

Thermal conductivity of liquids: Heterocyclic nitrogen compounds

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THERMAL CONDUCTIVITY OF LIQUIDS: HETEROCYCLIC NITROGEN COMPOUNDS

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

Formula	Name	Alternative Name(s)	
PYRIDINES			
1. C ₅ H ₅ N	Pyridine	Azabenzene	7
2. 2-CH ₃ C ₅ H ₄ N	2-Methylpyridine	2-Picoline 2-Methylazabenzene	9
3. 3-CH ₃ C ₅ H ₄ N	3-Methylpyridine	3-Picoline 3-Methylazabenzene	10
4. 4-CH ₃ C ₅ H ₄ N	4-Methylpyridine	4-Picoline 4-Methylazabenzene	11
5. 2-(CH ₃ CH ₂)C ₅ H ₄ N	2-Ethylpyridine	2-Ethylazabenzene	12
6. 3-(CH ₃ CH ₂)C ₅ H ₄ N	3-Ethylpyridine	3-Ethylazabenzene	13
7. 4-(CH ₃ CH ₂)C ₅ H ₄ N	4-Ethylpyridine	4-Ethylazabenzene	14
8. 2,3-(CH ₃) ₂ C ₅ H ₃ N	2,3-Dimethylpyridine	2,3-Lutidine 2,3-Dimethylazabenzene	15
9. 2,4-(CH ₃) ₂ C ₅ H ₃ N	2,4-Dimethylpyridine	2,4-Lutidine 2,4-Dimethylazabenzene	16
10. 2,5-(CH ₃) ₂ C ₅ H ₃ N	2,5-Dimethylpyridine	2,5-Lutidine 2,5-Dimethylazabenzene	17
11. 2,6-(CH ₃) ₂ C ₅ H ₃ N	2,6-Dimethylpyridine	2,6-Lutidine 2,6-Dimethylazabenzene	18
12. 3,4-(CH ₃) ₂ C ₅ H ₃ N	3,4-Dimethylpyridine	3,4-Lutidine 3,4-Dimethylazabenzene	19
13. 3,5-(CH ₃) ₂ C ₅ H ₃ N	3,5-Dimethylpyridine	3,5-Lutidine 3,5-Dimethylazabenzene	20

Formula	Name	Alternative Name(s)	
14. $2,5-(\text{CH}_3)(\text{CH}_3\text{CH}_2)\text{C}_5\text{H}_3\text{N}$	2-Methyl-5-ethylpyridine	5-Ethyl-2-picoline	5-Ethyl-2-methylpyridine 5-Ethyl-2-methylazabenzene 21
15. $2,4,6-(\text{CH}_3)_3\text{C}_5\text{H}_2\text{N}$	2,4,6-Trimethylpyridine	2,4,6-Collidine	<i>sym</i> -Collidine 2,4,6-Trimethylazabenzene 22
16. $2,5-(\text{CH}_3)(\text{H}_2\text{C}=\text{CH})\text{C}_5\text{H}_3\text{N}$	2-Methyl-5-vinylpyridine	5-Vinyl-2-picoline	2-Methyl-5-vinylazabenzene 23

QUINOLINES and ISOQUINOLINES

17. $\text{C}_9\text{H}_7\text{N}$	Quinoline	1-Azanaphthalene	24
18. $\text{C}_9\text{H}_7\text{N}$	Isoquinoline	2-Azanaphthalene	26
19. $2-\text{CH}_3\text{C}_9\text{H}_6\text{N}$	2-Methylquinoline	Quinaldine	2-Methyl-1-azanaphthalene 27
20. $4-\text{CH}_3\text{C}_9\text{H}_6\text{N}$	4-Methylquinoline	Lepidine	4-Methyl-1-azanaphthalene 28
21. $6-\text{CH}_3\text{C}_9\text{H}_6\text{N}$	6-Methylquinoline		6-Methyl-1-azanaphthalene 29
22. $7-\text{CH}_3\text{C}_9\text{H}_6\text{N}$	7-Methylquinoline	<i>m</i> -Toluquinoline	7-Methyl-1-azanaphthalene 30
23. $8-\text{CH}_3\text{C}_9\text{H}_6\text{N}$	8-Methylquinoline		8-Methyl-1-azanaphthalene 31
24. $3-\text{CH}_3\text{C}_9\text{H}_6\text{N}$	3-Methylisoquinoline		3-Methyl-2-azanaphthalene 32
25. $2,4-(\text{CH}_3)_2\text{C}_9\text{H}_5\text{N}$	2,4-Dimethylquinoline	4-Methylquinaldine	2,4-Dimethyl-1-azanaphthalene 33
26. $2,6-(\text{CH}_3)_2\text{C}_9\text{H}_5\text{N}$	2,6-Dimethylquinoline	6-Methylquinaldine	2,6-Dimethyl-1-azanaphthalene 34

