

Manual of Petroleum Measurement Standards Chapter 12—Calculation of Petroleum Quantities

Section 3—Volumetric Shrinkage Resulting From Blending Light Hydrocarbons With Crude Oils

FIRST EDITION, JULY 1996
REAFFIRMED, FEBRUARY 2006



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Section 3—Volumetric Shrinkage Resulting From Blending Light Hydrocarbons With Crude Oils

Measurement Coordination

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Chapter 12—Calculation of Petroleum Quantities

SECTION 3—VOLUMETRIC SHRINKAGE RESULTING FROM BLENDING LIGHT HYDROCARBONS WITH CRUDE OILS

0 Introduction

The transportation of crude oil and products can bring hydrocarbons of different densities and properties together in situations where the liquids are mixed. This mixing of hydrocarbons of different properties is known to result in volumetric discrepancies from the ideal combination, which would yield a total volume representing the sum of the components. The discrepancy is most often a shrinkage resulting from the smaller molecules of the light material filling the voids of the heavier molecules. An analogy is the addition of Ping-Pong balls to a room already filled with basketballs. A considerable number of the smaller balls can be added before the voids are filled. Thus, the combined volume is less than the sum of the two components. Likewise, as the balls become more and more different in size, the shrinkage increases. The same is true for hydrocarbon liquids where the molecule size is directly related to density.

The petroleum industry first concerned itself with volumetric shrinkage in the 1950s when it became advantageous to mix small volumes of butane, natural gasoline, condensate, and other light or volatile hydrocarbons with crude oil for transportation in existing pipelines. Each component was measured at the receipt point and the combined stream was measured at the delivery terminal. There was a recognized loss that was identified as volumetric shrinkage. To quantify this loss, API initiated efforts that ultimately led to the publication of API Bulletin 2509C in 1962 based on data made available by eight oil and pipeline companies. The equation published in the bulletin made it possible to predict the shrinkage and separate this predictable loss from the real loss/gain of the system. The 2509C correlation recommendation was to calculate shrinkage at concentrations up to 21 percent of the lighter component.

Increased marine movements and terminaling of crude oils during the 1980s escalated the mixing of crude oils of different gravities and crude oils with condensates or other light hydrocarbons in marine vessels, shore tanks, and pipeline systems. Each of these operations experienced losses due to shrinkage. With the many problems and uncertainties associated with reconciliation of marine transfers, it again became important to improve the determination of the volume reduction resulting from mixing of hydrocarbons. Simultaneously, there was interest in improving the database to support various predictions and custody transfer applications, primarily in pipeline systems handling a wide range of fluids.

These interests motivated the API Committee on Petroleum Measurement to seek improved data to cover a wider range of products and mixture ratios. Initial efforts at enlarging the database with a planned laboratory test program proved unjustifiably expensive and prohibitive. Ultimately the search for data led to the discovery of recent studies by Booker¹ and by Schuchardt.² Results from these works were combined with the data used to derive API Bulletin 2509C, as collected in unpublished reports by Childress³ and Scott.⁴ Analysis of these data, achieved largely through the efforts of G. Thomson and P. Richmond of Phillips Petroleum Company, has resulted in the new correlation equation and accompanying tables presented in this document.

¹D.R. Booker. "Volumetric Shrinkage of Spiked Crude Oils," Ph.D. Thesis, University of Exeter, England, August 1989.

²K. Schuchardt. "Volumetric Shrinkage Resulting from Blending Crude Oils," DGMK-Project 405-2, July 1991.

³H.M. Childress. "Volume Shrinkage Occurring in Blending Indirect Products Such as Butane, Natural Gasoline, and Produced Distillates with Crude," Project No. 1237, Exxon Research and Engineering Company, May 1955.

⁴P.R. Scott. "Volumetric Shrinkage of Crude-Volatile Blends," Technical Report No. 3-61, Shell Pipeline Corporation, Houston, Texas, January 1962.

The majority of the available data covering blends of light and heavy hydrocarbons indicates that the change in volume is a shrinkage. However, there are ample data in the work by Booker, showing expansion of certain mixtures of crude oils with light hydrocarbons. Similar diversity in behavior is observed in mixtures of two and three pure components, as documented in the review by Battino.⁵ These results were excluded from the database used to derive this new correlation, because they cannot be predicted simply on the basis of density. Also, because there are few data available showing the variation of shrinkage with temperature and pressure, these variables have been ignored in deriving the new equation. Therefore, it is recommended that the correlation be used only for predictions near 15°C (60°F) and between 100 kilopascals (15 pounds per square inch absolute) and 700 kilopascals (115 pounds per square inch absolute), since the data were obtained under these conditions.

For situations where there may be a doubt about the applicability of the new equation or tables, it is recommended that one of the test methods discussed in Appendix C be used to provide the best possible analysis for a specific application.

1 Scope

This standard provides a procedure to quantify the volume shrinkage that occurs when blending lighter hydrocarbons (580–890 kilograms per cubic meter, 112–27 degrees API) with crude oils (644–979 kilograms per cubic meter, 88–13 degrees API). Shrinkage factors are computed from the standard densities of the hydrocarbon and the crude oil (in either International System of Units [SI] or customary units) and the volume fraction of the hydrocarbon. The standard also recommends precautions when using the tables and provides guidance about the range of components it covers.

The purpose of this standard is to provide a procedure to quantify the volume reduction that occurs when mixing hydrocarbons of different density or API gravity. The standard provides shrinkage factors related to inverse density (metric system) or gravity (customary system) differentials for blends of 0 to 100 percent light with heavy hydrocarbons. The tables are entered with density differentials of Standard conditions and percentage light hydrocarbon in total mix.

2 References

API

- Bul 2509C *Volumetric Shrinkage from Blending Volatile Hydrocarbons with Crude Oils*. (Superseded by the *Manual of Petroleum Measurement Standards* Chapter 12.3)

3 History and Development

In 1962, the API Admixture Measurement Committee adopted the following empirical formula suggested by Rossini and known as API 2509C.

$$S_L = 0.0000214C^{-0.0704} G^{1.76} \quad (1)$$

Where:

- S_L = shrinkage factor, as decimal fraction of lighter component volume.
- C = concentration, in liquid volume percent of lighter component in mixture.
- G = gravity difference, in degrees API.

⁵Rubin Battino. "Volume Changes on Mixing for Binary Mixtures of Liquids," Chem. Rev. 71(1), 5 (1971).

Eight oil and pipeline companies provided volumetric shrinkage data. There were 460 data points at light component concentrations up to 21 percent and 48 data points at light component concentrations between 21 and 50 percent. Most of the data came from Childress.³

Later work at Shell Oil by Scott⁴ indicated that shrinkage values calculated from Equation 1 could be significantly in error for concentrations above 30 percent. He also noted that Equation 1 does not predict a maximum shrinkage near 50 percent or return to 0 for 100 percent concentration. Scott measured volumetric shrinkage data to about 90 percent light and developed a correlation with maximum shrinkage near 50 percent that returns to 0 for 100 percent concentration. (See Figure B-3.)

In the 1980s, with changes in oil movements resulting in greatly increased intermixing of crudes, condensates, and light hydrocarbons and recognition that there were potential shortcomings in the API 2509C shrinkage correction tables, there was an increased interest in more accurately accounting for shrinkage by broadening the base of crudes evaluated in development of the shrinkage tables. To address these concerns, a Committee on Dynamic Petroleum Measurement (CODM) Working Group was organized in the spring of 1980 to review and revise API Bulletin 2509C.

At first, enlarging the shrinkage database with laboratory tests was considered but the estimated costs were prohibitive. As an alternate solution, an extensive literature search was undertaken, which is summarized below. The literature search resulted in a selection of shrinkage information from four main sources, which provided a wider database covering essentially the full range of 0 to 100 percent concentrations of light in heavy hydrocarbon mixes.

Robinson,⁶ in his work, proposed a spiked crude density prediction method based on the COSTALD⁷ equation. However, any theoretical advantages were lost because the five COSTALD parameters (critical temperature, critical pressure, acentric factor, characteristic volume, and molecular weight) were correlated as a function of crude oil density at 15°C. Also, Booker¹ determined that the Robinson approach does not perform as well as the API 2509C procedure.

Schuchardt² measured volumetric shrinkage for a wide variety of Western Europe crude/condensate/product mixtures. He noted that a density-difference-based correlation could not explain all volumetric shrinkage (or expansion). However, the overall trend of his data does support the use of density difference as a correlating parameter.

Booker measured volumetric shrinkage data for seven crudes (two North Sea, one Dorset, and four African) spiked with six light paraffinic mixtures (boiling ranges of 30–40°C to 120–160°C), n-heptane, cyclohexane, toluene, and Lucini condensate. Ashcroft, Booker, and Turner⁸ correlated Booker's light paraffinic volume shrinkage data using Equation 1 modified to predict zero shrinkage at a 100 percent spike. Interestingly, all of Booker's crude samples expanded when spiked with toluene or cyclohexane, and some crudes expanded when spiked with heavier paraffinic mixtures.

Equation 1 was modified to predict zero shrinkage at a 100 percent spike as suggested by Ashcroft, Booker, and Turner and presented to the API Volumetric Shrinkage Committee.⁹ Shrinkage was correlated as percent of total volume. The ranges of density of oil and light hydrocarbon are given in Table 1. More complete information on the data sets is given in Appendix B.

⁶E.R. Robinson. "Calculate Density of Spiked Crudes," *Hydrocarbon Processing*, pp. 115–120, May 1983.

⁷R.W. Hankinson and G.W. Thomson. "A New Correlation for Saturated Densities of Liquids and Their Mixtures," *AIChE Journal*, pp. 653–663, Volume 25, Number 4, July 1979.

⁸S.J. Ashcroft, D.R. Booker, and J.C. Turner. "Find Shrinkage of Spiked Crudes," *Hydrocarbon Processing*, pp. 109–111, October 1991.

⁹P.C. Richmond. "Comparison of API 2509C and Alternative Equations to Schuchardt, Childress, and Scott Data," presented at Ritz-Carlton Pentagon City, October 23, 1991.

Table 1—Density Ranges of Fluids Used in Shrinkage Measurements Selected for Derivation of New Correlation

Data Source	Heavy Components		Light Components		Number of Data Sets
	kg/m ³ (15°C 101.325 kPa)	°API Gravity (60°F, 14.7 psia)	kg/m ³ (15°C 101.325 kPa)	°API Gravity (60°F, 14.7 psia)	
Childress	644–936	88.2–19.6	581–826	112.0–39.7	268
Scott	735–854	61.0–34.1	586–743	110.0–58.9	42
Schuchardt	727–979	63.1–13.0	715–889	66.4–27.6	307
Booker	833–915	38.3–23.1	630–761	93.1–54.4	198
Overall	644–979	88.2–13.0	581–889	112.0–27.6	

4 Data and Mathematical Model Selection

The data used to derive the correlation presented in this document originated from four separate experimental studies, authored by Childress, Scott, Schuchardt, and Booker. The ranges of density of oil and light hydrocarbon are given in Table 1. The data are described in more detail in Tables B-1 to B-4. Available information on the sources and densities of crudes and light components is included, together with the number of data sets and summarized statistical data. Sources of the data are also shown graphically in Figure B-1.

The selection of an appropriate mathematical model was based on the ability of different correlations to predict the experimental results. As expected from the form of the equation, API 2509C performs very poorly above a 25 percent spike. This is apparent from the large deviations between predicted and experimental values (i.e. the absolute residuals) plotted in Figure B-6.

Improvement was obtained by selecting the form of correlation equation proposed by Ashcroft et al.⁸ Figure B-6 shows the average absolute residuals determined using the model of Ashcroft et al., and Figure B-7 plots those obtained by fitting all of the data to an equation of the same form. Statistical differentiation between these latter two equations was achieved using an *F*-test as suggested by Beck and Arnold.¹⁰ This test confirmed that the new equation presented in this standard gives the best prediction of the available experimental data over the entire range of compositional variation.

Data sets that exhibited the anomalous behavior of expansion rather than shrinkage were not used in deriving the new correlation. This included Booker's toluene and cyclohexane spiked crude data sets and Schuchardt's results from crude blends with gasoil.

The available experimental data were obtained at somewhat different temperatures and pressures. The older Childress and Scott data were obtained at 60°F and 100 psig, whereas the Booker and Schuchardt data apply to 15°C and ambient atmospheric pressure. Booker also reported results obtained at 25°C, but corrected these to 15°C using API correlations. The new correlation presented in this standard was derived from the data as presented in the referenced sources, with no attempt to normalize to a standard pressure and temperature. For the Booker data sets obtained at 25°C, the values corrected to 15°C, as given by Booker, were used.

5 Recommended Standard

5.1 STANDARD FOR CALCULATING SHRINKAGE

The standard is the printed tables in either SI or customary units found in Section 8 below. The equations used to generate the standard are also provided (see Section 5.3) and can be used to develop computer subroutines to replicate the results in the printed table.

¹⁰J.V. Beck, and K.J. Arnold. *Parameter Estimation in Engineering and Science*, John Wiley & Sons, New York (1977).

5.2 DISCRIMINATION LEVELS

The following discrimination levels as given in Table 2 are suggested for the variables required in this standard. Use of these discriminations will provide uniform calculation results consistent with the precision of the tables and the equations.

Table 2—Discrimination Levels for Calculations

Customary Units	Variable	SI Units
XX.0 barrels	Component volumes	XX.X m ³
XX.X degrees API	Component density	XXX.X kg/m ³
XX.X percent	Percent light component	XX.X percent
XX.X degrees API	API gravity difference	—
—	Inverse density difference	0.XXXX (m ³ /kg) × 10 ³
XX.XXXX percent	S = volumetric shrinkage	XX.XXXX percent
XX.0 barrels	Shrinkage volume	XX.X m ³

5.3 EQUATIONS

The following equations were used to calculate the tables for predicting volumetric shrinkage:

Customary Units:

$$S = 4.86 \times 10^{-8} C (100 - C)^{0.819} G^{2.28} \quad (2)$$

Where:

S = volumetric shrinkage, as percent of the total mixture ideal volume.

C = concentration in liquid volume percent of lighter component.

G = gravity difference, in degrees API.

SI Units:

$$S = 2.69 \times 10^4 C (100 - C)^{0.819} (1/dL - 1/dH)^{2.28} \quad (3)$$

Where:

S = volumetric shrinkage, as percent of total mixture ideal volume.

C = concentration in liquid volume percent of lighter component.

$(1/dL - 1/dH)$ = inverse density difference of light (dL) and heavy (dH) components, in m³/kg.

Note: To assist those who will use calculators and tables to calculate the shrinkage volume, Table 4 has been developed to provide values for $(1/dL - 1/dH)$.

5.4 EXAMPLES USING THE TABLES

5.4.1 For Customary System of Units

Example:

Blend 95,000 bbl 30.7°API crude with 5,000 bbl 86.5°API natural gasoline.

Step 1: Find the percentage of the light component (C).

$$C = \frac{5,000}{100,000}(100) = 5\%$$

Step 2: Find the API gravity difference (G).

$$G = 86.5 - 30.7 = 55.8^\circ$$

Step 3: Determine the shrinkage factor (S).

- Go to Table 3 for shrinkage values near 5 percent light component and 55.8°API gravity difference.

	5%
55	0.0941
55.8	
56	0.0980

- Since the gravity difference falls between two table entries, linear interpolation must be used, as follows:

$$S = 0.0941 + \frac{(55.8 - 55)}{(56 - 55)} (0.0980 - 0.0941) = 0.0972\%$$

Step 4: Determine the physical shrinkage.

$$\text{Shrinkage} = 100,000 \times \frac{0.0972}{100} = 97 \text{ bbl}$$

Step 5: Determine the mixture volume.

$$\text{Volume} = 100,000 - 97 = 99,903 \text{ bbl}$$

5.4.2 For SI System Units

Example:

Blend 9,500 m³ of 872.0 kg/m³ crude with 500.0 m³ of 648.0 kg/m³ natural gasoline.

Step 1: Find the percentage of the light component (C).

$$C = \frac{500.0}{10,000} (100) = 5\%$$

Step 2: Compute the inverse density factor $1000 \times (1/dL - 1/dH)$.

- Go to Table 4 for the inverse density factors surrounding 648 kg/m³ light component density and 872 kg/m³ crude density.

	880	872	870
640	0.4261		0.4131
648	<i>A1</i>		<i>A2</i>
650	0.4021		0.3890

- Compute intermediate quantities *A1* and *A2*.

$$A1 = 0.4261 + \left(\frac{648 - 640}{650 - 640} \right) (0.4021 - 0.4261) = 0.4069$$

$$A2 = 0.4131 + \left(\frac{648 - 640}{650 - 640} \right) (0.3890 - 0.4131) = 0.3938$$

- Compute the final interpolated inverse density factor.

$$1000 (1/dL - 1/dH) = 0.4069 + \left(\frac{872 - 880}{870 - 880} \right) (0.3938 - 0.4069) = 0.3964$$

Step 3: Determine the shrinkage factor (*S*).

- Go to Table 5 for shrinkage values near 5 percent light component and 0.3964 inverse density factor.

	5%
0.3900	0.0946
0.3964	
0.4000	0.1003

- Because the inverse density factor falls between two table entries, linear interpolation must be used, as follows:

$$S = 0.0946 + \left(\frac{0.3964 - 0.3900}{0.4000 - 0.3900} \right) (0.1003 - 0.0946) = 0.0982\%$$

Step 4: Determine the physical shrinkage.

$$\text{Shrinkage} = 10,000 \times \frac{0.0982}{100} = 9.8 \text{ m}^3$$

Step 5: Determine the mixture volume.

$$\text{Volume} = 10,000 - 9.8 = 9,990.2 \text{ m}^3$$

6 Precautions on Use of the New MPMS Chapter 12.3 Equations and Tables

6.1 EFFECT OF TEMPERATURE AND PRESSURE ON VOLUMETRIC SHRINKAGE

The new correlation is based on experimental data gathered at conditions of absolute pressure in the range of 100–700 kilopascals, 15–115 pounds per square inch absolute, and temperatures near 15°C or 60°F. Thus, it is recommended that all shrinkage calculations be limited to conditions within that range.

6.2 DIFFERENCE BETWEEN CUSTOMARY AND METRIC TABLES

Shrinkage factors obtained from Table 3 in customary units will not necessarily be numerically equivalent to factors determined from Tables 4 and 5 in SI units. This difference is partially the result of the difference in standard temperatures (60°F versus 15°C), but even after volume correction using the API correlation, shrinkage factors may show a relative difference of as much as 0.4 percent. For custody transfer purposes, it is therefore recommended that buyers and sellers agree on which set of tables they will use.

6.3 LIMITATIONS AND ALTERNATIVES

The correlation equation or tables given in this text can predict volumetric shrinkage within the stated precision for mixtures of hydrocarbons over a relatively wide range in density difference and mixture ratios. However, the available experimental data suggest that factors other than density difference affect the volumetric behavior. Current understanding is insufficient to allow accurate prediction of the effect of composition, and thus experimental confirmation is recommended for hydrocarbon types not represented in the existing data sets. It is recommended that when an accurate shrinkage is required for specific mixtures or when there are extenuating circumstances that may make use of the shrinkage tables questionable, the shrinkage may be determined by testing the individual components in a qualified lab using one of the test methods included in Appendix C.

6.4 EXCLUSIONS

Users of this standard are cautioned that the equations presented are strictly empirical in nature, derived by obtaining a “best fit” between available experimental data and values predicted by a mathematical equation. For this reason, the equation should only be used to predict shrinkage for mixtures within the overall density range shown in Table 1. In addition, although the influence of parameters other than density difference is not addressed in this correlation, there is indication within the available data that shrinkage is affected by compositional and other variations.

The tables or equations provided here are not to be used for volumetric corrections that might be necessary for the blending of gasoline components (including oxygenates, or the newer reformulated fuels) as these materials were not included in the data referenced above.

7 Precision Statement

The new correlation equation presented in this report predicts mixture volumes within ± 0.04 percent of the experimental values for 75 percent of the regressed data over the entire range of blend ratios.

Correlation of volumetric shrinkage with density difference is dependent on the accuracy of determination of the fluid densities. Other factors not included in this correlation, particularly compositional uniqueness, will affect the reliability of the predicted shrinkage value.

The values of percent total shrinkage presented in Tables 3 and 5 are given with four digits after the decimal. Note that the prediction and measurement errors support only two digit resolution at most (XX.XX percent shrinkage). The additional digits are provided for convenience in calculations involving custody transfer quantities. If the correlation is being used to correct values for a fluid balance determination, one should note that the predicted shrinkage is technically defensible to two digits.

8 Shrinkage Tables

The following tables are the standard for calculation of volumetric shrinkage. (See examples in 5.4.)

a. Volumetric Shrinkage Percentage Factors for Blending Two Hydrocarbons with Gravity Differences from 10° to 100° API and from 1 to 99 percent Light Hydrocarbon Component in Total Blend (Table 3)

This table is entered with the difference in API gravity between the light and heavy hydrocarbon components and the percentage by volume of the light hydrocarbon in the mix to obtain a percentage shrinkage of the total volume of the mixture. Multiplication of the percentage factor extracted from the table (divided by 100) by the total volume of the mixture equals the volumetric shrinkage that occurs from mixing the light with the heavy hydrocarbon component.

b. Inverse Density Difference in $\text{m}^3/\text{kg} \times 10^3$ for Light Hydrocarbon Densities from 580 to 890 kg/m^3 at 15°C and Heavy Hydrocarbon Densities from 980 to 640 kg/m^3 at 15°C (Table 4—Metric)

This table is entered with the densities of the light and heavy components in kilograms per cubic meter to obtain the inverse of the light component density (dL) minus the inverse of the heavy component density (dH), required to enter the SI version Table 5, for determination of volumetric shrinkage.

c. Volumetric Shrinkage Percentage Factors for Blending Two Hydrocarbons with Differences in Inverse Densities at 15°C in m^3/kg Determined from Table 4 and from 1 to 99 Percent Light Hydrocarbon Component in Total Blend (Table 5—Metric)

This table is entered with the difference between inverse densities of the light and heavy components (from Table 4) and the percentage light component in the total mix to determine a percentage shrinkage of the total volume of the mixture. Multiplication of the percentage factor extracted from the table (divided by 100) by the total volume of the mixture equals the volume shrinkage that occurs from mixing the light with the heavy hydrocarbon component.

Table 3—Volumetric Shrinkage Percentage Factors for Blending Two Hydrocarbons with Gravity Differences from 10°API to 100°API and from 1 to 99 Percent Light Hydrocarbon Component in Total Blend

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	1	2	3	4	5	6
10	0.0004	0.0008	0.0012	0.0016	0.0019	0.0023
11	0.0005	0.0010	0.0015	0.0019	0.0024	0.0029
12	0.0006	0.0012	0.0018	0.0024	0.0029	0.0035
13	0.0007	0.0014	0.0021	0.0028	0.0035	0.0042
14	0.0009	0.0017	0.0025	0.0034	0.0042	0.0049
15	0.0010	0.0020	0.0030	0.0039	0.0049	0.0058
16	0.0012	0.0023	0.0034	0.0045	0.0056	0.0067
17	0.0013	0.0027	0.0039	0.0052	0.0065	0.0077
18	0.0015	0.0030	0.0045	0.0059	0.0074	0.0088
19	0.0017	0.0034	0.0051	0.0067	0.0083	0.0099
20	0.0019	0.0038	0.0057	0.0076	0.0094	0.0111
21	0.0022	0.0043	0.0064	0.0084	0.0105	0.0125
22	0.0024	0.0048	0.0071	0.0094	0.0116	0.0139
23	0.0027	0.0053	0.0079	0.0104	0.0129	0.0153
24	0.0029	0.0058	0.0087	0.0115	0.0142	0.0169
25	0.0032	0.0064	0.0095	0.0126	0.0156	0.0185
26	0.0035	0.0070	0.0104	0.0138	0.0170	0.0203
27	0.0038	0.0076	0.0113	0.0150	0.0186	0.0221
28	0.0042	0.0083	0.0123	0.0163	0.0202	0.0240
29	0.0045	0.0090	0.0133	0.0176	0.0219	0.0260
30	0.0049	0.0097	0.0144	0.0191	0.0236	0.0281
31	0.0053	0.0104	0.0155	0.0205	0.0254	0.0303
32	0.0057	0.0112	0.0167	0.0221	0.0274	0.0325
33	0.0061	0.0120	0.0179	0.0237	0.0293	0.0349
34	0.0065	0.0129	0.0192	0.0253	0.0314	0.0374
35	0.0069	0.0138	0.0205	0.0271	0.0336	0.0399
36	0.0074	0.0147	0.0218	0.0289	0.0358	0.0426
37	0.0079	0.0156	0.0233	0.0307	0.0381	0.0453
38	0.0084	0.0166	0.0247	0.0327	0.0405	0.0482
39	0.0089	0.0176	0.0262	0.0347	0.0430	0.0511
40	0.0094	0.0187	0.0278	0.0367	0.0455	0.0541
41	0.0100	0.0198	0.0294	0.0388	0.0481	0.0573
42	0.0105	0.0209	0.0310	0.0410	0.0509	0.0605
43	0.0111	0.0220	0.0328	0.0433	0.0537	0.0638
44	0.0117	0.0232	0.0345	0.0456	0.0566	0.0673
45	0.0123	0.0244	0.0363	0.0480	0.0595	0.0708
46	0.0129	0.0257	0.0382	0.0505	0.0626	0.0745
47	0.0136	0.0270	0.0401	0.0530	0.0657	0.0782
48	0.0143	0.0283	0.0421	0.0556	0.0690	0.0820
49	0.0150	0.0297	0.0441	0.0583	0.0723	0.0860
50	0.0157	0.0311	0.0462	0.0611	0.0757	0.0900
51	0.0164	0.0325	0.0483	0.0639	0.0792	0.0942
52	0.0171	0.0340	0.0505	0.0668	0.0828	0.0985
53	0.0179	0.0355	0.0528	0.0697	0.0864	0.1028
54	0.0187	0.0370	0.0551	0.0728	0.0902	0.1073

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	1	2	3	4	5	6
55	0.0195	0.0386	0.0574	0.0759	0.0941	0.1119
56	0.0203	0.0402	0.0598	0.0791	0.0980	0.1166
57	0.0211	0.0419	0.0623	0.0823	0.1020	0.1214
58	0.0220	0.0436	0.0648	0.0857	0.1062	0.1263
59	0.0228	0.0453	0.0674	0.0891	0.1104	0.1313
60	0.0237	0.0471	0.0700	0.0925	0.1147	0.1364
61	0.0246	0.0489	0.0727	0.0961	0.1191	0.1417
62	0.0256	0.0507	0.0754	0.0997	0.1236	0.1470
63	0.0265	0.0526	0.0782	0.1034	0.1282	0.1525
64	0.0275	0.0545	0.0811	0.1072	0.1329	0.1581
65	0.0285	0.0565	0.0840	0.1111	0.1377	0.1638
66	0.0295	0.0585	0.0870	0.1150	0.1425	0.1696
67	0.0305	0.0605	0.0900	0.1190	0.1475	0.1755
68	0.0316	0.0626	0.0931	0.1231	0.1526	0.1815
69	0.0326	0.0647	0.0963	0.1273	0.1577	0.1877
70	0.0337	0.0669	0.0995	0.1315	0.1630	0.1939
71	0.0348	0.0691	0.1028	0.1358	0.1684	0.2003
72	0.0360	0.0713	0.1061	0.1402	0.1738	0.2068
73	0.0371	0.0736	0.1095	0.1447	0.1794	0.2134
74	0.0383	0.0759	0.1129	0.1493	0.1850	0.2201
75	0.0395	0.0783	0.1164	0.1539	0.1908	0.2269
76	0.0407	0.0807	0.1200	0.1586	0.1966	0.2339
77	0.0419	0.0831	0.1236	0.1634	0.2026	0.2410
78	0.0432	0.0856	0.1273	0.1683	0.2086	0.2482
79	0.0444	0.0881	0.1311	0.1733	0.2148	0.2555
80	0.0457	0.0907	0.1349	0.1783	0.2210	0.2629
81	0.0470	0.0933	0.1388	0.1835	0.2274	0.2705
82	0.0484	0.0959	0.1427	0.1887	0.2338	0.2781
83	0.0497	0.0986	0.1467	0.1939	0.2404	0.2859
84	0.0511	0.1014	0.1508	0.1993	0.2470	0.2939
85	0.0525	0.1041	0.1549	0.2048	0.2538	0.3019
86	0.0539	0.1069	0.1591	0.2103	0.2606	0.3101
87	0.0554	0.1098	0.1633	0.2159	0.2676	0.3183
88	0.0568	0.1127	0.1676	0.2216	0.2747	0.3267
89	0.0583	0.1156	0.1720	0.2274	0.2818	0.3353
90	0.0598	0.1186	0.1764	0.2333	0.2891	0.3439
91	0.0613	0.1216	0.1809	0.2392	0.2965	0.3527
92	0.0629	0.1247	0.1855	0.2453	0.3039	0.3616
93	0.0644	0.1278	0.1901	0.2514	0.3115	0.3706
94	0.0660	0.1310	0.1948	0.2576	0.3192	0.3798
95	0.0677	0.1342	0.1996	0.2639	0.3270	0.3890
96	0.0693	0.1374	0.2044	0.2702	0.3349	0.3984
97	0.0709	0.1407	0.2093	0.2767	0.3429	0.4080
98	0.0726	0.1440	0.2142	0.2833	0.3510	0.4176
99	0.0743	0.1474	0.2193	0.2899	0.3593	0.4274
100	0.0760	0.1508	0.2243	0.2966	0.3676	0.4373

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	7	8	9	10	11	12
10	0.0027	0.0030	0.0034	0.0037	0.0040	0.0043
11	0.0033	0.0037	0.0042	0.0046	0.0050	0.0054
12	0.0040	0.0046	0.0051	0.0056	0.0061	0.0066
13	0.0048	0.0055	0.0061	0.0067	0.0073	0.0079
14	0.0057	0.0065	0.0072	0.0079	0.0087	0.0094
15	0.0067	0.0076	0.0084	0.0093	0.0101	0.0110
16	0.0078	0.0088	0.0098	0.0108	0.0117	0.0127
17	0.0089	0.0101	0.0112	0.0124	0.0135	0.0146
18	0.0101	0.0115	0.0128	0.0141	0.0154	0.0166
19	0.0115	0.0130	0.0145	0.0159	0.0174	0.0188
20	0.0129	0.0146	0.0163	0.0179	0.0195	0.0211
21	0.0144	0.0163	0.0182	0.0200	0.0218	0.0236
22	0.0160	0.0181	0.0202	0.0223	0.0243	0.0262
23	0.0177	0.0201	0.0224	0.0247	0.0269	0.0290
24	0.0195	0.0221	0.0247	0.0272	0.0296	0.0320
25	0.0214	0.0243	0.0271	0.0298	0.0325	0.0351
26	0.0234	0.0266	0.0296	0.0326	0.0355	0.0384
27	0.0256	0.0289	0.0323	0.0355	0.0387	0.0419
28	0.0278	0.0314	0.0351	0.0386	0.0421	0.0455
29	0.0301	0.0341	0.0380	0.0418	0.0456	0.0493
30	0.0325	0.0368	0.0410	0.0452	0.0493	0.0532
31	0.0350	0.0397	0.0442	0.0487	0.0531	0.0574
32	0.0376	0.0426	0.0475	0.0523	0.0571	0.0617
33	0.0404	0.0457	0.0510	0.0562	0.0612	0.0662
34	0.0432	0.0490	0.0546	0.0601	0.0655	0.0708
35	0.0462	0.0523	0.0583	0.0642	0.0700	0.0757
36	0.0492	0.0558	0.0622	0.0685	0.0746	0.0807
37	0.0524	0.0594	0.0662	0.0729	0.0794	0.0859
38	0.0557	0.0631	0.0703	0.0775	0.0844	0.0913
39	0.0591	0.0669	0.0746	0.0822	0.0896	0.0968
40	0.0626	0.0709	0.0791	0.0871	0.0949	0.1026
41	0.0662	0.0750	0.0837	0.0921	0.1004	0.1085
42	0.0700	0.0793	0.0884	0.0973	0.1061	0.1146
43	0.0738	0.0836	0.0932	0.1027	0.1119	0.1210
44	0.0778	0.0881	0.0983	0.1082	0.1179	0.1275
45	0.0819	0.0928	0.1034	0.1139	0.1241	0.1342
46	0.0861	0.0975	0.1087	0.1197	0.1305	0.1411
47	0.0904	0.1024	0.1142	0.1258	0.1371	0.1482
48	0.0949	0.1075	0.1198	0.1319	0.1438	0.1554
49	0.0994	0.1126	0.1256	0.1383	0.1507	0.1629
50	0.1041	0.1180	0.1315	0.1448	0.1578	0.1706
51	0.1089	0.1234	0.1376	0.1515	0.1651	0.1785
52	0.1139	0.1290	0.1438	0.1584	0.1726	0.1866
53	0.1189	0.1347	0.1502	0.1654	0.1803	0.1948
54	0.1241	0.1406	0.1567	0.1726	0.1881	0.2033

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	7	8	9	10	11	12
55	0.1294	0.1466	0.1634	0.1800	0.1962	0.2120
56	0.1348	0.1527	0.1703	0.1875	0.2044	0.2209
57	0.1404	0.1590	0.1773	0.1952	0.2128	0.2300
58	0.1461	0.1655	0.1845	0.2031	0.2214	0.2393
59	0.1519	0.1720	0.1918	0.2112	0.2302	0.2488
60	0.1578	0.1788	0.1993	0.2195	0.2392	0.2585
61	0.1639	0.1856	0.2070	0.2279	0.2484	0.2685
62	0.1700	0.1926	0.2148	0.2365	0.2578	0.2786
63	0.1764	0.1998	0.2228	0.2453	0.2673	0.2890
64	0.1828	0.2071	0.2309	0.2542	0.2771	0.2995
65	0.1894	0.2145	0.2392	0.2634	0.2871	0.3103
66	0.1961	0.2221	0.2477	0.2727	0.2973	0.3213
67	0.2029	0.2299	0.2563	0.2822	0.3076	0.3325
68	0.2099	0.2378	0.2651	0.2919	0.3182	0.3439
69	0.2170	0.2458	0.2741	0.3018	0.3290	0.3556
70	0.2243	0.2540	0.2832	0.3119	0.3399	0.3674
71	0.2316	0.2624	0.2926	0.3221	0.3511	0.3795
72	0.2391	0.2709	0.3020	0.3326	0.3625	0.3918
73	0.2468	0.2795	0.3117	0.3432	0.3741	0.4043
74	0.2545	0.2883	0.3215	0.3540	0.3859	0.4171
75	0.2625	0.2973	0.3315	0.3650	0.3978	0.4300
76	0.2705	0.3064	0.3417	0.3762	0.4100	0.4432
77	0.2787	0.3157	0.3520	0.3876	0.4225	0.4566
78	0.2870	0.3251	0.3625	0.3992	0.4351	0.4702
79	0.2955	0.3347	0.3732	0.4109	0.4479	0.4841
80	0.3041	0.3444	0.3840	0.4229	0.4609	0.4982
81	0.3128	0.3543	0.3951	0.4350	0.4742	0.5125
82	0.3217	0.3644	0.4063	0.4474	0.4876	0.5270
83	0.3307	0.3746	0.4177	0.4599	0.5013	0.5418
84	0.3398	0.3850	0.4292	0.4726	0.5152	0.5568
85	0.3491	0.3955	0.4410	0.4856	0.5292	0.5720
86	0.3586	0.4062	0.4529	0.4987	0.5435	0.5875
87	0.3682	0.4170	0.4650	0.5120	0.5581	0.6032
88	0.3779	0.4280	0.4773	0.5255	0.5728	0.6191
89	0.3877	0.4392	0.4897	0.5392	0.5877	0.6353
90	0.3977	0.4505	0.5024	0.5531	0.6029	0.6517
91	0.4079	0.4620	0.5152	0.5673	0.6183	0.6683
92	0.4182	0.4737	0.5282	0.5816	0.6339	0.6851
93	0.4286	0.4855	0.5413	0.5961	0.6497	0.7022
94	0.4392	0.4975	0.5547	0.6108	0.6657	0.7196
95	0.4499	0.5097	0.5683	0.6257	0.6820	0.7372
96	0.4608	0.5220	0.5820	0.6408	0.6985	0.7550
97	0.4718	0.5345	0.5959	0.6561	0.7152	0.7730
98	0.4830	0.5471	0.6100	0.6717	0.7321	0.7913
99	0.4943	0.5599	0.6243	0.6874	0.7493	0.8098
100	0.5057	0.5729	0.6388	0.7033	0.7666	0.8286

