ASTM **Designation: D 4311 – 96**

Standard Practice for
Determining Asphalt Volume Correction to a Base Temperature[1]

This standard is issued under the fixed designation D 4311; 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 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 a table to convert asphalt volumes to 15°C from volumes measured at any temperature from − 25 to + 275°C.

NOTE 1—Correction factors in Table 1 are for use in place of correction factors provided in Guide D 1250, which do not address requirements for asphalt specifications.[2]

2. Referenced Documents

2.1 *ASTM Standards:*
D 70 Test Method for Specific Gravity and Density of Semi-Solid Bituminous Materials[3]
D 1250 Guide for Petroleum Measurement Tables[4]
D 3142 Test Method for Specific Gravity or API Gravity of Liquid Asphalts by Hydrometer Method[3]
D 3289 Test Method for Specific Gravity or Density of Semi-Solid and Solid Bituminous Materials by Nickel Crucible[3]

3. Significance and Use

3.1 Asphalts change in volume with change in temperature. They are loaded or transferred at widely varying temperatures. Volume correction factors are used to adjust bulk volumes measured at those temperatures to corresponding volumes at a base temperature of 15°C 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

4. Procedure

4.1 Volume correction factors are provided for volume adjustments to 15°C in Table 1. The table is entered with asphalt temperature at which bulk volume is measured.

4.2 The table provides 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. Column A factors apply to the majority of asphalts.

4.2.1 Values for density at 15°C may be obtained by Test Method D 70 or Test Method D 3289.

4.2.2 Observed API gravity or specific gravity at test temperature obtained by Test Method D 3142 must be corrected to the base temperature of 15°C. Use of Guide D 1250 tables for crudes, designated as Table 5A, 23A, or 53A, is recommended to obtain corrected 15°C values for asphalts. In Guide D 1250, the term relative density has been substituted for specific gravity.

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

4.2.3.1 Table 1—A Factor Asphalts

$$A = 1.0094684142 - 6.33413410744 \times 10^{-4}\,[T(\text{°C})] + 1.45710416212 \times 10^{-7}\,[T(\text{°C})]^2 \tag{1}$$

where:
A = volume correction factor, and
$T(\text{°C})$ = temperature of asphalt in° C.

4.2.3.2 Table 1—B Factor Asphalts

$$B = 1.0108020095 - 7.2343515319 \times 10^{-4}\,[T(\text{°C})] + 2.1996598346 \times 10^{-7}\,[T(\text{°C})]^2 \tag{2}$$

where:
B = volume correction factor, and
$T(\text{°C})$ = temperature of asphalt in° C.

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

NOTE 2—The volume correction factors are designed to generate values similar to those found in the original published Guide D 1250 – 80 for Group 0 and 1 Oils. The table has been corrected to a base temperature of 15°C rather than 60°F as originally published. See Appendix for details.

4.3 Enter the desired table with the asphalt temperature at which the volume measurement was made, and read the volume correction factor in a selected column A or B.

4.4 Multiply the volume measurement by the appropriate volume correction factor to obtain the adjusted volume of asphalt at 15°C.

5. Example of Use

5.1 *Example A*—Volume of asphalt cement is measured to be 5000 m^3 at a temperature of 135°C. Asphalt cement density at 15°C is 1015 kg/m^3. Determine the volume of asphalt cement at the standard base temperature of 15°C.

5.1.1 Column A factors from Table 1 are applicable since density at 15°C exceeds 966 kg/m^3 or higher.

5.1.2 A volume correction factor of 0.9266 is read for

observed temperature of 135°C. Multiplying the measured volume of 5000 m^3 by 0.9266 results in 4633 m^3 of asphalt at 15°C.

5.2 *Example B*—Volume of asphalt cement is measured to be 347 m^3 at a temperature of 153°C. The asphalt cement density at 15°C is 960 kg/m^3. Determine the volume of the asphalt cement at a temperature of 15°C.

