Designation: D1555 – 21

Standard Test Method for Calculation of Volume and Weight of Industrial Aromatic Hydrocarbons and Cyclohexane[1]

This standard is issued under the fixed designation D1555; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This standard is for use in calculating the weight and volume of benzene, toluene, mixed xylenes, styrene, orthoxylene, meta-xylene, para-xylene, cumene, ethylbenzene, 300 to 350°F and 350 to 400°F aromatic hydrocarbons, and cyclohexane. A method is given for calculating the volume at a desired temperature t_b°F from an observed volume at t_o°F. Table 1 lists the density *in Vacuo* at 60°F for chemicals used to develop the relationship. Densities (or weights) "*in vacuo*" represent the true density (or weight) if measured in a vacuum without the buoyancy effect of air acting on the liquid. It is representative of the actual amount of product present. Densities (or weights) "*in air*" represent what would actually be measured on a scale. The difference is on the order of 0.13 %. Modern densitometers measure density *in vacuo* and the ASTM recommends the use of *in vacuo* densities (or weights).

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.2.1 A complete SI unit companion standard has been developed in Test Method D1555M.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1217 Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer

D1555M Test Method for Calculation of Volume and Weight of Industrial Aromatic Hydrocarbons and Cyclohexane [Metric]

D3505 Test Method for Density or Relative Density of Pure Liquid Chemicals

D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

2.2 *Other Documents:*

American Petroleum Society Research Project 44[3]

Patterson, J. B., and Morris, E. C. *Metrologia*, 31, 1994, pp. 277-288

NSRDS-NIST 75-121 TRC Thermodynamic Tables—Hydrocarbons, Supplement No. 121, April 30, 2001[4]

3. Significance and Use

3.1 This test method is suitable for use in calculating weights and volumes of the products outlined in Section 1. The information presented in this method can be used for determining quantities of the above-stated aromatic hydrocarbons in tanks, shipping containers, etc.

4. Basic Data

4.1 Densities of materials should be determined by measurement (see Section 7). Densities of pure materials at 60°F may be estimated from densities furnished by NSRDS-NIST 75-121 (National Standard Reference Data Series—National Institute of Standards and Technology).

[1] This test method is under the jurisdiction of ASTM Committee D16 on Aromatic, Industrial, Specialty and Related Chemicals and is the direct responsibility of Subcommittee D16.01 on Benzene, Toluene, Xylenes, Cyclohexane and Their Derivatives.

Current edition approved July 1, 2021. Published August 2021. Originally approved in 1957. Last previous edition approved in 2016 as D1555 – 16. DOI: 10.1520/D1555-21.

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] "Selected Values of Properties of Hydrocarbons and Related Compounds," prepared by American Petroleum Institute Research Project 44 at the Chemical Thermodynamics Center, Department of Chemistry, Texas A&M, College Station, TX.

[4] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

TABLE 1 Physical Properties

Product	Freezing Point °F	Boiling Point °F	Density *in Vacuo* at 60°F g/cc[A,B]	Density *in Vacuo* at 60°F lb/gal[C]	Density *in Air* at 60°F lb/gal[D]
Benzene	42.0	176.2	0.88373	7.3751	7.3662
Cumene	-140.9	306.3	0.86538	7.2219	7.2130
Cyclohexane	43.8	177.3	0.78265	6.5315	6.5225
Ethylbenzene	-139.0	277.1	0.87077	7.2669	7.2580
Styrene	-23.1	293.4	0.90979	7.5926	7.5837
Toluene	-139.0	231.1	0.87096	7.2685	7.2596
m-Xylene	-54.2	282.4	0.86784	7.2425	7.2336
o-Xylene	-13.3	291.9	0.88340	7.3723	7.3634
p-Xylene	55.9	281.0	0.86456	7.2151	7.2062

[A] Based on regression of 2001 TRC Thermodynamic Tables, Hydrocarbons, NSRDS-NIST 75-121 (April 30, 2001). The data is presented in Appendix X1.
[B] Specific Gravity has been deleted from this table as unnecessary to this standard. If needed, divide 60°F density in g/cc by 0.999016 g/cc. See Appendix X2.
[C] Produced by multiplying the density *in vacuo* at 60°F in g/cc by 8.345404452 and rounding to 4 decimal places.
[D] Produced using Density - g/cc *in air* · 1.000149926 – 0.001199407795) · 8.345404452, rounding to 4 decimal places. See Appendix X3.

