METRIC
DESIGNATION: D 1555M – 08
~~Designation:D1555M–04a~~

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

This standard is issued under the fixed designation D 1555M; 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.

1. Scope*

1.1 This standard is for use in calculating the weight and volume of benzene, toluene, mixed xylenes, styrene, ortho-xylene, meta-xylene, para-xylene, cumene, ethylbenzene, 148.9 to 176.7°C and 176.7 to 204.4°C aromatic hydrocarbons, and cyclohexane. A method is given for calculating the volume at 15°C and 20°C from an observed volume at *t*°C. Table 1 lists the density in grams per cubic centimetre at 15°C and 20°C for high purity chemicals.

1.2 Calculated results shall be rounded off in accordance with the rounding-off method of Practice E 29.

~~1.3~~

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 1217 Test Method for Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer
D 1555 Test Method for Calculation of Volume and Weight of Industrial Aromatic Hydrocarbons and Cyclohexane
D 3505 Test Method for Density or Relative Density of Pure Liquid Chemicals
D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.2 *Other Documents:*

Patterson, J. B., and Morris, E. C., *Metrologia* , 31, 1994, pp. 277-288
TRC Thermodynamic Tables—Hydrocarbons, NSRDS-NIST 75-121, Supplement No. 121, April 30, 2001

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 can be used for determining quantities of the above-stated aromatic hydrocarbons in tanks, shipping containers, etc.

4. Basic Data

4.1 Densities of pure materials at 15°C and 20°C are derived from densities furnished by NSRDS-NIST 75-121 (National Standard Reference Data Series—National Institute of Standards and Technology). Densities of impure materials should be determined by actual measurement (see Section 7).

4.2 The VCF (Volume Correction Factor) equations provided below are derived from the Volume Correction implementation procedures presented in Method D 1555 - 04~~.~~a.

4.3 The former VCF tables were based on data for compounds of the highest purity, 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

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

Current edition approved ~~Dec.~~Feb. 1, ~~2004.~~2008. Published ~~January 2005.~~March 2008. Originally approved in 1993. Last previous edition approved in 2004 as D 1555M – 04a.

[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.

***A Summary of Changes section appears at the end of this standard.**

TABLE 1 Physical Properties

Product	Freezing Point °C	Boiling Point °C	Density *in Vacuo* at 15°C g/cc[A,B,C]	Density *in Air* at 15°C g/cc[D]	Density *in Vacuo* at 20°C g/cc[C,E,F]	Density *in Air* at 20°C g/cc[D]
Benzene	5.6	80.1	0.88431	0.88324	0.87908	0.87801
Cumene	-96.1	152.4	0.86586	0.86479	0.86160	0.86053
Cyclohexane	6.6	80.7	0.78317	0.78209	0.77849	0.77741
Ethylbenzene	-95.0	136.2	0.87126	0.87019	0.86685	0.86578
Styrene	-30.6	145.2	0.91028	0.90922	0.90586	0.90480
Toluene	-95.0	110.6	0.87147	0.87040	0.86686	0.86579
m-Xylene	-47.9	139.1	0.86831	0.86724	0.86408	0.86301
o-Xylene	-25.2	144.4	0.88387	0.88280	0.87968	0.87861
p-Xylene	13.3	138.3	0.86503	0.86396	0.86076	0.85969

[A] Obtained from Method D 1555 – 04a by multiplying the chemical's 60°F density by the volume correction factor for 59°F.
[B] Specific Gravity at 15°C is not presented in this table as it is unnecessary to this standard. If needed, divide 15°C density in g/cc by 0.999102 g/cc. See Appendix X1.
[C] g/cc can be converted to kg/1000L or kg/m ^{3} by multiplying by 1000.
[D] Produced using g/cc = (Density · 1.00014992597 – 0.00119940779543) and rounding to 5 decimal places. See Appendix X2.
[E] Obtained from Method D 1555 - 04a by multiplying the chemical's 60°F density by the volume correction factor for 68°F.
[F] Specific Gravity at 20°C is not presented in this table as it is unnecessary to this standard. If needed, divide 20°C density in g/cc by 0.998206 g/cc. See Appendix X1.

NOTE 1—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 and API recommend the use of *in vacuo* densities (or weights); however, the purchaser and seller should agree on which to use in their transactions.