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	13	14	15	16	17	18
10	0.0047	0.0050	0.0053	0.0056	0.0059	0.0062
11	0.0058	0.0062	0.0066	0.0069	0.0073	0.0077
12	0.0071	0.0075	0.0080	0.0085	0.0089	0.0093
13	0.0085	0.0091	0.0096	0.0102	0.0107	0.0112
14	0.0101	0.0107	0.0114	0.0120	0.0126	0.0133
15	0.0118	0.0125	0.0133	0.0141	0.0148	0.0155
16	0.0136	0.0145	0.0154	0.0163	0.0171	0.0180
17	0.0156	0.0167	0.0177	0.0187	0.0197	0.0206
18	0.0178	0.0190	0.0202	0.0213	0.0224	0.0235
19	0.0202	0.0215	0.0228	0.0241	0.0254	0.0266
20	0.0227	0.0242	0.0257	0.0271	0.0285	0.0299
21	0.0253	0.0270	0.0287	0.0303	0.0319	0.0334
22	0.0282	0.0300	0.0319	0.0337	0.0354	0.0372
23	0.0312	0.0333	0.0353	0.0373	0.0392	0.0411
24	0.0344	0.0366	0.0389	0.0411	0.0432	0.0453
25	0.0377	0.0402	0.0427	0.0451	0.0474	0.0497
26	0.0412	0.0440	0.0467	0.0493	0.0519	0.0544
27	0.0449	0.0479	0.0509	0.0537	0.0565	0.0593
28	0.0488	0.0521	0.0553	0.0584	0.0614	0.0644
29	0.0529	0.0564	0.0599	0.0632	0.0665	0.0698
30	0.0571	0.0609	0.0647	0.0683	0.0719	0.0754
31	0.0616	0.0657	0.0697	0.0736	0.0775	0.0812
32	0.0662	0.0706	0.0749	0.0792	0.0833	0.0873
33	0.0710	0.0757	0.0804	0.0849	0.0893	0.0937
34	0.0760	0.0811	0.0860	0.0909	0.0956	0.1003
35	0.0812	0.0866	0.0919	0.0971	0.1022	0.1071
36	0.0866	0.0924	0.0980	0.1035	0.1089	0.1142
37	0.0922	0.0983	0.1043	0.1102	0.1160	0.1216
38	0.0979	0.1045	0.1109	0.1171	0.1232	0.1292
39	0.1039	0.1109	0.1176	0.1243	0.1307	0.1371
40	0.1101	0.1174	0.1246	0.1317	0.1385	0.1452
41	0.1165	0.1242	0.1318	0.1393	0.1465	0.1536
42	0.1230	0.1313	0.1393	0.1471	0.1548	0.1623
43	0.1298	0.1385	0.1470	0.1553	0.1633	0.1712
44	0.1368	0.1459	0.1549	0.1636	0.1721	0.1805
45	0.1440	0.1536	0.1630	0.1722	0.1812	0.1900
46	0.1514	0.1615	0.1714	0.1811	0.1905	0.1997
47	0.1590	0.1696	0.1800	0.1902	0.2001	0.2098
48	0.1668	0.1780	0.1889	0.1995	0.2099	0.2201
49	0.1749	0.1865	0.1980	0.2091	0.2200	0.2307
50	0.1831	0.1953	0.2073	0.2190	0.2304	0.2415
51	0.1916	0.2044	0.2169	0.2291	0.2410	0.2527
52	0.2002	0.2136	0.2267	0.2395	0.2519	0.2641
53	0.2091	0.2231	0.2367	0.2501	0.2631	0.2758
54	0.2182	0.2328	0.2470	0.2610	0.2746	0.2879

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	13	14	15	16	17	18
55	0.2275	0.2427	0.2576	0.2721	0.2863	0.3002
56	0.2371	0.2529	0.2684	0.2835	0.2983	0.3127
57	0.2469	0.2633	0.2795	0.2952	0.3106	0.3256
58	0.2568	0.2740	0.2908	0.3072	0.3232	0.3388
59	0.2670	0.2849	0.3023	0.3194	0.3360	0.3523
60	0.2775	0.2960	0.3141	0.3318	0.3491	0.3660
61	0.2881	0.3074	0.3262	0.3446	0.3625	0.3801
62	0.2990	0.3190	0.3385	0.3576	0.3762	0.3944
63	0.3101	0.3308	0.3511	0.3709	0.3902	0.4091
64	0.3215	0.3429	0.3639	0.3844	0.4045	0.4240
65	0.3330	0.3553	0.3770	0.3983	0.4190	0.4393
66	0.3448	0.3679	0.3904	0.4124	0.4339	0.4549
67	0.3569	0.3807	0.4040	0.4268	0.4490	0.4707
68	0.3691	0.3938	0.4179	0.4414	0.4644	0.4869
69	0.3816	0.4071	0.4320	0.4564	0.4802	0.5034
70	0.3943	0.4207	0.4464	0.4716	0.4962	0.5202
71	0.4073	0.4345	0.4611	0.4871	0.5125	0.5373
72	0.4205	0.4486	0.4760	0.5029	0.5291	0.5547
73	0.4339	0.4629	0.4912	0.5189	0.5460	0.5724
74	0.4476	0.4775	0.5067	0.5353	0.5632	0.5904
75	0.4615	0.4923	0.5225	0.5519	0.5807	0.6088
76	0.4757	0.5074	0.5385	0.5688	0.5985	0.6274
77	0.4901	0.5228	0.5548	0.5861	0.6166	0.6464
78	0.5047	0.5384	0.5713	0.6036	0.6350	0.6657
79	0.5196	0.5543	0.5882	0.6213	0.6537	0.6853
80	0.5347	0.5704	0.6053	0.6394	0.6728	0.7053
81	0.5500	0.5868	0.6227	0.6578	0.6921	0.7256
82	0.5656	0.6034	0.6403	0.6765	0.7117	0.7461
83	0.5815	0.6203	0.6583	0.6954	0.7317	0.7670
84	0.5976	0.6375	0.6765	0.7147	0.7519	0.7883
85	0.6139	0.6549	0.6950	0.7342	0.7725	0.8098
86	0.6305	0.6726	0.7138	0.7540	0.7934	0.8317
87	0.6474	0.6906	0.7329	0.7742	0.8145	0.8539
88	0.6645	0.7088	0.7522	0.7946	0.8360	0.8765
89	0.6818	0.7273	0.7718	0.8154	0.8579	0.8994
90	0.6994	0.7461	0.7918	0.8364	0.8800	0.9226
91	0.7172	0.7651	0.8120	0.8577	0.9025	0.9461
92	0.7353	0.7844	0.8324	0.8794	0.9252	0.9700
93	0.7537	0.8040	0.8532	0.9013	0.9483	0.9942
94	0.7723	0.8239	0.8743	0.9236	0.9717	1.0187
95	0.7911	0.8440	0.8956	0.9461	0.9955	1.0436
96	0.8103	0.8644	0.9173	0.9690	1.0195	1.0688
97	0.8296	0.8850	0.9392	0.9922	1.0439	1.0944
98	0.8493	0.9060	0.9614	1.0156	1.0686	1.1203
99	0.8691	0.9272	0.9839	1.0394	1.0936	1.1465
100	0.8893	0.9487	1.0067	1.0635	1.1189	1.1731

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	19	20	21	22	23	24
10	0.0064	0.0067	0.0070	0.0072	0.0075	0.0077
11	0.0080	0.0083	0.0087	0.0090	0.0093	0.0096
12	0.0097	0.0102	0.0106	0.0109	0.0113	0.0117
13	0.0117	0.0122	0.0127	0.0131	0.0136	0.0140
14	0.0139	0.0144	0.0150	0.0156	0.0161	0.0166
15	0.0162	0.0169	0.0176	0.0182	0.0188	0.0194
16	0.0188	0.0196	0.0203	0.0211	0.0218	0.0225
17	0.0216	0.0225	0.0234	0.0242	0.0251	0.0259
18	0.0246	0.0256	0.0266	0.0276	0.0285	0.0295
19	0.0278	0.0290	0.0301	0.0312	0.0323	0.0333
20	0.0312	0.0326	0.0338	0.0351	0.0363	0.0375
21	0.0349	0.0364	0.0378	0.0392	0.0406	0.0419
22	0.0388	0.0405	0.0420	0.0436	0.0451	0.0466
23	0.0430	0.0448	0.0465	0.0482	0.0499	0.0515
24	0.0474	0.0493	0.0513	0.0532	0.0550	0.0568
25	0.0520	0.0542	0.0563	0.0583	0.0604	0.0623
26	0.0568	0.0592	0.0615	0.0638	0.0660	0.0681
27	0.0619	0.0645	0.0671	0.0695	0.0719	0.0743
28	0.0673	0.0701	0.0729	0.0755	0.0781	0.0807
29	0.0729	0.0760	0.0789	0.0818	0.0847	0.0874
30	0.0788	0.0821	0.0853	0.0884	0.0915	0.0944
31	0.0849	0.0884	0.0919	0.0953	0.0986	0.1018
32	0.0912	0.0951	0.0988	0.1024	0.1060	0.1094
33	0.0979	0.1020	0.1060	0.1099	0.1137	0.1173
34	0.1048	0.1092	0.1134	0.1176	0.1217	0.1256
35	0.1119	0.1166	0.1212	0.1256	0.1300	0.1342
36	0.1193	0.1244	0.1292	0.1340	0.1386	0.1431
37	0.1270	0.1324	0.1376	0.1426	0.1475	0.1523
38	0.1350	0.1407	0.1462	0.1516	0.1568	0.1619
39	0.1432	0.1493	0.1551	0.1608	0.1664	0.1717
40	0.1518	0.1581	0.1643	0.1704	0.1762	0.1819
41	0.1605	0.1673	0.1738	0.1802	0.1864	0.1925
42	0.1696	0.1767	0.1837	0.1904	0.1970	0.2033
43	0.1790	0.1865	0.1938	0.2009	0.2078	0.2146
44	0.1886	0.1965	0.2042	0.2117	0.2190	0.2261
45	0.1985	0.2068	0.2149	0.2228	0.2305	0.2380
46	0.2087	0.2175	0.2260	0.2343	0.2424	0.2502
47	0.2192	0.2284	0.2374	0.2461	0.2546	0.2628
48	0.2300	0.2396	0.2490	0.2582	0.2671	0.2757
49	0.2410	0.2512	0.2610	0.2706	0.2799	0.2890
50	0.2524	0.2630	0.2733	0.2834	0.2931	0.3026
51	0.2641	0.2751	0.2859	0.2964	0.3067	0.3166
52	0.2760	0.2876	0.2989	0.3099	0.3205	0.3309
53	0.2883	0.3004	0.3121	0.3236	0.3348	0.3456
54	0.3008	0.3134	0.3257	0.3377	0.3493	0.3607

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	19	20	21	22	23	24
55	0.3137	0.3268	0.3397	0.3521	0.3643	0.3761
56	0.3268	0.3405	0.3539	0.3669	0.3795	0.3918
57	0.3403	0.3546	0.3685	0.3820	0.3952	0.4080
58	0.3540	0.3689	0.3834	0.3975	0.4112	0.4245
59	0.3681	0.3836	0.3986	0.4133	0.4275	0.4413
60	0.3825	0.3985	0.4142	0.4294	0.4442	0.4586
61	0.3972	0.4139	0.4301	0.4459	0.4613	0.4762
62	0.4122	0.4295	0.4463	0.4627	0.4787	0.4942
63	0.4275	0.4454	0.4629	0.4799	0.4965	0.5125
64	0.4431	0.4617	0.4798	0.4975	0.5146	0.5313
65	0.4591	0.4783	0.4971	0.5154	0.5331	0.5504
66	0.4753	0.4953	0.5147	0.5336	0.5520	0.5699
67	0.4919	0.5126	0.5327	0.5522	0.5713	0.5898
68	0.5088	0.5302	0.5510	0.5712	0.5909	0.6100
69	0.5260	0.5481	0.5696	0.5906	0.6109	0.6307
70	0.5436	0.5664	0.5886	0.6103	0.6313	0.6517
71	0.5614	0.5850	0.6080	0.6303	0.6520	0.6731
72	0.5796	0.6040	0.6277	0.6507	0.6732	0.6949
73	0.5982	0.6233	0.6477	0.6715	0.6947	0.7171
74	0.6170	0.6429	0.6681	0.6927	0.7166	0.7397
75	0.6362	0.6629	0.6889	0.7142	0.7388	0.7627
76	0.6557	0.6832	0.7100	0.7361	0.7615	0.7861
77	0.6755	0.7039	0.7315	0.7584	0.7845	0.8099
78	0.6957	0.7249	0.7533	0.7810	0.8079	0.8341
79	0.7162	0.7463	0.7755	0.8040	0.8317	0.8587
80	0.7370	0.7680	0.7981	0.8274	0.8559	0.8836
81	0.7582	0.7900	0.8210	0.8512	0.8805	0.9090
82	0.7797	0.8124	0.8443	0.8753	0.9055	0.9348
83	0.8016	0.8352	0.8680	0.8999	0.9309	0.9610
84	0.8238	0.8583	0.8920	0.9248	0.9567	0.9876
85	0.8463	0.8818	0.9164	0.9501	0.9828	1.0146
86	0.8692	0.9056	0.9412	0.9758	1.0094	1.0421
87	0.8924	0.9298	0.9663	1.0018	1.0363	1.0699
88	0.9159	0.9544	0.9918	1.0283	1.0637	1.0981
89	0.9398	0.9793	1.0177	1.0551	1.0915	1.1268
90	0.9641	1.0045	1.0440	1.0823	1.1196	1.1559
91	0.9887	1.0302	1.0706	1.1099	1.1482	1.1854
92	1.0136	1.0562	1.0976	1.1379	1.1772	1.2153
93	1.0389	1.0825	1.1250	1.1663	1.2065	1.2456
94	1.0646	1.1092	1.1528	1.1951	1.2363	1.2763
95	1.0906	1.1363	1.1809	1.2243	1.2665	1.3075
96	1.1169	1.1638	1.2095	1.2539	1.2971	1.3391
97	1.1436	1.1916	1.2384	1.2839	1.3281	1.3711
98	1.1707	1.2198	1.2677	1.3143	1.3596	1.4036
99	1.1981	1.2484	1.2974	1.3450	1.3914	1.4364
100	1.2259	1.2773	1.3274	1.3762	1.4236	1.4697

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	25	26	27	28	29	30
10	0.0079	0.0082	0.0084	0.0086	0.0088	0.0090
11	0.0099	0.0102	0.0104	0.0107	0.0110	0.0112
12	0.0120	0.0124	0.0127	0.0130	0.0134	0.0137
13	0.0145	0.0149	0.0153	0.0157	0.0160	0.0164
14	0.0171	0.0176	0.0181	0.0185	0.0190	0.0194
15	0.0200	0.0206	0.0212	0.0217	0.0222	0.0227
16	0.0232	0.0239	0.0245	0.0251	0.0257	0.0263
17	0.0266	0.0274	0.0282	0.0289	0.0296	0.0302
18	0.0304	0.0312	0.0321	0.0329	0.0337	0.0344
19	0.0343	0.0353	0.0363	0.0372	0.0381	0.0389
20	0.0386	0.0397	0.0408	0.0418	0.0428	0.0438
21	0.0431	0.0444	0.0456	0.0467	0.0478	0.0489
22	0.0480	0.0493	0.0507	0.0520	0.0532	0.0544
23	0.0531	0.0546	0.0561	0.0575	0.0589	0.0602
24	0.0585	0.0602	0.0618	0.0634	0.0649	0.0663
25	0.0642	0.0660	0.0678	0.0695	0.0712	0.0728
26	0.0702	0.0722	0.0742	0.0760	0.0779	0.0796
27	0.0765	0.0787	0.0808	0.0829	0.0849	0.0868
28	0.0831	0.0855	0.0878	0.0900	0.0922	0.0943
29	0.0901	0.0926	0.0951	0.0975	0.0999	0.1021
30	0.0973	0.1001	0.1028	0.1054	0.1079	0.1103
31	0.1048	0.1078	0.1108	0.1136	0.1163	0.1189
32	0.1127	0.1159	0.1191	0.1221	0.1250	0.1278
33	0.1209	0.1244	0.1277	0.1310	0.1341	0.1371
34	0.1294	0.1331	0.1367	0.1402	0.1435	0.1468
35	0.1383	0.1422	0.1461	0.1498	0.1534	0.1568
36	0.1474	0.1517	0.1558	0.1597	0.1635	0.1672
37	0.1569	0.1614	0.1658	0.1700	0.1741	0.1780
38	0.1668	0.1716	0.1762	0.1807	0.1850	0.1891
39	0.1770	0.1820	0.1869	0.1917	0.1963	0.2007
40	0.1875	0.1928	0.1980	0.2031	0.2079	0.2126
41	0.1983	0.2040	0.2095	0.2148	0.2200	0.2249
42	0.2095	0.2155	0.2213	0.2270	0.2324	0.2376
43	0.2211	0.2274	0.2335	0.2395	0.2452	0.2507
44	0.2330	0.2397	0.2461	0.2524	0.2584	0.2642
45	0.2452	0.2523	0.2591	0.2656	0.2720	0.2781
46	0.2578	0.2652	0.2724	0.2793	0.2860	0.2924
47	0.2708	0.2785	0.2861	0.2933	0.3003	0.3071
48	0.2841	0.2922	0.3001	0.3077	0.3151	0.3222
49	0.2978	0.3063	0.3146	0.3225	0.3303	0.3377
50	0.3118	0.3207	0.3294	0.3378	0.3458	0.3536
51	0.3262	0.3356	0.3446	0.3534	0.3618	0.3700
52	0.3410	0.3508	0.3602	0.3693	0.3782	0.3867
53	0.3561	0.3663	0.3762	0.3857	0.3950	0.4039
54	0.3716	0.3823	0.3926	0.4025	0.4122	0.4215

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	25	26	27	28	29	30
55	0.3875	0.3986	0.4093	0.4197	0.4298	0.4395
56	0.4038	0.4153	0.4265	0.4373	0.4478	0.4579
57	0.4204	0.4324	0.4441	0.4553	0.4662	0.4767
58	0.4374	0.4499	0.4620	0.4738	0.4851	0.4960
59	0.4548	0.4678	0.4804	0.4926	0.5044	0.5157
60	0.4725	0.4861	0.4992	0.5118	0.5241	0.5359
61	0.4907	0.5047	0.5183	0.5315	0.5442	0.5565
62	0.5092	0.5238	0.5379	0.5516	0.5648	0.5775
63	0.5281	0.5433	0.5579	0.5721	0.5857	0.5989
64	0.5474	0.5631	0.5783	0.5930	0.6072	0.6208
65	0.5671	0.5834	0.5991	0.6143	0.6290	0.6432
66	0.5872	0.6040	0.6203	0.6361	0.6513	0.6660
67	0.6077	0.6251	0.6420	0.6583	0.6740	0.6892
68	0.6286	0.6466	0.6640	0.6809	0.6972	0.7129
69	0.6499	0.6685	0.6865	0.7039	0.7208	0.7370
70	0.6715	0.6908	0.7094	0.7274	0.7448	0.7616
71	0.6936	0.7135	0.7327	0.7513	0.7693	0.7866
72	0.7161	0.7366	0.7564	0.7757	0.7942	0.8121
73	0.7390	0.7601	0.7806	0.8004	0.8196	0.8380
74	0.7623	0.7841	0.8052	0.8257	0.8454	0.8645
75	0.7859	0.8084	0.8302	0.8513	0.8717	0.8913
76	0.8100	0.8332	0.8557	0.8774	0.8984	0.9186
77	0.8345	0.8584	0.8816	0.9040	0.9256	0.9464
78	0.8595	0.8841	0.9079	0.9309	0.9532	0.9747
79	0.8848	0.9101	0.9347	0.9584	0.9813	1.0034
80	0.9105	0.9366	0.9618	0.9863	1.0099	1.0326
81	0.9367	0.9635	0.9895	1.0146	1.0389	1.0623
82	0.9633	0.9908	1.0176	1.0434	1.0683	1.0924
83	0.9903	1.0186	1.0461	1.0726	1.0983	1.1230
84	1.0177	1.0468	1.0750	1.1023	1.1287	1.1541
85	1.0455	1.0754	1.1044	1.1325	1.1596	1.1857
86	1.0738	1.1045	1.1343	1.1631	1.1909	1.2177
87	1.1024	1.1340	1.1646	1.1941	1.2227	1.2502
88	1.1315	1.1639	1.1953	1.2257	1.2550	1.2833
89	1.1611	1.1943	1.2265	1.2576	1.2877	1.3167
90	1.1910	1.2251	1.2582	1.2901	1.3210	1.3507
91	1.2214	1.2564	1.2903	1.3230	1.3547	1.3852
92	1.2522	1.2881	1.3228	1.3564	1.3888	1.4201
93	1.2835	1.3202	1.3558	1.3902	1.4235	1.4556
94	1.3152	1.3528	1.3893	1.4246	1.4586	1.4915
95	1.3473	1.3859	1.4232	1.4593	1.4943	1.5279
96	1.3798	1.4193	1.4576	1.4946	1.5304	1.5648
97	1.4128	1.4533	1.4925	1.5303	1.5669	1.6023
98	1.4463	1.4877	1.5278	1.5666	1.6040	1.6402
99	1.4801	1.5225	1.5635	1.6032	1.6416	1.6786
100	1.5144	1.5578	1.5998	1.6404	1.6796	1.7175

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	31	32	33	34	35	36
10	0.0092	0.0094	0.0096	0.0097	0.0099	0.0101
11	0.0114	0.0117	0.0119	0.0121	0.0123	0.0125
12	0.0139	0.0142	0.0145	0.0148	0.0150	0.0152
13	0.0167	0.0171	0.0174	0.0177	0.0180	0.0183
14	0.0198	0.0202	0.0206	0.0210	0.0213	0.0216
15	0.0232	0.0237	0.0241	0.0245	0.0249	0.0253
16	0.0269	0.0274	0.0279	0.0284	0.0289	0.0293
17	0.0309	0.0315	0.0321	0.0326	0.0332	0.0337
18	0.0352	0.0359	0.0365	0.0372	0.0378	0.0384
19	0.0398	0.0406	0.0413	0.0421	0.0428	0.0434
20	0.0447	0.0456	0.0465	0.0473	0.0481	0.0488
21	0.0500	0.0510	0.0519	0.0528	0.0537	0.0546
22	0.0556	0.0567	0.0577	0.0588	0.0597	0.0607
23	0.0615	0.0627	0.0639	0.0650	0.0661	0.0671
24	0.0677	0.0691	0.0704	0.0716	0.0728	0.0740
25	0.0744	0.0758	0.0773	0.0786	0.0799	0.0812
26	0.0813	0.0829	0.0845	0.0860	0.0874	0.0888
27	0.0886	0.0904	0.0921	0.0937	0.0953	0.0968
28	0.0963	0.0982	0.1001	0.1018	0.1035	0.1051
29	0.1043	0.1064	0.1084	0.1103	0.1121	0.1139
30	0.1127	0.1149	0.1171	0.1192	0.1211	0.1230
31	0.1214	0.1239	0.1262	0.1284	0.1306	0.1326
32	0.1305	0.1332	0.1357	0.1381	0.1404	0.1425
33	0.1400	0.1428	0.1455	0.1481	0.1506	0.1529
34	0.1499	0.1529	0.1558	0.1585	0.1612	0.1637
35	0.1601	0.1633	0.1664	0.1694	0.1722	0.1749
36	0.1708	0.1742	0.1774	0.1806	0.1836	0.1865
37	0.1818	0.1854	0.1889	0.1922	0.1954	0.1985
38	0.1932	0.1970	0.2007	0.2043	0.2077	0.2109
39	0.2049	0.2090	0.2130	0.2167	0.2203	0.2238
40	0.2171	0.2215	0.2256	0.2296	0.2334	0.2371
41	0.2297	0.2343	0.2387	0.2429	0.2470	0.2508
42	0.2427	0.2475	0.2522	0.2566	0.2609	0.2650
43	0.2560	0.2612	0.2661	0.2708	0.2753	0.2796
44	0.2698	0.2752	0.2804	0.2854	0.2901	0.2946
45	0.2840	0.2897	0.2951	0.3004	0.3054	0.3101
46	0.2986	0.3046	0.3103	0.3158	0.3210	0.3261
47	0.3136	0.3199	0.3259	0.3317	0.3372	0.3424
48	0.3290	0.3356	0.3419	0.3480	0.3538	0.3593
49	0.3449	0.3518	0.3584	0.3647	0.3708	0.3766
50	0.3611	0.3684	0.3753	0.3819	0.3883	0.3943
51	0.3778	0.3854	0.3926	0.3996	0.4062	0.4125
52	0.3949	0.4028	0.4104	0.4176	0.4246	0.4312
53	0.4124	0.4207	0.4286	0.4362	0.4434	0.4503
54	0.4304	0.4390	0.4473	0.4552	0.4627	0.4700

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	31	32	33	34	35	36
55	0.4488	0.4578	0.4664	0.4746	0.4825	0.4900
56	0.4676	0.4770	0.4859	0.4945	0.5027	0.5106
57	0.4869	0.4966	0.5059	0.5149	0.5234	0.5316
58	0.5066	0.5167	0.5264	0.5357	0.5446	0.5531
59	0.5267	0.5372	0.5473	0.5570	0.5663	0.5751
60	0.5473	0.5582	0.5687	0.5788	0.5884	0.5976
61	0.5683	0.5796	0.5906	0.6010	0.6110	0.6205
62	0.5898	0.6015	0.6129	0.6237	0.6341	0.6440
63	0.6117	0.6239	0.6356	0.6469	0.6576	0.6679
64	0.6340	0.6467	0.6589	0.6705	0.6817	0.6923
65	0.6568	0.6700	0.6826	0.6946	0.7062	0.7172
66	0.6801	0.6937	0.7067	0.7193	0.7312	0.7426
67	0.7038	0.7179	0.7314	0.7443	0.7567	0.7685
68	0.7280	0.7426	0.7565	0.7699	0.7827	0.7949
69	0.7526	0.7677	0.7821	0.7960	0.8092	0.8218
70	0.7777	0.7933	0.8082	0.8225	0.8362	0.8492
71	0.8033	0.8194	0.8348	0.8496	0.8637	0.8771
72	0.8293	0.8459	0.8618	0.8771	0.8917	0.9056
73	0.8558	0.8729	0.8894	0.9051	0.9201	0.9345
74	0.8828	0.9004	0.9174	0.9336	0.9491	0.9639
75	0.9102	0.9284	0.9459	0.9626	0.9786	0.9939
76	0.9381	0.9569	0.9749	0.9921	1.0086	1.0244
77	0.9665	0.9858	1.0044	1.0222	1.0392	1.0554
78	0.9954	1.0153	1.0344	1.0527	1.0702	1.0869
79	1.0247	1.0452	1.0649	1.0837	1.1017	1.1189
80	1.0545	1.0756	1.0958	1.1152	1.1338	1.1515
81	1.0848	1.1065	1.1273	1.1473	1.1663	1.1845
82	1.1156	1.1379	1.1593	1.1798	1.1994	1.2181
83	1.1469	1.1698	1.1918	1.2129	1.2330	1.2523
84	1.1786	1.2022	1.2248	1.2465	1.2672	1.2869
85	1.2109	1.2351	1.2583	1.2806	1.3018	1.3221
86	1.2436	1.2684	1.2923	1.3152	1.3370	1.3579
87	1.2768	1.3023	1.3268	1.3503	1.3727	1.3941
88	1.3105	1.3367	1.3618	1.3859	1.4090	1.4309
89	1.3447	1.3716	1.3974	1.4221	1.4457	1.4683
90	1.3794	1.4070	1.4334	1.4588	1.4830	1.5062
91	1.4146	1.4429	1.4700	1.4960	1.5209	1.5446
92	1.4503	1.4793	1.5071	1.5338	1.5593	1.5836
93	1.4865	1.5162	1.5447	1.5720	1.5982	1.6231
94	1.5232	1.5536	1.5828	1.6108	1.6376	1.6632
95	1.5604	1.5916	1.6215	1.6502	1.6776	1.7038
96	1.5981	1.6300	1.6607	1.6901	1.7181	1.7449
97	1.6363	1.6690	1.7004	1.7305	1.7592	1.7867
98	1.6750	1.7085	1.7406	1.7714	1.8008	1.8289
99	1.7142	1.7485	1.7814	1.8129	1.8430	1.8718
100	1.7539	1.7890	1.8227	1.8549	1.8857	1.9151

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	37	38	39	40	41	42
10	0.0102	0.0103	0.0105	0.0106	0.0107	0.0108
11	0.0127	0.0128	0.0130	0.0132	0.0133	0.0134
12	0.0155	0.0157	0.0159	0.0161	0.0162	0.0164
13	0.0185	0.0188	0.0190	0.0193	0.0195	0.0197
14	0.0220	0.0223	0.0225	0.0228	0.0231	0.0233
15	0.0257	0.0261	0.0264	0.0267	0.0270	0.0273
16	0.0298	0.0302	0.0306	0.0309	0.0313	0.0316
17	0.0342	0.0347	0.0351	0.0355	0.0359	0.0363
18	0.0390	0.0395	0.0400	0.0405	0.0409	0.0413
19	0.0441	0.0447	0.0452	0.0458	0.0463	0.0467
20	0.0495	0.0502	0.0508	0.0514	0.0520	0.0525
21	0.0554	0.0561	0.0568	0.0575	0.0581	0.0587
22	0.0615	0.0624	0.0632	0.0639	0.0646	0.0653
23	0.0681	0.0690	0.0699	0.0708	0.0715	0.0723
24	0.0751	0.0761	0.0770	0.0780	0.0788	0.0796
25	0.0824	0.0835	0.0846	0.0856	0.0865	0.0874
26	0.0901	0.0913	0.0925	0.0936	0.0946	0.0956
27	0.0982	0.0995	0.1008	0.1020	0.1031	0.1041
28	0.1067	0.1081	0.1095	0.1108	0.1120	0.1131
29	0.1155	0.1171	0.1186	0.1200	0.1213	0.1226
30	0.1248	0.1265	0.1282	0.1297	0.1311	0.1324
31	0.1345	0.1364	0.1381	0.1397	0.1413	0.1427
32	0.1446	0.1466	0.1485	0.1502	0.1519	0.1534
33	0.1551	0.1573	0.1593	0.1611	0.1629	0.1646
34	0.1661	0.1683	0.1705	0.1725	0.1744	0.1762
35	0.1774	0.1798	0.1821	0.1843	0.1863	0.1882
36	0.1892	0.1918	0.1942	0.1965	0.1987	0.2007
37	0.2014	0.2041	0.2067	0.2092	0.2115	0.2136
38	0.2140	0.2169	0.2197	0.2223	0.2247	0.2270
39	0.2271	0.2302	0.2331	0.2358	0.2384	0.2409
40	0.2405	0.2438	0.2469	0.2499	0.2526	0.2552
41	0.2545	0.2580	0.2612	0.2643	0.2672	0.2699
42	0.2688	0.2725	0.2760	0.2793	0.2823	0.2852
43	0.2837	0.2875	0.2912	0.2947	0.2979	0.3009
44	0.2989	0.3030	0.3069	0.3105	0.3139	0.3171
45	0.3146	0.3189	0.3230	0.3268	0.3304	0.3338
46	0.3308	0.3353	0.3396	0.3436	0.3474	0.3509
47	0.3474	0.3522	0.3567	0.3609	0.3649	0.3686
48	0.3645	0.3695	0.3742	0.3786	0.3828	0.3867
49	0.3821	0.3873	0.3922	0.3969	0.4012	0.4053
50	0.4001	0.4055	0.4107	0.4156	0.4201	0.4244
51	0.4186	0.4243	0.4297	0.4348	0.4395	0.4440
52	0.4375	0.4435	0.4491	0.4545	0.4594	0.4641
53	0.4569	0.4632	0.4691	0.4746	0.4798	0.4847
54	0.4768	0.4833	0.4895	0.4953	0.5007	0.5058

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	37	38	39	40	41	42
55	0.4972	0.5040	0.5104	0.5165	0.5221	0.5274
56	0.5180	0.5251	0.5318	0.5381	0.5440	0.5495
57	0.5394	0.5467	0.5537	0.5603	0.5664	0.5722
58	0.5612	0.5689	0.5761	0.5829	0.5893	0.5953
59	0.5835	0.5915	0.5990	0.6061	0.6128	0.6190
60	0.6063	0.6146	0.6224	0.6298	0.6367	0.6432
61	0.6296	0.6382	0.6463	0.6540	0.6611	0.6679
62	0.6534	0.6623	0.6707	0.6787	0.6861	0.6931
63	0.6776	0.6869	0.6956	0.7039	0.7116	0.7188
64	0.7024	0.7120	0.7211	0.7296	0.7376	0.7451
65	0.7277	0.7376	0.7470	0.7559	0.7642	0.7719
66	0.7535	0.7637	0.7735	0.7826	0.7912	0.7993
67	0.7797	0.7904	0.8005	0.8099	0.8188	0.8271
68	0.8065	0.8175	0.8280	0.8378	0.8470	0.8556
69	0.8338	0.8452	0.8560	0.8661	0.8756	0.8845
70	0.8616	0.8734	0.8845	0.8950	0.9048	0.9140
71	0.8900	0.9021	0.9136	0.9244	0.9346	0.9441
72	0.9188	0.9313	0.9432	0.9544	0.9649	0.9747
73	0.9481	0.9611	0.9733	0.9849	0.9957	1.0058
74	0.9780	0.9914	1.0040	1.0159	1.0271	1.0375
75	1.0084	1.0222	1.0352	1.0475	1.0590	1.0697
76	1.0393	1.0535	1.0669	1.0796	1.0914	1.1025
77	1.0708	1.0854	1.0992	1.1122	1.1245	1.1359
78	1.1027	1.1178	1.1320	1.1455	1.1580	1.1698
79	1.1352	1.1507	1.1654	1.1792	1.1922	1.2043
80	1.1683	1.1842	1.1993	1.2135	1.2269	1.2393
81	1.2018	1.2182	1.2338	1.2484	1.2621	1.2749
82	1.2359	1.2528	1.2688	1.2838	1.2979	1.3111
83	1.2706	1.2879	1.3043	1.3198	1.3343	1.3478
84	1.3057	1.3236	1.3404	1.3563	1.3712	1.3851
85	1.3414	1.3598	1.3771	1.3934	1.4087	1.4230
86	1.3777	1.3965	1.4143	1.4311	1.4468	1.4615
87	1.4145	1.4338	1.4521	1.4693	1.4854	1.5005
88	1.4518	1.4717	1.4904	1.5081	1.5246	1.5401
89	1.4897	1.5101	1.5293	1.5474	1.5644	1.5803
90	1.5282	1.5490	1.5688	1.5874	1.6048	1.6211
91	1.5672	1.5886	1.6088	1.6279	1.6457	1.6624
92	1.6067	1.6286	1.6494	1.6689	1.6873	1.7044
93	1.6468	1.6693	1.6905	1.7106	1.7294	1.7469
94	1.6874	1.7105	1.7323	1.7528	1.7721	1.7900
95	1.7287	1.7523	1.7746	1.7956	1.8153	1.8338
96	1.7704	1.7946	1.8175	1.8390	1.8592	1.8781
97	1.8127	1.8375	1.8609	1.8830	1.9037	1.9230
98	1.8556	1.8810	1.9049	1.9275	1.9487	1.9685
99	1.8991	1.9250	1.9495	1.9727	1.9943	2.0146
100	1.9431	1.9696	1.9947	2.0184	2.0406	2.0613

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	43	44	45	46	47	48
10	0.0109	0.0110	0.0111	0.0112	0.0112	0.0113
11	0.0136	0.0137	0.0138	0.0139	0.0140	0.0140
12	0.0165	0.0167	0.0168	0.0169	0.0170	0.0171
13	0.0199	0.0200	0.0202	0.0203	0.0205	0.0206
14	0.0235	0.0237	0.0239	0.0241	0.0242	0.0243
15	0.0275	0.0278	0.0280	0.0282	0.0283	0.0285
16	0.0319	0.0322	0.0324	0.0326	0.0328	0.0330
17	0.0366	0.0369	0.0372	0.0375	0.0377	0.0379
18	0.0417	0.0421	0.0424	0.0427	0.0429	0.0432
19	0.0472	0.0476	0.0479	0.0483	0.0486	0.0488
20	0.0530	0.0535	0.0539	0.0543	0.0546	0.0549
21	0.0593	0.0598	0.0602	0.0607	0.0610	0.0614
22	0.0659	0.0665	0.0670	0.0674	0.0679	0.0682
23	0.0729	0.0736	0.0741	0.0746	0.0751	0.0755
24	0.0804	0.0810	0.0817	0.0822	0.0828	0.0832
25	0.0882	0.0890	0.0896	0.0903	0.0908	0.0913
26	0.0965	0.0973	0.0980	0.0987	0.0993	0.0999
27	0.1051	0.1060	0.1068	0.1076	0.1082	0.1088
28	0.1142	0.1152	0.1161	0.1169	0.1176	0.1183
29	0.1237	0.1248	0.1257	0.1266	0.1274	0.1281
30	0.1337	0.1348	0.1358	0.1368	0.1376	0.1384
31	0.1440	0.1453	0.1464	0.1474	0.1483	0.1491
32	0.1548	0.1562	0.1574	0.1585	0.1595	0.1603
33	0.1661	0.1675	0.1688	0.1700	0.1711	0.1720
34	0.1778	0.1793	0.1807	0.1820	0.1831	0.1841
35	0.1900	0.1916	0.1931	0.1944	0.1956	0.1967
36	0.2026	0.2043	0.2059	0.2073	0.2086	0.2097
37	0.2156	0.2174	0.2191	0.2207	0.2220	0.2232
38	0.2291	0.2311	0.2329	0.2345	0.2360	0.2372
39	0.2431	0.2452	0.2471	0.2488	0.2503	0.2517
40	0.2576	0.2597	0.2618	0.2636	0.2652	0.2667
41	0.2725	0.2748	0.2769	0.2789	0.2806	0.2821
42	0.2879	0.2903	0.2926	0.2946	0.2964	0.2981
43	0.3037	0.3063	0.3087	0.3108	0.3128	0.3145
44	0.3201	0.3228	0.3253	0.3276	0.3296	0.3314
45	0.3369	0.3398	0.3424	0.3448	0.3469	0.3488
46	0.3542	0.3572	0.3600	0.3625	0.3648	0.3668
47	0.3720	0.3752	0.3781	0.3807	0.3831	0.3852
48	0.3903	0.3936	0.3967	0.3994	0.4019	0.4041
49	0.4091	0.4126	0.4158	0.4187	0.4213	0.4236
50	0.4284	0.4320	0.4354	0.4384	0.4411	0.4435
51	0.4482	0.4520	0.4555	0.4587	0.4615	0.4640
52	0.4684	0.4724	0.4761	0.4794	0.4824	0.4850
53	0.4892	0.4934	0.4972	0.5007	0.5038	0.5066
54	0.5105	0.5149	0.5189	0.5225	0.5257	0.5286

