



Viscosity of liquids: Glycol ethers

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Dr A.P. Laughton	— Advantica Technologies Ltd, Loughborough, UK
Prof. K.N. Marsh†	— University of Canterbury, New Zealand
Mrs K.M. de Reuck	— Imperial College London, London, UK
Dr C. Tsonopoulos†	— Independent.

* Emeritus Member.

† Corresponding Member.

The technical work involved in the assessment of the available information and the construction and subsequent development of the Data Item was undertaken (under contract to ESDU) by

Dr J.H. Dymond — Independent

The person with overall responsibility for the work in this subject area is Mr S.J. Pugh, Head of Thermofluids Group.

VISCOSITY OF LIQUIDS: GLYCOL ETHERS

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Data sheets for each of the liquids are given in the following order:

Formula	Name	Alternative Name(s)	
MONOALKYL GLYCOL ETHERS			
1. $\text{CH}_3\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monomethyl ether	2-Methoxyethanol 3-Oxabutan-1-ol Methyl glycol Methyl cellosolve	7
2. $\text{CH}_3\text{CH}_2\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monoethyl ether	2-Ethoxyethanol 3-Oxapentan-1-ol Ethyl glycol Ethyl cellosolve Cellosolve	9
3. $\text{CH}_3[\text{CH}_2]_2\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monopropyl ether	2-Propoxyethanol 3-Oxahexan-1-ol Propyl glycol Propyl cellosolve	11
4. $(\text{CH}_3)_2\text{CHO}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monoisopropyl ether	2-Isopropoxyethanol 2-(1-Methylethoxy)ethanol 4-Methyl-3-oxapentan-1-ol Isopropyl glycol Isopropyl cellosolve	12

Formula	Name	Alternative Name(s)	
5. $\text{CH}_3[\text{CH}_2]_3\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monobutyl ether	2-Butoxyethanol 3-Oxaheptan-1-ol Butyl glycol Butyl cellosolve	13
6. $(\text{CH}_3)_2\text{CHCH}_2\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monoisobutyl ether	2-Isobutoxyethanol 2-(2-Methylpropoxy)ethanol 5-Methyl-3-oxahexan-1-ol Isobutyl glycol Isobutyl cellosolve	15
7. $\text{CH}_3[\text{CH}_2]_4\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monopentyl ether	2-Pentoxyethanol 3-Oxaoctan-1-ol Pentyl glycol Pentyl cellosolve	16
8. $\text{CH}_3[\text{CH}_2]_5\text{O}[\text{CH}_2]_2\text{OH}$	Ethylene glycol monohexyl ether	2-Hexoxyethanol 3-Oxanonan-1-ol Hexyl glycol Hexyl cellosolve	17
9. $\text{CH}_3(\text{O}[\text{CH}_2]_2)_2\text{OH}$	Diethylene glycol monomethyl ether	2-(2-Methoxyethoxy)ethanol 3,6-Dioxaheptan-1-ol Methyl diglycol Methyl digol Methyl carbitol	18
10. $\text{CH}_3\text{CH}_2(\text{O}[\text{CH}_2]_2)_2\text{OH}$	Diethylene glycol monoethyl ether	2-(2-Ethoxyethoxy)ethanol 3,6-Dioxaoctan-1-ol Ethyl diglycol Ethyl digol Ethyl carbitol Carbitol	19
11. $\text{CH}_3[\text{CH}_2]_2(\text{O}[\text{CH}_2]_2)_2\text{OH}$	Diethylene glycol monopropyl ether	2-(2-Propoxyethoxy)ethanol 3,6-Dioxanonan-1-ol Propyl diglycol Propyl digol Propyl carbitol	20
12. $\text{CH}_3[\text{CH}_2]_3(\text{O}[\text{CH}_2]_2)_2\text{OH}$	Diethylene glycol monobutyl ether	2-(2-Butoxyethoxy)ethanol 3,6-Dioxadecan-1-ol Butyl diglycol Butyl digol Butyl carbitol	21
13. $\text{CH}_3[\text{CH}_2]_5(\text{O}[\text{CH}_2]_2)_2\text{OH}$	Diethylene glycol monohexyl ether	2-(2-Hexoxyethoxy)ethanol 3,6-Dioxadodecan-1-ol Hexyl diglycol Hexyl digol Hexyl carbitol	22