TABLE ~~1~~ 2 Physical Properties

Impure Products	~~Freezing Point °C~~	~~Boiling Point °C~~	~~Density *in VRacuo* at 15°C g/cc[A,B,C]~~	~~Density *in Air* at 15°C g/cc[D]~~ e
~~Benzene~~	~~5.6~~	~~80.1~~	~~0.88431~~	0.88324
Benzene	95.6	80.	to10.884310%	
~~Cumene~~	~~-96.1~~	~~152.4~~	~~0.86586~~	0.86479
Cumene	96.1	152.4	to10.86586	0%
~~Cyclohexane~~	~~6.6~~	~~80.7~~	~~0.783~~ 17	0.78209
Cyclohexane	6.6	890.7	0.783 to 17	00%
~~Ethylbenzene~~	~~-95.0~~	~~136.2~~	~~0.87126~~	0.87019
Ethylbenzene	95.0	to136.2	0.87126	0%
~~Styrene~~	~~-30.6~~	~~145.2~~	~~0.9~~ 1028	0.90922
Styrene	-30.6	145.2	0.95 to1028	0%
~~Toluene~~	~~-95.00%~~			
Toluene	95 to 100%			
~~110.6~~	~~0.87147~~	~~0.87040~~		
Mixed Xylenes	0.87147	0.87040Allproportions		
~~*m*-Xylene~~	~~-47.9 139.1~~	~~0.86831~~	0.86724	
m-Xylene	95 to 139.1	0.86831	0%	
~~*o*-Xylene~~	~~-25.2~~	~~144.4~~	~~0.88387~~	0.88280
o-Xylene	95.2	to144.4	0.88387	0%
~~*p*-Xylene~~	~~13.3~~	00%		
p-Xylene	94 to 13.3	00%		
~~138.3~~	~~0.8All proportions~~			
148.9-176.7°C Aromatic Hydrocarbons	All proportions			
~~176501~~	~~0.86394~~			
176.7-204.4°C Aromatic Hydrocarbons	All proportions			

~~AObtained from Method D1555–04 by multiplying the chemical's 60°F density by the volume correction factor for 59°F.~~

~~BSpecific Gravity at 15°C is not presented in this table as it is unnecessary to this standard. If needed, divide 15°C density in g/cc by 0.999102 g/cc. See Appendix X1.~~

~~Cg/cc can be converted to kg/1000L or kg/m^3 by multiplying by 1000.~~

~~DProduced using g/cc = (Density · 1.00014992597 – 0.00119940779543) and rounding to 5 decimal places. See Appendix X2.~~

NOTE—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 and API recommend the use of *in vacuo* densities (or weights); however, the purchaser and seller should agree on which to use in their transactions.

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 15°C and 20°C. Alternatively, if the composition has been quantified one can use the VCFs of each component (if available) to calculate a weighted average density at different temperatures and then process the data as mentioned above.

5. Volume Correction Factor Implementation Procedure

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

$$VCF = \frac{(a + b\,(1.8t+32) + c\,(1.8t+32)^2 + d\,(1.8t+32)^3 + e\,(1.8t+32)^4)/VCF^{59F}}{XX} \quad (1)$$

where:

t = ~~temperature in °C~~temperature in °C,
VCF^XX = VCF^59F or VCF^68F, and

~~and the~~ constants a through e and VCF~~59F~~XX are specific to each compound (obtained from Method D 1555 – 04a and presented in Table 3).

~~5.1.1Temperature~~5.2 Temperature may be entered in tenths of a degree Centigrade.

~~5.1.2The~~5.3 The final result is rounded to 5 places past the decimal. No intermediate rounding or truncation should be done.

~~5.1.3The~~5.4 The equations are valid for liquid product up to 60°C (65.5°C for *p*-xylene).

~~5.1.4This~~5.5 This implementation procedure replaces the printed tables of ~~the~~ previous editions of this Method for determining VCFs. **The implementation procedure is the Standard, not the printed tables**. However, a printout ~~of~~from the implementation procedure is provided in 0.5°C increments for the user's convenience (Tables 4 and 5).

6. Use of the Implementation Procedure

6.1 *Volume Reduction to 15°C*—Enter the appropriate equation with the temperature to the nearest 0.1 degree Centigrade at which the bulk volume was measured (temperature *t*). After performing the mathematical operations, round the resulting VCF to 5 places past the decimal. Multiply the bulk volume measurement at temperature *t* by the VCF.

NOTE 1—The purchaser and seller should agree on a reasonable policy in regard to rounding of final numbers in all computations. Rounding the final weight or volume to five significant figures is, in most cases, also acceptable.

6.1.1 *Example 1*—What is the volume at 15°C and at 20°C of a tank car of *p*-xylene whose volume was measured to be 35,129 litres at a mean temperature of 31.7°C?

~~6.1.1.1Enter~~ For 15°C, enter Eq 1 with 31.7 and the appropriate constants from Table 3 to calculate a VCF of 0.98341. The volume at 15°C is:

