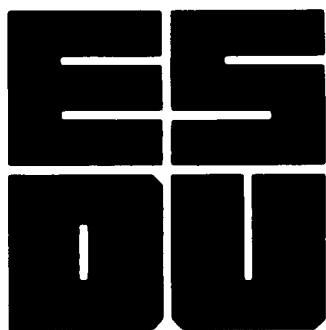


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With Amendment A
July 1984



Engineering Sciences Data
Item Number

81025

Approved for Issue
August 1981

SPONSORS
Institution of Chemical Engineers

Vapour pressures and critical points of liquids

XIX: Phenol and derivatives

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ENGINEERING SCIENCES DATA ITEM No. 81025

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The work on this Item was carried out in the Internal Flow and Physical Properties Group of the Engineering Sciences Data Unit under the supervision of Mr R.Partington, Group Head. The member of staff who undertook the construction and subsequent development of the Item was

Mr J.Walton — Senior Engineer.

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In order to assist the preparation of new work, and particularly to assist the periodic review and revision of work already issued, users are encouraged to make known their experience in using the information and procedures and to notify the Unit of any additional information which they can provide or to which reference can be made. Prepaid reply service cards are available for this purpose. Whenever an Item is revised, users who are Associates of ESDU (i.e. have a standing order for one or more Sub-series) automatically receive any material required to up-date Items in the Sub-series held. While it is always advisable to check by use of the current edition of the Engineering Sciences Data Index that Items held

(Continued on inside back cover)

* Corresponding Member

VAPOUR PRESSURES AND CRITICAL POINTS OF LIQUIDS XIX: PHENOL AND DERIVATIVES

1. INTRODUCTION

This Data Item presents saturated vapour pressures of the derivatives of phenol listed in Table I (pages 2 and 3).

The range and quality of the experimental data for each compound, on which the tabulated values are based is discussed in Section A.1 of Appendix A.

Table I shows, for each compound, alternative names, empirical and structural formulae, molecular weight, normal boiling point, dT/dp at the normal boiling point and acentric factor. The name in bold type is that based on BSI Recommendations.

Tables II to IX present values of vapour pressure, in kPa, at 5 K intervals of temperature down to a temperature either just above the melting point, or at which the pressure is approximately 0.001 kPa, whichever is the higher. For those compounds which are known or considered likely to be thermally stable up to the critical point, the Tables extend over the whole temperature range. However some of the compounds considered here are known, or thought, to decompose at temperatures well below their estimated critical value, so for these compounds the estimated values of critical temperature and pressure, T_c and p_c , used in the vapour pressure equation are given, but the vapour pressures in Tables II to IX terminate at a lower convenient arbitrary temperature.

The values of vapour pressure given in the Tables were obtained by evaluating, for each compound, a Wagner equation of the form

$$\log_e p = \log_e p_c + (T_c/T)[b_1 q + b_2 q^{3/2} + b_3 q^3 + b_4 q^6], \quad (1)$$

where

$$q = 1 - T/T_c.$$

This equation has been fitted to the experimental data that have been selected and weighted in accordance with a critical assessment of all the data. Table X gives T_c , $\log_e p_c$ and the coefficients b_1, b_2, b_3, b_4 for each compound that, when used in Equation (1), give p in kPa for T in kelvins.

The suggested uncertainties in the tabulated values of vapour pressure that the user should allow for are discussed and tabulated in Appendix A.

The location of the Table giving the vapour pressure values for each compound is shown on the foldout flap attached to the last page.

A full explanation of the correlation procedure used to derive the tabulated values of vapour pressure together with notation and units, a simple interpolation procedure, conversion factors and References is given in the introductory Data Item, Reference 1.

2. REFERENCES

1. ESDU Vapour pressures and critical points of liquids. Introduction to Data Items issued after July 1980. Item No.80016, Engineering Sciences Data Unit, London, 1980.