PYRROLES

27. $\text{C}_4\text{H}_4\text{NH}$	Pyrrole	Azole	Azacyclo-2,4-diene 35
28. $\text{C}_4\text{H}_4\text{NCH}_3$	1-Methylpyrrole	<i>N</i> -Methylpyrrole	1-Methylazole 1-Methylazacyclo-2,4-diene 36
29. $2,5-(\text{CH}_3)_2\text{C}_4\text{H}_2\text{NH}$	2,5-Dimethylpyrrole	2,5-Dimethylazole	2,5-Dimethylazacyclo-2,4-diene 37

PYRROLIDINES and PIPERIDINES

30. $\text{C}_4\text{H}_8\text{NH}$	Pyrrolidine	Tetrahydropyrrole	Tetramethyleneimine Azacyclopentane 38
31. $\text{C}_5\text{H}_{10}\text{NH}$	Piperidine	Hexahydropyridine	Pentamethyleneimine Azacyclohexane 39

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THERMAL CONDUCTIVITY OF LIQUIDS: HETEROCYCLIC NITROGEN COMPOUNDS

1. INTRODUCTION

This Item presents values of thermal conductivity at saturation pressure, in tabular form, for liquid heterocyclic nitrogen compounds.

The data on which these recommended values of thermal conductivity are based are the most reliable available and the temperature range covered is from the melting temperature to approximately 0.9 of the critical temperature. Quantities are expressed in SI units and conversion factors to other units are provided in Section 3.

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

References to sources of supplementary information are given in Section 6. Reference 6 is a useful summary and contains the older data sources used in the preparation of this Data Item. All the data sources consulted for each particular compound are listed on the appropriate data sheet.

2. NOTATION AND UNITS

The SI unit of thermal conductivity is the watt per metre kelvin (W/m K). A convenient submultiple SI unit for the range of thermal conductivity in this Item is the milliwatt per metre kelvin (mW/m K); hence that is the unit adopted here.

A	constant for each liquid in Equation (4.2)	mW/m K
A'	constant for each liquid in Equation (4.1)	mW/m K
B'	non-dimensional constant for each liquid in Equation (4.1)	–
B, C, D	non-dimensional constants for each liquid in Equation (4.2)	–
p	pressure	N/m ² (Pa)
T	kelvin temperature	K
t	Celsius temperature, $T - 273.15$	°C
λ	thermal conductivity	mW/m K

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

$$\begin{aligned}
 1 \text{ mW/m K} &= 0.8598 \times 10^{-3} \text{ kcal/m h } ^\circ\text{C}^* \\
 &= 2.3885 \times 10^{-6} \text{ cal/cm s } ^\circ\text{C}^* \\
 &= 0.5778 \times 10^{-3} \text{ Chu/ft h } ^\circ\text{C}^* \\
 &= 0.5778 \times 10^{-3} \text{ Btu/ft h } ^\circ\text{F}^* \\
 &= 6.9335 \times 10^{-3} \text{ Btu in/ft}^2 \text{ h } ^\circ\text{F}^*
 \end{aligned}$$

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

* The values used for the calorie and British Thermal Unit are International Table values.

4. THERMAL CONDUCTIVITY

4.1 Thermal Conductivity at Saturation Pressure

In Reference 2 Riedel showed that the experimental data for the thermal conductivity of normal (that is unassociated) liquids along the saturation line could be represented by the equation:

$$\lambda = A' [1 + (20/3)(1 - T_r)^{2/3}].$$

For the liquids considered in this Item a better representation of the data is obtained, over a wide temperature range, from the modified equation which was used in some earlier ESDU Items:

$$\lambda = A' [1 + B'(1 - T_r)^{2/3}]. \quad (4.1)$$

The range of applicability of Equation (4.1) is limited for most compounds; recent data from several sources show that there may be marked deviations in the regions of the triple point and the critical point from extrapolations of Equation (4.1) fitted in the intermediate region.