TABLE 2 3 Application Range of Implementation Procedure

~~Impure~~Products	~~Rang~~	b	c	d	e	VCF^59F	VCF^68F
~~Benzene~~	~~92~~	~~-6.2307 × 10^-4~~	~~-2.85 to 10^-7~~	~~1.2692 × 10%^-10~~	~~0~~	~~1.00066~~	~~0.99474~~
Benzene	1.038382492	-6.2307 × 10^-4	-2.8505 × 10^-7	1.2692 × 10^-10	0	1.00066	0.99474
~~Cumene~~	~~1.032401114~~	~~-5.3445 × 10^-4~~	~~-95 to 10^-8~~	~~3.6272 × 10%^-11~~	~~0~~	~~1.00055~~	~~0.99563~~
Cumene	1.032401114	-5.3445 × 10^-4	-9.5067 × 10^-8	3.6272 × 10^-11	0	1.00055	0.99563
~~Cyclohexane~~	~~9337296~~	~~-6.4728 × 10 to^-4~~	~~-10^-7~~	~~1.0%3538 × 10^-10~~	~~0~~	~~1.00066~~	~~0.99468~~
Cyclohexane	1.039337296	-6.4728 × 10^-4	-1.4582 × 10^-7	1.03538 × 10^-10	0	1.00066	0.99468
~~Ethylbenzene~~	~~1.033346632~~	~~-5.5243 × 10^-4~~	~~8.37035 × 10^-10~~	~~1.2692 × 10^-9~~	~~5 to10^-12~~	~~1.0%00560~~	~~0.99550~~
Ethylbenzene	1.033346632	-5.5243 × 10^-4	8.37035 × 10^-10	-1.2692 × 10^-9	5.55061 × 10^-12	1.00056	0.99550
~~Styrene~~	~~95 to15~~	~~-5.3444 × 10^-4~~	~~-4.4323 × 10%^-8~~	~~0~~	~~0~~	~~1.00054~~	~~0.99568~~
Styrene	1.032227515	-5.3444 × 10^-4	-4.4323 × 10^-8	0	0	1.00054	0.99568
~~Toluene~~	~~95 to100%~~						
Toluene	1.00%						
35323647	Mixed Xylenes	All proportions 2.46508 × 10^-9	-7.2802 × 10^-12	0	1.00059	0.99529	
35323647	-5.8887 × 10^-4	2.46508 × 10^-9	-7.2802 × 10^-12	0	1.00059	0.99529	
~~*m*-Xylene~~	~~95 to14~~	~~-5.2326 × 10^-4~~	~~-1.3253 × 10%^-7~~	~~7.35960 × 10^-11~~	~~0~~	~~1.00054~~	~~0.99567~~
m-Xylene[A]	1.031887514	-5.2326 × 10^-4	-1.3253 × 10^-7	-7.35960 × 10^-11	0	1.00054	0.99567
~~*o*-Xylene~~	~~9~~	~~5 to 10^-4~~	~~-2.5217 × 10%^-9~~	~~2.13840 × 10^-10~~	~~0~~	~~1.00053~~	~~0.99579~~
o-Xylene	1.031436449	-5.2302 × 10^-4	-2.5217 × 10^-9	-2.13840 × 10^-10	0	1.00053	0.99579
~~*p*-Xylene~~	~~91.032307000~~	~~-5.2815 × 10^-4 to~~	~~10^-7~~	~~1.89256 × 10%^-10~~	~~0~~	~~1.00054~~	~~0.99560~~
p-Xylene	1.032307000	-5.2815 × 10^-4	-1.8416 × 10^-7	1.89256 × 10^-10	0	1.00054	0.99560
~~148.9-176.7°C Aromatic Hydrocarbons~~	~~All proportions~~	~~1.031118000~~	~~-5.1827 × 10^-4~~	~~-3.5109 × 10^-9~~	~~-1.98360 × 10^-11~~	~~0~~	~~1.00052~~	~~0.99585~~
148.9-176.7°C	1.031118000	-5.1827 × 10^-4	-3.5109 × 10^-9	-1.98360 × 10^-11	0	1.00052	0.99585
~~176.7-204.4°C Aromatic Hydrocarbons~~	~~All proportions~~	~~1.029099000~~	~~-4.8287 × 10^-4~~	~~-3.7692 × 10^-8~~	~~3.78575 × 10^-11~~	~~0~~	~~1.00049~~	~~0.99610~~
176.7-204.4°C	1.029099000	-4.8287 × 10^-4	-3.7692 × 10^-8	3.78575 × 10^-11	0	1.00049	0.99610

[A] and Mixed Xylenes.

