184	186	189	191	193
50	146	148	150	153	155	157	160	162	164	167	169	171	174	176	178	180	183	185	187	189	191	194
55	147	149	152	154	156	158	161	163	165	168	170	172	174	177	179	181	183	186	188	190	192	194
60	148	151	153	155	157	160	162	164	166	169	171	173	175	177	180	182	184	186	188	191	193	195
65	150	152	154	156	158	161	163	165	167	169	172	174	176	178	180	183	185	187	189	191	193	196
70	151	153	155	157	160	162	164	166	168	170	173	175	177	179	181	183	186	188	190	192	194	196
75	152	154	157	159	161	163	165	167	169	171	174	176	178	180	182	184	186	189	191	193	195	197
80	154	156	158	160	162	164	166	168	170	172	175	177	179	181	183	185	187	189	191	193	196	198
85	155	157	159	161	163	165	167	169	171	173	175	178	180	182	184	186	188	190	192	194	196	198
90	157	159	161	163	164	166	168	170	172	174	176	179	181	183	185	187	189	191	193	195	197	199
95	159	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200
100	160	162	164	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201
105	162	163	165	167	168	170	172	174	176	178	180	182	183	185	187	189	191	193	195	197	199	201
110	164	165	167	168	170	172	173	175	177	179	181	183	184	186	188	190	192	194	196	198	200	202
115	165	167	168	170	171	173	175	176	178	180	182	184	186	187	189	191	193	195	197	199	201	203
120	167	168	170	171	173	174	176	178	179	181	183	185	187	188	190	192	194	196	198	200	202	204
125	169	170	171	173	174	176	177	179	180	182	184	186	188	189	191	193	195	197	199	201	203	204
130	171	172	173	174	175	177	178	180	182	183	185	187	189	190	192	194	196	198	200	201	203	205
135	172	173	174	176	177	178	180	181	183	185	186	188	190	191	193	195	197	199	200	202	204	206
140	174	175	176	177	178	180	181	183	184	186	187	189	191	192	194	196	198	200	201	203	205	207
145	176	177	178	179	180	181	183	184	185	187	189	190	192	194	195	197	199	200	202	204	206	208
150	178	179	180	180	182	183	184	185	187	188	190	191	193	195	196	198	200	201	203	205	207	209
155	180	181	181	182	183	184	185	187	188	190	191	193	194	196	197	199	201	202	204	206	208	209
160	182	182	183	184	185	186	187	188	189	191	192	194	195	197	198	200	202	203	205	207	208	210
165	184	184	185	185	186	187	188	189	191	192	193	195	196	198	199	201	203	204	206	208	209	211
170	186	186	187	187	188	189	190	191	192	193	195	196	198	199	201	202	204	205	207	209	210	212
175	188	188	188	189	189	190	191	192	193	195	196	197	199	200	202	203	205	206	208	209	211	213
180	190	190	190	191	191	192	193	194	195	196	197	198	200	201	203	204	206	207	209	210	212	214
185	192	192	192	192	193	193	194	195	196	197	198	200	201	202	204	205	207	208	210	211	213	215
190	194	194	194	194	194	195	196	197	198	199	200	201	202	204	205	206	208	209	211	212	214	215
195	196	196	196	196	196	197	197	198	199	200	201	202	203	205	206	207	209	210	212	213	215	216
200	198	198	197	198	198	198	199	200	200	201	202	203	205	206	207	208	210	211	213	214	216	217
205	200	200	199	199	199	200	200	201	202	203	204	205	206	207	208	210	211	212	214	215	217	218
210	202	202	201	201	201	201	202	203	203	204	205	206	207	208	209	211	212	213	215	216	218	219
215	204	204	203	203	203	203	203	204	205	205	206	207	208	209	211	212	213	214	216	217	219	220
220	206	206	205	205	205	205	205	206	206	207	208	209	210	211	212	213	214	215	217	218	220	221
225	209	208	207	207	206	206	207	207	208	208	209	210	211	212	213	214	215	216	218	219	220	222
230	211	210	209	208	208	208	208	209	209	210	210	211	212	213	214	215	216	218	219	220	221	223
235	213	212	211	210	210	210	210	210	210	211	212	212	213	214	215	216	217	219	220	221	222	224
240	215	214	213	212	212	211	211	212	212	212	213	214	215	215	216	217	219	220	221	222	223	225

TABLE 13. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.3000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	191	195	200	204	208	212	217	221	225	229	233	237	241	245	248	252	256	259	263	267	270	274
5	191	195	200	204	209	213	217	221	225	229	233	237	241	245	248	252	256	260	263	267	270	274
10	191	196	200	205	209	213	217	221	225	229	233	237	241	245	249	253	256	260	263	267	271	274
15	192	196	201	205	209	213	218	222	226	230	234	238	241	245	249	253	256	260	264	267	271	274
20	192	197	201	205	210	214	218	222	226	230	234	238	242	246	249	253	257	260	264	268	271	275
25	193	197	202	206	210	214	218	223	227	231	234	238	242	246	250	253	257	261	264	268	271	275
30	193	198	202	206	211	215	219	223	227	231	235	239	243	246	250	254	257	261	265	268	272	275
35	194	198	203	207	211	215	219	223	227	231	235	239	243	247	250	254	258	261	265	268	272	275
40	195	199	203	207	212	216	220	224	228	232	236	239	243	247	251	254	258	262	265	269	272	276
45	195	199	204	208	212	216	220	224	228	232	236	240	244	247	251	255	258	262	266	269	273	276
50	196	200	204	208	213	217	221	225	229	233	236	240	244	248	251	255	259	262	266	269	273	276
55	196	201	205	209	213	217	221	225	229	233	237	241	244	248	252	256	259	263	266	270	273	277
60	197	201	205	210	214	218	222	226	230	233	237	241	245	249	252	256	260	263	267	270	274	277
65	198	202	206	210	214	218	222	226	230	234	238	242	245	249	253	256	260	263	267	270	274	277
70	198	203	207	211	215	219	223	227	231	234	238	242	246	249	253	257	260	264	267	271	274	278
75	199	203	207	211	215	219	223	227	231	235	239	242	246	250	253	257	261	264	268	271	275	278
80	200	204	208	212	216	220	224	228	232	235	239	243	247	250	254	257	261	265	268	272	275	278
85	200	204	209	213	216	220	224	228	232	236	240	243	247	251	254	258	261	265	268	272	275	279
90	201	205	209	213	217	221	225	229	233	236	240	244	247	251	255	258	262	265	269	272	276	279
95	202	206	210	214	218	222	225	229	233	237	241	244	248	252	255	259	262	266	269	273	276	279
100	203	207	210	214	218	222	226	230	234	237	241	245	248	252	256	259	263	266	270	273	276	280
105	203	207	211	215	219	223	227	230	234	238	242	245	249	252	256	260	263	267	270	273	277	280
110	204	208	212	216	220	223	227	231	235	238	242	246	249	253	256	260	263	267	270	274	277	280
115	205	209	212	216	220	224	228	231	235	239	243	246	250	253	257	260	264	267	271	274	278	281
120	206	209	213	217	221	225	228	232	236	239	243	247	250	254	257	261	264	268	271	275	278	281
125	206	210	214	218	221	225	229	233	236	240	244	247	251	254	258	261	265	268	272	275	278	282
130	207	211	215	218	222	226	229	233	237	240	244	248	251	255	258	262	265	269	272	275	279	282
135	208	212	215	219	223	226	230	234	237	241	245	248	252	255	259	262	266	269	272	276	279	282
140	209	212	216	220	223	227	231	234	238	242	245	249	252	256	259	263	266	269	273	276	279	283
145	209	213	217	220	224	228	231	235	239	242	246	249	253	256	260	263	266	270	273	277	280	283
150	210	214	217	221	225	228	232	236	239	243	246	250	253	257	260	263	267	270	274	277	280	283
155	211	215	218	222	225	229	233	236	240	243	247	250	254	257	261	264	267	271	274	277	281	284
160	212	215	219	223	226	230	233	237	240	244	247	251	254	258	261	264	268	271	274	278	281	284
165	213	216	220	223	227	230	234	237	241	244	248	251	255	258	261	265	268	272	275	278	281	285
170	214	217	221	224	227	231	234	238	241	245	248	252	255	259	262	265	269	272	275	279	282	285
175	214	218	221	225	228	232	235	239	242	245	249	252	256	259	262	266	269	272	276	279	282	285
180	215	219	222	225	229	232	236	239	243	246	249	253	256	260	263	266	270	273	276	279	283	286
185	216	219	223	226	230	233	236	240	243	247	250	253	257	260	263	267	270	273	277	280	283	286
190	217	220	224	227	230	234	237	240	244	247	251	254	257	261	264	267	270	274	277	280	283	287
195	218	221	224	228	231	234	238	241	244	248	251	254	258	261	264	268	271	274	277	281	284	287
200	219	222	225	228	232	235	238	242	245	248	252	255	258	262	265	268	271	275	278	281	284	287
205	220	223	226	229	232	236	239	242	246	249	252	256	259	262	265	269	272	275	278	282	285	288
210	221	224	227	230	233	236	240	243	246	250	253	256	259	263	266	269	272	276	279	282	285	288
215	222	225	228	231	234	237	240	244	247	250	253	257	260	263	266	270	273	276	279	282	286	289
220	222	225	228	232	235	238	241	244	248	251	254	257	260	264	267	270	273	276	280	283	286	289
225	223	226	229	232	235	239	242	245	248	251	255	258	261	264	267	271	274	277	280	283	286	290
230	224	227	230	233	236	239	242	246	249	252	255	258	262	265	268	271	274	277	281	284	287	290
235	225	228	231	234	237	240	243	246	249	253	256	259	262	265	268	272	275	278	281	284	287	290
240	226	229	232	235	238	241	244	247	250	253	256	259	263	266	269	272	275	278	281	285	288	291

TABLE 13. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.3000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	277	281	284	287	291	294	297	301	304	307	310	314	317	320	323	326	329	332	335	338	341	344
5	277	281	284	288	291	294	298	301	304	307	311	314	317	320	323	326	329	332	335	338	341	344
10	278	281	284	288	291	294	298	301	304	308	311	314	317	320	323	326	329	332	335	338	341	344
15	278	281	285	288	291	295	298	301	304	308	311	314	317	320	323	326	330	333	336	339	342	345
20	278	282	285	288	292	295	298	301	305	308	311	314	317	321	324	327	330	333	336	339	342	345
25	278	282	285	289	292	295	298	302	305	308	311	314	318	321	324	327	330	333	336	339	342	345
30	279	282	285	289	292	295	299	302	305	308	312	315	318	321	324	327	330	333	336	339	342	345
35	279	282	286	289	292	296	299	302	305	309	312	315	318	321	324	327	330	333	336	339	342	345
40	279	283	286	289	293	296	299	302	306	309	312	315	318	321	324	328	331	334	337	340	343	345
45	280	283	286	290	293	296	299	303	306	309	312	315	319	322	325	328	331	334	337	340	343	346
50	280	283	287	290	293	297	300	303	306	309	313	316	319	322	325	328	331	334	337	340	343	346
55	280	284	287	290	294	297	300	303	306	310	313	316	319	322	325	328	331	334	337	340	343	346
60	280	284	287	291	294	297	300	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346
65	281	284	287	291	294	297	301	304	307	310	313	316	320	323	326	329	332	335	338	341	344	347
70	281	284	288	291	294	298	301	304	307	310	314	317	320	323	326	329	332	335	338	341	344	347
75	281	285	288	291	295	298	301	304	308	311	314	317	320	323	326	329	332	335	338	341	344	347
80	282	285	288	292	295	298	301	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347
85	282	285	289	292	295	299	302	305	308	311	314	317	321	324	327	330	333	336	339	342	344	347
90	282	286	289	292	296	299	302	305	308	312	315	318	321	324	327	330	333	336	339	342	345	348
95	283	286	289	293	296	299	302	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348
100	283	286	290	293	296	299	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348
105	283	287	290	293	297	300	303	306	309	312	315	319	322	325	328	331	334	337	340	342	345	348
110	284	287	290	294	297	300	303	306	310	313	316	319	322	325	328	331	334	337	340	343	346	349
115	284	287	291	294	297	300	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346	349
120	285	288	291	294	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346	349
125	285	288	291	295	298	301	304	307	310	314	317	320	323	326	329	332	335	338	341	343	346	349
130	285	289	292	295	298	301	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347	349
135	286	289	292	295	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347	350
140	286	289	292	296	299	302	305	308	311	314	317	321	324	327	330	333	335	338	341	344	347	350
145	286	290	293	296	299	302	305	309	312	315	318	321	324	327	330	333	336	339	342	344	347	350
150	287	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348	350
155	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348	351
160	287	291	294	297	300	303	306	310	313	316	319	322	325	328	331	334	337	339	342	345	348	351
165	288	291	294	297	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343	345	348	351
170	288	291	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346	349	351
175	289	292	295	298	301	304	307	311	314	317	320	323	326	329	331	334	337	340	343	346	349	352
180	289	292	295	298	302	305	308	311	314	317	320	323	326	329	332	335	338	341	343	346	349	352
185	289	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347	349	352
190	290	293	296	299	302	305	308	312	315	318	321	324	326	329	332	335	338	341	344	347	350	352
195	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	338	341	344	347	350	353
200	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	344	347	350	353
205	291	294	297	300	303	306	309	313	316	319	321	324	327	330	333	336	339	342	345	348	350	353
210	291	295	298	301	304	307	310	313	316	319	322	325	328	331	334	336	339	342	345	348	351	353
215	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	342	345	348	351	354
220	292	295	298	301	304	308	311	314	317	319	322	325	328	331	334	337	340	343	346	348	351	354
225	293	296	299	302	305	308	311	314	317	320	323	326	329	332	334	337	340	343	346	349	351	354
230	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	340	343	346	349	352	355
235	293	296	300	303	306	309	312	315	318	320	323	326	329	332	335	338	341	344	346	349	352	355
240	294	297	300	303	306	309	312	315	318	321	324	327	330	332	335	338	341	344	347	349	352	355

TABLE 14. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2500

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	96	97	98	98	99	99	100	101	101	102	102	103	104	104	105	105	106	107	107	108	108	109
5	97	98	98	99	100	100	101	101	102	103	103	104	104	105	106	106	107	107	108	109	109	110
10	99	99	100	100	101	102	102	103	103	104	105	105	106	106	107	107	108	109	109	110	110	111
15	100	101	102	102	103	103	104	104	105	105	106	107	107	108	108	109	109	110	111	111	112	112
20	102	103	103	104	105	105	106	106	107	107	108	108	109	109	110	110	111	112	112	113	113	114
25	105	105	106	106	107	107	108	108	109	109	110	110	111	111	112	112	113	113	114	114	115	115
30	107	108	108	109	109	110	110	110	111	111	112	112	113	113	114	114	115	115	116	116	117	117
35	110	111	111	111	112	112	113	113	113	114	114	115	115	116	116	116	117	117	118	118	119	119
40	114	114	114	115	115	115	116	116	116	117	117	117	118	118	118	119	119	120	120	121	121	121
45	117	118	118	118	118	118	119	119	119	120	120	120	120	121	121	121	122	122	123	123	123	124
50	122	122	122	122	122	122	122	122	123	123	123	123	124	124	124	124	125	125	125	126	126	126
55	126	126	126	126	126	126	126	126	126	126	126	127	127	127	127	127	128	128	128	128	129	129
60	132	131	131	131	131	130	130	130	130	130	130	130	130	130	131	131	131	131	131	131	132	132
65	137	137	136	136	135	135	135	135	134	134	134	134	134	134	134	134	134	134	134	134	135	135
70	143	142	142	141	140	140	140	139	139	139	138	138	138	138	138	138	138	138	138	138	138	138
75	149	148	147	147	146	145	145	144	144	143	143	143	142	142	142	142	142	141	141	141	141	141
80	156	155	154	152	152	151	150	149	149	148	148	147	147	146	146	146	146	145	145	145	145	145
85	163	161	160	159	157	156	155	155	154	153	152	152	151	151	150	150	150	149	149	149	149	148
90	169	168	166	165	163	162	161	160	159	158	158	157	156	155	155	154	154	154	153	153	153	152
95	176	174	173	171	170	168	167	166	165	164	163	162	161	160	160	159	158	158	157	157	157	156
100	183	181	179	177	176	174	173	171	170	169	168	167	166	165	164	164	163	162	162	161	161	160
105	190	187	186	184	182	180	179	177	176	174	173	172	171	170	169	168	167	167	166	165	165	164
110	196	194	192	190	188	186	184	183	181	180	179	177	176	175	174	173	172	171	170	170	169	168
115	203	200	198	196	194	192	190	189	187	185	184	183	181	180	179	178	177	176	175	174	173	173
120	209	207	204	202	200	198	196	194	192	191	189	188	186	185	184	183	182	180	179	179	178	177
125	215	213	210	208	206	204	202	200	198	196	195	193	192	190	189	187	186	185	184	183	182	181
130	221	219	216	214	212	210	207	205	203	202	200	198	197	195	194	192	191	190	189	188	186	185
135	227	225	222	220	217	215	213	211	209	207	205	203	202	200	199	197	196	194	193	192	191	190
140	233	231	228	226	223	221	218	216	214	212	210	209	207	205	203	202	200	199	198	196	195	194
145	239	236	234	231	229	226	224	222	220	217	215	214	212	210	208	207	205	204	202	201	200	198
150	245	242	239	237	234	232	229	227	225	223	221	219	217	215	213	211	210	208	207	205	204	203
155	250	247	245	242	239	237	234	232	230	228	226	224	222	220	218	216	214	213	211	210	208	207
160	256	253	250	247	245	242	240	237	235	233	231	228	226	224	223	221	219	217	216	214	213	211
165	261	258	255	253	250	247	245	242	240	238	235	233	231	229	227	225	224	222	220	219	217	216
170	266	263	260	258	255	252	250	247	245	243	240	238	236	234	232	230	228	226	225	223	221	220
175	271	268	266	263	260	257	255	252	250	247	245	243	241	239	237	235	233	231	229	227	226	224
180	276	273	271	268	265	262	260	257	255	252	250	248	245	243	241	239	237	235	233	232	230	228
185	281	278	275	273	270	267	264	262	259	257	254	252	250	248	246	243	242	240	238	236	234	232
190	286	283	280	277	275	272	269	267	264	262	259	257	254	252	250	248	246	244	242	240	238	237
195	291	288	285	282	279	277	274	271	269	266	264	261	259	257	254	252	250	248	246	244	242	241
200	296	293	290	287	284	281	279	276	273	271	268	266	263	261	259	257	254	252	250	248	247	245
205	301	298	295	292	289	286	283	280	278	275	273	270	268	265	263	261	259	257	255	253	251	249
210	305	302	299	296	293	290	288	285	282	280	277	275	272	270	267	265	263	261	259	257	255	253
215	310	307	304	301	298	295	292	289	287	284	281	279	276	274	272	269	267	265	263	261	259	257
220	314	311	308	305	302	299	297	294	291	288	286	283	281	278	276	273	271	269	267	265	263	261
225	319	316	313	310	307	304	301	298	295	293	290	287	285	282	280	278	275	273	271	269	267	265
230	323	320	317	314	311	308	305	302	300	297	294	292	289	287	284	282	279	277	275	273	271	269
235	328	325	322	318	315	313	310	307	304	301	298	296	293	291	288	286	283	281	279	277	275	272
240	332	329	326	323	320	317	314	311	308	305	303	300	297	295	292	290	287	285	283	281	278	276

TABLE 14. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2500

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	110	111	112	114	115	116	117	118	119	121	122	123	124	125	126	127	128	130	131	132	133	134
5	111	112	113	114	116	117	118	119	120	121	122	123	125	126	127	128	129	130	131	132	133	134
10	112	113	114	115	117	118	119	120	121	122	123	124	126	127	128	129	130	131	132	133	134	135
15	113	114	116	117	118	119	120	121	122	123	124	125	127	128	129	130	131	132	133	134	135	136
20	115	116	117	118	119	120	121	122	123	125	126	127	128	129	130	131	132	133	134	135	136	137
25	116	117	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138
30	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139
35	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
40	122	123	124	125	126	127	128	129	129	130	131	132	133	134	135	136	137	138	139	140	141	142
45	124	125	126	127	128	129	130	130	131	132	133	134	135	136	137	138	139	139	140	141	142	143
50	127	128	128	129	130	131	131	132	133	134	135	136	137	137	138	139	140	141	142	143	144	145
55	129	130	131	131	132	133	134	134	135	136	137	138	138	139	140	141	142	143	143	144	145	146
60	132	133	133	134	134	135	136	136	137	138	139	139	140	141	142	143	143	144	145	146	147	148
65	135	136	136	136	137	138	138	139	139	140	141	141	142	143	144	144	145	146	147	147	148	149
70	138	138	139	139	140	140	141	141	142	142	143	143	144	145	145	146	147	148	148	149	150	151
75	141	142	142	142	142	143	143	144	144	145	145	146	146	147	147	148	149	149	150	151	152	152
80	145	145	145	145	145	145	146	146	146	147	147	148	148	149	150	150	151	151	152	153	153	154
85	148	148	148	148	148	148	148	149	149	149	150	150	151	151	152	152	153	153	154	155	155	156
90	152	151	151	151	151	151	151	151	152	152	152	153	153	153	154	154	155	155	156	156	157	158
95	156	155	155	154	154	154	154	154	154	155	155	155	155	156	156	156	157	157	158	158	159	159
100	159	159	158	158	157	157	157	157	157	157	157	158	158	158	158	159	159	159	160	160	161	161
105	163	162	162	161	161	160	160	160	160	160	160	160	160	160	161	161	161	162	162	162	163	163
110	167	166	165	165	164	164	163	163	163	163	163	163	163	163	163	163	164	164	164	165	165	165
115	171	170	169	168	168	167	167	166	166	166	165	165	165	165	166	166	166	166	166	167	167	167
120	175	174	173	172	171	170	170	169	169	169	168	168	168	168	168	168	168	168	169	169	169	169
125	180	178	177	176	175	174	173	172	172	172	171	171	171	171	171	171	171	171	171	171	171	171
130	184	182	181	179	178	177	176	176	175	175	174	174	173	173	173	173	173	173	173	173	173	174
135	188	186	184	183	182	181	180	179	178	178	177	177	176	176	176	176	176	175	175	176	176	176
140	192	190	188	187	185	184	183	182	181	181	180	180	179	179	178	178	178	178	178	178	178	178
145	196	194	192	191	189	188	187	186	185	184	183	182	182	181	181	181	181	180	180	180	180	180
150	200	198	196	194	193	191	190	189	188	187	186	185	185	184	184	183	183	183	183	183	182	182
155	205	202	200	198	196	195	193	192	191	190	189	188	188	187	186	186	186	185	185	185	185	185
160	209	206	204	202	200	198	197	196	194	193	192	191	191	190	189	189	188	188	188	187	187	187
165	213	210	208	206	204	202	200	199	198	196	195	194	193	193	192	191	191	190	190	190	189	189
170	217	214	212	210	208	206	204	202	201	200	198	197	196	196	195	194	194	193	193	192	192	192
175	221	218	216	213	211	209	207	206	204	203	202	200	199	198	198	197	196	196	195	195	194	194
180	225	222	220	217	215	213	211	209	207	206	205	203	202	201	200	200	199	198	198	197	197	196
185	229	226	224	221	219	216	214	212	211	209	208	206	205	204	203	202	202	201	200	200	199	199
190	233	230	227	225	222	220	218	216	214	212	211	210	208	207	206	205	204	203	203	202	202	201
195	237	234	231	228	226	223	221	219	217	216	214	213	211	210	209	208	207	206	205	205	204	203
200	241	238	235	232	230	227	225	223	221	219	217	216	214	213	212	211	210	209	208	207	206	206
205	245	242	239	236	233	231	228	226	224	222	220	219	217	216	215	213	212	211	210	210	209	208
210	249	246	243	240	237	234	232	229	227	225	223	222	220	219	217	216	215	214	213	212	211	211
215	253	250	246	243	240	238	235	233	231	228	227	225	223	222	220	219	218	217	216	215	214	213
220	257	253	250	247	244	241	238	236	234	232	230	228	226	225	223	222	220	219	218	217	216	216
225	261	257	254	250	247	245	242	239	237	235	233	231	229	227	226	224	223	222	221	220	219	218
230	265	261	257	254	251	248	245	243	240	238	236	234	232	230	229	227	226	225	223	222	221	220
235	268	265	261	258	254	251	249	246	244	241	239	237	235	233	232	230	229	227	226	225	224	223
240	272	268	265	261	258	255	252	249	247	244	242	240	238	236	234	233	231	230	229	227	226	225