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	43	44	45	46	47	48
55	0.5323	0.5369	0.5410	0.5448	0.5482	0.5512
56	0.5547	0.5594	0.5637	0.5677	0.5712	0.5743
57	0.5775	0.5824	0.5869	0.5910	0.5947	0.5980
58	0.6009	0.6060	0.6107	0.6150	0.6188	0.6222
59	0.6248	0.6301	0.6350	0.6394	0.6434	0.6469
60	0.6492	0.6547	0.6598	0.6644	0.6685	0.6722
61	0.6741	0.6798	0.6851	0.6899	0.6942	0.6980
62	0.6996	0.7055	0.7110	0.7159	0.7204	0.7243
63	0.7255	0.7317	0.7374	0.7425	0.7472	0.7512
64	0.7521	0.7585	0.7644	0.7697	0.7745	0.7787
65	0.7791	0.7858	0.7919	0.7974	0.8023	0.8067
66	0.8067	0.8136	0.8199	0.8256	0.8308	0.8353
67	0.8349	0.8420	0.8485	0.8544	0.8597	0.8644
68	0.8635	0.8709	0.8777	0.8838	0.8893	0.8941
69	0.8928	0.9004	0.9074	0.9137	0.9194	0.9244
70	0.9225	0.9304	0.9376	0.9442	0.9500	0.9552
71	0.9529	0.9610	0.9684	0.9752	0.9813	0.9866
72	0.9837	0.9921	0.9998	1.0068	1.0131	1.0186
73	1.0152	1.0238	1.0318	1.0390	1.0454	1.0511
74	1.0472	1.0561	1.0643	1.0717	1.0784	1.0843
75	1.0797	1.0889	1.0974	1.1050	1.1119	1.1180
76	1.1128	1.1223	1.1310	1.1389	1.1460	1.1522
77	1.1465	1.1563	1.1652	1.1733	1.1806	1.1871
78	1.1807	1.1908	1.2000	1.2084	1.2159	1.2225
79	1.2155	1.2259	1.2354	1.2440	1.2517	1.2586
80	1.2509	1.2615	1.2713	1.2802	1.2881	1.2952
81	1.2868	1.2978	1.3078	1.3170	1.3251	1.3324
82	1.3233	1.3346	1.3449	1.3543	1.3627	1.3702
83	1.3604	1.3720	1.3826	1.3923	1.4009	1.4086
84	1.3981	1.4100	1.4209	1.4308	1.4397	1.4476
85	1.4363	1.4485	1.4598	1.4699	1.4791	1.4872
86	1.4751	1.4877	1.4992	1.5097	1.5191	1.5274
87	1.5145	1.5274	1.5393	1.5500	1.5596	1.5682
88	1.5545	1.5677	1.5799	1.5909	1.6008	1.6096
89	1.5951	1.6087	1.6211	1.6324	1.6426	1.6516
90	1.6362	1.6502	1.6629	1.6745	1.6850	1.6942
91	1.6780	1.6923	1.7054	1.7173	1.7279	1.7374
92	1.7203	1.7350	1.7484	1.7606	1.7715	1.7812
93	1.7632	1.7783	1.7920	1.8045	1.8158	1.8257
94	1.8067	1.8222	1.8363	1.8491	1.8606	1.8707
95	1.8509	1.8667	1.8811	1.8942	1.9060	1.9164
96	1.8956	1.9118	1.9266	1.9400	1.9521	1.9627
97	1.9409	1.9575	1.9726	1.9864	1.9987	2.0097
98	1.9868	2.0038	2.0193	2.0334	2.0460	2.0572
99	2.0334	2.0507	2.0666	2.0810	2.0939	2.1054
100	2.0805	2.0982	2.1145	2.1292	2.1425	2.1542

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	49	50	51	52	53	54
10	0.0114	0.0114	0.0114	0.0115	0.0115	0.0115
11	0.0141	0.0142	0.0142	0.0143	0.0143	0.0143
12	0.0172	0.0173	0.0173	0.0174	0.0174	0.0174
13	0.0207	0.0207	0.0208	0.0209	0.0209	0.0209
14	0.0245	0.0246	0.0246	0.0247	0.0247	0.0248
15	0.0286	0.0287	0.0288	0.0289	0.0290	0.0290
16	0.0332	0.0333	0.0334	0.0335	0.0336	0.0336
17	0.0381	0.0382	0.0384	0.0385	0.0385	0.0386
18	0.0434	0.0436	0.0437	0.0438	0.0439	0.0439
19	0.0491	0.0493	0.0494	0.0496	0.0496	0.0497
20	0.0552	0.0554	0.0556	0.0557	0.0558	0.0559
21	0.0617	0.0619	0.0621	0.0623	0.0624	0.0624
22	0.0686	0.0688	0.0691	0.0692	0.0694	0.0694
23	0.0759	0.0762	0.0764	0.0766	0.0768	0.0768
24	0.0836	0.0839	0.0842	0.0844	0.0846	0.0847
25	0.0918	0.0921	0.0924	0.0927	0.0928	0.0929
26	0.1003	0.1007	0.1011	0.1013	0.1015	0.1016
27	0.1094	0.1098	0.1102	0.1104	0.1106	0.1107
28	0.1188	0.1193	0.1197	0.1200	0.1202	0.1203
29	0.1287	0.1292	0.1296	0.1300	0.1302	0.1303
30	0.1390	0.1396	0.1401	0.1404	0.1407	0.1408
31	0.1498	0.1504	0.1509	0.1513	0.1516	0.1518
32	0.1611	0.1617	0.1623	0.1627	0.1630	0.1631
33	0.1728	0.1735	0.1741	0.1745	0.1748	0.1750
34	0.1850	0.1857	0.1863	0.1868	0.1871	0.1873
35	0.1976	0.1984	0.1990	0.1995	0.1999	0.2001
36	0.2107	0.2116	0.2122	0.2128	0.2132	0.2134
37	0.2243	0.2252	0.2259	0.2265	0.2269	0.2272
38	0.2384	0.2393	0.2401	0.2407	0.2411	0.2414
39	0.2529	0.2539	0.2547	0.2554	0.2559	0.2561
40	0.2679	0.2690	0.2699	0.2706	0.2711	0.2713
41	0.2835	0.2846	0.2855	0.2862	0.2868	0.2871
42	0.2995	0.3007	0.3016	0.3024	0.3029	0.3033
43	0.3160	0.3172	0.3183	0.3191	0.3196	0.3200
44	0.3330	0.3343	0.3354	0.3362	0.3368	0.3372
45	0.3505	0.3519	0.3530	0.3539	0.3546	0.3549
46	0.3685	0.3700	0.3712	0.3721	0.3728	0.3732
47	0.3870	0.3885	0.3898	0.3908	0.3915	0.3919
48	0.4060	0.4077	0.4090	0.4100	0.4108	0.4112
49	0.4256	0.4273	0.4287	0.4298	0.4305	0.4310
50	0.4456	0.4474	0.4489	0.4500	0.4508	0.4513
51	0.4662	0.4681	0.4696	0.4708	0.4717	0.4722
52	0.4873	0.4893	0.4909	0.4921	0.4930	0.4935
53	0.5090	0.5110	0.5127	0.5140	0.5149	0.5154
54	0.5311	0.5332	0.5350	0.5363	0.5373	0.5379

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	49	50	51	52	53	54
55	0.5538	0.5560	0.5578	0.5592	0.5603	0.5609
56	0.5770	0.5793	0.5812	0.5827	0.5838	0.5844
57	0.6008	0.6032	0.6052	0.6067	0.6078	0.6084
58	0.6251	0.6276	0.6296	0.6312	0.6324	0.6331
59	0.6499	0.6525	0.6547	0.6563	0.6575	0.6582
60	0.6753	0.6780	0.6802	0.6820	0.6832	0.6839
61	0.7013	0.7041	0.7064	0.7082	0.7094	0.7102
62	0.7278	0.7307	0.7330	0.7349	0.7362	0.7370
63	0.7548	0.7578	0.7603	0.7622	0.7636	0.7644
64	0.7824	0.7855	0.7881	0.7901	0.7915	0.7924
65	0.8105	0.8138	0.8164	0.8185	0.8200	0.8209
66	0.8393	0.8426	0.8454	0.8475	0.8490	0.8499
67	0.8685	0.8720	0.8748	0.8771	0.8786	0.8796
68	0.8984	0.9020	0.9049	0.9072	0.9088	0.9098
69	0.9288	0.9325	0.9355	0.9379	0.9396	0.9406
70	0.9597	0.9636	0.9667	0.9692	0.9709	0.9720
71	0.9913	0.9952	0.9985	1.0010	1.0028	1.0039
72	1.0234	1.0275	1.0308	1.0335	1.0353	1.0364
73	1.0561	1.0603	1.0638	1.0665	1.0684	1.0696
74	1.0894	1.0937	1.0973	1.1001	1.1021	1.1033
75	1.1232	1.1277	1.1314	1.1343	1.1363	1.1375
76	1.1577	1.1623	1.1661	1.1690	1.1712	1.1724
77	1.1927	1.1975	1.2014	1.2044	1.2066	1.2079
78	1.2283	1.2332	1.2372	1.2404	1.2426	1.2440
79	1.2645	1.2696	1.2737	1.2769	1.2792	1.2806
80	1.3013	1.3065	1.3108	1.3141	1.3165	1.3179
81	1.3387	1.3440	1.3484	1.3518	1.3543	1.3557
82	1.3767	1.3822	1.3867	1.3902	1.3927	1.3942
83	1.4152	1.4209	1.4255	1.4291	1.4317	1.4333
84	1.4544	1.4602	1.4650	1.4687	1.4714	1.4729
85	1.4942	1.5002	1.5051	1.5089	1.5116	1.5132
86	1.5346	1.5407	1.5457	1.5496	1.5524	1.5541
87	1.5756	1.5819	1.5870	1.5910	1.5939	1.5956
88	1.6172	1.6236	1.6289	1.6330	1.6360	1.6378
89	1.6594	1.6660	1.6714	1.6757	1.6787	1.6805
90	1.7022	1.7090	1.7145	1.7189	1.7220	1.7239
91	1.7456	1.7526	1.7583	1.7627	1.7659	1.7678
92	1.7897	1.7968	1.8027	1.8072	1.8105	1.8124
93	1.8343	1.8416	1.8476	1.8523	1.8557	1.8577
94	1.8796	1.8871	1.8933	1.8981	1.9015	1.9035
95	1.9255	1.9332	1.9395	1.9444	1.9479	1.9500
96	1.9720	1.9799	1.9863	1.9914	1.9950	1.9971
97	2.0192	2.0272	2.0338	2.0390	2.0427	2.0449
98	2.0669	2.0752	2.0820	2.0872	2.0910	2.0933
99	2.1153	2.1238	2.1307	2.1361	2.1400	2.1423
100	2.1644	2.1730	2.1801	2.1856	2.1896	2.1919

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	55	56	57	58	59	60
10	0.0115	0.0115	0.0115	0.0115	0.0114	0.0114
11	0.0143	0.0143	0.0143	0.0143	0.0142	0.0142
12	0.0174	0.0174	0.0174	0.0174	0.0173	0.0173
13	0.0209	0.0209	0.0209	0.0209	0.0208	0.0207
14	0.0248	0.0248	0.0247	0.0247	0.0246	0.0245
15	0.0290	0.0290	0.0290	0.0289	0.0288	0.0287
16	0.0336	0.0336	0.0336	0.0335	0.0334	0.0333
17	0.0386	0.0386	0.0385	0.0385	0.0384	0.0382
18	0.0440	0.0439	0.0439	0.0438	0.0437	0.0435
19	0.0497	0.0497	0.0496	0.0496	0.0494	0.0493
20	0.0559	0.0559	0.0558	0.0557	0.0556	0.0554
21	0.0625	0.0624	0.0624	0.0623	0.0621	0.0619
22	0.0695	0.0694	0.0693	0.0692	0.0690	0.0688
23	0.0769	0.0768	0.0767	0.0766	0.0764	0.0761
24	0.0847	0.0847	0.0846	0.0844	0.0842	0.0839
25	0.0930	0.0929	0.0928	0.0926	0.0924	0.0921
26	0.1017	0.1016	0.1015	0.1013	0.1010	0.1007
27	0.1108	0.1107	0.1106	0.1104	0.1101	0.1097
28	0.1204	0.1203	0.1202	0.1200	0.1196	0.1192
29	0.1304	0.1303	0.1302	0.1299	0.1296	0.1292
30	0.1409	0.1408	0.1407	0.1404	0.1400	0.1395
31	0.1518	0.1517	0.1516	0.1513	0.1509	0.1504
32	0.1632	0.1631	0.1630	0.1626	0.1622	0.1617
33	0.1751	0.1750	0.1748	0.1745	0.1740	0.1734
34	0.1874	0.1873	0.1871	0.1868	0.1863	0.1856
35	0.2002	0.2001	0.1999	0.1995	0.1990	0.1983
36	0.2135	0.2134	0.2132	0.2128	0.2122	0.2115
37	0.2272	0.2271	0.2269	0.2265	0.2259	0.2251
38	0.2415	0.2414	0.2411	0.2407	0.2400	0.2392
39	0.2562	0.2561	0.2558	0.2553	0.2547	0.2538
40	0.2714	0.2713	0.2710	0.2705	0.2698	0.2689
41	0.2872	0.2871	0.2867	0.2862	0.2854	0.2845
42	0.3034	0.3033	0.3029	0.3024	0.3016	0.3005
43	0.3201	0.3200	0.3196	0.3190	0.3182	0.3171
44	0.3373	0.3372	0.3368	0.3362	0.3353	0.3342
45	0.3551	0.3549	0.3545	0.3539	0.3529	0.3517
46	0.3733	0.3732	0.3727	0.3720	0.3711	0.3698
47	0.3921	0.3919	0.3915	0.3907	0.3897	0.3884
48	0.4113	0.4112	0.4107	0.4100	0.4089	0.4075
49	0.4311	0.4310	0.4305	0.4297	0.4286	0.4271
50	0.4515	0.4513	0.4508	0.4499	0.4488	0.4472
51	0.4723	0.4721	0.4716	0.4707	0.4695	0.4679
52	0.4937	0.4935	0.4930	0.4920	0.4907	0.4891
53	0.5156	0.5154	0.5148	0.5139	0.5125	0.5108
54	0.5381	0.5379	0.5373	0.5362	0.5348	0.5330

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	55	56	57	58	59	60
55	0.5611	0.5608	0.5602	0.5592	0.5577	0.5558
56	0.5846	0.5844	0.5837	0.5826	0.5811	0.5791
57	0.6087	0.6084	0.6077	0.6066	0.6050	0.6029
58	0.6333	0.6330	0.6323	0.6311	0.6295	0.6273
59	0.6584	0.6582	0.6575	0.6562	0.6545	0.6523
60	0.6842	0.6839	0.6831	0.6819	0.6801	0.6777
61	0.7104	0.7102	0.7094	0.7080	0.7062	0.7038
62	0.7373	0.7370	0.7362	0.7348	0.7328	0.7303
63	0.7647	0.7644	0.7635	0.7621	0.7601	0.7575
64	0.7926	0.7923	0.7914	0.7899	0.7879	0.7852
65	0.8211	0.8208	0.8199	0.8184	0.8162	0.8134
66	0.8502	0.8499	0.8489	0.8474	0.8451	0.8422
67	0.8799	0.8796	0.8786	0.8769	0.8746	0.8716
68	0.9101	0.9098	0.9087	0.9070	0.9046	0.9016
69	0.9409	0.9406	0.9395	0.9377	0.9353	0.9321
70	0.9723	0.9719	0.9708	0.9690	0.9665	0.9632
71	1.0043	1.0039	1.0027	1.0009	0.9982	0.9948
72	1.0368	1.0364	1.0352	1.0333	1.0306	1.0271
73	1.0699	1.0695	1.0683	1.0663	1.0635	1.0599
74	1.1036	1.1032	1.1020	1.0999	1.0970	1.0933
75	1.1379	1.1375	1.1362	1.1341	1.1311	1.1272
76	1.1728	1.1724	1.1711	1.1689	1.1658	1.1618
77	1.2083	1.2078	1.2065	1.2042	1.2010	1.1969
78	1.2444	1.2439	1.2425	1.2402	1.2369	1.2327
79	1.2811	1.2806	1.2791	1.2767	1.2734	1.2690
80	1.3183	1.3178	1.3163	1.3139	1.3104	1.3059
81	1.3562	1.3557	1.3542	1.3516	1.3480	1.3434
82	1.3947	1.3941	1.3926	1.3900	1.3863	1.3816
83	1.4338	1.4332	1.4316	1.4289	1.4251	1.4203
84	1.4735	1.4729	1.4712	1.4685	1.4646	1.4596
85	1.5138	1.5132	1.5115	1.5086	1.5046	1.4995
86	1.5547	1.5541	1.5523	1.5494	1.5453	1.5400
87	1.5962	1.5956	1.5938	1.5908	1.5866	1.5812
88	1.6383	1.6377	1.6358	1.6328	1.6285	1.6229
89	1.6811	1.6804	1.6785	1.6754	1.6710	1.6653
90	1.7245	1.7238	1.7218	1.7186	1.7141	1.7082
91	1.7685	1.7678	1.7658	1.7625	1.7578	1.7518
92	1.8131	1.8124	1.8103	1.8069	1.8022	1.7960
93	1.8583	1.8576	1.8555	1.8520	1.8471	1.8408
94	1.9042	1.9035	1.9013	1.8977	1.8927	1.8863
95	1.9507	1.9499	1.9477	1.9441	1.9390	1.9323
96	1.9978	1.9971	1.9948	1.9911	1.9858	1.9790
97	2.0456	2.0448	2.0425	2.0387	2.0333	2.0263
98	2.0940	2.0932	2.0908	2.0869	2.0814	2.0743
99	2.1430	2.1422	2.1398	2.1358	2.1301	2.1229
100	2.1927	2.1919	2.1894	2.1853	2.1795	2.1721

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	61	62	63	64	65	66
10	0.0114	0.0113	0.0112	0.0112	0.0111	0.0110
11	0.0141	0.0140	0.0140	0.0139	0.0138	0.0136
12	0.0172	0.0171	0.0170	0.0169	0.0168	0.0166
13	0.0206	0.0205	0.0204	0.0203	0.0201	0.0200
14	0.0244	0.0243	0.0242	0.0240	0.0238	0.0236
15	0.0286	0.0285	0.0283	0.0281	0.0279	0.0277
16	0.0331	0.0330	0.0328	0.0326	0.0323	0.0321
17	0.0381	0.0379	0.0376	0.0374	0.0371	0.0368
18	0.0434	0.0431	0.0429	0.0426	0.0423	0.0419
19	0.0490	0.0488	0.0485	0.0482	0.0478	0.0474
20	0.0551	0.0549	0.0545	0.0542	0.0538	0.0533
21	0.0616	0.0613	0.0610	0.0605	0.0601	0.0596
22	0.0685	0.0682	0.0678	0.0673	0.0668	0.0662
23	0.0758	0.0754	0.0750	0.0745	0.0739	0.0733
24	0.0835	0.0831	0.0826	0.0821	0.0815	0.0808
25	0.0917	0.0912	0.0907	0.0901	0.0894	0.0887
26	0.1003	0.0998	0.0992	0.0985	0.0978	0.0970
27	0.1093	0.1087	0.1081	0.1074	0.1066	0.1057
28	0.1187	0.1181	0.1175	0.1167	0.1158	0.1148
29	0.1286	0.1280	0.1272	0.1264	0.1254	0.1244
30	0.1390	0.1383	0.1375	0.1365	0.1355	0.1344
31	0.1497	0.1490	0.1481	0.1471	0.1460	0.1448
32	0.1610	0.1602	0.1592	0.1582	0.1570	0.1557
33	0.1727	0.1718	0.1708	0.1697	0.1684	0.1670
34	0.1849	0.1839	0.1829	0.1816	0.1803	0.1787
35	0.1975	0.1965	0.1953	0.1940	0.1926	0.1910
36	0.2106	0.2095	0.2083	0.2069	0.2054	0.2036
37	0.2242	0.2230	0.2217	0.2203	0.2186	0.2168
38	0.2382	0.2370	0.2356	0.2341	0.2323	0.2303
39	0.2527	0.2515	0.2500	0.2483	0.2465	0.2444
40	0.2678	0.2664	0.2649	0.2631	0.2611	0.2589
41	0.2833	0.2818	0.2802	0.2783	0.2762	0.2739
42	0.2993	0.2978	0.2960	0.2941	0.2918	0.2894
43	0.3158	0.3142	0.3124	0.3103	0.3079	0.3053
44	0.3328	0.3311	0.3292	0.3270	0.3245	0.3218
45	0.3502	0.3485	0.3465	0.3442	0.3416	0.3387
46	0.3682	0.3664	0.3643	0.3618	0.3591	0.3561
47	0.3868	0.3848	0.3826	0.3800	0.3772	0.3740
48	0.4058	0.4037	0.4014	0.3987	0.3957	0.3924
49	0.4253	0.4232	0.4207	0.4179	0.4148	0.4113
50	0.4453	0.4431	0.4405	0.4376	0.4343	0.4306
51	0.4659	0.4636	0.4609	0.4578	0.4544	0.4505
52	0.4870	0.4846	0.4817	0.4785	0.4749	0.4709
53	0.5086	0.5061	0.5031	0.4998	0.4960	0.4918
54	0.5308	0.5281	0.5250	0.5215	0.5176	0.5132

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	61	62	63	64	65	66
55	0.5534	0.5507	0.5475	0.5438	0.5397	0.5352
56	0.5767	0.5738	0.5704	0.5666	0.5624	0.5576
57	0.6004	0.5974	0.5939	0.5900	0.5855	0.5806
58	0.6247	0.6216	0.6179	0.6138	0.6092	0.6041
59	0.6495	0.6463	0.6425	0.6382	0.6334	0.6281
60	0.6749	0.6715	0.6676	0.6632	0.6582	0.6526
61	0.7008	0.6973	0.6932	0.6886	0.6834	0.6777
62	0.7273	0.7236	0.7194	0.7146	0.7092	0.7033
63	0.7543	0.7505	0.7462	0.7412	0.7356	0.7294
64	0.7819	0.7780	0.7734	0.7683	0.7625	0.7561
65	0.8100	0.8060	0.8013	0.7959	0.7899	0.7833
66	0.8387	0.8345	0.8296	0.8241	0.8179	0.8110
67	0.8680	0.8636	0.8586	0.8529	0.8464	0.8393
68	0.8978	0.8933	0.8881	0.8822	0.8755	0.8681
69	0.9282	0.9235	0.9181	0.9120	0.9051	0.8975
70	0.9591	0.9543	0.9488	0.9424	0.9353	0.9274
71	0.9906	0.9857	0.9799	0.9734	0.9661	0.9579
72	1.0227	1.0176	1.0117	1.0050	0.9974	0.9890
73	1.0554	1.0501	1.0440	1.0371	1.0292	1.0206
74	1.0887	1.0832	1.0769	1.0697	1.0617	1.0527
75	1.1225	1.1169	1.1104	1.1030	1.0947	1.0854
76	1.1569	1.1511	1.1444	1.1368	1.1282	1.1187
77	1.1919	1.1860	1.1791	1.1712	1.1624	1.1526
78	1.2275	1.2214	1.2143	1.2062	1.1971	1.1870
79	1.2637	1.2574	1.2500	1.2417	1.2323	1.2219
80	1.3004	1.2939	1.2864	1.2778	1.2682	1.2575
81	1.3378	1.3311	1.3234	1.3145	1.3046	1.2936
82	1.3758	1.3689	1.3609	1.3518	1.3416	1.3303
83	1.4143	1.4072	1.3990	1.3897	1.3792	1.3676
84	1.4535	1.4462	1.4378	1.4282	1.4174	1.4055
85	1.4932	1.4858	1.4771	1.4672	1.4562	1.4439
86	1.5336	1.5259	1.5170	1.5069	1.4955	1.4829
87	1.5745	1.5667	1.5575	1.5471	1.5355	1.5225
88	1.6161	1.6080	1.5987	1.5880	1.5760	1.5627
89	1.6583	1.6500	1.6404	1.6294	1.6172	1.6035
90	1.7011	1.6926	1.6827	1.6715	1.6589	1.6449
91	1.7445	1.7357	1.7256	1.7141	1.7012	1.6868
92	1.7885	1.7795	1.7692	1.7574	1.7441	1.7294
93	1.8331	1.8239	1.8133	1.8012	1.7876	1.7726
94	1.8784	1.8690	1.8581	1.8457	1.8318	1.8163
95	1.9242	1.9146	1.9035	1.8908	1.8765	1.8607
96	1.9707	1.9609	1.9495	1.9365	1.9219	1.9056
97	2.0178	2.0078	1.9961	1.9827	1.9678	1.9512
98	2.0656	2.0553	2.0433	2.0297	2.0144	1.9974
99	2.1140	2.1034	2.0911	2.0772	2.0615	2.0441
100	2.1630	2.1521	2.1396	2.1253	2.1093	2.0915

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	67	68	69	70	71	72
10	0.0109	0.0108	0.0106	0.0105	0.0104	0.0102
11	0.0135	0.0134	0.0132	0.0131	0.0129	0.0127
12	0.0165	0.0163	0.0161	0.0159	0.0157	0.0155
13	0.0198	0.0196	0.0194	0.0191	0.0189	0.0186
14	0.0234	0.0232	0.0229	0.0226	0.0223	0.0220
15	0.0274	0.0271	0.0268	0.0265	0.0261	0.0257
16	0.0318	0.0314	0.0311	0.0307	0.0303	0.0298
17	0.0365	0.0361	0.0357	0.0352	0.0348	0.0342
18	0.0415	0.0411	0.0406	0.0401	0.0396	0.0390
19	0.0470	0.0465	0.0460	0.0454	0.0448	0.0441
20	0.0528	0.0523	0.0517	0.0510	0.0503	0.0496
21	0.0590	0.0584	0.0578	0.0570	0.0563	0.0554
22	0.0656	0.0650	0.0642	0.0634	0.0626	0.0616
23	0.0726	0.0719	0.0711	0.0702	0.0692	0.0682
24	0.0800	0.0792	0.0783	0.0773	0.0763	0.0752
25	0.0878	0.0869	0.0859	0.0849	0.0837	0.0825
26	0.0961	0.0951	0.0940	0.0928	0.0916	0.0902
27	0.1047	0.1036	0.1024	0.1012	0.0998	0.0983
28	0.1137	0.1126	0.1113	0.1099	0.1084	0.1068
29	0.1232	0.1219	0.1206	0.1191	0.1175	0.1157
30	0.1331	0.1317	0.1302	0.1286	0.1269	0.1250
31	0.1434	0.1420	0.1404	0.1386	0.1367	0.1347
32	0.1542	0.1526	0.1509	0.1490	0.1470	0.1449
33	0.1654	0.1637	0.1619	0.1598	0.1577	0.1554
34	0.1771	0.1752	0.1733	0.1711	0.1688	0.1663
35	0.1892	0.1872	0.1851	0.1828	0.1803	0.1777
36	0.2017	0.1996	0.1974	0.1949	0.1923	0.1895
37	0.2147	0.2125	0.2101	0.2075	0.2047	0.2017
38	0.2282	0.2258	0.2233	0.2205	0.2175	0.2143
39	0.2421	0.2396	0.2369	0.2340	0.2308	0.2274
40	0.2565	0.2538	0.2510	0.2479	0.2445	0.2409
41	0.2713	0.2685	0.2655	0.2622	0.2587	0.2549
42	0.2867	0.2837	0.2805	0.2770	0.2733	0.2693
43	0.3025	0.2993	0.2960	0.2923	0.2883	0.2841
44	0.3187	0.3155	0.3119	0.3080	0.3039	0.2994
45	0.3355	0.3320	0.3283	0.3242	0.3198	0.3151
46	0.3527	0.3491	0.3451	0.3409	0.3363	0.3313
47	0.3705	0.3666	0.3625	0.3580	0.3532	0.3480
48	0.3887	0.3847	0.3803	0.3756	0.3705	0.3651
49	0.4074	0.4032	0.3986	0.3937	0.3884	0.3827
50	0.4266	0.4222	0.4174	0.4122	0.4067	0.4007
51	0.4463	0.4417	0.4367	0.4313	0.4255	0.4192
52	0.4665	0.4617	0.4565	0.4508	0.4447	0.4382
53	0.4872	0.4822	0.4767	0.4708	0.4645	0.4577
54	0.5084	0.5032	0.4975	0.4913	0.4847	0.4776

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	67	68	69	70	71	72
55	0.5302	0.5247	0.5187	0.5123	0.5054	0.4980
56	0.5524	0.5467	0.5405	0.5338	0.5266	0.5189
57	0.5751	0.5692	0.5627	0.5558	0.5483	0.5402
58	0.5984	0.5922	0.5855	0.5782	0.5704	0.5621
59	0.6222	0.6158	0.6088	0.6012	0.5931	0.5844
60	0.6465	0.6398	0.6326	0.6247	0.6163	0.6073
61	0.6713	0.6644	0.6568	0.6487	0.6400	0.6306
62	0.6967	0.6895	0.6817	0.6732	0.6641	0.6544
63	0.7226	0.7151	0.7070	0.6982	0.6888	0.6787
64	0.7490	0.7412	0.7328	0.7237	0.7140	0.7035
65	0.7759	0.7679	0.7592	0.7498	0.7397	0.7288
66	0.8034	0.7951	0.7861	0.7763	0.7659	0.7547
67	0.8314	0.8228	0.8135	0.8034	0.7926	0.7810
68	0.8600	0.8511	0.8415	0.8310	0.8198	0.8078
69	0.8891	0.8799	0.8699	0.8592	0.8476	0.8352
70	0.9188	0.9093	0.8989	0.8878	0.8758	0.8630
71	0.9489	0.9391	0.9285	0.9170	0.9046	0.8914
72	0.9797	0.9696	0.9586	0.9467	0.9339	0.9203
73	1.0110	1.0006	0.9892	0.9770	0.9638	0.9497
74	1.0429	1.0321	1.0204	1.0077	0.9941	0.9796
75	1.0753	1.0641	1.0521	1.0390	1.0250	1.0100
76	1.1082	1.0968	1.0843	1.0709	1.0565	1.0410
77	1.1418	1.1300	1.1171	1.1033	1.0884	1.0725
78	1.1758	1.1637	1.1505	1.1362	1.1209	1.1045
79	1.2105	1.1980	1.1844	1.1697	1.1540	1.1371
80	1.2457	1.2328	1.2189	1.2038	1.1875	1.1701
81	1.2815	1.2683	1.2539	1.2383	1.2216	1.2038
82	1.3179	1.3042	1.2895	1.2735	1.2563	1.2379
83	1.3548	1.3408	1.3256	1.3092	1.2915	1.2726
84	1.3923	1.3779	1.3623	1.3454	1.3273	1.3078
85	1.4304	1.4156	1.3995	1.3822	1.3636	1.3436
86	1.4690	1.4538	1.4374	1.4196	1.4004	1.3799
87	1.5083	1.4927	1.4758	1.4575	1.4378	1.4168
88	1.5481	1.5321	1.5147	1.4960	1.4758	1.4542
89	1.5885	1.5721	1.5542	1.5350	1.5143	1.4921
90	1.6295	1.6126	1.5943	1.5746	1.5534	1.5306
91	1.6710	1.6538	1.6350	1.6148	1.5930	1.5697
92	1.7132	1.6955	1.6763	1.6555	1.6332	1.6093
93	1.7560	1.7378	1.7181	1.6968	1.6739	1.6494
94	1.7993	1.7807	1.7605	1.7387	1.7153	1.6901
95	1.8432	1.8242	1.8035	1.7812	1.7571	1.7314
96	1.8878	1.8683	1.8471	1.8242	1.7996	1.7732
97	1.9329	1.9129	1.8913	1.8678	1.8426	1.8156
98	1.9787	1.9582	1.9360	1.9120	1.8862	1.8586
99	2.0250	2.0041	1.9813	1.9568	1.9304	1.9021
100	2.0719	2.0505	2.0273	2.0022	1.9751	1.9462

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	73	74	75	76	77	78
10	0.0101	0.0099	0.0097	0.0095	0.0093	0.0091
11	0.0125	0.0123	0.0120	0.0118	0.0116	0.0113
12	0.0152	0.0150	0.0147	0.0144	0.0141	0.0138
13	0.0183	0.0180	0.0176	0.0173	0.0169	0.0165
14	0.0216	0.0213	0.0209	0.0205	0.0200	0.0196
15	0.0253	0.0249	0.0244	0.0240	0.0234	0.0229
16	0.0294	0.0288	0.0283	0.0277	0.0272	0.0265
17	0.0337	0.0331	0.0325	0.0319	0.0312	0.0305
18	0.0384	0.0377	0.0370	0.0363	0.0355	0.0347
19	0.0434	0.0427	0.0419	0.0411	0.0402	0.0392
20	0.0488	0.0480	0.0471	0.0462	0.0452	0.0441
21	0.0546	0.0536	0.0526	0.0516	0.0505	0.0493
22	0.0607	0.0596	0.0585	0.0574	0.0561	0.0548
23	0.0671	0.0660	0.0648	0.0635	0.0621	0.0607
24	0.0740	0.0727	0.0714	0.0699	0.0684	0.0668
25	0.0812	0.0798	0.0783	0.0768	0.0751	0.0734
26	0.0888	0.0873	0.0857	0.0839	0.0821	0.0802
27	0.0968	0.0951	0.0934	0.0915	0.0895	0.0874
28	0.1051	0.1033	0.1014	0.0994	0.0973	0.0950
29	0.1139	0.1119	0.1099	0.1077	0.1054	0.1029
30	0.1231	0.1209	0.1187	0.1163	0.1138	0.1112
31	0.1326	0.1303	0.1279	0.1254	0.1227	0.1198
32	0.1426	0.1401	0.1375	0.1348	0.1319	0.1288
33	0.1529	0.1503	0.1475	0.1446	0.1414	0.1382
34	0.1637	0.1609	0.1579	0.1547	0.1514	0.1479
35	0.1749	0.1719	0.1687	0.1653	0.1618	0.1580
36	0.1865	0.1833	0.1799	0.1763	0.1725	0.1685
37	0.1985	0.1951	0.1915	0.1876	0.1836	0.1793
38	0.2109	0.2073	0.2035	0.1994	0.1951	0.1906
39	0.2238	0.2200	0.2159	0.2116	0.2070	0.2022
40	0.2371	0.2330	0.2287	0.2242	0.2193	0.2142
41	0.2508	0.2465	0.2420	0.2371	0.2320	0.2266
42	0.2650	0.2605	0.2556	0.2505	0.2451	0.2394
43	0.2796	0.2748	0.2697	0.2643	0.2586	0.2526
44	0.2947	0.2896	0.2842	0.2786	0.2726	0.2662
45	0.3101	0.3048	0.2992	0.2932	0.2869	0.2802
46	0.3261	0.3205	0.3146	0.3083	0.3016	0.2946
47	0.3425	0.3366	0.3304	0.3238	0.3168	0.3094
48	0.3593	0.3532	0.3466	0.3397	0.3324	0.3246
49	0.3766	0.3702	0.3633	0.3560	0.3484	0.3403
50	0.3944	0.3876	0.3804	0.3728	0.3648	0.3563
51	0.4126	0.4055	0.3980	0.3900	0.3816	0.3728
52	0.4313	0.4239	0.4160	0.4077	0.3989	0.3896
53	0.4504	0.4427	0.4345	0.4258	0.4166	0.4069
54	0.4700	0.4619	0.4534	0.4443	0.4348	0.4247

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	73	74	75	76	77	78
55	0.4901	0.4817	0.4728	0.4633	0.4533	0.4428
56	0.5106	0.5019	0.4926	0.4827	0.4723	0.4614
57	0.5317	0.5225	0.5129	0.5026	0.4918	0.4804
58	0.5532	0.5437	0.5336	0.5229	0.5117	0.4998
59	0.5752	0.5653	0.5548	0.5437	0.5320	0.5197
60	0.5976	0.5874	0.5765	0.5650	0.5528	0.5400
61	0.6206	0.6099	0.5986	0.5867	0.5740	0.5607
62	0.6440	0.6330	0.6212	0.6088	0.5957	0.5819
63	0.6679	0.6565	0.6443	0.6315	0.6178	0.6035
64	0.6924	0.6805	0.6679	0.6545	0.6404	0.6256
65	0.7173	0.7050	0.6919	0.6781	0.6635	0.6481
66	0.7427	0.7299	0.7164	0.7021	0.6870	0.6710
67	0.7686	0.7554	0.7414	0.7266	0.7109	0.6944
68	0.7950	0.7814	0.7669	0.7516	0.7354	0.7183
69	0.8219	0.8078	0.7928	0.7770	0.7603	0.7426
70	0.8493	0.8347	0.8193	0.8029	0.7856	0.7674
71	0.8772	0.8622	0.8462	0.8293	0.8114	0.7926
72	0.9057	0.8901	0.8736	0.8562	0.8377	0.8183
73	0.9346	0.9186	0.9015	0.8835	0.8645	0.8444
74	0.9640	0.9475	0.9299	0.9114	0.8917	0.8710
75	0.9940	0.9769	0.9588	0.9397	0.9194	0.8981
76	1.0245	1.0069	0.9882	0.9685	0.9476	0.9256
77	1.0555	1.0374	1.0181	0.9978	0.9763	0.9536
78	1.0870	1.0683	1.0485	1.0276	1.0054	0.9821
79	1.1190	1.0998	1.0794	1.0579	1.0351	1.0110
80	1.1516	1.1318	1.1109	1.0886	1.0652	1.0404
81	1.1847	1.1643	1.1428	1.1199	1.0958	1.0703
82	1.2183	1.1974	1.1752	1.1517	1.1269	1.1007
83	1.2524	1.2309	1.2081	1.1840	1.1585	1.1315
84	1.2871	1.2650	1.2416	1.2167	1.1905	1.1629
85	1.3223	1.2996	1.2755	1.2500	1.2231	1.1947
86	1.3580	1.3347	1.3100	1.2838	1.2561	1.2270
87	1.3943	1.3704	1.3450	1.3181	1.2897	1.2597
88	1.4311	1.4065	1.3805	1.3529	1.3237	1.2930
89	1.4684	1.4432	1.4165	1.3882	1.3583	1.3267
90	1.5063	1.4805	1.4531	1.4240	1.3933	1.3610
91	1.5448	1.5183	1.4901	1.4604	1.4289	1.3957
92	1.5837	1.5566	1.5277	1.4972	1.4649	1.4309
93	1.6233	1.5954	1.5659	1.5346	1.5015	1.4666
94	1.6633	1.6348	1.6045	1.5724	1.5386	1.5028
95	1.7039	1.6747	1.6437	1.6108	1.5761	1.5395
96	1.7451	1.7152	1.6834	1.6498	1.6142	1.5767
97	1.7868	1.7562	1.7237	1.6892	1.6528	1.6144
98	1.8291	1.7977	1.7644	1.7292	1.6919	1.6526
99	1.8720	1.8398	1.8058	1.7697	1.7315	1.6913
100	1.9153	1.8825	1.8476	1.8107	1.7717	1.7305