4.2 The VCF (Volume Correction Factor) equations provided below were derived from the Volume Correction Tables presented in the previous edition of this standard, Method D1555-95. Although reported as based on the American Petroleum Institute Research Project 44, the actual documentation that could be found is incomplete. As regression of the NIST data (Appendix X1) provided VCFs that differ from the historical VCFs by only 0 to ± 0.12 % (depending on the compound), a decision was made to use the previous method's VCF tables.

4.3 The VCF tables were regressed with a commercially available data regression program (TableCurve 2D V4). However, any modern regression program should produce the same results.

4.4 The former VCF tables were based on data for compounds used in American Petroleum Institute Research Project 44 for which the purity is not clearly defined, but were reported to be usable for materials in the ranges indicated in Table 2. The data supporting this conclusion appears to be unavailable at the present time; however there is no reason to change this recommendation. If, depending on the composition of the impurities, there is reason to suspect that the VCF implementation procedures presented below do not apply to a particular impure product, a separate implementation procedure should be independently determined. This may be done by measuring the density of a representative sample at different temperatures throughout the expected working temperature range, regressing the data to obtain a temperature/density equation that best reproduces the observed data, and then dividing the constants of the temperature/density equation by the calculated density at 60°F.

TABLE 2 Application Range of Implementation Procedure

Impure Products	Range
Benzene	95 to 100 %
Cumene	95 to 100 %
Cyclohexane	90 to 100 %
Ethylbenzene	95 to 100 %
Styrene	95 to 100 %
Toluene	95 to 100 %
Mixed Xylenes	All proportions
m-Xylene	95 to 100 %
o-Xylene	95 to 100 %
p-Xylene	94 to 100 %
300-350°F Aromatic Hydrocarbons	All proportions
350-400°F Aromatic Hydrocarbons	All proportions

5. Volume Correction Factor Implementation Procedure

5.1 The following general equation is used to generate the Volume Correction Factors:

$$VCF = \frac{a + bt_o + ct_o^2 + dt_o^3 + et_o^4}{a + bt_b + ct_b^2 + dt_b^3 + et_b^4} \quad (1)$$

where:

t_o = observed temperature, and
t_b = base temperature where value is needed.

and constants a through e are specific to each compound (presented in Table 3).

5.1.1 Temperature may be entered in tenths of a degree Fahrenheit.

5.1.2 The calculated result is rounded to the appropriate significant figures if it is to be reported and not rounded if to be used in another calculation. No intermediate rounding or truncation should be done.

5.1.3 The equations are valid for liquid product up to 140°F (150°F for *p*-xylene).

5.1.4 This implementation procedure replaces the printed table in a previous edition of this standard (Method D1555 – 95) for determining VCFs. **The implementation procedure is the Standard, not the printed table.** However, the printed table is provided in 1°F increments for the user's convenience (Table 4).

6. Use of the Implementation Procedure

6.1 *Convert Volume to 60°F*—Enter the appropriate equation with the temperature to the nearest 0.1 degree Fahrenheit at which the bulk volume was measured (temperature *t*). Multiply the bulk volume measurement at temperature *t* by the VCF.

6.1.1 *Example 1*—What is the volume at 60°F of a tank car of *p*-xylene whose volume was measured to be 9280 gal at a mean temperature of 88.7°F?