TABLE I (Part 1)
Phenol and Phenol Derivatives

No.	Name		Alternative Names	
	(Name based on BSI Recommendations in Bold Type)			
1	C ₆ H ₆ O	Phenol		
2	C ₇ H ₈ O	2-Methylphenol	<i>o</i> -Cresol	
3	C ₇ H ₈ O	3-Methylphenol	<i>m</i> -Cresol	
4	C ₇ H ₈ O	4-Methylphenol	<i>p</i> -Cresol	
5	C ₈ H ₁₀ O	2-Ethylphenol		
6	C ₈ H ₁₀ O	3-Ethylphenol		
7	C ₈ H ₁₀ O	4-Ethylphenol		
8	C ₈ H ₁₀ O	2,3-Dimethylphenol	2,3-Xylenol	
9	C ₈ H ₁₀ O	2,4-Dimethylphenol	2,4-Xylenol	
10	C ₈ H ₁₀ O	2,5-Dimethylphenol	2,5-Xylenol	
11	C ₈ H ₁₀ O	2,6-Dimethylphenol	2,6-Xylenol	
12	C ₈ H ₁₀ O	3,4-Dimethylphenol	3,4-Xylenol	
13	C ₈ H ₁₀ O	3,5-Dimethylphenol	3,5-Xylenol	
14	C ₉ H ₁₂ O	2-Propylphenol		
15	C ₉ H ₁₂ O	4-Propylphenol		
16	C ₉ H ₁₂ O	2-isoPropylphenol	<i>o</i> -Cumenol	2-Isopropylphenol
17	C ₉ H ₁₂ O	4-isoPropylphenol	<i>p</i> -Cumenol	4-Isopropylphenol
18	C ₉ H ₁₂ O	5-Methyl-3-ethylphenol	5-Ethyl-<i>m</i>-cresol (—OH at 1)	5-Ethyl-3-methylphenol
19	C ₉ H ₁₂ O	2,3,4-Trimethylphenol	<i>unsym</i> -Hemimellitenol	
20	C ₉ H ₁₂ O	2,3,5-Trimethylphenol	<i>isopseudo</i> Cumenol	
21	C ₉ H ₁₂ O	2,4,5-Trimethylphenol	<i>pseudo</i> Cumenol	
22	C ₉ H ₁₂ O	2,4,6-Trimethylphenol	Mesitol	
23	C ₉ H ₁₂ O	3,4,5-Trimethylphenol	<i>sym</i> -Hemimellitenol	
24	C ₁₀ H ₁₄ O	2-secButylphenol		
25	C ₁₀ H ₁₄ O	4-secButylphenol		
26	C ₁₀ H ₁₄ O	4-isoButylphenol		4-Isobutylphenol
27	C ₁₀ H ₁₄ O	2-tertButylphenol		
28	C ₁₀ H ₁₄ O	4-tertButylphenol		
29	C ₁₀ H ₁₄ O	2-Methyl-5-isopropylphenol	Carvacrol	5-Isopropyl- <i>o</i> -cresol
30	C ₁₀ H ₁₄ O	5-Methyl-2-isopropylphenol	Thymol	6-Isopropyl- <i>m</i> -cresol
31	C ₁₀ H ₁₄ O	3,5-Diethylphenol		
32	C ₁₀ H ₁₄ O	2,3,5,6-Tetramethylphenol	Durenol	
33	C ₁₁ H ₁₆ O	4-tertButyl-2-methylphenol	4-tertButyl-<i>o</i>-cresol (—OH at 1)	
34	C ₁₁ H ₁₆ O	2-tertButyl-4-methylphenol	2-tertButyl-<i>p</i>-cresol (—OH at 1)	
35	C ₁₂ H ₁₈ O	4-tertButyl-2-ethylphenol		
36	C ₁₂ H ₁₈ O	2-tertButyl-4-ethylphenol		
37	C ₁₂ H ₁₈ O	4-tertButyl-2,3-dimethylphenol	4-tertButyl-2,3-xylenol	
38	C ₁₂ H ₁₈ O	6-tertButyl-2,4-dimethylphenol	6-tertButyl-2,4-xylenol	
39	C ₁₂ H ₁₈ O	4-tertButyl-2,5-dimethylphenol	4-tertButyl-2,5-xylenol	
40	C ₁₂ H ₁₈ O	4-tertButyl-2,6-dimethylphenol	4-tertButyl-2,6-xylenol	
41	C ₁₂ H ₁₈ O	6-tertButyl-3,4-dimethylphenol	6-tertButyl-3,4-xylenol	
42	C ₁₂ H ₁₈ O	2,4-Diisopropylphenol		2,4-Diisopropylphenol
43	C ₁₄ H ₂₂ O	4-(1,1,3,3-Tetramethylbutyl)phenol	4-<i>tt</i>-Octylphenol	
44	C ₁₄ H ₂₂ O	2,4-Di-tertbutylphenol		
45	C ₁₄ H ₂₂ O	2,6-Di-tertbutylphenol		
46	C ₁₅ H ₂₄ O	4,6-Di-tertbutyl-2-methylphenol	4,6-Di-tertbutyl-<i>o</i>-cresol (—OH at 1)	
47	C ₁₅ H ₂₄ O	4,6-Di-tertbutyl-3-methylphenol	4,6-Di-tertbutyl-<i>m</i>-cresol (—OH at 1)	
48	C ₁₅ H ₂₄ O	2,6-Di-tertbutyl-4-methylphenol	2,6-Di-tertbutyl-<i>p</i>-cresol (—OH at 1)	
49	C ₁₆ H ₂₆ O	4,6-Di-tertbutyl-2-ethylphenol		
50	C ₁₆ H ₂₆ O	4,6-Di-tertbutyl-3-ethylphenol		
51	C ₁₆ H ₂₆ O	2,6-Di-tertbutyl-4-ethylphenol		
52	C ₁₈ H ₃₀ O	2,4,6-Tri-tertbutylphenol		

