



Designation: D4311/D4311M – 09

# Standard Practice for Determining Asphalt Volume Correction to a Base Temperature<sup>1</sup>

This standard is issued under the fixed designation D4311/D4311M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This practice provides tables of volume correction factors which may be used to convert volumes of asphalt measured at different temperatures to a volume at a standard base temperature. These tables are applicable to all types of asphalts except emulsified asphalts.

1.2 This practice provides tables to convert asphalt volumes to 15°C [60°F] from volumes measured at any temperature from –25 to +275°C [0 to 500°F].

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.

NOTE 1—Correction factors in Table 1 and Table 2 are for use in place of correction factors provided in Guide D1250, which do not address requirements for asphalt specifications.<sup>2</sup>

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</sup>

D70 Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)

D1250 Guide for Use of the Petroleum Measurement Tables

D3142 Test Method for Specific Gravity, API Gravity, or Density of Cutback Asphalts by Hydrometer Method

D3289 Test Method for Density of Semi-Solid and Solid Bituminous Materials (Nickel Crucible Method)

## 3. Significance and Use

3.1 Asphalts change in volume with change in temperature. They are loaded or transferred at widely varying temperatures.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.40 on Asphalt Specifications.

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<sup>2</sup> Factors originally published for Groups 0 and 1 oils in Tables 7, 25, and 55 in D1250 – 52 T. Last previous edition D1250 – 04.

<sup>3</sup> 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.

Volume correction factors are used to adjust bulk volumes measured at those temperatures to corresponding volumes at a base temperature of 15°C or [60°F] for the purposes of custody transfer and accounting operations.

3.2 Correction factors as provided in this practice have proven to be sufficiently accurate for the intended purposes.

3.3 Coefficients of expansion used for development of data in this practice are as follows:

Table	Column A	Column B
1	0.00035	0.00040
2	0.00063	0.00072

## 4. Procedure

4.1 Volume correction factors are provided for volume adjustments to 15°C in Table 1 and [60°F] in Table 2. The tables are entered with asphalt temperature at which bulk volume is measured.

4.2 The tables provide two sets of factors in columns labeled A and B. The selection of the appropriate column, A or B, is defined by table footnotes. The selection is based on asphalt density at 15°C, API gravity at [60°F], or by the specific gravity [60/60°F]. Column A factors apply to the majority of asphalts.

4.2.1 Values for density at 15°C, API gravity at [60°F], and specific gravity [60/60°F] may be obtained by Test Method D70, Test Method D3289, or Test Method D3142.

4.2.2 Volume correction factors (see Note 2) for Table 1 were generated using the following formulas:

4.2.2.1 Table 1—A Factor Asphalts:

$$A = 1.009 - 6.3341 \times 10^{-4} [T(^{\circ}\text{C})] + 1.4571 \times 10^{-7} [T(^{\circ}\text{C})]^2 \quad (1)$$

where:

A = volume correction factor, and  
T(°C) = temperature of asphalt in °C.

4.2.2.2 Table 1—B Factor Asphalts:

$$B = 1.0108 - 7.2344 \times 10^{-4} [T(^{\circ}\text{C})] + 2.199 \times 10^{-7} [T(^{\circ}\text{C})]^2 \quad (2)$$

where:

B = volume correction factor, and  
T(°C) = temperature of asphalt in °C.