TABLE 3 VCF Constants

Product	a	b	c	d	E
Benzene	1.038382492	-6.2307×10^{-4}	-2.8505×10^{-7}	1.2692×10^{-10}	0
Cumene	1.032401114	-5.3445×10^{-4}	-9.5067×10^{-8}	3.6272×10^{-11}	0
Cyclohexane	1.039337296	-6.4728×10^{-4}	-1.4582×10^{-7}	1.03538×10^{-10}	0
Ethylbenzene	1.033346632	-5.5243×10^{-4}	8.37035×10^{-10}	-1.2692×10^{-9}	5.55061×10^{-12}
Styrene	1.032227515	-5.3444×10^{-4}	-4.4323×10^{-8}	0	0
Toluene	1.035323647	-5.8887×10^{-4}	2.46508×10^{-9}	-7.2802×10^{-12}	0
m-Xylene[A]	1.031887514	-5.2326×10^{-4}	-1.3253×10^{-7}	-7.35960×10^{-11}	0
o-Xylene	1.031436449	-5.2302×10^{-4}	-2.5217×10^{-9}	-2.13840×10^{-10}	0
p-Xylene	1.032307000	-5.2815×10^{-4}	-1.8416×10^{-7}	1.89256×10^{-10}	0
300-350°F	1.031118000	-5.1827×10^{-4}	-3.5109×10^{-9}	-1.98360×10^{-11}	0
350-400°F	1.029099000	-4.8287×10^{-4}	-3.7692×10^{-8}	3.78575×10^{-11}	0

[A] And mixed xylenes.

6.1.1.1 Enter 88.7°F and the appropriate constants from Table 3 into Eq 1 to calculate a VCF of 0.984143256178277. Multiply the volume at 88.7°F by the VCF to obtain the volume at 60°F.

$$9280 \ gal \times 0.984143256178277 = 9,132.84941733442 \ or \ 9133 \text{ gal}$$

If this value is to be reported, it may be rounded as required by the user. The unrounded intermediate value should be used for additional calculations.

6.2 *Converting Volume to Weight for Chemicals Listed in Table 1*—Convert the measured bulk volume to gallons at 60°F as described in 6.1. Determine the density (all weights *in vacuo*) at 60°F in grams per milliliter (equivalent to grams per cubic centimeter and kilograms per liter) as described in Section 7. To obtain the weight multiply the density in pound per gallon and the volume in gallons. To obtain the density in pounds per gallon *in vacuo* multiple the measured density by 8.345404452. To obtain the pounds per gallon *in air* at 60°F, use the following equation to determine the pound per gallon *in air*, refer to Appendix X3.

$$D_{\text{lb per gallon } in \ air \text{ at 60 F}} = [1.000149926 \times D_{in \ vacuo \text{ at 60 F}} - 0.00119940779543] \times 8.345404452$$

To obtain the weight in pounds, multiply the density in pounds per gallon by the volume in gallons.

6.2.1 The density of the *p*-xylene in Example 1 was determined by Test Method D4052 to be 0.8646 g/mL (*in vacuo*) at 60°F. The weight is:

$$9280 \text{ gal} \times 0.984143256178277 \times 8.345404452 \times 0.8646 = 65.897.4967627663 \ \text{lb}_{in \ vacuo}$$

or

$$9280 \text{ gal} \times 0.984143256178277 \times 8.345404452 \times [1.000149926 \times 0.8646 - 0.0011994077951] = 65,815.960860521 \ \text{lb}_{in \ air}$$

If this value is to be reported, it may be rounded as required by the user. The unrounded intermediate value should be used for additional calculations.

7. Density Determination

7.1 Density determinations may be carried out by any procedure known to be reliable to at least 4 digits. Test Methods D1217, D3505, and D4052 are suitable and are written to give density *in vacuo*. They should be used with caution, however, as they may be using older data than that upon which this standard is based upon.