TABLE 3 4 VCF Constants

Volume Correction to 15°C

PTemperodueature °C	aBenzene	bCumene	Cyclohexane	dEthyl Benzene	Styrene	VCF5Toluene	*m*-Xylene and Mixed Xylenes	*o*-Xylene*p*-Xylene		148.9F to 176.7°C Aromatic Hydrocarbons	176.7 to 204.4°C Aromatic Hydrocarbons
-20.5	...	...	...	...	...	...	...	...	...	...	...
Benzene	1.038382492	6.2307	× 10-4	2.8505 × 10-7	1.2692 × 10-10	0	1.000667	...	...	...	...
-20.0	...	...	...	...	...	1.03707	...	...	...	...	...
Cumene	1.032401114	5.3445	× 10-4	9.5067 × 10-8	3.6272 × 10-11	0	1.000554	...	...	...	...
-19.5	...	...	...	...	...	1.03654	...	...	...	...	...
Cyclohexane	1.039337296	6.4728	× 10-4	1.4582 × 10-7	1.03538 × 10-10	0	1.0006601	...	...	...	...
-19.0	...	...	...	...	...	1.03601	...	...	...	...	...
Ethylbenzene	1.033346632	5.5243	× 10-4	8.37035×10-10	1.2692 × 10-9	5.55061×10-12	1.0005648	...	...	...	...
-18.5	...	...	...	...	...	1.03548	...	...	...	...	...
Styrene	1.032227515	5.3444	× 10-4	4.4323 × 10-8	0	0	1.0005495	...	...	...	...
-18.0	...	...	...	...	...	1.03495	...	...	...	...	...
Toluene	1.035323647	5.8887	× 10-4	2.46508× 10-9	7.2802 × 10-12	0	1.03442	...	...	...	...
-17.5	...	...	...	...	...	1.03442	...	...	...	...	...
-17.0	...	...	...	...	...	1.03389	...	...	...	...	...
-16.5	...	...	...	...	...	1.03336	...	...	...	...	...
-16.0	...	...	...	...	...	1.03283	...	...	...	...	...
-15.5	...	...	...	...	...	1.03230	...	...	...	...	...
-15.0	...	1.02916	...	1.03001	...	1.03177	1.02871	1.02828	...	1.02799	1.02618
-14.5	...	1.02868	...	1.02951	...	1.03124	1.02824	1.02781	...	1.02753	1.02575
-14.0	...	1.02820	...	1.02901	...	1.03071	1.02777	1.02734	...	1.02706	1.02531
-13.5	...	1.02771	...	1.02852	...	1.03018	1.02730	1.02686	...	1.02659	1.02488
-13.0	...	1.02723	...	1.02802	...	1.02965	1.02682	1.02639	...	1.02613	1.02444
-12.5	...	1.02675	...	1.02752	...	1.02912	1.02635	1.02592	...	1.02566	1.02401
-12.0	...	1.02627	...	1.02702	...	1.02859	1.02588	1.02545	...	1.02519	1.02357
-11.5	...	1.02579	...	1.02653	...	1.02806	1.02540	1.02498	...	1.02473	1.02314
-11.0	...	1.02530	...	1.02603	...	1.02753	1.02493	1.02451	...	1.02426	1.02270
-10.5	...	1.02482	...	1.02553	...	1.02700	1.02446	1.02404	...	1.02380	1.02227
-10.0	...	1.02434	...	1.02504	...	1.02647	1.02398	1.02357	...	1.02333	1.02183
-9.5	...	1.02385	...	1.02454	...	1.02594	1.02351	1.02310	...	1.02286	1.02140
-9.0	...	1.02337	...	1.02404	1.02322	1.02542	1.02303	1.02263	...	1.02240	1.02096
-8.5	...	1.02289	...	1.02354	1.02274	1.02489	1.02256	1.02216	...	1.02193	1.02052
-8.0	...	1.02240	...	1.02304	1.02226	1.02436	1.02208	1.02169	...	1.02146	1.02009
-7.5	...	1.02192	...	1.02255	1.02177	1.02383	1.02161	1.02122	...	1.02100	1.01965
-7.0	...	1.02144	...	1.02205	1.02129	1.02330	1.02113	1.02075	...	1.02053	1.01922
-6.5	...	1.02095	...	1.02155	1.02081	1.02277	1.02066	1.02028	...	1.02007	1.01878
-6.0	...	1.02047	...	1.02105	1.02033	1.02224	1.02018	1.01980	...	1.01960	1.01835