5.2.1 Column B factors from Table 1 are applicable since density is between 850 and 965 kg/m^3 at 15°C.

5.2.2 A volume correction factor of 0.9046 is read for an observed temperature of 154°C. Multiplying the measured volume of 347 kg/m by 0.9046 results in 313.9 m^3 at 15°C.

6. Keywords

6.1 base temperature; volume correction

TABLE 1 Volume Reduction to 15°C

Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor – 25 to + 50°C 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	1.9787
−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

[A] Use column A factors for asphalts with density at 15°C of 966 kg/m^3 or higher.

[B] Use column B factors for asphalts with density at 15°C of 850 to 965 kg/m^3.

D 4311

TABLE 1 *Continued*

Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor – 25 to + 50°C to 15°C	
	A	B		A	B		A	B
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
51.0	0.9775	0.9745	76.0	0.9622	0.9571	101.0	0.9470	0.9400
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
52.5	0.9766	0.9734	77.5	0.9613	0.9561	102.5	0.9461	0.9390
53.0	0.9763	0.9731	78.0	0.9609	0.9557	103.0	0.9458	0.9386
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
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	0.9597	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

[A]Use column A factors for asphalts with density at 15°C of 966 kg/m^3 or higher.
[B]Use column B factors for asphalts with density at 15°C of 850 to 965 kg/m^3.

Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, ° C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor – 25 to + 50°C to 15°C	
	A	B		A	B		A	B
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
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

[A] Use column A factors for asphalts with density at 15°C of 966 kg/m^3 or higher.
[B] Use column B factors for asphalts with density at 15°C of 850 to 965 kg/m^3.

TABLE 1 *Continued*

Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor to 15°C		Observed Temperature, °C	Volume Correction[A,B] Factor – 25 to + 50°C to 15°C	
	A	B		A	B		A	B
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
215.0	0.8800	0.8654	240.0	0.8658	0.8498	265.0	0.8518	0.8345
215.5	0.8797	0.8651	240.5	0.8656	0.8495	265.5	0.8516	0.8342
216.0	0.8794	0.8648	241.0	0.8653	0.8492	266.0	0.8513	0.8339
216.5	0.8792	0.8645	241.5	0.8650	0.8489	266.5	0.8510	0.8336
217.0	0.8789	0.8642	242.0	0.8647	0.8486	267.0	0.8507	0.8333
217.5	0.8786	0.8639	242.5	0.8644	0.8483	267.5	0.8505	0.8330
218.0	0.8783	0.8635	243.0	0.8642	0.8480	268.0	0.8502	0.8327
218.5	0.8780	0.8632	243.5	0.8639	0.8477	268.5	0.8499	0.8324
219.0	0.8777	0.8629	244.0	0.8636	0.8474	269.0	0.8496	0.8321
219.5	0.8775	0.8626	244.5	0.8633	0.8471	269.5	0.8493	0.8318
220.0	0.8772	0.8623	245.0	0.8630	0.8468	270.0	0.8491	0.8315
220.5	0.8769	0.8620	245.5	0.8627	0.8465	270.5	0.8488	0.8312
221.0	0.8766	0.8617	246.0	0.8625	0.8461	271.0	0.8485	0.8309
221.5	0.8763	0.8614	246.5	0.8622	0.8458	271.5	0.8482	0.8306
222.0	0.8760	0.8610	247.0	0.8619	0.8455	272.0	0.8480	0.8303
222.5	0.8757	0.8607	247.5	0.8616	0.8452	272.5	0.8477	0.8300
223.0	0.8755	0.8604	248.0	0.8613	0.8449	273.0	0.8474	0.8297
223.5	0.8752	0.8601	248.5	0.8611	0.8446	273.5	0.8471	0.8294
224.0	0.8749	0.8598	249.0	0.8608	0.8443	274.0	0.8469	0.8291
224.5	0.8746	0.8595	249.5	0.8605	0.8440	274.5	0.8466	0.8288

[A]Use column A factors for asphalts with density at 15°C of 966 kg/m^3 or higher.
[B]Use column B factors for asphalts with density at 15°C of 850 to 965 kg/m^3.