8. Precision and Bias

8.1 Since this is a calculation method, no precision and bias statement is required.

9. Keywords

9.1 aromatic; benzene; calculation; conversion; cumene; density; ethylbenzene; *in air*; *in vacuo*; *m*-xylene; mixed xylene; *o*-xylene; *p*-xylene; specific gravity; styrene; 300 to 350°F aromatic hydrocarbons; 350 to 400°F aromatic hydrocarbons; toluene; volume; weight

TABLE 4 Volume Correction Factors

	Volume Correction to 60°F										
Temperature °F	Benzene	Cumene	Cyclohexane	Ethylbenzene	Styrene	Toluene	*m*-Xylene and Mixed Xylenes	*o*-Xylene	*p*-Xylene	300 to 350° Aromatic Hydrocarbons	350 to 400° Aromatic Hydrocarbons
-5.0	...	...	...	...	...	1.03827	...	...	...	...	...
-4.0	...	...	...	...	...	1.03768	...	...	...	...	...
-3.0	...	...	...	...	...	1.03709	...	...	...	...	...
-2.0	...	...	...	...	...	1.03650	...	...	...	...	...
-1.0	...	...	...	...	...	1.03591	...	...	...	...	...
0.0	...	...	...	...	...	1.03532	...	...	...	...	...
1.0	...	...	...	...	...	1.03473	...	...	...	...	...
2.0	...	...	...	...	...	1.03415	...	...	...	...	...
3.0	...	...	...	...	...	1.03356	...	...	...	...	...
4.0	...	...	...	...	...	1.03297	...	...	...	...	...
5.0	...	1.02973	...	1.03058	...	1.03238	1.02927	1.02882	...	1.02853	1.02668
6.0	...	1.02919	...	1.03003	...	1.03179	1.02874	1.02830	...	1.02801	1.02620
7.0	...	1.02866	...	1.02948	...	1.03120	1.02822	1.02778	...	1.02749	1.02572
8.0	...	1.02812	...	1.02893	...	1.03061	1.02769	1.02725	...	1.02697	1.02523
9.0	...	1.02758	...	1.02837	...	1.03002	1.02717	1.02673	...	1.02645	1.02475
10.0	...	1.02705	...	1.02782	...	1.02944	1.02664	1.02621	...	1.02593	1.02427
11.0	...	1.02651	...	1.02727	...	1.02885	1.02612	1.02568	...	1.02542	1.02378
12.0	...	1.02597	...	1.02672	...	1.02826	1.02559	1.02516	...	1.02490	1.02330
13.0	...	1.02544	...	1.02616	...	1.02767	1.02506	1.02464	...	1.02438	1.02282
14.0	...	1.02490	...	1.02561	...	1.02708	1.02454	1.02411	...	1.02386	1.02233
15.0	...	1.02436	...	1.02506	1.02420	1.02649	1.02401	1.02359	...	1.02334	1.02185
16.0	...	1.02383	...	1.02450	1.02367	1.02590	1.02348	1.02307	...	1.02282	1.02136
17.0	...	1.02329	...	1.02395	1.02313	1.02531	1.02295	1.02254	...	1.02231	1.02088
18.0	...	1.02275	...	1.02340	1.02259	1.02472	1.02243	1.02202	...	1.02179	1.02040
19.0	...	1.02221	...	1.02284	1.02206	1.02414	1.02190	1.02150	...	1.02127	1.01991
20.0	...	1.02167	...	1.02229	1.02152	1.02355	1.02137	1.02097	...	1.02075	1.01943
21.0	...	1.02114	...	1.02174	1.02098	1.02296	1.02084	1.02045	...	1.02023	1.01894
22.0	...	1.02060	...	1.02118	1.02045	1.02237	1.02031	1.01993	...	1.01971	1.01846
23.0	...	1.02006	...	1.02063	1.01991	1.02178	1.01978	1.01940	...	1.01920	1.01797
24.0	...	1.01952	...	1.02007	1.01938	1.02119	1.01925	1.01888	...	1.01868	1.01749
25.0	...	1.01898	...	1.01952	1.01884	1.02060	1.01872	1.01836	...	1.01816	1.01700
26.0	...	1.01844	...	1.01896	1.01830	1.02001	1.01819	1.01783	...	1.01764	1.01652
27.0	...	1.01790	...	1.01841	1.01777	1.01943	1.01766	1.01731	...	1.01712	1.01603
28.0	...	1.01736	...	1.01785	1.01723	1.01884	1.01713	1.01679	...	1.01660	1.01555
29.0	...	1.01682	...	1.01730	1.01669	1.01825	1.01660	1.01626	...	1.01608	1.01506