-5.5	...	1.01998	...	1.02055	1.01984	1.02171	1.01971	1.01933	...	1.01913	1.01791
-5.0	...	1.01950	...	1.02006	1.01936	1.02118	1.01923	1.01886	...	1.01867	1.01747
-4.5	...	1.01901	...	1.01956	1.01888	1.02065	1.01875	1.01839	...	1.01820	1.01704
-4.0	...	1.01853	...	1.01906	1.01840	1.02012	1.01828	1.01792	...	1.01773	1.01660
-3.5	...	1.01804	...	1.01856	1.01791	1.01959	1.01780	1.01745	...	1.01727	1.01617
-3.0	...	1.01756	...	1.01806	1.01743	1.01906	1.01732	1.01698	...	1.01680	1.01573
-2.5	...	1.01707	...	1.01756	1.01695	1.01853	1.01685	1.01651	...	1.01633	1.01529
-2.0	...	1.01659	...	1.01706	1.01646	1.01800	1.01637	1.01604	...	1.01587	1.01486
-1.5	...	1.01610	...	1.01656	1.01598	1.01747	1.01589	1.01557	...	1.01540	1.01442
-1.0	...	1.01562	...	1.01606	1.01550	1.01694	1.01541	1.01510	...	1.01493	1.01399
-0.5	...	1.01513	...	1.01557	1.01502	1.01641	1.01494	1.01462	...	1.01447	1.01355
0.0	...	1.01464	...	1.01507	1.01453	1.01588	1.01446	1.01415	...	1.01400	1.01311
0.5	...	1.01416	...	1.01457	1.01405	1.01535	1.01398	1.01368	...	1.01354	1.01268
1.0	...	1.01367	...	1.01407	1.01357	1.01482	1.01350	1.01321	...	1.01307	1.01224
1.5	...	1.01319	...	1.01357	1.01308	1.01429	1.01302	1.01274	...	1.01260	1.01180
2.0	...	1.01270	...	1.01307	1.01260	1.01376	1.01254	1.01227	...	1.01214	1.01137
2.5	...	1.01221	...	1.01257	1.01211	1.01324	1.01206	1.01180	...	1.01167	1.01093
m-Xylene[4]	1.031887514	5.2326	×10-4	1.3253 × 10-7	7.35960×10-11	0	1.01271	1.01158	1.01132	...	1.01120	1.01049
3.0	...	1.01173	...	1.01206	1.01163	1.01271	1.01158	1.01132	...	1.01120	1.01049
3.5	...	1.01124	...	1.01156	1.01115	1.01218	1.01110	1.01085	...	1.01074	1.01006
o-Xylene	1.031436449	5.2302	×10-4	2.5217 × 10-9	2.13840 ×10-10	0	1.01165	1.00562	1.01038	...	1.01027	1.00962
4.0	...	1.01075	...	1.01106	1.01066	1.01165	1.01062	1.01038	...	1.01027	1.00962
p-Xylene	1.032307000	5.2815	×10-4	1.8416 × 10-7	1.89256 ×10-100		1.01112	1.0054	1.00991	...	1.00980	1.00918
4.5	...	1.01026	...	1.01056	1.01018	1.01112	1.01014	1.00991	...	1.00980	1.00918
148.9-176.7°C	1.031118000	5.1827	×10-4	3.5109 × 10-9	1.98360×10-11	0	1.0059	1.00966	1.00944	...	1.00934	1.008752
5.0	...	1.00978	...	1.01006	1.00970	1.01059	1.00966	1.00944	...	1.00934	1.00875
176.7-204.4°C	1.029099000	4.8287	×10-4	3.7692 × 10-8	3.78575×10-11	0	1.0006	1.00918	1.00897	...	1.00887	1.00831
5.5	...	1.00929	...	1.00956	1.00921	1.01006	1.00918	1.00897	...	1.00887	1.00831
6.0	1.01054	1.00880	...	1.00906	1.00873	1.00953	1.00870	1.00850	...	1.00840	1.00787
6.5	1.00995	1.00831	...	1.00856	1.00824	1.00900	1.00822	1.00802	...	1.00794	1.00744
7.0	1.00937	1.00782	1.00952	1.00805	1.00776	1.00847	1.00774	1.00755	...	1.00747	1.00700
7.5	1.00879	1.00734	1.00893	1.00755	1.00727	1.00794	1.00725	1.00708	...	1.00700	1.00656
8.0	1.00821	1.00685	1.00833	1.00705	1.00679	1.00741	1.00677	1.00661	...	1.00654	1.00612