TABLE I (Part 2)
General Information

No.	Name	M.W.	Structural Formula	Normal Boiling Point				Acentric Factor ω
				$p = 101.325 \text{ kPa}$		$p = 760 \text{ mmHg}$		
				T K	dT/dp K/kPa	t °C	dt/dp °C/mmHg	
1	Phenol	94.113	$\text{C}_6\text{H}_5\text{OH}$	455.03	0.3596	181.88	0.04794	0.443
2	2-Methylphenol	108.140	$2\text{-CH}_3\text{C}_6\text{H}_4\text{OH}$	464.19	0.3769	191.04	0.05024	0.436
3	3-Methylphenol	108.140	$3\text{-CH}_3\text{C}_6\text{H}_4\text{OH}$	475.43	0.3759	202.28	0.05012	0.451
4	4-Methylphenol	108.140	$4\text{-CH}_3\text{C}_6\text{H}_4\text{OH}$	475.14	0.3743	201.99	0.04991	0.509
5	2-Ethylphenol	122.166	$2\text{-C}_2\text{H}_5\text{C}_6\text{H}_4\text{OH}$	477.71	0.3900	204.56	0.05200	0.475
6	3-Ethylphenol	122.166	$3\text{-C}_2\text{H}_5\text{C}_6\text{H}_4\text{OH}$	491.62	0.3894	218.47	0.05192	0.489
7	4-Ethylphenol	122.166	$4\text{-C}_2\text{H}_5\text{C}_6\text{H}_4\text{OH}$	491.18	0.3890	218.03	0.05186	0.491
8	2,3-Dimethylphenol	122.166	$2,3\text{-(CH}_3)_2\text{C}_6\text{H}_3\text{OH}$	490.07	0.3983	216.92	0.05311	0.495
9	2,4-Dimethylphenol	122.166	$2,4\text{-(CH}_3)_2\text{C}_6\text{H}_3\text{OH}$	484.13	0.3907	210.98	0.05209	0.506
10	2,5-Dimethylphenol	122.166	$2,5\text{-(CH}_3)_2\text{C}_6\text{H}_3\text{OH}$	484.33	0.3925	211.18	0.05233	0.514
11	2,6-Dimethylphenol	122.166	$2,6\text{-(CH}_3)_2\text{C}_6\text{H}_3\text{OH}$	474.22	0.3977	201.07	0.05303	0.489
12	3,4-Dimethylphenol	122.166	$3,4\text{-(CH}_3)_2\text{C}_6\text{H}_3\text{OH}$	500.15	0.3946	227.00	0.05261	0.512
13	3,5-Dimethylphenol	122.166	$3,5\text{-(CH}_3)_2\text{C}_6\text{H}_3\text{OH}$	494.89	0.3895	221.74	0.05192	0.544
14	2-Propylphenol	136.193	$2\text{-}n\text{-C}_3\text{H}_7\text{C}_6\text{H}_4\text{OH}$	495.84	0.3734	222.69	0.04978	0.607
15	4-Propylphenol	136.193	$4\text{-}n\text{-C}_3\text{H}_7\text{C}_6\text{H}_4\text{OH}$	507.52	0.3884	234.37	0.05178	0.629
16	2-isoPropylphenol	136.193	$2\text{-}i\text{-C}_3\text{H}_7\text{C}_6\text{H}_4\text{OH}$	487.61	0.3725	214.46	0.04967	0.558
17	4-isoPropylphenol	136.193	$4\text{-}i\text{-C}_3\text{H}_7\text{C}_6\text{H}_4\text{OH}$	501.23	0.3782	228.08	0.05043	0.599
18	5-Methyl-3-ethylphenol	136.193	$5\text{-CH}_3\text{-3-C}_2\text{H}_5\text{C}_6\text{H}_3\text{OH}$	508.93	0.4003	235.78	0.05336	0.563
19	2,3,4-Trimethylphenol	136.193	$2,3,4\text{-(CH}_3)_3\text{C}_6\text{H}_2\text{OH}$	509.14	0.4103	235.99	0.05470	0.541