TABLE 14. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2500

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	135	138	140	143	146	148	151	153	156	158	161	163	166	168	171	173	175	178	180	182	185	187
5	136	138	141	144	146	149	151	154	156	159	161	164	166	169	171	173	176	178	180	183	185	187
10	136	139	142	144	147	149	152	154	157	159	162	164	167	169	172	174	176	179	181	183	186	188
15	137	140	142	145	148	150	153	155	158	160	163	165	167	170	172	175	177	179	182	184	186	188
20	138	141	143	146	149	151	154	156	158	161	163	166	168	171	173	175	178	180	182	184	187	189
25	139	142	144	147	149	152	154	157	159	162	164	166	169	171	174	176	178	180	183	185	187	190
30	140	143	145	148	150	153	155	158	160	163	165	167	170	172	174	177	179	181	183	186	188	190
35	142	144	147	149	151	154	156	159	161	163	166	168	170	173	175	177	180	182	184	186	189	191
40	143	145	148	150	152	155	157	160	162	164	167	169	171	174	176	178	180	183	185	187	189	191
45	144	146	149	151	154	156	158	161	163	165	167	170	172	174	177	179	181	183	186	188	190	192
50	146	148	150	152	155	157	159	162	164	166	168	171	173	175	177	180	182	184	186	188	191	193
55	147	149	151	154	156	158	160	163	165	167	169	172	174	176	178	180	183	185	187	189	191	193
60	148	151	153	155	157	159	161	164	166	168	170	173	175	177	179	181	183	186	188	190	192	194
65	150	152	154	156	158	160	163	165	167	169	171	174	176	178	180	182	184	186	189	191	193	195
70	151	153	155	158	160	162	164	166	168	170	172	175	177	179	181	183	185	187	189	191	194	196
75	153	155	157	159	161	163	165	167	169	171	173	176	178	180	182	184	186	188	190	192	194	196
80	155	157	158	160	162	164	166	168	170	172	174	177	179	181	183	185	187	189	191	193	195	197
85	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
90	158	160	162	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199
95	160	162	163	165	167	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200
100	162	163	165	166	168	170	172	173	175	177	179	181	183	185	187	189	191	193	195	197	198	200
105	164	165	167	168	170	171	173	175	177	178	180	182	184	186	188	190	192	194	195	197	199	201
110	166	167	168	170	171	173	174	176	178	180	181	183	185	187	189	191	193	194	196	198	200	202
115	168	169	170	171	173	174	176	177	179	181	183	184	186	188	190	192	194	195	197	199	201	203
120	170	171	172	173	174	176	177	179	180	182	184	186	187	189	191	193	195	196	198	200	202	204
125	172	173	174	175	176	177	179	180	182	183	185	187	188	190	192	194	196	197	199	201	203	205
130	174	175	175	177	178	179	180	182	183	185	186	188	190	191	193	195	197	198	200	202	204	206
135	176	177	177	178	179	181	182	183	185	186	188	189	191	193	194	196	198	199	201	203	205	207
140	178	179	179	180	181	182	183	185	186	187	189	190	192	194	195	197	199	200	202	204	206	207
145	180	181	181	182	183	184	185	186	187	189	190	192	193	195	196	198	200	201	203	205	207	208
150	182	183	183	184	185	185	187	188	189	190	192	193	195	196	198	199	201	202	204	206	208	209
155	185	185	185	186	186	187	188	189	190	192	193	194	196	197	199	200	202	204	205	207	209	210
160	187	187	187	187	188	189	190	191	192	193	194	196	197	198	200	201	203	205	206	208	209	211
165	189	189	189	189	190	191	191	192	193	194	196	197	198	200	201	203	204	206	207	209	210	212
170	191	191	191	191	192	192	193	194	195	196	197	198	200	201	202	204	205	207	208	210	211	213
175	194	193	193	193	194	194	195	195	196	197	198	200	201	202	204	205	206	208	209	211	212	214
180	196	195	195	195	195	196	196	197	198	199	200	201	202	203	205	206	208	209	210	212	213	215
185	198	198	197	197	197	198	198	199	199	200	201	202	204	205	206	207	209	210	211	213	214	216
190	201	200	199	199	199	199	200	200	201	202	203	204	205	206	207	208	210	211	213	214	215	217
195	203	202	201	201	201	201	202	202	203	203	204	205	206	207	208	210	211	212	214	215	217	218
200	205	204	204	203	203	203	203	204	204	205	206	207	208	209	210	211	212	213	215	216	218	219
205	208	206	206	205	205	205	205	205	206	206	207	208	209	210	211	212	213	215	216	217	219	220
210	210	209	208	207	207	207	207	207	207	208	209	209	210	211	212	213	215	216	217	218	220	221
215	212	211	210	209	209	208	208	209	209	209	210	211	212	213	214	215	216	217	218	219	221	222
220	215	213	212	211	211	210	210	210	211	211	212	212	213	214	215	216	217	218	219	220	222	223
225	217	216	214	213	213	212	212	212	212	213	213	214	214	215	216	217	218	219	220	222	223	224
230	220	218	216	215	215	214	214	214	214	214	215	215	216	217	217	218	219	220	222	223	224	225
235	222	220	219	217	217	216	216	215	216	216	216	217	217	218	219	220	221	222	223	224	225	226
240	224	222	221	219	219	218	217	217	217	217	218	218	219	219	220	221	222	223	224	225	226	227

TABLE 14. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2500

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	189	194	198	203	207	211	215	219	223	227	231	235	239	243	247	250	254	258	261	265	269	272
5	190	194	198	203	207	211	215	220	224	228	232	236	239	243	247	251	254	258	262	265	269	272
10	190	195	199	203	208	212	216	220	224	228	232	236	240	244	247	251	255	258	262	265	269	272
15	191	195	199	204	208	212	216	220	224	228	232	236	240	244	248	251	255	259	262	266	269	273
20	191	196	200	204	208	213	217	221	225	229	233	237	240	244	248	252	255	259	263	266	270	273
25	192	196	200	205	209	213	217	221	225	229	233	237	241	245	248	252	256	259	263	266	270	273
30	192	197	201	205	209	214	218	222	226	230	234	237	241	245	249	252	256	260	263	267	270	274
35	193	197	202	206	210	214	218	222	226	230	234	238	242	245	249	253	256	260	264	267	271	274
40	194	198	202	206	211	215	219	223	227	231	234	238	242	246	249	253	257	260	264	267	271	274
45	194	199	203	207	211	215	219	223	227	231	235	239	242	246	250	254	257	261	264	268	271	275
50	195	199	203	208	212	216	220	224	228	232	235	239	243	247	250	254	258	261	265	268	272	275
55	196	200	204	208	212	216	220	224	228	232	236	240	243	247	251	254	258	262	265	269	272	275
60	196	200	205	209	213	217	221	225	229	233	236	240	244	248	251	255	258	262	265	269	272	276
65	197	201	205	209	213	217	221	225	229	233	237	241	244	248	252	255	259	262	266	269	273	276
70	198	202	206	210	214	218	222	226	230	234	237	241	245	248	252	256	259	263	266	270	273	276
75	198	203	207	211	215	219	223	226	230	234	238	242	245	249	252	256	260	263	267	270	273	277
80	199	203	207	211	215	219	223	227	231	235	238	242	246	249	253	256	260	264	267	270	274	277
85	200	204	208	212	216	220	224	228	231	235	239	243	246	250	253	257	260	264	267	271	274	278
90	201	205	209	213	217	220	224	228	232	236	239	243	247	250	254	257	261	264	268	271	275	278
95	202	206	209	213	217	221	225	229	232	236	240	244	247	251	254	258	261	265	268	272	275	278
100	202	206	210	214	218	222	226	229	233	237	240	244	248	251	255	258	262	265	269	272	275	279
105	203	207	211	215	219	222	226	230	234	237	241	245	248	252	255	259	262	266	269	272	276	279
110	204	208	212	215	219	223	227	231	234	238	241	245	249	252	256	259	263	266	270	273	276	280
115	205	209	212	216	220	224	227	231	235	238	242	246	249	253	256	260	263	267	270	273	277	280
120	206	209	213	217	221	224	228	232	235	239	243	246	250	253	257	260	264	267	270	274	277	280
125	207	210	214	218	221	225	229	232	236	240	243	247	250	254	257	261	264	267	271	274	277	281
130	207	211	215	218	222	226	229	233	237	240	244	247	251	254	258	261	265	268	271	275	278	281
135	208	212	216	219	223	226	230	234	237	241	244	248	251	255	258	262	265	268	272	275	278	282
140	209	213	216	220	224	227	231	234	238	241	245	248	252	255	259	262	265	269	272	275	279	282
145	210	214	217	221	224	228	231	235	238	242	245	249	252	256	259	263	266	269	273	276	279	282
150	211	214	218	221	225	229	232	236	239	243	246	249	253	256	260	263	266	270	273	276	280	283
155	212	215	219	222	226	229	233	236	240	243	247	250	253	257	260	264	267	270	274	277	280	283
160	213	216	220	223	227	230	233	237	240	244	247	251	254	257	261	264	267	271	274	277	280	284
165	214	217	220	224	227	231	234	238	241	244	248	251	255	258	261	265	268	271	274	278	281	284
170	215	218	221	225	228	231	235	238	242	245	248	252	255	258	262	265	268	272	275	278	281	285
175	216	219	222	225	229	232	236	239	242	246	249	252	256	259	262	266	269	272	275	279	282	285
180	217	220	223	226	230	233	236	240	243	246	250	253	256	260	263	266	269	273	276	279	282	285
185	218	221	224	227	230	234	237	240	244	247	250	254	257	260	263	267	270	273	276	280	283	286
190	218	222	225	228	231	234	238	241	244	248	251	254	257	261	264	267	270	274	277	280	283	286
195	219	222	226	229	232	235	238	242	245	248	251	255	258	261	264	268	271	274	277	280	284	287
200	220	223	226	230	233	236	239	242	246	249	252	255	259	262	265	268	271	275	278	281	284	287
205	221	224	227	230	234	237	240	243	246	250	253	256	259	262	266	269	272	275	278	281	285	288
210	222	225	228	231	234	237	241	244	247	250	253	257	260	263	266	269	272	276	279	282	285	288
215	223	226	229	232	235	238	241	244	248	251	254	257	260	264	267	270	273	276	279	282	285	289
220	224	227	230	233	236	239	242	245	248	251	255	258	261	264	267	270	273	277	280	283	286	289
225	225	228	231	234	237	240	243	246	249	252	255	258	262	265	268	271	274	277	280	283	286	289
230	226	229	232	235	238	241	244	247	250	253	256	259	262	265	268	271	275	278	281	284	287	290
235	227	230	233	236	238	241	244	247	250	253	257	260	263	266	269	272	275	278	281	284	287	290
240	228	231	234	236	239	242	245	248	251	254	257	260	263	266	269	273	276	279	282	285	288	291

TABLE 14. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2500

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	276	279	282	286	289	292	296	299	302	305	308	312	315	318	321	324	327	330	333	336	339	342
5	276	279	283	286	289	293	296	299	302	305	309	312	315	318	321	324	327	330	333	336	339	342
10	276	279	283	286	289	293	296	299	302	306	309	312	315	318	321	324	327	330	333	336	339	342
15	276	280	283	286	290	293	296	300	303	306	309	312	315	318	321	325	328	331	334	337	340	342
20	277	280	283	287	290	293	297	300	303	306	309	312	316	319	322	325	328	331	334	337	340	343
25	277	280	284	287	290	294	297	300	303	306	310	313	316	319	322	325	328	331	334	337	340	343
30	277	281	284	287	291	294	297	300	303	307	310	313	316	319	322	325	328	331	334	337	340	343
35	277	281	284	288	291	294	297	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343
40	278	281	285	288	291	294	298	301	304	307	310	313	317	320	323	326	329	332	335	338	341	343
45	278	281	285	288	291	295	298	301	304	307	311	314	317	320	323	326	329	332	335	338	341	344
50	278	282	285	288	292	295	298	301	305	308	311	314	317	320	323	326	329	332	335	338	341	344
55	279	282	285	289	292	295	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344
60	279	282	286	289	292	296	299	302	305	308	311	315	318	321	324	327	330	333	336	339	341	344
65	279	283	286	289	293	296	299	302	305	309	312	315	318	321	324	327	330	333	336	339	342	345
70	280	283	286	290	293	296	299	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345
75	280	284	287	290	293	297	300	303	306	309	312	315	318	321	325	328	330	333	336	339	342	345
80	281	284	287	290	294	297	300	303	306	310	313	316	319	322	325	328	331	334	337	340	342	345
85	281	284	288	291	294	297	300	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346
90	281	285	288	291	294	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346
95	282	285	288	291	295	298	301	304	307	310	314	317	320	323	326	329	332	335	337	340	343	346
100	282	285	289	292	295	298	301	305	308	311	314	317	320	323	326	329	332	335	338	341	343	346
105	282	286	289	292	295	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347
110	283	286	289	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344	347
115	283	286	290	293	296	299	302	306	309	312	315	318	321	324	327	330	333	336	338	341	344	347
120	284	287	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345	347
125	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	345	348
130	284	288	291	294	297	300	303	307	310	313	316	319	322	325	328	331	334	336	339	342	345	348
135	285	288	291	294	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	342	345	348
140	285	288	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343	346	348
145	286	289	292	295	298	301	305	308	311	314	317	320	323	326	329	331	334	337	340	343	346	349
150	286	289	292	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	340	343	346	349
155	286	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344	346	349
160	287	290	293	296	299	303	306	309	312	315	318	321	324	327	329	332	335	338	341	344	347	350
165	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	338	341	344	347	350
170	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	344	347	350
175	288	291	294	297	301	304	307	310	313	316	319	322	325	327	330	333	336	339	342	345	348	350
180	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	336	339	342	345	348	351
185	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	342	345	348	351
190	289	293	296	299	302	305	308	311	314	317	320	323	326	328	331	334	337	340	343	346	348	351
195	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	337	340	343	346	349	351
200	290	293	296	299	303	306	309	312	314	317	320	323	326	329	332	335	338	341	343	346	349	352
205	291	294	297	300	303	306	309	312	315	318	321	324	327	329	332	335	338	341	344	346	349	352
210	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	335	338	341	344	347	350	352
215	292	295	298	301	304	307	310	313	316	318	321	324	327	330	333	336	339	341	344	347	350	353
220	292	295	298	301	304	307	310	313	316	319	322	325	328	330	333	336	339	342	345	347	350	353
225	292	295	299	302	305	307	310	313	316	319	322	325	328	331	334	336	339	342	345	348	350	353
230	293	296	299	302	305	308	311	314	317	320	322	325	328	331	334	337	340	342	345	348	351	353
235	293	296	299	302	305	308	311	314	317	320	323	326	329	331	334	337	340	343	345	348	351	354
240	294	297	300	303	306	309	312	315	317	320	323	326	329	332	335	337	340	343	346	348	351	354

TABLE 15. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	95	96	96	97	97	98	99	99	100	100	101	102	102	103	103	104	105	105	106	106	107	108
5	96	97	97	98	98	99	100	100	101	101	102	103	103	104	104	105	106	106	107	107	108	109
10	98	98	99	99	100	101	101	102	102	103	103	104	105	105	106	106	107	108	108	109	109	110
15	100	100	101	101	102	102	103	104	104	105	105	106	106	107	107	108	109	109	110	110	111	111
20	102	102	103	103	104	105	105	106	106	107	107	108	108	109	109	110	110	111	111	112	112	113
25	105	105	106	106	106	107	107	108	108	109	109	110	110	111	111	112	112	113	113	114	114	115
30	108	108	109	109	109	110	110	111	111	111	112	112	113	113	114	114	115	115	116	116	116	117
35	111	112	112	112	113	113	113	114	114	114	115	115	116	116	116	117	117	118	118	118	119	119
40	116	116	116	116	116	117	117	117	117	118	118	118	119	119	119	120	120	120	121	121	121	122
45	120	120	120	120	120	121	121	121	121	121	121	122	122	122	122	123	123	123	124	124	124	125
50	126	126	125	125	125	125	125	125	125	125	125	125	126	126	126	126	126	126	127	127	127	127
55	132	132	131	131	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	131
60	139	138	138	137	136	136	135	135	135	134	134	134	134	134	134	134	134	134	134	134	134	134
65	147	146	144	144	143	142	141	141	140	140	139	139	139	138	138	138	138	138	138	138	138	138
70	155	153	152	151	150	149	148	147	146	145	145	144	144	143	143	143	142	142	142	142	142	142
75	163	162	160	158	157	156	154	153	152	151	151	150	149	149	148	148	147	147	147	146	146	146
80	172	170	168	166	164	163	161	160	159	158	157	156	155	154	153	153	152	152	151	151	150	150
85	181	178	176	174	172	170	168	167	165	164	163	162	161	160	159	158	157	157	156	156	155	155
90	190	187	184	182	180	178	176	174	172	171	169	168	167	166	165	164	163	162	161	161	160	159
95	198	195	192	190	187	185	183	181	179	177	176	174	173	172	170	169	168	167	166	166	165	164
100	206	203	200	198	195	193	190	188	186	184	182	181	179	178	176	175	174	173	172	171	170	169
105	214	211	208	205	202	200	197	195	193	191	189	187	185	184	182	181	180	178	177	176	175	174
110	222	219	216	213	210	207	205	202	200	198	196	194	192	190	188	187	185	184	183	181	180	179
115	229	226	223	220	217	214	211	209	206	204	202	200	198	196	194	193	191	190	188	187	185	184
120	236	233	230	227	224	221	218	216	213	211	208	206	204	202	200	198	197	195	194	192	191	189
125	243	240	237	234	231	228	225	222	220	217	215	212	210	208	206	204	202	201	199	197	196	195
130	250	247	244	240	237	234	231	229	226	223	221	218	216	214	212	210	208	206	204	203	201	200
135	257	253	250	247	244	241	238	235	232	229	227	224	222	220	218	216	214	212	210	208	206	205
140	263	260	256	253	250	247	244	241	238	235	233	230	228	226	223	221	219	217	215	213	212	210
145	270	266	263	259	256	253	250	247	244	241	239	236	234	231	229	227	224	222	220	219	217	215
150	276	272	269	265	262	259	256	253	250	247	244	242	239	237	234	232	230	228	226	224	222	220
155	282	278	275	271	268	265	262	259	256	253	250	247	245	242	240	237	235	233	231	229	227	225
160	287	284	281	277	274	271	267	264	261	258	256	253	250	248	245	243	240	238	236	234	232	230
165	293	290	286	283	279	276	273	270	267	264	261	258	256	253	250	248	246	243	241	239	237	235
170	299	295	292	288	285	282	279	275	272	269	266	264	261	258	256	253	251	248	246	244	242	240
175	304	301	297	294	290	287	284	281	278	275	272	269	266	263	261	258	256	253	251	249	246	244
180	310	306	303	299	296	293	289	286	283	280	277	274	271	268	266	263	261	258	256	253	251	249
185	315	312	308	305	301	298	295	291	288	285	282	279	276	273	271	268	266	263	261	258	256	254
190	320	317	313	310	306	303	300	296	293	290	287	284	281	278	276	273	270	268	265	263	261	258
195	326	322	318	315	311	308	305	301	298	295	292	289	286	283	281	278	275	273	270	268	265	263
200	331	327	323	320	317	313	310	306	303	300	297	294	291	288	285	283	280	277	275	272	270	268
205	336	332	328	325	322	318	315	311	308	305	302	299	296	293	290	287	285	282	279	277	274	272
210	341	337	333	330	326	323	320	316	313	310	307	304	301	298	295	292	289	286	284	281	279	276
215	346	342	338	335	331	328	324	321	318	315	311	308	305	302	299	297	294	291	288	286	283	281
220	350	347	343	340	336	333	329	326	323	319	316	313	310	307	304	301	298	296	293	290	288	285
225	355	352	348	344	341	337	334	331	327	324	321	318	314	311	309	306	303	300	297	295	292	290
230	360	356	353	349	346	342	339	335	332	329	325	322	319	316	313	310	307	304	302	299	296	294
235	365	361	357	354	350	347	343	340	336	333	330	327	324	320	317	314	312	309	306	303	301	298
240	369	366	362	358	355	351	348	344	341	338	334	331	328	325	322	319	316	313	310	308	305	302