For the liquids considered in this Item a good representation of the data* between the melting temperature and $T_r = 0.9$ is obtained from the equation:

$$\lambda = A[1 + B(1 - T_r)^{1/3} + C(1 - T_r)^{2/3} + D(1 - T_r)]. \quad (4.2)$$

Measurements of thermal conductivity have been made for relatively few liquids at $T_r > 0.9$ and so, because of the uncertain variation of thermal conductivity in the critical region, data are presented only for temperatures up to $T_r \approx 0.9$. The equation extrapolates in a physically realistic manner to within a few kelvin of the critical point.

The critical temperatures for these compounds have been taken from ESDU 77019 (Reference 7). In this Item, the critical temperatures should be regarded as correlating parameters only and should not be taken as a source of accurate values.

* Experimental data at temperatures below the normal boiling temperature, t_b are often at 1 atm pressure. As indicated in Section 4.2 the difference between values of λ at 1 atm pressure and at saturation pressure below t_b is not significant.

The derived values of A , B , C and D given in Table 7.1 are a correlated set of values giving the best fit to the experimental data, not only as individual compounds but also as members of their chemical series. This method of correlating data for a series of compounds has been described in References 8 and 9. For the pyridines, quinolines and isoquinolines in this Item, it was found that C and D are directly related to B^* , as was observed for non-hydrogen-bonded compounds such as the alkanes. Correlated values of the constants A , B , C and D were used to estimate constants for liquids for which no experimental data exist. Using these values with the values of T_c given in Table 7.1, values of λ in mW/m K have been calculated for each compound from Equation (4.2) and are presented in the data sheets. For users who require values of λ in other units, Equation (4.2) may be used with the coefficient A converted to the appropriate unit (see Section 3) and with B , C and D as given in Table 7.1.

4.2 Effect of Pressure

At temperatures up to the normal boiling point, the effect of pressure from the saturation pressure to $50 \times 10^5 \text{ N/m}^2$ (up to 50 atm) is to increase the thermal conductivity by approximately 1 per cent and, for most practical purposes, values at saturation pressure may be taken as equal to those at atmospheric pressure.

Reference 1 gives measurements of thermal conductivity for a number of liquids up to $12\,000 \times 10^5 \text{ N/m}^2$ ($\approx 12\,000 \text{ atm}$) at 30°C and 75°C . A generalised correlation of these results is given in Reference 3, but a knowledge of the critical pressure of the substance is required for its use.

For pressures up to $500 \times 10^5 \text{ N/m}^2$ ($\approx 500 \text{ atm}$) between the melting temperature and the normal boiling point a very approximate relationship:

$$\lambda_p/\lambda \approx 1 + 0.2p \times 10^{-8}, \quad (4.3)$$

may be used where λ_p is the thermal conductivity at pressure p and λ is the thermal conductivity at a pressure of 10^5 N/m^2 ($\approx 1 \text{ atm}$), both at the same temperature.

5. EXPLANATION OF TABLES

The constants of Equation (4.2) are given in Table 7.1 and on the data sheets. Compounds for which no experimental data exist and for which A , B , C and D were estimated as described in Section 4.1 are indicated by an asterisk against their compound number in Table 7.1. Values of the thermal conductivity are given in the data sheets at 10 kelvin intervals in K and $^\circ\text{C}$ from either the melting temperature, or an appropriate starting temperature where the melting temperature is unknown, to a temperature corresponding with $T_r \approx 0.9$. Melting temperatures were taken either from ESDU 77019 (Reference 7), the literature or estimated.

The sources are given in the data sheets and extrapolated values are indicated in parentheses.

For uniformity and ease of interpolation the data are presented and can be read to more significant digits than is warranted by their estimated accuracy.

The experimental data from the most reliable individual sources have a repeatability of about ± 1 per cent although differences in technique used by different workers (and possibly also in the purity of samples) can increase the uncertainty in the absolute values to about ± 2 per cent. However, such reliable data are not available for all the compounds considered, nor over the whole temperature range covered. Although it is considered that the correlation procedures adopted keep the errors in the values presented to a minimum,

* $C = 1 - 3B$ and $D = 3B$.

the user should in general allow for an uncertainty of ± 5 per cent unless the value in the data sheet is truncated to a whole number. Where whole numbers are given the uncertainty increases to ± 10 per cent.