Formula	Name	Alternative Name(s)	
14. $\text{CH}_3(\text{O}[\text{CH}_2]_2)_3\text{OH}$	Triethylene glycol monomethyl ether	2-(2-(2-Methoxyethoxy)ethoxy)ethanol 3,6,9-Trioxadecan-1-ol Methyl trigol Methyl triglycol	23
15. $\text{CH}_3\text{OCH}_2\text{CH}(\text{CH}_3)\text{OCH}_2\text{CH}(\text{CH}_3)\text{OH}$	Dipropylene glycol monomethyl ether	1-(2-Methoxyisopropoxy)propan-2-ol 1-(1-Methyl-2-methoxyethoxy)propan-2-ol 5-Methyl-4,7-dioxaoctan-2-ol	24
16. $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}(\text{CH}_3)\text{OCH}_2\text{CH}(\text{CH}_3)\text{OH}$	Dipropylene glycol monoethyl ether	1-(2-Ethoxyisopropoxy)propan-2-ol 1-(1-Methyl-2-ethoxyethoxy)propan-2-ol 5-Methyl-4,7-dioxanonan-2-ol	25
17. $\text{CH}_3[\text{CH}_2]_2\text{OCH}_2\text{CH}(\text{CH}_3)\text{OCH}_2\text{CH}(\text{CH}_3)\text{OH}$	Dipropylene glycol monopropyl ether	1-(2-Propoxyisopropoxy)propan-2-ol 1-(1-Methyl-2-propoxyethoxy)propan-2-ol 5-Methyl-4,7-dioxadecan-2-ol	26
18. $\text{CH}_3[\text{CH}_2]_3\text{OCH}_2\text{CH}(\text{CH}_3)\text{OCH}_2\text{CH}(\text{CH}_3)\text{OH}$	Dipropylene glycol monobutyl ether	1-(2-Butoxyisopropoxy)propan-2-ol 1-(1-Methyl-2-butoxyethoxy)propan-2-ol 5-Methyl-4,7-dioxaundecan-2-ol	27
DIALKYL GLYCOL ETHERS			
19. $\text{CH}_3\text{O}[\text{CH}_2]_2\text{OCH}_3$	Ethylene glycol dimethyl ether	1,2-Dimethoxyethane 2,5-Dioxahexane Dimethyl glycol Dimethyl cellosolve Monoglyme	28
20. $\text{CH}_3\text{CH}_2\text{O}[\text{CH}_2]_2\text{OCH}_2\text{CH}_3$	Ethylene glycol diethyl ether	1,2-Diethoxyethane 3,6-Dioxaoctane Diethyl glycol Diethyl cellosolve Ethyl glyme	30
21. $\text{CH}_3[\text{CH}_2]_2\text{O}[\text{CH}_2]_2\text{O}[\text{CH}_2]_2\text{CH}_3$	Ethylene glycol dipropyl ether	1,2-Dipropoxyethane 4,7-Dioxadecane Dipropyl glycol Dipropyl cellosolve Propyl glyme	31
22. $\text{CH}_3[\text{CH}_2]_3\text{O}[\text{CH}_2]_2\text{O}[\text{CH}_2]_3\text{CH}_3$	Ethylene glycol dibutyl ether	1,2-Dibutoxyethane 5,8-Dioxadodecane Dibutyl glycol Dibutyl cellosolve Butyl glyme	32
23. $\text{CH}_3(\text{O}[\text{CH}_2]_2)_2\text{OCH}_3$	Diethylene glycol dimethyl ether	Bis(2-methoxyethyl) ether 2,5,8-Trioxanonane Dimethyl diglycol Dimethyl digol Dimethyl carbitol Diglyme	33