TABLE 15. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	109	110	111	112	113	115	116	117	118	119	120	121	123	124	125	126	127	128	129	130	131	133
5	110	111	112	113	114	115	117	118	119	120	121	122	123	124	126	127	128	129	130	131	132	133
10	111	112	113	114	115	117	118	119	120	121	122	123	124	125	127	128	129	130	131	132	133	134
15	112	114	115	116	117	118	119	120	121	122	123	124	126	127	128	129	130	131	132	133	134	135
20	114	115	116	117	118	119	120	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
25	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137
30	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139
35	120	121	122	123	124	125	126	127	128	128	129	130	131	132	133	134	135	136	137	138	139	140
40	123	123	124	125	126	127	128	129	129	130	131	132	133	134	135	136	137	138	139	140	141	141
45	125	126	127	127	128	129	130	131	131	132	133	134	135	136	137	138	138	139	140	141	142	143
50	128	129	129	130	131	131	132	133	134	134	135	136	137	138	138	139	140	141	142	143	144	145
55	131	132	132	133	133	134	135	135	136	137	137	138	139	140	140	141	142	143	144	144	145	146
60	134	135	135	136	136	137	137	138	138	139	140	140	141	142	142	143	144	145	145	146	147	148
65	138	138	138	139	139	139	140	140	141	141	142	143	143	144	145	145	146	147	147	148	149	150
70	142	142	142	142	142	142	143	143	143	144	144	145	146	146	147	147	148	149	149	150	151	151
75	146	145	145	145	145	145	146	146	146	147	147	147	148	148	149	150	150	151	151	152	153	153
80	150	149	149	149	149	149	149	149	149	149	150	150	150	151	151	152	152	153	153	154	155	155
85	154	153	153	153	152	152	152	152	152	152	153	153	153	153	154	154	155	155	156	156	157	157
90	158	158	157	156	156	156	155	155	155	155	155	156	156	156	156	157	157	157	158	158	159	159
95	163	162	161	160	160	159	159	159	159	158	158	158	159	159	159	159	159	160	160	161	161	161
100	168	166	165	164	164	163	162	162	162	162	161	161	161	161	162	162	162	162	163	163	163	164
105	172	171	170	169	168	167	166	166	165	165	165	164	164	164	164	164	165	165	165	165	166	166
110	177	176	174	173	172	171	170	169	169	168	168	168	167	167	167	167	167	167	167	168	168	168
115	182	180	179	177	176	175	174	173	172	172	171	171	170	170	170	170	170	170	170	170	170	171
120	187	185	183	181	180	179	178	177	176	175	174	174	174	173	173	173	173	173	173	173	173	173
125	192	190	188	186	184	183	181	180	179	179	178	177	177	176	176	176	175	175	175	175	175	175
130	197	194	192	190	188	187	185	184	183	182	181	181	180	179	179	179	178	178	178	178	178	178
135	202	199	197	195	193	191	189	188	187	186	185	184	183	183	182	182	181	181	181	180	180	180
140	207	204	201	199	197	195	193	192	191	189	188	187	186	186	185	184	184	184	183	183	183	183
145	212	209	206	204	201	199	197	196	194	193	192	191	190	189	188	188	187	186	186	186	186	185
150	217	213	211	208	206	203	201	200	198	197	195	194	193	192	191	191	190	189	189	188	188	188
155	221	218	215	212	210	208	206	204	202	200	199	198	196	195	194	194	193	192	192	191	191	190
160	226	223	220	217	214	212	210	207	206	204	202	201	200	199	198	197	196	195	195	194	194	193
165	231	227	224	221	218	216	214	211	209	208	206	205	203	202	201	200	199	198	197	197	196	196
170	236	232	229	226	223	220	218	215	213	211	210	208	207	205	204	203	202	201	200	200	199	198
175	240	237	233	230	227	224	222	219	217	215	213	211	210	209	207	206	205	204	203	202	202	201
180	245	241	238	234	231	228	226	223	221	219	217	215	213	212	210	209	208	207	206	205	204	204
185	250	246	242	238	235	232	230	227	225	222	220	218	217	215	214	212	211	210	209	208	207	206
190	254	250	246	243	239	236	233	231	228	226	224	222	220	218	217	215	214	213	212	211	210	209
195	259	254	251	247	244	240	237	235	232	230	227	225	224	222	220	219	217	216	215	214	213	212
200	263	259	255	251	248	244	241	238	236	233	231	229	227	225	223	222	220	219	218	217	216	215
205	267	263	259	255	252	248	245	242	240	237	235	232	230	228	227	225	223	222	221	220	218	217
210	272	267	263	259	256	252	249	246	243	241	238	236	234	232	230	228	226	225	224	222	221	220
215	276	272	267	263	260	256	253	250	247	244	242	239	237	235	233	231	230	228	227	225	224	223
220	280	276	272	268	264	260	257	254	251	248	245	243	240	238	236	234	233	231	230	228	227	226
225	285	280	276	272	268	264	261	257	254	251	249	246	244	242	239	238	236	234	232	231	230	228
230	289	284	280	276	272	268	264	261	258	255	252	250	247	245	243	241	239	237	235	234	232	231
235	293	288	284	280	276	272	268	265	261	258	256	253	250	248	246	244	242	240	238	237	235	234
240	297	292	288	284	279	276	272	268	265	262	259	256	254	251	249	247	245	243	241	240	238	237

TABLE 15. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	134	136	139	142	144	147	149	152	155	157	160	162	164	167	169	172	174	176	179	181	183	186
5	134	137	140	142	145	147	150	152	155	158	160	162	165	167	170	172	174	177	179	181	184	186
10	135	138	140	143	146	148	151	153	156	158	161	163	166	168	170	173	175	177	180	182	184	187
15	136	139	141	144	147	149	152	154	157	159	161	164	166	169	171	173	176	178	180	183	185	187
20	137	140	142	145	147	150	152	155	157	160	162	165	167	169	172	174	176	179	181	183	186	188
25	138	141	143	146	148	151	153	156	158	161	163	165	168	170	173	175	177	179	182	184	186	188
30	140	142	145	147	150	152	154	157	159	162	164	166	169	171	173	176	178	180	182	185	187	189
35	141	143	146	148	151	153	155	158	160	163	165	167	170	172	174	176	179	181	183	185	188	190
40	142	145	147	149	152	154	157	159	161	164	166	168	170	173	175	177	179	182	184	186	188	190
45	144	146	148	151	153	155	158	160	162	165	167	169	171	174	176	178	180	183	185	187	189	191
50	145	148	150	152	154	157	159	161	163	166	168	170	172	175	177	179	181	183	186	188	190	192
55	147	149	151	153	156	158	160	162	164	167	169	171	173	176	178	180	182	184	186	189	191	193
60	149	151	153	155	157	159	161	163	166	168	170	172	174	176	179	181	183	185	187	189	191	194
65	150	152	154	156	158	161	163	165	167	169	171	173	175	178	180	182	184	186	188	190	192	194
70	152	154	156	158	160	162	164	166	168	170	172	174	176	179	181	183	185	187	189	191	193	195
75	154	156	158	159	161	163	165	167	169	171	173	175	178	180	182	184	186	188	190	192	194	196
80	156	158	159	161	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197
85	158	159	161	163	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
90	160	161	163	164	166	168	170	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199
95	162	163	165	166	168	169	171	173	175	177	178	180	182	184	186	188	190	192	194	196	198	200
100	164	165	167	168	169	171	173	174	176	178	180	181	183	185	187	189	191	193	195	197	199	200
105	166	167	168	170	171	173	174	176	178	179	181	183	185	186	188	190	192	194	196	198	199	201
110	168	169	170	172	173	174	176	177	179	181	182	184	186	188	189	191	193	195	197	199	200	202
115	171	172	172	174	175	176	177	179	180	182	184	185	187	189	191	192	194	196	198	200	201	203
120	173	174	174	175	177	178	179	180	182	183	185	187	188	190	192	193	195	197	199	201	202	204
125	175	176	177	177	178	180	181	182	183	185	186	188	190	191	193	195	196	198	200	202	203	205
130	178	178	179	179	180	181	182	184	185	186	188	189	191	193	194	196	197	199	201	203	204	206
135	180	180	181	181	182	183	184	185	187	188	189	191	192	194	195	197	199	200	202	204	205	207
140	183	183	183	183	184	185	186	187	188	189	191	192	194	195	197	198	200	201	203	205	206	208
145	185	185	185	186	186	187	188	189	190	191	192	194	195	196	198	199	201	203	204	206	208	209
150	188	187	187	188	188	189	189	190	191	193	194	195	196	198	199	201	202	204	205	207	209	210
155	190	190	190	190	190	191	191	192	193	194	195	196	198	199	200	202	203	205	206	208	210	211
160	193	192	192	192	192	193	193	194	195	196	197	198	199	200	202	203	205	206	208	209	211	212
165	195	195	194	194	194	194	195	196	196	197	198	199	201	202	203	204	206	207	209	210	212	213
170	198	197	196	196	196	196	197	197	198	199	200	201	202	203	204	206	207	208	210	211	213	214
175	201	199	199	198	198	198	199	199	200	201	201	202	203	205	206	207	208	210	211	213	214	215
180	203	202	201	201	200	200	201	201	202	202	203	204	205	206	207	208	210	211	212	214	215	217
185	206	204	203	203	203	202	203	203	203	204	205	205	206	207	209	210	211	212	213	215	216	218
190	208	207	206	205	205	204	204	205	205	206	206	207	208	209	210	211	212	213	215	216	217	219
195	211	209	208	207	207	206	206	207	207	207	208	209	209	210	211	212	213	215	216	217	218	220
200	214	212	211	210	209	209	208	208	209	209	209	210	211	212	213	214	215	216	217	218	220	221
205	216	215	213	212	211	211	210	210	210	211	211	212	212	213	214	215	216	217	218	220	221	222
210	219	217	215	214	213	213	212	212	212	212	213	213	214	215	215	216	217	218	220	221	222	223
215	222	220	218	216	215	215	214	214	214	214	214	215	215	216	217	218	219	220	221	222	223	224
220	225	222	220	219	218	217	216	216	216	216	216	216	217	218	218	219	220	221	222	223	224	225
225	227	225	223	221	220	219	218	218	218	218	218	218	219	219	220	221	221	222	223	224	225	227
230	230	227	225	223	222	221	220	220	219	219	219	220	220	221	221	222	223	224	225	226	227	228
235	233	230	228	226	224	223	222	222	221	221	221	221	222	222	223	223	224	225	226	227	228	229
240	235	232	230	228	226	225	224	224	223	223	223	223	223	224	224	225	225	226	227	228	229	230

TABLE 15. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	188	192	197	201	205	210	214	218	222	226	230	234	238	241	245	249	253	256	260	263	267	270
5	188	193	197	201	206	210	214	218	222	226	230	234	238	242	245	249	253	256	260	264	267	271
10	189	193	198	202	206	210	215	219	223	227	231	234	238	242	246	250	253	257	260	264	267	271
15	189	194	198	202	207	211	215	219	223	227	231	235	239	242	246	250	254	257	261	264	268	271
20	190	194	199	203	207	211	215	220	224	228	231	235	239	243	247	250	254	258	261	265	268	272
25	191	195	199	204	208	212	216	220	224	228	232	236	240	243	247	251	254	258	261	265	268	272
30	191	196	200	204	208	212	217	221	225	228	232	236	240	244	247	251	255	258	262	265	269	272
35	192	196	201	205	209	213	217	221	225	229	233	237	240	244	248	252	255	259	262	266	269	273
40	193	197	201	205	210	214	218	222	226	229	233	237	241	245	248	252	256	259	263	266	270	273
45	193	198	202	206	210	214	218	222	226	230	234	238	241	245	249	252	256	260	263	267	270	273
50	194	198	203	207	211	215	219	223	227	231	234	238	242	246	249	253	256	260	263	267	270	274
55	195	199	203	207	211	215	219	223	227	231	235	239	242	246	250	253	257	260	264	267	271	274
60	196	200	204	208	212	216	220	224	228	232	235	239	243	246	250	254	257	261	264	268	271	275
65	196	201	205	209	213	217	221	224	228	232	236	240	243	247	251	254	258	261	265	268	272	275
70	197	201	205	209	213	217	221	225	229	233	236	240	244	247	251	255	258	262	265	269	272	275
75	198	202	206	210	214	218	222	226	230	233	237	241	244	248	252	255	259	262	266	269	272	276
80	199	203	207	211	215	219	222	226	230	234	238	241	245	248	252	256	259	263	266	269	273	276
85	200	204	208	212	215	219	223	227	231	234	238	242	245	249	253	256	260	263	266	270	273	277
90	201	205	208	212	216	220	224	228	231	235	239	242	246	250	253	257	260	263	267	270	274	277
95	201	205	209	213	217	221	224	228	232	236	239	243	246	250	254	257	261	264	267	271	274	277
100	202	206	210	214	218	221	225	229	233	236	240	243	247	251	254	258	261	264	268	271	275	278
105	203	207	211	215	218	222	226	230	233	237	240	244	248	251	255	258	261	265	268	272	275	278
110	204	208	212	215	219	223	227	230	234	237	241	245	248	252	255	259	262	265	269	272	275	279
115	205	209	213	216	220	224	227	231	234	238	242	245	249	252	256	259	262	266	269	273	276	279
120	206	210	213	217	221	224	228	232	235	239	242	246	249	253	256	260	263	266	270	273	276	280
125	207	211	214	218	221	225	229	232	236	239	243	246	250	253	257	260	264	267	270	273	277	280
130	208	211	215	219	222	226	229	233	236	240	243	247	250	254	257	261	264	267	271	274	277	280
135	209	212	216	219	223	227	230	234	237	241	244	248	251	254	258	261	265	268	271	274	278	281
140	210	213	217	220	224	227	231	234	238	241	245	248	252	255	258	262	265	268	272	275	278	281
145	211	214	218	221	225	228	232	235	238	242	245	249	252	256	259	262	266	269	272	275	279	282
150	212	215	219	222	225	229	232	236	239	243	246	249	253	256	259	263	266	269	273	276	279	282
155	213	216	219	223	226	230	233	236	240	243	247	250	253	257	260	263	267	270	273	276	280	283
160	214	217	220	224	227	230	234	237	241	244	247	251	254	257	261	264	267	270	274	277	280	283
165	215	218	221	225	228	231	235	238	241	245	248	251	255	258	261	264	268	271	274	277	281	284
170	216	219	222	225	229	232	235	239	242	245	249	252	255	258	262	265	268	271	275	278	281	284
175	217	220	223	226	230	233	236	239	243	246	249	253	256	259	262	266	269	272	275	278	281	285
180	218	221	224	227	230	234	237	240	243	247	250	253	256	260	263	266	269	273	276	279	282	285
185	219	222	225	228	231	234	238	241	244	247	251	254	257	260	263	267	270	273	276	279	282	286
190	220	223	226	229	232	235	238	242	245	248	251	254	258	261	264	267	270	274	277	280	283	286
195	221	224	227	230	233	236	239	242	246	249	252	255	258	262	265	268	271	274	277	280	283	287
200	222	225	228	231	234	237	240	243	246	249	253	256	259	262	265	268	272	275	278	281	284	287
205	223	226	229	232	235	238	241	244	247	250	253	256	260	263	266	269	272	275	278	281	284	287
210	224	227	230	233	236	239	242	245	248	251	254	257	260	263	266	270	273	276	279	282	285	288
215	226	228	231	234	237	240	243	246	249	252	255	258	261	264	267	270	273	276	279	282	285	288
220	227	229	232	235	237	240	243	246	249	252	255	258	262	265	268	271	274	277	280	283	286	289
225	228	230	233	236	238	241	244	247	250	253	256	259	262	265	268	271	274	277	280	283	286	289
230	229	231	234	237	239	242	245	248	251	254	257	260	263	266	269	272	275	278	281	284	287	290
235	230	232	235	237	240	243	246	249	252	255	258	261	264	267	270	273	276	279	282	285	287	290
240	231	233	236	238	241	244	247	249	252	255	258	261	264	267	270	273	276	279	282	285	288	291

TABLE 15. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.2000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	274	277	281	284	287	291	294	297	300	303	307	310	313	316	319	322	325	328	331	334	337	340
5	274	277	281	284	288	291	294	297	300	304	307	310	313	316	319	322	325	328	331	334	337	340
10	274	278	281	284	288	291	294	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340
15	275	278	281	285	288	291	295	298	301	304	307	310	314	317	320	323	326	329	332	335	337	340
20	275	278	282	285	288	292	295	298	301	304	308	311	314	317	320	323	326	329	332	335	338	341
25	275	279	282	285	289	292	295	298	302	305	308	311	314	317	320	323	326	329	332	335	338	341
30	276	279	282	286	289	292	295	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341
35	276	279	283	286	289	293	296	299	302	305	308	312	315	318	321	324	327	330	333	336	338	341
40	276	280	283	286	290	293	296	299	302	306	309	312	315	318	321	324	327	330	333	336	339	342
45	277	280	283	287	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342
50	277	280	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342
55	277	281	284	287	291	294	297	300	303	307	310	313	316	319	322	325	328	331	334	337	339	342
60	278	281	285	288	291	294	297	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343
65	278	282	285	288	291	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	343
70	279	282	285	288	292	295	298	301	304	307	311	314	317	320	323	326	329	332	334	337	340	343
75	279	282	286	289	292	295	298	302	305	308	311	314	317	320	323	326	329	332	335	338	340	343
80	279	283	286	289	292	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341	344
85	280	283	286	290	293	296	299	302	305	308	312	315	318	321	324	327	329	332	335	338	341	344
90	280	284	287	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	338	341	344
95	281	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	342	344
100	281	284	288	291	294	297	300	303	306	309	313	316	319	322	324	327	330	333	336	339	342	345
105	282	285	288	291	294	297	301	304	307	310	313	316	319	322	325	328	331	334	336	339	342	345
110	282	285	288	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340	342	345
115	282	286	289	292	295	298	301	304	307	311	314	317	320	322	325	328	331	334	337	340	343	346
120	283	286	289	292	295	299	302	305	308	311	314	317	320	323	326	329	332	334	337	340	343	346
125	283	286	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	340	343	346
130	284	287	290	293	296	299	302	306	309	312	315	318	321	323	326	329	332	335	338	341	344	346
135	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	335	338	341	344	347
140	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	341	344	347
145	285	288	291	294	297	301	304	307	310	313	316	319	322	324	327	330	333	336	339	342	344	347
150	285	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	333	336	339	342	345	348
155	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	339	342	345	348
160	286	289	293	296	299	302	305	308	311	314	317	320	323	325	328	331	334	337	340	343	345	348
165	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	334	337	340	343	346	348
170	287	290	293	297	300	303	306	309	312	315	317	320	323	326	329	332	335	338	340	343	346	349
175	288	291	294	297	300	303	306	309	312	315	318	321	324	327	329	332	335	338	341	343	346	349
180	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	335	338	341	344	347	349
185	289	292	295	298	301	304	307	310	313	316	319	321	324	327	330	333	336	339	341	344	347	350
190	289	292	295	298	301	304	307	310	313	316	319	322	325	328	330	333	336	339	342	344	347	350
195	290	293	296	299	302	305	308	311	313	316	319	322	325	328	331	334	336	339	342	345	348	350
200	290	293	296	299	302	305	308	311	314	317	320	323	325	328	331	334	337	340	342	345	348	351
205	291	294	297	300	303	305	308	311	314	317	320	323	326	329	331	334	337	340	343	345	348	351
210	291	294	297	300	303	306	309	312	315	318	320	323	326	329	332	335	337	340	343	346	348	351
215	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	338	340	343	346	349	351
220	292	295	298	301	304	307	310	313	315	318	321	324	327	330	332	335	338	341	344	346	349	352
225	292	295	298	301	304	307	310	313	316	319	322	324	327	330	333	336	338	341	344	347	349	352
230	293	296	299	302	305	308	310	313	316	319	322	325	328	330	333	336	339	341	344	347	350	352
235	293	296	299	302	305	308	311	314	317	319	322	325	328	331	334	336	339	342	345	347	350	353
240	294	297	300	303	306	308	311	314	317	320	323	326	328	331	334	337	339	342	345	348	350	353

TABLE 16. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1500

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	94	94	95	96	96	97	97	98	99	99	100	100	101	102	102	103	103	104	105	105	106	106
5	95	96	96	97	97	98	99	99	100	100	101	101	102	103	103	104	104	105	106	106	107	107
10	97	97	98	98	99	100	100	101	101	102	102	103	104	104	105	105	106	106	107	108	108	109
15	99	99	100	101	101	102	102	103	103	104	104	105	106	106	107	107	108	108	109	109	110	110
20	102	102	103	103	104	104	105	105	106	106	107	107	108	108	109	109	110	110	111	111	112	112
25	105	105	106	106	106	107	107	108	108	109	109	110	110	111	111	112	112	113	113	113	114	114
30	108	109	109	109	110	110	111	111	111	112	112	113	113	113	114	114	115	115	116	116	116	117
35	113	113	113	114	114	114	114	115	115	115	115	116	116	116	117	117	118	118	118	119	119	120
40	118	118	118	118	118	118	119	119	119	119	119	120	120	120	120	121	121	121	121	122	122	122
45	125	124	124	124	124	124	124	124	124	124	124	124	124	124	124	124	125	125	125	125	125	126
50	132	132	131	130	130	130	129	129	129	129	129	128	128	128	128	129	129	129	129	129	129	129
55	141	140	139	138	137	136	136	135	135	134	134	134	134	133	133	133	133	133	133	133	133	133
60	152	150	148	147	145	144	143	142	142	141	140	140	139	139	139	138	138	138	138	138	137	137
65	163	160	158	156	154	153	151	150	149	148	147	146	145	145	144	144	143	143	143	142	142	142
70	175	172	169	166	164	162	160	158	157	155	154	153	152	151	150	150	149	149	148	148	147	147
75	186	183	180	177	174	171	169	167	165	164	162	161	159	158	157	156	155	154	154	153	153	152
80	198	194	190	187	184	181	179	176	174	172	170	168	167	165	164	163	162	161	160	159	158	157
85	209	205	201	197	194	191	188	185	183	180	178	176	174	173	171	170	168	167	166	165	164	163
90	219	215	211	207	204	200	197	194	191	189	186	184	182	180	178	177	175	174	172	171	170	169
95	229	224	220	217	213	209	206	203	200	197	195	192	190	188	186	184	182	181	179	178	176	175
100	238	234	230	226	222	218	215	212	208	206	203	200	198	195	193	191	189	187	186	184	183	181
105	247	242	238	234	230	227	223	220	217	214	211	208	205	203	200	198	196	194	192	191	189	187
110	255	251	247	243	239	235	231	228	225	222	218	216	213	210	208	205	203	201	199	197	195	194
115	263	259	255	251	247	243	239	236	232	229	226	223	220	217	215	212	210	208	206	204	202	200
120	271	267	263	258	255	251	247	243	240	237	233	230	227	225	222	219	217	214	212	210	208	206
125	278	274	270	266	262	258	254	251	247	244	241	237	234	231	229	226	223	221	219	216	214	212
130	286	281	277	273	269	265	262	258	254	251	248	244	241	238	235	233	230	227	225	223	220	218
135	293	289	284	280	276	272	269	265	261	258	254	251	248	245	242	239	236	234	231	229	226	224
140	300	295	291	287	283	279	275	272	268	264	261	258	254	251	248	245	243	240	237	235	232	230
145	306	302	298	294	290	286	282	278	275	271	267	264	261	258	255	252	249	246	243	241	238	236
150	313	308	304	300	296	292	288	285	281	277	274	270	267	264	261	258	255	252	249	247	244	242
155	319	315	311	307	303	299	295	291	287	284	280	277	273	270	267	264	261	258	255	252	250	247
160	325	321	317	313	309	305	301	297	293	290	286	283	279	276	273	270	267	264	261	258	255	253
165	331	327	323	319	315	311	307	303	299	296	292	289	285	282	279	275	272	269	266	264	261	258
170	337	333	329	325	321	317	313	309	305	301	298	294	291	288	284	281	278	275	272	269	266	264
175	343	339	335	331	327	323	319	315	311	307	304	300	297	293	290	287	284	280	277	275	272	269
180	349	345	340	336	332	328	324	320	317	313	309	306	302	299	295	292	289	286	283	280	277	274
185	354	350	346	342	338	334	330	326	322	318	315	311	308	304	301	298	294	291	288	285	282	279
190	360	356	352	348	343	339	335	332	328	324	320	317	313	310	306	303	300	296	293	290	287	285
195	365	361	357	353	349	345	341	337	333	329	326	322	318	315	311	308	305	302	299	296	293	290
200	371	367	362	358	354	350	346	342	338	335	331	327	324	320	317	313	310	307	304	301	298	295
205	376	372	368	364	360	356	352	348	344	340	336	333	329	325	322	318	315	312	309	306	303	300
210	381	377	373	369	365	361	357	353	349	345	341	338	334	330	327	324	320	317	314	310	307	304
215	387	382	378	374	370	366	362	358	354	350	346	343	339	335	332	328	325	322	319	315	312	309
220	392	387	383	379	375	371	367	363	359	355	351	348	344	340	337	333	330	327	323	320	317	314
225	397	393	388	384	380	376	372	368	364	360	356	353	349	345	342	338	335	332	328	325	322	319
230	402	398	393	389	385	381	377	373	369	365	361	358	354	350	347	343	340	336	333	330	327	323
235	407	402	398	394	390	386	382	378	374	370	366	362	359	355	351	348	344	341	338	334	331	328
240	412	407	403	399	395	391	387	383	379	375	371	367	364	360	356	353	349	346	342	339	336	333