30.0	...	1.01628	...	1.01674	1.01615	1.01766	1.01607	1.01574	...	1.01557	1.01458
31.0	...	1.01574	...	1.01619	1.01562	1.01707	1.01554	1.01521	...	1.01505	1.01409
32.0	...	1.01520	...	1.01563	1.01508	1.01648	1.01501	1.01469	...	1.01453	1.01361
33.0	...	1.01466	...	1.01508	1.01454	1.01589	1.01447	1.01417	...	1.01401	1.01312
34.0	...	1.01412	...	1.01452	1.01401	1.01530	1.01394	1.01364	...	1.01349	1.01264
35.0	...	1.01358	...	1.01397	1.01347	1.01472	1.01341	1.01312	...	1.01297	1.01215
36.0	...	1.01304	...	1.01341	1.01293	1.01413	1.01287	1.01259	...	1.01245	1.01167
37.0	...	1.01250	...	1.01285	1.01239	1.01354	1.01234	1.01207	...	1.01194	1.01118
38.0	...	1.01196	...	1.01230	1.01185	1.01295	1.01181	1.01155	...	1.01142	1.01070
39.0	...	1.01142	...	1.01174	1.01132	1.01236	1.01127	1.01102	...	1.01090	1.01021
40.0	...	1.01087	...	1.01118	1.01078	1.01177	1.01074	1.01050	...	1.01038	1.00973
41.0	...	1.01033	...	1.01063	1.01024	1.01118	1.01021	1.00997	...	1.00986	1.00924
42.0	...	1.00979	...	1.01007	1.00970	1.01059	1.00967	1.00945	...	1.00934	1.00875
43.0	1.01107	1.00925		1.00951	1.00916	1.01001	1.00914	1.00892	...	1.00882	1.00827
44.0	1.01043	1.00870	1.01058	1.00895	1.00863	1.00942	1.00860	1.00840	...	1.00831	1.00778
45.0	1.00978	1.00816	1.00992	1.00840	1.00809	1.00883	1.00807	1.00788	...	1.00779	1.00730
46.0	1.00913	1.00762	1.00926	1.00784	1.00755	1.00824	1.00753	1.00735	...	1.00727	1.00681
47.0	1.00848	1.00708	1.00860	1.00728	1.00701	1.00765	1.00699	1.00683	...	1.00675	1.00632
48.0	1.00783	1.00653	1.00794	1.00672	1.00647	1.00706	1.00646	1.00630	...	1.00623	1.00584
49.0	1.00718	1.00599	1.00728	1.00616	1.00593	1.00647	1.00592	1.00578	...	1.00571	1.00535
50.0	1.00653	1.00545	1.00662	1.00560	1.00539	1.00589	1.00538	1.00525	...	1.00519	1.00487
51.0	1.00588	1.00490	1.00596	1.00504	1.00486	1.00530	1.00485	1.00473	...	1.00467	1.00438
52.0	1.00523	1.00436	1.00530	1.00448	1.00432	1.00471	1.00431	1.00420	...	1.00416	1.00389
53.0	1.00458	1.00381	1.00464	1.00393	1.00378	1.00412	1.00377	1.00368	...	1.00364	1.00341
54.0	1.00393	1.00327	1.00398	1.00337	1.00324	1.00353	1.00323	1.00315	...	1.00312	1.00292
55.0	1.00327	1.00272	1.00331	1.00281	1.00270	1.00294	1.00270	1.00263	...	1.00260	1.00243
56.0	1.00262	1.00218	1.00265	1.00224	1.00216	1.00235	1.00216	1.00210	1.00219	1.00208	1.00195
57.0	1.00196	1.00164	1.00199	1.00168	1.00162	1.00176	1.00162	1.00158	1.00164	1.00156	1.00146
58.0	1.00131	1.00109	1.00132	1.00112	1.00108	1.00118	1.00108	1.00105	1.00109	1.00104	1.00097
59.0	1.00066	1.00055	1.00066	1.00056	1.00054	1.00059	1.00054	1.00053	1.00054	1.00052	1.00049
60.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
61.0	0.99934	0.99945	0.99933	0.99944	0.99946	0.99941	0.99946	0.99947	0.99945	0.99949	0.99951
62.0	0.99869	0.99891	0.99867	0.99888	0.99892	0.99882	0.99892	0.99895	0.99890	0.99897	0.99903
63.0	0.99803	0.99836	0.99801	0.99832	0.99838	0.99823	0.99838	0.99842	0.99835	0.99845	0.99854
64.0	0.99737	0.99782	0.99734	0.99775	0.99784	0.99764	0.99784	0.99790	0.99780	0.99793	0.99805
65.0	0.99671	0.99727	0.99668	0.99719	0.99730	0.99706	0.99730	0.99737	0.99725	0.99741	0.99756