Formula	Name	Alternative Name(s)	
24. $\text{CH}_3\text{CH}_2(\text{O}[\text{CH}_2]_2)_2\text{OCH}_2\text{CH}_3$	Diethylene glycol diethyl ether	Bis(2-ethoxyethyl) ether 3,6,9-Trioxaundecane Diethyl diglycol Diethyl digol Diethyl carbitol Ethyl diglyme	35
25. $\text{CH}_3[\text{CH}_2]_2(\text{O}[\text{CH}_2]_2)_2\text{O}[\text{CH}_2]_2\text{CH}_3$	Diethylene glycol dipropyl ether	Bis(2-propoxyethyl) ether 4,7,10-Trioxatridecane Dipropyl diglycol Dipropyl digol Dipropyl carbitol Propyl diglyme	36
26. $\text{CH}_3[\text{CH}_2]_3(\text{O}[\text{CH}_2]_2)_2\text{O}[\text{CH}_2]_3\text{CH}_3$	Diethylene glycol dibutyl ether	Bis(2-butoxyethyl) ether 5,8,11-Trioxapentadecane Dibutyl diglycol Dibutyl digol Dibutyl carbitol Butyl diglyme	37
27. $\text{CH}_3(\text{O}[\text{CH}_2]_2)_3\text{OCH}_3$	Triethylene glycol dimethyl ether	1,2-Bis(2-methoxyethoxy)ethane 2,5,8,11-Tetraoxadodecane Dimethyl triglycol Dimethyl trigol Triglyme	39
28. $\text{CH}_3[\text{CH}_2]_3(\text{O}[\text{CH}_2]_2)_3\text{O}[\text{CH}_2]_3\text{CH}_3$	Triethylene glycol dibutyl ether	1,2-Bis(2-butoxyethoxy)ethane 5,8,11,14-Tetraoxaoctadecane Dibutyl triglycol Dibutyl trigol Butyl triglyme	41
29. $\text{CH}_3(\text{O}[\text{CH}_2]_2)_4\text{OCH}_3$	Tetraethylene glycol dimethyl ether	Bis(2-(2-methoxyethoxy)ethyl) ether 2,5,8,11,14-Pentaoxapentadecane Dimethyl tetraglycol Dimethyl tetragol Tetraglyme	42
30. $\text{CH}_3(\text{O}[\text{CH}_2]_2)_5\text{OCH}_3$	Pentaethylene glycol dimethyl ether	1,2-Bis(2-(2-methoxyethoxy)ethoxy)ethane 2,5,8,11,14,17-Hexaoxaoctadecane Dimethyl pentaglycol Dimethyl pentagol Pentaglyme	44
31. $\text{CH}_3\text{OCH}_2\text{CH}(\text{CH}_3)\text{OCH}_2\text{CH}(\text{CH}_3)\text{OCH}_3$	Dipropylene glycol dimethyl ether	1-Methyl-2-methoxyethyl 2-methoxypropyl ether 3,6-Dimethyl-2,5,8-trioxanonane Proglyme	45
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VISCOSITY OF LIQUIDS: GLYCOL ETHERS

1. INTRODUCTION

This Item presents values for the viscosity at saturation pressure, in tabular form, for liquid glycol ethers. The range covered is from just above the melting temperature to about 0.9 times the critical temperature.

The values given are based on data which are believed to be the most reliable available and have been reviewed and suitably extended. In common with other Items, quantities are expressed in SI units and conversion factors to other units are provided in Section 3.

Section 4 gives the procedure used to obtain the values of viscosity presented and indicates the effect of pressure. Section 5 gives an explanation of the Tables and indicates the uncertainties in the values presented.

Appendix A provides a complete bibliography of data sources for this Item. Data sources for individual compounds are listed on the appropriate Data Sheet.

2. NOTATION AND UNITS

The SI unit of dynamic viscosity is the newton second per square metre (N s/m^2). The values presented in the tables are given in millinewton second per square metre (mN s/m^2), a submultiple which is convenient for the magnitudes considered and which is equal to the c.g.s. centipoise (cP).

A, B	dimensionless constants for each liquid in Equation (4.1)	-
C	constant for each liquid in Equation (4.2)	K
D	constant for each liquid in Equation (4.1)	mN s/m^2
p	pressure	N/m^2 (Pa)
T	kelvin temperature	K
t	Celsius temperature, $T - 273.15$	$^{\circ}\text{C}$
α	constant in Equation (4.3)	m^2/N
η	dynamic viscosity	mN s/m^2 (cP)
θ	dimensionless temperature dependent variable in Equation (4.2)	-

Subscripts

c	denotes value at the critical point
p	denotes value at pressure p
r	denotes reduced quantity, <i>e.g.</i> $T_r = T/T_c$.

