

for six alkyltellurium compounds. These averages exclude three single occurrences: one tertiary mercaptan, one double branched alkyl selenide and one double branched alkyl diselenide. In eleven of 108 compounds errors in calculated b.p.s exceed 5.0°, namely: C₂H₅SH, 5.3°; CH₃CH₂CH-(CH₃)SH, 5.6°; HS(CH₂)₁₀SH, 5.1°; (CH₃)₂S, 6.1°; (CH₃)₂S₂, 8.5°; (*n*-C₄H₉)₂S, 7.7°; CH₃SeH, 6.1°; (C₂H₅)₂Se₂, 5.9°; (CH₃)₂Se₂, 5.9°; CH₃TeH, 5.9°; *n*-C₄H₉TeH, 6.6°.

Slight association through hydrogen bonding is the probable cause of a higher b.p.n. for sulfur in mercaptans and dithiols than in sulfides and disulfides.

With one exception, in single branched selenols, the greater the branching of the alkyl group or groups, the less the value of b.p.n. for sulfur, selenium, or tellurium. Selenium shows a relative constancy of b.p.n.; upon omission of the two lone occurrences, the b.p.n. 9.84 \pm 0.33 fits the 14 alkylselenium compounds fairly well. In selenium there is less displacement of valence electrons than in tellurium, and also less association through hydrogen bonding than in sulfur. The tellurols, RTeH, have no association through hydrogen bonding, but have some slight displacement of valence electrons.

In the two comparable series of compounds RMH and RMR—in which M is sulfur, selenium or tellurium—the b.p.n. increases from sulfur to selenium to tellurium. Oxygen (2) varies too much for comparison.

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Specific Volumes of *n*-Alkanes

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A table of the specific volumes of eight pure *n*-alkanes from seven to forty carbons in chain length is presented. The values are listed at seven even temperatures from ambient to 300° C., and at eleven even pressures from ambient to 5000 bars. These values are believed to be accurate to within 0.2% for 97% of the specific volumes listed.

IN 1954-58, Simon and Cornish of Arthur D. Little, Inc., under contract to Union Carbide Corporation, made some very accurate measurements on eight pure *n*-alkanes over broad ranges of temperature and pressure. A sampling of these data was published in 1960 (1-3). The experimental method chosen by Simon and Cornish did not provide means for the direct calculation of the specific volumes from the measurements taken. Computer time was required in order to convert these measurements into specific volumes—thus, the delay in presenting these data for publication.

With the cooperation of S.S. Kurtz, Jr., of the Sun Oil Company, these calculations have now been completed and a table has been compiled (Table I) giving the specific volumes of eight pure *n*-alkanes from seven to forty carbons in chain length at seven even temperatures from ambient to 300° C., and at eleven even pressures from ambient to 5000 bars. Although the precision of the measurements is at least 0.02%, the overall accuracy for 97% of the specific volumes reported is believed to be of the order of 0.2%.

The method of measurement chosen by Simon and Cornish was selected because it provided a very accurate

direct measurement of the length of the column in the piezometer. With this method, however, the mass of the sample contained in the piezometer could be measured with only one-tenth of this accuracy. It is not necessary to know the weight of the sample in order to compute the specific volumes—hence the limitation of the experimental method chosen lies only in the amount of machine time required to make these calculations.

Essentially, it is not necessary to know the weight of the sample in the piezometer because the computations described below deal with compressions which are dimensionless ratios entirely independent of the quantity of sample involved. Compressions are the ratios of the measured volumes to the hypothetical volume of the sample at the same temperature but at zero pressure. These ratios would be the same for any sample weight.

It has been explained in a prior publication (2) that the Hudleston equation:

$$\ln \frac{P v^{2/3}}{(v^0)^{1/3} - (v)^{1/3}} = A + B[(v^0)^{1/3} - (v)^{1/3}] \quad (1)$$

may be used as a tool to extrapolate highly accurate

measurements of volume v made under high pressures P to the corresponding (hypothetical) volume v^0 at zero pressure. (If the measurements are not precise to at least 0.04%, however, the value of the zero-pressure volume obtained by means of this extrapolation is uncertain and the method fails.) Since the piezometer tube is of uniform cross section, the volume of the contained sample is proportional to the length of the column of sample, which is measured as the distance d between a steel float resting on the mercury column and a steel plug at the top of the piezometer. Therefore, the extrapolation to zero pressure may be made with the Hudleston equation using the d 's as the variable just as well as with the v 's. This is the principle of the first set of calculations. In carrying out the experimental procedure, it was simple to vary the pressure, but a considerable period of time was required to reach equilibrium after each change in temperature. Consequently, many "runs" were made consisting of a large number of pairs of measurements of pressure P and distance d at constant temperature T .