Some fluids have poor thermal stability coupled with a high critical temperature. Values have been tabulated for all fluids up to $T_r \approx 0.9$ but many of these fluids will decompose at elevated temperatures. As most compounds will decompose rapidly at temperatures above about 300 °C, uncertainties of greater than ± 10 per cent may occur for temperatures ≥ 573 K.

The structural formulae of all the compounds in this Item are given in Appendix A.

6. REFERENCES

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

1. BRIDGMAN, P.W. The thermal conductivity of liquids under pressure. *Proc. Am. Acad. Arts Sci.*, Vol. 59, No. 7, pp. 141-169, 1923.
2. RIEDEL, L. New measurements of the thermal conductivity of organic liquids. (In German). *Chem. Ing. Tech.*, Vol. 23, No. 13, pp. 321-324, 1951.
3. LENOIR, J.M. Effect of pressure on the thermal conductivity of liquids. *Petrol. Refiner*, Vol. 36, No. 8, pp. 162-164, 1957.
4. BSI *Recommendations for names for chemicals used in industry*. British Standards Institution, BS 2474, 1965 and 1983.
5. HMSO *Classification of chemicals in the Brussels nomenclature and in the United Kingdom Customs and Excise tariff*. HMSO, London, UK, 1973. (Superseded by: *A guide to the tariff classification of chemicals in the combined nomenclature*. HMSO, London, UK, 1991.)
6. JAMIESON, D.T.
IRVING, J.B.
TUDHOPE, J.S. *The thermal conductivity of liquids: a data survey to 1973*. HMSO, Edinburgh, UK, 1975.
7. ESDU Vapour pressures and critical points of liquids: Heterocyclic nitrogen compounds. Data Item 77019, ESDU International plc, London, UK, 1977.
8. JAMIESON, D.T. Thermal conductivity of liquids. *J. Chem. Eng. Data*, Vol. 24, No. 3, pp. 244-246, 1979.
9. JAMIESON, D.T.
CARTWRIGHT, G. Thermal conductivity of associated fluids. *J. Chem. Eng. Data*, Vol. 25, No. 3, pp. 199-201, 1980.

7. TABLES

TABLE 7.1 Constants for Equation (4.2)

	Compound	T_c	A	B	C	D	Range of Applicability °C	
		K	mW/m K					
1.	Pyridine	620.	62.1	2.2	-5.6	6.6	-42.2	to 290
2.	2-Methylpyridine	621.	60.6	1.8	-4.4	5.4	-67.2	to 290
3.*	3-Methylpyridine	645.	60.6	1.8	-4.4	5.4	-18.2	to 310
4.*	4-Methylpyridine	646.	60.6	1.8	-4.4	5.4	-6.2	to 310
5.	2-Ethylpyridine	634.	58.6	1.6	-3.8	4.8	-63.0	to 300
6.*	3-Ethylpyridine	661.	59.1	1.6	-3.8	4.8	-77.0	to 330
7.*	4-Ethylpyridine	663.	58.6	1.6	-3.8	4.8	-90.0	to 330
8.*	2,3-Dimethylpyridine	655.4	59.7	1.6	-3.8	4.8	-70	to 320
9.*	2,4-Dimethylpyridine	647.	59.7	1.6	-3.8	4.8	-60.2	to 310
10.*	2,5-Dimethylpyridine	644.2	59.7	1.6	-3.8	4.8	-16.2	to 310
11.*	2,6-Dimethylpyridine	623.8	59.7	1.6	-3.8	4.8	-6.2	to 290
12.	3,4-Dimethylpyridine	683.8	62.3	1.6	-3.8	4.8	-12.2	to 350
13.*	3,5-Dimethylpyridine	667.3	62.3	1.6	-3.8	4.8	-10.5	to 330
14.*	2-Methyl-5-ethylpyridine	662.	62.0	1.4	-3.2	4.2	-70.0	to 330
15.	2,4,6-Trimethylpyridine	645.	63.8	1.4	-3.2	4.2	-44.0	to 310
16.*	2-Methyl-5-vinylpyridine	675.	63.4	1.4	-3.2	4.2	-70	to 340
17.	Quinoline	782.	66.2	1.0	-2.0	3.0	-15.2	to 440
18.*	Isoquinoline	803.	63.5	1.0	-2.0	3.0	24.8	to 450
19.*	2-Methylquinoline	787.	63.5	1.0	-2.0	3.0	-2.0	to 440
20.*	4-Methylquinoline	797.	63.5	1.0	-2.0	3.0	9.0	to 450
21.*	6-Methylquinoline	797.	63.5	1.0	-2.0	3.0	33.0	to 450
22.*	7-Methylquinoline	793.	63.5	1.0	-2.0	3.0	39.0	to 450
23.*	8-Methylquinoline	791.	63.5	1.0	-2.0	3.0	20	to 440
24.*	3-Methylisoquinoline	808.	63.5	1.0	-2.0	3.0	64.0	to 460
25.*	2,4-Dimethylquinoline	807.	63.2	1.0	-2.0	3.0	15.0	to 460
26.*	2,6-Dimethylquinoline	804.	63.2	1.0	-2.0	3.0	57.0	to 460
27.	Pyrrole	639.8	106.0	3.5	-8.1	6.0	-23.2	to 310
28.*	1-Methylpyrrole	596.	98.0	3.5	-8.1	6.0	-57.0	to 270
29.*	2,5-Dimethylpyrrole	661.	93.6	3.5	-8.1	6.0	-70	to 330
30.	Pyrrolidine	568.6	67.5	3.5	-8.1	7.5	-58.2	to 240
31.	Piperidine	594.	39.2	3.5	-8.1	9.0	-9.2	to 270