TABLE 16. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1500

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	108	109	110	111	112	113	114	116	117	118	119	120	121	122	124	125	126	127	128	129	130	131
5	108	110	111	112	113	114	115	116	118	119	120	121	122	123	124	125	126	128	129	130	131	132
10	110	111	112	113	114	116	117	118	119	120	121	122	123	124	125	127	128	129	130	131	132	133
15	112	113	114	115	116	117	118	119	120	121	122	123	125	126	127	128	129	130	131	132	133	134
20	113	114	115	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
25	115	116	117	118	119	120	121	122	123	124	126	127	128	129	130	131	132	133	134	135	136	137
30	118	119	120	121	122	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138
35	120	121	122	123	124	125	126	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
40	123	124	125	125	126	127	128	129	129	130	131	132	133	134	135	136	137	137	138	139	140	141
45	126	127	127	128	129	130	130	131	132	133	133	134	135	136	137	138	138	139	140	141	142	143
50	130	130	131	131	132	132	133	134	134	135	136	136	137	138	139	140	140	141	142	143	144	145
55	133	134	134	134	135	135	136	136	137	138	138	139	140	140	141	142	142	143	144	145	146	146
60	137	137	138	138	138	138	139	139	140	140	141	141	142	143	143	144	145	145	146	147	148	148
65	142	141	141	141	142	142	142	142	143	143	144	144	145	145	146	146	147	148	148	149	150	150
70	146	146	146	145	145	145	145	146	146	146	147	147	147	148	148	149	149	150	151	151	152	152
75	151	150	150	150	149	149	149	149	149	149	150	150	150	151	151	151	152	152	153	153	154	155
80	156	155	155	154	153	153	153	153	153	153	153	153	153	153	154	154	154	155	155	156	156	157
85	162	160	159	158	158	157	157	156	156	156	156	156	156	156	157	157	157	157	158	158	159	159
90	167	166	164	163	162	161	161	160	160	160	160	159	159	159	160	160	160	160	160	161	161	161
95	173	171	169	168	167	166	165	164	164	163	163	163	163	163	163	163	163	163	163	163	164	164
100	179	177	175	173	172	170	169	169	168	167	167	166	166	166	166	166	166	166	166	166	166	166
105	185	182	180	178	176	175	174	173	172	171	170	170	170	169	169	169	169	169	169	169	169	169
110	191	188	185	183	181	180	178	177	176	175	174	174	173	173	172	172	172	172	172	172	172	172
115	197	194	191	189	186	185	183	181	180	179	178	177	177	176	176	175	175	175	175	174	174	174
120	202	199	196	194	191	189	188	186	185	183	182	181	180	180	179	179	178	178	178	177	177	177
125	208	205	202	199	196	194	192	190	189	187	186	185	184	183	183	182	181	181	181	180	180	180
130	214	211	207	204	202	199	197	195	193	192	190	189	188	187	186	185	185	184	184	183	183	183
135	220	216	213	209	207	204	202	199	198	196	194	193	192	191	190	189	188	187	187	186	186	186
140	226	222	218	215	212	209	206	204	202	200	198	197	196	194	193	192	191	191	190	189	189	189
145	231	227	223	220	217	214	211	209	206	204	203	201	199	198	197	196	195	194	193	193	192	191
150	237	233	229	225	222	219	216	213	211	209	207	205	203	202	200	199	198	197	196	196	195	194
155	242	238	234	230	227	223	220	218	215	213	211	209	207	206	204	203	202	201	200	199	198	197
160	248	243	239	235	232	228	225	222	220	217	215	213	211	209	208	206	205	204	203	202	201	200
165	253	249	244	240	236	233	230	227	224	221	219	217	215	213	212	210	209	207	206	205	204	204
170	259	254	249	245	241	238	234	231	228	226	223	221	219	217	215	214	212	211	210	208	207	207
175	264	259	254	250	246	242	239	236	233	230	227	225	223	221	219	217	216	214	213	212	211	210
180	269	264	259	255	251	247	243	240	237	234	231	229	227	225	223	221	219	218	216	215	214	213
185	274	269	264	260	256	252	248	244	241	238	235	233	231	228	226	224	223	221	220	218	217	216
190	279	274	269	264	260	256	252	249	246	242	240	237	234	232	230	228	226	224	223	221	220	219
195	284	279	274	269	265	261	257	253	250	247	244	241	238	236	234	232	230	228	226	225	223	222
200	289	284	279	274	269	265	261	257	254	251	248	245	242	240	237	235	233	231	230	228	226	225
205	294	288	283	278	274	270	266	262	258	255	252	249	246	243	241	239	237	235	233	231	230	228
210	299	293	288	283	278	274	270	266	262	259	256	253	250	247	245	242	240	238	236	234	233	231
215	303	298	293	288	283	278	274	270	266	263	260	256	254	251	248	246	244	241	239	238	236	234
220	308	302	297	292	287	283	278	274	270	267	263	260	257	254	252	249	247	245	243	241	239	237
225	313	307	302	297	292	287	283	278	275	271	267	264	261	258	255	253	250	248	246	244	242	241
230	317	312	306	301	296	291	287	283	279	275	271	268	265	262	259	256	254	252	249	247	245	244
235	322	316	311	305	300	295	291	287	283	279	275	272	268	265	263	260	257	255	253	251	249	247
240	326	321	315	310	305	300	295	291	287	283	279	275	272	269	266	263	261	258	256	254	252	250

TABLE 16. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1500

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	132	135	138	140	143	146	148	151	153	156	158	161	163	166	168	170	173	175	177	180	182	184
5	133	136	138	141	144	146	149	151	154	156	159	161	164	166	168	171	173	175	178	180	182	185
10	134	137	139	142	144	147	150	152	155	157	159	162	164	167	169	171	174	176	178	181	183	185
15	135	138	140	143	145	148	150	153	155	158	160	163	165	167	170	172	175	177	179	181	184	186
20	136	139	141	144	146	149	151	154	156	159	161	164	166	168	171	173	175	178	180	182	184	187
25	138	140	143	145	148	150	152	155	157	160	162	164	167	169	171	174	176	178	181	183	185	187
30	139	141	144	146	149	151	154	156	158	161	163	165	168	170	172	175	177	179	181	184	186	188
35	140	143	145	148	150	152	155	157	159	162	164	166	169	171	173	176	178	180	182	184	187	189
40	142	144	147	149	151	154	156	158	161	163	165	167	170	172	174	176	179	181	183	185	187	190
45	144	146	148	150	153	155	157	159	162	164	166	168	171	173	175	177	180	182	184	186	188	190
50	145	148	150	152	154	156	159	161	163	165	167	170	172	174	176	178	181	183	185	187	189	191
55	147	149	151	153	156	158	160	162	164	166	169	171	173	175	177	179	182	184	186	188	190	192
60	149	151	153	155	157	159	161	163	165	168	170	172	174	176	178	180	182	185	187	189	191	193
65	151	153	155	157	159	161	163	165	167	169	171	173	175	177	179	181	184	186	188	190	192	194
70	153	155	157	158	160	162	164	166	168	170	172	174	176	178	180	182	185	187	189	191	193	195
75	155	157	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196
80	157	159	160	162	164	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197
85	160	161	162	164	165	167	169	171	172	174	176	178	180	182	184	186	188	190	192	194	196	198
90	162	163	164	166	167	169	171	172	174	176	178	179	181	183	185	187	189	191	193	195	197	199
95	164	165	166	168	169	171	172	174	176	177	179	181	183	184	186	188	190	192	194	196	198	200
100	167	168	169	170	171	172	174	176	177	179	180	182	184	186	188	189	191	193	195	197	199	201
105	169	170	171	172	173	174	176	177	179	180	182	184	185	187	189	191	192	194	196	198	200	202
110	172	172	173	174	175	176	178	179	180	182	183	185	187	188	190	192	194	195	197	199	201	203
115	174	175	175	176	177	178	179	181	182	183	185	187	188	190	191	193	195	197	198	200	202	204
120	177	177	178	178	179	180	181	182	184	185	187	188	190	191	193	194	196	198	199	201	203	205
125	180	180	180	181	181	182	183	184	185	187	188	190	191	193	194	196	197	199	201	202	204	206
130	183	182	182	183	183	184	185	186	187	188	190	191	192	194	195	197	199	200	202	203	205	207
135	185	185	185	185	186	186	187	188	189	190	191	193	194	195	197	198	200	201	203	205	206	208
140	188	188	187	187	188	188	189	190	191	192	193	194	195	197	198	200	201	203	204	206	207	209
145	191	190	190	190	190	190	191	192	193	194	195	196	197	198	200	201	202	204	205	207	209	210
150	194	193	192	192	192	193	193	194	194	195	196	197	199	200	201	202	204	205	207	208	210	211
155	197	196	195	195	195	195	195	196	196	197	198	199	200	201	202	204	205	207	208	209	211	212
160	200	199	198	197	197	197	197	198	198	199	200	201	202	203	204	205	206	208	209	211	212	214
165	203	201	200	200	199	199	199	199	200	201	201	202	203	204	205	207	208	209	211	212	213	215
170	206	204	203	202	202	201	201	202	202	202	203	204	205	206	207	208	209	210	212	213	215	216
175	209	207	205	205	204	204	203	204	204	204	205	206	206	207	208	209	211	212	213	214	216	217
180	212	210	208	207	206	206	206	206	206	206	207	207	208	209	210	211	212	213	214	216	217	218
185	215	213	211	210	209	208	208	208	208	208	208	209	210	211	211	212	213	215	216	217	218	220
190	218	215	214	212	211	210	210	210	210	210	210	211	211	212	213	214	215	216	217	218	219	221
195	221	218	216	215	213	213	212	212	212	212	212	212	213	214	214	215	216	217	218	220	221	222
200	224	221	219	217	216	215	214	214	214	214	214	214	215	215	216	217	218	219	220	221	222	223
205	227	224	222	220	218	217	216	216	216	216	216	216	216	217	218	218	219	220	221	222	223	224
210	230	227	224	222	221	220	219	218	218	218	218	218	218	219	219	220	221	222	222	223	225	226
215	233	230	227	225	223	222	221	220	220	219	219	220	220	220	221	221	222	223	224	225	226	227
220	236	233	230	228	226	224	223	222	222	221	221	221	222	222	222	223	224	224	225	226	227	228
225	239	235	233	230	228	227	225	224	224	223	223	223	223	224	224	224	225	226	227	227	228	229
230	242	238	235	233	231	229	228	227	226	225	225	225	225	225	226	226	227	227	228	229	230	231
235	245	241	238	235	233	231	230	229	228	227	227	227	227	227	227	228	228	229	229	230	231	232
240	248	244	241	238	236	234	232	231	230	229	229	229	228	229	229	229	230	230	231	232	232	233

TABLE 16. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1500

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	187	191	195	200	204	208	212	216	221	225	228	232	236	240	244	247	251	255	258	262	265	269
5	187	191	196	200	204	209	213	217	221	225	229	233	237	240	244	248	251	255	259	262	266	269
10	188	192	196	201	205	209	213	217	221	225	229	233	237	241	244	248	252	255	259	262	266	269
15	188	193	197	201	205	210	214	218	222	226	230	234	237	241	245	249	252	256	259	263	266	270
20	189	193	198	202	206	210	214	218	222	226	230	234	238	242	245	249	253	256	260	263	267	270
25	190	194	198	202	207	211	215	219	223	227	231	234	238	242	246	249	253	257	260	264	267	270
30	190	195	199	203	207	211	215	219	223	227	231	235	239	242	246	250	253	257	261	264	267	271
35	191	195	200	204	208	212	216	220	224	228	232	235	239	243	247	250	254	257	261	264	268	271
40	192	196	200	204	209	213	217	221	225	228	232	236	240	243	247	251	254	258	261	265	268	272
45	193	197	201	205	209	213	217	221	225	229	233	237	240	244	248	251	255	258	262	265	269	272
50	193	198	202	206	210	214	218	222	226	230	233	237	241	244	248	252	255	259	262	266	269	272
55	194	198	202	207	211	215	219	222	226	230	234	238	241	245	249	252	256	259	263	266	270	273
60	195	199	203	207	211	215	219	223	227	231	234	238	242	246	249	253	256	260	263	267	270	273
65	196	200	204	208	212	216	220	224	228	231	235	239	242	246	250	253	257	260	264	267	270	274
70	197	201	205	209	213	217	221	224	228	232	236	239	243	247	250	254	257	261	264	267	271	274
75	198	202	206	210	214	217	221	225	229	233	236	240	244	247	251	254	258	261	265	268	271	275
80	199	203	207	210	214	218	222	226	229	233	237	240	244	248	251	255	258	262	265	268	272	275
85	200	203	207	211	215	219	223	226	230	234	237	241	245	248	252	255	259	262	266	269	272	276
90	200	204	208	212	216	220	223	227	231	234	238	242	245	249	252	256	259	263	266	269	273	276
95	201	205	209	213	217	220	224	228	231	235	239	242	246	249	253	256	260	263	267	270	273	276
100	202	206	210	214	217	221	225	229	232	236	239	243	246	250	253	257	260	264	267	270	274	277
105	203	207	211	215	218	222	226	229	233	236	240	244	247	251	254	257	261	264	268	271	274	277
110	204	208	212	215	219	223	226	230	234	237	241	244	248	251	255	258	261	265	268	271	275	278
115	205	209	213	216	220	224	227	231	234	238	241	245	248	252	255	259	262	265	269	272	275	278
120	206	210	214	217	221	224	228	231	235	238	242	245	249	252	256	259	262	266	269	272	276	279
125	208	211	215	218	222	225	229	232	236	239	243	246	250	253	256	260	263	266	270	273	276	279
130	209	212	215	219	222	226	229	233	236	240	243	247	250	254	257	260	264	267	270	273	277	280
135	210	213	216	220	223	227	230	234	237	241	244	247	251	254	257	261	264	267	271	274	277	280
140	211	214	217	221	224	228	231	234	238	241	245	248	251	255	258	261	265	268	271	274	278	281
145	212	215	218	222	225	228	232	235	239	242	245	249	252	255	259	262	265	268	272	275	278	281
150	213	216	219	223	226	229	233	236	239	243	246	249	253	256	259	263	266	269	272	275	279	282
155	214	217	220	224	227	230	233	237	240	243	247	250	253	257	260	263	266	270	273	276	279	282
160	215	218	221	225	228	231	234	238	241	244	247	251	254	257	261	264	267	270	273	277	280	283
165	216	219	222	226	229	232	235	238	242	245	248	251	255	258	261	264	268	271	274	277	280	283
170	217	220	223	226	230	233	236	239	242	246	249	252	255	259	262	265	268	271	274	278	281	284
175	219	221	224	227	231	234	237	240	243	246	250	253	256	259	262	266	269	272	275	278	281	284
180	220	223	225	228	231	235	238	241	244	247	250	254	257	260	263	266	269	272	276	279	282	285
185	221	224	226	229	232	235	239	242	245	248	251	254	257	261	264	267	270	273	276	279	282	285
190	222	225	228	230	233	236	239	243	246	249	252	255	258	261	264	267	271	274	277	280	283	286
195	223	226	229	231	234	237	240	243	246	249	253	256	259	262	265	268	271	274	277	280	283	286
200	224	227	230	232	235	238	241	244	247	250	253	256	259	263	266	269	272	275	278	281	284	287
205	226	228	231	233	236	239	242	245	248	251	254	257	260	263	266	269	272	275	278	281	284	287
210	227	229	232	234	237	240	243	246	249	252	255	258	261	264	267	270	273	276	279	282	285	288
215	228	230	233	235	238	241	244	247	250	253	256	259	262	265	268	271	274	277	280	283	286	288
220	229	232	234	237	239	242	245	248	250	253	256	259	262	265	268	271	274	277	280	283	286	289
225	230	233	235	238	240	243	246	248	251	254	257	260	263	266	269	272	275	278	281	284	287	290
230	232	234	236	239	241	244	247	249	252	255	258	261	264	267	270	273	275	278	281	284	287	290
235	233	235	237	240	242	245	247	250	253	256	259	262	264	267	270	273	276	279	282	285	288	291
240	234	236	238	241	243	246	248	251	254	257	259	262	265	268	271	274	277	280	283	285	288	291

TABLE 16. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1500

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	272	276	279	282	286	289	292	295	299	302	305	308	311	314	317	320	323	326	329	332	335	338
5	272	276	279	283	286	289	292	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338
10	273	276	280	283	286	289	293	296	299	302	305	308	311	315	318	321	324	327	329	332	335	338
15	273	277	280	283	286	290	293	296	299	302	306	309	312	315	318	321	324	327	330	333	336	338
20	274	277	280	284	287	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	336	339
25	274	277	281	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339
30	274	278	281	284	287	291	294	297	300	303	306	310	313	316	319	322	325	328	330	333	336	339
35	275	278	281	285	288	291	294	297	301	304	307	310	313	316	319	322	325	328	331	334	337	339
40	275	278	282	285	288	291	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	340
45	275	279	282	285	289	292	295	298	301	304	307	311	314	317	320	323	325	328	331	334	337	340
50	276	279	282	286	289	292	295	298	302	305	308	311	314	317	320	323	326	329	332	335	337	340
55	276	280	283	286	289	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	341
60	277	280	283	286	290	293	296	299	302	305	308	311	315	318	320	323	326	329	332	335	338	341
65	277	280	284	287	290	293	296	300	303	306	309	312	315	318	321	324	327	330	333	335	338	341
70	278	281	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	339	341
75	278	281	284	288	291	294	297	300	303	306	309	313	316	318	321	324	327	330	333	336	339	342
80	278	282	285	288	291	294	298	301	304	307	310	313	316	319	322	325	328	331	333	336	339	342
85	279	282	285	288	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	339	342
90	279	283	286	289	292	295	298	301	304	308	311	314	317	319	322	325	328	331	334	337	340	343
95	280	283	286	289	292	296	299	302	305	308	311	314	317	320	323	326	329	331	334	337	340	343
100	280	283	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	337	340	343
105	281	284	287	290	293	296	300	303	306	309	312	315	318	321	323	326	329	332	335	338	341	343
110	281	284	287	291	294	297	300	303	306	309	312	315	318	321	324	327	330	332	335	338	341	344
115	282	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	338	341	344
120	282	285	288	291	295	298	301	304	307	310	313	316	319	322	324	327	330	333	336	339	342	344
125	282	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	333	336	339	342	345
130	283	286	289	292	295	298	302	305	308	311	314	316	319	322	325	328	331	334	337	339	342	345
135	283	287	290	293	296	299	302	305	308	311	314	317	320	323	326	328	331	334	337	340	343	345
140	284	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	334	337	340	343	346
145	284	288	291	294	297	300	303	306	309	312	315	318	320	323	326	329	332	335	338	340	343	346
150	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	329	332	335	338	341	343	346
155	285	288	292	295	298	301	304	307	310	313	315	318	321	324	327	330	333	335	338	341	344	347
160	286	289	292	295	298	301	304	307	310	313	316	319	322	324	327	330	333	336	339	341	344	347
165	286	289	292	296	299	302	304	307	310	313	316	319	322	325	328	331	333	336	339	342	344	347
170	287	290	293	296	299	302	305	308	311	314	317	320	322	325	328	331	334	336	339	342	345	348
175	287	290	293	296	299	302	305	308	311	314	317	320	323	326	328	331	334	337	340	342	345	348
180	288	291	294	297	300	303	306	309	312	315	317	320	323	326	329	332	334	337	340	343	345	348
185	288	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	338	340	343	346	348
190	289	292	295	298	301	304	307	310	312	315	318	321	324	327	330	332	335	338	341	343	346	349
195	289	292	295	298	301	304	307	310	313	316	319	321	324	327	330	333	335	338	341	344	346	349
200	290	293	296	299	302	305	308	310	313	316	319	322	325	327	330	333	336	339	341	344	347	349
205	290	293	296	299	302	305	308	311	314	317	319	322	325	328	331	333	336	339	342	344	347	350
210	291	294	297	300	303	306	308	311	314	317	320	323	325	328	331	334	337	339	342	345	347	350
215	291	294	297	300	303	306	309	312	315	317	320	323	326	329	331	334	337	340	342	345	348	350
220	292	295	298	301	304	306	309	312	315	318	321	323	326	329	332	335	337	340	343	345	348	351
225	292	295	298	301	304	307	310	313	315	318	321	324	327	329	332	335	338	340	343	346	348	351
230	293	296	299	302	305	307	310	313	316	319	322	324	327	330	333	335	338	341	343	346	349	351
235	294	296	299	302	305	308	311	314	316	319	322	325	327	330	333	336	338	341	344	346	349	352
240	294	297	300	303	306	308	311	314	317	320	322	325	328	331	333	336	339	341	344	347	349	352