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	79	80	81	82	83	84
10	0.0089	0.0086	0.0084	0.0081	0.0078	0.0075
11	0.0110	0.0107	0.0104	0.0101	0.0097	0.0094
12	0.0134	0.0131	0.0127	0.0123	0.0119	0.0114
13	0.0161	0.0157	0.0152	0.0147	0.0142	0.0137
14	0.0191	0.0186	0.0180	0.0174	0.0169	0.0162
15	0.0223	0.0217	0.0211	0.0204	0.0197	0.0190
16	0.0259	0.0252	0.0244	0.0237	0.0228	0.0220
17	0.0297	0.0289	0.0280	0.0272	0.0262	0.0253
18	0.0338	0.0329	0.0319	0.0309	0.0299	0.0288
19	0.0383	0.0372	0.0361	0.0350	0.0338	0.0326
20	0.0430	0.0418	0.0406	0.0393	0.0380	0.0366
21	0.0481	0.0468	0.0454	0.0440	0.0425	0.0409
22	0.0534	0.0520	0.0505	0.0489	0.0472	0.0455
23	0.0591	0.0575	0.0559	0.0541	0.0523	0.0503
24	0.0652	0.0634	0.0616	0.0596	0.0576	0.0555
25	0.0715	0.0696	0.0676	0.0654	0.0632	0.0609
26	0.0782	0.0761	0.0739	0.0716	0.0691	0.0666
27	0.0852	0.0829	0.0805	0.0780	0.0753	0.0725
28	0.0926	0.0901	0.0875	0.0847	0.0818	0.0788
29	0.1003	0.0976	0.0948	0.0918	0.0887	0.0854
30	0.1084	0.1055	0.1024	0.0992	0.0958	0.0922
31	0.1168	0.1137	0.1103	0.1069	0.1032	0.0994
32	0.1256	0.1222	0.1186	0.1149	0.1110	0.1069
33	0.1347	0.1311	0.1272	0.1232	0.1190	0.1146
34	0.1442	0.1403	0.1362	0.1319	0.1274	0.1227
35	0.1540	0.1499	0.1455	0.1409	0.1361	0.1311
36	0.1643	0.1598	0.1552	0.1503	0.1452	0.1398
37	0.1748	0.1701	0.1652	0.1600	0.1545	0.1488
38	0.1858	0.1808	0.1755	0.1700	0.1642	0.1581
39	0.1971	0.1918	0.1862	0.1804	0.1742	0.1678
40	0.2089	0.2032	0.1973	0.1911	0.1846	0.1777
41	0.2210	0.2150	0.2087	0.2021	0.1953	0.1880
42	0.2334	0.2271	0.2205	0.2136	0.2063	0.1987
43	0.2463	0.2397	0.2327	0.2253	0.2177	0.2096
44	0.2596	0.2525	0.2452	0.2375	0.2294	0.2209
45	0.2732	0.2658	0.2581	0.2499	0.2414	0.2325
46	0.2872	0.2795	0.2713	0.2628	0.2538	0.2444
47	0.3017	0.2935	0.2850	0.2760	0.2666	0.2567
48	0.3165	0.3080	0.2990	0.2896	0.2797	0.2694
49	0.3317	0.3228	0.3134	0.3035	0.2932	0.2823
50	0.3474	0.3380	0.3281	0.3178	0.3070	0.2956
51	0.3634	0.3536	0.3433	0.3325	0.3212	0.3093
52	0.3799	0.3696	0.3588	0.3475	0.3357	0.3233
53	0.3967	0.3860	0.3748	0.3630	0.3506	0.3376
54	0.4140	0.4028	0.3911	0.3788	0.3659	0.3523

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	79	80	81	82	83	84
55	0.4317	0.4200	0.4078	0.3950	0.3815	0.3674
56	0.4498	0.4377	0.4249	0.4115	0.3975	0.3828
57	0.4683	0.4557	0.4424	0.4285	0.4139	0.3986
58	0.4873	0.4741	0.4603	0.4458	0.4306	0.4147
59	0.5066	0.4930	0.4786	0.4635	0.4477	0.4312
60	0.5264	0.5122	0.4973	0.4816	0.4652	0.4480
61	0.5467	0.5319	0.5164	0.5001	0.4831	0.4652
62	0.5673	0.5520	0.5359	0.5190	0.5013	0.4828
63	0.5884	0.5725	0.5558	0.5383	0.5199	0.5007
64	0.6099	0.5934	0.5761	0.5580	0.5389	0.5190
65	0.6318	0.6148	0.5968	0.5780	0.5583	0.5377
66	0.6542	0.6365	0.6180	0.5985	0.5781	0.5567
67	0.6770	0.6587	0.6395	0.6194	0.5983	0.5762
68	0.7003	0.6814	0.6615	0.6407	0.6188	0.5960
69	0.7240	0.7044	0.6839	0.6624	0.6398	0.6161
70	0.7481	0.7279	0.7067	0.6845	0.6611	0.6367
71	0.7727	0.7519	0.7299	0.7069	0.6828	0.6576
72	0.7978	0.7762	0.7536	0.7299	0.7050	0.6789
73	0.8233	0.8010	0.7777	0.7532	0.7275	0.7006
74	0.8492	0.8263	0.8022	0.7769	0.7504	0.7227
75	0.8756	0.8519	0.8271	0.8010	0.7737	0.7451
76	0.9024	0.8781	0.8525	0.8256	0.7975	0.7680
77	0.9297	0.9046	0.8783	0.8506	0.8216	0.7912
78	0.9575	0.9316	0.9045	0.8760	0.8461	0.8148
79	0.9857	0.9591	0.9311	0.9018	0.8710	0.8388
80	1.0144	0.9870	0.9582	0.9280	0.8964	0.8632
81	1.0435	1.0153	0.9857	0.9547	0.9221	0.8880
82	1.0731	1.0442	1.0137	0.9818	0.9483	0.9132
83	1.1032	1.0734	1.0421	1.0093	0.9749	0.9388
84	1.1338	1.1031	1.0710	1.0372	1.0019	0.9648
85	1.1648	1.1333	1.1003	1.0656	1.0293	0.9912
86	1.1962	1.1639	1.1300	1.0944	1.0571	1.0180
87	1.2282	1.1950	1.1602	1.1236	1.0853	1.0452
88	1.2606	1.2266	1.1908	1.1533	1.1140	1.0728
89	1.2935	1.2586	1.2219	1.1834	1.1430	1.1008
90	1.3269	1.2910	1.2534	1.2139	1.1725	1.1292
91	1.3607	1.3240	1.2854	1.2449	1.2024	1.1580
92	1.3951	1.3574	1.3178	1.2763	1.2328	1.1872
93	1.4299	1.3913	1.3507	1.3082	1.2636	1.2168
94	1.4652	1.4256	1.3841	1.3404	1.2947	1.2469
95	1.5010	1.4604	1.4179	1.3732	1.3264	1.2773
96	1.5372	1.4957	1.4521	1.4064	1.3584	1.3082
97	1.5740	1.5315	1.4868	1.4400	1.3909	1.3395
98	1.6112	1.5677	1.5220	1.4741	1.4238	1.3712
99	1.6490	1.6044	1.5576	1.5086	1.4571	1.4033
100	1.6872	1.6416	1.5938	1.5435	1.4909	1.4358

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	85	86	87	88	89	90
10	0.0072	0.0069	0.0066	0.0062	0.0059	0.0055
11	0.0090	0.0086	0.0082	0.0078	0.0073	0.0068
12	0.0110	0.0105	0.0100	0.0095	0.0089	0.0083
13	0.0132	0.0126	0.0120	0.0113	0.0107	0.0100
14	0.0156	0.0149	0.0142	0.0134	0.0127	0.0118
15	0.0182	0.0174	0.0166	0.0157	0.0148	0.0138
16	0.0211	0.0202	0.0192	0.0182	0.0172	0.0160
17	0.0242	0.0232	0.0221	0.0209	0.0197	0.0184
18	0.0276	0.0264	0.0251	0.0238	0.0224	0.0210
19	0.0312	0.0299	0.0284	0.0269	0.0254	0.0237
20	0.0351	0.0336	0.0320	0.0303	0.0285	0.0267
21	0.0393	0.0375	0.0357	0.0339	0.0319	0.0298
22	0.0437	0.0417	0.0397	0.0376	0.0355	0.0332
23	0.0483	0.0462	0.0440	0.0417	0.0392	0.0367
24	0.0532	0.0509	0.0485	0.0459	0.0432	0.0404
25	0.0584	0.0559	0.0532	0.0504	0.0474	0.0444
26	0.0639	0.0611	0.0582	0.0551	0.0519	0.0485
27	0.0696	0.0666	0.0634	0.0600	0.0566	0.0529
28	0.0756	0.0723	0.0689	0.0652	0.0614	0.0575
29	0.0819	0.0784	0.0746	0.0707	0.0666	0.0623
30	0.0885	0.0847	0.0806	0.0763	0.0719	0.0673
31	0.0954	0.0912	0.0869	0.0823	0.0775	0.0725
32	0.1026	0.0981	0.0934	0.0885	0.0833	0.0779
33	0.1100	0.1052	0.1002	0.0949	0.0894	0.0836
34	0.1178	0.1126	0.1072	0.1016	0.0957	0.0895
35	0.1258	0.1203	0.1145	0.1085	0.1022	0.0956
36	0.1342	0.1283	0.1221	0.1157	0.1090	0.1019
37	0.1428	0.1366	0.1300	0.1232	0.1160	0.1085
38	0.1518	0.1451	0.1382	0.1309	0.1233	0.1153
39	0.1610	0.1540	0.1466	0.1389	0.1308	0.1223
40	0.1706	0.1631	0.1553	0.1471	0.1386	0.1296
41	0.1805	0.1726	0.1643	0.1556	0.1466	0.1371
42	0.1907	0.1823	0.1736	0.1644	0.1549	0.1448
43	0.2012	0.1924	0.1831	0.1735	0.1634	0.1528
44	0.2120	0.2027	0.1930	0.1828	0.1722	0.1610
45	0.2232	0.2134	0.2031	0.1924	0.1812	0.1695
46	0.2346	0.2243	0.2136	0.2023	0.1906	0.1782
47	0.2464	0.2356	0.2243	0.2125	0.2001	0.1872
48	0.2585	0.2472	0.2353	0.2229	0.2100	0.1964
49	0.2710	0.2591	0.2467	0.2337	0.2201	0.2058
50	0.2837	0.2713	0.2583	0.2447	0.2305	0.2155
51	0.2968	0.2838	0.2702	0.2560	0.2411	0.2255
52	0.3103	0.2967	0.2825	0.2676	0.2520	0.2357
53	0.3241	0.3099	0.2950	0.2795	0.2632	0.2462
54	0.3382	0.3233	0.3078	0.2916	0.2747	0.2569

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units						
Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	85	86	87	88	89	90
55	0.3526	0.3372	0.3210	0.3041	0.2864	0.2679
56	0.3674	0.3513	0.3345	0.3168	0.2984	0.2791
57	0.3825	0.3658	0.3482	0.3299	0.3107	0.2906
58	0.3980	0.3806	0.3623	0.3432	0.3233	0.3023
59	0.4138	0.3957	0.3767	0.3569	0.3361	0.3144
60	0.4300	0.4111	0.3914	0.3708	0.3492	0.3266
61	0.4465	0.4269	0.4065	0.3851	0.3626	0.3392
62	0.4634	0.4431	0.4218	0.3996	0.3763	0.3520
63	0.4806	0.4595	0.4375	0.4144	0.3903	0.3651
64	0.4982	0.4763	0.4535	0.4296	0.4046	0.3784
65	0.5161	0.4935	0.4698	0.4451	0.4191	0.3920
66	0.5344	0.5109	0.4864	0.4608	0.4340	0.4059
67	0.5530	0.5288	0.5034	0.4769	0.4491	0.4201
68	0.5720	0.5469	0.5207	0.4933	0.4646	0.4345
69	0.5914	0.5654	0.5383	0.5100	0.4803	0.4492
70	0.6111	0.5843	0.5563	0.5270	0.4963	0.4642
71	0.6312	0.6035	0.5746	0.5443	0.5126	0.4795
72	0.6516	0.6231	0.5932	0.5619	0.5292	0.4950
73	0.6724	0.6430	0.6121	0.5799	0.5461	0.5108
74	0.6936	0.6632	0.6314	0.5982	0.5633	0.5269
75	0.7152	0.6838	0.6511	0.6167	0.5809	0.5433
76	0.7371	0.7048	0.6710	0.6357	0.5987	0.5599
77	0.7594	0.7261	0.6913	0.6549	0.6168	0.5769
78	0.7821	0.7478	0.7120	0.6744	0.6352	0.5941
79	0.8051	0.7698	0.7329	0.6943	0.6539	0.6116
80	0.8286	0.7922	0.7543	0.7145	0.6729	0.6294
81	0.8524	0.8150	0.7759	0.7350	0.6923	0.6475
82	0.8765	0.8381	0.7979	0.7559	0.7119	0.6658
83	0.9011	0.8616	0.8203	0.7771	0.7319	0.6845
84	0.9260	0.8855	0.8430	0.7986	0.7521	0.7035
85	0.9514	0.9097	0.8661	0.8204	0.7727	0.7227
86	0.9771	0.9343	0.8895	0.8426	0.7936	0.7422
87	1.0032	0.9592	0.9132	0.8651	0.8148	0.7620
88	1.0297	0.9845	0.9373	0.8880	0.8363	0.7822
89	1.0565	1.0102	0.9618	0.9111	0.8581	0.8026
90	1.0838	1.0363	0.9866	0.9346	0.8802	0.8233
91	1.1114	1.0627	1.0118	0.9585	0.9027	0.8443
92	1.1395	1.0896	1.0373	0.9827	0.9255	0.8656
93	1.1679	1.1167	1.0632	1.0072	0.9486	0.8872
94	1.1968	1.1443	1.0894	1.0320	0.9720	0.9091
95	1.2260	1.1723	1.1161	1.0573	0.9957	0.9313
96	1.2556	1.2006	1.1430	1.0828	1.0198	0.9538
97	1.2856	1.2293	1.1703	1.1087	1.0442	0.9766
98	1.3160	1.2584	1.1980	1.1349	1.0689	0.9997
99	1.3469	1.2878	1.2261	1.1615	1.0939	1.0231
100	1.3781	1.3177	1.2545	1.1884	1.1192	1.0468

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units Gravity Difference (Degrees API)	Light-Product Concentration					
	Percent Shrinkage					
	91	92	93	94	95	96
10	0.0051	0.0047	0.0042	0.0038	0.0033	0.0028
11	0.0063	0.0058	0.0053	0.0047	0.0041	0.0034
12	0.0077	0.0071	0.0064	0.0057	0.0050	0.0042
13	0.0093	0.0085	0.0077	0.0069	0.0060	0.0050
14	0.0110	0.0101	0.0091	0.0081	0.0071	0.0060
15	0.0128	0.0118	0.0107	0.0095	0.0083	0.0070
16	0.0149	0.0137	0.0124	0.0110	0.0096	0.0081
17	0.0171	0.0157	0.0142	0.0127	0.0110	0.0093
18	0.0195	0.0179	0.0162	0.0144	0.0126	0.0106
19	0.0220	0.0202	0.0183	0.0163	0.0142	0.0120
20	0.0247	0.0227	0.0206	0.0183	0.0160	0.0134
21	0.0277	0.0254	0.0230	0.0205	0.0178	0.0150
22	0.0308	0.0282	0.0256	0.0228	0.0198	0.0167
23	0.0340	0.0312	0.0283	0.0252	0.0220	0.0185
24	0.0375	0.0344	0.0312	0.0278	0.0242	0.0204
25	0.0412	0.0378	0.0342	0.0305	0.0266	0.0224
26	0.0450	0.0413	0.0374	0.0334	0.0290	0.0244
27	0.0491	0.0450	0.0408	0.0364	0.0316	0.0266
28	0.0533	0.0489	0.0443	0.0395	0.0344	0.0289
29	0.0577	0.0530	0.0480	0.0428	0.0372	0.0314
30	0.0624	0.0573	0.0519	0.0462	0.0402	0.0339
31	0.0672	0.0617	0.0559	0.0498	0.0434	0.0365
32	0.0723	0.0663	0.0601	0.0536	0.0466	0.0392
33	0.0775	0.0712	0.0645	0.0574	0.0500	0.0421
34	0.0830	0.0762	0.0690	0.0615	0.0535	0.0451
35	0.0886	0.0814	0.0737	0.0657	0.0572	0.0481
36	0.0945	0.0868	0.0786	0.0701	0.0610	0.0513
37	0.1006	0.0924	0.0837	0.0746	0.0649	0.0546
38	0.1069	0.0982	0.0890	0.0792	0.0690	0.0581
39	0.1135	0.1042	0.0944	0.0841	0.0732	0.0616
40	0.1202	0.1103	0.1000	0.0891	0.0775	0.0653
41	0.1272	0.1167	0.1058	0.0942	0.0820	0.0690
42	0.1343	0.1233	0.1118	0.0996	0.0867	0.0729
43	0.1417	0.1301	0.1179	0.1050	0.0914	0.0770
44	0.1494	0.1371	0.1243	0.1107	0.0964	0.0811
45	0.1572	0.1443	0.1308	0.1165	0.1014	0.0854
46	0.1653	0.1518	0.1375	0.1225	0.1066	0.0898
47	0.1736	0.1594	0.1444	0.1287	0.1120	0.0943
48	0.1822	0.1672	0.1515	0.1350	0.1175	0.0989
49	0.1909	0.1753	0.1588	0.1415	0.1232	0.1037
50	0.1999	0.1835	0.1663	0.1482	0.1290	0.1086
51	0.2092	0.1920	0.1740	0.1550	0.1349	0.1136
52	0.2186	0.2007	0.1819	0.1620	0.1410	0.1187
53	0.2283	0.2096	0.1899	0.1692	0.1473	0.1240
54	0.2383	0.2187	0.1982	0.1766	0.1537	0.1294

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units		Light-Product Concentration				
Gravity Difference (Degrees API)	Percent Shrinkage					
	91	92	93	94	95	96
55	0.2484	0.2281	0.2067	0.1841	0.1603	0.1349
56	0.2589	0.2376	0.2153	0.1918	0.1670	0.1406
57	0.2695	0.2474	0.2242	0.1997	0.1739	0.1463
58	0.2804	0.2574	0.2333	0.2078	0.1809	0.1523
59	0.2916	0.2677	0.2425	0.2161	0.1881	0.1583
60	0.3030	0.2781	0.2520	0.2245	0.1954	0.1645
61	0.3146	0.2888	0.2617	0.2331	0.2029	0.1708
62	0.3265	0.2997	0.2716	0.2419	0.2106	0.1773
63	0.3386	0.3109	0.2817	0.2509	0.2184	0.1839
64	0.3510	0.3222	0.2920	0.2601	0.2264	0.1906
65	0.3636	0.3338	0.3025	0.2695	0.2346	0.1974
66	0.3765	0.3456	0.3132	0.2790	0.2429	0.2044
67	0.3896	0.3577	0.3241	0.2887	0.2513	0.2116
68	0.4030	0.3700	0.3353	0.2987	0.2600	0.2188
69	0.4167	0.3825	0.3466	0.3088	0.2688	0.2262
70	0.4306	0.3953	0.3582	0.3191	0.2777	0.2338
71	0.4447	0.4082	0.3699	0.3296	0.2869	0.2415
72	0.4591	0.4215	0.3819	0.3402	0.2962	0.2493
73	0.4738	0.4349	0.3941	0.3511	0.3056	0.2573
74	0.4887	0.4486	0.4065	0.3622	0.3153	0.2654
75	0.5039	0.4626	0.4192	0.3734	0.3251	0.2736
76	0.5193	0.4768	0.4320	0.3849	0.3350	0.2820
77	0.5351	0.4912	0.4451	0.3965	0.3452	0.2905
78	0.5510	0.5059	0.4584	0.4084	0.3555	0.2992
79	0.5673	0.5208	0.4719	0.4204	0.3659	0.3080
80	0.5838	0.5359	0.4856	0.4326	0.3766	0.3170
81	0.6005	0.5513	0.4996	0.4451	0.3874	0.3261
82	0.6176	0.5670	0.5137	0.4577	0.3984	0.3353
83	0.6349	0.5828	0.5281	0.4705	0.4096	0.3447
84	0.6525	0.5990	0.5428	0.4835	0.4209	0.3543
85	0.6703	0.6154	0.5576	0.4968	0.4324	0.3640
86	0.6884	0.6320	0.5727	0.5102	0.4441	0.3738
87	0.7068	0.6489	0.5880	0.5238	0.4560	0.3838
88	0.7255	0.6660	0.6035	0.5376	0.4680	0.3939
89	0.7444	0.6834	0.6192	0.5517	0.4802	0.4042
90	0.7636	0.7010	0.6352	0.5659	0.4926	0.4146
91	0.7831	0.7189	0.6514	0.5803	0.5052	0.4252
92	0.8029	0.7370	0.6679	0.5950	0.5179	0.4359
93	0.8229	0.7554	0.6845	0.6098	0.5308	0.4468
94	0.8432	0.7741	0.7014	0.6249	0.5439	0.4579
95	0.8638	0.7930	0.7186	0.6401	0.5572	0.4690
96	0.8847	0.8121	0.7359	0.6556	0.5707	0.4804
97	0.9058	0.8316	0.7535	0.6713	0.5843	0.4919
98	0.9273	0.8512	0.7713	0.6872	0.5982	0.5035
99	0.9490	0.8712	0.7894	0.7033	0.6122	0.5153
100	0.9710	0.8914	0.8077	0.7196	0.6263	0.5272

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units			
Gravity Difference (Degrees API)	Light-Product Concentration		
	Percent Shrinkage		
	97	98	99
10	0.0022	0.0016	0.0009
11	0.0027	0.0020	0.0011
12	0.0033	0.0024	0.0014
13	0.0040	0.0029	0.0017
14	0.0048	0.0034	0.0020
15	0.0056	0.0040	0.0023
16	0.0065	0.0047	0.0027
17	0.0074	0.0054	0.0031
18	0.0084	0.0061	0.0035
19	0.0095	0.0069	0.0040
20	0.0107	0.0078	0.0045
21	0.0120	0.0087	0.0050
22	0.0133	0.0097	0.0055
23	0.0148	0.0107	0.0061
24	0.0163	0.0118	0.0067
25	0.0178	0.0129	0.0074
26	0.0195	0.0141	0.0081
27	0.0213	0.0154	0.0088
28	0.0231	0.0167	0.0096
29	0.0250	0.0181	0.0104
30	0.0270	0.0196	0.0112
31	0.0291	0.0211	0.0121
32	0.0313	0.0227	0.0130
33	0.0336	0.0244	0.0139
34	0.0360	0.0261	0.0149
35	0.0384	0.0279	0.0159
36	0.0410	0.0297	0.0170
37	0.0436	0.0316	0.0181
38	0.0464	0.0336	0.0192
39	0.0492	0.0356	0.0204
40	0.0521	0.0378	0.0216
41	0.0551	0.0400	0.0229
42	0.0582	0.0422	0.0242
43	0.0614	0.0445	0.0255
44	0.0648	0.0469	0.0269
45	0.0682	0.0494	0.0283
46	0.0717	0.0519	0.0297
47	0.0753	0.0545	0.0312
48	0.0790	0.0572	0.0328
49	0.0828	0.0600	0.0343
50	0.0867	0.0628	0.0360
51	0.0907	0.0657	0.0376
52	0.0948	0.0687	0.0393
53	0.0990	0.0717	0.0411
54	0.1033	0.0749	0.0429

Table 3—Volumetric Shrinkage Table (Continued)

Customary Units			
Gravity Difference (Degrees API)	Light-Product Concentration		
	Percent Shrinkage		
	97	98	99
55	0.1077	0.0781	0.0447
56	0.1122	0.0813	0.0466
57	0.1168	0.0847	0.0485
58	0.1216	0.0881	0.0505
59	0.1264	0.0916	0.0525
60	0.1313	0.0952	0.0545
61	0.1364	0.0988	0.0566
62	0.1415	0.1026	0.0587
63	0.1468	0.1064	0.0609
64	0.1521	0.1103	0.0631
65	0.1576	0.1142	0.0654
66	0.1632	0.1183	0.0677
67	0.1689	0.1224	0.0701
68	0.1747	0.1266	0.0725
69	0.1806	0.1309	0.0750
70	0.1866	0.1353	0.0775
71	0.1928	0.1397	0.0800
72	0.1990	0.1443	0.0826
73	0.2054	0.1489	0.0852
74	0.2118	0.1536	0.0879
75	0.2184	0.1583	0.0907
76	0.2251	0.1632	0.0934
77	0.2319	0.1681	0.0963
78	0.2389	0.1731	0.0991
79	0.2459	0.1782	0.1021
80	0.2531	0.1834	0.1050
81	0.2603	0.1887	0.1080
82	0.2677	0.1940	0.1111
83	0.2752	0.1995	0.1142
84	0.2828	0.2050	0.1174
85	0.2906	0.2106	0.1206
86	0.2984	0.2163	0.1239
87	0.3064	0.2221	0.1272
88	0.3145	0.2279	0.1305
89	0.3227	0.2339	0.1339
90	0.3310	0.2399	0.1374
91	0.3395	0.2460	0.1409
92	0.3480	0.2523	0.1444
93	0.3567	0.2586	0.1481
94	0.3655	0.2649	0.1517
95	0.3744	0.2714	0.1554
96	0.3835	0.2780	0.1592
97	0.3927	0.2846	0.1630
98	0.4019	0.2913	0.1668
99	0.4114	0.2982	0.1707
100	0.4209	0.3051	0.1747

Table 4—Inverse Density Difference in $\text{m}^3/\text{kg} \times 10^3$
for Light Hydrocarbon Densities from 580 to 890 kg/m^3 at 15°C and Heavy
Hydrocarbon Component Densities from 980 to 640 kg/m^3 at 15°C

Light Component Density (kg/m^3)	Heavy Component Density (kg/m^3)					
	980	970	960	950	940	930
580	0.7037	0.6932	0.6825	0.6715	0.6603	0.6489
590	0.6745	0.6640	0.6532	0.6423	0.6311	0.6196
600	0.6463	0.6357	0.6250	0.6140	0.6028	0.5914
610	0.6189	0.6084	0.5977	0.5867	0.5755	0.5641
620	0.5925	0.5820	0.5712	0.5603	0.5491	0.5376
630	0.5669	0.5564	0.5456	0.5347	0.5235	0.5120
640	0.5421	0.5316	0.5208	0.5099	0.4987	0.4872
650	0.5181	0.5075	0.4968	0.4858	0.4746	0.4632
660	0.4947	0.4842	0.4735	0.4625	0.4513	0.4399
670	0.4721	0.4616	0.4509	0.4399	0.4287	0.4173
680	0.4502	0.4397	0.4289	0.4180	0.4068	0.3953
690	0.4289	0.4183	0.4076	0.3966	0.3854	0.3740
700	0.4082	0.3976	0.3869	0.3759	0.3647	0.3533
710	0.3880	0.3775	0.3668	0.3558	0.3446	0.3332
720	0.3685	0.3580	0.3472	0.3363	0.3251	0.3136
730	0.3495	0.3389	0.3282	0.3172	0.3060	0.2946
740	0.3309	0.3204	0.3097	0.2987	0.2875	0.2761
750	0.3129	0.3024	0.2917	0.2807	0.2695	0.2581
760	0.2954	0.2849	0.2741	0.2632	0.2520	0.2405
770	0.2783	0.2678	0.2570	0.2461	0.2349	0.2234
780	0.2616	0.2511	0.2404	0.2294	0.2182	0.2068
790	0.2454	0.2349	0.2242	0.2132	0.2020	0.1906
800	0.2296	0.2191	0.2083	0.1974	0.1862	0.1747
810	0.2142	0.2036	0.1929	0.1819	0.1707	0.1593
820	0.1991	0.1886	0.1778	0.1669	0.1557	0.1442
830	0.1844	0.1739	0.1632	0.1522	0.1410	0.1296
840	0.1701	0.1595	0.1488	0.1378	0.1266	0.1152
850	0.1561	0.1455	0.1348	0.1238	0.1126	0.1012
860	0.1424	0.1319	0.1211	0.1102	0.0990	0.0875
870	0.1290	0.1185	0.1078	0.0968	0.0856	0.0742
880	0.1160	0.1054	0.0947	0.0837	0.0725	0.0611
890	0.1032	0.0927	0.0819	0.0710	0.0598	

Note: Inverse Density Difference Values in this table have been multiplied by 1000 for convenient tabulation. For example, the first value, 0.7037, should be read 0.7037×10^{-3} .

Table 4—Inverse Density Difference $\text{m}^3/\text{kg} \times 10^3$ (Continued)

Light Component Density (kg/m^3)	Heavy Component Density (kg/m^3)					
	920	910	900	890	880	870
580	0.6372	0.6252	0.6130	0.6005	0.5878	0.5747
590	0.6080	0.5960	0.5838	0.5713	0.5586	0.5455
600	0.5797	0.5678	0.5556	0.5431	0.5303	0.5172
610	0.5524	0.5404	0.5282	0.5157	0.5030	0.4899
620	0.5259	0.5140	0.5018	0.4893	0.4765	0.4635
630	0.5003	0.4884	0.4762	0.4637	0.4509	0.4379
640	0.4755	0.4636	0.4514	0.4389	0.4261	0.4131
650	0.4515	0.4396	0.4274	0.4149	0.4021	0.3890
660	0.4282	0.4163	0.4040	0.3916	0.3788	0.3657
670	0.4056	0.3936	0.3814	0.3689	0.3562	0.3431
680	0.3836	0.3717	0.3595	0.3470	0.3342	0.3212
690	0.3623	0.3504	0.3382	0.3257	0.3129	0.2999
700	0.3416	0.3297	0.3175	0.3050	0.2922	0.2791
710	0.3215	0.3095	0.2973	0.2849	0.2721	0.2590
720	0.3019	0.2900	0.2778	0.2653	0.2525	0.2395
730	0.2829	0.2710	0.2588	0.2463	0.2335	0.2204
740	0.2644	0.2525	0.2402	0.2278	0.2150	0.2019
750	0.2464	0.2344	0.2222	0.2097	0.1970	0.1839
760	0.2288	0.2169	0.2047	0.1922	0.1794	0.1664
770	0.2117	0.1998	0.1876	0.1751	0.1623	0.1493
780	0.1951	0.1832	0.1709	0.1585	0.1457	0.1326
790	0.1789	0.1669	0.1547	0.1422	0.1295	0.1164
800	0.1630	0.1511	0.1389	0.1264	0.1136	0.1006
810	0.1476	0.1357	0.1235	0.1110	0.0982	0.0851
820	0.1326	0.1206	0.1084	0.0959	0.0831	0.0701
830	0.1179	0.1059	0.0937	0.0812	0.0685	0.0554
840	0.1035	0.0916	0.0794	0.0669	0.0541	
850	0.0895	0.0776	0.0654	0.0529		
860	0.0758	0.0639	0.0517			
870	0.0625	0.0505				

Table 4—Inverse Density Difference $\text{m}^3/\text{kg} \times 10^3$ (Continued)

Light Component Density (kg/m^3)	Heavy Component Density (kg/m^3)					
	860	850	840	830	820	810
580	0.5613	0.5477	0.5337	0.5193	0.5046	0.4896
590	0.5321	0.5184	0.5044	0.4901	0.4754	0.4603
600	0.5039	0.4902	0.4762	0.4618	0.4472	0.4321
610	0.4766	0.4629	0.4489	0.4345	0.4198	0.4048
620	0.4501	0.4364	0.4224	0.4081	0.3934	0.3783
630	0.4245	0.4108	0.3968	0.3825	0.3678	0.3527
640	0.3997	0.3860	0.3720	0.3577	0.3430	0.3279
650	0.3757	0.3620	0.3480	0.3336	0.3189	0.3039
660	0.3524	0.3387	0.3247	0.3103	0.2956	0.2806
670	0.3297	0.3161	0.3021	0.2877	0.2730	0.2580
680	0.3078	0.2941	0.2801	0.2658	0.2511	0.2360
690	0.2865	0.2728	0.2588	0.2445	0.2298	0.2147
700	0.2658	0.2521	0.2381	0.2238	0.2091	0.1940
710	0.2457	0.2320	0.2180	0.2036	0.1889	0.1739
720	0.2261	0.2124	0.1984	0.1841	0.1694	0.1543
730	0.2071	0.1934	0.1794	0.1650	0.1504	0.1353
740	0.1886	0.1749	0.1609	0.1465	0.1318	0.1168
750	0.1705	0.1569	0.1429	0.1285	0.1138	0.0988
760	0.1530	0.1393	0.1253	0.1110	0.0963	0.0812
770	0.1359	0.1222	0.1082	0.0939	0.0792	0.0641
780	0.1193	0.1056	0.0916	0.0772	0.0625	
790	0.1030	0.0894	0.0753	0.0610		
800	0.0872	0.0735	0.0595			
810	0.0718	0.0581				
820	0.0567					

Table 4—Inverse Density Difference $\text{m}^3/\text{kg} \times 10^3$ (Continued)

Light Component Density (kg/m^3)	Heavy Component Density (kg/m^3)					
	800	790	780	770	760	750
580	0.4741	0.4583	0.4421	0.4254	0.4083	0.3908
590	0.4449	0.4291	0.4129	0.3962	0.3791	0.3616
600	0.4167	0.4008	0.3846	0.3680	0.3509	0.3333
610	0.3893	0.3735	0.3573	0.3406	0.3236	0.3060
620	0.3629	0.3471	0.3309	0.3142	0.2971	0.2796
630	0.3373	0.3215	0.3053	0.2886	0.2715	0.2540
640	0.3125	0.2967	0.2804	0.2638	0.2467	0.2292
650	0.2885	0.2726	0.2564	0.2398	0.2227	0.2051
660	0.2652	0.2493	0.2331	0.2165	0.1994	0.1818
670	0.2425	0.2267	0.2105	0.1938	0.1767	0.1592
680	0.2206	0.2048	0.1885	0.1719	0.1548	0.1373
690	0.1993	0.1835	0.1672	0.1506	0.1335	0.1159
700	0.1786	0.1627	0.1465	0.1299	0.1128	0.0952
710	0.1585	0.1426	0.1264	0.1097	0.0927	0.0751
720	0.1389	0.1231	0.1068	0.0902	0.0731	0.0556
730	0.1199	0.1040	0.0878	0.0712	0.0541	
740	0.1014	0.0855	0.0693	0.0527		
750	0.0833	0.0675	0.0513			
760	0.0658					

Table 4—Inverse Density Difference $\text{m}^3/\text{kg} \times 10^3$ (Continued)

Light Component Density (kg/m^3)	Heavy Component Density (kg/m^3)					
	800	790	780	770	760	750
580	0.4741	0.4583	0.4421	0.4254	0.4083	0.3908
590	0.4449	0.4291	0.4129	0.3962	0.3791	0.3616
600	0.4167	0.4008	0.3846	0.3680	0.3509	0.3333
610	0.3893	0.3735	0.3573	0.3406	0.3236	0.3060
620	0.3629	0.3471	0.3309	0.3142	0.2971	0.2796
630	0.3373	0.3215	0.3053	0.2886	0.2715	0.2540
640	0.3125	0.2967	0.2804	0.2638	0.2467	0.2292
650	0.2885	0.2726	0.2564	0.2398	0.2227	0.2051
660	0.2652	0.2493	0.2331	0.2165	0.1994	0.1818
670	0.2425	0.2267	0.2105	0.1938	0.1767	0.1592
680	0.2206	0.2048	0.1885	0.1719	0.1548	0.1373
690	0.1993	0.1835	0.1672	0.1506	0.1335	0.1159
700	0.1786	0.1627	0.1465	0.1299	0.1128	0.0952
710	0.1585	0.1426	0.1264	0.1097	0.0927	0.0751
720	0.1389	0.1231	0.1068	0.0902	0.0731	0.0556
730	0.1199	0.1040	0.0878	0.0712	0.0541	
740	0.1014	0.0855	0.0693	0.0527		
750	0.0833	0.0675	0.0513			
760	0.0658					

Table 4—Inverse Density Difference $\text{m}^3/\text{kg} \times 10^3$ (Continued)

Light Component Density (kg/m^3)	Heavy Component Density (kg/m^3)				
	680	670	660	650	640
580	0.2535	0.2316	0.2090	0.1857	0.1616
590	0.2243	0.2024	0.1798	0.1565	0.1324
600	0.1961	0.1741	0.1515	0.1282	0.1042
610	0.1688	0.1468	0.1242	0.1009	0.0768
620	0.1423	0.1204	0.0978	0.0744	0.0504
630	0.1167	0.0948	0.0722		
640	0.0919	0.0700			
650	0.0679				

Table 5—Volumetric Shrinkage Percentage Factors for Blending
Two Hydrocarbons with Differences in Inverse Densities at 15°C
in m³/kg Determined from Table 4 and from 1 to 99 Percent Light Hydrocarbon
Component in Total Blend

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	1	2	3	4	5	6
0.0700	0.0004	0.0008	0.0012	0.0015	0.0019	0.0022
0.0800	0.0005	0.0010	0.0016	0.0021	0.0026	0.0030
0.0900	0.0007	0.0014	0.0020	0.0027	0.0033	0.0040
0.1000	0.0009	0.0017	0.0026	0.0034	0.0043	0.0051
0.1100	0.0011	0.0022	0.0032	0.0043	0.0053	0.0063
0.1200	0.0013	0.0026	0.0039	0.0052	0.0064	0.0077
0.1300	0.0016	0.0032	0.0047	0.0062	0.0077	0.0092
0.1400	0.0019	0.0038	0.0056	0.0074	0.0092	0.0109
0.1500	0.0022	0.0044	0.0065	0.0086	0.0107	0.0127
0.1600	0.0026	0.0051	0.0076	0.0100	0.0124	0.0148
0.1700	0.0029	0.0058	0.0087	0.0115	0.0143	0.0170
0.1800	0.0034	0.0067	0.0099	0.0131	0.0162	0.0193
0.1900	0.0038	0.0075	0.0112	0.0148	0.0184	0.0219
0.2000	0.0043	0.0085	0.0126	0.0167	0.0206	0.0246
0.2100	0.0048	0.0095	0.0141	0.0186	0.0231	0.0275
0.2200	0.0053	0.0105	0.0157	0.0207	0.0257	0.0305
0.2300	0.0059	0.0117	0.0173	0.0229	0.0284	0.0338
0.2400	0.0065	0.0128	0.0191	0.0252	0.0313	0.0372
0.2500	0.0071	0.0141	0.0210	0.0277	0.0343	0.0409
0.2600	0.0078	0.0154	0.0229	0.0303	0.0376	0.0447
0.2700	0.0085	0.0168	0.0250	0.0330	0.0409	0.0487
0.2800	0.0092	0.0182	0.0271	0.0359	0.0445	0.0529
0.2900	0.0100	0.0198	0.0294	0.0389	0.0482	0.0573
0.3000	0.0108	0.0214	0.0318	0.0420	0.0520	0.0619
0.3100	0.0116	0.0230	0.0342	0.0452	0.0561	0.0667
0.3200	0.0125	0.0247	0.0368	0.0486	0.0603	0.0717
0.3300	0.0134	0.0265	0.0395	0.0522	0.0647	0.0769
0.3400	0.0143	0.0284	0.0422	0.0559	0.0692	0.0824
0.3500	0.0153	0.0303	0.0451	0.0597	0.0740	0.0880
0.3600	0.0163	0.0324	0.0481	0.0636	0.0789	0.0938
0.3700	0.0174	0.0344	0.0512	0.0677	0.0839	0.0999
0.3800	0.0185	0.0366	0.0544	0.0720	0.0892	0.1061
0.3900	0.0196	0.0388	0.0578	0.0764	0.0946	0.1126
0.4000	0.0207	0.0411	0.0612	0.0809	0.1003	0.1193
0.4100	0.0219	0.0435	0.0647	0.0856	0.1061	0.1262
0.4200	0.0232	0.0460	0.0684	0.0904	0.1121	0.1333
0.4300	0.0245	0.0485	0.0722	0.0954	0.1182	0.1407
0.4400	0.0258	0.0511	0.0761	0.1005	0.1246	0.1482
0.4500	0.0271	0.0538	0.0801	0.1058	0.1312	0.1560
0.4600	0.0285	0.0566	0.0842	0.1113	0.1379	0.1641
0.4700	0.0300	0.0594	0.0884	0.1169	0.1448	0.1723
0.4800	0.0314	0.0623	0.0927	0.1226	0.1520	0.1808
0.4900	0.0329	0.0653	0.0972	0.1285	0.1593	0.1895
0.5000	0.0345	0.0684	0.1018	0.1346	0.1668	0.1984
0.5100	0.0361	0.0716	0.1065	0.1408	0.1745	0.2076

Note: Difference of Inverse Density Values in this table have been multiplied by 1000 for convenient tabulation.
For example, the first value, 0.0700, should be read (0.0700 × 10⁻³).