TABLE 4 *Continued*

Volume Correction to 15°C											
~~P~~Tempe~~redu~~c~~a~~ture °C	~~a~~Benzene	~~b~~Cumene	Cyclohexane	~~d~~Ethyl Benzene	Styrene	~~VCF~~[5]Toluene	*m*-Xylene and Mixed Xylenes	*o*-Xylene*p*-Xylene		148.9~~F~~ to 176.7°C Aromatic Hydrocarbons	176.7 to 204.4°C Aromatic Hydrocarbons
8.5	1.00762	1.00636	1.00774	1.00655	1.00631	1.00688	1.00629	1.00614	...	1.00607	1.00569
9.0	1.00704	1.00587	1.00715	1.00605	1.00582	1.00635	1.00581	1.00566	...	1.00560	1.00525
9.5	1.00645	1.00538	1.00655	1.00554	1.00534	1.00582	1.00532	1.00519	...	1.00514	1.00481
10.0	1.00587	1.00489	1.00596	1.00504	1.00485	1.00529	1.00484	1.00472	...	1.00467	1.00437
10.5	1.00528	1.00440	1.00536	1.00454	1.00437	1.00476	1.00436	1.00425	...	1.00420	1.00394
11.0	1.00470	1.00391	1.00477	1.00403	1.00388	1.00423	1.00387	1.00378	...	1.00374	1.00350
11.5	1.00411	1.00342	1.00417	1.00353	1.00340	1.00370	1.00339	1.00330	...	1.00327	1.00306
12.0	1.00352	1.00294	1.00358	1.00303	1.00291	1.00317	1.00291	1.00283	...	1.00280	1.00262
12.5	1.00294	1.00245	1.00298	1.00252	1.00243	1.00264	1.00242	1.00236	...	1.00234	1.00219
13.0	1.00235	1.00196	1.00239	1.00202	1.00194	1.00212	1.00194	1.00189	...	1.00187	1.00175
13.5	1.00176	1.00147	1.00179	1.00152	1.00146	1.00159	1.00145	1.00141	1.00148	1.00140	1.00131
14.0	1.00117	1.00098	1.00119	1.00101	1.00097	1.00106	1.00097	1.00094	1.00099	1.00094	1.00087
14.5	1.00058	1.00049	1.00060	1.00051	1.00049	1.00053	1.00048	1.00047	1.00050	1.00047	1.00043
15.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
15.5	0.99941	0.99950	0.99940	0.99950	0.99952	0.99947	0.99951	0.99952	0.99951	0.99954	0.99956
16.0	0.99882	0.99901	0.99881	0.99899	0.99903	0.99894	0.99903	0.99905	0.99902	0.99907	0.99912
16.5	0.99822	0.99852	0.99821	0.99849	0.99854	0.99841	0.99854	0.99858	0.99852	0.99860	0.99868
17.0	0.99763	0.99803	0.99761	0.99798	0.99806	0.99788	0.99806	0.99810	0.99803	0.99814	0.99824
17.5	0.99704	0.99754	0.99702	0.99748	0.99757	0.99735	0.99757	0.99763	0.99754	0.99767	0.99781
18.0	0.99645	0.99705	0.99642	0.99697	0.99709	0.99682	0.99708	0.99716	0.99704	0.99720	0.99737
18.5	0.99586	0.99656	0.99582	0.99647	0.99660	0.99629	0.99659	0.99668	0.99655	0.99674	0.99693
19.0	0.99527	0.99607	0.99522	0.99596	0.99612	0.99576	0.99611	0.99621	0.99605	0.99627	0.99649
19.5	0.99467	0.99557	0.99462	0.99545	0.99563	0.99523	0.99562	0.99574	0.99556	0.99580	0.99605
20.0	0.99408	0.99508	0.99402	0.99495	0.99514	0.99470	0.99513	0.99526	0.99506	0.99534	0.99561
20.5	0.99349	0.99459	0.99343	0.99444	0.99466	0.99417	0.99464	0.99479	0.99457	0.99487	0.99518
21.0	0.99289	0.99410	0.99283	0.99393	0.99417	0.99364	0.99416	0.99432	0.99407	0.99440	0.99474
21.5	0.99230	0.99361	0.99223	0.99343	0.99368	0.99311	0.99367	0.99384	0.99358	0.99393	0.99430
22.0	0.99170	0.99311	0.99163	0.99292	0.99320	0.99258	0.99318	0.99337	0.99308	0.99347	0.99386
22.5	0.99111	0.99262	0.99103	0.99241	0.99271	0.99206	0.99269	0.99289	0.99258	0.99300	0.99342
23.0	0.99051	0.99213	0.99043	0.99191	0.99223	0.99153	0.99220	0.99242	0.99209	0.99253	0.99298
23.5	0.98991	0.99164	0.98983	0.99140	0.99174	0.99100	0.99171	0.99195	0.99159	0.99207	0.99254
24.0	0.98932	0.99114	0.98923	0.99089	0.99125	0.99047	0.99122	0.99147	0.99109	0.99160	0.99210
24.5	0.98872	0.99065	0.98863	0.99038	0.99076	0.98994	0.99073	0.99100	0.99060	0.99113	0.99167
25.0	0.98812	0.99016	0.98803	0.98988	0.99028	0.98941	0.99024	0.99053	0.99010	0.99067	0.99123