TABLE 17. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	93	93	94	94	95	96	96	97	97	98	99	99	100	100	101	102	102	103	103	104	105	105
5	94	94	95	96	96	97	97	98	99	99	100	100	101	102	102	103	103	104	104	105	106	106
10	96	96	97	98	98	99	99	100	100	101	102	102	103	103	104	104	105	106	106	107	107	108
15	98	99	99	100	100	101	102	102	103	103	104	104	105	105	106	106	107	107	108	109	109	110
20	101	102	102	103	103	104	104	105	105	106	106	107	107	108	108	109	109	110	110	111	111	112
25	105	105	106	106	107	107	107	108	108	109	109	110	110	110	111	111	112	112	113	113	114	114
30	110	110	110	110	111	111	111	112	112	112	113	113	113	114	114	114	115	115	116	116	116	117
35	115	115	115	115	116	116	116	116	116	116	117	117	117	117	118	118	118	119	119	119	120	120
40	123	122	122	122	121	121	121	121	121	121	121	121	122	122	122	122	122	122	123	123	123	123
45	132	131	130	129	129	128	128	128	127	127	127	127	127	127	127	127	127	127	127	127	127	127
50	144	142	140	139	138	137	136	135	134	134	133	133	133	132	132	132	132	132	132	132	132	132
55	159	156	153	151	148	147	145	144	143	142	141	140	139	139	138	138	138	137	137	137	137	137
60	176	171	167	164	161	158	156	154	152	151	149	148	147	146	145	145	144	143	143	143	142	142
65	193	187	183	178	175	171	168	165	163	161	159	157	156	154	153	152	151	150	150	149	148	148
70	208	203	198	193	188	184	181	177	174	172	169	167	165	163	162	160	159	158	157	156	155	154
75	223	217	212	207	202	197	193	189	186	183	180	177	175	173	171	169	167	166	164	163	162	161
80	236	230	225	220	215	210	205	201	198	194	191	188	185	182	180	178	176	174	172	171	169	168
85	248	242	237	232	226	222	217	213	209	205	201	198	195	192	189	187	184	182	180	179	177	175
90	259	253	248	243	238	233	228	224	220	215	212	208	205	202	199	196	193	191	189	187	185	183
95	269	264	258	253	248	243	239	234	230	226	222	218	214	211	208	205	202	199	197	195	193	190
100	279	274	268	263	258	253	248	244	240	235	231	227	224	220	217	214	211	208	205	203	200	198
105	288	283	278	273	268	263	258	253	249	245	240	237	233	229	226	222	219	216	213	211	208	206
110	297	292	287	281	276	272	267	262	258	253	249	245	241	238	234	231	227	224	221	219	216	213
115	305	300	295	290	285	280	275	271	266	262	258	254	250	246	242	239	235	232	229	226	223	221
120	314	308	303	298	293	288	284	279	275	270	266	262	258	254	250	247	243	240	237	234	231	228
125	321	316	311	306	301	296	292	287	283	278	274	270	266	262	258	254	251	248	244	241	238	235
130	329	324	319	314	309	304	299	295	290	286	282	277	273	269	266	262	258	255	251	248	245	242
135	336	331	326	321	316	312	307	302	298	293	289	285	281	277	273	269	265	262	259	255	252	249
140	343	338	333	328	324	319	314	309	305	301	296	292	288	284	280	276	272	269	265	262	259	256
145	350	345	340	335	331	326	321	317	312	308	303	299	295	291	287	283	279	276	272	269	266	262
150	357	352	347	342	337	333	328	323	319	314	310	306	302	298	294	290	286	282	279	275	272	269
155	364	359	354	349	344	339	335	330	326	321	317	313	308	304	300	296	293	289	285	282	278	275
160	370	365	360	356	351	346	341	337	332	328	323	319	315	311	307	303	299	295	292	288	285	281
165	377	372	367	362	357	352	348	343	339	334	330	325	321	317	313	309	305	302	298	294	291	287
170	383	378	373	368	363	359	354	349	345	340	336	332	327	323	319	315	311	308	304	300	297	293
175	389	384	379	374	370	365	360	356	351	347	342	338	334	329	325	321	317	314	310	306	303	299
180	395	390	385	380	376	371	366	362	357	353	348	344	340	335	331	327	323	320	316	312	309	305
185	401	396	391	386	382	377	372	368	363	359	354	350	346	341	337	333	329	325	322	318	314	311
190	407	402	397	392	388	383	378	374	369	364	360	356	351	347	343	339	335	331	327	324	320	316
195	413	408	403	398	393	389	384	379	375	370	366	361	357	353	349	345	341	337	333	329	326	322
200	418	413	409	404	399	394	390	385	380	376	372	367	363	359	354	350	346	342	338	335	331	327
205	424	419	414	409	405	400	395	391	386	382	377	373	368	364	360	356	352	348	344	340	336	333
210	429	425	420	415	410	406	401	396	392	387	383	378	374	370	365	361	357	353	349	346	342	338
215	435	430	425	420	416	411	406	402	397	393	388	384	379	375	371	367	363	359	355	351	347	343
220	440	435	431	426	421	416	412	407	403	398	393	389	385	380	376	372	368	364	360	356	352	349
225	446	441	436	431	427	422	417	412	408	403	399	394	390	386	381	377	373	369	365	361	357	354
230	451	446	441	437	432	427	422	418	413	409	404	400	395	391	387	382	378	374	370	366	363	359
235	456	451	447	442	437	432	428	423	418	414	409	405	400	396	392	388	383	379	375	371	368	364
240	461	457	452	447	442	438	433	428	424	419	414	410	406	401	397	393	389	384	380	376	373	369

TABLE 17. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	106	107	109	110	111	112	113	114	116	117	118	119	120	121	122	123	124	126	127	128	129	130
5	107	108	110	111	112	113	114	115	116	118	119	120	121	122	123	124	125	126	127	129	130	131
10	109	110	111	112	113	114	116	117	118	119	120	121	122	123	124	125	126	128	129	130	131	132
15	111	112	113	114	115	116	117	118	119	120	121	123	124	125	126	127	128	129	130	131	132	133
20	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134
25	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
30	118	119	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	135	136	137
35	121	121	122	123	124	125	126	126	127	128	129	130	131	132	133	134	134	135	136	137	138	139
40	124	125	125	126	127	127	128	129	130	131	131	132	133	134	135	136	136	137	138	139	140	141
45	128	128	129	129	130	130	131	132	132	133	134	135	135	136	137	138	139	139	140	141	142	143
50	132	132	132	133	133	134	134	135	135	136	137	137	138	139	139	140	141	142	142	143	144	145
55	136	136	136	137	137	137	137	138	138	139	139	140	141	141	142	142	143	144	145	145	146	147
60	141	141	141	141	141	141	141	141	142	142	142	143	143	144	144	145	146	146	147	148	148	149
65	147	146	146	145	145	145	145	145	145	145	146	146	146	147	147	148	148	149	149	150	151	151
70	153	152	151	150	150	149	149	149	149	149	149	149	150	150	150	151	151	152	152	153	153	154
75	159	158	156	155	155	154	154	153	153	153	153	153	153	153	153	154	154	154	155	155	156	156
80	166	164	162	161	160	159	158	158	157	157	157	157	156	157	157	157	157	157	158	158	158	159
85	173	170	168	167	165	164	163	162	162	161	161	160	160	160	160	160	160	160	160	161	161	161
90	180	177	174	172	171	169	168	167	166	165	165	164	164	164	164	163	163	163	164	164	164	164
95	187	184	181	179	176	175	173	172	171	170	169	168	168	167	167	167	167	167	167	167	167	167
100	194	191	187	185	182	180	179	177	176	174	173	173	172	171	171	171	170	170	170	170	170	170
105	201	198	194	191	188	186	184	182	181	179	178	177	176	175	175	174	174	173	173	173	173	173
110	209	204	201	197	194	192	189	187	186	184	183	181	180	179	179	178	177	177	177	176	176	176
115	216	211	207	204	200	198	195	193	191	189	187	186	185	184	183	182	181	181	180	180	179	179
120	223	218	214	210	207	203	201	198	196	194	192	190	189	188	187	186	185	184	184	183	183	182
125	230	225	220	216	213	209	206	203	201	199	197	195	193	192	191	190	189	188	187	187	186	186
130	237	232	227	222	219	215	212	209	206	204	202	200	198	196	195	194	193	192	191	190	189	189
135	243	238	233	229	225	221	217	214	211	209	206	204	202	201	199	198	197	195	194	194	193	192
140	250	244	239	235	230	226	223	220	217	214	211	209	207	205	203	202	201	199	198	197	196	196
145	256	251	246	241	236	232	228	225	222	219	216	214	211	209	208	206	205	203	202	201	200	199
150	263	257	252	247	242	238	234	230	227	224	221	218	216	214	212	210	209	207	206	204	203	202
155	269	263	258	252	248	243	239	235	232	229	226	223	221	218	216	214	213	211	209	208	207	206
160	275	269	263	258	253	249	245	241	237	234	231	228	225	223	220	218	217	215	213	212	211	209
165	281	275	269	264	259	254	250	246	242	239	235	232	230	227	225	223	221	219	217	216	214	213
170	287	281	275	269	264	260	255	251	247	243	240	237	234	231	229	227	225	223	221	219	218	216
175	293	286	281	275	270	265	260	256	252	248	245	242	239	236	233	231	229	227	225	223	221	220
180	298	292	286	280	275	270	265	261	257	253	249	246	243	240	237	235	233	231	229	227	225	223
185	304	298	292	286	280	275	270	266	262	258	254	251	247	244	242	239	237	234	232	230	229	227
190	310	303	297	291	286	280	275	271	267	262	259	255	252	249	246	243	241	238	236	234	232	231
195	315	308	302	296	291	285	280	276	271	267	263	260	256	253	250	247	245	242	240	238	236	234
200	320	314	307	301	296	290	285	281	276	272	268	264	261	257	254	251	249	246	244	242	240	238
205	326	319	313	307	301	295	290	285	281	276	272	268	265	261	258	255	253	250	248	245	243	241
210	331	324	318	312	306	300	295	290	285	281	277	273	269	266	262	259	256	254	251	249	247	245
215	336	329	323	317	311	305	300	295	290	285	281	277	273	270	267	263	260	258	255	253	250	248
220	341	334	328	322	316	310	305	299	295	290	286	282	278	274	271	267	264	261	259	256	254	252
225	346	339	333	326	320	315	309	304	299	294	290	286	282	278	275	271	268	265	262	260	257	255
230	351	344	338	331	325	319	314	309	304	299	294	290	286	282	279	275	272	269	266	264	261	259
235	356	349	343	336	330	324	318	313	308	303	299	294	290	286	283	279	276	273	270	267	265	262
240	361	354	347	341	335	329	323	318	312	307	303	298	294	290	287	283	280	277	274	271	268	266

TABLE 17. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	131	134	136	139	142	144	147	149	152	154	157	159	162	164	167	169	171	174	176	178	181	183
5	132	134	137	140	142	145	147	150	152	155	157	160	162	165	167	170	172	174	177	179	181	183
10	133	135	138	141	143	146	148	151	153	156	158	161	163	166	168	170	173	175	177	180	182	184
15	134	137	139	142	144	147	149	152	154	157	159	162	164	166	169	171	173	176	178	180	183	185
20	135	138	140	143	145	148	150	153	155	158	160	163	165	167	170	172	174	177	179	181	183	186
25	137	139	142	144	147	149	152	154	156	159	161	164	166	168	171	173	175	177	180	182	184	186
30	138	141	143	146	148	150	153	155	158	160	162	165	167	169	171	174	176	178	180	183	185	187
35	140	142	145	147	149	152	154	156	159	161	163	166	168	170	172	175	177	179	181	184	186	188
40	142	144	146	149	151	153	155	158	160	162	164	167	169	171	173	176	178	180	182	184	187	189
45	144	146	148	150	152	155	157	159	161	163	166	168	170	172	175	177	179	181	183	185	188	190
50	145	148	150	152	154	156	158	160	163	165	167	169	171	173	176	178	180	182	184	186	188	191
55	148	149	151	153	156	158	160	162	164	166	168	170	172	175	177	179	181	183	185	187	189	191
60	150	151	153	155	157	159	161	163	165	167	170	172	174	176	178	180	182	184	186	188	190	192
65	152	154	155	157	159	161	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193
70	154	156	157	159	161	163	165	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194
75	157	158	159	161	163	164	166	168	170	172	174	176	178	180	182	184	185	187	189	191	193	195
80	159	160	162	163	165	166	168	170	172	173	175	177	179	181	183	185	187	189	191	193	194	196
85	162	163	164	165	167	168	170	171	173	175	177	179	180	182	184	186	188	190	192	194	196	197
90	164	165	166	167	169	170	172	173	175	177	178	180	182	184	185	187	189	191	193	195	197	199
95	167	168	169	170	171	172	174	175	177	178	180	182	183	185	187	189	190	192	194	196	198	200
100	170	170	171	172	173	174	176	177	178	180	181	183	185	186	188	190	192	193	195	197	199	201
105	173	173	174	174	175	176	178	179	180	182	183	185	186	188	190	191	193	195	196	198	200	202
110	176	176	176	177	178	178	180	181	182	183	185	186	188	189	191	193	194	196	198	199	201	203
115	179	179	179	179	180	181	182	183	184	185	186	188	189	191	192	194	196	197	199	201	202	204
120	182	182	182	182	182	183	184	185	186	187	188	190	191	192	194	195	197	199	200	202	204	205
125	185	185	184	184	185	185	186	187	188	189	190	191	193	194	195	197	198	200	202	203	205	206
130	188	188	187	187	187	187	188	189	190	191	192	193	194	196	197	198	200	201	203	204	206	208
135	192	191	190	190	190	190	190	191	192	193	194	195	196	197	198	200	201	203	204	206	207	209
140	195	194	193	192	192	192	193	193	194	194	195	196	198	199	200	201	203	204	206	207	209	210
145	198	197	196	195	195	195	195	195	196	196	197	198	199	200	202	203	204	206	207	208	210	211
150	202	200	199	198	197	197	197	197	198	198	199	200	201	202	203	204	206	207	208	210	211	213
155	205	203	201	200	200	199	199	200	200	200	201	202	203	204	205	206	207	208	210	211	212	214
160	208	206	204	203	202	202	202	202	202	202	203	204	204	205	206	207	209	210	211	212	214	215
165	212	209	207	206	205	204	204	204	204	204	205	206	206	207	208	209	210	211	212	214	215	216
170	215	213	210	209	208	207	206	206	206	206	207	207	208	209	210	211	212	213	214	215	216	218
175	219	216	213	212	210	210	209	209	208	209	209	209	210	211	211	212	213	214	215	217	218	219
180	222	219	217	215	213	212	211	211	211	211	211	211	212	212	213	214	215	216	217	218	219	220
185	225	222	220	217	216	215	214	213	213	213	213	213	214	214	215	215	216	217	218	219	220	222
190	229	225	223	220	219	217	216	216	215	215	215	215	215	216	216	217	218	219	220	221	222	223
195	232	229	226	223	221	220	219	218	217	217	217	217	217	218	218	219	220	220	221	222	223	224
200	236	232	229	226	224	222	221	220	220	219	219	219	219	219	220	220	221	222	223	224	225	226
205	239	235	232	229	227	225	224	223	222	221	221	221	221	221	222	222	223	223	224	225	226	227
210	243	238	235	232	230	228	226	225	224	223	223	223	223	223	223	224	224	225	226	227	227	228
215	246	242	238	235	232	230	229	227	226	226	225	225	225	225	225	226	226	227	227	228	229	230
220	250	245	241	238	235	233	231	230	229	228	227	227	227	227	227	227	228	228	229	230	230	231
225	253	248	244	241	238	236	234	232	231	230	229	229	229	229	229	229	229	230	230	231	232	233
230	256	251	247	244	241	238	236	235	233	232	231	231	231	230	230	231	231	231	232	233	233	234
235	260	255	250	247	244	241	239	237	236	234	234	233	233	232	232	232	233	233	233	234	235	235
240	263	258	253	250	246	244	241	239	238	237	236	235	234	234	234	234	234	235	235	236	236	237

TABLE 17. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	185	190	194	198	203	207	211	215	219	223	227	231	235	239	242	246	250	253	257	260	264	267
5	186	190	194	199	203	207	211	216	220	224	227	231	235	239	243	246	250	254	257	261	264	268
10	186	191	195	199	204	208	212	216	220	224	228	232	236	239	243	247	250	254	257	261	264	268
15	187	191	196	200	204	208	213	217	221	224	228	232	236	240	243	247	251	254	258	261	265	268
20	188	192	196	201	205	209	213	217	221	225	229	233	237	240	244	248	251	255	258	262	265	269
25	188	193	197	201	206	210	214	218	222	226	229	233	237	241	244	248	252	255	259	262	266	269
30	189	194	198	202	206	210	214	218	222	226	230	234	238	241	245	249	252	256	259	263	266	270
35	190	194	199	203	207	211	215	219	223	227	231	234	238	242	245	249	253	256	260	263	267	270
40	191	195	199	203	208	212	216	220	223	227	231	235	239	242	246	250	253	257	260	264	267	270
45	192	196	200	204	208	212	216	220	224	228	232	235	239	243	246	250	254	257	261	264	267	271
50	193	197	201	205	209	213	217	221	225	229	232	236	240	243	247	251	254	258	261	265	268	271
55	194	198	202	206	210	214	218	222	225	229	233	237	240	244	248	251	255	258	262	265	268	272
60	194	199	203	207	211	215	218	222	226	230	234	237	241	245	248	252	255	259	262	265	269	272
65	195	199	203	207	211	215	219	223	227	231	234	238	242	245	249	252	256	259	263	266	269	273
70	196	200	204	208	212	216	220	224	227	231	235	239	242	246	249	253	256	260	263	266	270	273
75	197	201	205	209	213	217	221	224	228	232	236	239	243	246	250	253	257	260	264	267	270	274
80	198	202	206	210	214	218	221	225	229	233	236	240	243	247	250	254	257	261	264	267	271	274
85	199	203	207	211	215	218	222	226	230	233	237	240	244	247	251	254	258	261	265	268	271	275
90	200	204	208	212	216	219	223	227	230	234	238	241	245	248	252	255	258	262	265	268	272	275
95	201	205	209	213	216	220	224	227	231	235	238	242	245	249	252	256	259	262	266	269	272	276
100	203	206	210	214	217	221	225	228	232	235	239	242	246	249	253	256	260	263	266	270	273	276
105	204	207	211	215	218	222	225	229	233	236	240	243	247	250	253	257	260	263	267	270	273	277
110	205	208	212	215	219	223	226	230	233	237	240	244	247	251	254	257	261	264	267	271	274	277
115	206	209	213	216	220	224	227	231	234	238	241	244	248	251	255	258	261	265	268	271	274	278
120	207	210	214	217	221	224	228	231	235	238	242	245	249	252	255	259	262	265	268	272	275	278
125	208	212	215	218	222	225	229	232	236	239	242	246	249	253	256	259	263	266	269	272	275	279
130	209	213	216	219	223	226	230	233	236	240	243	247	250	253	257	260	263	266	270	273	276	279
135	210	214	217	220	224	227	230	234	237	241	244	247	251	254	257	260	264	267	270	273	277	280
140	212	215	218	221	225	228	231	235	238	241	245	248	251	255	258	261	264	268	271	274	277	280
145	213	216	219	222	226	229	232	236	239	242	245	249	252	255	259	262	265	268	271	274	278	281
150	214	217	220	223	227	230	233	236	240	243	246	249	253	256	259	262	266	269	272	275	278	281
155	215	218	221	224	228	231	234	237	240	244	247	250	253	257	260	263	266	269	273	276	279	282
160	217	219	222	225	229	232	235	238	241	245	248	251	254	257	261	264	267	270	273	276	279	282
165	218	221	224	227	230	233	236	239	242	245	249	252	255	258	261	264	267	271	274	277	280	283
170	219	222	225	228	231	234	237	240	243	246	249	252	256	259	262	265	268	271	274	277	280	283
175	220	223	226	229	232	235	238	241	244	247	250	253	256	259	263	266	269	272	275	278	281	284
180	222	224	227	230	233	236	239	242	245	248	251	254	257	260	263	266	269	272	276	279	282	285
185	223	225	228	231	234	237	240	243	246	249	252	255	258	261	264	267	270	273	276	279	282	285
190	224	227	229	232	235	238	240	243	246	249	252	255	259	262	265	268	271	274	277	280	283	286
195	225	228	230	233	236	239	241	244	247	250	253	256	259	262	265	268	271	274	277	280	283	286
200	227	229	232	234	237	240	242	245	248	251	254	257	260	263	266	269	272	275	278	281	284	287
205	228	230	233	235	238	241	243	246	249	252	255	258	261	264	267	270	273	276	279	282	284	287
210	229	232	234	236	239	242	244	247	250	253	256	259	262	264	267	270	273	276	279	282	285	288
215	231	233	235	237	240	243	245	248	251	254	257	259	262	265	268	271	274	277	280	283	286	289
220	232	234	236	239	241	244	246	249	252	255	257	260	263	266	269	272	275	278	280	283	286	289
225	233	235	237	240	242	245	247	250	253	255	258	261	264	267	270	272	275	278	281	284	287	290
230	235	237	239	241	243	246	248	251	254	256	259	262	265	267	270	273	276	279	282	285	287	290
235	236	238	240	242	244	247	249	252	254	257	260	263	265	268	271	274	277	280	282	285	288	291
240	238	239	241	243	245	248	250	253	255	258	261	263	266	269	272	275	277	280	283	286	289	291

TABLE 17. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.1000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	271	274	277	281	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336
5	271	274	278	281	284	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336
10	271	275	278	281	285	288	291	294	297	300	304	307	310	313	316	319	322	325	328	330	333	336
15	272	275	278	282	285	288	291	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337
20	272	275	279	282	285	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337
25	272	276	279	282	286	289	292	295	298	301	305	308	311	314	317	320	323	326	328	331	334	337
30	273	276	280	283	286	289	292	296	299	302	305	308	311	314	317	320	323	326	329	332	334	337
35	273	277	280	283	286	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338
40	274	277	280	284	287	290	293	296	299	302	306	309	312	315	318	321	323	326	329	332	335	338
45	274	277	281	284	287	290	294	297	300	303	306	309	312	315	318	321	324	327	330	332	335	338
50	275	278	281	284	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	336	338
55	275	278	282	285	288	291	294	297	301	304	307	310	313	316	319	322	324	327	330	333	336	339
60	275	279	282	285	288	292	295	298	301	304	307	310	313	316	319	322	325	328	331	333	336	339
65	276	279	282	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	337	339
70	276	280	283	286	289	292	296	299	302	305	308	311	314	317	320	323	325	328	331	334	337	340
75	277	280	283	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	334	337	340
80	277	281	284	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335	338	340
85	278	281	284	287	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	338	341
90	278	281	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	335	338	341
95	279	282	285	288	291	295	298	301	304	307	310	313	316	318	321	324	327	330	333	336	338	341
100	279	282	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	330	333	336	339	342
105	280	283	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	336	339	342
110	280	283	287	290	293	296	299	302	305	308	311	314	317	320	323	325	328	331	334	337	339	342
115	281	284	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	331	334	337	340	343
120	281	284	288	291	294	297	300	303	306	309	312	315	317	320	323	326	329	332	335	337	340	343
125	282	285	288	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	338	340	343
130	282	285	288	292	295	298	301	304	307	310	312	315	318	321	324	327	330	332	335	338	341	344
135	283	286	289	292	295	298	301	304	307	310	313	316	319	322	324	327	330	333	336	338	341	344
140	283	286	289	293	296	299	302	305	307	310	313	316	319	322	325	328	330	333	336	339	342	344
145	284	287	290	293	296	299	302	305	308	311	314	317	319	322	325	328	331	334	336	339	342	345
150	284	287	290	293	296	299	302	305	308	311	314	317	320	323	326	328	331	334	337	339	342	345
155	285	288	291	294	297	300	303	306	309	312	315	317	320	323	326	329	332	334	337	340	343	345
160	285	288	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	337	340	343	346
165	286	289	292	295	298	301	304	307	310	313	315	318	321	324	327	330	332	335	338	341	343	346
170	286	290	292	295	298	301	304	307	310	313	316	319	321	324	327	330	333	335	338	341	344	346
175	287	290	293	296	299	302	305	308	311	313	316	319	322	325	328	330	333	336	339	341	344	347
180	288	291	294	296	299	302	305	308	311	314	317	320	322	325	328	331	333	336	339	342	344	347
185	288	291	294	297	300	303	306	309	311	314	317	320	323	326	328	331	334	337	339	342	345	347
190	289	292	295	297	300	303	306	309	312	315	318	320	323	326	329	331	334	337	340	342	345	348
195	289	292	295	298	301	304	307	310	312	315	318	321	324	326	329	332	335	337	340	343	345	348
200	290	293	296	299	301	304	307	310	313	316	318	321	324	327	330	332	335	338	340	343	346	348
205	290	293	296	299	302	305	308	310	313	316	319	322	324	327	330	333	335	338	341	343	346	349
210	291	294	297	300	302	305	308	311	314	317	319	322	325	328	330	333	336	338	341	344	346	349
215	291	294	297	300	303	306	309	311	314	317	320	323	325	328	331	333	336	339	342	344	347	350
220	292	295	298	301	303	306	309	312	315	317	320	323	326	328	331	334	337	339	342	345	347	350
225	293	295	298	301	304	307	310	312	315	318	321	323	326	329	332	334	337	340	342	345	348	350
230	293	296	299	302	304	307	310	313	316	318	321	324	327	329	332	335	337	340	343	345	348	351
235	294	297	299	302	305	308	311	313	316	319	322	324	327	330	332	335	338	340	343	346	348	351
240	294	297	300	303	305	308	311	314	317	319	322	325	327	330	333	335	338	341	343	346	349	351