3. CONVERSION FACTORS

$$\begin{aligned}
 1 \text{ mN s/m}^2 &= 1 \text{ centipoise} \\
 &= 145.04 \times 10^{-9} \text{ lbf s/in}^2 \\
 &= 101.97 \times 10^{-6} \text{ kgf s/m}^2 \\
 &= 10^{-3} \text{ kg/m s}
 \end{aligned}$$

$$\begin{aligned}
 10^5 \text{ Pa} &= 1 \text{ bar} \\
 &= 14.5038 \text{ lbf/in}^2 \\
 &= 1.0197 \text{ kgf/cm}^2 \\
 &= 0.9869 \text{ atm} \\
 &= 750.062 \text{ mmHg.}
 \end{aligned}$$

4. LIQUID VISCOSITY

4.1 Viscosity at Saturation Pressure

The two equations most commonly used to describe variations of viscosity with temperature at saturation pressure are:

$$\ln \eta = A' + \frac{B'}{T},$$

$$\text{and} \quad \ln \eta = A'' + \frac{B''}{T - C''}.$$

Both of these can provide adequate representations of viscosity over limited ranges of temperature but are unsatisfactory over the full range. The first form often produces large deviations near the melting temperature or at higher viscosities, and neither is realistic for near-critical temperatures. Several equations are available which use molar volume as an independent variable but these are limited by the need for accurate volumetric data or an equation of state.

The following equation (Reference 1), which has been used for the present work has been found to give a good representation of the data from the melting temperature to $T_r = 0.9$:

$$\ln \frac{\eta}{D} = A(\theta - 1)^{1/3} + B(\theta - 1)^{4/3}, \quad (4.1)$$

$$\text{where} \quad \theta = \frac{T_c - C}{T - C}. \quad (4.2)$$

Relatively few reliable data are available at reduced temperatures greater than 0.9; however, the equation form is consistent with observed trends in that region and produces reasonable estimates close to the critical temperature.

The critical temperatures for these substances have been taken from ESDU 95004, 95008 (References 2 and 3) and Reference 4. Where values are not available, they have been estimated from values for similar compounds. These are indicated by a ‡ in Table 7.1.

Constants B , C and D were all treated initially as adjustable parameters and determined, for a series of fixed values of A , by least-square percentage deviation fits of Equation (4.1) to the data sets which were considered to have the lowest uncertainties. The constant D is in effect a pseudo-critical viscosity, which is produced by the equation at the critical point. Owing to the uncertainties in the experimental data, and the deviations between different data sets for certain compounds, it was found that different sets of constants gave equally acceptable data fits in some cases. Overall, it was found that satisfactory fits could be obtained with A taken as constant and equal to 2.0 and that, for the monoalkyl glycol ethers, C could be taken as equal to one sixth of the critical temperature. For the dialkyl glycol ethers, C equal to one fifth of the critical temperature gave a better data fit. Values for the constants B and D were chosen so as to give a good correlation with corresponding values for other members of each chemical series, whilst maintaining an acceptable fit to the data for the compound under study. In this way, a set of viscosity values was produced, which varied consistently throughout the series. Furthermore, viscosity values can be calculated with confidence for those compounds for which no experimental data were found, with values for B and D obtained by interpolation from graphs giving their variation with total carbon plus oxygen number. Such compounds are indicated by an asterisk in Table 7.1, where the critical temperatures, and the optimum values for A , B , C and D derived from the data fits are listed.

4.2 Effect of Pressure

No accurate general expression is available for estimating the effect of pressure on the viscosity of these liquids. However, the simple expression given for n -alkanes in ESDU 79027 (Reference 1) applies to these liquids under similar conditions and is reproduced here as an approximate guide.

The viscosity of liquids with high viscosity at saturation pressure increases more rapidly with pressure than that of liquids with a low viscosity at saturation pressure. In most cases, the viscosity increases by about 1 per cent for a pressure increase of 1 MPa (10 bar). Below the normal boiling point, the difference between values measured at atmospheric pressure and those at saturation is therefore very small.

For liquids from the melting temperature to about $0.75T_c$, the following relationship may be used as an approximate guide:

$$\ln \frac{\eta_p}{\eta} = \alpha p, \quad (4.3)$$

where η_p is the viscosity at pressure p , η is the viscosity at saturation pressure, and α is a pressure-viscosity coefficient. The average value for α is $1 \times 10^{-8} \text{ m}^2/\text{N}$ for pressures up to 50 MPa. For liquids in general, the higher the viscosity at saturation pressure, the higher the value of α .