In prior publications (2-4), most of the results reported were based on calculations involving "duplicate points". That is, measurements of P and d on different samples of the compound, each taken at the same pressure and temperature. Since not very many of the measurements were taken at identical pressures and temperatures, the duplicate points represented only about 10% of the total number of measurements taken. In the prior publications, the results of duplicate point measurements were averaged, but in the present study no averaging or smoothing was introduced at this stage. Instead, each one of the 101 runs was analyzed as if it were a separate experiment, and d^0 , the zero-pressure distance, was computed in each case. This was done by finding the best line through the points for each of a number of assigned values of d^0 , then selecting the value of d^0 that gave the least Standard Percentage Error (SPE) in d . Once d^0 was known, the compressions (d/d^0) were computed for each value of d for each run. Conversion of compressions to specific volumes is straightforward at temperatures well below the normal boiling point, because the specific volume of a liquid at a given temperature at atmospheric pressure is substantially the zero-pressure volume of one gram of the substance at that temperature. This is so because liquids are so incompressible that an increase of pressure of from zero to one bar, at temperatures well below the normal boiling point, will not affect the specific volume by more than two units in the fourth decimal place. Thus $\beta = -[(1/v)/(\partial v/\partial P)_T]$ has the following values for n -heptane (4) at $P = 0$.

IBM listings giving the experimental values of d and P at each temperature of measurement for the 68 valid experimental runs have been deposited with the American Documentation Institute.

$T, ^\circ\text{C.}$	β
0	0.00011
30	0.00015
50	0.00018

Whence a change of one bar for n -heptane at zero pressure (specific volume approximately unity) could not exceed 0.0002 up to 50° C. For higher molecular weight n -alkanes, the error is less. At temperatures well below the normal boiling point of each compound, therefore, the specific volumes were taken to be $1/\rho$, in which the density ρ was obtained from API 44 tables (5).

Volumes under pressure are merely the product of the zero-pressure volumes and the compressions. The zero-pressure volumes are in the same ratio as the zero-pressure distances. Hence, at temperatures above the normal boiling points, the zero pressure volumes could be calculated from the known values at lower temperatures, provided only that the same sample weight was involved in all cases.

In some instances, different sample weights were used at the high and the low temperatures, and in these cases the equivalent zero-pressure distances were obtained from simulated sample weights calculated from other considerations.

In this manner, specific volumes were calculated corresponding to the d 's for about two-thirds of the total number of runs made. These were put through the Hudleston equation routine to establish the degree of conformance to the smooth curve through all of the points for each run (SPE), and likewise in order to generate values of v at even temperatures and pressures for use in subsequent calculations.

At this point, plots of $\ln v$ vs. P were made for each of the 68 valid experimental runs that survived the first screening.

From these graphs, the one run for each compound at each temperature that appeared to be most consistent with data at other temperatures was chosen. Thus, to this point in the research there had been no averaging or smoothing of the original measurements. Instead, the view was adopted that any of the 68 runs was just as likely to be accurate as any other. At this point, however, judgment was applied, based on the consistency of the $\ln v$ vs. P plots, to decide which run to accept as "most accurate" at each level of temperature. The grand average SPE for the 46 "best" runs for the eight compounds at even temperatures between ambient and 300° C. was 0.0234%. This established the fact that the experimental measurements must be precise to at least this figure.

MOLECULAR WEIGHT CORRELATION

The next step was to correlate these "observed" specific volumes with molecular weight using the equation:

$$\ln v = f(1/m) \quad (2)$$

A linear equation in $1/m$ was generally satisfactory, although a second or third degree expansion was preferable for pressures below 200 bars, with n -heptane and n -nonane. There were a few points in the low pressure region where the agreement was not excellent, but for 97% of the cases, the average SPE of this correlation was 0.17%.

Although the values that have been correlated with molecular weight are undoubtedly more accurate than the corresponding experimental values, the fact that there is this slight disparity between the "observed" and the "molecular-weight correlated" values indicates that the absolute certainty of the tabulated values could be in doubt by as much as 0.2% over 97% of the range of the variables.