4.2.2.3 These formulas may be used in lieu of Table 1 to calculate volume correction factors.

**TABLE 1 Volume Reduction to 15°C**

Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C		Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C		Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C	
	A	B		A	B		A	B
-25.0	1.0254	1.0290	0	1.0095	1.0108	25.0	0.9937	0.9929
-24.5	1.0251	1.0287	0.5	1.0092	1.0104	25.5	0.9934	0.9925
-24.0	1.0248	1.0283	1.0	1.0088	1.0101	26.0	0.9931	0.9921
-23.5	1.0244	1.0279	1.5	1.0085	1.0097	26.5	0.9928	0.9918
-23.0	1.0241	1.0276	2.0	1.0082	1.0094	27.0	0.9925	0.9914
-22.5	1.0238	1.0272	2.5	1.0079	1.0090	27.5	0.9922	0.9911
-22.0	1.0235	1.0268	3.0	1.0076	1.0086	28.0	0.9918	0.9907
-21.5	1.0232	1.0265	3.5	1.0073	1.0083	28.5	0.9915	0.9904
-21.0	1.0228	1.0261	4.0	1.0069	1.0079	29.0	0.9912	0.9900
-20.5	1.0225	1.0257	4.5	1.0066	1.0076	29.5	0.9909	0.9897
-20.0	1.0222	1.0254	5.0	1.0063	1.0072	30.0	0.9906	0.9893
-19.5	1.0219	1.0250	5.5	1.0060	1.0068	30.5	0.9903	0.9889
-19.0	1.0216	1.0246	6.0	1.0057	1.0065	31.0	0.9900	0.9886
-18.5	1.0212	1.0243	6.5	1.0054	1.0061	31.5	0.9897	0.9882
-18.0	1.0209	1.0239	7.0	1.0050	1.0057	32.0	0.9893	0.9879
-17.5	1.0206	1.0235	7.5	1.0047	1.0054	32.5	0.9890	0.9875
-17.0	1.0203	1.0232	8.0	1.0044	1.0050	33.0	0.9887	0.9872
-16.5	1.0200	1.0228	8.5	1.0041	1.0047	33.5	0.9884	0.9868
-16.0	1.0196	1.0224	9.0	1.0038	1.0043	34.0	0.9881	0.9865
-15.5	1.0193	1.0221	9.5	1.0035	1.0039	34.5	0.9878	0.9861
-15.0	1.0190	1.0217	10.0	1.0031	1.0036	35.0	0.9875	0.9858
-14.5	1.0187	1.0213	10.5	1.0028	1.0032	35.5	0.9872	0.9854
-14.0	1.0184	1.0210	11.0	1.0025	1.0029	36.0	0.9869	0.9850
-13.5	1.0180	1.0206	11.5	1.0022	1.0025	36.5	0.9865	0.9847
-13.0	1.0177	1.0202	12.0	1.0019	1.0022	37.0	0.9862	0.9843
-12.5	1.0174	1.0199	12.5	1.0016	1.0018	37.5	0.9859	0.9840
-12.0	1.0171	1.0195	13.0	1.0013	1.0014	38.0	0.9856	0.9836