* An asterisk against the compound number indicates that no experimental data were found and the constants A , B , C and D were estimated.

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C_5H_5N PYRIDINE* (AZABENZENE)

$$\lambda = A[1 + B(1 - T_r)^{1/3} + C(1 - T_r)^{2/3} + D(1 - T_r)]$$

where

λ = thermal conductivity at saturation pressure (mW/m K)

$T_r = T/T_c$, T = temperature (K)

$T_c = 620. \text{ K}$

$A = 62.1$, $B = 2.2$, $C = -5.6$, $D = 6.6$

T K	λ mW/m K	T K	λ mW/m K	t °C	λ mW/m K	t °C	λ mW/m K
230.95	(181.)	400	(130.)	-42.2	(181.)	130	(129.)
		410	(127.)	-40	(181.)	140	(126.)
240	(178.)	420	(124.)	-30	(177.)	150	(124.)
250	(175.)	430	(122.)	-20	174.2	160	(121.)
260	172.0	440	(119.)	-10	171.0	170	(118.)
270	168.8	450	(116.)	0	167.9	180	(116.)
280	165.7	460	(114.)	10	164.7	190	(113.)
290	162.6	470	(111.)	20	161.6	200	(111.)
300	159.5	480	(109.)	30	158.5	210	(108.)
310	156.4	490	(106.)	40	155.4	220	(106.)
320	153.3	500	(104.)	50	152.4	230	(103.)
330	150.3	510	(102.)	60	149.4	240	(101.)
340	147.3	520	(100.)	70	146.4	250	(99.)
350	(144.3)	530	(97.)	80	(143.4)	260	(97.)
360	(141.4)	540	(95.)	90	(140.5)	270	(95.)
370	(138.5)	550	(93.)	100	(137.6)	280	(93.)
380	(135.6)	560	(91.)	110	(134.7)	290	(91.)
390	(133.)			120	(132.)		

* The use of azine as a synonym for pyridine is forbidden in the IUPAC 1993 Guide for the nomenclature of organic compounds.

- RIEDEL, L. *Mitt. Kältetech. Inst., Karlsruhe*, No. 2, 1948.
- CHALLONER, A.R. *Proc. R. Soc. London, Ser. A*, Vol. 245, No. 1241, pp. 259-267, 1958.
- GUNDRY, H.A.
- POWELL, R.W.
- FILIPPOV, L.P. *Vestn. Mosk. Gos. Univ. Ser. 3, Fiz. Astron.*, Vol. 15, No. 3, pp. 61-68, 1960.
- POWELL, R.W. NPL Report No. BP17, National Physical Laboratory, Teddington, Middlesex, UK, 1963.
- TYE, R.P.
- RASTORGUEV, Yu.L. *Zh. Fiz. Khim.*, Vol. 41, No. 6, pp. 1352-1356, 1967.
- GANIEV, Yu.A.
- JAMIESON, D.T. Unpublished data, National Engineering Laboratory, East Kilbride, UK, 1983.