5. EXPLANATION OF TABLES

The values of A , B , C and D to be used in Equations (4.1) and (4.2) are given in Table 7.1 together with the critical temperature and the range of applicability.

Values of the viscosity of individual compounds are given on separate sheets at 10 kelvin intervals with temperatures in K and °C. Extrapolated values are indicated in parenthesis. The sources of data used to derive the correlation are listed.

Experimental data from the most reliable individual sources have an estimated uncertainty of $\pm 2\%$. However, such data are few in number and are generally restricted to temperatures close to ambient. Such data were available for ten of the compounds in this Item for temperature bands that include ambient.

For many of these compounds, data from different sources differ widely, especially for low viscosities. Whilst it is considered that the procedure adopted here reduces the errors in the values presented to a minimum, it is recommended that the user allows for uncertainties of $\pm 2\%$, $\pm 5\%$, $\pm 10\%$ or $\pm 20\%$ as

indicated in the Tables. Although values have been tabulated for all liquids up to $T_r = 0.9$, this class of compounds has poor thermal stability, with decomposition likely to occur at temperatures above 200 °C, where uncertainties in viscosity may exceed the values quoted.

There is some confusion surrounding the correct structures and nomenclature for the propylene glycol alkyl and dialkyl ethers. It is believed that the structures given in this Item and on the glycol ethers physical properties page of the *Dow Chemical Website, <http://www.dow.com//> are those most commonly accepted. Also it is probable that the viscosity data for these compounds, from sources referred to in this Item are for samples containing mixtures of isomers with the predominant isomer being that given here. Whilst it is unlikely that the uncertainties in viscosity below 200 °C for the dipropylene glycol alkyl and dialkyl ethers listed in this Item exceed those quoted, the user is advised to use the tables for these substances with some caution.

6. REFERENCES

The references given are recommended sources of information supplementary to that in this Item.

1. ESDU Viscosity of liquids: Aliphatic hydrocarbons Part 1. Alkanes. Data Item 79027, ESDU International plc, London, UK, 1979.
2. ESDU Vapour pressures and critical points of liquids: Glycol ethers (alkyl cellosolves, carbitols, tri- and tetra-glyme). Data Item 95004, ESDU International plc, London, UK, 1995.
3. ESDU Thermal conductivity of liquids: Glycol ethers. Data Item 95008, ESDU International plc, London, UK, 1995.
4. ESTEVE, X.
CONESA, A.
CORONAS, A. Liquid densities, kinematic viscosities, and heat capacities of some alkylene glycol dialkyl ethers. *J. Chem. Eng. Data*, Vol. 48, No. 2, pp. 392-397, 2003.

* We are indebted to Dr Sumnesh Gupta for drawing our attention to the data on the Dow Chemical website.

7. TABLES

TABLE 7.1 Constants for Equations (4.1) and (4.2)