25.5	0.98752	0.98966	0.98743	0.98937	0.98979	0.98888	0.98975	0.99005	0.98960	0.99020	0.99079
26.0	0.98693	0.98917	0.98683	0.98886	0.98930	0.98835	0.98926	0.98958	0.98910	0.98973	0.99035
26.5	0.98633	0.98868	0.98622	0.98835	0.98882	0.98782	0.98877	0.98910	0.98861	0.98927	0.98991
27.0	0.98573	0.98818	0.98562	0.98784	0.98833	0.98729	0.98828	0.98863	0.98811	0.98880	0.98947
27.5	0.98513	0.98769	0.98502	0.98733	0.98784	0.98676	0.98779	0.98816	0.98761	0.98833	0.98903
28.0	0.98453	0.98719	0.98442	0.98683	0.98736	0.98623	0.98730	0.98768	0.98711	0.98786	0.98859
28.5	0.98393	0.98670	0.98382	0.98632	0.98687	0.98570	0.98680	0.98720	0.98661	0.98740	0.98815
29.0	0.98333	0.98621	0.98322	0.98581	0.98638	0.98517	0.98631	0.98673	0.98611	0.98693	0.98771
29.5	0.98272	0.98571	0.98261	0.98530	0.98589	0.98464	0.98582	0.98625	0.98561	0.98646	0.98727
30.0	0.98212	0.98522	0.98201	0.98479	0.98541	0.98411	0.98533	0.98578	0.98511	0.98600	0.98683
30.5	0.98152	0.98472	0.98141	0.98428	0.98492	0.98358	0.98484	0.98530	0.98461	0.98553	0.98639
31.0	0.98092	0.98423	0.98080	0.98377	0.98443	0.98305	0.98434	0.98483	0.98411	0.98506	0.98595
31.5	0.98032	0.98373	0.98020	0.98326	0.98394	0.98253	0.98385	0.98435	0.98361	0.98459	0.98552
32.0	0.97971	0.98324	0.97960	0.98275	0.98345	0.98200	0.98336	0.98388	0.98311	0.98413	0.98508
32.5	0.97911	0.98274	0.97899	0.98224	0.98297	0.98147	0.98286	0.98340	0.98261	0.98366	0.98464
33.0	0.97850	0.98225	0.97839	0.98173	0.98248	0.98094	0.98237	0.98293	0.98211	0.98319	0.98420
33.5	0.97790	0.98175	0.97779	0.98122	0.98199	0.98041	0.98187	0.98245	0.98161	0.98273	0.98376
34.0	0.97729	0.98125	0.97718	0.98071	0.98150	0.97988	0.98138	0.98198	0.98111	0.98226	0.98332
34.5	0.97669	0.98076	0.97658	0.98020	0.98101	0.97935	0.98088	0.98150	0.98061	0.98179	0.98288
35.0	0.97608	0.98026	0.97597	0.97969	0.98053	0.97882	0.98039	0.98102	0.98010	0.98132	0.98244
35.5	0.97548	0.97977	0.97537	0.97918	0.98004	0.97829	0.97989	0.98055	0.97960	0.98086	0.98200
36.0	0.97487	0.97927	0.97476	0.97867	0.97955	0.97776	0.97940	0.98007	0.97910	0.98039	0.98156
36.5	0.97426	0.97877	0.97416	0.97816	0.97906	0.97723	0.97890	0.97959	0.97860	0.97992	0.98112
37.0	0.97366	0.97828	0.97355	0.97765	0.97857	0.97670	0.97841	0.97912	0.97809	0.97945	0.98068
37.5	0.97305	0.97778	0.97295	0.97713	0.97808	0.97617	0.97791	0.97864	0.97759	0.97899	0.98024
38.0	0.97244	0.97728	0.97234	0.97662	0.97760	0.97564	0.97741	0.97816	0.97709	0.97852	0.97980
38.5	0.97183	0.97679	0.97174	0.97611	0.97711	0.97511	0.97692	0.97769	0.97658	0.97805	0.97936
39.0	0.97122	0.97629	0.97113	0.97560	0.97662	0.97458	0.97642	0.97721	0.97608	0.97758	0.97892
39.5	0.97061	0.97579	0.97053	0.97509	0.97613	0.97405	0.97592	0.97673	0.97558	0.97712	0.97848
40.0	0.97000	0.97529	0.96992	0.97458	0.97564	0.97353	0.97543	0.97626	0.97207	0.97665	0.97804
40.5	0.96939	0.97480	0.96931	0.97407	0.97515	0.97300	0.97493	0.97578	0.97457	0.97618	0.97760
41.0	0.96878	0.97430	0.96871	0.97356	0.97466	0.97247	0.97443	0.97530	0.97407	0.97571	0.97716
41.5	0.96817	0.97380	0.96810	0.97304	0.97417	0.97194	0.97393	0.97483	0.97356	0.97525	0.97672
42.0	0.96756	0.97330	0.96749	0.97253	0.97368	0.97141	0.97343	0.97435	0.97306	0.97478	0.97627
42.5	0.96695	0.97281	0.96688	0.97202	0.97319	0.97088	0.97293	0.97387	0.97255	0.97431	0.97583
43.0	0.96634	0.97231	0.96628	0.97151	0.97270	0.97035	0.97244	0.97339	0.97205	0.97384	0.97539