-11.5	1.0168	1.0192	13.5	1.0009	1.0011	38.5	0.9853	0.9833
-11.0	1.0165	1.0188	14.0	1.0006	1.0007	39.0	0.9850	0.9829
-10.5	1.0161	1.0184	14.5	1.0003	1.0004	39.5	0.9847	0.9826
-10.0	1.0158	1.0181	15.0	1.0000	1.0000	40.0	0.9844	0.9822
-9.5	1.0155	1.0177	15.5	0.9997	0.9996	40.5	0.9841	0.9819
-9.0	1.0152	1.0173	16.0	0.9994	0.9993	41.0	0.9837	0.9815
-8.5	1.0149	1.0170	16.5	0.9991	0.9989	41.5	0.9834	0.9812
-8.0	1.0145	1.0166	17.0	0.9987	0.9986	42.0	0.9831	0.9808
-7.5	1.0142	1.0162	17.5	0.9984	0.9982	42.5	0.9828	0.9805
-7.0	1.0139	1.0159	18.0	0.9981	0.9979	43.0	0.9825	0.9801
-6.5	1.0136	1.0155	18.5	0.9978	0.9975	43.5	0.9822	0.9797
-6.0	1.0133	1.0152	19.0	0.9975	0.9971	44.0	0.9819	0.9794
-5.5	1.0130	1.0148	19.5	0.9972	0.9968	44.5	0.9816	0.9790
-5.0	1.0126	1.0144	20.0	0.9969	0.9964	45.0	0.9813	0.9787
-4.5	1.0123	1.0141	20.5	0.9965	0.9961	45.5	0.9809	0.9783
-4.0	1.0120	1.0137	21.0	0.9962	0.9957	46.0	0.9806	0.9780
-3.5	1.0117	1.0133	21.5	0.9959	0.9953	46.5	0.9803	0.9776
-3.0	1.0114	1.0130	22.0	0.9956	0.9950	47.0	0.9800	0.9773
-2.5	1.0111	1.0126	22.5	0.9953	0.9946	47.5	0.9797	0.9769
-2.0	1.0107	1.0122	23.0	0.9950	0.9943	48.0	0.9794	0.9766
-1.5	1.0104	1.0119	23.5	0.9947	0.9939	48.5	0.9791	0.9762
-1.0	1.0101	1.0115	24.0	0.9944	0.9936	49.0	0.9788	0.9759
-0.5	1.0098	1.0112	24.5	0.9940	0.9932	49.5	0.9785	0.9755
50.0	0.9782	0.9752	75.0	0.9628	0.9578	100.0	0.9476	0.9407
50.5	0.9779	0.9748	75.5	0.9625	0.9574	100.5	0.9473	0.9403
51.5	0.9772	0.9741	76.5	0.9619	0.9567	101.5	0.9467	0.9396
52.0	0.9769	0.9738	77.0	0.9616	0.9564	102.0	0.9464	0.9393
51.0	0.9775	0.9745	76.0	0.9622	0.9571	101.0	0.9470	0.9400
52.5	0.9766	0.9734	77.5	0.9613	0.9561	102.5	0.9461	0.9390
53.5	0.9760	0.9727	78.5	0.9606	0.9554	103.5	0.9455	0.9383
54.0	0.9757	0.9724	79.0	0.9603	0.9550	104.0	0.9452	0.9379
54.5	0.9754	0.9720	79.5	0.9600	0.9547	104.5	0.9449	0.9376
53.0	0.9763	0.9731	78.0	0.9609	0.9557	103.0	0.9458	0.9386