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	1	2	3	4	5	6
0.5200	0.0377	0.0748	0.1113	0.1472	0.1824	0.2170
0.5300	0.0394	0.0782	0.1162	0.1537	0.1905	0.2266
0.5400	0.0411	0.0816	0.1213	0.1604	0.1988	0.2365
0.5500	0.0429	0.0850	0.1265	0.1672	0.2073	0.2466
0.5600	0.0447	0.0886	0.1318	0.1742	0.2159	0.2569
0.5700	0.0465	0.0923	0.1372	0.1814	0.2248	0.2675
0.5800	0.0484	0.0960	0.1428	0.1888	0.2339	0.2783
0.5900	0.0503	0.0998	0.1485	0.1963	0.2432	0.2894
0.6000	0.0523	0.1037	0.1542	0.2039	0.2527	0.3007
0.6100	0.0543	0.1077	0.1602	0.2118	0.2624	0.3122
0.6200	0.0563	0.1118	0.1662	0.2198	0.2724	0.3240
0.6300	0.0584	0.1159	0.1724	0.2279	0.2825	0.3360
0.6400	0.0606	0.1201	0.1787	0.2363	0.2928	0.3483
0.6500	0.0628	0.1245	0.1851	0.2448	0.3033	0.3609
0.6600	0.0650	0.1289	0.1917	0.2534	0.3141	0.3736
0.6700	0.0672	0.1334	0.1984	0.2623	0.3250	0.3867
0.6800	0.0696	0.1379	0.2052	0.2713	0.3362	0.4000
0.6900	0.0719	0.1426	0.2121	0.2805	0.3476	0.4135
0.7000	0.0743	0.1474	0.2192	0.2898	0.3592	0.4273
0.7100	0.0767	0.1522	0.2264	0.2993	0.3710	0.4413
0.7200	0.0792	0.1572	0.2338	0.3090	0.3830	0.4556
0.7300	0.0818	0.1622	0.2412	0.3189	0.3952	0.4702
0.7400	0.0843	0.1673	0.2488	0.3290	0.4077	0.4850
0.7500	0.0870	0.1725	0.2566	0.3392	0.4204	0.5001
0.7600	0.0896	0.1778	0.2644	0.3496	0.4332	0.5154
0.7700	0.0923	0.1831	0.2724	0.3602	0.4464	0.5310
0.7800	0.0951	0.1886	0.2806	0.3709	0.4597	0.5469
0.7900	0.0979	0.1942	0.2888	0.3818	0.4732	0.5630
0.8000	0.1007	0.1998	0.2972	0.3930	0.4870	0.5793
0.8100	0.1036	0.2056	0.3058	0.4042	0.5010	0.5960
0.8200	0.1066	0.2114	0.3144	0.4157	0.5152	0.6129
0.8300	0.1096	0.2173	0.3232	0.4274	0.5296	0.6301
0.8400	0.1126	0.2233	0.3322	0.4392	0.5443	0.6475
0.8500	0.1157	0.2294	0.3413	0.4512	0.5592	0.6652
0.8600	0.1188	0.2356	0.3505	0.4634	0.5743	0.6832
0.8700	0.1220	0.2419	0.3599	0.4758	0.5896	0.7015
0.8800	0.1252	0.2483	0.3694	0.4883	0.6052	0.7200
0.8900	0.1285	0.2548	0.3790	0.5011	0.6210	0.7388
0.9000	0.1318	0.2614	0.3888	0.5140	0.6370	0.7578
0.9100	0.1351	0.2680	0.3987	0.5271	0.6533	0.7772
0.9200	0.1386	0.2748	0.4088	0.5404	0.6698	0.7968
0.9300	0.1420	0.2817	0.4190	0.5539	0.6865	0.8167
0.9400	0.1455	0.2886	0.4293	0.5676	0.7034	0.8368
0.9500	0.1491	0.2957	0.4398	0.5814	0.7206	0.8572
0.9600	0.1527	0.3028	0.4504	0.5955	0.7380	0.8780
0.9700	0.1563	0.3101	0.4612	0.6097	0.7556	0.8989

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	7	8	9	10	11	12
0.0700	0.0026	0.0029	0.0033	0.0036	0.0039	0.0042
0.0800	0.0035	0.0040	0.0044	0.0049	0.0053	0.0058
0.0900	0.0046	0.0052	0.0058	0.0064	0.0070	0.0075
0.1000	0.0058	0.0066	0.0074	0.0081	0.0089	0.0096
0.1100	0.0073	0.0082	0.0092	0.0101	0.0110	0.0119
0.1200	0.0089	0.0100	0.0112	0.0123	0.0134	0.0145
0.1300	0.0106	0.0120	0.0134	0.0148	0.0161	0.0174
0.1400	0.0126	0.0143	0.0159	0.0175	0.0191	0.0206
0.1500	0.0147	0.0167	0.0186	0.0205	0.0223	0.0242
0.1600	0.0171	0.0193	0.0216	0.0238	0.0259	0.0280
0.1700	0.0196	0.0222	0.0248	0.0273	0.0297	0.0321
0.1800	0.0223	0.0253	0.0282	0.0311	0.0339	0.0366
0.1900	0.0253	0.0286	0.0319	0.0351	0.0383	0.0414
0.2000	0.0284	0.0322	0.0359	0.0395	0.0431	0.0465
0.2100	0.0317	0.0360	0.0401	0.0442	0.0481	0.0520
0.2200	0.0353	0.0400	0.0446	0.0491	0.0535	0.0578
0.2300	0.0391	0.0443	0.0493	0.0543	0.0592	0.0640
0.2400	0.0430	0.0488	0.0544	0.0599	0.0652	0.0705
0.2500	0.0472	0.0535	0.0597	0.0657	0.0716	0.0774
0.2600	0.0517	0.0585	0.0653	0.0718	0.0783	0.0846
0.2700	0.0563	0.0638	0.0711	0.0783	0.0854	0.0923
0.2800	0.0612	0.0693	0.0773	0.0851	0.0927	0.1002
0.2900	0.0663	0.0751	0.0837	0.0922	0.1005	0.1086
0.3000	0.0716	0.0811	0.0904	0.0996	0.1085	0.1173
0.3100	0.0772	0.0874	0.0974	0.1073	0.1169	0.1264
0.3200	0.0829	0.0940	0.1048	0.1154	0.1257	0.1359
0.3300	0.0890	0.1008	0.1124	0.1237	0.1349	0.1458
0.3400	0.0952	0.1079	0.1203	0.1324	0.1444	0.1560
0.3500	0.1017	0.1153	0.1285	0.1415	0.1542	0.1667
0.3600	0.1085	0.1229	0.1370	0.1509	0.1645	0.1778
0.3700	0.1155	0.1308	0.1459	0.1606	0.1751	0.1892
0.3800	0.1227	0.1390	0.1550	0.1707	0.1860	0.2011
0.3900	0.1302	0.1475	0.1645	0.1811	0.1974	0.2133
0.4000	0.1380	0.1563	0.1742	0.1919	0.2091	0.2260
0.4100	0.1459	0.1653	0.1843	0.2030	0.2212	0.2391
0.4200	0.1542	0.1747	0.1947	0.2144	0.2337	0.2526
0.4300	0.1627	0.1843	0.2055	0.2262	0.2466	0.2665
0.4400	0.1714	0.1942	0.2165	0.2384	0.2599	0.2809
0.4500	0.1805	0.2044	0.2279	0.2510	0.2735	0.2957
0.4600	0.1897	0.2149	0.2396	0.2639	0.2876	0.3109
0.4700	0.1993	0.2257	0.2517	0.2771	0.3020	0.3265
0.4800	0.2091	0.2368	0.2640	0.2907	0.3169	0.3425
0.4900	0.2191	0.2482	0.2768	0.3047	0.3322	0.3590
0.5000	0.2295	0.2599	0.2898	0.3191	0.3478	0.3759
0.5100	0.2400	0.2719	0.3032	0.3338	0.3639	0.3933

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	7	8	9	10	11	12
0.5200	0.2509	0.2842	0.3169	0.3490	0.3803	0.4111
0.5300	0.2621	0.2968	0.3310	0.3644	0.3972	0.4294
0.5400	0.2735	0.3098	0.3454	0.3803	0.4145	0.4480
0.5500	0.2851	0.3230	0.3601	0.3966	0.4322	0.4672
0.5600	0.2971	0.3366	0.3752	0.4132	0.4504	0.4868
0.5700	0.3093	0.3504	0.3907	0.4302	0.4689	0.5068
0.5800	0.3219	0.3646	0.4065	0.4476	0.4879	0.5273
0.5900	0.3346	0.3791	0.4227	0.4654	0.5073	0.5483
0.6000	0.3477	0.3939	0.4392	0.4836	0.5271	0.5697
0.6100	0.3611	0.4090	0.4560	0.5021	0.5473	0.5916
0.6200	0.3747	0.4245	0.4733	0.5211	0.5680	0.6139
0.6300	0.3886	0.4402	0.4908	0.5405	0.5891	0.6367
0.6400	0.4028	0.4563	0.5088	0.5602	0.6106	0.6600
0.6500	0.4173	0.4727	0.5271	0.5804	0.6326	0.6838
0.6600	0.4321	0.4895	0.5458	0.6009	0.6550	0.7080
0.6700	0.4472	0.5066	0.5648	0.6219	0.6779	0.7327
0.6800	0.4625	0.5240	0.5842	0.6433	0.7012	0.7579
0.6900	0.4782	0.5417	0.6040	0.6650	0.7249	0.7835
0.7000	0.4942	0.5598	0.6241	0.6872	0.7491	0.8096
0.7100	0.5104	0.5782	0.6446	0.7098	0.7737	0.8362
0.7200	0.5269	0.5969	0.6655	0.7328	0.7988	0.8633
0.7300	0.5438	0.6160	0.6868	0.7562	0.8243	0.8909
0.7400	0.5609	0.6354	0.7084	0.7801	0.8502	0.9190
0.7500	0.5783	0.6551	0.7304	0.8043	0.8767	0.9476
0.7600	0.5961	0.6752	0.7528	0.8290	0.9035	0.9766
0.7700	0.6141	0.6956	0.7756	0.8540	0.9309	1.0062
0.7800	0.6324	0.7164	0.7988	0.8795	0.9587	1.0362
0.7900	0.6511	0.7375	0.8223	0.9055	0.9869	1.0667
0.8000	0.6700	0.7590	0.8462	0.9318	1.0156	1.0978
0.8100	0.6893	0.7808	0.8706	0.9586	1.0448	1.1293
0.8200	0.7088	0.8029	0.8953	0.9858	1.0745	1.1613
0.8300	0.7287	0.8254	0.9203	1.0134	1.1046	1.1939
0.8400	0.7488	0.8483	0.9458	1.0414	1.1351	1.2269
0.8500	0.7693	0.8715	0.9717	1.0699	1.1662	1.2605
0.8600	0.7901	0.8950	0.9979	1.0988	1.1977	1.2946
0.8700	0.8112	0.9189	1.0246	1.1282	1.2297	1.3291
0.8800	0.8326	0.9432	1.0516	1.1580	1.2622	1.3642
0.8900	0.8544	0.9678	1.0791	1.1882	1.2951	1.3998
0.9000	0.8764	0.9928	1.1069	1.2188	1.3285	1.4359
0.9100	0.8988	1.0181	1.1352	1.2499	1.3624	1.4726
0.9200	0.9215	1.0438	1.1638	1.2815	1.3968	1.5097
0.9300	0.9445	1.0699	1.1929	1.3135	1.4316	1.5474
0.9400	0.9678	1.0963	1.2223	1.3459	1.4670	1.5856
0.9500	0.9914	1.1230	1.2522	1.3788	1.5028	1.6243
0.9600	1.0154	1.1502	1.2824	1.4121	1.5391	1.6636
0.9700	1.0396	1.1777	1.3131	1.4458	1.5759	1.7034

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	13	14	15	16	17	18
0.0700	0.0046	0.0049	0.0052	0.0055	0.0057	0.0060
0.0800	0.0062	0.0066	0.0070	0.0074	0.0078	0.0082
0.0900	0.0081	0.0086	0.0092	0.0097	0.0102	0.0107
0.1000	0.0103	0.0110	0.0116	0.0123	0.0129	0.0136
0.1100	0.0128	0.0136	0.0145	0.0153	0.0161	0.0169
0.1200	0.0156	0.0166	0.0176	0.0186	0.0196	0.0206
0.1300	0.0187	0.0200	0.0212	0.0224	0.0235	0.0247
0.1400	0.0221	0.0236	0.0251	0.0265	0.0279	0.0292
0.1500	0.0259	0.0277	0.0293	0.0310	0.0326	0.0342
0.1600	0.0300	0.0320	0.0340	0.0359	0.0378	0.0396
0.1700	0.0345	0.0368	0.0390	0.0412	0.0434	0.0455
0.1800	0.0393	0.0419	0.0445	0.0470	0.0494	0.0518
0.1900	0.0444	0.0474	0.0503	0.0531	0.0559	0.0586
0.2000	0.0499	0.0533	0.0565	0.0597	0.0628	0.0659
0.2100	0.0558	0.0596	0.0632	0.0668	0.0702	0.0736
0.2200	0.0621	0.0662	0.0703	0.0742	0.0781	0.0819
0.2300	0.0687	0.0733	0.0778	0.0821	0.0864	0.0906
0.2400	0.0757	0.0807	0.0857	0.0905	0.0952	0.0998
0.2500	0.0831	0.0886	0.0940	0.0993	0.1045	0.1096
0.2600	0.0908	0.0969	0.1028	0.1086	0.1143	0.1198
0.2700	0.0990	0.1056	0.1121	0.1184	0.1246	0.1306
0.2800	0.1076	0.1148	0.1218	0.1286	0.1353	0.1419
0.2900	0.1165	0.1243	0.1319	0.1394	0.1466	0.1537
0.3000	0.1259	0.1343	0.1425	0.1506	0.1584	0.1661
0.3100	0.1357	0.1447	0.1536	0.1622	0.1707	0.1790
0.3200	0.1458	0.1556	0.1651	0.1744	0.1835	0.1924
0.3300	0.1564	0.1669	0.1771	0.1871	0.1969	0.2064
0.3400	0.1675	0.1787	0.1896	0.2003	0.2107	0.2209
0.3500	0.1789	0.1909	0.2025	0.2140	0.2251	0.2360
0.3600	0.1908	0.2035	0.2160	0.2282	0.2400	0.2517
0.3700	0.2031	0.2166	0.2299	0.2429	0.2555	0.2679
0.3800	0.2158	0.2302	0.2443	0.2581	0.2715	0.2847
0.3900	0.2290	0.2443	0.2592	0.2738	0.2881	0.3020
0.4000	0.2426	0.2588	0.2746	0.2901	0.3052	0.3200
0.4100	0.2566	0.2738	0.2905	0.3069	0.3229	0.3385
0.4200	0.2711	0.2892	0.3069	0.3242	0.3411	0.3576
0.4300	0.2861	0.3052	0.3239	0.3421	0.3599	0.3774
0.4400	0.3015	0.3216	0.3413	0.3605	0.3793	0.3977
0.4500	0.3173	0.3385	0.3592	0.3795	0.3993	0.4186
0.4600	0.3336	0.3559	0.3777	0.3990	0.4198	0.4401
0.4700	0.3504	0.3738	0.3967	0.4190	0.4409	0.4622
0.4800	0.3676	0.3922	0.4162	0.4396	0.4625	0.4849
0.4900	0.3853	0.4110	0.4362	0.4608	0.4848	0.5083
0.5000	0.4035	0.4304	0.4568	0.4825	0.5077	0.5322
0.5100	0.4221	0.4503	0.4779	0.5048	0.5311	0.5568

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	13	14	15	16	17	18
0.5200	0.4412	0.4707	0.4995	0.5276	0.5552	0.5820
0.5300	0.4608	0.4916	0.5217	0.5511	0.5798	0.6078
0.5400	0.4809	0.5130	0.5444	0.5751	0.6050	0.6343
0.5500	0.5014	0.5349	0.5676	0.5996	0.6309	0.6614
0.5600	0.5224	0.5573	0.5914	0.6248	0.6573	0.6891
0.5700	0.5439	0.5803	0.6158	0.6505	0.6844	0.7175
0.5800	0.5659	0.6037	0.6407	0.6768	0.7121	0.7465
0.5900	0.5884	0.6277	0.6662	0.7037	0.7404	0.7762
0.6000	0.6114	0.6523	0.6922	0.7312	0.7693	0.8065
0.6100	0.6349	0.6773	0.7188	0.7593	0.7989	0.8375
0.6200	0.6589	0.7029	0.7459	0.7880	0.8290	0.8691
0.6300	0.6834	0.7290	0.7736	0.8172	0.8598	0.9014
0.6400	0.7084	0.7557	0.8019	0.8471	0.8913	0.9344
0.6500	0.7338	0.7828	0.8308	0.8776	0.9234	0.9680
0.6600	0.7598	0.8106	0.8602	0.9087	0.9561	1.0023
0.6700	0.7863	0.8389	0.8902	0.9404	0.9894	1.0373
0.6800	0.8134	0.8677	0.9208	0.9727	1.0234	1.0729
0.6900	0.8409	0.8970	0.9519	1.0056	1.0580	1.1092
0.7000	0.8689	0.9270	0.9837	1.0392	1.0933	1.1462
0.7100	0.8975	0.9574	1.0160	1.0733	1.1293	1.1839
0.7200	0.9266	0.9884	1.0490	1.1081	1.1659	1.2222
0.7300	0.9562	1.0200	1.0825	1.1435	1.2031	1.2613
0.7400	0.9863	1.0522	1.1166	1.1795	1.2410	1.3010
0.7500	1.0170	1.0849	1.1513	1.2162	1.2796	1.3415
0.7600	1.0481	1.1181	1.1866	1.2535	1.3188	1.3826
0.7700	1.0798	1.1519	1.2225	1.2914	1.3587	1.4244
0.7800	1.1121	1.1863	1.2590	1.3299	1.3993	1.4669
0.7900	1.1449	1.2213	1.2961	1.3691	1.4405	1.5102
0.8000	1.1782	1.2568	1.3338	1.4090	1.4824	1.5541
0.8100	1.2120	1.2929	1.3721	1.4494	1.5250	1.5988
0.8200	1.2464	1.3296	1.4110	1.4906	1.5683	1.6441
0.8300	1.2813	1.3669	1.4506	1.5323	1.6122	1.6902
0.8400	1.3168	1.4047	1.4907	1.5748	1.6568	1.7370
0.8500	1.3528	1.4431	1.5315	1.6178	1.7022	1.7845
0.8600	1.3894	1.4821	1.5729	1.6616	1.7482	1.8327
0.8700	1.4265	1.5217	1.6149	1.7059	1.7949	1.8817
0.8800	1.4641	1.5619	1.6575	1.7510	1.8422	1.9313
0.8900	1.5023	1.6027	1.7008	1.7967	1.8903	1.9817
0.9000	1.5411	1.6440	1.7447	1.8430	1.9391	2.0329
0.9100	1.5804	1.6860	1.7892	1.8900	1.9886	2.0847
0.9200	1.6203	1.7285	1.8343	1.9377	2.0387	2.1373
0.9300	1.6607	1.7716	1.8801	1.9861	2.0896	2.1907
0.9400	1.7017	1.8154	1.9265	2.0351	2.1412	2.2448
0.9500	1.7433	1.8597	1.9735	2.0848	2.1935	2.2996
0.9600	1.7854	1.9046	2.0212	2.1352	2.2465	2.3551
0.9700	1.8281	1.9502	2.0696	2.1862	2.3002	2.4114

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	19	20	21	22	23	24
0.0700	0.0063	0.0065	0.0068	0.0071	0.0073	0.0075
0.0800	0.0085	0.0089	0.0092	0.0096	0.0099	0.0102
0.0900	0.0111	0.0116	0.0121	0.0125	0.0129	0.0134
0.1000	0.0142	0.0148	0.0154	0.0159	0.0165	0.0170
0.1100	0.0176	0.0184	0.0191	0.0198	0.0205	0.0211
0.1200	0.0215	0.0224	0.0233	0.0241	0.0249	0.0258
0.1300	0.0258	0.0269	0.0279	0.0289	0.0299	0.0309
0.1400	0.0305	0.0318	0.0331	0.0343	0.0355	0.0366
0.1500	0.0357	0.0372	0.0387	0.0401	0.0415	0.0428
0.1600	0.0414	0.0431	0.0448	0.0465	0.0481	0.0496
0.1700	0.0475	0.0495	0.0515	0.0534	0.0552	0.0570
0.1800	0.0541	0.0564	0.0586	0.0608	0.0629	0.0649
0.1900	0.0613	0.0638	0.0663	0.0688	0.0711	0.0734
0.2000	0.0688	0.0717	0.0746	0.0773	0.0800	0.0825
0.2100	0.0770	0.0802	0.0833	0.0864	0.0894	0.0923
0.2200	0.0856	0.0892	0.0927	0.0961	0.0994	0.1026
0.2300	0.0947	0.0987	0.1025	0.1063	0.1100	0.1135
0.2400	0.1043	0.1087	0.1130	0.1171	0.1212	0.1251
0.2500	0.1145	0.1193	0.1240	0.1286	0.1330	0.1373
0.2600	0.1252	0.1305	0.1356	0.1406	0.1454	0.1501
0.2700	0.1365	0.1422	0.1478	0.1532	0.1585	0.1636
0.2800	0.1483	0.1545	0.1606	0.1665	0.1722	0.1778
0.2900	0.1606	0.1674	0.1739	0.1803	0.1865	0.1926
0.3000	0.1735	0.1808	0.1879	0.1948	0.2015	0.2081
0.3100	0.1870	0.1949	0.2025	0.2099	0.2172	0.2242
0.3200	0.2010	0.2095	0.2177	0.2257	0.2335	0.2410
0.3300	0.2157	0.2247	0.2335	0.2421	0.2505	0.2586
0.3400	0.2308	0.2405	0.2500	0.2592	0.2681	0.2768
0.3500	0.2466	0.2570	0.2671	0.2769	0.2864	0.2957
0.3600	0.2630	0.2740	0.2848	0.2952	0.3054	0.3153
0.3700	0.2799	0.2917	0.3031	0.3143	0.3251	0.3356
0.3800	0.2975	0.3100	0.3221	0.3340	0.3455	0.3567
0.3900	0.3156	0.3289	0.3418	0.3543	0.3666	0.3784
0.4000	0.3344	0.3484	0.3621	0.3754	0.3883	0.4009
0.4100	0.3538	0.3686	0.3831	0.3971	0.4108	0.4241
0.4200	0.3737	0.3894	0.4047	0.4196	0.4340	0.4481
0.4300	0.3943	0.4109	0.4270	0.4427	0.4580	0.4728
0.4400	0.4156	0.4330	0.4500	0.4665	0.4826	0.4982
0.4500	0.4374	0.4558	0.4736	0.4910	0.5080	0.5244
0.4600	0.4599	0.4792	0.4980	0.5163	0.5341	0.5514
0.4700	0.4830	0.5033	0.5230	0.5422	0.5609	0.5791
0.4800	0.5067	0.5280	0.5487	0.5689	0.5885	0.6075
0.4900	0.5311	0.5534	0.5751	0.5963	0.6168	0.6368
0.5000	0.5562	0.5795	0.6023	0.6244	0.6459	0.6668
0.5100	0.5819	0.6063	0.6301	0.6532	0.6757	0.6976

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	19	20	21	22	23	24
0.5200	0.6082	0.6337	0.6586	0.6828	0.7063	0.7292
0.5300	0.6352	0.6619	0.6878	0.7131	0.7377	0.7616
0.5400	0.6628	0.6907	0.7178	0.7441	0.7698	0.7947
0.5500	0.6912	0.7202	0.7484	0.7759	0.8027	0.8287
0.5600	0.7202	0.7504	0.7798	0.8085	0.8363	0.8634
0.5700	0.7498	0.7813	0.8119	0.8418	0.8708	0.8990
0.5800	0.7801	0.8129	0.8448	0.8758	0.9060	0.9353
0.5900	0.8111	0.8452	0.8784	0.9106	0.9420	0.9725
0.6000	0.8428	0.8782	0.9127	0.9462	0.9788	1.0105
0.6100	0.8752	0.9119	0.9477	0.9825	1.0164	1.0493
0.6200	0.9083	0.9464	0.9835	1.0197	1.0548	1.0889
0.6300	0.9420	0.9815	1.0201	1.0575	1.0940	1.1294
0.6400	0.9764	1.0174	1.0573	1.0962	1.1340	1.1707
0.6500	1.0116	1.0540	1.0954	1.1356	1.1748	1.2128
0.6600	1.0474	1.0914	1.1342	1.1759	1.2164	1.2558
0.6700	1.0839	1.1294	1.1738	1.2169	1.2588	1.2996
0.6800	1.1212	1.1682	1.2141	1.2587	1.3021	1.3442
0.6900	1.1591	1.2078	1.2552	1.3013	1.3461	1.3897
0.7000	1.1978	1.2481	1.2970	1.3447	1.3910	1.4361
0.7100	1.2372	1.2891	1.3397	1.3889	1.4368	1.4833
0.7200	1.2772	1.3309	1.3831	1.4339	1.4833	1.5313
0.7300	1.3180	1.3734	1.4273	1.4797	1.5307	1.5803
0.7400	1.3596	1.4166	1.4722	1.5263	1.5789	1.6300
0.7500	1.4018	1.4607	1.5180	1.5738	1.6280	1.6807
0.7600	1.4448	1.5055	1.5645	1.6220	1.6779	1.7322
0.7700	1.4885	1.5510	1.6119	1.6711	1.7287	1.7846
0.7800	1.5330	1.5973	1.6600	1.7210	1.7803	1.8379
0.7900	1.5781	1.6444	1.7089	1.7717	1.8328	1.8921
0.8000	1.6241	1.6922	1.7586	1.8232	1.8861	1.9471
0.8100	1.6707	1.7408	1.8091	1.8756	1.9403	2.0031
0.8200	1.7181	1.7902	1.8605	1.9288	1.9953	2.0599
0.8300	1.7663	1.8404	1.9126	1.9829	2.0512	2.1176
0.8400	1.8151	1.8913	1.9656	2.0378	2.1080	2.1762
0.8500	1.8648	1.9431	2.0193	2.0935	2.1657	2.2358
0.8600	1.9152	1.9956	2.0739	2.1501	2.2242	2.2962
0.8700	1.9663	2.0489	2.1293	2.2075	2.2836	2.3575
0.8800	2.0183	2.1030	2.1855	2.2658	2.3439	2.4197
0.8900	2.0709	2.1579	2.2425	2.3249	2.4051	2.4829
0.9000	2.1244	2.2135	2.3004	2.3849	2.4671	2.5470
0.9100	2.1786	2.2700	2.3591	2.4458	2.5301	2.6119
0.9200	2.2335	2.3273	2.4186	2.5075	2.5939	2.6778
0.9300	2.2893	2.3854	2.4790	2.5700	2.6586	2.7447
0.9400	2.3458	2.4442	2.5402	2.6335	2.7243	2.8124
0.9500	2.4031	2.5039	2.6022	2.6978	2.7908	2.8811
0.9600	2.4611	2.5644	2.6651	2.7630	2.8582	2.9507
0.9700	2.5200	2.6257	2.7288	2.8290	2.9265	3.0213

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	25	26	27	28	29	30
0.0700	0.0078	0.0080	0.0082	0.0084	0.0086	0.0088
0.0800	0.0105	0.0108	0.0111	0.0114	0.0117	0.0119
0.0900	0.0138	0.0142	0.0145	0.0149	0.0153	0.0156
0.1000	0.0175	0.0180	0.0185	0.0190	0.0194	0.0199
0.1100	0.0218	0.0224	0.0230	0.0236	0.0241	0.0247
0.1200	0.0265	0.0273	0.0280	0.0287	0.0294	0.0301
0.1300	0.0319	0.0328	0.0336	0.0345	0.0353	0.0361
0.1400	0.0377	0.0388	0.0398	0.0409	0.0418	0.0428
0.1500	0.0441	0.0454	0.0466	0.0478	0.0490	0.0501
0.1600	0.0511	0.0526	0.0540	0.0554	0.0567	0.0580
0.1700	0.0587	0.0604	0.0620	0.0636	0.0651	0.0666
0.1800	0.0669	0.0688	0.0707	0.0725	0.0742	0.0759
0.1900	0.0757	0.0778	0.0799	0.0820	0.0839	0.0858
0.2000	0.0851	0.0875	0.0899	0.0921	0.0943	0.0965
0.2100	0.0951	0.0978	0.1004	0.1030	0.1054	0.1078
0.2200	0.1057	0.1087	0.1117	0.1145	0.1172	0.1199
0.2300	0.1170	0.1203	0.1236	0.1267	0.1297	0.1327
0.2400	0.1289	0.1326	0.1362	0.1396	0.1430	0.1462
0.2500	0.1415	0.1455	0.1494	0.1532	0.1569	0.1604
0.2600	0.1547	0.1591	0.1634	0.1676	0.1716	0.1754
0.2700	0.1686	0.1734	0.1781	0.1826	0.1870	0.1912
0.2800	0.1832	0.1884	0.1935	0.1984	0.2032	0.2077
0.2900	0.1984	0.2041	0.2096	0.2149	0.2201	0.2250
0.3000	0.2144	0.2205	0.2265	0.2322	0.2378	0.2431
0.3100	0.2310	0.2376	0.2441	0.2502	0.2562	0.2620
0.3200	0.2484	0.2555	0.2624	0.2690	0.2755	0.2817
0.3300	0.2664	0.2741	0.2814	0.2886	0.2955	0.3021
0.3400	0.2852	0.2934	0.3013	0.3089	0.3163	0.3234
0.3500	0.3047	0.3134	0.3218	0.3300	0.3379	0.3455
0.3600	0.3249	0.3342	0.3432	0.3519	0.3603	0.3684
0.3700	0.3458	0.3557	0.3653	0.3746	0.3836	0.3922
0.3800	0.3675	0.3780	0.3882	0.3981	0.4076	0.4168
0.3900	0.3899	0.4011	0.4119	0.4224	0.4325	0.4422
0.4000	0.4131	0.4249	0.4364	0.4475	0.4582	0.4685
0.4100	0.4370	0.4495	0.4617	0.4734	0.4847	0.4956
0.4200	0.4617	0.4749	0.4877	0.5001	0.5121	0.5236
0.4300	0.4872	0.5011	0.5146	0.5277	0.5403	0.5525
0.4400	0.5134	0.5281	0.5423	0.5561	0.5694	0.5822
0.4500	0.5404	0.5558	0.5708	0.5853	0.5993	0.6128
0.4600	0.5681	0.5844	0.6002	0.6154	0.6301	0.6443
0.4700	0.5967	0.6138	0.6303	0.6463	0.6618	0.6767
0.4800	0.6260	0.6440	0.6613	0.6781	0.6943	0.7100
0.4900	0.6562	0.6750	0.6931	0.7107	0.7277	0.7441
0.5000	0.6871	0.7068	0.7258	0.7442	0.7620	0.7792
0.5100	0.7188	0.7394	0.7593	0.7786	0.7972	0.8152

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	25	26	27	28	29	30
0.5200	0.7514	0.7729	0.7937	0.8139	0.8333	0.8521
0.5300	0.7847	0.8072	0.8289	0.8500	0.8703	0.8899
0.5400	0.8189	0.8423	0.8650	0.8870	0.9082	0.9287
0.5500	0.8539	0.8783	0.9020	0.9249	0.9470	0.9684
0.5600	0.8897	0.9152	0.9398	0.9637	0.9867	1.0090
0.5700	0.9263	0.9528	0.9785	1.0034	1.0274	1.0505
0.5800	0.9638	0.9914	1.0181	1.0440	1.0689	1.0930
0.5900	1.0021	1.0308	1.0586	1.0854	1.1114	1.1365
0.6000	1.0412	1.0711	1.0999	1.1278	1.1548	1.1808
0.6100	1.0812	1.1122	1.1422	1.1712	1.1992	1.2262
0.6200	1.1221	1.1542	1.1853	1.2154	1.2445	1.2725
0.6300	1.1638	1.1971	1.2293	1.2606	1.2907	1.3198
0.6400	1.2063	1.2408	1.2743	1.3066	1.3379	1.3680
0.6500	1.2497	1.2855	1.3201	1.3537	1.3860	1.4173
0.6600	1.2940	1.3310	1.3669	1.4016	1.4351	1.4675
0.6700	1.3391	1.3775	1.4146	1.4505	1.4852	1.5187
0.6800	1.3851	1.4248	1.4632	1.5003	1.5362	1.5708
0.6900	1.4320	1.4730	1.5127	1.5511	1.5882	1.6240
0.7000	1.4798	1.5221	1.5632	1.6028	1.6412	1.6782
0.7100	1.5284	1.5722	1.6145	1.6555	1.6951	1.7333
0.7200	1.5779	1.6231	1.6668	1.7092	1.7500	1.7895
0.7300	1.6283	1.6750	1.7201	1.7638	1.8060	1.8467
0.7400	1.6796	1.7277	1.7743	1.8193	1.8629	1.9048
0.7500	1.7318	1.7814	1.8294	1.8759	1.9207	1.9640
0.7600	1.7849	1.8360	1.8855	1.9334	1.9796	2.0242
0.7700	1.8389	1.8916	1.9426	1.9919	2.0395	2.0855
0.7800	1.8938	1.9481	2.0006	2.0514	2.1004	2.1478
0.7900	1.9497	2.0055	2.0595	2.1118	2.1623	2.2111
0.8000	2.0064	2.0638	2.1194	2.1733	2.2252	2.2754
0.8100	2.0640	2.1231	2.1803	2.2357	2.2892	2.3407
0.8200	2.1226	2.1833	2.2422	2.2991	2.3541	2.4072
0.8300	2.1821	2.2445	2.3050	2.3635	2.4201	2.4746
0.8400	2.2425	2.3067	2.3688	2.4290	2.4871	2.5431
0.8500	2.3038	2.3697	2.4336	2.4954	2.5551	2.6127
0.8600	2.3661	2.4338	2.4994	2.5628	2.6241	2.6833
0.8700	2.4292	2.4988	2.5661	2.6313	2.6942	2.7549
0.8800	2.4934	2.5648	2.6339	2.7008	2.7654	2.8277
0.8900	2.5584	2.6317	2.7026	2.7712	2.8375	2.9015
0.9000	2.6245	2.6996	2.7724	2.8427	2.9107	2.9763
0.9100	2.6914	2.7685	2.8431	2.9153	2.9850	3.0523
0.9200	2.7593	2.8383	2.9148	2.9888	3.0603	3.1293
0.9300	2.8282	2.9092	2.9876	3.0634	3.1367	3.2074
0.9400	2.8980	2.9810	3.0613	3.1390	3.2141	3.2866
0.9500	2.9688	3.0538	3.1361	3.2157	3.2926	3.3668
0.9600	3.0405	3.1276	3.2119	3.2934	3.3722	3.4482
0.9700	3.1132	3.2023	3.2886	3.3721	3.4528	3.5306