20	2,3,5-Trimethylphenol	136.193	$2,3,5\text{-(CH}_3)_3\text{C}_6\text{H}_2\text{OH}$	508.54	0.4099	235.99	0.05465	0.554
21	2,4,5-Trimethylphenol	136.193	$2,4,5\text{-(CH}_3)_3\text{C}_6\text{H}_2\text{OH}$	505.15	0.4062	232.00	0.05416	0.558
22	2,4,6-Trimethylphenol	136.193	$2,4,6\text{-(CH}_3)_3\text{C}_6\text{H}_2\text{OH}$	493.00	0.4053	219.85	0.05403	0.503
23	3,4,5-Trimethylphenol	136.193	$3,4,5\text{-(CH}_3)_3\text{C}_6\text{H}_2\text{OH}$	521.24	0.3999	248.09	0.05331	0.594
24	2-secButylphenol	150.220	$2\text{-}s\text{-C}_4\text{H}_9\text{C}_6\text{H}_4\text{OH}$	500.89	0.4123	227.74	0.05497	0.539
25	4-secButylphenol	150.220	$4\text{-}s\text{-C}_4\text{H}_9\text{C}_6\text{H}_4\text{OH}$	514.12	0.4106	240.97	0.05474	0.609
26	4-isoButylphenol	150.220	$4\text{-}i\text{-C}_4\text{H}_9\text{C}_6\text{H}_4\text{OH}$	510.13	0.4100	236.98	0.05466	0.603
27	2-tertButylphenol	150.220	$2\text{-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_4\text{OH}$	497.40	0.4209	224.25	0.05611	0.501
28	4-tertButylphenol	150.220	$4\text{-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_4\text{OH}$	513.04	0.4110	239.89	0.05479	0.534
29	2-Methyl-5-isopropylphenol	150.220	$2\text{-CH}_3\text{-5-}i\text{-C}_3\text{H}_7\text{C}_6\text{H}_3\text{OH}$	510.59	0.4161	237.44	0.05548	0.558
30	5-Methyl-2-isopropylphenol	150.220	$5\text{-CH}_3\text{-2-}i\text{-C}_3\text{H}_7\text{C}_6\text{H}_3\text{OH}$	506.43	0.4167	233.28	0.05557	0.546
31	3,5-Diethylphenol	150.220	$3,5\text{-(C}_2\text{H}_5)_2\text{C}_6\text{H}_3\text{OH}$	521.46	0.4265	248.31	0.05687	0.608
32	2,3,5,6-Tetramethylphenol	150.220	$2,3,5,6\text{-(CH}_3)_4\text{C}_6\text{HOH}$	521.61	0.4436	248.46	0.05914	0.507
33	4-tertButyl-2-methylphenol	164.247	$2\text{-CH}_3\text{-4-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_3\text{OH}$	523.87	0.4365	250.72	0.05820	0.593
34	2-tertButyl-4-methylphenol	164.247	$4\text{-CH}_3\text{-2-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_3\text{OH}$	515.56	0.4340	242.45	0.05786	0.567
35	4-tertButyl-2-ethylphenol	178.274	$2\text{-C}_2\text{H}_5\text{-4-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_3\text{OH}$	531.35	0.4410	258.20	0.05879	0.608
36	2-tertButyl-4-ethylphenol	178.274	$4\text{-C}_2\text{H}_5\text{-2-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_3\text{OH}$	527.03	0.4375	253.88	0.05833	0.604
37	4-tertButyl-2,3-dimethylphenol	178.274	$2,3\text{-(CH}_3)_2\text{-4-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_2\text{OH}$	529.30	0.4401	256.15	0.05868	0.603