TABLE 4 *Continued*

~~P~~Temper~~oduc~~ature °C	~~a~~Benzene	~~b~~Cumene	Cyclohexane	~~d~~Ethyl Benzene	Styrene	~~VCF~~[5]Toluene	*m*-Xylene and Mixed Xylenes	*o*-Xylene	*p*-Xylene	148.9~~F~~ to 176.7°C Aromatic Hydrocarbons	176.7 to 204.4°C Aromatic Hydrocarbons
					Volume Correction to 15°C						
43.5	0.96572	0.97181	0.96567	0.97100	0.97221	0.96982	0.97194	0.97291	0.97154	0.97338	0.97495
44.0	0.96511	0.97131	0.96506	0.97409	0.97172	0.96929	0.97144	0.97243	0.97104	0.97291	0.97451
44.5	0.96450	0.97081	0.96445	0.96998	0.97124	0.96876	0.97094	0.97196	0.97053	0.97244	0.97407
45.0	0.96388	0.97031	0.96385	0.96946	0.97075	0.96823	0.97044	0.97148	0.97002	0.97197	0.97363
45.5	0.96327	0.96981	0.96324	0.96895	0.97026	0.96770	0.96994	0.97101	0.96952	0.97151	0.97319
46.0	0.96265	0.96932	0.96263	0.96844	0.96977	0.96717	0.96944	0.97052	0.96901	0.97104	0.97275
46.5	0.96204	0.96882	0.96202	0.96793	0.96928	0.96664	0.96894	0.97004	0.96850	0.97057	0.97231
47.0	0.96142	0.96832	0.96141	0.96742	0.96879	0.96611	0.96843	0.96957	0.96800	0.97010	0.97187
47.5	0.96081	0.96782	0.96080	0.96691	0.96830	0.96558	0.96793	0.96909	0.96749	0.96964	0.97143
48.0	0.96019	0.96732	0.96019	0.96639	0.96781	0.96505	0.96743	0.96861	0.96698	0.96917	0.97099
48.5	0.95958	0.96682	0.95958	0.96588	0.96732	0.96453	0.96693	0.96813	0.96648	0.96870	0.97054
49.0	0.95896	0.96632	0.95897	0.96537	0.96683	0.96400	0.96643	0.96765	0.96597	0.96823	0.97010
49.5	0.95834	0.96582	0.95836	0.96486	0.96634	0.96347	0.96592	0.96717	0.96546	0.96777	0.96966
50.0	0.95772	0.96532	0.95775	0.96435	0.96584	0.96294	0.96542	0.96669	0.96495	0.96730	0.96922
50.5	0.95711	0.96482	0.95714	0.96384	0.96535	0.96241	0.96492	0.96621	0.96445	0.96683	0.96878
51.0	0.95649	0.96432	0.96653	0.96332	0.96486	0.96188	0.96442	0.96573	0.96394	0.96636	0.96834
51.5	0.95587	0.96382	0.95592	0.96281	0.96437	0.96135	0.96391	0.96525	0.96343	0.96589	0.96790
52.0	0.95525	0.96332	0.95531	0.96230	0.96388	0.96082	0.96341	0.96477	0.96292	0.96543	0.96746
52.5	0.95463	0.96282	0.95470	0.96179	0.96339	0.96029	0.96291	0.96429	0.96241	0.96496	0.96702
53.0	0.95401	0.96231	0.95409	0.96128	0.96290	0.95976	0.96240	0.96381	0.96190	0.96449	0.96657
53.5	0.95339	0.96181	0.95348	0.96077	0.96241	0.95923	0.96190	0.96333	0.96139	0.96402	0.96613
54.0	0.95277	0.96131	0.95287	0.96026	0.96192	0.95870	0.96139	0.96285	0.96089	0.96356	0.96569
54.5	0.95215	0.96081	0.95226	0.95975	0.96143	0.95817	0.96089	0.96237	0.96038	0.96309	0.96525
55.0	0.95153	0.96031	0.95165	0.95924	0.96094	0.95764	0.96038	0.96189	0.95987	0.96262	0.96481
55.5	0.95090	0.95981	0.95103	0.95873	0.96045	0.95711	0.95988	0.96141	0.95936	0.96215	0.96437
56.0	0.95028	0.95931	0.95042	0.95822	0.95995	0.95658	0.95937	0.96092	0.95885	0.96168	0.96393
56.5	0.94966	0.95881	0.94981	0.95771	0.95946	0.95605	0.95886	0.96044	0.95834	0.96122	0.96348
57.0	0.94904	0.95830	0.94920	0.95720	0.95897	0.95552	0.95836	0.95996	0.95783	0.96075	0.96304
57.5	0.94841	0.95780	0.94859	0.95669	0.95848	0.95500	0.95785	0.95948	0.95732	0.96028	0.96260
58.0	0.94779	0.95730	0.94797	0.05618	0.95799	0.95447	0.95735	0.95900	0.95680	0.95981	0.96216
58.5	0.94716	0.95680	0.94736	0.95567	0.95750	0.95394	0.95684	0.95852	0.95629	0.95934	0.96172
59.0	0.94654	0.95629	0.94675	0.95516	0.95700	0.95341	0.95633	0.95803	0.95578	0.95888	0.96128
59.5	0.94592	0.95579	0.94613	0.95465	0.95651	0.95288	0.95582	0.95755	0.95527	0.95841	0.96083
60.0	0.94529	0.95529	0.94552	0.95414	0.95602	0.95235	0.95532	0.95757	0.95476	0.95794	0.96039
60.5	...	...	...	...	...	...	...	...	0.95425	...	...
61.0	...	...	...	...	...	...	...	...	0.95374	...	...
61.5	...	...	...	...	...	...	...	...	0.95323	...	...
62.0	...	...	...	...	...	...	...	...	0.95271	...	...
62.5	...	...	...	...	...	...	...	...	0.95220	...	...
63.0	...	...	...	...	...	...	...	...	0.95169	...	...
63.5	...	...	...	...	...	...	...	...	0.95118	...	...
64.0	...	...	...	...	...	...	...	...	0.95066	...	...
64.5	...	...	...	...	...	...	...	...	0.95015	...	...
65.0	...	...	...	...	...	...	...	...	0.94964	...	...
65.5	...	...	...	...	...	...	...	...	0.94912	...	...

~~[A]and Mixed Xylenes.~~

~~35,129·0.98341=34,546litres~~

$$35{,}129 \cdot 0.98341 = 34{,}546 \text{ litres}$$

For 20°C, enter Eq 1 with 31.7 and the appropriate constants for Table 3 to calculate a VCF of 0.98829. The volume at 20°C is:

$$35{,}129 \cdot 0.98829 = 34{,}718 \textit{ litres}$$

6.2 *Converting Volume to Weight for Chemicals Listed in Table 1*—Multiply the volume in litres at 15°C or 20°C by the appropriate density in kg/L at 15°C or 20°C (see Table 1 ~~and~~ and Note 1 in Table 1~~Note).~~).

6.2.1 *Example 2*—What is the weight of *p*-xylene whose volume is 34,546 litres?

~~6.2.1.1The weight is:~~

The weight at 15°C is:

~~34,546·0.86501=29,883kg*invacuo*~~

$$34{,}546 \cdot 0.86503 = 29{,}884 \text{kg}$$ ~~*invacuo*~~

~~or~~ in vacuo or

~~34,546·0.86394=29,846kg *in air*~~

$$34{,}546 \cdot 0.86396 = 29{,}847 \text{ kg } \textit{in air}$$