TABLE 18. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0500

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	91	92	93	93	94	94	95	96	96	97	97	98	99	99	100	100	101	102	102	103	103	104
5	93	93	94	95	95	96	96	97	98	98	99	99	100	100	101	102	102	103	103	104	104	105
10	95	96	96	97	97	98	98	99	99	100	101	101	102	102	103	103	104	105	105	106	106	107
15	98	98	99	99	100	100	101	101	102	102	103	103	104	105	105	106	106	107	107	108	108	109
20	101	102	102	103	103	103	104	104	105	105	106	106	107	107	108	108	109	109	110	110	111	111
25	106	106	106	107	107	107	108	108	108	109	109	110	110	110	111	111	112	112	113	113	113	114
30	111	111	112	112	112	112	112	112	113	113	113	114	114	114	114	115	115	115	116	116	117	117
35	119	119	119	118	118	118	118	118	118	118	118	118	118	119	119	119	119	119	120	120	120	121
40	130	129	128	127	126	126	125	125	125	124	124	124	124	124	124	124	124	124	124	124	125	125
45	148	144	141	139	138	136	135	134	133	132	132	131	131	130	130	130	130	130	130	130	130	130
50	173	166	161	156	153	150	147	145	144	142	141	140	139	138	138	137	136	136	136	135	135	135
55	201	192	185	178	172	167	163	160	157	154	152	150	149	147	146	145	144	144	143	142	142	141
60	225	216	208	200	193	187	181	176	172	169	165	163	160	158	156	155	153	152	151	150	149	148
65	244	236	228	220	213	206	200	194	189	184	180	176	173	170	168	165	163	162	160	159	157	156
70	260	252	245	237	230	223	217	211	205	200	195	191	187	183	180	177	174	172	170	168	166	165
75	275	267	260	253	246	239	232	226	220	215	210	205	200	196	193	189	186	183	180	178	176	174
80	288	280	273	266	260	253	247	240	234	229	223	218	214	209	205	201	198	194	191	189	186	184
85	299	292	286	279	272	266	259	253	247	242	236	231	226	222	217	213	209	205	202	199	196	193
90	310	304	297	290	284	278	271	265	259	254	248	243	238	233	229	224	220	216	213	209	206	203
95	321	314	308	301	295	289	283	277	271	265	260	254	249	244	240	235	231	227	223	220	216	213
100	331	324	318	311	305	299	293	287	281	276	270	265	260	255	250	246	241	237	233	229	226	222
105	340	334	327	321	315	309	303	297	291	286	280	275	270	265	260	256	251	247	243	239	235	232
110	349	343	337	330	324	318	312	307	301	295	290	285	280	275	270	265	261	256	252	248	244	241
115	358	352	345	339	333	327	321	316	310	305	299	294	289	284	279	274	270	265	261	257	253	249
120	366	360	354	348	342	336	330	324	319	313	308	303	298	293	288	283	278	274	270	266	262	258
125	374	368	362	356	350	344	339	333	327	322	317	311	306	301	296	292	287	282	278	274	270	266
130	382	376	370	364	358	352	347	341	336	330	325	319	314	309	304	300	295	291	286	282	278	274
135	390	384	378	372	366	360	355	349	343	338	333	327	322	317	312	308	303	298	294	290	286	282
140	397	391	385	379	374	368	362	357	351	346	340	335	330	325	320	315	311	306	302	297	293	289
145	404	399	393	387	381	375	370	364	359	353	348	343	338	333	328	323	318	314	309	305	301	296
150	411	406	400	394	388	383	377	372	366	361	355	350	345	340	335	330	326	321	316	312	308	304
155	418	413	407	401	395	390	384	379	373	368	363	357	352	347	342	337	333	328	324	319	315	311
160	425	420	414	408	402	397	391	386	380	375	370	364	359	354	349	344	340	335	330	326	322	317
165	432	426	421	415	409	404	398	393	387	382	376	371	366	361	356	351	346	342	337	333	328	324
170	439	433	427	422	416	410	405	399	394	388	383	378	373	368	363	358	353	348	344	339	335	331
175	445	439	434	428	423	417	411	406	400	395	390	385	379	374	369	365	360	355	350	346	342	337
180	452	446	440	435	429	423	418	412	407	402	396	391	386	381	376	371	366	362	357	352	348	344
185	458	452	447	441	435	430	424	419	413	408	403	398	392	387	382	377	373	368	363	359	354	350
190	464	458	453	447	442	436	431	425	420	414	409	404	399	394	389	384	379	374	369	365	360	356
195	470	465	459	453	448	442	437	431	426	421	415	410	405	400	395	390	385	380	376	371	366	362
200	476	471	465	459	454	448	443	437	432	427	421	416	411	406	401	396	391	386	382	377	372	368
205	482	477	471	466	460	454	449	444	438	433	427	422	417	412	407	402	397	392	388	383	378	374
210	488	483	477	471	466	460	455	449	444	439	433	428	423	418	413	408	403	398	393	389	384	380
215	494	488	483	477	472	466	461	455	450	445	439	434	429	424	419	414	409	404	399	395	390	385
220	500	494	489	483	478	472	467	461	456	450	445	440	435	430	424	420	415	410	405	400	396	391
225	505	500	494	489	483	478	472	467	462	456	451	446	440	435	430	425	420	415	411	406	401	397
230	511	506	500	495	489	484	478	473	467	462	457	451	446	441	436	431	426	421	416	412	407	402
235	517	511	506	500	495	489	484	478	473	468	462	457	452	447	441	436	431	427	422	417	412	408
240	522	517	511	506	500	495	489	484	479	473	468	463	457	452	447	442	437	432	427	423	418	413

TABLE 18. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0500

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	105	106	107	109	110	111	112	113	114	115	117	118	119	120	121	122	123	124	125	127	128	129
5	106	107	108	110	111	112	113	114	115	116	117	119	120	121	122	123	124	125	126	127	128	130
10	108	109	110	111	112	113	115	116	117	118	119	120	121	122	123	124	125	126	128	129	130	131
15	110	111	112	113	114	115	116	117	118	119	120	122	123	124	125	126	127	128	129	130	131	132
20	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133
25	115	116	117	118	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
30	118	119	119	120	121	122	123	124	125	126	126	127	128	129	130	131	132	133	134	135	136	137
35	121	122	123	123	124	125	126	126	127	128	129	130	131	131	132	133	134	135	136	137	138	139
40	125	126	126	127	127	128	129	129	130	131	132	132	133	134	135	135	136	137	138	139	140	141
45	130	130	130	131	131	131	132	133	133	134	134	135	136	136	137	138	139	139	140	141	142	143
50	135	135	135	135	135	135	136	136	136	137	138	138	139	139	140	141	141	142	143	143	144	145
55	141	140	140	140	140	140	140	140	140	140	141	141	142	142	143	143	144	145	145	146	147	147
60	147	146	145	145	144	144	144	144	144	144	145	145	145	146	146	146	147	147	148	149	149	150
65	154	153	152	151	150	149	149	149	148	148	148	149	149	149	149	150	150	150	151	151	152	152
70	162	160	158	157	156	155	154	153	153	153	153	152	153	153	153	153	153	153	154	154	155	155
75	171	168	165	163	162	161	159	159	158	157	157	157	157	156	156	156	157	157	157	157	158	158
80	179	176	173	171	168	167	165	164	163	162	162	161	161	160	160	160	160	160	160	160	161	161
85	189	184	181	178	175	173	171	170	169	167	167	166	165	165	164	164	164	164	164	164	164	164
90	198	193	189	186	183	180	178	176	174	173	172	171	170	169	169	168	168	168	167	167	167	167
95	207	202	197	193	190	187	184	182	180	178	177	176	175	174	173	172	172	171	171	171	171	171
100	216	210	206	201	197	194	191	188	186	184	182	181	180	178	177	177	176	175	175	175	174	174
105	225	219	214	209	205	201	198	195	192	190	188	186	185	183	182	181	180	179	179	178	178	178
110	234	227	222	217	212	208	204	201	198	196	193	191	190	188	187	186	185	184	183	182	182	181
115	242	236	230	224	220	215	211	208	205	202	199	197	195	193	192	190	189	188	187	186	186	185
120	250	244	238	232	227	222	218	214	211	208	205	202	200	198	197	195	194	192	191	190	189	189
125	258	252	245	239	234	229	225	221	217	214	211	208	206	203	201	200	198	197	195	194	193	193
130	266	259	253	247	241	236	231	227	223	220	216	214	211	209	206	204	203	201	200	199	197	196
135	274	267	260	254	248	243	238	233	229	226	222	219	216	214	211	209	207	206	204	203	201	200
140	281	274	267	261	255	249	244	240	235	232	228	225	222	219	216	214	212	210	208	207	206	204
145	289	281	274	268	262	256	251	246	242	237	234	230	227	224	221	219	217	215	213	211	210	208
150	296	288	281	274	268	262	257	252	248	243	239	236	232	229	226	224	221	219	217	216	214	212
155	303	295	288	281	275	269	263	258	253	249	245	241	238	234	231	229	226	224	222	220	218	216
160	309	302	294	288	281	275	269	264	259	255	250	247	243	240	236	234	231	228	226	224	222	220
165	316	308	301	294	287	281	275	270	265	260	256	252	248	245	241	238	236	233	231	228	226	225
170	323	315	307	300	294	287	281	276	271	266	261	257	253	250	246	243	240	238	235	233	231	229
175	329	321	313	306	300	293	287	282	276	271	267	262	258	255	251	248	245	242	239	237	235	233
180	335	327	320	312	306	299	293	287	282	277	272	268	264	260	256	253	250	247	244	241	239	237
185	341	333	326	318	312	305	299	293	287	282	277	273	269	265	261	257	254	251	248	246	243	241
190	348	339	332	324	317	311	304	299	293	288	283	278	274	270	266	262	259	256	253	250	247	245
195	354	345	338	330	323	316	310	304	298	293	288	283	279	274	270	267	263	260	257	254	251	249
200	359	351	343	336	329	322	315	309	304	298	293	288	284	279	275	271	268	264	261	258	256	253
205	365	357	349	342	334	327	321	315	309	303	298	293	288	284	280	276	272	269	266	263	260	257
210	371	363	355	347	340	333	326	320	314	308	303	298	293	289	285	281	277	273	270	267	264	261
215	377	368	360	353	345	338	332	325	319	313	308	303	298	293	289	285	281	278	274	271	268	265
220	382	374	366	358	351	344	337	330	324	318	313	308	303	298	294	290	286	282	278	275	272	269
225	388	379	371	363	356	349	342	336	329	323	318	313	308	303	298	294	290	286	283	279	276	273
230	393	385	377	369	361	354	347	341	334	328	323	317	312	307	303	298	294	290	287	283	280	277
235	399	390	382	374	366	359	352	346	339	333	328	322	317	312	307	303	299	295	291	287	284	281
240	404	396	387	379	372	364	357	351	344	338	332	327	321	316	312	307	303	299	295	291	288	285

TABLE 18. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0500

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	130	132	135	138	140	143	146	148	151	153	156	158	161	163	165	168	170	172	175	177	179	182
5	131	133	136	138	141	144	146	149	151	154	156	159	161	164	166	168	171	173	175	178	180	182
10	132	134	137	140	142	145	147	150	152	155	157	160	162	164	167	169	171	174	176	178	181	183
15	133	136	138	141	143	146	148	151	153	156	158	160	163	165	168	170	172	175	177	179	181	184
20	134	137	140	142	145	147	149	152	154	157	159	161	164	166	169	171	173	175	178	180	182	184
25	136	139	141	143	146	148	151	153	155	158	160	163	165	167	169	172	174	176	179	181	183	185
30	138	140	142	145	147	150	152	154	157	159	161	164	166	168	171	173	175	177	179	182	184	186
35	140	142	144	146	149	151	153	156	158	160	163	165	167	169	172	174	176	178	180	183	185	187
40	141	144	146	148	150	153	155	157	159	162	164	166	168	170	173	175	177	179	181	184	186	188
45	143	146	148	150	152	154	156	159	161	163	165	167	169	172	174	176	178	180	182	185	187	189
50	146	148	150	152	154	156	158	160	162	164	166	169	171	173	175	177	179	181	184	186	188	190
55	148	150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180	183	185	187	189	191
60	150	152	154	156	157	159	161	163	165	167	169	171	173	175	178	180	182	184	186	188	190	192
65	153	154	156	158	159	161	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193
70	156	157	158	160	161	163	165	167	169	170	172	174	176	178	180	182	184	186	188	190	192	194
75	158	159	161	162	164	165	167	169	170	172	174	176	178	180	182	183	185	187	189	191	193	195
80	161	162	163	164	166	167	169	170	172	174	176	177	179	181	183	185	187	189	190	192	194	196
85	164	165	166	167	168	169	171	172	174	176	177	179	181	183	184	186	188	190	192	194	195	197
90	167	168	169	169	170	172	173	174	176	177	179	181	182	184	186	188	189	191	193	195	197	199
95	171	171	171	172	173	174	175	176	178	179	181	182	184	186	187	189	191	193	194	196	198	200
100	174	174	174	175	175	176	177	178	180	181	183	184	186	187	189	190	192	194	196	197	199	201
105	177	177	177	177	178	179	180	181	182	183	184	186	187	189	190	192	194	195	197	199	200	202
110	181	180	180	180	181	181	182	183	184	185	186	188	189	190	192	194	195	197	198	200	202	203
115	184	184	183	183	183	184	184	185	186	187	188	189	191	192	194	195	197	198	200	201	203	205
120	188	187	186	186	186	186	187	187	188	189	190	191	193	194	195	197	198	200	201	203	204	206
125	192	190	189	189	189	189	189	190	190	191	192	193	194	196	197	198	200	201	203	204	206	207
130	196	194	193	192	191	191	192	192	193	193	194	195	196	197	199	200	201	203	204	206	207	209
135	199	197	196	195	194	194	194	194	195	195	196	197	198	199	200	202	203	204	206	207	208	210
140	203	201	199	198	197	197	197	197	197	198	198	199	200	201	202	203	204	206	207	208	210	211
145	207	205	203	201	200	200	199	199	199	200	200	201	202	203	204	205	206	207	209	210	211	213
150	211	208	206	204	203	202	202	202	202	202	202	203	204	205	206	207	208	209	210	211	213	214
155	215	212	209	208	206	205	205	204	204	204	205	205	206	206	207	208	209	210	212	213	214	215
160	219	215	213	211	209	208	207	207	207	207	207	207	208	208	209	210	211	212	213	214	216	217
165	223	219	216	214	212	211	210	209	209	209	209	209	210	210	211	212	213	214	215	216	217	218
170	227	223	220	217	215	214	213	212	211	211	211	211	212	212	213	214	214	215	216	217	218	220
175	231	227	223	221	218	217	215	215	214	214	213	214	214	214	215	215	216	217	218	219	220	221
180	235	230	227	224	221	220	218	217	216	216	216	216	216	216	217	217	218	219	220	220	221	223
185	239	234	230	227	225	223	221	220	219	218	218	218	218	218	219	219	220	220	221	222	223	224
190	243	238	234	230	228	226	224	222	221	221	220	220	220	220	220	221	221	222	223	224	225	225
195	247	242	237	234	231	228	227	225	224	223	223	222	222	222	222	223	223	224	224	225	226	227
200	251	245	241	237	234	231	229	228	226	226	225	224	224	224	224	225	225	225	226	227	228	228
205	255	249	244	240	237	234	232	230	229	228	227	227	226	226	226	226	227	227	228	228	229	230
210	258	253	248	244	240	237	235	233	232	230	230	229	228	228	228	228	229	229	229	230	231	232
215	262	256	251	247	243	240	238	236	234	233	232	231	231	230	230	230	230	231	231	232	232	233
220	266	260	255	250	247	243	241	239	237	235	234	233	233	232	232	232	232	233	233	233	234	235
225	270	264	258	254	250	246	244	241	239	238	237	236	235	234	234	234	234	234	235	235	236	236
230	274	267	262	257	253	249	246	244	242	240	239	238	237	237	236	236	236	236	236	237	237	238
235	278	271	265	260	256	252	249	247	245	243	241	240	239	239	238	238	238	238	238	238	239	239
240	282	275	269	264	259	255	252	249	247	245	244	242	241	241	240	240	240	240	240	240	240	241

TABLE 18. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0500

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	184	188	193	197	201	206	210	214	218	222	226	230	233	237	241	245	248	252	255	259	262	266
5	184	189	193	198	202	206	210	214	218	222	226	230	234	238	241	245	249	252	256	259	263	266
10	185	190	194	198	202	207	211	215	219	223	227	230	234	238	242	245	249	253	256	260	263	266
15	186	190	195	199	203	207	211	215	219	223	227	231	235	238	242	246	249	253	257	260	263	267
20	187	191	195	200	204	208	212	216	220	224	228	231	235	239	243	246	250	253	257	260	264	267
25	187	192	196	200	204	208	213	217	220	224	228	232	236	240	243	247	250	254	257	261	264	268
30	188	193	197	201	205	209	213	217	221	225	229	233	236	240	244	247	251	254	258	261	265	268
35	189	193	198	202	206	210	214	218	222	226	229	233	237	241	244	248	251	255	258	262	265	269
40	190	194	198	203	207	211	215	219	222	226	230	234	238	241	245	248	252	255	259	262	266	269
45	191	195	199	203	207	211	215	219	223	227	231	234	238	242	245	249	252	256	259	263	266	270
50	192	196	200	204	208	212	216	220	224	228	231	235	239	242	246	249	253	256	260	263	267	270
55	193	197	201	205	209	213	217	221	224	228	232	236	239	243	247	250	254	257	260	264	267	270
60	194	198	202	206	210	214	218	221	225	229	233	236	240	244	247	251	254	258	261	264	268	271
65	195	199	203	207	211	215	218	222	226	230	233	237	241	244	248	251	255	258	261	265	268	271
70	196	200	204	208	212	215	219	223	227	230	234	238	241	245	248	252	255	259	262	265	269	272
75	197	201	205	209	212	216	220	224	227	231	235	238	242	245	249	252	256	259	263	266	269	272
80	198	202	206	210	213	217	221	225	228	232	235	239	243	246	250	253	256	260	263	266	270	273
85	199	203	207	211	214	218	222	225	229	233	236	240	243	247	250	254	257	260	264	267	270	274
90	200	204	208	211	215	219	223	226	230	233	237	240	244	247	251	254	258	261	264	268	271	274
95	202	205	209	212	216	220	223	227	231	234	238	241	245	248	251	255	258	262	265	268	271	275
100	203	206	210	213	217	221	224	228	231	235	238	242	245	249	252	255	259	262	265	269	272	275
105	204	207	211	214	218	222	225	229	232	236	239	243	246	249	253	256	259	263	266	269	272	276
110	205	209	212	216	219	223	226	230	233	236	240	243	247	250	253	257	260	263	267	270	273	276
115	206	210	213	217	220	223	227	230	234	237	241	244	247	251	254	257	261	264	267	270	274	277
120	208	211	214	218	221	224	228	231	235	238	241	245	248	252	255	258	261	265	268	271	274	277
125	209	212	215	219	222	225	229	232	236	239	242	246	249	252	255	259	262	265	268	272	275	278
130	210	213	216	220	223	226	230	233	236	240	243	246	250	253	256	259	263	266	269	272	275	278
135	211	214	218	221	224	227	231	234	237	241	244	247	250	254	257	260	263	266	270	273	276	279
140	213	216	219	222	225	228	232	235	238	241	245	248	251	254	258	261	264	267	270	273	277	280
145	214	217	220	223	226	229	233	236	239	242	245	249	252	255	258	261	265	268	271	274	277	280
150	215	218	221	224	227	230	234	237	240	243	246	249	253	256	259	262	265	268	272	275	278	281
155	217	219	222	225	228	231	235	238	241	244	247	250	253	257	260	263	266	269	272	275	278	281
160	218	221	224	226	229	232	236	239	242	245	248	251	254	257	260	264	267	270	273	276	279	282
165	219	222	225	228	231	234	237	240	243	246	249	252	255	258	261	264	267	270	273	277	280	283
170	221	223	226	229	232	235	238	241	244	247	250	253	256	259	262	265	268	271	274	277	280	283
175	222	225	227	230	233	236	239	241	244	247	251	254	257	260	263	266	269	272	275	278	281	284
180	224	226	229	231	234	237	240	242	245	248	251	254	257	260	263	266	269	272	275	278	281	284
185	225	227	230	232	235	238	241	243	246	249	252	255	258	261	264	267	270	273	276	279	282	285
190	226	229	231	234	236	239	242	244	247	250	253	256	259	262	265	268	271	274	277	280	283	286
195	228	230	232	235	237	240	243	245	248	251	254	257	260	263	266	269	272	274	277	280	283	286
200	229	231	234	236	238	241	244	246	249	252	255	258	261	264	266	269	272	275	278	281	284	287
205	231	233	235	237	240	242	245	247	250	253	256	259	261	264	267	270	273	276	279	282	285	287
210	232	234	236	238	241	243	246	248	251	254	257	259	262	265	268	271	274	277	279	282	285	288
215	234	236	238	240	242	244	247	249	252	255	258	260	263	266	269	272	274	277	280	283	286	289
220	235	237	239	241	243	246	248	251	253	256	258	261	264	267	270	272	275	278	281	284	286	289
225	237	238	240	242	244	247	249	252	254	257	259	262	265	268	270	273	276	279	281	284	287	290
230	238	240	242	243	246	248	250	253	255	258	260	263	266	268	271	274	277	279	282	285	288	291
235	240	241	243	245	247	249	251	254	256	259	261	264	267	269	272	275	277	280	283	286	288	291
240	241	243	244	246	248	250	252	255	257	260	262	265	267	270	273	275	278	281	284	286	289	292