2-CH₃C₅H₄N 2-METHYLPYRIDINE (2-PICOLINE, 2-METHYLAZABENZENE)

$$\lambda = A[1 + B(1 - T_r)^{1/3} + C(1 - T_r)^{2/3} + D(1 - T_r)]$$

where

λ = thermal conductivity at saturation pressure (mW/m K)

$$T_r = T/T_c, \quad T = \text{temperature (K)}$$

$$T_c = 621. \text{ K}$$

$$A = 60.6, \quad B = 1.8, \quad C = -4.4, \quad D = 5.4$$

T K	λ mW/m K	T K	λ mW/m K	t °C	λ mW/m K	t °C	λ mW/m K
205.95	(171.)	390	(122.9)	-67.2	(171.)	120	(122.1)
210	(170.)	400	(120.5)	-60	(168.9)	130	(119.7)
220	(167.0)	410	(118.1)	-50	166.1	140	(117.3)
230	164.3	420	(115.7)	-40	163.4	150	(115.0)
240	161.5	430	(113.)	-30	160.7	160	(113.)
250	158.8	440	(111.)	-20	158.0	170	(110.)
260	156.1	450	(109.)	-10	155.3	180	(108.)
270	153.5	460	(107.)	0	152.6	190	(106.)
280	150.8	470	(104.)	10	150.0	200	(104.)
290	148.2	480	(102.)	20	147.3	210	(102.)
300	145.6	490	(100.)	30	144.7	220	(99.)
310	143.0	500	(98.)	40	142.1	230	(97.)
320	140.4	510	(96.)	50	139.6	240	(95.)
330	137.8	520	(94.)	60	137.0	250	(93.)
340	135.3	530	(92.)	70	134.5	260	(91.)
350	132.7	540	(90.)	80	131.9	270	(89.)
360	130.2	550	(88.)	90	129.5	280	(88.)
370	127.8	560	(86.)	100	127.0	290	(86.)
380	(125.3)			110	(124.5)		

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3-CH₃C₅H₄N 3-METHYLPYRIDINE (3-PICOLINE, 3-METHYLAZABENZENE)

$$\lambda = A[1 + B(1 - T_r)^{1/3} + C(1 - T_r)^{2/3} + D(1 - T_r)]$$

where

λ = thermal conductivity at saturation pressure (mW/m K)

$$T_r = T/T_c, \quad T = \text{temperature (K)}$$

$$T_c = 645. \text{ K}$$

$$A = 60.6, \quad B = 1.8, \quad C = -4.4, \quad D = 5.4$$

T K	λ mW/m K	T K	λ mW/m K	t °C	λ mW/m K	t °C	λ mW/m K
254.95	(160.)	420	(119.)	-18.2	(160.)	150	(119.)
260	(159.)	430	(117.)	-10	(157.9)	160	(116.)
270	(156.2)	440	(115.)	0	(155.3)	170	(114.)
280	(153.6)	450	(113.)	10	(152.8)	180	(112.)
290	(151.0)	460	(110.)	20	(150.2)	190	(110.)
300	(148.5)	470	(108.)	30	(147.7)	200	(108.)
310	(146.0)	480	(106.)	40	(145.2)	210	(105.)
320	(143.4)	490	(104.)	50	(142.7)	220	(103.)
330	(141.0)	500	(102.)	60	(140.2)	230	(101.)
340	(138.5)	510	(100.)	70	(137.7)	240	(99.)
350	(136.0)	520	(98.)	80	(135.3)	250	(97.)
360	(133.6)	530	(96.)	90	(132.8)	260	(95.)
370	(131.)	540	(94.)	100	(130.)	270	(93.)
380	(129.)	550	(92.)	110	(128.)	280	(91.)
390	(126.)	560	(90.)	120	(126.)	290	(90.)
400	(124.)	570	(88.)	130	(123.)	300	(88.)
410	(122.)	580	(87.)	140	(121.)	310	(86.)