**TABLE 1** *Continued*

Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C		Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C		Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C	
	A	B		A	B		A	B
55.0	0.9751	0.9717	80.0	0.9597	0.9543	105.0	0.9446	0.9373
55.5	0.9748	0.9713	80.5	0.9594	0.9540	105.5	0.9443	0.9369
56.0	0.9745	0.9710	81.0	0.9591	0.9536	106.0	0.9440	0.9366
56.5	0.9741	0.9706	81.5	0.9588	0.9533	106.5	0.9437	0.9363
57.0	0.9738	0.9703	82.0	0.9585	0.9530	107.0	0.9434	0.9359
57.5	0.9735	0.9699	82.5	0.9582	0.9526	107.5	0.9431	0.9356
58.0	0.9732	0.9696	83.0	0.9579	0.9523	108.0	0.9428	0.9352
58.5	0.9729	0.9692	83.5	0.9576	0.9519	108.5	0.9425	0.9349
59.0	0.9726	0.9689	84.0	0.9573	0.9516	109.0	0.9422	0.9346
59.5	0.9723	0.9685	84.5	0.9570	0.9512	109.5	0.9419	0.9342
60.0	0.9720	0.9682	85.0	0.9567	0.9509	110.0	0.9416	0.9339
60.5	0.9717	0.9678	85.5	0.9564	0.9506	110.5	0.9413	0.9335
61.0	0.9714	0.9675	86.0	0.9561	0.9502	111.0	0.9410	0.9332
61.5	0.9711	0.9671	86.5	0.9558	0.9499	111.5	0.9407	0.9329
62.0	0.9708	0.9668	87.0	0.9555	0.9495	112.0	0.9404	0.9325
62.5	0.9704	0.9664	87.5	0.9552	0.9492	112.5	0.9401	0.9322
63.0	0.9701	0.9661	88.0	0.9549	0.9488	113.0	0.9398	0.9319
63.5	0.9698	0.9658	88.5	0.9546	0.9485	113.5	0.9395	0.9315
64.0	0.9695	0.9654	89.0	0.9542	0.9482	114.0	0.9392	0.9312
64.5	0.9692	0.9651	89.5	0.9539	0.9478	114.5	0.9389	0.9309
65.0	0.9689	0.9647	90.0	0.9536	0.9475	115.0	0.9386	0.9305
65.5	0.9686	0.9644	90.5	0.9533	0.9471	115.5	0.9383	0.9302
66.0	0.9683	0.9640	91.0	0.9530	0.9468	116.0	0.9380	0.9298
66.5	0.9680	0.9637	91.5	0.9527	0.9464	116.5	0.9377	0.9295
67.0	0.9677	0.9633	92.0	0.9524	0.9461	117.0	0.9374	0.9292
67.5	0.9674	0.9630	92.5	0.9521	0.9458	117.5	0.9371	0.9288
68.0	0.9671	0.9626	93.0	0.9518	0.9454	118.0	0.9368	0.9285
68.5	0.9668	0.9623	93.5	0.9515	0.9451	118.5	0.9365	0.9282
69.0	0.9665	0.9619	94.0	0.9512	0.9447	119.0	0.9362	0.9278
69.5	0.9661	0.9616	94.5	0.9509	0.9444	119.5	0.9359	0.9275
70.0	0.9658	0.9612	95.0	0.9506	0.9441	120.0	0.9356	0.9272
70.5	0.9655	0.9609	95.5	0.9503	0.9437	120.5	0.9353	0.9268
71.0	0.9652	0.9605	96.0	0.9500	0.9434	121.0	0.9350	0.9265
71.5	0.9649	0.9602	96.5	0.9497	0.9430	121.5	0.9347	0.9262
72.0	0.9646	0.9599	97.0	0.9494	0.9427	122.0	0.9344	0.9258
72.5	0.9643	0.9595	97.5	0.9491	0.9424	122.5	0.9341	0.9255
73.0	0.9640	0.9592	98.0	0.9488	0.9420	123.0	0.9338	0.9251
73.5	0.9637	0.9588	98.5	0.9485	0.9417	123.5	0.9335	0.9248
74.0	0.9634	0.9585	99.0	0.9482	0.9413	124.0	0.9332	0.9245
74.5	0.9631	0.9581	99.5	0.9479	0.9410	124.5	0.9329	0.9241
125.0	0.9326	0.9238	150.0	0.9177	0.9072	175.0	0.9031	0.8909
125.5	0.9323	0.9235	150.5	0.9174	0.9069	175.5	0.9028	0.8906
126.0	0.9320	0.9231	151.0	0.9171	0.9066	176.0	0.9025	0.8903
126.5	0.9317	0.9228	151.5	0.9169	0.9063	176.5	0.9022	0.8900
127.0	0.9314	0.9225	152.0	0.9166	0.9059	177.0	0.9019	0.8896
127.5	0.9311	0.9221	152.5	0.9163	0.9056	177.5	0.9016	0.8893
128.0	0.9308	0.9218	153.0	0.9160	0.9053	178.0	0.9013	0.8890
128.5	0.9305	0.9215	153.5	0.9157	0.9049	178.5	0.9010	0.8887
129.0	0.9302	0.9211	154.0	0.9154	0.9046	179.0	0.9008	0.8884
129.5	0.9299	0.9208	154.5	0.9151	0.9043	179.5	0.9005	0.8880
130.0	0.9296	0.9205	155.0	0.9148	0.9040	180.0	0.9002	0.8877
130.5	0.9293	0.9201	155.5	0.9145	0.9036	180.5	0.8999	0.8874
131.0	0.9290	0.9198	156.0	0.9142	0.9033	181.0	0.8996	0.8871
131.5	0.9287	0.9195	156.5	0.9139	0.9030	181.5	0.8993	0.8867
132.0	0.9284	0.9191	157.0	0.9136	0.9026	182.0	0.8990	0.8864
132.5	0.9281	0.9188	157.5	0.9133	0.9023	182.5	0.8987	0.8861
133.0	0.9278	0.9185	158.0	0.9130	0.9020	183.0	0.8984	0.8858
133.5	0.9275	0.9181	158.5	0.9127	0.9017	183.5	0.8981	0.8855
134.0	0.9272	0.9178	159.0	0.9124	0.9013	184.0	0.8979	0.8851
134.5	0.9269	0.9175	159.5	0.9121	0.9010	184.5	0.8976	0.8848