TABLE 4 *Continued*

Temperature °F	Benzene	Cumene	Cyclohexane	Ethylbenzene	Styrene	Toluene	*m*-Xylene and Mixed Xylenes	*o*-Xylene	*p*-Xylene	300 to 350° Aromatic Hydrocarbons	350 to 400° Aromatic Hydrocarbons
Volume Correction to 60°F											
66.0	0.99605	0.99672	0.99601	0.99663	0.99676	0.99647	0.99675	0.99684	0.99670	0.99689	0.99708
67.0	0.99540	0.99618	0.99535	0.99607	0.99622	0.99588	0.99621	0.99632	0.99615	0.99637	0.99659
68.0	0.99474	0.99563	0.99468	0.99550	0.99568	0.99529	0.99567	0.99579	0.99560	0.99585	0.99610
69.0	0.99408	0.99508	0.99401	0.99494	0.99514	0.99470	0.99513	0.99527	0.99505	0.99533	0.99561
70.0	0.99341	0.99454	0.99335	0.99438	0.99460	0.99411	0.99458	0.99474	0.99450	0.99482	0.99513
71.0	0.99275	0.99399	0.99268	0.99382	0.99406	0.99352	0.99404	0.99421	0.99395	0.99430	0.99464
72.0	0.99209	0.99344	0.99202	0.99325	0.99352	0.99294	0.99350	0.99369	0.99340	0.99378	0.99415
73.0	0.99143	0.99289	0.99135	0.99269	0.99298	0.99235	0.99295	0.99316	0.99284	0.99326	0.99366
74.0	0.99077	0.99235	0.99068	0.99212	0.99244	0.99176	0.99241	0.99263	0.99229	0.99274	0.99318
75.0	0.99010	0.99180	0.99001	0.99156	0.99190	0.99117	0.99187	0.99211	0.99174	0.99222	0.99269
76.0	0.98944	0.99125	0.98935	0.99099	0.99135	0.99058	0.99132	0.99158	0.99119	0.99170	0.99220
77.0	0.98877	0.99070	0.98868	0.99043	0.99081	0.98999	0.99078	0.99105	0.99063	0.99118	0.99171
78.0	0.98811	0.99015	0.98801	0.98987	0.99027	0.98940	0.99023	0.99052	0.99008	0.99066	0.99122
79.0	0.98744	0.98960	0.98734	0.98930	0.98973	0.98881	0.98969	0.99000	0.98953	0.99014	0.99074
80.0	0.98678	0.98906	0.98667	0.98874	0.98919	0.98823	0.98914	0.98947	0.98897	0.98962	0.99025
81.0	0.98611	0.98851	0.98601	0.98817	0.98865	0.98764	0.98859	0.98894	0.98842	0.98910	0.98976
82.0	0.98544	0.98796	0.98534	0.98760	0.98811	0.98705	0.98805	0.98841	0.98786	0.98859	0.98927
83.0	0.98478	0.98741	0.98467	0.98704	0.98756	0.98646	0.98750	0.98789	0.98731	0.98807	0.98878
84.0	0.98411	0.98686	0.98400	0.98647	0.98702	0.98587	0.98695	0.98736	0.98676	0.98755	0.98829
85.0	0.98344	0.98631	0.98333	0.98591	0.98648	0.98528	0.98641	0.98683	0.98620	0.98703	0.98781
86.0	0.98277	0.98576	0.98266	0.98534	0.98594	0.98469	0.98586	0.98630	0.98564	0.98651	0.98732
87.0	0.98210	0.98521	0.98199	0.98477	0.98540	0.98411	0.98531	0.98577	0.98509	0.98599	0.98683