Compound	$^{\dagger}T_c$ K	A	B	C K	D mN s/m ²	Range of Applicability °C
1. Ethylene glycol monomethyl ether	573.	2.0	0.795	95.5	0.0510	-50 to 240
2. Ethylene glycol monoethyl ether	584.	2.0	0.847	97.3	0.0485	-40 to 250
3. Ethylene glycol monopropyl ether	600.	2.0	0.980	100.0	0.0420	-30 to 260
4. Ethylene glycol monoisopropyl ether	587.	2.0	1.050	97.8	0.0397	-30 to 260
5. Ethylene glycol monobutyl ether	626.	2.0	1.020	104.3	0.0330	-20 to 290
6. * Ethylene glycol monoisobutyl ether	606.	2.0	1.050	101.0	0.0330	-20 to 270
7. * Ethylene glycol monopentyl ether	645.	2.0	1.030	107.5	0.0290	-10 to 310
8. Ethylene glycol monohexyl ether	670.	2.0	1.035	111.7	0.0270	-10 to 330
9. Diethylene glycol monomethyl ether	662.	2.0	0.700	110.3	0.0530	-20 to 310
10. Diethylene glycol monoethyl ether	668.	2.0	0.700	111.3	0.0500	-20 to 330
11. * Diethylene glycol monopropyl ether	675.	2.0	0.780	112.5	0.0435	-20 to 330
12. Diethylene glycol monobutyl ether	689.	2.0	0.830	114.8	0.0380	-10 to 340
13. Diethylene glycol monohexyl ether	732.	2.0	0.830	122.0	0.0270	10 to 380
14. Triethylene glycol monomethyl ether	$^{\ddagger}732.$	2.0	0.680	122.0	0.0450	10 to 380
15. Dipropylene glycol monomethyl ether	$^{\ddagger}700.$	2.0	0.750	116.7	0.0312	0 to 350
16. * Dipropylene glycol monoethyl ether	$^{\ddagger}708.$	2.0	0.725	118.0	0.0298	0 to 360
17. Dipropylene glycol monopropyl ether	$^{\ddagger}720.$	2.0	0.715	120.0	0.0290	10 to 370
18. Dipropylene glycol monobutyl ether	$^{\ddagger}732.$	2.0	0.710	122.0	0.0285	10 to 380
19. Ethylene glycol dimethyl ether	535.	2.0	0.260	107.0	0.0346	-60 to 210
20. Ethylene glycol diethyl ether	563.	2.0	0.339	112.6	0.0362	-60 to 230
21. * Ethylene glycol dipropyl ether	598.	2.0	0.365	119.6	0.0383	-50 to 260
22. * Ethylene glycol dibutyl ether	642.	2.0	0.372	128.4	0.0410	-50 to 300
23. Diethylene glycol dimethyl ether	610.	2.0	0.335	122.0	0.0432	-60 to 270
24. Diethylene glycol diethyl ether	635.	2.0	0.360	127.0	0.0417	-40 to 290
25. * Diethylene glycol dipropyl ether	656.	2.0	0.372	131.2	0.0440	-30 to 310
26. Diethylene glycol dibutyl ether	685.	2.0	0.360	137.0	0.0470	-20 to 330
27. Triethylene glycol dimethyl ether	$^a666.$	2.0	0.369	133.2	0.0487	-10 to 320
28. Triethylene glycol dibutyl ether	$^{\ddagger}720.$	2.0	0.354	144.0	0.0533	-10 to 370
29. Tetraethylene glycol dimethyl ether	$^a713.$	2.0	0.366	142.6	0.0540	-10 to 360
30. Pentaethylene glycol dimethyl ether	$^{\ddagger}751.$	2.0	0.353	150.2	0.0599	0 to 400
31. Dipropylene glycol dimethyl ether	$^b611.8$	2.0	0.341	122.4	0.0423	-30 to 270

* Indicates compounds for which no experimental data were found.

† Critical temperatures were taken from ESDU 95008, (a) ESDU 95004, (b) Esteve, Conesa and Coronas (Reference 4) or (‡) estimated from values for other members in the series.

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CH₃O[CH₂]₂OH ETHYLENE GLYCOL MONOMETHYL ETHER
(2-METHOXYETHANOL, 3-OXABUTAN-1-OL, METHYL GLYCOL, METHYL CELLOSOLVE)

$$\ln(\eta/D) = A(\theta - 1)^{1/3} + B(\theta - 1)^{4/3}$$

where $\theta = (T_c - C)/(T - C)$

η = viscosity at saturation pressure (mN s/m²)