**TABLE 1** *Continued*

Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C		Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C		Observed Temperature, °C	Volume Correction <sup>A,B</sup> Factor to 15°C	
	A	B		A	B		A	B
135.0	0.9266	0.9171	160.0	0.9119	0.9007	185.0	0.8973	0.8845
135.5	0.9263	0.9168	160.5	0.9116	0.9004	185.5	0.8970	0.8842
136.0	0.9260	0.9165	161.0	0.9113	0.9000	186.0	0.8967	0.8839
136.5	0.9257	0.9162	161.5	0.9110	0.8997	186.5	0.8964	0.8835
137.0	0.9254	0.9158	162.0	0.9107	0.8994	187.0	0.8961	0.8832
137.5	0.9251	0.9155	162.5	0.9104	0.8991	187.5	0.8958	0.8829
138.0	0.9248	0.9152	163.0	0.9101	0.8987	188.0	0.8955	0.8826
138.5	0.9245	0.9148	163.5	0.9098	0.8984	188.5	0.8952	0.8823
139.0	0.9242	0.9145	164.0	0.9095	0.8981	189.0	0.8950	0.8819
139.5	0.9239	0.9142	164.5	0.9092	0.8977	189.5	0.8947	0.8816
140.0	0.9236	0.9138	165.0	0.9089	0.8974	190.0	0.8944	0.8813
140.5	0.9234	0.9135	165.5	0.9086	0.8971	190.5	0.8941	0.8810
141.0	0.9231	0.9132	166.0	0.9083	0.8968	191.0	0.8938	0.8807
141.5	0.9228	0.9128	166.5	0.9080	0.8964	191.5	0.8935	0.8803
142.0	0.9225	0.9125	167.0	0.9078	0.8961	192.0	0.8932	0.8800
142.5	0.9222	0.9122	167.5	0.9075	0.8958	192.5	0.8929	0.8797
143.0	0.9219	0.9118	168.0	0.9072	0.8955	193.0	0.8926	0.8794
143.5	0.9216	0.9115	168.5	0.9069	0.8951	193.5	0.8924	0.8791
144.0	0.9213	0.9112	169.0	0.9066	0.8948	194.0	0.8921	0.8787
144.5	0.9210	0.9109	169.5	0.9063	0.8945	194.5	0.8918	0.8784
145.0	0.9207	0.9105	170.0	0.9060	0.8942	195.0	0.8915	0.8781
145.5	0.9204	0.9102	170.5	0.9057	0.8939	195.5	0.8912	0.8778
146.0	0.9201	0.9099	171.0	0.9054	0.8935	196.0	0.8909	0.8775
146.5	0.9198	0.9095	171.5	0.9051	0.8932	196.5	0.8906	0.8771
147.0	0.9195	0.9092	172.0	0.9048	0.8929	197.0	0.8903	0.8768
147.5	0.9192	0.9089	172.5	0.9045	0.8926	197.5	0.8901	0.8765
148.0	0.9189	0.9086	173.0	0.9042	0.8922	198.0	0.8898	0.8762
148.5	0.9186	0.9082	173.5	0.9040	0.8919	198.5	0.8895	0.8759
149.0	0.9183	0.9079	174.0	0.9037	0.8916	199.0	0.8892	0.8755
149.5	0.9180	0.9076	174.5	0.9034	0.8913	199.5	0.8889	0.8752
200.0	0.8886	0.8749	225.0	0.8743	0.8592	250.0	0.8602	0.8437
200.5	0.8883	0.8746	225.5	0.8740	0.8589	250.5	0.8599	0.8434
201.0	0.8880	0.8743	226.0	0.8738	0.8585	251.0	0.8597	0.8431
201.5	0.8878	0.8740	226.5	0.8735	0.8582	251.5	0.8594	0.8438
202.0	0.8875	0.8736	227.0	0.8732	0.8579	252.0	0.8591	0.8425
202.5	0.8872	0.8733	227.5	0.8729	0.8576	252.5	0.8588	0.8422
203.0	0.8869	0.8730	228.0	0.8726	0.8573	253.0	0.8585	0.8419
203.5	0.8866	0.8727	228.5	0.8723	0.8570	253.5	0.8583	0.8415
204.0	0.8863	0.8724	229.0	0.8721	0.8567	254.0	0.8580	0.8412
204.5	0.8860	0.8721	229.5	0.8718	0.8564	254.5	0.8577	0.8409
205.0	0.8857	0.8717	230.0	0.8715	0.8560	255.0	0.8574	0.8406
205.5	0.8855	0.8714	230.5	0.8712	0.8557	255.5	0.8571	0.8403
206.0	0.8852	0.8711	231.0	0.8709	0.8554	256.0	0.8569	0.8400
206.5	0.8849	0.8708	231.5	0.8706	0.8551	256.5	0.8566	0.8397
207.0	0.8846	0.8705	232.0	0.8704	0.8548	257.0	0.8563	0.8394
207.5	0.8843	0.8702	232.5	0.8701	0.8545	257.5	0.8560	0.8391
208.0	0.8840	0.8698	233.0	0.8698	0.8542	258.0	0.8557	0.8388
208.5	0.8837	0.8695	233.5	0.8695	0.8539	258.5	0.8555	0.8385
209.0	0.8834	0.8692	234.0	0.8692	0.8536	259.0	0.8552	0.8382
209.5	0.8832	0.8689	234.5	0.8689	0.8533	259.5	0.8549	0.8379
210.0	0.8829	0.8686	235.0	0.8687	0.8529	260.0	0.8546	0.8376
210.5	0.8826	0.8683	235.5	0.8684	0.8526	260.5	0.8544	0.8373
211.0	0.8823	0.8680	236.0	0.8681	0.8523	261.0	0.8541	0.8370
211.5	0.8820	0.8676	236.5	0.8678	0.8520	261.5	0.8538	0.8367
212.0	0.8817	0.8673	237.0	0.8675	0.8517	262.0	0.8535	0.8364
212.5	0.8814	0.8670	237.5	0.8673	0.8514	262.5	0.8532	0.8361
213.0	0.8812	0.8667	238.0	0.8670	0.8511	263.0	0.8530	0.8358
213.5	0.8809	0.8664	238.5	0.8667	0.8508	263.5	0.8527	0.8354
214.0	0.8806	0.8661	239.0	0.8664	0.8505	264.0	0.8524	0.8351
214.5	0.8803	0.8657	239.5	0.8661	0.8502	264.5	0.8521	0.8348