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

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

where:

A = volume correction factor, and

$T(°C)$ = temperature of asphalt in° C.

4.2.3.2 Table 1—B Factor Asphalts

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

where:

[1] This practice is under the jurisdiction of ASTM Committee D-4 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.40 on Asphalt Specifications.

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[2] Factors originally published for Groups 0 and 1 oils in Tables 7, 25, and 55 in D1250 – 52 T. Last previous edition D1250 – 80.

[3] *Annual Book of ASTM Standards*, Vol 04.03.

[4] *Annual Book of ASTM Standards*, Vol 05.01, description only; tables published separately in three volumes.

B = volume correction factor, and
$T(°C)$ = 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.