38	6-tertButyl-2,4-dimethylphenol	178.274	$2,4\text{-(CH}_3)_2\text{-6-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_2\text{OH}$	520.83	0.4358	247.68	0.05810	0.584
39	4-tertButyl-2,5-dimethylphenol	178.274	$2,5\text{-(CH}_3)_2\text{-4-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_2\text{OH}$	545.73	0.4559	272.58	0.06078	0.637
40	4-tertButyl-2,6-dimethylphenol	178.274	$2,6\text{-(CH}_3)_2\text{-4-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_2\text{OH}$	524.97	0.4373	251.82	0.05830	0.596
41	6-tertButyl-3,4-dimethylphenol	178.274	$3,4\text{-(CH}_3)_2\text{-6-}t\text{-C}_4\text{H}_9\text{C}_6\text{H}_2\text{OH}$	533.43	0.4419	260.28	0.05892	0.614
42	2,4-Diisopropylphenol	178.274	$2,4\text{-(}i\text{-C}_3\text{H}_7)_2\text{C}_6\text{H}_3\text{OH}$	528.07	0.4413	254.92	0.05883	0.590
43	4-(1,1,3,3-Tetramethylbutyl)phenol	206.327	$4\text{-[(CH}_3)_3\text{CCH}_2\text{(CH}_3)_2\text{C]C}_6\text{H}_4\text{OH}$	563.60	0.4607	290.45	0.06142	0.616
44	2,4-Ditertbutylphenol	206.327	$2,4\text{-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_3\text{OH}$	540.48	0.4533	267.33	0.06044	0.624
45	2,6-Ditertbutylphenol	206.327	$2,6\text{-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_3\text{OH}$	526.11	0.4422	252.96	0.05895	0.606
46	4,6-Ditertbutyl-2-methylphenol	220.354	$2\text{-CH}_3\text{-4,6-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_2\text{OH}$	543.90	0.4570	270.75	0.06093	0.624
47	4,6-Ditertbutyl-3-methylphenol	220.354	$3\text{-CH}_3\text{-4,6-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_2\text{OH}$	563.38	0.4645	290.23	0.06193	0.694
48	2,6-Ditertbutyl-4-methylphenol	220.354	$4\text{-CH}_3\text{-2,6-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_2\text{OH}$	542.06	0.4581	268.91	0.06107	0.611
49	4,6-Ditertbutyl-2-ethylphenol	234.381	$2\text{-C}_2\text{H}_5\text{-4,6-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_2\text{OH}$	551.14	0.4589	277.99	0.06119	0.651
50	4,6-Ditertbutyl-3-ethylphenol	234.381	$3\text{-C}_2\text{H}_5\text{-4,6-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_2\text{OH}$	570.38	0.4641	297.23	0.06188	0.730
51	2,6-Ditertbutyl-4-ethylphenol	234.381	$4\text{-C}_2\text{H}_5\text{-2,6-(}t\text{-C}_4\text{H}_9)_2\text{C}_6\text{H}_2\text{OH}$	549.15	0.4598	276.00	0.06131	0.636
52	2,4,6-Tritertbutylphenol	262.434	$2,4,6\text{-(}t\text{-C}_4\text{H}_9)_3\text{C}_6\text{H}_2\text{OH}$	554.55	0.4625	281.40	0.06167	0.659