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	31	32	33	34	35	36
0.0700	0.0090	0.0092	0.0093	0.0095	0.0097	0.0098
0.0800	0.0122	0.0124	0.0127	0.0129	0.0131	0.0133
0.0900	0.0160	0.0163	0.0166	0.0169	0.0172	0.0174
0.1000	0.0203	0.0207	0.0211	0.0215	0.0218	0.0221
0.1100	0.0252	0.0257	0.0262	0.0267	0.0271	0.0275
0.1200	0.0307	0.0314	0.0319	0.0325	0.0330	0.0336
0.1300	0.0369	0.0376	0.0383	0.0390	0.0397	0.0403
0.1400	0.0437	0.0446	0.0454	0.0462	0.0470	0.0477
0.1500	0.0511	0.0521	0.0531	0.0541	0.0550	0.0558
0.1600	0.0592	0.0604	0.0615	0.0626	0.0637	0.0647
0.1700	0.0680	0.0694	0.0707	0.0719	0.0731	0.0743
0.1800	0.0775	0.0790	0.0805	0.0819	0.0833	0.0846
0.1900	0.0876	0.0894	0.0911	0.0927	0.0942	0.0957
0.2000	0.0985	0.1005	0.1024	0.1042	0.1059	0.1076
0.2100	0.1101	0.1123	0.1144	0.1164	0.1184	0.1202
0.2200	0.1224	0.1249	0.1272	0.1295	0.1316	0.1337
0.2300	0.1355	0.1382	0.1408	0.1433	0.1457	0.1479
0.2400	0.1493	0.1523	0.1551	0.1579	0.1605	0.1630
0.2500	0.1638	0.1671	0.1703	0.1733	0.1762	0.1789
0.2600	0.1792	0.1828	0.1862	0.1895	0.1926	0.1956
0.2700	0.1953	0.1992	0.2029	0.2065	0.2099	0.2132
0.2800	0.2122	0.2164	0.2205	0.2244	0.2281	0.2317
0.2900	0.2298	0.2344	0.2388	0.2431	0.2471	0.2509
0.3000	0.2483	0.2533	0.2580	0.2626	0.2670	0.2711
0.3100	0.2676	0.2729	0.2781	0.2830	0.2877	0.2922
0.3200	0.2877	0.2934	0.2989	0.3042	0.3093	0.3141
0.3300	0.3086	0.3147	0.3207	0.3263	0.3317	0.3369
0.3400	0.3303	0.3369	0.3432	0.3493	0.3551	0.3607
0.3500	0.3529	0.3599	0.3667	0.3732	0.3794	0.3853
0.3600	0.3763	0.3838	0.3910	0.3979	0.4045	0.4109
0.3700	0.4005	0.4085	0.4162	0.4236	0.4306	0.4373
0.3800	0.4256	0.4341	0.4423	0.4501	0.4576	0.4648
0.3900	0.4516	0.4606	0.4693	0.4776	0.4855	0.4931
0.4000	0.4784	0.4880	0.4972	0.5060	0.5144	0.5224
0.4100	0.5061	0.5163	0.5260	0.5353	0.5442	0.5527
0.4200	0.5347	0.5454	0.5557	0.5655	0.5749	0.5839
0.4300	0.5642	0.5755	0.5863	0.5967	0.6066	0.6161
0.4400	0.5946	0.6065	0.6179	0.6288	0.6392	0.6492
0.4500	0.6258	0.6383	0.6503	0.6619	0.6729	0.6833
0.4600	0.6580	0.6711	0.6838	0.6959	0.7074	0.7185
0.4700	0.6911	0.7049	0.7181	0.7308	0.7430	0.7546
0.4800	0.7250	0.7395	0.7534	0.7668	0.7795	0.7917
0.4900	0.7599	0.7751	0.7897	0.8037	0.8170	0.8298
0.5000	0.7958	0.8117	0.8269	0.8416	0.8556	0.8689
0.5100	0.8325	0.8492	0.8651	0.8804	0.8951	0.9090

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	31	32	33	34	35	36
0.5200	0.8702	0.8876	0.9043	0.9203	0.9356	0.9502
0.5300	0.9088	0.9270	0.9444	0.9611	0.9771	0.9924
0.5400	0.9484	0.9674	0.9856	1.0030	1.0197	1.0356
0.5500	0.9889	1.0087	1.0277	1.0458	1.0632	1.0798
0.5600	1.0304	1.0510	1.0708	1.0897	1.1078	1.1251
0.5700	1.0728	1.0943	1.1148	1.1346	1.1534	1.1714
0.5800	1.1162	1.1385	1.1599	1.1805	1.2001	1.2188
0.5900	1.1606	1.1838	1.2060	1.2274	1.2478	1.2672
0.6000	1.2059	1.2300	1.2532	1.2753	1.2965	1.3167
0.6100	1.2522	1.2773	1.3013	1.3243	1.3463	1.3673
0.6200	1.2995	1.3255	1.3504	1.3743	1.3972	1.4190
0.6300	1.3478	1.3747	1.4006	1.4254	1.4491	1.4717
0.6400	1.3971	1.4250	1.4518	1.4775	1.5021	1.5255
0.6500	1.4474	1.4763	1.5041	1.5307	1.5561	1.5804
0.6600	1.4986	1.5286	1.5573	1.5849	1.6112	1.6364
0.6700	1.5509	1.5819	1.6117	1.6402	1.6674	1.6934
0.6800	1.6042	1.6362	1.6670	1.6965	1.7247	1.7516
0.6900	1.6585	1.6916	1.7234	1.7539	1.7831	1.8109
0.7000	1.7138	1.7480	1.7809	1.8124	1.8426	1.8713
0.7100	1.7701	1.8055	1.8395	1.8720	1.9031	1.9328
0.7200	1.8275	1.8640	1.8991	1.9327	1.9648	1.9954
0.7300	1.8859	1.9235	1.9597	1.9944	2.0276	2.0592
0.7400	1.9453	1.9842	2.0215	2.0572	2.0914	2.1240
0.7500	2.0057	2.0458	2.0843	2.1212	2.1564	2.1901
0.7600	2.0672	2.1085	2.1482	2.1862	2.2225	2.2572
0.7700	2.1298	2.1723	2.2132	2.2524	2.2898	2.3255
0.7800	2.1933	2.2372	2.2793	2.3196	2.3582	2.3949
0.7900	2.2580	2.3031	2.3464	2.3880	2.4277	2.4655
0.8000	2.3237	2.3701	2.4147	2.4574	2.4983	2.5372
0.8100	2.3904	2.4382	2.4841	2.5280	2.5701	2.6101
0.8200	2.4583	2.5074	2.5546	2.5998	2.6430	2.6842
0.8300	2.5271	2.5777	2.6262	2.6726	2.7170	2.7594
0.8400	2.5971	2.6490	2.6988	2.7466	2.7922	2.8358
0.8500	2.6681	2.7215	2.7727	2.8217	2.8686	2.9133
0.8600	2.7402	2.7950	2.8476	2.8980	2.9461	2.9921
0.8700	2.8134	2.8697	2.9236	2.9754	3.0248	3.0720
0.8800	2.8877	2.9454	3.0008	3.0539	3.1047	3.1531
0.8900	2.9631	3.0223	3.0791	3.1336	3.1857	3.2354
0.9000	3.0395	3.1003	3.1586	3.2145	3.2679	3.3189
0.9100	3.1171	3.1794	3.2392	3.2965	3.3513	3.4035
0.9200	3.1957	3.2596	3.3209	3.3797	3.4358	3.4894
0.9300	3.2755	3.3409	3.4038	3.4640	3.5216	3.5765
0.9400	3.3563	3.4234	3.4878	3.5495	3.6085	3.6648
0.9500	3.4383	3.5070	3.5730	3.6362	3.6966	3.7543
0.9600	3.5214	3.5917	3.6593	3.7241	3.7859	3.8450
0.9700	3.6055	3.6776	3.7468	3.8131	3.8765	3.9369

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	37	38	39	40	41	42
0.0700	0.0100	0.0101	0.0102	0.0104	0.0105	0.0106
0.0800	0.0135	0.0137	0.0139	0.0140	0.0142	0.0143
0.0900	0.0177	0.0179	0.0181	0.0184	0.0186	0.0187
0.1000	0.0225	0.0228	0.0231	0.0233	0.0236	0.0238
0.1100	0.0279	0.0283	0.0287	0.0290	0.0293	0.0296
0.1200	0.0341	0.0345	0.0350	0.0354	0.0358	0.0361
0.1300	0.0409	0.0414	0.0420	0.0425	0.0429	0.0434
0.1400	0.0484	0.0491	0.0497	0.0503	0.0508	0.0513
0.1500	0.0566	0.0574	0.0581	0.0588	0.0595	0.0601
0.1600	0.0656	0.0665	0.0674	0.0682	0.0689	0.0696
0.1700	0.0753	0.0764	0.0773	0.0783	0.0791	0.0799
0.1800	0.0858	0.0870	0.0881	0.0892	0.0901	0.0910
0.1900	0.0971	0.0984	0.0997	0.1009	0.1020	0.1030
0.2000	0.1091	0.1106	0.1120	0.1134	0.1146	0.1158
0.2100	0.1220	0.1236	0.1252	0.1267	0.1281	0.1294
0.2200	0.1356	0.1375	0.1392	0.1409	0.1424	0.1439
0.2300	0.1501	0.1521	0.1541	0.1559	0.1576	0.1592
0.2400	0.1654	0.1676	0.1698	0.1718	0.1737	0.1754
0.2500	0.1815	0.1840	0.1863	0.1885	0.1906	0.1926
0.2600	0.1985	0.2012	0.2038	0.2062	0.2085	0.2106
0.2700	0.2163	0.2193	0.2221	0.2247	0.2272	0.2295
0.2800	0.2350	0.2382	0.2413	0.2441	0.2468	0.2493
0.2900	0.2546	0.2581	0.2614	0.2645	0.2674	0.2701
0.3000	0.2751	0.2788	0.2824	0.2857	0.2889	0.2918
0.3100	0.2964	0.3005	0.3043	0.3079	0.3113	0.3145
0.3200	0.3187	0.3230	0.3271	0.3310	0.3347	0.3381
0.3300	0.3418	0.3465	0.3509	0.3551	0.3590	0.3626
0.3400	0.3659	0.3709	0.3756	0.3801	0.3843	0.3882
0.3500	0.3909	0.3963	0.4013	0.4061	0.4105	0.4147
0.3600	0.4169	0.4225	0.4279	0.4330	0.4378	0.4422
0.3700	0.4437	0.4498	0.4555	0.4609	0.4660	0.4707
0.3800	0.4715	0.4780	0.4841	0.4898	0.4952	0.5002
0.3900	0.5003	0.5071	0.5136	0.5197	0.5254	0.5307
0.4000	0.5300	0.5373	0.5441	0.5506	0.5566	0.5623
0.4100	0.5607	0.5684	0.5756	0.5825	0.5889	0.5948
0.4200	0.5924	0.6005	0.6081	0.6154	0.6221	0.6284
0.4300	0.6251	0.6336	0.6417	0.6493	0.6564	0.6631
0.4400	0.6587	0.6677	0.6762	0.6842	0.6917	0.6987
0.4500	0.6933	0.7028	0.7117	0.7202	0.7281	0.7355
0.4600	0.7290	0.7389	0.7483	0.7572	0.7655	0.7733
0.4700	0.7656	0.7760	0.7859	0.7952	0.8040	0.8121
0.4800	0.8032	0.8142	0.8246	0.8343	0.8435	0.8521
0.4900	0.8419	0.8534	0.8643	0.8745	0.8841	0.8931
0.5000	0.8816	0.8936	0.9050	0.9157	0.9258	0.9352
0.5100	0.9223	0.9349	0.9468	0.9580	0.9686	0.9784

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	37	38	39	40	41	42
0.5200	0.9641	0.9772	0.9897	1.0014	1.0124	1.0227
0.5300	1.0068	1.0206	1.0336	1.0458	1.0573	1.0681
0.5400	1.0507	1.0650	1.0786	1.0914	1.1034	1.1146
0.5500	1.0956	1.1105	1.1247	1.1380	1.1505	1.1622
0.5600	1.1415	1.1571	1.1718	1.1857	1.1988	1.2109
0.5700	1.1885	1.2048	1.2201	1.2346	1.2481	1.2608
0.5800	1.2366	1.2535	1.2695	1.2845	1.2986	1.3118
0.5900	1.2857	1.3033	1.3199	1.3356	1.3502	1.3639
0.6000	1.3360	1.3542	1.3715	1.3877	1.4030	1.4172
0.6100	1.3873	1.4062	1.4241	1.4410	1.4569	1.4716
0.6200	1.4397	1.4593	1.4779	1.4954	1.5119	1.5272
0.6300	1.4932	1.5136	1.5328	1.5510	1.5681	1.5840
0.6400	1.5478	1.5689	1.5889	1.6077	1.6254	1.6419
0.6500	1.6035	1.6254	1.6461	1.6656	1.6839	1.7010
0.6600	1.6603	1.6829	1.7044	1.7246	1.7435	1.7612
0.6700	1.7182	1.7416	1.7638	1.7847	1.8043	1.8226
0.6800	1.7772	1.8015	1.8244	1.8460	1.8663	1.8853
0.6900	1.8373	1.8624	1.8862	1.9085	1.9295	1.9491
0.7000	1.8986	1.9245	1.9491	1.9722	1.9938	2.0141
0.7100	1.9610	1.9878	2.0131	2.0370	2.0594	2.0803
0.7200	2.0246	2.0522	2.0784	2.1030	2.1261	2.1477
0.7300	2.0892	2.1178	2.1448	2.1702	2.1940	2.2163
0.7400	2.1551	2.1845	2.2123	2.2385	2.2631	2.2861
0.7500	2.2220	2.2524	2.2811	2.3081	2.3335	2.3572
0.7600	2.2902	2.3215	2.3510	2.3789	2.4050	2.4294
0.7700	2.3595	2.3917	2.4221	2.4509	2.4778	2.5029
0.7800	2.4299	2.4631	2.4945	2.5240	2.5518	2.5777
0.7900	2.5015	2.5357	2.5680	2.5984	2.6270	2.6536
0.8000	2.5743	2.6095	2.6427	2.6740	2.7034	2.7308
0.8100	2.6483	2.6844	2.7186	2.7508	2.7811	2.8093
0.8200	2.7234	2.7606	2.7957	2.8289	2.8600	2.8890
0.8300	2.7997	2.8379	2.8741	2.9081	2.9401	2.9699
0.8400	2.8772	2.9165	2.9536	2.9886	3.0215	3.0521
0.8500	2.9559	2.9963	3.0344	3.0704	3.1041	3.1356
0.8600	3.0358	3.0772	3.1164	3.1534	3.1880	3.2204
0.8700	3.1169	3.1594	3.1997	3.2376	3.2732	3.3064
0.8800	3.1991	3.2428	3.2841	3.3231	3.3596	3.3937
0.8900	3.2826	3.3275	3.3699	3.4098	3.4473	3.4822
0.9000	3.3673	3.4133	3.4568	3.4978	3.5362	3.5721
0.9100	3.4533	3.5004	3.5450	3.5870	3.6264	3.6632
0.9200	3.5404	3.5887	3.6344	3.6775	3.7179	3.7557
0.9300	3.6287	3.6783	3.7251	3.7693	3.8107	3.8494
0.9400	3.7183	3.7691	3.8171	3.8623	3.9048	3.9444
0.9500	3.8091	3.8611	3.9103	3.9567	4.0001	4.0407
0.9600	3.9011	3.9544	4.0048	4.0523	4.0968	4.1384
0.9700	3.9944	4.0490	4.1005	4.1491	4.1947	4.2373

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	43	44	45	46	47	48
0.0700	0.0107	0.0108	0.0108	0.0109	0.0110	0.0110
0.0800	0.0145	0.0146	0.0147	0.0148	0.0149	0.0150
0.0900	0.0189	0.0191	0.0192	0.0194	0.0195	0.0196
0.1000	0.0241	0.0243	0.0245	0.0246	0.0248	0.0249
0.1100	0.0299	0.0302	0.0304	0.0306	0.0308	0.0310
0.1200	0.0365	0.0368	0.0371	0.0373	0.0375	0.0378
0.1300	0.0438	0.0441	0.0445	0.0448	0.0451	0.0453
0.1400	0.0518	0.0523	0.0527	0.0530	0.0534	0.0537
0.1500	0.0606	0.0612	0.0616	0.0621	0.0624	0.0628
0.1600	0.0703	0.0709	0.0714	0.0719	0.0723	0.0727
0.1700	0.0807	0.0814	0.0820	0.0826	0.0831	0.0835
0.1800	0.0919	0.0927	0.0934	0.0941	0.0946	0.0952
0.1900	0.1040	0.1048	0.1057	0.1064	0.1071	0.1076
0.2000	0.1169	0.1178	0.1188	0.1196	0.1203	0.1210
0.2100	0.1306	0.1317	0.1327	0.1337	0.1345	0.1352
0.2200	0.1452	0.1465	0.1476	0.1486	0.1495	0.1504
0.2300	0.1607	0.1621	0.1633	0.1645	0.1655	0.1664
0.2400	0.1771	0.1786	0.1800	0.1812	0.1824	0.1834
0.2500	0.1944	0.1960	0.1975	0.1989	0.2001	0.2012
0.2600	0.2125	0.2143	0.2160	0.2175	0.2189	0.2201
0.2700	0.2316	0.2336	0.2354	0.2371	0.2385	0.2398
0.2800	0.2517	0.2538	0.2558	0.2575	0.2592	0.2606
0.2900	0.2726	0.2749	0.2771	0.2790	0.2807	0.2823
0.3000	0.2945	0.2970	0.2993	0.3014	0.3033	0.3050
0.3100	0.3174	0.3201	0.3226	0.3248	0.3268	0.3286
0.3200	0.3412	0.3441	0.3468	0.3492	0.3514	0.3533
0.3300	0.3660	0.3691	0.3720	0.3746	0.3769	0.3790
0.3400	0.3918	0.3951	0.3982	0.4010	0.4035	0.4057
0.3500	0.4186	0.4221	0.4254	0.4284	0.4310	0.4334
0.3600	0.4463	0.4501	0.4536	0.4568	0.4596	0.4621
0.3700	0.4751	0.4791	0.4829	0.4862	0.4893	0.4919
0.3800	0.5049	0.5092	0.5131	0.5167	0.5199	0.5228
0.3900	0.5357	0.5403	0.5444	0.5482	0.5516	0.5547
0.4000	0.5675	0.5724	0.5768	0.5808	0.5844	0.5876
0.4100	0.6004	0.6055	0.6102	0.6145	0.6183	0.6217
0.4200	0.6343	0.6397	0.6447	0.6492	0.6532	0.6568
0.4300	0.6693	0.6750	0.6802	0.6849	0.6892	0.6930
0.4400	0.7053	0.7113	0.7168	0.7218	0.7263	0.7303
0.4500	0.7423	0.7487	0.7545	0.7597	0.7645	0.7686
0.4600	0.7805	0.7872	0.7932	0.7988	0.8037	0.8081
0.4700	0.8197	0.8267	0.8331	0.8389	0.8441	0.8488
0.4800	0.8600	0.8674	0.8741	0.8802	0.8856	0.8905
0.4900	0.9014	0.9091	0.9162	0.9225	0.9283	0.9334
0.5000	0.9439	0.9520	0.9593	0.9660	0.9720	0.9774
0.5100	0.9875	0.9959	1.0036	1.0106	1.0169	1.0225

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	43	44	45	46	47	48
0.5200	1.0322	1.0410	1.0491	1.0564	1.0630	1.0688
0.5300	1.0780	1.0872	1.0956	1.1033	1.1101	1.1162
0.5400	1.1250	1.1346	1.1434	1.1513	1.1585	1.1648
0.5500	1.1730	1.1830	1.1922	1.2005	1.2080	1.2146
0.5600	1.2222	1.2326	1.2422	1.2509	1.2586	1.2655
0.5700	1.2726	1.2834	1.2934	1.3024	1.3105	1.3176
0.5800	1.3240	1.3353	1.3457	1.3551	1.3635	1.3709
0.5900	1.3767	1.3884	1.3992	1.4089	1.4177	1.4254
0.6000	1.4304	1.4426	1.4538	1.4639	1.4730	1.4811
0.6100	1.4854	1.4980	1.5096	1.5202	1.5296	1.5380
0.6200	1.5415	1.5546	1.5667	1.5776	1.5874	1.5961
0.6300	1.5987	1.6124	1.6249	1.6362	1.6464	1.6554
0.6400	1.6572	1.6713	1.6843	1.6960	1.7066	1.7159
0.6500	1.7168	1.7315	1.7449	1.7570	1.7680	1.7776
0.6600	1.7776	1.7928	1.8067	1.8193	1.8306	1.8406
0.6700	1.8396	1.8553	1.8697	1.8827	1.8944	1.9048
0.6800	1.9028	1.9191	1.9339	1.9474	1.9595	1.9702
0.6900	1.9672	1.9840	1.9994	2.0133	2.0259	2.0369
0.7000	2.0329	2.0502	2.0661	2.0805	2.0934	2.1049
0.7100	2.0997	2.1176	2.1340	2.1489	2.1622	2.1740
0.7200	2.1677	2.1862	2.2031	2.2185	2.2323	2.2445
0.7300	2.2370	2.2560	2.2735	2.2894	2.3036	2.3162
0.7400	2.3074	2.3271	2.3451	2.3615	2.3762	2.3892
0.7500	2.3792	2.3994	2.4180	2.4349	2.4500	2.4634
0.7600	2.4521	2.4730	2.4922	2.5095	2.5251	2.5390
0.7700	2.5263	2.5478	2.5676	2.5855	2.6015	2.6158
0.7800	2.6017	2.6239	2.6442	2.6627	2.6792	2.6939
0.7900	2.6784	2.7012	2.7221	2.7411	2.7582	2.7733
0.8000	2.7563	2.7798	2.8013	2.8209	2.8384	2.8539
0.8100	2.8355	2.8597	2.8818	2.9019	2.9200	2.9359
0.8200	2.9159	2.9408	2.9636	2.9843	3.0028	3.0192
0.8300	2.9976	3.0232	3.0466	3.0679	3.0870	3.1038
0.8400	3.0806	3.1069	3.1310	3.1528	3.1724	3.1898
0.8500	3.1649	3.1919	3.2166	3.2390	3.2592	3.2770
0.8600	3.2504	3.2781	3.3035	3.3266	3.3473	3.3656
0.8700	3.3372	3.3657	3.3918	3.4154	3.4367	3.4554
0.8800	3.4253	3.4545	3.4813	3.5056	3.5274	3.5467
0.8900	3.5147	3.5447	3.5722	3.5971	3.6194	3.6392
0.9000	3.6054	3.6362	3.6643	3.6899	3.7128	3.7331
0.9100	3.6974	3.7289	3.7578	3.7840	3.8076	3.8284
0.9200	3.7907	3.8230	3.8526	3.8795	3.9036	3.9250
0.9300	3.8853	3.9184	3.9488	3.9763	4.0010	4.0229
0.9400	3.9812	4.0152	4.0463	4.0745	4.0998	4.1222
0.9500	4.0784	4.1132	4.1451	4.1740	4.1999	4.2229
0.9600	4.1770	4.2126	4.2452	4.2748	4.3014	4.3249
0.9700	4.2768	4.3133	4.3467	4.3770	4.4042	4.4283

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	49	50	51	52	53	54
0.0700	0.0111	0.0111	0.0112	0.0112	0.0112	0.0112
0.0800	0.0150	0.0151	0.0152	0.0152	0.0152	0.0152
0.0900	0.0197	0.0198	0.0198	0.0199	0.0199	0.0199
0.1000	0.0250	0.0251	0.0252	0.0253	0.0253	0.0253
0.1100	0.0311	0.0312	0.0313	0.0314	0.0315	0.0315
0.1200	0.0379	0.0381	0.0382	0.0383	0.0384	0.0384
0.1300	0.0455	0.0457	0.0459	0.0460	0.0461	0.0461
0.1400	0.0539	0.0541	0.0543	0.0544	0.0545	0.0546
0.1500	0.0631	0.0633	0.0635	0.0637	0.0638	0.0639
0.1600	0.0731	0.0734	0.0736	0.0738	0.0739	0.0740
0.1700	0.0839	0.0843	0.0845	0.0847	0.0849	0.0850
0.1800	0.0956	0.0960	0.0963	0.0965	0.0967	0.0968
0.1900	0.1081	0.1086	0.1089	0.1092	0.1094	0.1095
0.2000	0.1216	0.1220	0.1224	0.1228	0.1230	0.1231
0.2100	0.1359	0.1364	0.1369	0.1372	0.1374	0.1376
0.2200	0.1511	0.1517	0.1522	0.1526	0.1528	0.1530
0.2300	0.1672	0.1678	0.1684	0.1688	0.1691	0.1693
0.2400	0.1842	0.1850	0.1856	0.1860	0.1864	0.1866
0.2500	0.2022	0.2030	0.2037	0.2042	0.2045	0.2048
0.2600	0.2211	0.2220	0.2227	0.2233	0.2237	0.2239
0.2700	0.2410	0.2419	0.2427	0.2433	0.2438	0.2440
0.2800	0.2618	0.2628	0.2637	0.2644	0.2648	0.2651
0.2900	0.2836	0.2847	0.2857	0.2864	0.2869	0.2872
0.3000	0.3064	0.3076	0.3086	0.3094	0.3100	0.3103
0.3100	0.3302	0.3315	0.3326	0.3334	0.3340	0.3344
0.3200	0.3550	0.3564	0.3575	0.3585	0.3591	0.3595
0.3300	0.3808	0.3823	0.3835	0.3845	0.3852	0.3856
0.3400	0.4076	0.4092	0.4105	0.4116	0.4123	0.4128
0.3500	0.4354	0.4372	0.4386	0.4397	0.4405	0.4410
0.3600	0.4643	0.4662	0.4677	0.4689	0.4697	0.4702
0.3700	0.4943	0.4962	0.4978	0.4991	0.5000	0.5005
0.3800	0.5252	0.5273	0.5291	0.5304	0.5314	0.5319
0.3900	0.5573	0.5595	0.5613	0.5628	0.5638	0.5644
0.4000	0.5904	0.5928	0.5947	0.5962	0.5973	0.5979
0.4100	0.6246	0.6271	0.6291	0.6307	0.6319	0.6325
0.4200	0.6599	0.6625	0.6647	0.6663	0.6676	0.6683
0.4300	0.6962	0.6990	0.7013	0.7031	0.7043	0.7051
0.4400	0.7337	0.7366	0.7390	0.7409	0.7422	0.7430
0.4500	0.7723	0.7754	0.7779	0.7799	0.7813	0.7821
0.4600	0.8120	0.8152	0.8179	0.8199	0.8214	0.8223
0.4700	0.8528	0.8562	0.8590	0.8611	0.8627	0.8636
0.4800	0.8947	0.8983	0.9012	0.9035	0.9051	0.9061
0.4900	0.9378	0.9415	0.9446	0.9470	0.9487	0.9497
0.5000	0.9820	0.9859	0.9891	0.9916	0.9934	0.9945
0.5100	1.0273	1.0314	1.0348	1.0374	1.0393	1.0404

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	49	50	51	52	53	54
0.5200	1.0738	1.0781	1.0816	1.0844	1.0863	1.0875
0.5300	1.1215	1.1260	1.1296	1.1325	1.1346	1.1358
0.5400	1.1703	1.1750	1.1788	1.1818	1.1840	1.1852
0.5500	1.2203	1.2252	1.2292	1.2323	1.2345	1.2359
0.5600	1.2715	1.2766	1.2807	1.2840	1.2863	1.2877
0.5700	1.3239	1.3291	1.3335	1.3369	1.3393	1.3407
0.5800	1.3774	1.3829	1.3874	1.3909	1.3935	1.3950
0.5900	1.4322	1.4379	1.4426	1.4462	1.4488	1.4504
0.6000	1.4881	1.4940	1.4989	1.5027	1.5054	1.5071
0.6100	1.5453	1.5514	1.5565	1.5604	1.5632	1.5649
0.6200	1.6036	1.6100	1.6153	1.6194	1.6223	1.6240
0.6300	1.6632	1.6698	1.6753	1.6795	1.6826	1.6844
0.6400	1.7240	1.7309	1.7365	1.7409	1.7441	1.7460
0.6500	1.7860	1.7932	1.7990	1.8036	1.8068	1.8088
0.6600	1.8493	1.8567	1.8627	1.8675	1.8708	1.8729
0.6700	1.9138	1.9215	1.9277	1.9326	1.9361	1.9382
0.6800	1.9796	1.9875	1.9939	1.9990	2.0026	2.0048
0.6900	2.0466	2.0547	2.0614	2.0667	2.0704	2.0726
0.7000	2.1148	2.1233	2.1302	2.1356	2.1394	2.1417
0.7100	2.1843	2.1930	2.2002	2.2058	2.2098	2.2121
0.7200	2.2551	2.2641	2.2715	2.2772	2.2814	2.2838
0.7300	2.3272	2.3364	2.3441	2.3500	2.3542	2.3568
0.7400	2.4005	2.4101	2.4179	2.4240	2.4284	2.4310
0.7500	2.4751	2.4850	2.4931	2.4994	2.5039	2.5066
0.7600	2.5510	2.5611	2.5695	2.5760	2.5807	2.5834
0.7700	2.6281	2.6386	2.6472	2.6539	2.6587	2.6616
0.7800	2.7066	2.7174	2.7263	2.7332	2.7381	2.7411
0.7900	2.7864	2.7975	2.8066	2.8137	2.8188	2.8219
0.8000	2.8674	2.8789	2.8883	2.8956	2.9008	2.9040
0.8100	2.9498	2.9616	2.9712	2.9788	2.9842	2.9874
0.8200	3.0335	3.0456	3.0555	3.0633	3.0688	3.0721
0.8300	3.1185	3.1310	3.1412	3.1491	3.1548	3.1582
0.8400	3.2048	3.2176	3.2281	3.2363	3.2421	3.2456
0.8500	3.2925	3.3056	3.3164	3.3248	3.3308	3.3344
0.8600	3.3815	3.3950	3.4060	3.4147	3.4208	3.4245
0.8700	3.4718	3.4856	3.4970	3.5059	3.5122	3.5160
0.8800	3.5634	3.5777	3.5893	3.5984	3.6049	3.6088
0.8900	3.6564	3.6710	3.6830	3.6923	3.6990	3.7030
0.9000	3.7508	3.7658	3.7780	3.7876	3.7945	3.7985
0.9100	3.8465	3.8618	3.8744	3.8842	3.8913	3.8955
0.9200	3.9435	3.9593	3.9722	3.9822	3.9894	3.9938
0.9300	4.0419	4.0581	4.0713	4.0816	4.0890	4.0934
0.9400	4.1417	4.1582	4.1718	4.1824	4.1899	4.1945
0.9500	4.2429	4.2598	4.2737	4.2845	4.2923	4.2969
0.9600	4.3454	4.3627	4.3769	4.3880	4.3960	4.4007
0.9700	4.4493	4.4670	4.4816	4.4930	4.5011	4.5059

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	55	56	57	58	59	60
0.0700	0.0112	0.0112	0.0112	0.0112	0.0112	0.0111
0.0800	0.0152	0.0152	0.0152	0.0152	0.0152	0.0151
0.0900	0.0199	0.0199	0.0199	0.0199	0.0198	0.0198
0.1000	0.0254	0.0253	0.0253	0.0253	0.0252	0.0251
0.1100	0.0315	0.0315	0.0315	0.0314	0.0313	0.0312
0.1200	0.0384	0.0384	0.0384	0.0383	0.0382	0.0381
0.1300	0.0461	0.0461	0.0460	0.0460	0.0458	0.0457
0.1400	0.0546	0.0546	0.0545	0.0544	0.0543	0.0541
0.1500	0.0639	0.0639	0.0638	0.0637	0.0635	0.0633
0.1600	0.0740	0.0740	0.0739	0.0738	0.0736	0.0733
0.1700	0.0850	0.0850	0.0849	0.0847	0.0845	0.0842
0.1800	0.0969	0.0968	0.0967	0.0965	0.0963	0.0959
0.1900	0.1096	0.1095	0.1094	0.1092	0.1089	0.1085
0.2000	0.1232	0.1231	0.1230	0.1227	0.1224	0.1220
0.2100	0.1376	0.1376	0.1374	0.1372	0.1368	0.1363
0.2200	0.1530	0.1530	0.1528	0.1525	0.1521	0.1516
0.2300	0.1694	0.1693	0.1691	0.1688	0.1684	0.1678
0.2400	0.1866	0.1866	0.1863	0.1860	0.1855	0.1849
0.2500	0.2048	0.2048	0.2045	0.2041	0.2036	0.2029
0.2600	0.2240	0.2239	0.2237	0.2232	0.2226	0.2219
0.2700	0.2441	0.2440	0.2438	0.2433	0.2427	0.2418
0.2800	0.2652	0.2651	0.2648	0.2643	0.2636	0.2627
0.2900	0.2873	0.2872	0.2869	0.2863	0.2856	0.2846
0.3000	0.3104	0.3103	0.3099	0.3094	0.3085	0.3075
0.3100	0.3345	0.3344	0.3340	0.3334	0.3325	0.3314
0.3200	0.3596	0.3595	0.3591	0.3584	0.3575	0.3562
0.3300	0.3858	0.3856	0.3852	0.3844	0.3834	0.3821
0.3400	0.4129	0.4128	0.4123	0.4115	0.4104	0.4090
0.3500	0.4411	0.4410	0.4405	0.4396	0.4385	0.4370
0.3600	0.4704	0.4702	0.4697	0.4688	0.4676	0.4660
0.3700	0.5007	0.5005	0.5000	0.4990	0.4977	0.4960
0.3800	0.5321	0.5319	0.5313	0.5303	0.5289	0.5271
0.3900	0.5646	0.5644	0.5637	0.5627	0.5612	0.5593
0.4000	0.5981	0.5979	0.5972	0.5961	0.5945	0.5925
0.4100	0.6328	0.6325	0.6318	0.6306	0.6290	0.6268
0.4200	0.6685	0.6682	0.6675	0.6662	0.6645	0.6622
0.4300	0.7053	0.7051	0.7043	0.7030	0.7011	0.6987
0.4400	0.7433	0.7430	0.7422	0.7408	0.7388	0.7363
0.4500	0.7824	0.7821	0.7812	0.7797	0.7777	0.7750
0.4600	0.8226	0.8223	0.8213	0.8198	0.8176	0.8149
0.4700	0.8639	0.8636	0.8626	0.8610	0.8587	0.8558
0.4800	0.9064	0.9061	0.9050	0.9033	0.9010	0.8979
0.4900	0.9500	0.9497	0.9486	0.9468	0.9443	0.9411
0.5000	0.9948	0.9944	0.9933	0.9915	0.9888	0.9855
0.5100	1.0408	1.0404	1.0392	1.0372	1.0345	1.0310

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	55	56	57	58	59	60
0.5200	1.0879	1.0875	1.0862	1.0842	1.0813	1.0777
0.5300	1.1362	1.1357	1.1345	1.1323	1.1293	1.1255
0.5400	1.1856	1.1852	1.1838	1.1816	1.1785	1.1745
0.5500	1.2363	1.2358	1.2344	1.2321	1.2289	1.2247
0.5600	1.2881	1.2876	1.2862	1.2838	1.2804	1.2760
0.5700	1.3412	1.3407	1.3392	1.3366	1.3331	1.3286
0.5800	1.3954	1.3949	1.3933	1.3907	1.3870	1.3823
0.5900	1.4509	1.4503	1.4487	1.4460	1.4422	1.4373
0.6000	1.5076	1.5070	1.5053	1.5025	1.4985	1.4934
0.6100	1.5655	1.5649	1.5631	1.5602	1.5561	1.5508
0.6200	1.6246	1.6240	1.6221	1.6191	1.6148	1.6093
0.6300	1.6850	1.6843	1.6824	1.6793	1.6748	1.6691
0.6400	1.7466	1.7459	1.7439	1.7407	1.7361	1.7301
0.6500	1.8094	1.8087	1.8067	1.8033	1.7985	1.7924
0.6600	1.8735	1.8728	1.8707	1.8672	1.8622	1.8559
0.6700	1.9389	1.9381	1.9359	1.9323	1.9272	1.9206
0.6800	2.0055	2.0047	2.0024	1.9987	1.9934	1.9866
0.6900	2.0733	2.0725	2.0702	2.0663	2.0609	2.0538
0.7000	2.1425	2.1417	2.1392	2.1352	2.1296	2.1223
0.7100	2.2129	2.2121	2.2096	2.2054	2.1996	2.1921
0.7200	2.2846	2.2837	2.2812	2.2769	2.2709	2.2631
0.7300	2.3576	2.3567	2.3540	2.3496	2.3434	2.3354
0.7400	2.4319	2.4310	2.4282	2.4236	2.4173	2.4090
0.7500	2.5075	2.5065	2.5037	2.4990	2.4924	2.4839
0.7600	2.5843	2.5833	2.5804	2.5756	2.5688	2.5600
0.7700	2.6625	2.6615	2.6585	2.6535	2.6465	2.6375
0.7800	2.7420	2.7410	2.7379	2.7327	2.7255	2.7162
0.7900	2.8228	2.8217	2.8186	2.8133	2.8058	2.7963
0.8000	2.9050	2.9038	2.9006	2.8951	2.8875	2.8776
0.8100	2.9884	2.9873	2.9839	2.9783	2.9704	2.9603
0.8200	3.0732	3.0720	3.0686	3.0628	3.0547	3.0443
0.8300	3.1593	3.1581	3.1545	3.1486	3.1403	3.1296
0.8400	3.2468	3.2455	3.2419	3.2358	3.2272	3.2162
0.8500	3.3356	3.3343	3.3305	3.3243	3.3155	3.3042
0.8600	3.4257	3.4244	3.4205	3.4141	3.4051	3.3935
0.8700	3.5172	3.5159	3.5119	3.5053	3.4961	3.4841
0.8800	3.6101	3.6087	3.6046	3.5978	3.5883	3.5761
0.8900	3.7043	3.7029	3.6987	3.6917	3.6820	3.6694
0.9000	3.7999	3.7984	3.7941	3.7870	3.7770	3.7641
0.9100	3.8968	3.8953	3.8909	3.8836	3.8734	3.8602
0.9200	3.9951	3.9936	3.9891	3.9816	3.9711	3.9576
0.9300	4.0948	4.0933	4.0886	4.0810	4.0702	4.0563
0.9400	4.1959	4.1943	4.1896	4.1817	4.1707	4.1564
0.9500	4.2984	4.2967	4.2919	4.2838	4.2725	4.2579
0.9600	4.4022	4.4005	4.3956	4.3873	4.3758	4.3608
0.9700	4.5075	4.5058	4.5007	4.4922	4.4804	4.4651