APPENDIX

(Nonmandatory Information)

X1. FORMULAS USED IN DETERMINING VOLUME CORRECTIONS TO A BASE TEMPERATURE

X1.1 *Volume Correction Formulas*—The formulas used in Table 1 were derived from the original tables listed in Guide D 1250 – 80 for Group 0 and 1 Oils in Tables 7.25. A linear regression analysis for the tables is listed below for each factor.

$$A = 1.0211326242 - 3.548988118 \times 10^{-4} [T(°F)]$$
$$+ 4.49881 \times 10^{-8} [T(°F)]^2$$

(X1.1)

where:
A = volume correction factor, and
$T(°F)$ = temperature of asphalt cement in° F.

$$B = 1.02413769 - 4.0641418 \times 10^{-4} [T(°F)]$$
$$+ 6.79176 \times 10^{-8} [T(°F)]^2$$

(X1.2)

where:
B = volume correction factor, and
$T(°F)$ = temperature of asphalt cement in° F.

X1.1.1 These two formulas generate the same values as the original table at all temperatures except those listed below:

Factor A		
Temperature,° F	D 1250 Table	Calculated Value
7	1.0186	1.0187
49	1.0038	1.0039
59	1.0003	1.0004
246	0.9365	0.9366
Factor B		
Temperature, °F	D 1250 Table	Calculated Value
17	1.0174	1.0172
336	0.8952	0.8953
372	0.8823	0.8824
449	0.8554	0.8553
479	0.8451	0.8450
499	0.8383	0.8382

The differences are always in the 4th digit and the difference is never more than one. The 10 exceptions out of 1000 results indicates an exceptionally good fit to the original data.

X1.2 *Temperature Correction to 15°C*—Because the original tables were developed around correcting asphalt cement to a base temperature of 60°F (15.6°C) it was determined to use the formulas used to derive this table in converting to a new base temperature of 15°C. The first step is to convert the 60°F formula to an equivalent 15.6°C formula by replacing (°F) = 32 + 1.8(°C). This results in new (A) and (B) factor formulas listed below:

$$A = 1.00982193004 - 6.3363523212 \times 10^{-4} [T(°C)]$$
$$+ 1.45761444 \times 10^{-7} [T(°C)]^2$$

(X1.3)

$$B = 1.01120198386 - 7.2372141648 \times 10^{-4} [T(°C)]$$
$$+ 2.20053024 \times 10^{-7} [T(°C)]^2$$

(X1.4)

X1.2.1 To convert to a base temperature of 15°C rather than 15.6°C, a value of 15°C was substituted into the above equations. The result for each factor is listed below:

$$A = 1.0003502$$ (X1.5)

$$B = 1.0003957$$ (X1.6)

X1.2.2 To convert to a base temperature of 15°C the following adjustment was made to A and B Factor Formulas:

$$A = (1.00982193004 \div 1.0003502)$$
$$- (6.3363523212 \times 10^{-4} \div 1.0003502) [T(°C)]$$
$$\div (1.45761444 \times 10^{-7} \div 1.0003502) [T(°C)]^2$$

(X1.7)

$$A = 1.0094684142 - 6.33413410744$$
$$\times 10^{-4} [T(°C)] + 1.45710416212 \times 10^{-7} T(°C)]^2$$

(X1.8)

$$B = (1.01120198386 \div 1.0003957) - (7.2372141648$$
$$\times 10^{-4} \div 1.0003957) [T(°C)]$$
$$+ (2.20053024 \times 10^{-7} \div 1.0003957) [T(°C)]$$ (X1.9)

$$B = 1.0108020095 - 7.2343515319$$
$$\times 10^{-4} [T(°C)] + 2.1996598346 \times 10^{-7} [T(°C)]^2$$

(X1.10)

These calculated formulas and the resulting table is listed in this practice.