TABLE II

- 1

C₆H₆O

Phenol
- 2

C₇H₈O

2-Methylphenol

o-Cresol
- 3

C₇H₈O

3-Methylphenol

m-Cresol
- 4

C₇H₈O

4-Methylphenol

p-Cresol
- 5

C₈H₁₀O

2-Ethylphenol
- 6

C₈H₁₀O

3-Ethylphenol
- 7

C₈H₁₀O

4-Ethylphenol

No.	1	2	3	4	5	6	7	No.	1	2	3	4	5	6	7
T _c	694.25	697.55	705.75	704.55	703.0	718.8	716.4	No.	continued						
p _c	6130	5005	4560	5150	4300	4150	4050								
T K	p kPa							T K	p kPa						
720								395	13.955	10.884	6.910	6.835	6.930	3.820	3.850
715						3962.1	3980.4	390	11.407	8.898	5.574	5.500	5.612	3.037	3.059
710						3730.1	3744.4	385	9.261	7.226	4.464	4.393	4.513	2.395	2.411
705			4520.3			3512.1	3523.9	380	7.464	5.826	3.548	3.483	3.601	1.874	1.885
700			4266.4	4835.0	4133.3	3306.5	3316.4	375	5.971	4.663	2.798	2.739	2.851	1.453	1.461
695		4844.5	4026.7	4518.2	3874.2	3112.2	3120.7	370	4.740	3.703	2.189	2.136	2.238	1.117	1.122
690	5795.6	4549.3	3799.5	4225.3	3633.4	2928.3	2935.7	365	3.731	2.917	1.698	1.651	1.742	0.850	0.854
685	5432.5	4274.1	3583.7	3952.9	3408.1	2754.1	2760.7	360	2.912	2.278	1.305	1.265	1.344	0.641	0.643
680	5094.9	4016.1	3378.5	3698.7	3196.9	2589.0	2595.0	355	2.252	1.764	0.994	0.959	1.026	0.478	0.479
675	4779.4	3773.4	3183.3	3460.9	2998.3	2432.5	2438.0	350	1.726	1.352	0.749	0.720	0.776	0.353	0.354
670	4483.6	3544.7	2997.5	3238.0	2811.4	2284.0	2289.3	345	1.309	1.027	0.559	0.535	0.581	0.258	0.258
665	4205.7	3329.0	2820.7	3028.8	2635.2	2143.2	2148.2	340	0.983	0.772	0.413	0.394	0.430	0.186	0.186
660	3944.3	3125.2	2652.4	2832.4	2469.2	2009.6	2014.4	335	0.730	0.574	0.301	0.286	0.314	0.132	0.132
655	3698.0	2932.6	2492.3	2647.7	2312.5	1882.9	1887.6	330	0.535	0.421	0.217	0.205	0.227	0.093	0.093
650	3465.7	2750.5	2339.9	2473.9	2164.6	1762.7	1767.4	325	0.388	0.306	0.155	0.145	0.162	0.064	0.064
645	3246.7	2578.2	2194.9	2310.3	2024.9	1648.8	1653.4	320	0.278	0.219	0.109	0.102	0.114	0.044	0.044
640	3039.9	2415.3	2057.0	2156.3	1893.0	1540.8	1545.4	315	0.196	0.155	0.075	0.070	0.079	0.030	
635	2844.6	2261.0	1926.0	2011.3	1768.5	1438.5	1443.1	310		0.108	0.051	0.048	0.054	0.020	
630	2660.2	2115.1	1801.5	1874.7	1650.9	1341.6	1346.2	305		0.074	0.035		0.036	0.013	
625	2486.1	1977.1	1683.3	1746.0	1539.8	1249.9	1254.4	300			0.023		0.024	0.008	
620	2321.5	1846.5	1571.1	1624.7	1435.0	1163.1	1167.7	295			0.015		0.016	0.005	
615	2166.1	1723.0	1464.7	1510.6	1336.0	1081.1	1085.6	290			0.009		0.010	0.003	
610	2019.3	1606.2	1363.9	1403.1	1242.7	1003.6	1008.1	285			0.006		0.006	0.002	
605	1880.7	1495.8	1268.4	1301.9	1154.6	930.51	934.90	280					0.004	0.001	