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	61	62	63	64	65	66
0.0700	0.0111	0.0110	0.0110	0.0109	0.0108	0.0107
0.0800	0.0150	0.0150	0.0149	0.0148	0.0147	0.0145
0.0900	0.0197	0.0196	0.0195	0.0193	0.0192	0.0190
0.1000	0.0250	0.0249	0.0247	0.0246	0.0244	0.0242
0.1100	0.0311	0.0309	0.0307	0.0305	0.0303	0.0301
0.1200	0.0379	0.0377	0.0375	0.0372	0.0370	0.0367
0.1300	0.0455	0.0453	0.0450	0.0447	0.0444	0.0440
0.1400	0.0539	0.0536	0.0533	0.0529	0.0525	0.0521
0.1500	0.0630	0.0627	0.0624	0.0619	0.0615	0.0610
0.1600	0.0730	0.0727	0.0723	0.0718	0.0712	0.0706
0.1700	0.0839	0.0834	0.0830	0.0824	0.0818	0.0811
0.1800	0.0955	0.0951	0.0945	0.0939	0.0932	0.0924
0.1900	0.1081	0.1075	0.1069	0.1062	0.1054	0.1045
0.2000	0.1215	0.1209	0.1202	0.1194	0.1185	0.1175
0.2100	0.1358	0.1351	0.1343	0.1334	0.1324	0.1313
0.2200	0.1510	0.1502	0.1493	0.1483	0.1472	0.1460
0.2300	0.1671	0.1662	0.1653	0.1642	0.1629	0.1616
0.2400	0.1841	0.1832	0.1821	0.1809	0.1795	0.1780
0.2500	0.2021	0.2010	0.1999	0.1985	0.1970	0.1954
0.2600	0.2210	0.2198	0.2186	0.2171	0.2155	0.2137
0.2700	0.2408	0.2396	0.2382	0.2366	0.2348	0.2329
0.2800	0.2616	0.2603	0.2588	0.2571	0.2551	0.2530
0.2900	0.2834	0.2820	0.2804	0.2785	0.2764	0.2741
0.3000	0.3062	0.3047	0.3029	0.3009	0.2986	0.2961
0.3100	0.3300	0.3283	0.3264	0.3242	0.3218	0.3191
0.3200	0.3547	0.3530	0.3509	0.3486	0.3459	0.3430
0.3300	0.3805	0.3786	0.3764	0.3739	0.3711	0.3680
0.3400	0.4073	0.4053	0.4029	0.4002	0.3972	0.3939
0.3500	0.4352	0.4330	0.4305	0.4276	0.4244	0.4208
0.3600	0.4640	0.4617	0.4590	0.4559	0.4525	0.4487
0.3700	0.4939	0.4915	0.4886	0.4853	0.4817	0.4776
0.3800	0.5249	0.5223	0.5192	0.5158	0.5119	0.5076
0.3900	0.5569	0.5541	0.5509	0.5472	0.5431	0.5385
0.4000	0.5900	0.5871	0.5836	0.5798	0.5754	0.5705
0.4100	0.6242	0.6211	0.6174	0.6133	0.6087	0.6036
0.4200	0.6594	0.6561	0.6523	0.6480	0.6431	0.6377
0.4300	0.6958	0.6923	0.6883	0.6837	0.6785	0.6728
0.4400	0.7332	0.7296	0.7253	0.7205	0.7150	0.7090
0.4500	0.7718	0.7679	0.7634	0.7583	0.7526	0.7463
0.4600	0.8114	0.8074	0.8027	0.7973	0.7913	0.7846
0.4700	0.8522	0.8479	0.8430	0.8374	0.8311	0.8241
0.4800	0.8941	0.8896	0.8845	0.8786	0.8719	0.8646
0.4900	0.9372	0.9325	0.9270	0.9209	0.9139	0.9062
0.5000	0.9813	0.9764	0.9707	0.9643	0.9570	0.9489
0.5100	1.0267	1.0215	1.0156	1.0088	1.0012	0.9927

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	61	62	63	64	65	66
0.5200	1.0731	1.0678	1.0615	1.0545	1.0465	1.0377
0.5300	1.1208	1.1152	1.1087	1.1013	1.0930	1.0837
0.5400	1.1696	1.1637	1.1569	1.1492	1.1406	1.1309
0.5500	1.2195	1.2134	1.2064	1.1983	1.1893	1.1792
0.5600	1.2707	1.2643	1.2570	1.2486	1.2392	1.2287
0.5700	1.3230	1.3164	1.3087	1.3000	1.2902	1.2793
0.5800	1.3765	1.3696	1.3617	1.3526	1.3424	1.3310
0.5900	1.4312	1.4241	1.4158	1.4063	1.3957	1.3839
0.6000	1.4871	1.4797	1.4711	1.4613	1.4502	1.4380
0.6100	1.5442	1.5365	1.5276	1.5174	1.5059	1.4932
0.6200	1.6026	1.5946	1.5853	1.5747	1.5628	1.5496
0.6300	1.6621	1.6538	1.6442	1.6332	1.6209	1.6072
0.6400	1.7229	1.7143	1.7043	1.6929	1.6801	1.6660
0.6500	1.7849	1.7759	1.7656	1.7538	1.7406	1.7259
0.6600	1.8481	1.8389	1.8281	1.8160	1.8023	1.7871
0.6700	1.9126	1.9030	1.8919	1.8793	1.8651	1.8494
0.6800	1.9783	1.9684	1.9569	1.9439	1.9292	1.9129
0.6900	2.0452	2.0350	2.0231	2.0096	1.9945	1.9777
0.7000	2.1134	2.1029	2.0906	2.0767	2.0610	2.0436
0.7100	2.1829	2.1720	2.1593	2.1449	2.1288	2.1108
0.7200	2.2536	2.2424	2.2293	2.2144	2.1977	2.1792
0.7300	2.3256	2.3140	2.3005	2.2852	2.2680	2.2488
0.7400	2.3989	2.3869	2.3730	2.3572	2.3394	2.3197
0.7500	2.4735	2.4611	2.4468	2.4304	2.4121	2.3918
0.7600	2.5493	2.5365	2.5218	2.5049	2.4861	2.4651
0.7700	2.6264	2.6133	2.5981	2.5807	2.5613	2.5397
0.7800	2.7048	2.6913	2.6756	2.6578	2.6377	2.6155
0.7900	2.7845	2.7706	2.7545	2.7361	2.7155	2.6926
0.8000	2.8656	2.8512	2.8346	2.8157	2.7945	2.7709
0.8100	2.9479	2.9331	2.9161	2.8966	2.8748	2.8505
0.8200	3.0315	3.0164	2.9988	2.9788	2.9563	2.9314
0.8300	3.1165	3.1009	3.0828	3.0623	3.0392	3.0135
0.8400	3.2027	3.1867	3.1682	3.1470	3.1233	3.0970
0.8500	3.2903	3.2739	3.2548	3.2331	3.2087	3.1817
0.8600	3.3793	3.3624	3.3428	3.3205	3.2954	3.2676
0.8700	3.4695	3.4522	3.4321	3.4092	3.3835	3.3549
0.8800	3.5611	3.5433	3.5227	3.4992	3.4728	3.4435
0.8900	3.6540	3.6358	3.6146	3.5905	3.5634	3.5334
0.9000	3.7483	3.7296	3.7079	3.6831	3.6554	3.6245
0.9100	3.8440	3.8247	3.8025	3.7771	3.7486	3.7170
0.9200	3.9409	3.9212	3.8984	3.8724	3.8432	3.8108
0.9300	4.0393	4.0191	3.9957	3.9690	3.9391	3.9059
0.9400	4.1390	4.1183	4.0943	4.0670	4.0364	4.0023
0.9500	4.2401	4.2189	4.1943	4.1663	4.1349	4.1000
0.9600	4.3425	4.3208	4.2956	4.2670	4.2348	4.1991
0.9700	4.4463	4.4241	4.3983	4.3690	4.3361	4.2995

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	67	68	69	70	71	72
0.0700	0.0106	0.0105	0.0104	0.0103	0.0101	0.0100
0.0800	0.0144	0.0143	0.0141	0.0139	0.0137	0.0135
0.0900	0.0188	0.0186	0.0184	0.0182	0.0180	0.0177
0.1000	0.0240	0.0237	0.0234	0.0232	0.0228	0.0225
0.1100	0.0298	0.0295	0.0291	0.0288	0.0284	0.0280
0.1200	0.0363	0.0359	0.0355	0.0351	0.0346	0.0341
0.1300	0.0436	0.0431	0.0426	0.0421	0.0415	0.0409
0.1400	0.0516	0.0511	0.0505	0.0499	0.0492	0.0485
0.1500	0.0604	0.0598	0.0591	0.0584	0.0576	0.0567
0.1600	0.0700	0.0692	0.0685	0.0676	0.0667	0.0657
0.1700	0.0803	0.0795	0.0786	0.0776	0.0766	0.0755
0.1800	0.0915	0.0906	0.0895	0.0884	0.0872	0.0860
0.1900	0.1035	0.1025	0.1013	0.1000	0.0987	0.0972
0.2000	0.1164	0.1152	0.1139	0.1125	0.1109	0.1093
0.2100	0.1301	0.1287	0.1273	0.1257	0.1240	0.1222
0.2200	0.1446	0.1431	0.1415	0.1397	0.1379	0.1358
0.2300	0.1600	0.1584	0.1566	0.1547	0.1526	0.1503
0.2400	0.1763	0.1745	0.1725	0.1704	0.1681	0.1656
0.2500	0.1936	0.1916	0.1894	0.1870	0.1845	0.1818
0.2600	0.2117	0.2095	0.2071	0.2045	0.2018	0.1988
0.2700	0.2307	0.2283	0.2257	0.2229	0.2199	0.2167
0.2800	0.2506	0.2480	0.2452	0.2422	0.2389	0.2354
0.2900	0.2715	0.2687	0.2656	0.2623	0.2588	0.2550
0.3000	0.2933	0.2903	0.2870	0.2834	0.2796	0.2755
0.3100	0.3161	0.3128	0.3093	0.3054	0.3013	0.2969
0.3200	0.3398	0.3363	0.3325	0.3284	0.3239	0.3192
0.3300	0.3645	0.3607	0.3566	0.3522	0.3475	0.3424
0.3400	0.3902	0.3861	0.3818	0.3770	0.3720	0.3665
0.3500	0.4168	0.4125	0.4079	0.4028	0.3974	0.3915
0.3600	0.4445	0.4399	0.4349	0.4295	0.4237	0.4175
0.3700	0.4731	0.4683	0.4629	0.4572	0.4510	0.4444
0.3800	0.5028	0.4976	0.4920	0.4859	0.4793	0.4723
0.3900	0.5335	0.5280	0.5220	0.5155	0.5086	0.5011
0.4000	0.5652	0.5593	0.5530	0.5461	0.5388	0.5309
0.4100	0.5979	0.5917	0.5850	0.5778	0.5700	0.5616
0.4200	0.6317	0.6252	0.6181	0.6104	0.6022	0.5934
0.4300	0.6665	0.6596	0.6521	0.6441	0.6354	0.6261
0.4400	0.7024	0.6951	0.6872	0.6787	0.6696	0.6597
0.4500	0.7393	0.7317	0.7234	0.7144	0.7048	0.6944
0.4600	0.7773	0.7692	0.7605	0.7511	0.7410	0.7301
0.4700	0.8163	0.8079	0.7987	0.7889	0.7782	0.7668
0.4800	0.8565	0.8476	0.8380	0.8276	0.8165	0.8045
0.4900	0.8977	0.8884	0.8784	0.8675	0.8558	0.8432
0.5000	0.9400	0.9303	0.9198	0.9084	0.8961	0.8830
0.5100	0.9834	0.9733	0.9622	0.9503	0.9375	0.9238

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	67	68	69	70	71	72
0.5200	1.0280	1.0173	1.0058	0.9933	0.9799	0.9656
0.5300	1.0736	1.0625	1.0505	1.0374	1.0234	1.0085
0.5400	1.1203	1.1088	1.0962	1.0826	1.0680	1.0524
0.5500	1.1682	1.1561	1.1430	1.1289	1.1136	1.0973
0.5600	1.2172	1.2046	1.1910	1.1762	1.1603	1.1433
0.5700	1.2673	1.2542	1.2400	1.2246	1.2081	1.1904
0.5800	1.3186	1.3050	1.2902	1.2742	1.2570	1.2386
0.5900	1.3710	1.3568	1.3414	1.3248	1.3069	1.2878
0.6000	1.4245	1.4098	1.3938	1.3766	1.3580	1.3381
0.6100	1.4793	1.4640	1.4474	1.4294	1.4102	1.3895
0.6200	1.5351	1.5193	1.5020	1.4834	1.4634	1.4420
0.6300	1.5922	1.5757	1.5578	1.5385	1.5178	1.4956
0.6400	1.6504	1.6333	1.6148	1.5948	1.5733	1.5502
0.6500	1.7097	1.6921	1.6729	1.6522	1.6299	1.6060
0.6600	1.7703	1.7520	1.7322	1.7107	1.6876	1.6629
0.6700	1.8321	1.8131	1.7926	1.7704	1.7465	1.7209
0.6800	1.8950	1.8754	1.8542	1.8312	1.8065	1.7800
0.6900	1.9591	1.9389	1.9169	1.8932	1.8676	1.8403
0.7000	2.0245	2.0036	1.9808	1.9563	1.9299	1.9017
0.7100	2.0910	2.0694	2.0460	2.0206	1.9934	1.9642
0.7200	2.1588	2.1365	2.1122	2.0861	2.0579	2.0278
0.7300	2.2277	2.2047	2.1797	2.1527	2.1237	2.0926
0.7400	2.2979	2.2742	2.2484	2.2206	2.1906	2.1585
0.7500	2.3694	2.3449	2.3183	2.2896	2.2587	2.2256
0.7600	2.4420	2.4168	2.3894	2.3598	2.3279	2.2938
0.7700	2.5159	2.4899	2.4616	2.4311	2.3984	2.3632
0.7800	2.5910	2.5642	2.5351	2.5037	2.4700	2.4338
0.7900	2.6673	2.6398	2.6099	2.5775	2.5428	2.5055
0.8000	2.7450	2.7166	2.6858	2.6525	2.6167	2.5784
0.8100	2.8238	2.7946	2.7629	2.7287	2.6919	2.6525
0.8200	2.9039	2.8739	2.8413	2.8061	2.7683	2.7277
0.8300	2.9853	2.9545	2.9210	2.8848	2.8459	2.8042
0.8400	3.0679	3.0362	3.0018	2.9646	2.9246	2.8818
0.8500	3.1518	3.1193	3.0839	3.0457	3.0046	2.9606
0.8600	3.2370	3.2036	3.1673	3.1280	3.0858	3.0406
0.8700	3.3235	3.2891	3.2518	3.2116	3.1682	3.1218
0.8800	3.4112	3.3760	3.3377	3.2963	3.2519	3.2043
0.8900	3.5003	3.4641	3.4248	3.3824	3.3368	3.2879
0.9000	3.5906	3.5535	3.5132	3.4696	3.4228	3.3727
0.9100	3.6822	3.6441	3.6028	3.5582	3.5102	3.4588
0.9200	3.7751	3.7361	3.6937	3.6479	3.5987	3.5460
0.9300	3.8693	3.8293	3.7859	3.7390	3.6886	3.6345
0.9400	3.9648	3.9238	3.8793	3.8313	3.7796	3.7242
0.9500	4.0616	4.0197	3.9741	3.9248	3.8719	3.8152
0.9600	4.1598	4.1168	4.0701	4.0197	3.9655	3.9074
0.9700	4.2592	4.2152	4.1674	4.1158	4.0603	4.0008

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	73	74	75	76	77	78
0.0700	0.0098	0.0097	0.0095	0.0093	0.0091	0.0089
0.0800	0.0133	0.0131	0.0128	0.0126	0.0123	0.0120
0.0900	0.0174	0.0171	0.0168	0.0165	0.0161	0.0157
0.1000	0.0221	0.0218	0.0214	0.0209	0.0205	0.0200
0.1100	0.0275	0.0271	0.0266	0.0260	0.0255	0.0249
0.1200	0.0336	0.0330	0.0324	0.0317	0.0310	0.0303
0.1300	0.0403	0.0396	0.0389	0.0381	0.0373	0.0364
0.1400	0.0477	0.0469	0.0460	0.0451	0.0441	0.0431
0.1500	0.0558	0.0549	0.0539	0.0528	0.0516	0.0504
0.1600	0.0647	0.0636	0.0624	0.0611	0.0598	0.0584
0.1700	0.0743	0.0730	0.0716	0.0702	0.0687	0.0671
0.1800	0.0846	0.0832	0.0816	0.0800	0.0783	0.0764
0.1900	0.0957	0.0941	0.0923	0.0905	0.0885	0.0865
0.2000	0.1076	0.1057	0.1038	0.1017	0.0995	0.0972
0.2100	0.1202	0.1182	0.1160	0.1137	0.1112	0.1086
0.2200	0.1337	0.1314	0.1290	0.1264	0.1237	0.1208
0.2300	0.1479	0.1454	0.1427	0.1399	0.1368	0.1337
0.2400	0.1630	0.1602	0.1573	0.1541	0.1508	0.1473
0.2500	0.1789	0.1759	0.1726	0.1691	0.1655	0.1617
0.2600	0.1957	0.1923	0.1887	0.1850	0.1810	0.1768
0.2700	0.2132	0.2096	0.2057	0.2016	0.1972	0.1927
0.2800	0.2317	0.2277	0.2235	0.2190	0.2143	0.2093
0.2900	0.2510	0.2467	0.2421	0.2373	0.2321	0.2268
0.3000	0.2711	0.2665	0.2616	0.2563	0.2508	0.2450
0.3100	0.2922	0.2872	0.2819	0.2762	0.2703	0.2640
0.3200	0.3141	0.3087	0.3030	0.2970	0.2906	0.2838
0.3300	0.3370	0.3312	0.3250	0.3185	0.3117	0.3044
0.3400	0.3607	0.3545	0.3479	0.3410	0.3336	0.3259
0.3500	0.3853	0.3787	0.3717	0.3643	0.3564	0.3481
0.3600	0.4109	0.4038	0.3964	0.3884	0.3801	0.3712
0.3700	0.4374	0.4299	0.4219	0.4135	0.4046	0.3952
0.3800	0.4648	0.4568	0.4484	0.4394	0.4299	0.4200
0.3900	0.4932	0.4847	0.4757	0.4662	0.4562	0.4456
0.4000	0.5225	0.5135	0.5040	0.4939	0.4833	0.4720
0.4100	0.5527	0.5432	0.5332	0.5225	0.5113	0.4994
0.4200	0.5839	0.5739	0.5633	0.5520	0.5401	0.5276
0.4300	0.6161	0.6056	0.5943	0.5825	0.5699	0.5567
0.4400	0.6493	0.6381	0.6263	0.6138	0.6006	0.5866
0.4500	0.6834	0.6717	0.6593	0.6461	0.6322	0.6175
0.4600	0.7185	0.7062	0.6931	0.6793	0.6646	0.6492
0.4700	0.7546	0.7417	0.7280	0.7134	0.6980	0.6818
0.4800	0.7918	0.7782	0.7638	0.7485	0.7324	0.7154
0.4900	0.8299	0.8156	0.8005	0.7845	0.7676	0.7498
0.5000	0.8690	0.8541	0.8383	0.8215	0.8038	0.7851
0.5100	0.9091	0.8935	0.8770	0.8594	0.8409	0.8214

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	73	74	75	76	77	78
0.5200	0.9503	0.9340	0.9167	0.8984	0.8790	0.8586
0.5300	0.9925	0.9754	0.9574	0.9382	0.9180	0.8967
0.5400	1.0357	1.0179	0.9990	0.9791	0.9580	0.9357
0.5500	1.0799	1.0614	1.0417	1.0209	0.9989	0.9757
0.5600	1.1252	1.1059	1.0854	1.0637	1.0408	1.0166
0.5700	1.1715	1.1514	1.1301	1.1075	1.0837	1.0585
0.5800	1.2189	1.1980	1.1758	1.1523	1.1275	1.1013
0.5900	1.2674	1.2456	1.2226	1.1981	1.1723	1.1451
0.6000	1.3169	1.2943	1.2703	1.2449	1.2181	1.1898
0.6100	1.3675	1.3440	1.3191	1.2927	1.2649	1.2355
0.6200	1.4191	1.3948	1.3689	1.3416	1.3127	1.2822
0.6300	1.4718	1.4466	1.4198	1.3914	1.3614	1.3298
0.6400	1.5256	1.4995	1.4717	1.4423	1.4112	1.3784
0.6500	1.5805	1.5534	1.5246	1.4942	1.4620	1.4280
0.6600	1.6365	1.6084	1.5787	1.5471	1.5138	1.4786
0.6700	1.6936	1.6646	1.6337	1.6011	1.5666	1.5302
0.6800	1.7518	1.7217	1.6898	1.6561	1.6204	1.5827
0.6900	1.8111	1.7800	1.7470	1.7121	1.6752	1.6363
0.7000	1.8715	1.8394	1.8053	1.7692	1.7311	1.6909
0.7100	1.9330	1.8998	1.8646	1.8274	1.7880	1.7465
0.7200	1.9956	1.9614	1.9251	1.8866	1.8459	1.8031
0.7300	2.0594	2.0241	1.9866	1.9469	1.9049	1.8607
0.7400	2.1243	2.0878	2.0492	2.0082	1.9649	1.9193
0.7500	2.1903	2.1527	2.1128	2.0706	2.0260	1.9789
0.7600	2.2574	2.2187	2.1776	2.1341	2.0881	2.0396
0.7700	2.3257	2.2858	2.2435	2.1987	2.1513	2.1013
0.7800	2.3952	2.3541	2.3105	2.2643	2.2155	2.1640
0.7900	2.4658	2.4235	2.3786	2.3310	2.2808	2.2278
0.8000	2.5375	2.4940	2.4478	2.3989	2.3472	2.2926
0.8100	2.6104	2.5656	2.5181	2.4678	2.4146	2.3585
0.8200	2.6845	2.6384	2.5895	2.5378	2.4831	2.4254
0.8300	2.7597	2.7123	2.6621	2.6089	2.5527	2.4934
0.8400	2.8361	2.7874	2.7358	2.6811	2.6233	2.5624
0.8500	2.9136	2.8637	2.8106	2.7544	2.6951	2.6325
0.8600	2.9924	2.9411	2.8866	2.8289	2.7679	2.7036
0.8700	3.0723	3.0196	2.9637	2.9044	2.8419	2.7758
0.8800	3.1534	3.0993	3.0419	2.9811	2.9169	2.8491
0.8900	3.2357	3.1802	3.1213	3.0589	2.9930	2.9235
0.9000	3.3192	3.2623	3.2018	3.1378	3.0702	2.9989
0.9100	3.4039	3.3455	3.2835	3.2179	3.1486	3.0754
0.9200	3.4898	3.4299	3.3664	3.2991	3.2280	3.1530
0.9300	3.5769	3.5155	3.4504	3.3814	3.3086	3.2317
0.9400	3.6652	3.6023	3.5356	3.4649	3.3902	3.3115
0.9500	3.7547	3.6903	3.6219	3.5495	3.4730	3.3924
0.9600	3.8454	3.7794	3.7094	3.6353	3.5569	3.4743
0.9700	3.9373	3.8698	3.7981	3.7222	3.6420	3.5574

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	79	80	81	82	83	84
0.0700	0.0087	0.0084	0.0082	0.0079	0.0076	0.0074
0.0800	0.0117	0.0114	0.0111	0.0107	0.0104	0.0100
0.0900	0.0153	0.0149	0.0145	0.0140	0.0136	0.0131
0.1000	0.0195	0.0190	0.0184	0.0178	0.0172	0.0166
0.1100	0.0242	0.0236	0.0229	0.0222	0.0214	0.0206
0.1200	0.0296	0.0288	0.0279	0.0271	0.0261	0.0252
0.1300	0.0355	0.0345	0.0335	0.0325	0.0314	0.0302
0.1400	0.0420	0.0409	0.0397	0.0384	0.0371	0.0358
0.1500	0.0492	0.0478	0.0465	0.0450	0.0435	0.0418
0.1600	0.0570	0.0554	0.0538	0.0521	0.0503	0.0485
0.1700	0.0654	0.0637	0.0618	0.0598	0.0578	0.0557
0.1800	0.0745	0.0725	0.0704	0.0682	0.0659	0.0634
0.1900	0.0843	0.0820	0.0796	0.0771	0.0745	0.0717
0.2000	0.0948	0.0922	0.0895	0.0867	0.0837	0.0806
0.2100	0.1059	0.1030	0.1000	0.0969	0.0936	0.0901
0.2200	0.1178	0.1146	0.1112	0.1077	0.1041	0.1002
0.2300	0.1303	0.1268	0.1231	0.1192	0.1152	0.1109
0.2400	0.1436	0.1397	0.1356	0.1314	0.1269	0.1222
0.2500	0.1576	0.1534	0.1489	0.1442	0.1393	0.1341
0.2600	0.1724	0.1677	0.1628	0.1577	0.1523	0.1467
0.2700	0.1878	0.1828	0.1774	0.1718	0.1660	0.1599
0.2800	0.2041	0.1986	0.1928	0.1867	0.1803	0.1737
0.2900	0.2211	0.2151	0.2088	0.2023	0.1954	0.1881
0.3000	0.2388	0.2324	0.2256	0.2185	0.2111	0.2033
0.3100	0.2574	0.2504	0.2431	0.2355	0.2274	0.2190
0.3200	0.2767	0.2692	0.2614	0.2531	0.2445	0.2355
0.3300	0.2968	0.2888	0.2804	0.2715	0.2623	0.2526
0.3400	0.3177	0.3091	0.3001	0.2907	0.2808	0.2704
0.3500	0.3394	0.3303	0.3206	0.3105	0.2999	0.2889
0.3600	0.3619	0.3522	0.3419	0.3311	0.3198	0.3080
0.3700	0.3853	0.3749	0.3639	0.3525	0.3405	0.3279
0.3800	0.4094	0.3984	0.3868	0.3746	0.3618	0.3484
0.3900	0.4344	0.4227	0.4104	0.3974	0.3839	0.3697
0.4000	0.4602	0.4478	0.4347	0.4210	0.4067	0.3917
0.4100	0.4869	0.4737	0.4599	0.4454	0.4302	0.4143
0.4200	0.5144	0.5005	0.4859	0.4706	0.4545	0.4377
0.4300	0.5427	0.5281	0.5127	0.4965	0.4796	0.4619
0.4400	0.5719	0.5565	0.5403	0.5232	0.5054	0.4867
0.4500	0.6020	0.5857	0.5687	0.5508	0.5320	0.5123
0.4600	0.6329	0.6158	0.5979	0.5791	0.5593	0.5386
0.4700	0.6648	0.6468	0.6279	0.6082	0.5874	0.5657
0.4800	0.6974	0.6786	0.6588	0.6381	0.6163	0.5935
0.4900	0.7310	0.7113	0.6905	0.6688	0.6460	0.6221
0.5000	0.7655	0.7448	0.7231	0.7003	0.6764	0.6514
0.5100	0.8008	0.7792	0.7565	0.7326	0.7077	0.6815

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	79	80	81	82	83	84
0.5200	0.8371	0.8145	0.7907	0.7658	0.7397	0.7124
0.5300	0.8742	0.8506	0.8258	0.7998	0.7725	0.7440
0.5400	0.9123	0.8877	0.8618	0.8346	0.8062	0.7764
0.5500	0.9513	0.9256	0.8986	0.8703	0.8406	0.8095
0.5600	0.9912	0.9644	0.9363	0.9068	0.8759	0.8435
0.5700	1.0320	1.0041	0.9748	0.9441	0.9119	0.8782
0.5800	1.0737	1.0447	1.0143	0.9823	0.9488	0.9137
0.5900	1.1164	1.0862	1.0546	1.0214	0.9865	0.9501
0.6000	1.1600	1.1287	1.0958	1.0613	1.0251	0.9872
0.6100	1.2046	1.1720	1.1379	1.1020	1.0644	1.0251
0.6200	1.2501	1.2163	1.1808	1.1436	1.1046	1.0638
0.6300	1.2965	1.2615	1.2247	1.1861	1.1457	1.1033
0.6400	1.3439	1.3076	1.2695	1.2295	1.1876	1.1437
0.6500	1.3923	1.3547	1.3152	1.2737	1.2303	1.1848
0.6600	1.4416	1.4026	1.3617	1.3188	1.2739	1.2268
0.6700	1.4919	1.4516	1.4092	1.3648	1.3183	1.2696
0.6800	1.5431	1.5014	1.4577	1.4117	1.3636	1.3132
0.6900	1.5953	1.5523	1.5070	1.4595	1.4098	1.3576
0.7000	1.6485	1.6040	1.5573	1.5082	1.4568	1.4029
0.7100	1.7027	1.6567	1.6084	1.5578	1.5047	1.4490
0.7200	1.7579	1.7104	1.6606	1.6082	1.5534	1.4960
0.7300	1.8141	1.7651	1.7136	1.6596	1.6030	1.5438
0.7400	1.8712	1.8207	1.7676	1.7119	1.6535	1.5924
0.7500	1.9294	1.8773	1.8225	1.7651	1.7049	1.6419
0.7600	1.9885	1.9348	1.8784	1.8192	1.7572	1.6922
0.7700	2.0487	1.9934	1.9352	1.8743	1.8104	1.7434
0.7800	2.1099	2.0529	1.9930	1.9302	1.8644	1.7955
0.7900	2.1720	2.1134	2.0518	1.9871	1.9194	1.8484
0.8000	2.2352	2.1749	2.1115	2.0449	1.9752	1.9022
0.8100	2.2994	2.2373	2.1721	2.1037	2.0320	1.9568
0.8200	2.3647	2.3008	2.2337	2.1634	2.0896	2.0123
0.8300	2.4309	2.3653	2.2963	2.2240	2.1482	2.0687
0.8400	2.4982	2.4308	2.3599	2.2856	2.2076	2.1260
0.8500	2.5666	2.4972	2.4244	2.3481	2.2680	2.1841
0.8600	2.6359	2.5647	2.4900	2.4115	2.3293	2.2432
0.8700	2.7063	2.6332	2.5565	2.4759	2.3915	2.3031
0.8800	2.7778	2.7028	2.6240	2.5413	2.4546	2.3639
0.8900	2.8503	2.7733	2.6924	2.6076	2.5187	2.4256
0.9000	2.9238	2.8448	2.7619	2.6749	2.5837	2.4882
0.9100	2.9984	2.9174	2.8324	2.7431	2.6496	2.5516
0.9200	3.0741	2.9910	2.9038	2.8124	2.7165	2.6160
0.9300	3.1508	3.0657	2.9763	2.8825	2.7843	2.6813
0.9400	3.2286	3.1414	3.0498	2.9537	2.8530	2.7475
0.9500	3.3074	3.2181	3.1243	3.0258	2.9227	2.8146
0.9600	3.3873	3.2958	3.1997	3.0989	2.9933	2.8826
0.9700	3.4683	3.3746	3.2762	3.1730	3.0648	2.9515

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	85	86	87	88	89	90
0.0700	0.0071	0.0068	0.0064	0.0061	0.0057	0.0054
0.0800	0.0096	0.0092	0.0087	0.0083	0.0078	0.0073
0.0900	0.0125	0.0120	0.0114	0.0108	0.0102	0.0095
0.1000	0.0159	0.0152	0.0145	0.0137	0.0129	0.0121
0.1100	0.0198	0.0189	0.0180	0.0171	0.0161	0.0150
0.1200	0.0242	0.0231	0.0220	0.0208	0.0196	0.0183
0.1300	0.0290	0.0277	0.0264	0.0250	0.0235	0.0220
0.1400	0.0343	0.0328	0.0312	0.0296	0.0279	0.0261
0.1500	0.0402	0.0384	0.0366	0.0346	0.0326	0.0305
0.1600	0.0465	0.0445	0.0424	0.0401	0.0378	0.0353
0.1700	0.0534	0.0511	0.0486	0.0461	0.0434	0.0406
0.1800	0.0609	0.0582	0.0554	0.0525	0.0494	0.0462
0.1900	0.0689	0.0658	0.0627	0.0594	0.0559	0.0523
0.2000	0.0774	0.0740	0.0705	0.0667	0.0629	0.0588
0.2100	0.0865	0.0827	0.0788	0.0746	0.0703	0.0657
0.2200	0.0962	0.0920	0.0876	0.0829	0.0781	0.0731
0.2300	0.1064	0.1018	0.0969	0.0918	0.0865	0.0809
0.2400	0.1173	0.1122	0.1068	0.1012	0.0953	0.0891
0.2500	0.1287	0.1231	0.1172	0.1110	0.1046	0.0978
0.2600	0.1408	0.1346	0.1282	0.1214	0.1143	0.1069
0.2700	0.1534	0.1467	0.1397	0.1323	0.1246	0.1165
0.2800	0.1667	0.1594	0.1517	0.1437	0.1354	0.1266
0.2900	0.1806	0.1727	0.1644	0.1557	0.1467	0.1372
0.3000	0.1951	0.1865	0.1776	0.1682	0.1584	0.1482
0.3100	0.2102	0.2010	0.1914	0.1813	0.1707	0.1597
0.3200	0.2260	0.2161	0.2057	0.1949	0.1836	0.1717
0.3300	0.2424	0.2318	0.2207	0.2091	0.1969	0.1842
0.3400	0.2595	0.2481	0.2362	0.2238	0.2108	0.1971
0.3500	0.2772	0.2651	0.2524	0.2391	0.2252	0.2106
0.3600	0.2956	0.2827	0.2691	0.2549	0.2401	0.2246
0.3700	0.3147	0.3009	0.2865	0.2714	0.2556	0.2391
0.3800	0.3344	0.3198	0.3044	0.2884	0.2716	0.2540
0.3900	0.3548	0.3393	0.3230	0.3060	0.2882	0.2695
0.4000	0.3759	0.3594	0.3422	0.3242	0.3053	0.2856
0.4100	0.3977	0.3803	0.3620	0.3430	0.3230	0.3021
0.4200	0.4201	0.4017	0.3825	0.3623	0.3412	0.3192
0.4300	0.4433	0.4239	0.4036	0.3823	0.3600	0.3367
0.4400	0.4672	0.4467	0.4253	0.4029	0.3794	0.3549
0.4500	0.4917	0.4702	0.4476	0.4240	0.3994	0.3735
0.4600	0.5170	0.4943	0.4706	0.4458	0.4199	0.3927
0.4700	0.5430	0.5192	0.4943	0.4682	0.4410	0.4125
0.4800	0.5697	0.5447	0.5186	0.4913	0.4627	0.4327
0.4900	0.5971	0.5709	0.5435	0.5149	0.4849	0.4536
0.5000	0.6252	0.5978	0.5692	0.5392	0.5078	0.4749
0.5100	0.6541	0.6254	0.5955	0.5641	0.5313	0.4969

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	85	86	87	88	89	90
0.5200	0.6837	0.6538	0.6224	0.5896	0.5553	0.5194
0.5300	0.7141	0.6828	0.6500	0.6158	0.5800	0.5424
0.5400	0.7452	0.7125	0.6783	0.6426	0.6052	0.5660
0.5500	0.7770	0.7429	0.7073	0.6701	0.6311	0.5902
0.5600	0.8096	0.7741	0.7370	0.6982	0.6575	0.6150
0.5700	0.8429	0.8060	0.7673	0.7269	0.6846	0.6403
0.5800	0.8770	0.8386	0.7984	0.7563	0.7123	0.6662
0.5900	0.9119	0.8719	0.8301	0.7864	0.7406	0.6927
0.6000	0.9475	0.9060	0.8625	0.8171	0.7695	0.7197
0.6100	0.9839	0.9408	0.8957	0.8485	0.7991	0.7474
0.6200	1.0210	0.9763	0.9295	0.8805	0.8293	0.7756
0.6300	1.0590	1.0126	0.9640	0.9132	0.8601	0.8044
0.6400	1.0977	1.0496	0.9993	0.9466	0.8915	0.8338
0.6500	1.1372	1.0874	1.0352	0.9807	0.9236	0.8638
0.6600	1.1775	1.1259	1.0719	1.0154	0.9563	0.8944
0.6700	1.2185	1.1651	1.1093	1.0508	0.9897	0.9256
0.6800	1.2604	1.2052	1.1474	1.0869	1.0237	0.9574
0.6900	1.3031	1.2460	1.1862	1.1237	1.0583	0.9899
0.7000	1.3465	1.2875	1.2258	1.1612	1.0936	1.0229
0.7100	1.3908	1.3298	1.2661	1.1994	1.1296	1.0565
0.7200	1.4358	1.3729	1.3071	1.2382	1.1662	1.0907
0.7300	1.4817	1.4168	1.3489	1.2778	1.2034	1.1256
0.7400	1.5284	1.4614	1.3914	1.3181	1.2413	1.1610
0.7500	1.5759	1.5068	1.4346	1.3590	1.2799	1.1971
0.7600	1.6242	1.5530	1.4786	1.4007	1.3192	1.2338
0.7700	1.6734	1.6000	1.5233	1.4431	1.3591	1.2711
0.7800	1.7233	1.6478	1.5688	1.4861	1.3996	1.3091
0.7900	1.7741	1.6964	1.6150	1.5299	1.4409	1.3477
0.8000	1.8257	1.7457	1.6620	1.5745	1.4828	1.3869
0.8100	1.8782	1.7959	1.7098	1.6197	1.5254	1.4267
0.8200	1.9315	1.8468	1.7583	1.6656	1.5687	1.4672
0.8300	1.9856	1.8986	1.8075	1.7123	1.6127	1.5083
0.8400	2.0405	1.9511	1.8576	1.7597	1.6573	1.5501
0.8500	2.0964	2.0045	1.9084	1.8078	1.7026	1.5925
0.8600	2.1530	2.0587	1.9600	1.8567	1.7486	1.6355
0.8700	2.2105	2.1137	2.0123	1.9063	1.7953	1.6792
0.8800	2.2689	2.1695	2.0654	1.9566	1.8427	1.7235
0.8900	2.3281	2.2261	2.1193	2.0077	1.8908	1.7685
0.9000	2.3882	2.2835	2.1740	2.0595	1.9396	1.8141
0.9100	2.4491	2.3418	2.2295	2.1120	1.9891	1.8604
0.9200	2.5109	2.4009	2.2857	2.1653	2.0393	1.9074
0.9300	2.5735	2.4608	2.3428	2.2193	2.0902	1.9550
0.9400	2.6371	2.5215	2.4006	2.2741	2.1418	2.0032
0.9500	2.7015	2.5831	2.4592	2.3297	2.1941	2.0521
0.9600	2.7667	2.6455	2.5187	2.3860	2.2471	2.1017
0.9700	2.8329	2.7088	2.5789	2.4430	2.3008	2.1520