$$T_c = 573. \text{ K}$$

$$A = 2.0, \quad B = 0.795, \quad C = 95.5, \quad D = 0.0510$$

<i>T</i>	η	Uncert. in η	<i>T</i>	η	Uncert. in η	<i>t</i>	η	Uncert. in η	<i>t</i>	η	Uncert. in η
K	mN s/m ²	%	K	mN s/m ²	%	°C	mN s/m ²	%	°C	mN s/m ²	%
220	(21.0)	20	370	(0.530)	10	-50	(17.7)	20	100	(0.511)	10
230	(12.5)	20	380	(0.475)	10	-40	(10.8)	20	110	(0.459)	10
240	(8.05)	10	390	(0.428)	10	-30	(7.10)	10	120	(0.415)	10
250	(5.51)	5	400	(0.389)	10	-20	(4.94)	5	130	(0.377)	10
260	3.96	5	410	(0.354)	10	-10	3.60	5	140	(0.344)	10
270	2.97	5	420	(0.324)	10	0	2.73	5	150	(0.315)	10
280	2.29	5	430	(0.297)	10	10	2.13	5	160	(0.289)	10
290	1.82	5	440	(0.274)	10	20	1.71	5	170	(0.267)	10
300	1.48	5	450	(0.252)	10	30	1.40	5	180	(0.246)	10
310	1.23	5	460	(0.233)	10	40	1.16	5	190	(0.228)	10
320	1.04	5	470	(0.216)	10	50	0.987	5	200	(0.211)	10
330	0.888	5	480	(0.200)	10	60	0.848	5	210	(0.195)	10
340	0.769	5	490	(0.185)	10	70	0.737	5	220	(0.181)	10
350	0.673	5	500	(0.171)	10	80	0.647	5	230	(0.167)	10
360	(0.595)	10	510	(0.158)	10	90	(0.573)	10	240	(0.154)	10

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CH₃CH₂O[CH₂]₂OH ETHYLENE GLYCOL MONOETHYL ETHER (2-ETHOXYETHANOL, 3-OXAPENTAN-1-OL, ETHYL GLYCOL, ETHYL CELLOSOLVE, CELLOSOLVE)

$$\ln(\eta/D) = A(\theta - 1)^{1/3} + B(\theta - 1)^{4/3}$$

where $\theta = (T_c - C)/(T - C)$

η = viscosity at saturation pressure (mN s/m²)

$$T_c = 584. \text{ K}$$

$$A = 2.0, \quad B = 0.847, \quad C = 97.3, \quad D = 0.0485$$

<i>T</i>	η	Uncert. in η	<i>T</i>	η	Uncert. in η	<i>t</i>	η	Uncert. in η	<i>t</i>	η	Uncert. in η
K	mN s/m ²	%	K	mN s/m ²	%	°C	mN s/m ²	%	°C	mN s/m ²	%
230	(17.8)	20	380	(0.505)	5	-40	(15.2)	20	110	(0.487)	5
240	(10.9)	10	390	(0.453)	5	-30	(9.53)	10	120	(0.438)	5
250	(7.21)	10	400	(0.408)	10	-20	(6.39)	10	130	(0.396)	10
260	(5.01)	10	410	(0.370)	10	-10	(4.52)	10	140	(0.359)	10
270	(3.65)	5	420	(0.337)	10	0	(3.33)	5	150	(0.328)	10
280	(2.76)	5	430	(0.309)	10	10	(2.54)	5	160	(0.300)	10
290	2.15	5	440	(0.283)	10	20	2.00	5	170	(0.276)	10
300	1.72	2	450	(0.261)	10	30	1.61	2	180	(0.254)	10
310	1.40	2	460	(0.240)	10	40	1.32	2	190	(0.235)	10
320	1.17	2	470	(0.222)	10	50	1.10	2	200	(0.217)	10
330	0.985	2	480	(0.206)	10	60	0.937	2	210	(0.201)	10
340	0.844	2	490	(0.190)	10	70	0.806	2	220	(0.186)	10
350	0.732	5	500	(0.176)	10	80	0.701	5	230	(0.172)	10
360	0.641	5	510	(0.163)	10	90	0.616	5	240	(0.159)	10
370	(0.566)	5	520	(0.151)	10	100	(0.546)	5	250	(0.147)	10

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SASTRY, N.V.

CH₃[CH₂]₂O[CH₂]₂OH ETHYLENE GLYCOL MONOPROPYL ETHER
(2-PROPOXYETHANOL, 3-OXAHEXAN-1-OL, PROPYL GLYCOL, PROPYL CELLOSOLVE)

$$\ln(\eta/D) = A(\theta - 1)^{1/3} + B(\theta - 1)^{4/3}$$

where $\theta = (T_c - C)/(T - C)$

η = viscosity at saturation pressure (mN s/m²)