600	1749.9	1391.6	1178.1	1206.6	1071.7	861.54	865.87	275					0.002	0.001	
595	1626.5	1293.1	1092.7	1117.1	993.49	796.56	800.80	270					0.001		
590	1510.1	1200.3	1012.1	1032.9	919.90	735.39	739.54								
585	1400.4	1112.7	936.09	953.83	850.67	677.87	681.91								
580	1297.0	1030.2	864.44	879.60	785.59	623.85	627.77								
575	1199.7	952.48	797.01	809.99	724.47	573.18	576.97								
570	1108.2	879.41	733.63	744.76	667.12	525.71	529.35								
565	1022.2	810.75	674.12	683.70	613.37	481.29	484.78								
560	941.46	746.29	618.34	626.60	563.03	439.80	443.13								
555	865.72	685.85	566.13	573.27	515.96	401.09	404.26								
550	794.75	629.25	517.33	523.52	471.99	365.04	368.05								
545	728.34	576.30	471.79	477.18	430.97	331.53	334.36								
540	666.27	526.84	429.36	434.07	392.76	300.43	303.09								
535	608.33	480.70	389.91	394.03	357.23	271.62	274.10								
530	554.34	437.73	353.29	356.90	324.23	244.99	247.29								
525	504.09	397.78	319.37	322.54	293.64	220.42	222.55								
520	457.41	360.68	288.00	290.79	265.34	197.80	199.76								
515	414.12	326.31	259.07	261.52	239.19	177.02	178.82								
510	374.05	294.53	232.43	234.59	215.09	157.99	159.63								
505	337.03	265.18	207.97	209.86	192.92	140.59	142.08								
500	302.90	238.15	185.56	187.22	172.57	124.73	126.07								
495	271.49	213.31	165.09	166.52	153.94	110.31	111.52								
490	242.67	190.54	146.42	147.67	136.92	97.239	98.317								
485	216.28	169.70	129.46	130.53	121.42	85.425	86.382								
480	192.18	150.69	114.09	115.00	107.32	74.781	75.625								
475	170.23	133.39	100.20	100.96	94.556	65.222	65.963								
470	150.28	117.69	87.686	88.324	83.021	56.667	57.313								
465	132.22	103.48	76.455	76.977	72.632	49.038	49.597								
460	115.92	90.673	66.407	66.826	63.306	42.259	42.740								
455	101.25	79.154	57.450	57.777	54.962	36.261	36.671								
450	88.089	68.833	49.495	49.742	47.524	30.973	31.321								
445	76.331	59.618	42.457	42.636	40.919	26.333	26.625								
440	65.862	51.421	36.256	36.376	35.076	22.278	22.522								
435	56.579	44.157	30.816	30.887	29.929	18.752	18.954								
430	48.380	37.747	26.065	26.095	25.414	15.700	15.865								
425	41.171	32.115	21.934	21.931	21.471	13.071	13.206								
420	34.860	27.187	18.360	18.332	18.045	10.821	10.929								
415	29.363	22.896	15.284	15.237	15.082	8.903	8.989								
410	24.597	19.179	12.650	12.589	12.533	7.280	7.347								
405	20.487	15.974	10.407	10.337	10.353	5.913	5.965								
400	16.962	13.226	8.508	8.434	8.498	4.770	4.810								