TEMPERATURE CORRELATION

The values of the specific volumes that were obtained from the molecular-weight correlation were chosen to represent the "true" values and are used in all subsequent calculations. These values were then correlated with temperature, using the following equation:

$$\ln [1 + \ln (1 + \ln v)] = f(T) \quad (3)$$

A third degree expansion in T gave a satisfactory fit in all cases except for n -heptane and n -nonane in the 0-100 bar region, and n -undecane through n -heptadecane at zero pressure. The average SPE over the rest of the range (90% of the points) is 0.04%.

PRESSURE CORRELATION

A number of pressure correlation equations was tried, but none was found that would represent the variation

satisfactorily with a power series in P . Therefore, the pressure correlation was made with the Hudleston equation. Rejecting only one run (n -heptane at 300° C.) the pressure correlation gave an SPE of 0.10%.

at seven levels of temperature from ambient to 300° C., and eleven levels of pressure from ambient to 5000 bars, that is believed to be accurate over 97% of the range to approximately 0.2%.

The values listed are the experimental values (precise to 0.02%) correlated against molecular weight. These molecular-weight correlated values were themselves correlated against temperature with agreement to 0.04% for 90% of the points, and against pressure with agreement to 0.10% over substantially the entire range.

RESULTS

Table I presents a set of specific volumes for eight pure n -alkanes from seven to forty carbons in chain length

Table I. Table of Specific Volumes
Correlated by Calculation from $\ln v$ vs. $1/m$ Lines
Temperature in ° C., pressure in bars, volumes in ml./gram

P	v	$\ln v$	v	$\ln v$	v	$\ln v$	v	$\ln v$
<i>n</i> -Heptane								
		30°		50°		100°		150°
0	1.4808	0.39258	1.5191	0.41812	1.6325	0.49011	1.7897	0.58205
50	1.4699	0.38520	1.5055	0.40913	1.6091	0.47570	1.7427	0.55543
100	1.4600	0.37844	1.4937	0.40123	1.5881	0.46251	1.7072	0.53486
200	1.4423	0.36620	1.4728	0.38715	1.5561	0.44216	1.6511	0.50147
300	1.4266	0.35532	1.4548	0.37483	1.5300	0.42524	1.6134	0.47836
500	1.4001	0.33651	1.4246	0.35389	1.4887	0.39788	1.5574	0.44300
1000	1.3502	0.30027	1.3695	0.31440	1.4184	0.34950	1.4687	0.38434
1500	1.3137	0.27285	1.3299	0.28507	1.3707	0.31530	1.4111	0.34439
2000	1.2848	0.25060	1.2988	0.26147	1.3345	0.28855	1.3682	0.31352
3000	1.2403	0.21537	1.2525	0.22514	1.2809	0.24755	1.3084	0.26877
5000	1.1793	0.16488	1.1887	0.17287	1.2110	0.19148	1.2305	0.20739
		200°		250°		300°		
0	2.0753	0.73011	3.3368	1.20501	20.7551	3.03279		