TABLE 18. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0500

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	269	273	276	279	282	286	289	292	295	298	301	304	308	311	314	317	319	322	325	328	331	334
5	269	273	276	279	283	286	289	292	295	299	302	305	308	311	314	317	320	323	325	328	331	334
10	270	273	276	280	283	286	289	293	296	299	302	305	308	311	314	317	320	323	326	329	332	334
15	270	274	277	280	283	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	332	335
20	271	274	277	281	284	287	290	293	296	300	303	306	309	312	315	318	321	323	326	329	332	335
25	271	274	278	281	284	287	291	294	297	300	303	306	309	312	315	318	321	324	327	330	332	335
30	271	275	278	281	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	333	335
35	272	275	279	282	285	288	291	294	298	301	304	307	310	313	316	319	321	324	327	330	333	336
40	272	276	279	282	285	289	292	295	298	301	304	307	310	313	316	319	322	325	328	330	333	336
45	273	276	279	283	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	334	336
50	273	277	280	283	286	289	293	296	299	302	305	308	311	314	317	320	322	325	328	331	334	337
55	274	277	280	283	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	331	334	337
60	274	278	281	284	287	290	293	296	299	303	306	309	312	314	317	320	323	326	329	332	335	337
65	275	278	281	284	288	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	338
70	275	278	282	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	332	335	338
75	276	279	282	285	288	292	295	298	301	304	307	310	313	316	318	321	324	327	330	333	336	338
80	276	279	283	286	289	292	295	298	301	304	307	310	313	316	319	322	325	327	330	333	336	339
85	277	280	283	286	289	292	296	299	302	305	308	311	313	316	319	322	325	328	331	333	336	339
90	277	280	284	287	290	293	296	299	302	305	308	311	314	317	320	323	325	328	331	334	337	339
95	278	281	284	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	331	334	337	340
100	278	281	285	288	291	294	297	300	303	306	309	312	315	318	320	323	326	329	332	335	337	340
105	279	282	285	288	291	294	297	300	303	306	309	312	315	318	321	324	326	329	332	335	338	340
110	279	283	286	289	292	295	298	301	304	307	310	313	315	318	321	324	327	330	332	335	338	341
115	280	283	286	289	292	295	298	301	304	307	310	313	316	319	322	324	327	330	333	336	338	341
120	280	284	287	290	293	296	299	302	305	308	311	313	316	319	322	325	328	330	333	336	339	341
125	281	284	287	290	293	296	299	302	305	308	311	314	317	320	322	325	328	331	334	336	339	342
130	282	285	288	291	294	297	300	303	306	308	311	314	317	320	323	326	328	331	334	337	339	342
135	282	285	288	291	294	297	300	303	306	309	312	315	318	320	323	326	329	332	334	337	340	343
140	283	286	289	292	295	298	301	304	307	309	312	315	318	321	324	326	329	332	335	337	340	343
145	283	286	289	292	295	298	301	304	307	310	313	316	318	321	324	327	330	332	335	338	341	343
150	284	287	290	293	296	299	302	305	307	310	313	316	319	322	324	327	330	333	335	338	341	344
155	284	287	290	293	296	299	302	305	308	311	314	316	319	322	325	328	330	333	336	339	341	344
160	285	288	291	294	297	300	303	306	308	311	314	317	320	323	325	328	331	334	336	339	342	344
165	286	288	291	294	297	300	303	306	309	312	315	317	320	323	326	328	331	334	337	339	342	345
170	286	289	292	295	298	301	304	306	309	312	315	318	321	323	326	329	332	334	337	340	342	345
175	287	290	293	295	298	301	304	307	310	313	315	318	321	324	327	329	332	335	337	340	343	345
180	287	290	293	296	299	302	305	307	310	313	316	319	321	324	327	330	332	335	338	341	343	346
185	288	291	294	297	299	302	305	308	311	314	316	319	322	325	327	330	333	336	338	341	344	346
190	288	291	294	297	300	303	306	308	311	314	317	320	322	325	328	331	333	336	339	341	344	347
195	289	292	295	298	301	303	306	309	312	315	317	320	323	326	328	331	334	336	339	342	344	347
200	290	293	295	298	301	304	307	309	312	315	318	321	323	326	329	331	334	337	339	342	345	347
205	290	293	296	299	302	304	307	310	313	316	318	321	324	326	329	332	335	337	340	342	345	348
210	291	294	297	299	302	305	308	310	313	316	319	321	324	327	330	332	335	338	340	343	346	348
215	291	294	297	300	303	305	308	311	314	316	319	322	325	327	330	333	335	338	341	343	346	349
220	292	295	298	300	303	306	309	312	314	317	320	322	325	328	330	333	336	338	341	344	346	349
225	293	295	298	301	304	307	309	312	315	317	320	323	326	328	331	334	336	339	341	344	347	349
230	293	296	299	302	304	307	310	313	315	318	321	323	326	329	331	334	337	339	342	344	347	350
235	294	297	299	302	305	308	310	313	316	318	321	324	326	329	332	334	337	340	342	345	347	350
240	295	297	300	303	305	308	311	314	316	319	322	324	327	330	332	335	337	340	343	345	348	350

TABLE 19. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0000

T, DEG K	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	90	91	92	92	93	93	94	95	95	96	96	97	97	98	99	99	100	100	101	102	102	103
5	92	92	93	93	94	95	95	96	96	97	98	98	99	99	100	100	101	102	102	103	103	104
10	94	95	95	96	96	97	97	98	98	99	100	100	101	101	102	102	103	104	104	105	105	106
15	97	98	98	99	99	100	100	101	101	102	102	103	103	104	104	105	105	106	106	107	107	108
20	101	101	102	102	103	103	104	104	104	105	105	106	106	107	107	108	108	109	109	110	110	110
25	106	107	107	107	107	108	108	108	109	109	109	110	110	110	111	111	111	112	112	113	113	114
30	114	114	114	114	114	114	114	114	114	114	114	114	115	115	115	115	116	116	116	117	117	117
35	126	125	124	123	122	122	121	121	121	121	120	120	120	120	120	120	121	121	121	121	121	121
40	153	146	141	138	136	134	132	131	130	129	129	128	128	127	127	127	127	127	127	127	127	127
45	216	197	180	168	160	154	150	146	144	142	140	139	137	136	136	135	134	134	133	133	133	133
50	253	239	225	210	197	186	177	169	164	159	156	153	150	148	147	145	144	143	142	141	140	140
55	277	265	254	242	230	219	208	198	190	182	176	171	167	163	160	158	156	154	152	151	150	148
60	296	286	275	265	255	244	234	225	215	207	199	193	187	182	177	173	170	167	164	162	160	159
65	313	303	293	284	274	265	255	246	238	229	221	214	207	201	195	190	186	182	178	175	172	170
70	327	318	309	300	291	282	273	265	256	248	240	233	226	219	213	207	202	197	193	189	186	183
75	341	332	323	315	306	298	289	281	273	265	257	250	243	236	230	224	218	213	208	203	199	196
80	353	345	336	328	320	312	303	296	288	280	273	265	258	252	245	239	233	228	222	218	213	209
85	365	357	348	340	332	324	317	309	301	294	286	279	272	266	259	253	247	241	236	231	226	222
90	376	368	360	352	344	336	329	321	314	306	299	292	285	279	272	266	260	255	249	244	239	234
95	386	378	371	363	355	348	340	333	325	318	311	304	298	291	285	279	273	267	261	256	251	246
100	396	388	381	373	366	358	351	344	336	329	322	316	309	303	296	290	284	278	273	267	262	257
105	406	398	391	383	376	368	361	354	347	340	333	326	320	313	307	301	295	289	284	278	273	268
110	415	407	400	393	385	378	371	364	357	350	343	337	330	324	318	311	306	300	294	289	283	278
115	424	417	409	402	395	388	381	374	367	360	353	347	340	334	328	321	315	310	304	299	293	288
120	433	425	418	411	404	397	390	383	376	369	363	356	350	343	337	331	325	319	314	308	303	298
125	441	434	427	420	413	406	399	392	385	378	372	365	359	352	346	340	334	329	323	317	312	307
130	449	442	435	428	421	414	407	400	394	387	380	374	368	361	355	349	343	338	332	326	321	316
135	457	450	443	436	430	423	416	409	402	396	389	383	376	370	364	358	352	346	341	335	330	324
140	465	458	451	445	438	431	424	417	411	404	397	391	385	378	372	366	360	355	349	343	338	333
145	473	466	459	452	446	439	432	425	419	412	406	399	393	387	381	375	369	363	357	352	346	341
150	481	474	467	460	453	447	440	433	427	420	414	407	401	395	389	383	377	371	365	360	354	349
155	488	481	475	468	461	454	448	441	434	428	421	415	409	402	396	390	384	379	373	367	362	357
160	496	489	482	475	469	462	455	448	442	435	429	423	416	410	404	398	392	386	381	375	370	364
165	503	496	489	483	476	469	463	456	449	443	436	430	424	418	412	406	400	394	388	383	377	372
170	510	503	497	490	483	476	470	463	457	450	444	437	431	425	419	413	407	401	396	390	384	379
175	517	510	504	497	490	484	477	470	464	457	451	445	438	432	426	420	414	408	403	397	392	386
180	524	517	511	504	497	491	484	478	471	465	458	452	446	439	433	427	421	416	410	404	399	393
185	531	524	518	511	504	498	491	485	478	472	465	459	453	446	440	434	428	423	417	411	406	400
190	538	531	524	518	511	505	498	491	485	478	472	466	459	453	447	441	435	429	424	418	413	407
195	544	538	531	524	518	511	505	498	492	485	479	473	466	460	454	448	442	436	430	425	419	414
200	551	544	538	531	525	518	511	505	498	492	486	479	473	467	461	455	449	443	437	431	426	420
205	557	551	544	538	531	525	518	512	505	499	492	486	480	474	467	461	455	450	444	438	432	427
210	564	557	551	544	538	531	525	518	512	505	499	493	486	480	474	468	462	456	450	445	439	433
215	570	564	557	551	544	538	531	525	518	512	505	499	493	487	480	474	468	463	457	451	445	440
220	577	570	564	557	551	544	538	531	525	518	512	505	499	493	487	481	475	469	463	457	452	446
225	583	576	570	563	557	550	544	537	531	525	518	512	506	499	493	487	481	475	469	464	458	452
230	589	583	576	570	563	557	550	544	537	531	524	518	512	506	499	493	487	481	476	470	464	459
235	595	589	582	576	569	563	556	550	544	537	531	524	518	512	506	500	494	488	482	476	470	465
240	601	595	589	582	576	569	563	556	550	543	537	531	524	518	512	506	500	494	488	482	476	471

TABLE 19. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0000

T, DEG K	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	104	105	106	107	109	110	111	112	113	114	115	116	118	119	120	121	122	123	124	125	126	127
5	105	106	107	108	110	111	112	113	114	115	116	117	119	120	121	122	123	124	125	126	127	128
10	107	108	109	110	111	112	113	115	116	117	118	119	120	121	122	123	124	125	126	127	128	130
15	109	110	111	112	113	114	115	116	117	118	119	121	122	123	124	125	126	127	128	129	130	131
20	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	131	132	133
25	114	115	116	117	118	119	120	121	122	123	124	125	126	126	127	128	129	130	131	132	133	134
30	118	119	119	120	121	122	123	123	124	125	126	127	128	129	130	131	131	132	133	134	135	136
35	122	122	123	124	124	125	126	126	127	128	129	130	130	131	132	133	134	135	135	136	137	138
40	127	127	127	128	128	129	129	130	130	131	132	132	133	134	135	135	136	137	138	139	139	140
45	132	132	132	132	133	133	133	134	134	135	135	136	136	137	138	138	139	140	140	141	142	143
50	139	138	138	138	137	137	138	138	138	138	139	139	140	140	141	141	142	142	143	144	144	145
55	147	145	144	144	143	143	143	142	142	143	143	143	143	144	144	144	145	145	146	147	147	148
60	156	154	152	150	149	149	148	148	147	147	147	147	147	147	148	148	148	149	149	150	150	151
65	166	163	160	158	156	155	154	153	153	152	152	152	152	152	152	152	152	152	152	153	153	154
70	177	173	169	167	164	162	161	159	158	158	157	157	156	156	156	156	156	156	156	156	157	157
75	189	184	179	176	173	170	168	166	165	163	163	162	161	161	160	160	160	160	160	160	160	160
80	201	195	190	185	181	178	175	173	171	170	168	167	166	166	165	165	164	164	164	164	164	164
85	214	206	200	195	191	187	183	181	178	176	175	173	172	171	170	169	169	168	168	168	167	167
90	225	218	211	205	200	196	192	188	186	183	181	179	178	176	175	174	173	173	172	172	171	171
95	237	229	221	215	209	204	200	196	193	190	188	185	184	182	181	179	178	177	177	176	176	175
100	248	239	232	225	219	213	209	204	201	197	194	192	190	188	186	185	183	182	181	181	180	179
105	258	250	242	235	228	222	217	212	208	205	201	199	196	194	192	190	189	187	186	185	184	184
110	269	260	252	244	237	231	225	220	216	212	208	205	202	200	198	196	194	192	191	190	189	188
115	278	269	261	253	246	240	234	228	224	219	215	212	209	206	204	201	199	198	196	195	193	192
120	288	279	270	262	255	248	242	236	231	227	222	219	215	212	209	207	205	203	201	199	198	197
125	297	288	279	271	263	256	250	244	239	234	229	225	222	218	215	213	210	208	206	204	203	201
130	306	296	288	279	272	264	258	252	246	241	236	232	228	225	222	219	216	214	211	209	208	206
135	314	305	296	288	280	272	266	259	254	248	243	239	235	231	228	224	222	219	217	214	213	211
140	323	313	304	296	288	280	273	267	261	255	250	245	241	237	234	230	227	224	222	220	217	215
145	331	321	312	303	295	288	281	274	268	262	257	252	247	243	239	236	233	230	227	225	222	220
150	339	329	320	311	303	295	288	281	275	269	264	258	254	249	245	242	238	235	232	230	227	225
155	346	337	327	319	310	302	295	288	282	276	270	265	260	256	251	247	244	241	238	235	232	230
160	354	344	335	326	318	310	302	295	289	282	277	271	266	262	257	253	249	246	243	240	237	235
165	361	352	342	333	325	317	309	302	295	289	283	277	272	267	263	259	255	251	248	245	242	239
170	369	359	349	340	332	323	316	309	302	295	289	284	278	273	269	264	260	257	253	250	247	244
175	376	366	356	347	338	330	322	315	308	302	295	290	284	279	274	270	266	262	258	255	252	249
180	383	373	363	354	345	337	329	322	315	308	302	296	290	285	280	276	271	267	264	260	257	254
185	390	380	370	361	352	343	336	328	321	314	308	302	296	291	286	281	277	272	269	265	262	258
190	396	386	377	367	358	350	342	334	327	320	314	308	302	296	291	286	282	278	274	270	266	263
195	403	393	383	374	365	356	348	340	333	326	320	313	307	302	297	292	287	283	279	275	271	268
200	410	400	390	380	371	363	354	347	339	332	325	319	313	307	302	297	292	288	284	280	276	273
205	416	406	396	387	377	369	361	353	345	338	331	325	319	313	308	302	298	293	289	285	281	277
210	423	412	402	393	384	375	367	359	351	344	337	330	324	318	313	308	303	298	294	289	286	282
215	429	419	409	399	390	381	373	365	357	350	343	336	330	324	318	313	308	303	299	294	290	286
220	435	425	415	405	396	387	378	370	363	355	348	341	335	329	323	318	313	308	303	299	295	291
225	441	431	421	411	402	393	384	376	368	361	354	347	341	334	329	323	318	313	308	304	300	296
230	448	437	427	417	408	399	390	382	374	366	359	352	346	340	334	328	323	318	313	309	304	300
235	454	443	433	423	414	405	396	387	380	372	365	358	351	345	339	333	328	323	318	313	309	305
240	460	449	439	429	419	410	401	393	385	377	370	363	356	350	344	338	333	327	323	318	313	309

TABLE 19. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0000

T, DEG K	200	205	210	215	220	225	230	235	240	245	250	255	260	265	270	275	280	285	290	295	300	305
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	129	131	134	137	139	142	144	147	149	152	154	157	159	162	164	166	169	171	174	176	178	180
5	129	132	135	137	140	142	145	148	150	153	155	157	160	162	165	167	169	172	174	176	179	181
10	131	133	136	138	141	143	146	149	151	153	156	158	161	163	166	168	170	173	175	177	179	182
15	132	135	137	140	142	145	147	150	152	155	157	159	162	164	166	169	171	173	176	178	180	182
20	134	136	139	141	143	146	148	151	153	156	158	160	163	165	167	170	172	174	177	179	181	183
25	135	138	140	142	145	147	150	152	154	157	159	161	164	166	168	171	173	175	177	180	182	184
30	137	139	142	144	146	149	151	153	156	158	160	163	165	167	170	172	174	176	178	181	183	185
35	139	141	143	146	148	150	153	155	157	159	162	164	166	168	171	173	175	177	179	182	184	186
40	141	143	145	148	150	152	154	156	159	161	163	165	167	170	172	174	176	178	181	183	185	187
45	143	145	147	149	152	154	156	158	160	162	164	167	169	171	173	175	177	179	182	184	186	188
50	146	148	150	151	153	156	158	160	162	164	166	168	170	172	174	176	179	181	183	185	187	189
55	148	150	152	154	156	157	159	161	163	165	167	169	172	174	176	178	180	182	184	186	188	190
60	151	153	154	156	158	159	161	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191
65	154	155	157	158	160	162	163	165	167	169	171	173	175	176	178	180	182	184	186	188	190	192
70	157	158	159	161	162	164	165	167	169	171	172	174	176	178	180	182	184	186	188	190	192	193
75	160	161	162	163	165	166	167	169	171	172	174	176	178	180	181	183	185	187	189	191	193	195
80	164	164	165	166	167	168	170	171	173	174	176	178	179	181	183	185	187	188	190	192	194	196
85	167	168	168	169	170	171	172	173	175	176	178	179	181	183	185	186	188	190	192	193	195	197
90	171	171	171	172	172	173	174	176	177	178	180	181	183	184	186	188	190	191	193	195	197	198
95	175	174	174	175	175	176	177	178	179	180	182	183	185	186	188	189	191	193	194	196	198	200
100	179	178	178	178	178	179	179	180	181	183	184	185	187	188	190	191	193	194	196	198	199	201
105	183	182	181	181	181	181	182	183	184	185	186	187	188	190	191	193	194	196	197	199	201	202
110	187	186	185	184	184	184	185	185	186	187	188	189	190	192	193	194	196	197	199	201	202	204
115	191	189	188	187	187	187	187	188	188	189	190	191	192	194	195	196	198	199	200	202	204	205
120	196	193	192	191	190	190	190	190	191	192	192	193	194	195	197	198	199	201	202	204	205	207
125	200	198	196	194	194	193	193	193	193	194	195	195	196	197	198	200	201	202	204	205	206	208
130	205	202	199	198	197	196	196	196	196	196	197	198	198	199	200	201	203	204	205	207	208	209
135	209	206	203	201	200	199	199	198	198	199	199	200	200	201	202	203	204	206	207	208	210	211
140	214	210	207	205	204	202	202	201	201	201	202	202	203	203	204	205	206	207	209	210	211	212
145	218	214	211	209	207	206	205	204	204	204	204	204	205	205	206	207	208	209	210	211	213	214
150	223	219	215	212	210	209	208	207	206	206	206	207	207	208	208	209	210	211	212	213	214	215
155	228	223	219	216	214	212	211	210	209	209	209	209	209	210	210	211	212	213	214	215	216	217
160	232	227	223	220	217	215	214	213	212	211	211	211	211	212	212	213	214	214	215	216	217	219
165	237	232	227	224	221	219	217	216	215	214	214	214	214	214	214	215	216	216	217	218	219	220
170	242	236	231	228	225	222	220	219	218	217	216	216	216	216	216	217	217	218	219	220	221	222
175	246	240	235	231	228	225	223	222	220	219	219	218	218	218	219	219	219	220	221	222	222	223
180	251	245	240	235	232	229	227	225	223	222	221	221	221	221	221	221	221	222	223	223	224	225
185	256	249	244	239	235	232	230	228	226	225	224	223	223	223	223	223	223	224	224	225	226	227
190	260	253	248	243	239	236	233	231	229	228	227	226	225	225	225	225	225	226	226	227	227	228
195	265	258	252	247	243	239	236	234	232	230	229	228	228	227	227	227	227	228	228	229	229	230
200	269	262	256	251	246	243	239	237	235	233	232	231	230	230	229	229	229	230	230	230	231	232
205	274	266	260	254	250	246	243	240	238	236	235	233	233	232	232	231	231	232	232	232	233	233
210	278	271	264	258	253	249	246	243	241	239	237	236	235	234	234	234	233	234	234	234	234	235
215	283	275	268	262	257	253	249	246	244	242	240	239	237	237	236	236	236	236	236	236	236	237
220	287	279	272	266	261	256	253	249	247	244	243	241	240	239	238	238	238	238	238	238	238	238
225	292	283	276	270	264	260	256	252	250	247	245	244	242	241	241	240	240	240	239	240	240	240
230	296	288	280	274	268	263	259	256	253	250	248	246	245	244	243	242	242	242	241	241	242	242
235	301	292	284	277	272	267	262	259	256	253	251	249	247	246	245	244	244	244	243	243	243	244
240	305	296	288	281	275	270	266	262	259	256	253	251	250	249	247	247	246	246	245	245	245	245

TABLE 19. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0000

T, DEG K	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	183	187	192	196	200	204	208	213	217	221	224	228	232	236	240	243	247	250	254	257	261	264
5	183	188	192	196	201	205	209	213	217	221	225	229	232	236	240	244	247	251	254	258	261	265
10	184	188	193	197	201	205	209	213	217	221	225	229	233	237	240	244	248	251	255	258	262	265
15	185	189	193	198	202	206	210	214	218	222	226	230	233	237	241	244	248	252	255	259	262	265
20	185	190	194	198	202	207	211	215	219	223	226	230	234	238	241	245	249	252	256	259	262	266
25	186	191	195	199	203	207	211	215	219	223	227	231	235	238	242	245	249	253	256	260	263	266
30	187	191	196	200	204	208	212	216	220	224	228	231	235	239	242	246	250	253	257	260	263	267
35	188	192	197	201	205	209	213	217	221	224	228	232	236	239	243	247	250	254	257	260	264	267
40	189	193	197	201	206	210	214	217	221	225	229	233	236	240	244	247	251	254	258	261	264	268
45	190	194	198	202	206	210	214	218	222	226	230	233	237	241	244	248	251	255	258	262	265	268
50	191	195	199	203	207	211	215	219	223	227	230	234	238	241	245	248	252	255	259	262	265	269
55	192	196	200	204	208	212	216	220	223	227	231	235	238	242	245	249	252	256	259	263	266	269
60	193	197	201	205	209	213	217	220	224	228	232	235	239	242	246	249	253	256	260	263	266	270
65	194	198	202	206	210	214	218	221	225	229	232	236	240	243	247	250	254	257	260	264	267	270
70	195	199	203	207	211	215	218	222	226	229	233	237	240	244	247	251	254	258	261	264	268	271
75	197	200	204	208	212	216	219	223	227	230	234	237	241	244	248	251	255	258	261	265	268	271
80	198	202	205	209	213	216	220	224	227	231	235	238	242	245	249	252	255	259	262	265	269	272
85	199	203	206	210	214	217	221	225	228	232	235	239	242	246	249	253	256	259	263	266	269	272
90	200	204	207	211	215	218	222	226	229	233	236	240	243	247	250	253	257	260	263	267	270	273
95	201	205	209	212	216	219	223	226	230	233	237	240	244	247	251	254	257	261	264	267	270	274
100	203	206	210	213	217	220	224	227	231	234	238	241	245	248	251	255	258	261	265	268	271	274
105	204	207	211	214	218	221	225	228	232	235	239	242	245	249	252	255	259	262	265	268	272	275
110	205	209	212	215	219	222	226	229	233	236	239	243	246	249	253	256	259	263	266	269	272	275
115	207	210	213	217	220	223	227	230	233	237	240	244	247	250	253	257	260	263	266	270	273	276
120	208	211	214	218	221	224	228	231	234	238	241	244	248	251	254	257	261	264	267	270	273	276
125	209	213	216	219	222	225	229	232	235	239	242	245	248	252	255	258	261	265	268	271	274	277
130	211	214	217	220	223	227	230	233	236	240	243	246	249	252	256	259	262	265	268	271	275	278
135	212	215	218	221	224	228	231	234	237	240	244	247	250	253	256	260	263	266	269	272	275	278
140	214	217	219	223	226	229	232	235	238	241	245	248	251	254	257	260	263	267	270	273	276	279
145	215	218	221	224	227	230	233	236	239	242	245	249	252	255	258	261	264	267	270	273	276	280
150	217	219	222	225	228	231	234	237	240	243	246	249	253	256	259	262	265	268	271	274	277	280
155	218	221	223	226	229	232	235	238	241	244	247	250	253	256	260	263	266	269	272	275	278	281
160	220	222	225	227	230	233	236	239	242	245	248	251	254	257	260	263	266	269	272	275	278	281
165	221	224	226	229	231	234	237	240	243	246	249	252	255	258	261	264	267	270	273	276	279	282
170	223	225	227	230	233	235	238	241	244	247	250	253	256	259	262	265	268	271	274	277	280	283
175	224	227	229	231	234	237	239	242	245	248	251	254	257	260	263	266	269	272	275	277	280	283
180	226	228	230	233	235	238	241	243	246	249	252	255	258	261	264	266	269	272	275	278	281	284
185	227	229	232	234	236	239	242	244	247	250	253	256	259	261	264	267	270	273	276	279	282	285
190	229	231	233	235	238	240	243	245	248	251	254	257	259	262	265	268	271	274	277	280	282	285
195	231	232	234	237	239	241	244	247	249	252	255	257	260	263	266	269	272	275	277	280	283	286
200	232	234	236	238	240	243	245	248	250	253	256	258	261	264	267	270	272	275	278	281	284	287
205	234	236	237	239	242	244	246	249	251	254	257	259	262	265	268	270	273	276	279	282	284	287
210	236	237	239	241	243	245	247	250	252	255	258	260	263	266	268	271	274	277	280	282	285	288
215	237	239	240	242	244	246	249	251	253	256	259	261	264	267	269	272	275	278	280	283	286	289
220	239	240	242	243	245	248	250	252	255	257	260	262	265	267	270	273	276	278	281	284	287	289
225	241	242	243	245	247	249	251	253	256	258	261	263	266	268	271	274	276	279	282	285	287	290
230	242	243	245	246	248	250	252	254	257	259	262	264	267	269	272	275	277	280	283	285	288	291
235	244	245	246	248	249	251	253	256	258	260	263	265	268	270	273	275	278	281	283	286	289	291
240	246	247	248	249	251	253	255	257	259	261	264	266	269	271	274	276	279	281	284	287	289	292