$$T_c = 600. \text{ K}$$

$$A = 2.0, \quad B = 0.980, \quad C = 100.0, \quad D = 0.0420$$

<i>T</i>	η	Uncert. in η	<i>T</i>	η	Uncert. in η	<i>t</i>	η	Uncert. in η	<i>t</i>	η	Uncert. in η
K	mN s/m ²	%	K	mN s/m ²	%	°C	mN s/m ²	%	°C	mN s/m ²	%
240	(20.5)	20	390	(0.479)	10	-30	(17.4)	20	120	(0.461)	10
250	(12.4)	10	400	(0.426)	10	-20	(10.7)	10	130	(0.412)	10
260	(7.99)	10	410	(0.383)	10	-10	(7.05)	10	140	(0.370)	10
270	(5.46)	5	420	(0.345)	10	0	(4.89)	5	150	(0.334)	10
280	(3.91)	5	430	(0.313)	10	10	(3.55)	5	160	(0.304)	10
290	(2.91)	5	440	(0.285)	10	20	(2.67)	5	170	(0.277)	10
300	2.23	5	450	(0.260)	10	30	2.06	5	180	(0.253)	10
310	1.76	5	460	(0.239)	10	40	1.64	5	190	(0.233)	10
320	(1.42)	5	470	(0.220)	10	50	(1.33)	5	200	(0.214)	10
330	(1.17)	5	480	(0.202)	10	60	(1.10)	5	210	(0.197)	10
340	(0.975)	5	490	(0.187)	10	70	(0.924)	5	220	(0.182)	10
350	(0.827)	10	500	(0.173)	10	80	(0.787)	10	230	(0.169)	10
360	(0.710)	10	510	(0.160)	10	90	(0.679)	10	240	(0.156)	10
370	(0.617)	10	520	(0.148)	10	100	(0.591)	10	250	(0.144)	10
380	(0.541)	10	530	(0.137)	10	110	(0.520)	10	260	(0.133)	10

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BHARDWAJ, R.K.

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(CH₃)₂CHO[CH₂]₂OH ETHYLENE GLYCOL MONOISOPROPYL ETHER
(2-ISOPROPOXYETHANOL, 2-(1-METHYLETHOXY)ETHANOL,
4-METHYL-3-OXAPENTAN-1-OL, ISOPROPYL GLYCOL, ISOPROPYL CELLOSOLVE)

$$\ln(\eta/D) = A(\theta - 1)^{1/3} + B(\theta - 1)^{4/3}$$

$$\text{where } \theta = (T_c - C)/(T - C)$$

η = viscosity at saturation pressure (mN s/m²)

$$T_c = 587. \text{ K}$$

$$A = 2.0, \quad B = 1.050, \quad C = 97.8, \quad D = 0.0397$$

<i>T</i> K	η mN s/m ²	Uncert. in η %	<i>T</i> K	η mN s/m ²	Uncert. in η %	<i>t</i> °C	η mN s/m ²	Uncert. in η %	<i>t</i> °C	η mN s/m ²	Uncert. in η %
240	(18.5)	20	390	(0.427)	10	-30	(15.6)	20	120	(0.411)	10
250	(11.1)	20	400	(0.380)	10	-20	(9.64)	20	130	(0.367)	10
260	(7.20)	10	410	(0.340)	10	-10	(6.35)	10	140	(0.329)	10
270	(4.92)	5	420	(0.306)	10	0	(4.41)	5	150	(0.297)	10
280	(3.52)	5	430	(0.277)	10	10	(3.19)	5	160	(0.269)	10
290	(2.62)	5	440	(0.252)	10	20	(2.40)	5	170	(0.245)	10
300	2.01	5	450	(0.230)	10	30	1.86	5	180	(0.224)	10
310	1.58	5	460	(0.211)	10	40	1.47	5	190	(0.205)	10
320	(1.27)	5	470	(0.194)	10	50	(1.19)	5	200	(0.189)	10
330	(1.05)	5	480	(0.178)	10	60	(0.986)	5	210	(0.173)	10
340	(0.873)	5	490	(0.164)	10	70	(0.828)	5	220	(0.160)	10
350	(0.740)	10	500	(0.151)	10	80	(0.704)	10	230	(0.147)	10
360	(0.635)	10	510	(0.139)	10	90	(0.607)	10	240	(0.136)	10
370	(0.551)	10	520	(0.128)	10	100	(0.528)	10	250	(0.125)	10
380	(0.483)	10	530	(0.118)	10	110	(0.464)	10	260	(0.115)	10

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BHARDWAJ, R.K.

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