50	1.9361	0.66067	2.2226	0.79866	2.5866	0.95033		
100	1.8618	0.62156	2.0654	0.72532	2.3166	0.84010		
200	1.7707	0.57139	1.9110	0.64763	2.0788	0.73177		
300	1.7110	0.53707	1.8215	0.59968	1.9339	0.65955		
500	1.6302	0.48867	1.7109	0.53704	1.7930	0.58387		
1000	1.5182	0.41749	1.5713	0.45189	1.6257	0.48596		
1500	1.4499	0.37148	1.4903	0.39899	1.5333	0.42740		
2000	1.4011	0.33728	1.4332	0.35989	1.4713	0.38617		
3000	1.3329	0.28737	1.3569	0.30523	1.3854	0.32598		
5000	1.2472	0.22088	1.2641	0.23439	1.2794	0.24635		
<i>n</i> -Nonane								
		30°		50°		100°		150°
0	1.4086	0.34260	1.4401	0.36471	1.5300	0.42527	1.6411	0.49537
50	1.4002	0.33659	1.4304	0.35796	1.5137	0.41455	1.6124	0.47769
100	1.3921	0.33083	1.4210	0.35132	1.5003	0.40569	1.5889	0.46303
200	1.3776	0.32031	1.4041	0.33936	1.4752	0.38877	1.5545	0.44114
300	1.3646	0.31087	1.3892	0.32875	1.4542	0.37446	1.5246	0.42170
500	1.3423	0.29435	1.3641	0.31050	1.4203	0.35088	1.4790	0.39133
1000	1.2995	0.26201	1.3171	0.27546	1.3609	0.30811	1.4044	0.33960
1500	1.2677	0.23719	1.2828	0.24902	1.3195	0.27756		
2000	1.2422	0.21687	1.2556	0.22759	1.2877	0.25285		
3000	1.2025	0.18443	1.2141	0.19401	1.2399	0.21506		
5000	1.1475	0.31758	1.1558	0.14477	1.1759	0.16206		
		200°		250°		300°		
0	1.7989	0.58718	2.1166	0.74981	3.9977	1.38572		
50	1.7425	0.55533	1.9259	0.65538	2.1931	0.78531		
100	1.6945	0.52738	1.8434	0.61160	2.0321	0.70908		
200	1.6418	0.49577	1.7464	0.55754	1.8778	0.63012		
300	1.5998	0.46987	1.6844	0.52142	1.7871	0.58059		
500	1.5415	0.43278	1.6085	0.47530	1.6785	0.51791		
1000	1.4485	0.37050	1.4928	0.40064	1.5405	0.43212		
1500	1.3896	0.32903	1.4235	0.35313	1.4616	0.37950		
2000	1.3474	0.29815	1.3753	0.31864	1.4098	0.34342		
3000	1.2860	0.25153	1.3077	0.26826	1.3341	0.28824		
5000	1.2087	0.18954	1.2238	0.20193	1.2393	0.21454		
<i>n</i> -Undecane								
		30°		50°		100°		150°
0	1.3646	0.31086	1.3928	0.33132	1.4706	0.38567	1.5634	0.44686
50	1.3572	0.30543	1.3843	0.32516	1.4576	0.37678	1.5418	0.43296
100	1.3503	0.30031	1.3762	0.31933	1.4467	0.36926	1.5236	0.42104
200	1.3376	0.29090	1.3617	0.30872	1.4255	0.35455	1.4955	0.40247
300	1.3263	0.28237	1.3488	0.29921	1.4076	0.34190	1.4702	0.38537
500	1.3065	0.26733	1.3267	0.28268	1.3782	0.32074	1.4308	0.35821
1000	1.2681	0.23748	1.2847	0.25049	1.3252	0.28158	1.3647	0.31091
1500	1.2390	0.21433	1.2535	0.22591	1.2877	0.25288	1.3197	0.27739
2000	1.2156	0.19524	1.2286	0.20584	1.2586	0.22996	1.2869	0.25224
3000	1.1789	0.16459	1.1901	0.17406	1.2144	0.19423	1.2348	0.21086
5000	1.1276	0.12007	1.1351	0.12676	1.1540	0.14320	1.1689	0.15602