88.0	0.98143	0.98466	0.98132	0.98421	0.98485	0.98352	0.98476	0.98525	0.98453	0.98547	0.98634
89.0	0.98076	0.98411	0.98065	0.98364	0.98431	0.98293	0.98422	0.98472	0.98398	0.98495	0.98585
90.0	0.98009	0.98356	0.97998	0.98307	0.98377	0.98234	0.98367	0.98419	0.98342	0.98443	0.98536
91.0	0.97942	0.98301	0.97931	0.98251	0.98323	0.98175	0.98312	0.98366	0.98286	0.98391	0.98487
92.0	0.97875	0.98246	0.97863	0.98194	0.98268	0.98116	0.98257	0.98313	0.98231	0.98339	0.98439
93.0	0.97807	0.98190	0.97796	0.98137	0.98214	0.98057	0.98202	0.98260	0.98175	0.98287	0.98390
94.0	0.97740	0.98135	0.97729	0.98080	0.98160	0.97999	0.98147	0.98207	0.98119	0.98235	0.98341
95.0	0.97673	0.98080	0.97662	0.98024	0.98106	0.97940	0.98092	0.98154	0.98063	0.98183	0.98292
96.0	0.97605	0.98025	0.97595	0.97967	0.98051	0.97881	0.98037	0.98101	0.98007	0.98131	0.98243
97.0	0.97538	0.97970	0.97527	0.97910	0.97997	0.97822	0.97982	0.98048	0.97952	0.98079	0.98194
98.0	0.97470	0.97915	0.97460	0.97853	0.97943	0.97763	0.97927	0.97996	0.97896	0.98028	0.98145
99.0	0.97403	0.97859	0.97393	0.97797	0.97888	0.97704	0.97871	0.97943	0.97840	0.97976	0.98096
100.0	0.97335	0.97804	0.97325	0.97740	0.97834	0.97645	0.97816	0.97890	0.97784	0.97924	0.98047
101.0	0.97268	0.97749	0.97258	0.97683	0.97780	0.97587	0.97761	0.97837	0.97728	0.97872	0.97998
102.0	0.97200	0.97694	0.97191	0.97626	0.97725	0.97528	0.97706	0.97784	0.97672	0.97820	0.97949
103.0	0.97132	0.97638	0.97123	0.97569	0.97671	0.97469	0.97651	0.97730	0.97616	0.97768	0.97900
104.0	0.97064	0.97583	0.97056	0.97512	0.97617	0.97410	0.97595	0.97677	0.97560	0.97716	0.97852
105.0	0.96996	0.97528	0.96989	0.97456	0.97562	0.97351	0.97540	0.97624	0.97504	0.97664	0.97803
106.0	0.96929	0.97472	0.96921	0.97399	0.97508	0.97292	0.97485	0.97571	0.97448	0.97612	0.97754
107.0	0.96861	0.97417	0.96854	0.97342	0.97453	0.97233	0.97429	0.97518	0.97392	0.97560	0.97705
108.0	0.96793	0.97362	0.96786	0.97285	0.97399	0.97175	0.97374	0.97465	0.97336	0.97508	0.97656
109.0	0.96725	0.97306	0.96719	0.97228	0.97345	0.97116	0.97318	0.97412	0.97280	0.97456	0.97607
110.0	0.96656	0.97251	0.96651	0.97171	0.97290	0.97057	0.97263	0.97359	0.97223	0.97404	0.97558
111.0	0.96588	0.97196	0.96583	0.97114	0.97236	0.96998	0.97207	0.97306	0.97167	0.97352	0.97509
112.0	0.96520	0.97140	0.96516	0.97058	0.97181	0.96939	0.97152	0.97253	0.97111	0.97300	0.97460