TABLE 19. - VISCOSITY OF HELIUM-NITROGEN SYSTEM, MICROPOISES

MOLE FRACTION OF HELIUM 0.0000

T, DEG K	530	540	550	560	570	580	590	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740
P, ATM	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS	VIS
1	268	271	274	278	281	284	287	290	294	297	300	303	306	309	312	315	318	321	323	326	329	332
5	268	271	275	278	281	284	288	291	294	297	300	303	306	309	312	315	318	321	324	327	329	332
10	268	272	275	278	281	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	330	332
15	269	272	275	279	282	285	288	291	294	298	301	304	307	310	313	316	318	321	324	327	330	333
20	269	273	276	279	282	285	289	292	295	298	301	304	307	310	313	316	319	322	325	327	330	333
25	270	273	276	279	283	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	331	333
30	270	273	277	280	283	286	289	292	296	299	302	305	308	311	314	317	319	322	325	328	331	334
35	271	274	277	280	283	287	290	293	296	299	302	305	308	311	314	317	320	323	326	328	331	334
40	271	274	278	281	284	287	290	293	296	299	302	305	308	311	314	317	320	323	326	329	331	334
45	271	275	278	281	284	288	291	294	297	300	303	306	309	312	315	318	320	323	326	329	332	335
50	272	275	278	282	285	288	291	294	297	300	303	306	309	312	315	318	321	324	327	329	332	335
55	272	276	279	282	285	288	291	295	298	301	304	307	310	312	315	318	321	324	327	330	332	335
60	273	276	279	283	286	289	292	295	298	301	304	307	310	313	316	319	322	324	327	330	333	336
65	273	277	280	283	286	289	292	295	298	301	304	307	310	313	316	319	322	325	328	330	333	336
70	274	277	280	284	287	290	293	296	299	302	305	308	311	314	317	319	322	325	328	331	334	336
75	275	278	281	284	287	290	293	296	299	302	305	308	311	314	317	320	323	325	328	331	334	337
80	275	278	281	285	288	291	294	297	300	303	306	309	312	314	317	320	323	326	329	331	334	337
85	276	279	282	285	288	291	294	297	300	303	306	309	312	315	318	321	323	326	329	332	335	337
90	276	279	282	286	289	292	295	298	301	304	307	310	312	315	318	321	324	327	329	332	335	338
95	277	280	283	286	289	292	295	298	301	304	307	310	313	316	319	321	324	327	330	333	335	338
100	277	280	283	287	290	293	296	299	302	305	307	310	313	316	319	322	325	327	330	333	336	338
105	278	281	284	287	290	293	296	299	302	305	308	311	314	317	319	322	325	328	331	333	336	339
110	278	282	285	288	291	294	297	300	303	305	308	311	314	317	320	323	325	328	331	334	336	339
115	279	282	285	288	291	294	297	300	303	306	309	312	315	317	320	323	326	329	331	334	337	340
120	280	283	286	289	292	295	298	301	304	306	309	312	315	318	321	323	326	329	332	334	337	340
125	280	283	286	289	292	295	298	301	304	307	310	313	315	318	321	324	327	329	332	335	338	340
130	281	284	287	290	293	296	299	302	304	307	310	313	316	319	322	324	327	330	333	335	338	341
135	281	284	287	290	293	296	299	302	305	308	311	314	316	319	322	325	327	330	333	336	338	341
140	282	285	288	291	294	297	300	303	305	308	311	314	317	320	322	325	328	331	333	336	339	341
145	283	286	288	291	294	297	300	303	306	309	312	314	317	320	323	326	328	331	334	336	339	342
150	283	286	289	292	295	298	301	304	306	309	312	315	318	320	323	326	329	331	334	337	340	342
155	284	287	290	293	295	298	301	304	307	310	313	315	318	321	324	326	329	332	335	337	340	343
160	284	287	290	293	296	299	302	305	307	310	313	316	319	321	324	327	330	332	335	338	340	343
165	285	288	291	294	297	299	302	305	308	311	314	316	319	322	325	327	330	333	335	338	341	343
170	286	289	291	294	297	300	303	306	308	311	314	317	320	322	325	328	330	333	336	338	341	344
175	286	289	292	295	298	301	303	306	309	312	315	317	320	323	325	328	331	334	336	339	342	344
180	287	290	293	295	298	301	304	307	310	312	315	318	321	323	326	329	331	334	337	339	342	345
185	287	290	293	296	299	302	304	307	310	313	316	318	321	324	326	329	332	334	337	340	342	345
190	288	291	294	297	299	302	305	308	311	313	316	319	321	324	327	330	332	335	338	340	343	345
195	289	292	294	297	300	303	306	308	311	314	317	319	322	325	327	330	333	335	338	341	343	346
200	289	292	295	298	301	303	306	309	312	314	317	320	322	325	328	330	333	336	338	341	344	346
205	290	293	296	298	301	304	307	309	312	315	318	320	323	326	328	331	334	336	339	341	344	347
210	291	293	296	299	302	305	307	310	313	315	318	321	323	326	329	331	334	337	339	342	344	347
215	291	294	297	300	302	305	308	311	313	316	319	321	324	327	329	332	334	337	340	342	345	347
220	292	295	298	300	303	306	308	311	314	316	319	322	324	327	330	332	335	338	340	343	345	348
225	293	295	298	301	304	306	309	312	314	317	320	322	325	328	330	333	335	338	341	343	346	348
230	293	296	299	301	304	307	310	312	315	317	320	323	325	328	331	333	336	338	341	344	346	349
235	294	297	299	302	305	307	310	313	315	318	321	323	326	329	331	334	336	339	341	344	347	349
240	295	297	300	303	305	308	311	313	316	319	321	324	326	329	332	334	337	339	342	344	347	349

COMPUTER SOURCE PROGRAM

```
C     VISCOSITY OF THE HELIUM-NITROGEN SYSTEM FROM 133 TO 740 DEG. K FOR       EQUATION NO.
C     PRESSURES BETWEEN 1 AND 240 ATMOSPHERES**************************
      DIMENSION BN(14),CN(13),DN(7),EN(8),X(21),V(1127),TEMP(22),PP(49)
      READ 5001,BN,CN,DN,EN,BP,BQ,BR,BU,BS,BT,Y,G,F,H,Q,R
      READ 5001,PP12,CD12,WTHE,WTN2
      READ 1001,PP
      K=0
      DO 1000 MN=1,1127,23
      K=K+1
 1000 V(MN)=PP(K)
  700 PRINT 900
      I1=1
      READ 901,XHE,MINT,INC
      PRINT 902,XHE
      INCK=0
      TEMP(1)=MINT
      DO 550 I=2,22
      INCK=INCK+INC
      TEMP(I)=MINT+INCK
  550 CONTINUE
      PRINT 903,TEMP
      PRINT 904
C     DENSE-GAS PARAMETER ALPHA ******************************************
      ALPHA=2.5254571*XHE**2+2.0*XHE*(1.0-XHE)*24.4447980+58.2659757*(1.
     10-XHE)**2                                                                (52)
C     THERMAL PRESSURE COEFFICIENT EXPONENT BETA*************************
      BETA=1.1160332-0.36651685*XHE+2.78372553*XHE**2-5.26596970*XHE**3+
     13.602589636*XHE**4                                                       (53)
C     COMPOSITION TERMS OF THE EQUATION OF STATE************************
  201 A=(BN(1))+(BN(2)*XHE)                                                    (29)
  202 BB=((BN(3))+(BN(4)*XHE)+(BN(5)*XHE*XHE))*BP                              (30)
  203 BC=((BN(6))+(BN(7)*XHE)+(BN(8)*XHE*XHE))*BQ                              (31)
  204 BD=((BN(9))+(BN(10)*XHE)+(BN(11)*XHE*XHE))*BR                            (32)
  205 BE=((BN(12))+(BN(13)*XHE)+(BN(14)*XHE*XHE))*BU                           (33)
  207 CF=(CN(1))+(CN(2)*XHE)                                                   (34)
  208 CG=((CN(3))+(CN(4)*XHE)+(CN(5)*XHE*XHE)+(CN(6)*(XHE**3)))*BP             (35)
  209 CH=((CN(7))+(CN(8)*XHE)+(CN(9)*XHE*XHE)+(CN(10)*(XHE**3)))*BQ            (36)
      CI=((CN(11))+(CN(12)*XHE)+(CN(13)*XHE*XHE))*BT                           (37)
  211 DI=((DN(1))+(DN(2)*XHE)+(DN(3)*XHE*XHE)+(DN(4)*(XHE**3)))*BQ             (38)
  212 DJ=((DN(5))+(DN(6)*XHE)+(DN(7)*XHE*XHE))*BS                              (39)
  214 EK=((EN(1))+(EN(2)*XHE)+(EN(3)*XHE*XHE)+(EN(4)*(XHE**3)))*BS             (40)
  215 EM=((EN(5))+(EN(6)*XHE)+(EN(7)*XHE*XHE)+(EN(8)*(XHE**3)))*BT             (41)
C     TEMPERATURE DEPENDENT TERMS OF THE EQUATION OF STATE**************
      DO 551 I=1,22
      T=TEMP(I)
      B=A+BB/T+BC/(T**2)+BD*T+BE*T**2                                          (25)
      C=CF+CG/T+CH/(T**2)+CI/(T**6)                                            (26)
      D=DI+DJ/T                                                                (27)
      E=EK+EM/T                                                                (28)
C     THERMAL PRESSURE TERMS OF THE EQUATION OF STATE ******************
      TPB=A-BC/(T**2)+2.0*BD*T+3.0*BE*(T**2)                                   (43)
      TPC=CF-CH/(T**2)-5.0*CI/(T**6)                                           (44)
      TPD=DI                                                                   (45)
      TPE=EK                                                                   (46)
      ZCI=1.0
      V1=4.2605563*(T)**0.67362904                                             (8)
      V2=-8.9188690E-01+7.7622418E-01*(T)-7.2970066E-04*(T**2)+4.9473812
     1E-07*(T**3)-1.3971248E-10*(T**4)                                         (10)

      IF(XHE-XHE**2)500,1500,302
  302 RT=T/PP12
C     LENNARD-JONES (6-12) COLLISION INTEGRAL 1,1 FUNCTION**************
      CI11=+7.6070438E-01-1.0254183E-02*RT+2.7105188E-04*(RT**2)-4.67750
     142E-06*(RT**3)+4.6185077E-08*(RT**4)-2.3278934E-10*(RT**5)+4.51968
     219E-13*(RT**6)+5.9761505E-01*(1.0/RT)+1.9897294E-01*((1.0/RT)**2)-
     31.3561679E-01*((1.0/RT)**3)+2.9639310E-02*((1.0/RT)**4)-1.9903389E
     4-03*((1.0/RT)**5)-8.4408981E-05*((1.0/RT)**6)                            (15)
```

```
C      LENNARD-JONES (6-12) COLLISION INTEGRAL 2,2 FUNCTION**************          EQUATION NO.
       CI22=+8.6881587E-01-1.2672727E-02*RT+3.6256347E-04*(RT**2)-6.57680
      194E-06*(RT**3)+6.7033760E-08*(RT**4)-3.4490075E-10*(RT**5)+6.78461
      222E-13*(RT**6)+4.7185172E-01*(1.0/RT)+5.4259734E-01*((1.0/RT)**2)-
      33.7823299E-01*((1.0/RT)**3)+1.0882350E-01*((1.0/RT)**4)-1.5367909E
      4-02*((1.0/RT)**5)+8.8652554E-04*((1.0/RT)**6)                              (15)
       ASTAR=CI22/CI11
       V12=26.693*((2.0*WTHE*WTN2*T)/(WTHE+WTN2))**0.5/(CD12**2*CI22)             (14)
C      CHAPMAN-ENSKOG EQUATION ******************************************
       XN2=1.0-XHE
       XV=XHE**2/V1+2.0*XHE*XN2/V12+XN2**2/V2                                     (14)
       YV=(3.0/5.0)*ASTAR*((XHE**2*WTHE)/(V1*WTN2)+(2.0*XHE*XN2*V12*(WTHE
      1+WTN2)**2)/(4.0*WTHE*WTN2*V1*V2)+(XN2**2*WTN2)/(V2*WTHE))                  (14)
       ZV=(3.0/5.0)*ASTAR*((XHE**2*WTHE)/WTN2+2.0*XHE*XN2*((WTHE+WTN2)**2
      1/(4.0*WTHE*WTN2)*(V12/V1+V12/V2)-1.0)+(XN2**2*WTN2)/WTHE)                  (14)
       VM=(1.0+ZV)/(XV+YV)                                                        (14)
 1500  I2=0
       I1=I1+1
       DO 551 K=I1,1127,23
       I2=I2+1
       P=PP(I2)
C      NEWTON-RAPHSON LOOP--ITERATION USED TO COMPUTE DENSITIES *********
  220  X(1)=ZCI*(R*T)/P
  221  DO 227 M=1,20
  222  XT=(P*X(M)**5)/(R*T)-X(M)**4-B*X(M)**3-C*X(M)**2-D*X(M)-E
       XTB=(Y*P*X(M)**4)/(R*T)-G*X(M)**3-F*B*X(M)**2-H*C*X(M)-D
       X(M+1)=X(M)-XT/XTB
       ZCC=(X(M+1)*P)/(R*T)
       DELTA=ABSF(ZCC-ZCI)
       ZCI=ZCC
C      CRITERION FOR CONVERGENCE OF THE ITERATIVE PROCESS ***************
       IF (DELTA-BU) 87,87,227
  227  CONTINUE
       PRINT 4005
   87  DZCC=P/(ZCC*R*T)
C      TP=THERMAL PRESSURE COEFFICIENT***********************************
       TP=(R*DZCC)*(1.0+DZCC*TPB+(DZCC**2)*TPC+(DZCC**3)*TPD+(DZCC**4)*TP
      1E)                                                                         (42)
       IF (XHE-XHE**2) 500,401,402
  401  IF(XHE) 500,501,502
C      VISCOSITY OF HELIUM **********************************************
  502  V(K)=V1+ALPHA*TP**BETA                                                     (20)
       GO TO 551
C      VISCOSITY OF NITROGEN ********************************************
  501  V(K)=V2+ALPHA*TP**BETA                                                     (20)
       GO TO 551
C      VISCOSITY OF MIXTURES ********************************************
  402  V(K)=VM+ALPHA*TP**BETA                                                     (20)
  551  CONTINUE
       IF(I1-23)600,1600,1600
 1600  PRINT 905,V
  600  GO TO 700
  500  PRINT 5099
  900  FORMAT (1H1,29X,60HTABLE    . - VISCOSITY OF HELIUM-NITROGEN SYSTEM
      1, MICROPOISES)
  901  FORMAT (F7.0,2I3)
  902  FORMAT (1H0,44X,23HMOLE FRACTION OF HELIUM,F7.4)
  903  FORMAT (1H0,9H T, DEG K,22I5)
  904  FORMAT (1H0,119H  P, ATM   VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS
      1 VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS  VIS
      2VIS)
  905  FORMAT (/I7,3X,22I5/,5(/(10(I7,3X,22I5/))))
  906  FORMAT (F18.11)
 1001  FORMAT (16F5.0)
 4005  FORMAT (1H0,15HN-R LOOP FAILED)
 5001  FORMAT (F20.0)
 5099  FORMAT (1X,15HDATA SET ERROR )
       END
```

Input Data

The numeric quantities to be transmitted for BN, CN, DN, and EN are those given in table 1, n_1 - n_{42}. BP, BQ, BR, BU, BS, and BT have the numerical values 10^2, 10^4, 10^{-2}, 10^{-6}, 10^6, and 10^8, respectively, and these constants are coefficients in equations 29-41. Y, G, F, and H have the numerical values 5.0, 4.0, 3.0, and 2.0, respectively. See the Newton-Raphson DO loop for the use of these numbers. R, PP12, CD12, WTHE, and WTN2 are the gas constant, energy well parameter ϵ_{12}/k, collision diameter σ_{12}, molecular weight of helium, and the molecular weight of nitrogen. Numerical values used in the program are 82.0597 cm^3 atm/g mole °K, 36.18° K, 3.1198 A, 4.0026, and 28.0134, respectively, for the variables named in the READ list.

All other quantities are computed in the program. Equation numbers in the report associative with Fortran arithmetic statements have been typed on the right-hand side of the source program listing to aid the reader relevant to the coding. Program names and symbols used in the report for physical properties have the following equivalency: ZCC = Z, DZCC = ρ, and TP = $(\partial P/\partial T)_V$.

Some prudence must be applied in computing compressibility factors in the Newton-Raphson DO loop if extensive changes are made in the present program. It is obligatory that the iterative solution for compressibility factors on a given isotherm be started at a pressure where the compressibility factor for the real gas is not too far removed from 1.0, such as 1.0 atmosphere, and then moved through successive increments of pressure; otherwise, the Newton-Raphson method will converge slowly or not at all. If the Newton-Raphson method fails to converge, an error message is printed in the present program.

DISCUSSION

The small deviations between experimental and computed viscosities clearly show that the correlation equations presented have led to an acceptable interpolation method. The suitability of the model to predict viscosities in areas not covered by experimental data is not so self-evident. The chief difference between interpolation and extrapolation lies in the reliability of the result. The low-density viscosity values computed for helium-nitrogen mixtures below 183.15° K are outside the range of experimental data. Unfortunately, the calculation of any gas transport property must be based on an assumed analytical form for the intermolecular potential because the correct functional form of the potential energy of interaction has eluded science.

Potential functions have been derived and classified in terms of families. Hanley and Childs (24) postulate that members of different potential families can be interchanged without materially altering the fit of experimental data, one can only make a significant selection of a function and its parameters from experimental viscosity data outside the reduced temperature range of about $2 < T^* < 5$, and any function will fit data in this reduced temperature range. Thus, from Hanley and Childs' postulates it is evident that low-temperature viscosity data in the above region of reduced temperatures cannot contribute to the selection of a potential model or the evaluation of its force constants.

The Lennard-Jones (6:12) potential function chosen in this report to represent the low-density viscosity behavior of helium-nitrogen mixtures indicates that ϵ_{12}/k is about 36.18° K. This value for ϵ_{12}/k was obtained from experimental mixture data in the temperature region 183.15° to 952.55° K. Therefore, assuming the L-J (6:12) potential is satisfactory for representing the viscosity behavior of low-density helium-nitrogen mixtures, experimental viscosity data in the temperature region 72° to 181° K could not contribute to either the selection of this potential or the evaluation of its force constants.

Hanley and Childs (24) also provide, from their studies on the transport properties of argon, the corollary that only one member of a potential family can fit viscosity data outside the insensitive reduced temperature range, $2 < T^* < 5$, and the given function will automatically fit data within this range.

The most optimistic surmise would be that the L-J (6:12) potential is the correct potential for the helium-nitrogen system and that low-density viscosity values can be safely predicted from a sensitive reduced temperature range over the entire insensitive range. We do not take this viewpoint. A perfect fit of any potential model to experimental data is obviously unrealistic, and Hanley and Childs' corollary suffers from a lack of clarity due to effects of experimental uncertainties. The L-J (6:12) potential was chosen as only one of many possible potentials, and it is quite evident that a perfect fit of the experimental data was not obtained. Therefore, the model chosen may not necessarily be the unique potential model of Hanley and Childs' corollary, only one potential model to fit the data, and the uncertainty in extrapolated values can be expected to be higher than in regions covered by experimental data. However, the temperature range subject to extrapolation is not great and using a potential model rather than some other empirical method undoubtedly increases the probability as to the correctness of the results.

Very few investigators evaluate or estimate the error in their viscosity measurement; they usually report only the precision (reproducibility) of their measurements. Discrepancies in the reported viscosity data of various investigators indicate that uncertainties in viscosity values are from 2 to 5 times, and more, than that of the estimated precision of measurements. Also, the accuracy of the computed viscosities is not necessarily a function of source data with which comparisons were made. Uncertainty in experimental data may not be due solely to random error but may result from unknown systematic errors.

Considering the experimental data used as a basis for the correlation equations and the hazards of extrapolations, we estimate that uncertainties in the computed viscosities are ±5 percent for the region 325° to 740° K, ±2 percent for the region 183° to 325° K, and ±5 percent below 183° K. The latter uncertainty may rise to ±10 percent as critical conditions are approached.

An interesting phenomenon of the helium-nitrogen system is that the low-density viscosity at constant temperature of a particular mixture may be higher than that of either of the pure components. This is shown in figure 3. The viscosity of the compressed gas at a given temperature of a particular mixture may be higher than that of either pure component, as can be seen in figure 13. An explanation of this phenomenon for the helium-nitrogen system has not been found.

The transport properties of helium-nitrogen mixtures are of great importance in the design of heat exchangers for helium purification processes. Data at low temperatures and high pressures are lacking. We hope that workers in this area of research will soon provide more experimental data.

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