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Table I. Table of Specific Volumes (Continued)

Correlated by Calculation from $\ln v$ vs. $1/m$ Lines
Temperature in ° C., pressure in bars, volumes in ml./gram

P	v	$\ln v$	v	$\ln v$	v	$\ln v$	v	$\ln v$
<i>n</i>-Undecane								
		200°		250°		300°		
0	1.6762	0.51653	1.8565	0.61869	2.4796	0.90809		
50	1.6455	0.49805	1.7844	0.57908	1.9837	0.68494		
100	1.6131	0.47817	1.7308	0.54857	1.8790	0.63073		
200	1.5708	0.45160	1.6600	0.50682	1.7680	0.56984		
300	1.5372	0.42994	1.6116	0.47723	1.6982	0.52957		
500	1.4873	0.39695	1.5461	0.43572	1.6090	0.47563		
1000	1.4055	0.34038	1.4445	0.36778	1.4883	0.39760		
1500	1.3523	0.30181	1.3823	0.32374	1.4174	0.34879		
2000	1.3140	0.27306	1.3394	0.29219	1.3716	0.31601		
3000	1.2568	0.22856	1.2771	0.24456	1.3022	0.26406		
5000	1.1847	0.16944	1.1986	0.18113	1.2143	0.19415		
<i>n</i>-Tridecane								
		30°		50°		100°		150°
0	1.3348	0.28878	1.3607	0.30800	1.4316	0.35879	1.5142	0.41489
50	1.3281	0.28375	1.3530	0.30234	1.4204	0.35091	1.4966	0.40318
100	1.3219	0.27908	1.3459	0.29707	1.4105	0.34391	1.4812	0.39281
200	1.3105	0.27043	1.3330	0.28740	1.3920	0.33074	1.4558	0.37557
300	1.3002	0.26254	1.3214	0.27866	1.3761	0.31925	1.4335	0.36010
500	1.2821	0.24853	1.3013	0.26333	1.3496	0.29977	1.3982	0.33516
1000	1.2466	0.22042	1.2625	0.23311	1.3010	0.26312	1.3377	0.29095
1500	1.2195	0.19842	1.2335	0.20983	1.2661	0.23591	1.2959	0.25918
2000	1.1975	0.18020	1.2101	0.19072	1.2387	0.21404	1.2657	0.23559
3000	1.1628	0.15078	1.1737	0.16017	1.1969	0.17973	1.2213	0.19513
5000	1.1139	0.10789	1.1210	0.11422	1.1389	0.13008	1.1527	0.14206
<i>n</i>-Pentadecane								
		220°		250°		300°		
0	1.6161	0.48002	1.7569	0.56355	1.9907	0.68849		
50	1.5862	0.46134	1.7011	0.53129	1.8576	0.61925		
100	1.5615	0.44565	1.6615	0.50773	1.7840	0.57887		
200	1.5249	0.42192	1.6050	0.47312	1.6979	0.52938		
300	1.4959	0.42073	1.5644	0.44749	1.6406	0.49507		
500	1.4507	0.37202	1.5041	0.40818	1.5624	0.44621		
1000	1.3763	0.31942	1.4119	0.34493	1.4529	0.37358		
1500	1.3270	0.28288	1.3543	0.30328	1.3874	0.32742		
2000	1.2913	0.25561	1.3149	0.27379	1.3457	0.29694		
3000	1.2369	0.21258	1.2562	0.22807	1.2805	0.24723		
5000	1.1682	0.15546	1.1814	0.16665	1.1972	0.17996		
<i>n</i>-Heptadecane								
		50°		100°		150°		
0	1.3201	0.27771	1.3831	0.32433	1.4548	1.37487		
50	1.3135	0.27267	1.3737	0.31749	1.4407	1.36515		
100	1.3075	0.26813	1.3648	0.31097	1.4283	1.35645		
200	1.2965	0.25969	1.3496	0.29979	1.4058	1.34059		
300	1.2865	0.25195	1.3362	0.28981	1.3871	1.32725		
500	1.2639	0.23818	1.3133	0.27252	1.3569	1.30521		
1000	1.2343	0.21053	1.2701	0.23912	1.3035	1.26501		
1500	1.2080	0.18893	1.2385	0.21386	1.2656	1.23550		
2000	1.1866	0.17106	1.2133	0.19335	1.2386	1.21394		
3000	1.1527	0.14212	1.1746	0.16089	1.1909	1.17467		
5000	1.1029	0.09793	1.1197	0.11302	1.1319	1.12391		
<i>n</i>-Nonadecane								
		200°		250°		300°		
0	1.5361	0.42925	1.6439	0.49707	1.7726	0.57245		
50	1.5158	0.41593	1.6062	0.47384	1.7169	0.54054		
100	1.4980	0.40409	1.5790	0.45680	1.6732	0.51475		
200	1.4677	0.38370	1.5367	0.42966	1.6126	0.47782		
300	1.4437	0.36722	1.5044	0.40838	1.5689	0.45035		
500	1.4044	0.33962	1.4512	0.37239	1.5038	0.40797		
1000	1.3393	0.29217	1.3706	0.31521	1.4083	0.34237		
1500	1.2947	0.25827	1.3188	0.27670	1.3494	0.29964		
2000	1.2623	0.23292	1.2839	0.24987	1.3128	0.27215		
3000	1.2114	0.19181	1.2295	0.20663	1.2528	0.22535		
5000	1.1472	0.13729	1.1593	0.14784	1.1753	0.16151		
<i>n</i>-Eicosane								
		100°		150°		200°		
0	1.3598	0.30734	1.4267	0.35536	1.5013	0.40633		
50	1.3514	0.30115	1.4141	0.34650	1.4831	0.39416		
100	1.3429	0.29485	1.4029	0.33851	1.4676	0.38361		
200	1.3293	0.28465	1.3819	0.32348	1.4403	0.36485		
300	1.3171	0.27540	1.3650	0.31117	1.4184	0.34951		
500	1.2959	0.25918	1.3372	0.29055	1.3823	0.32376		
1000	1.2553	0.22738	1.2870	0.25232	1.3216	0.27884		
1500	1.2252	0.20307	1.2510	0.22392	1.2792	0.24622		
2000	1.2011	0.18322	1.2255	0.20335	1.2484	0.22182		
3000	1.1638	0.15167	1.1790	0.16466	1.1992	0.18164		
5000	1.1104	0.10468	1.1219	0.11503	1.1370	0.12840		