113.0	0.96452	0.97085	0.96448	0.97001	0.97127	0.96880	0.97096	0.97199	0.97055	0.97248	0.97411
114.0	0.96384	0.97029	0.96381	0.96944	0.97073	0.96821	0.97040	0.97146	0.96998	0.97196	0.97362
115.0	0.96315	0.96974	0.96313	0.96887	0.97018	0.96763	0.96985	0.97093	0.96942	0.97144	0.97313
116.0	0.96247	0.96918	0.96245	0.96830	0.96964	0.96704	0.96929	0.97040	0.96886	0.97092	0.97264
117.0	0.96178	0.96863	0.96178	0.96773	0.96909	0.96645	0.96873	0.96987	0.96830	0.97040	0.97215
118.0	0.96110	0.96807	0.96110	0.96716	0.96855	0.96586	0.96818	0.96933	0.96773	0.96988	0.97166
119.0	0.96041	0.96752	0.96042	0.96659	0.96800	0.96527	0.96762	0.96880	0.96717	0.96936	0.97117
120.0	0.95973	0.96696	0.95974	0.96602	0.96746	0.96468	0.96706	0.96827	0.96660	0.96884	0.97068
121.0	0.95904	0.96641	0.95906	0.96546	0.96691	0.96409	0.96650	0.96774	0.96604	0.96832	0.97019
122.0	0.95836	0.96585	0.95839	0.96489	0.96637	0.96350	0.96594	0.96720	0.96548	0.96780	0.96970
123.0	0.95767	0.96529	0.95771	0.96432	0.96582	0.96292	0.96538	0.96667	0.96491	0.96728	0.96921
124.0	0.95698	0.96474	0.95703	0.96375	0.96528	0.96233	0.96483	0.96614	0.96435	0.96676	0.96872
125.0	0.95629	0.96418	0.95635	0.96318	0.96473	0.96174	0.96427	0.96560	0.96378	0.96624	0.96823
126.0	0.95560	0.96362	0.95567	0.96261	0.96418	0.96115	0.96371	0.96507	0.96321	0.96572	0.96773
127.0	0.95492	0.96307	0.95499	0.96205	0.96364	0.96056	0.96315	0.96453	0.96265	0.96520	0.96724
128.0	0.95423	0.96251	0.95431	0.96148	0.96309	0.95997	0.96258	0.96400	0.96208	0.96468	0.96675
129.0	0.95354	0.96195	0.95363	0.96091	0.96255	0.95938	0.96202	0.96347	0.96152	0.96416	0.96626
130.0	0.95284	0.96140	0.95295	0.96034	0.96200	0.95880	0.96146	0.96293	0.96095	0.96364	0.96577
131.0	0.95215	0.96084	0.95227	0.95977	0.96146	0.95821	0.96090	0.96240	0.96038	0.96312	0.96528
132.0	0.95146	0.96028	0.95159	0.95921	0.96091	0.95762	0.96034	0.96186	0.95982	0.96260	0.96479
133.0	0.95077	0.95972	0.95091	0.95864	0.96036	0.95703	0.95978	0.96133	0.95925	0.96208	0.96430
134.0	0.95008	0.95917	0.95023	0.95807	0.95982	0.95644	0.95921	0.96079	0.95868	0.96156	0.96381
135.0	0.94939	0.95861	0.94955	0.95750	0.95927	0.95585	0.95865	0.96026	0.95812	0.96104	0.96332
136.0	0.94869	0.95805	0.94887	0.95694	0.95872	0.95526	0.95809	0.95972	0.95755	0.96052	0.96283