Table I. Table of Specific Volumes (Continued)
 Correlated by Calculation from $\ln v$ vs. $1/m$ Lines
 Temperature in °C., pressure in bars, volumes in ml./gram

P	v	$\ln v$	v	$\ln v$	v	$\ln v$	v	$\ln v$			
<i>n</i> -Eicosane											
250°			300°								
0	1.5942	0.46637	1.7135	0.53854							
50	1.5637	0.44705	1.6575	0.50529							
100	1.5408	0.43229	1.6238	0.48475							
200	1.5038	0.40801	1.5727	0.45278							
300	1.4748	0.38851	1.5345	0.42817							
500	1.4260	0.35487	1.4759	0.38926							
1000	1.3508	0.30067	1.3869	0.32709							
1500	1.3017	0.26369	1.3312	0.28605							
2000	1.2689	0.23817	1.2970	0.26002							
3000	1.2167	0.19614	1.2394	0.21465							
5000	1.1487	0.13863	1.1647	0.15249							
<i>n</i> -Triacontane											
100°			150°			200°					
0	1.3171	0.27543	1.3743	0.31795	1.4375	0.36291					
50	1.3100	0.27001	1.3641	0.31046	1.4230	0.35274					
100	1.3025	0.26428	1.3549	0.30370	1.4101	0.34366					
200	1.2917	0.25593	1.3378	0.29103	1.3886	0.32828					
300	1.2816	0.24809	1.3240	0.28069	1.3700	0.31480					
500	1.2635	0.23390	1.3005	0.26276	1.3414	0.29370					
1000	1.2277	0.20512	1.2564	0.22825	1.2886	0.25356					
1500	1.2003	0.18261	1.2238	0.20196	1.2503	0.22339					
2000	1.1782	0.16402	1.2011	0.18326	1.2224	0.20077					
3000	1.1436	0.13420	1.1568	0.14568	1.1763	0.16237					
5000	1.0929	0.08885	1.1032	0.09820	1.1180	0.11154					
250°			300°								
0	1.5091	0.41151	1.6000	0.47000							
50	1.4881	0.39751	1.5611	0.44536							
100	1.4705	0.38559	1.5378	0.43038							
200	1.4409	0.36525	1.4995	0.40515							
300	1.4168	0.34843	1.4695	0.38488							
500	1.3794	0.32166	1.4245	0.35378							
1000	1.3140	0.27310	1.3473	0.29813							
1500	1.2700	0.23902	1.2973	0.26028							
2000	1.2411	0.21598	1.2675	0.23702							
3000	1.1927	0.17625	1.2145	0.19435							
5000	1.1288	0.12118	1.1450	0.13538							
<i>n</i> -Tetracontane											
150°			200°			250°			300°		
0	1.3476	0.29833	1.4059	0.34068	1.4706	0.38567	1.5441	0.43444			
50	1.3388	0.29180	1.3931	0.33151	1.4518	0.37282	1.5206	0.41908			
100	1.3306	0.28562	1.3809	0.32274	1.4357	0.36168	1.4983	0.40434			
200	1.3162	0.27475	1.3625	0.30929	1.4086	0.34256	1.4637	0.38099			
300	1.3040	0.26540	1.3453	0.29662	1.3864	0.32673	1.4366	0.36229			
500	1.2825	0.24881	1.3213	0.27861	1.3566	0.30500	1.3993	0.33598			
1000	1.2413	0.21617	1.2724	0.24088	1.2960	0.25927	1.3279	0.28359			
1500	1.2104	0.19094	1.2361	0.21193	1.2544	0.22665	1.2806	0.24735			
2000	1.1891	0.17319	1.2095	0.19021	1.2273	0.20485	1.2529	0.22548			
3000	1.1459	0.13616	1.1650	0.15270	1.1809	0.16627	1.2022	0.18416			
5000	1.0939	0.08975	1.1086	0.10308	1.1190	0.11242	1.1352	0.12679			

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