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	91	92	93	94	95	96
0.0700	0.0050	0.0046	0.0041	0.0037	0.0032	0.0027
0.0800	0.0068	0.0062	0.0056	0.0050	0.0044	0.0037
0.0900	0.0088	0.0081	0.0073	0.0065	0.0057	0.0048
0.1000	0.0112	0.0103	0.0093	0.0083	0.0072	0.0061
0.1100	0.0140	0.0128	0.0116	0.0103	0.0090	0.0076
0.1200	0.0170	0.0156	0.0142	0.0126	0.0110	0.0092
0.1300	0.0204	0.0187	0.0170	0.0151	0.0132	0.0111
0.1400	0.0242	0.0222	0.0201	0.0179	0.0156	0.0131
0.1500	0.0283	0.0260	0.0235	0.0210	0.0183	0.0154
0.1600	0.0328	0.0301	0.0273	0.0243	0.0212	0.0178
0.1700	0.0376	0.0346	0.0313	0.0279	0.0243	0.0204
0.1800	0.0429	0.0394	0.0357	0.0318	0.0277	0.0233
0.1900	0.0485	0.0445	0.0404	0.0360	0.0313	0.0263
0.2000	0.0545	0.0501	0.0454	0.0404	0.0352	0.0296
0.2100	0.0610	0.0560	0.0507	0.0452	0.0393	0.0331
0.2200	0.0678	0.0622	0.0564	0.0502	0.0437	0.0368
0.2300	0.0750	0.0689	0.0624	0.0556	0.0484	0.0407
0.2400	0.0826	0.0759	0.0687	0.0612	0.0533	0.0449
0.2500	0.0907	0.0833	0.0755	0.0672	0.0585	0.0493
0.2600	0.0992	0.0911	0.0825	0.0735	0.0640	0.0539
0.2700	0.1081	0.0992	0.0899	0.0801	0.0697	0.0587
0.2800	0.1174	0.1078	0.0977	0.0870	0.0758	0.0638
0.2900	0.1272	0.1168	0.1058	0.0943	0.0821	0.0691
0.3000	0.1375	0.1262	0.1143	0.1019	0.0887	0.0746
0.3100	0.1481	0.1360	0.1232	0.1098	0.0956	0.0804
0.3200	0.1592	0.1462	0.1325	0.1180	0.1027	0.0865
0.3300	0.1708	0.1568	0.1421	0.1266	0.1102	0.0928
0.3400	0.1828	0.1679	0.1521	0.1355	0.1180	0.0993
0.3500	0.1953	0.1793	0.1625	0.1448	0.1260	0.1061
0.3600	0.2083	0.1912	0.1733	0.1544	0.1344	0.1131
0.3700	0.2217	0.2035	0.1844	0.1643	0.1430	0.1204
0.3800	0.2356	0.2163	0.1960	0.1746	0.1520	0.1279
0.3900	0.2500	0.2295	0.2080	0.1853	0.1613	0.1357
0.4000	0.2649	0.2431	0.2203	0.1963	0.1709	0.1438
0.4100	0.2802	0.2572	0.2331	0.2077	0.1808	0.1521
0.4200	0.2960	0.2718	0.2463	0.2194	0.1910	0.1607
0.4300	0.3123	0.2867	0.2598	0.2315	0.2015	0.1696
0.4400	0.3291	0.3022	0.2738	0.2439	0.2123	0.1787
0.4500	0.3465	0.3180	0.2882	0.2568	0.2235	0.1881
0.4600	0.3643	0.3344	0.3030	0.2699	0.2350	0.1978
0.4700	0.3826	0.3512	0.3182	0.2835	0.2468	0.2077
0.4800	0.4014	0.3685	0.3339	0.2975	0.2589	0.2179
0.4900	0.4207	0.3862	0.3500	0.3118	0.2714	0.2284
0.5000	0.4405	0.4044	0.3665	0.3265	0.2842	0.2392
0.5100	0.4609	0.4231	0.3834	0.3415	0.2973	0.2502

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration					
	Percent Shrinkage					
	91	92	93	94	95	96
0.5200	0.4817	0.4422	0.4007	0.3570	0.3108	0.2616
0.5300	0.5031	0.4619	0.4185	0.3729	0.3245	0.2732
0.5400	0.5250	0.4820	0.4367	0.3891	0.3387	0.2851
0.5500	0.5475	0.5026	0.4554	0.4057	0.3532	0.2973
0.5600	0.5704	0.5236	0.4745	0.4227	0.3680	0.3097
0.5700	0.5939	0.5452	0.4940	0.4401	0.3831	0.3225
0.5800	0.6179	0.5673	0.5140	0.4579	0.3986	0.3355
0.5900	0.6425	0.5898	0.5345	0.4761	0.4145	0.3489
0.6000	0.6676	0.6129	0.5553	0.4947	0.4306	0.3625
0.6100	0.6932	0.6364	0.5767	0.5137	0.4472	0.3764
0.6200	0.7194	0.6604	0.5984	0.5331	0.4641	0.3906
0.6300	0.7461	0.6850	0.6207	0.5529	0.4813	0.4051
0.6400	0.7734	0.7100	0.6434	0.5732	0.4989	0.4200
0.6500	0.8012	0.7356	0.6665	0.5938	0.5169	0.4351
0.6600	0.8296	0.7616	0.6901	0.6148	0.5352	0.4505
0.6700	0.8586	0.7882	0.7142	0.6363	0.5538	0.4662
0.6800	0.8881	0.8153	0.7387	0.6581	0.5729	0.4822
0.6900	0.9181	0.8428	0.7637	0.6804	0.5923	0.4985
0.7000	0.9487	0.8710	0.7892	0.7031	0.6120	0.5152
0.7100	0.9799	0.8996	0.8152	0.7262	0.6321	0.5321
0.7200	1.0117	0.9287	0.8416	0.7497	0.6526	0.5493
0.7300	1.0440	0.9584	0.8685	0.7737	0.6735	0.5669
0.7400	1.0769	0.9886	0.8958	0.7981	0.6947	0.5847
0.7500	1.1103	1.0193	0.9237	0.8229	0.7163	0.6029
0.7600	1.1444	1.0506	0.9520	0.8481	0.7382	0.6214
0.7700	1.1790	1.0824	0.9808	0.8737	0.7606	0.6402
0.7800	1.2142	1.1147	1.0101	0.8998	0.7833	0.6593
0.7900	1.2500	1.1475	1.0398	0.9264	0.8063	0.6787
0.8000	1.2864	1.1809	1.0701	0.9533	0.8298	0.6985
0.8100	1.3233	1.2148	1.1008	0.9807	0.8536	0.7185
0.8200	1.3609	1.2493	1.1321	1.0085	0.8779	0.7389
0.8300	1.3990	1.2843	1.1638	1.0368	0.9025	0.7596
0.8400	1.4377	1.3199	1.1960	1.0655	0.9274	0.7807
0.8500	1.4770	1.3560	1.2287	1.0946	0.9528	0.8020
0.8600	1.5170	1.3926	1.2619	1.1242	0.9786	0.8237
0.8700	1.5575	1.4298	1.2956	1.1542	1.0047	0.8457
0.8800	1.5986	1.4675	1.3298	1.1847	1.0312	0.8680
0.8900	1.6403	1.5058	1.3645	1.2156	1.0581	0.8907
0.9000	1.6826	1.5447	1.3997	1.2470	1.0854	0.9137
0.9100	1.7256	1.5841	1.4354	1.2788	1.1131	0.9370
0.9200	1.7691	1.6241	1.4717	1.3111	1.1412	0.9606
0.9300	1.8133	1.6646	1.5084	1.3438	1.1697	0.9846
0.9400	1.8580	1.7057	1.5456	1.3769	1.1986	1.0089
0.9500	1.9034	1.7474	1.5834	1.4106	1.2278	1.0335
0.9600	1.9494	1.7896	1.6216	1.4447	1.2575	1.0585
0.9700	1.9960	1.8324	1.6604	1.4792	1.2876	1.0838

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration		
	Percent Shrinkage		
	97	98	99
0.0700	0.0022	0.0016	0.0009
0.0800	0.0029	0.0021	0.0012
0.0900	0.0038	0.0028	0.0016
0.1000	0.0049	0.0035	0.0020
0.1100	0.0060	0.0044	0.0025
0.1200	0.0074	0.0053	0.0031
0.1300	0.0089	0.0064	0.0037
0.1400	0.0105	0.0076	0.0044
0.1500	0.0123	0.0089	0.0051
0.1600	0.0142	0.0103	0.0059
0.1700	0.0163	0.0118	0.0068
0.1800	0.0186	0.0135	0.0077
0.1900	0.0210	0.0152	0.0087
0.2000	0.0236	0.0171	0.0098
0.2100	0.0264	0.0192	0.0110
0.2200	0.0294	0.0213	0.0122
0.2300	0.0325	0.0236	0.0135
0.2400	0.0358	0.0260	0.0149
0.2500	0.0393	0.0285	0.0163
0.2600	0.0430	0.0312	0.0178
0.2700	0.0469	0.0340	0.0194
0.2800	0.0509	0.0369	0.0211
0.2900	0.0552	0.0400	0.0229
0.3000	0.0596	0.0432	0.0247
0.3100	0.0642	0.0465	0.0266
0.3200	0.0690	0.0500	0.0287
0.3300	0.0740	0.0537	0.0307
0.3400	0.0793	0.0575	0.0329
0.3500	0.0847	0.0614	0.0351
0.3600	0.0903	0.0654	0.0375
0.3700	0.0961	0.0697	0.0399
0.3800	0.1021	0.0740	0.0424
0.3900	0.1084	0.0786	0.0450
0.4000	0.1148	0.0832	0.0477
0.4100	0.1215	0.0880	0.0504
0.4200	0.1283	0.0930	0.0533
0.4300	0.1354	0.0981	0.0562
0.4400	0.1427	0.1034	0.0592
0.4500	0.1502	0.1089	0.0623
0.4600	0.1579	0.1144	0.0655
0.4700	0.1658	0.1202	0.0688
0.4800	0.1740	0.1261	0.0722
0.4900	0.1824	0.1322	0.0757
0.5000	0.1910	0.1384	0.0793
0.5100	0.1998	0.1448	0.0829

Table 5—Volumetric Shrinkage Table (Continued)

Difference of Inverse Densities (m ³ /kg) × 10 ³	Light-Product Concentration		
	Percent Shrinkage		
	97	98	99
0.5200	0.2088	0.1514	0.0867
0.5300	0.2181	0.1581	0.0905
0.5400	0.2276	0.1650	0.0945
0.5500	0.2373	0.1720	0.0985
0.5600	0.2473	0.1792	0.1026
0.5700	0.2574	0.1866	0.1069
0.5800	0.2679	0.1942	0.1112
0.5900	0.2785	0.2019	0.1156
0.6000	0.2894	0.2098	0.1201
0.6100	0.3005	0.2178	0.1247
0.6200	0.3118	0.2260	0.1294
0.6300	0.3234	0.2344	0.1342
0.6400	0.3353	0.2430	0.1391
0.6500	0.3473	0.2517	0.1442
0.6600	0.3596	0.2607	0.1493
0.6700	0.3722	0.2698	0.1545
0.6800	0.3850	0.2790	0.1598
0.6900	0.3980	0.2885	0.1652
0.7000	0.4113	0.2981	0.1707
0.7100	0.4248	0.3079	0.1763
0.7200	0.4385	0.3179	0.1820
0.7300	0.4525	0.3280	0.1878
0.7400	0.4668	0.3384	0.1937
0.7500	0.4813	0.3489	0.1998
0.7600	0.4961	0.3596	0.2059
0.7700	0.5111	0.3704	0.2121
0.7800	0.5263	0.3815	0.2185
0.7900	0.5418	0.3927	0.2249
0.8000	0.5576	0.4042	0.2314
0.8100	0.5736	0.4158	0.2381
0.8200	0.5899	0.4276	0.2448
0.8300	0.6064	0.4396	0.2517
0.8400	0.6232	0.4517	0.2587
0.8500	0.6403	0.4641	0.2657
0.8600	0.6576	0.4766	0.2729
0.8700	0.6751	0.4894	0.2802
0.8800	0.6930	0.5023	0.2876
0.8900	0.7110	0.5154	0.2951
0.9000	0.7294	0.5287	0.3027
0.9100	0.7480	0.5422	0.3105
0.9200	0.7669	0.5559	0.3183
0.9300	0.7860	0.5697	0.3262
0.9400	0.8054	0.5838	0.3343
0.9500	0.8251	0.5980	0.3425
0.9600	0.8450	0.6125	0.3507
0.9700	0.8652	0.6271	0.3591

APPENDIX A—CORRELATING EQUATIONS AND SELECTING A MATHEMATICAL MODEL

In selecting a suitable mathematical model, the selected equations were evaluated and various correlations were regressed and compared using a model building F -test as detailed below.

For comparison purposes, the API 2509C (Rossini) equation was written in terms of total volume shrinkage as follows:

$$S = 0.0000214C^{0.9296} G^{1.76} \quad (\text{A-1})$$

Where:

S = volume shrinkage, as percent of total volume.

C = concentration, in liquid volume percent of lighter component in mixture.

G = gravity difference, in degrees API.

This equation is plotted in Figure B-2 of Appendix B. Beyond about 30 volume percent, this equation is essentially an extrapolation of the Childress volume shrinkage data.

Scott proposed the following equation:

$$S = K_1 K_2 \quad (\text{A-2})$$

Where:

K_1 = gravity factor
 $= 0.00147G + 0.000933G^2 + 0.000000317G^3$.

K_2 = concentration factor
 $= 0.00712C - 0.0000227C^2 - 0.000000485C^3$.

This equation is plotted in Figure B-3. The concentration factor was selected to predict a shrinkage of 0 percent at 0 percent and 100 percent spikes.

Ashcroft, Booker, and Turner regressed the following correlation to Booker's light paraffinic spiked crude data (for comparison purposes it is written in terms of total volume shrinkage):

$$S = 2.94 \times 10^{-8} C (100 - C)^{0.892} G^{2.34} \quad (\text{A-3})$$

This equation is plotted in Figure B-4.

A modified API 2509C equation was also considered. The following three correlations were regressed using the Childress, Scott, Schuchardt, and Booker volumetric shrinkage data:

$$S = 3.22 \times 10^{-8} C (100 - C) G^{2.20} \quad (\text{A-4})$$

$$S = 4.86 \times 10^{-8} C (100 - C)^{0.819} G^{2.28} \quad (\text{A-5})$$

$$S = 4.89 \times 10^{-8} C^{0.999} (100 - C)^{0.819} G^{2.28} \quad (\text{A-6})$$

A model building F -test suggested by Beck and Arnold¹⁰ was used to determine which parameters are needed (F values were compared with $F_{.95}(1, n - p) = 3.84$).

This test indicates that Equation A-5 should be used; this equation has the same form as that chosen by Ashcroft, Booker, and Turner. Equation A-5 is plotted in Figure B-5. This form retains the API 2509C equation simplicity, but unlike 2509C, Equation A-5 predicts 0 percent shrinkage at 0 and 100 percent spike.

Equation A-5, the Ashcroft, Booker, and Turner correlation, and the API 2509C equation were compared to the Childress, Scott, Schuchardt, and Booker volumetric shrinkage data. The Scott equation was not considered further, because it was compared to Equation A-4 and was found to overpredict shrinkage for volume percent greater than 25 percent.

The fit to the volumetric shrinkage data was quantified using the following error measures:

$$\text{The average absolute error} = \sum_{i=1}^N \left| \frac{[S^C - S^E]_i}{N} \right|$$

$$\text{The average bias error} = \sum_{i=1}^N \frac{[S^C - S^E]_i}{N}$$

$$\text{The root-mean-square error} = \sqrt{\sum_{i=1}^N \frac{[S^C - S^E]_i^2}{N}}$$

Where:

S^E = experimental volumetric shrinkage, as percent of total volume.

S^C = calculated volumetric shrinkage, as percent of total volume.

N = number of data points.

These values were computed both with respect to data from each source individually and with respect to data from all sources. Discrete volume percent concentration ranges were used because these error measures are strongly dependent on volume percentage concentration. The API 2509C equation was not applied for volume percent spikes greater than 50 percent.

APPENDIX B—VOLUMETRIC SHRINKAGE DATA

APPENDIX B—VOLUMETRIC SHRINKAGE DATA

Table B-1—Childress Data Set

Name or Source of Crude Oil	Crude Type	Light Component	Density of Crude Oil ^a	Density of Light Component ^a	Average Residual ^b	Average Relative Residual ^c	Number of Data Sets
Racoon Bend, TX	Naphthenic	Condensate	936.2	651.2	0.0305	0.1579	28
Talco	Intermediate	Intermediate	931.5	826.0	-0.0035	-0.3420	9
Talco	Intermediate	Condensate	930.9	651.2	-0.0021	0.0753	57
Boling	Mixed	Gasoline	892.7	726.0	0.0216	0.1785	14
Arkansas	Intermediate	Condensate	881.6	651.2	0.0201	0.0554	14
Arkansas	Intermediate	Intermediate	881.6	826.0	0.0004	0.2838	8
TCO #A-2	Paraffinic	Condensate	871.3	651.2	0.0313	0.1850	14
Anahuac	Intermediate	Condensate	851.9	742.8	-0.0140	0.0357	12
Not available	Naphthenic	Condensate	848.3	735.1	0.0296	0.5460	16
West Texas	Intermediate	Natural gasoline	844.3	650.9	-0.0018	-0.0754	10
Imogene	Paraffinic	Natural gasoline	837.3	666.2	0.0121	0.2304	8
Mississippi	Intermediate	Natural gasoline	826.0	688.9	0.0155	0.3023	32
Mississippi	Intermediate	Condensate	826.0	644.4	0.0131	0.2614	8
Not available	Condensate	Butane	724.9	581.1	0.0490	0.0812	14
Not available	Condensate	Condensate	724.9	644.4	0.0190	0.4469	14
Not available	Condensate	Butane	644.4	581.1	0.0207	0.5339	10

Note: Total number of data points = 268; overall average residual = 0.014; standard deviation of absolute residual = 0.03.

^aExpressed in kilograms per cubic meter at 101.3 kilopascals and 15°C.

^bActual experimental shrinkage value minus value calculated using new correlation equation.

^cActual residual/experimental shrinkage value.

Table B-2—Scott Data Set

Name or Source of Crude Oil	Crude Type	Density of Crude Oil ^a	Density of Light Component ^a	Average Residual ^b	Average Relative Residual ^c	Number of Data Sets
KCL A Lea	Absorption	854.0	654.2	0.0480	0.1280	12
Redwater	Windfall	850.4	743.2	0.0260	0.3340	8
HVI Sour	Fourteen	797.2	675.4	0.0740	0.3660	7
Woodriver	n-butane	735.1	585.9	0.0310	0.0950	11
Woodriver	n-butane	749.9	585.9	-0.0370	-0.2100	4

Note: Total number of data points = 42; overall average residual = 0.036; standard deviation of absolute residual = 0.04.

^aExpressed in kilograms per cubic meter at 101.3 kilopascals and 15°C.

^bActual experimental shrinkage value minus value calculated using new correlation equation.

^cActual residual/experimental shrinkage value.

Table B-3—Schuchardt Data Set

Name or Source of Crude Oil	Crude Type	Density of Crude Oil ^a	Density of Light Component ^a	Average Residual ^b	Average Relative Residual ^c	Number of Data Sets
Bolivar Coastal	Not specified	978.8	Various	-0.0487	-0.2397	9
Bolivar Coastal	Not specified	954.6	Various	-0.0210	-0.3921	9
Bolivar Coastal	Not specified	913.7	Various	-0.0132	0.2219	58
Bolivar Coastal	Not specified	911.9	Various	-0.0228	-0.1397	11
Souedie	Not specified	911.2	Various	-0.0226	-1.3242	10
Emsland	Not specified	899.7	Various	-0.0335	0.6972	70
Rabi Counda	Not specified	859.8	Various	-0.0890	1.4521	10
Soviet Export	Not specified	856.4	Various	-0.0144	0.6217	70
Amna	Not specified	843.9	Various	-0.0106	1.0237	10
Anoco Wax	Not specified	831.3	Various	-0.0321	-0.4224	40
Hassi'R Mel	Not specified	727.0	Various	-0.0174	-0.1896	10

Note: Total number of data points = 307; overall average residual = -0.025; standard deviation of absolute residual = 0.03.

^aExpressed in kilograms per cubic meter at 101.3 kilopascals and 15°C.

^bActual experimental shrinkage value minus value calculated using new correlation equation.

^cActual residual/experimental shrinkage value.

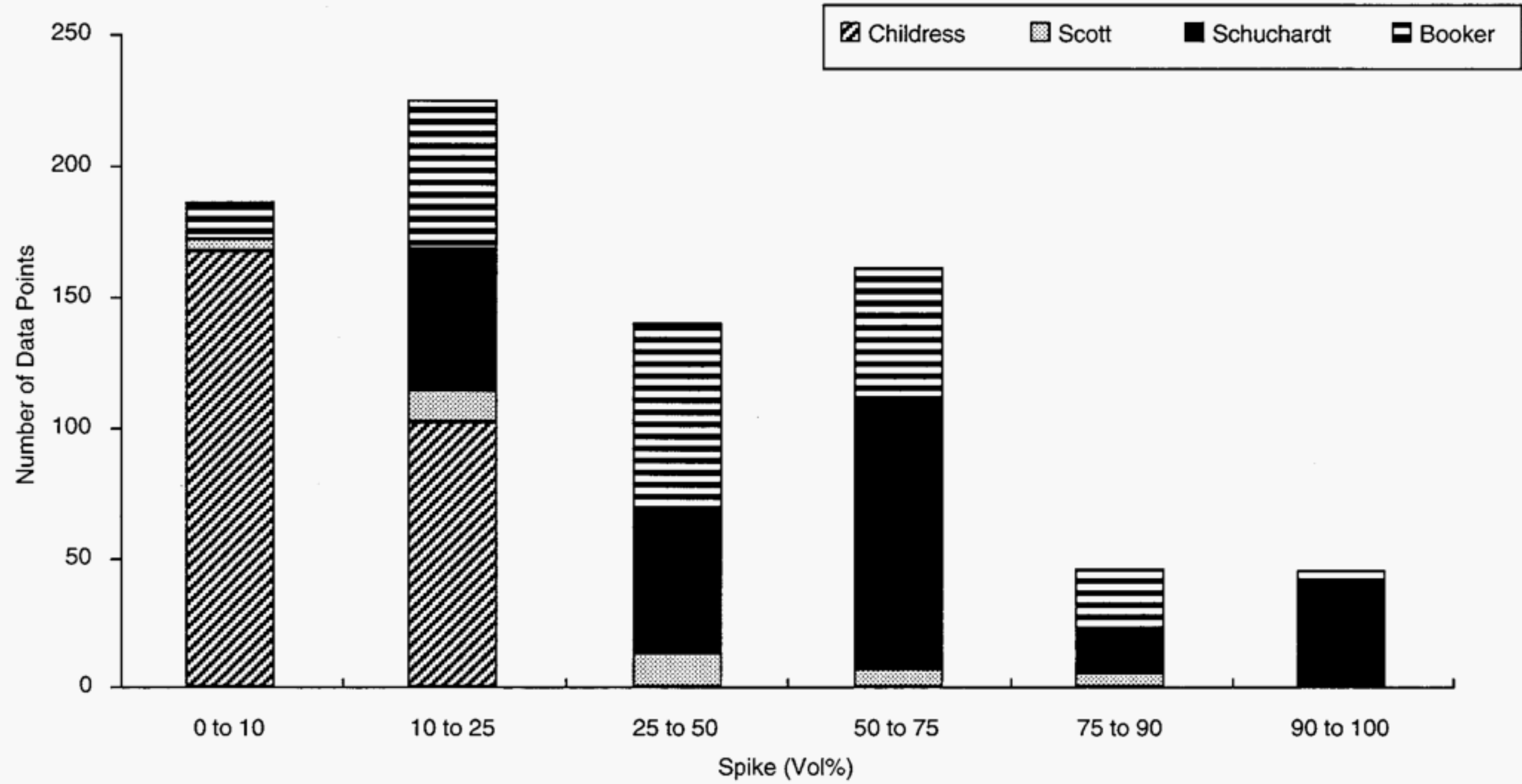


Figure B-1—Volumetric Shrinkage Data by Source

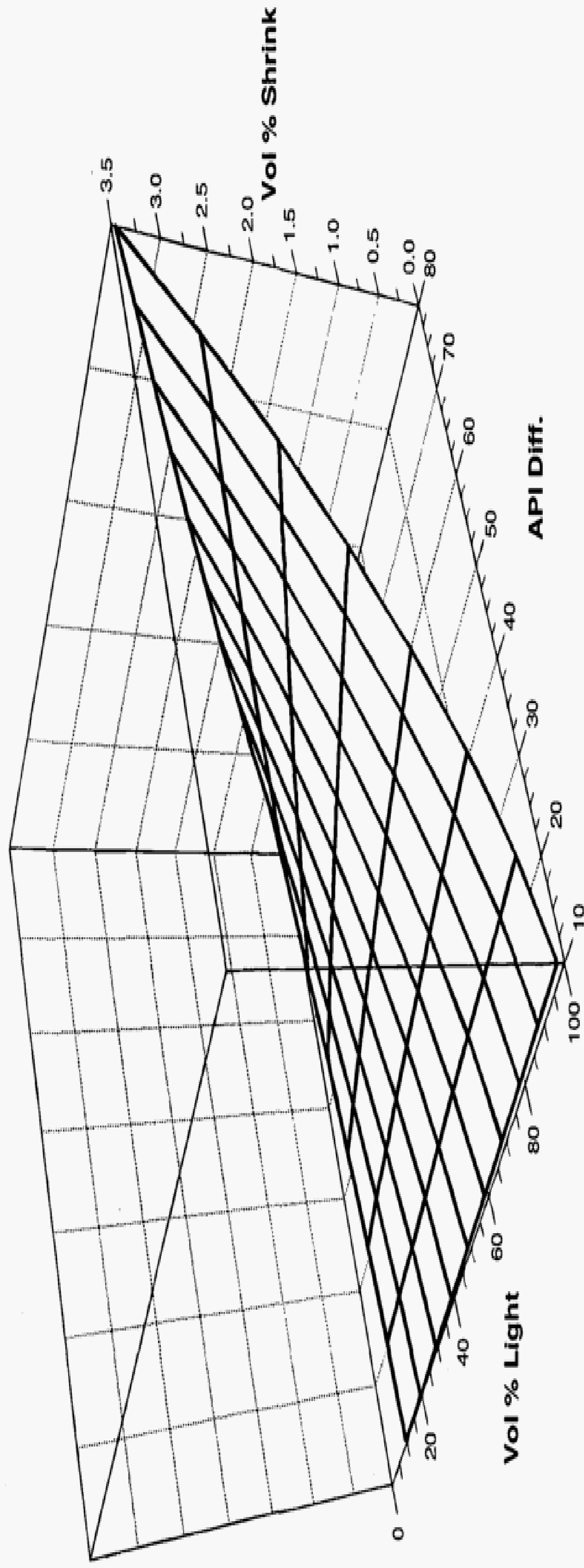


Figure B-2—API 2509C Equation Surface Plot

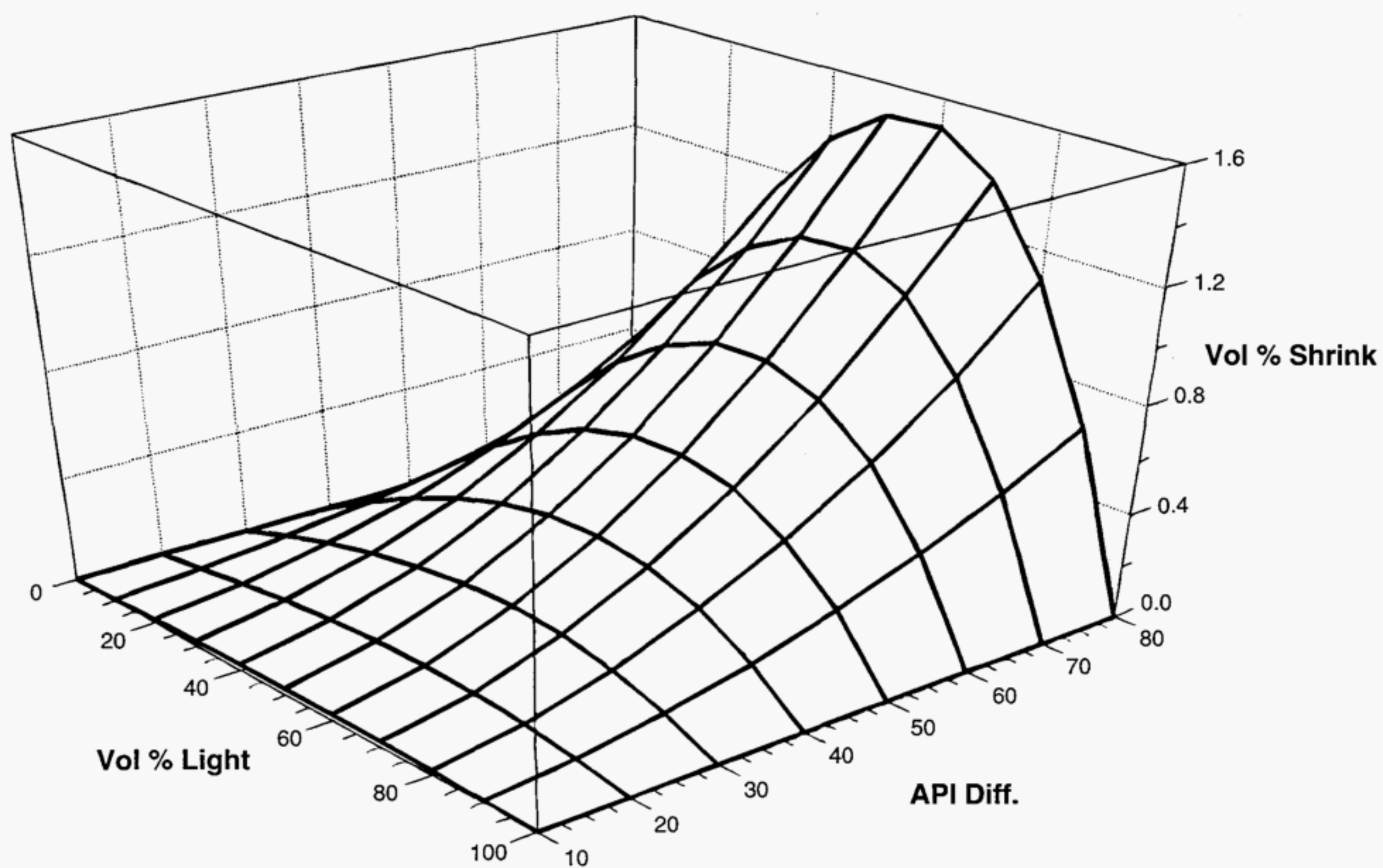


Figure B-3—Scott's Equation Surface Plot

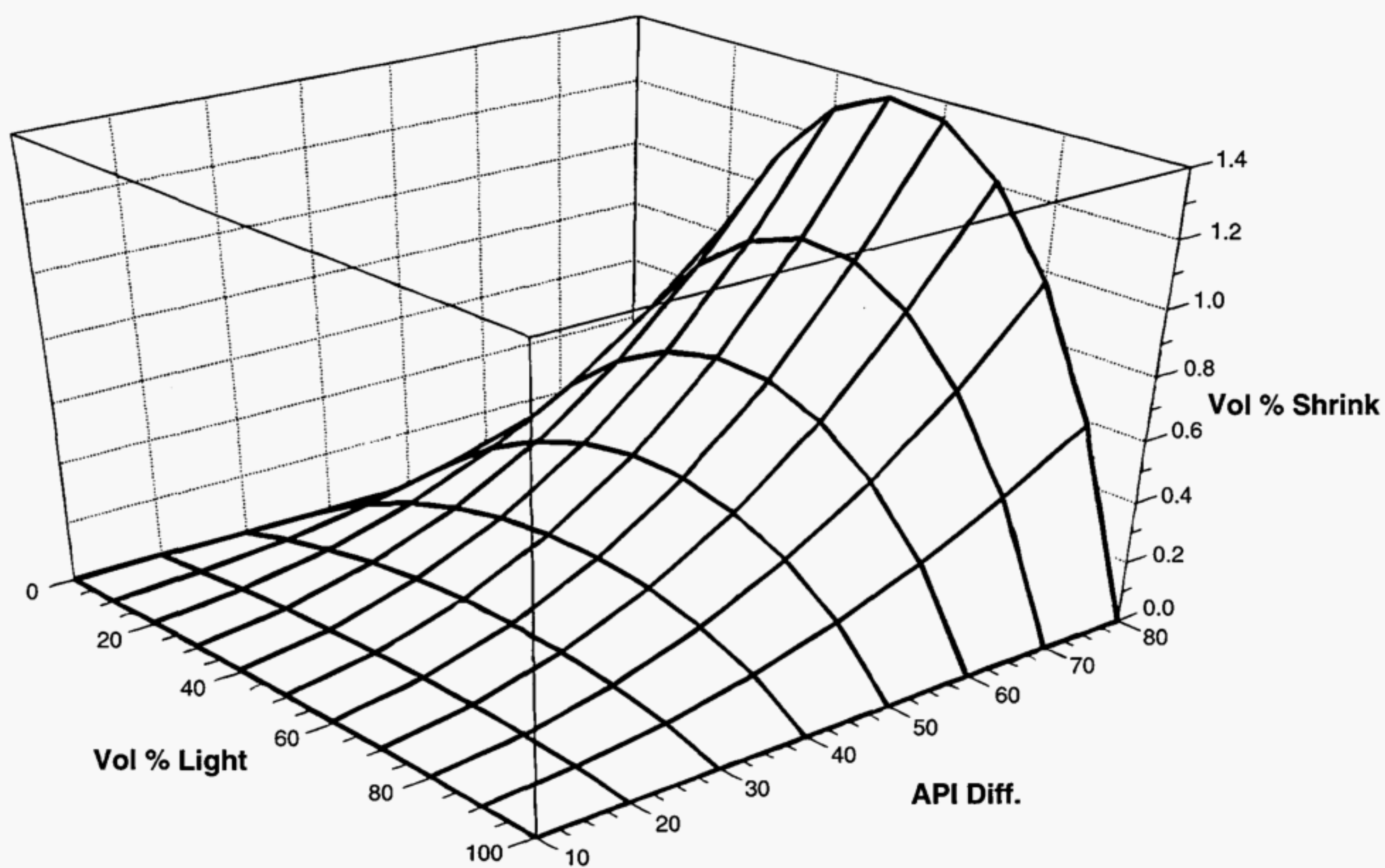


Figure B-4—Booker's Equation Surface Plot

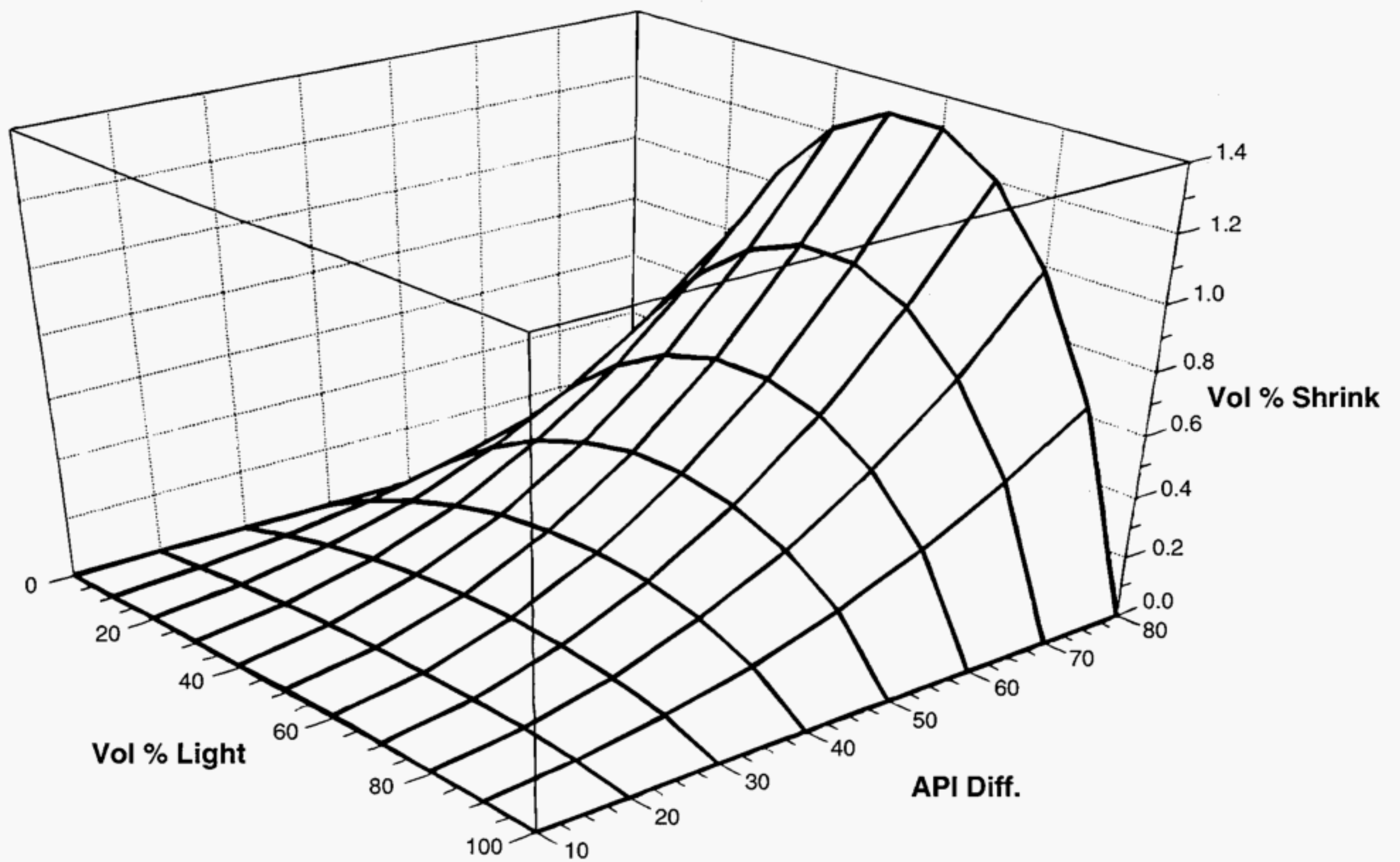


Figure B-5—API 12.3 Surface Plot

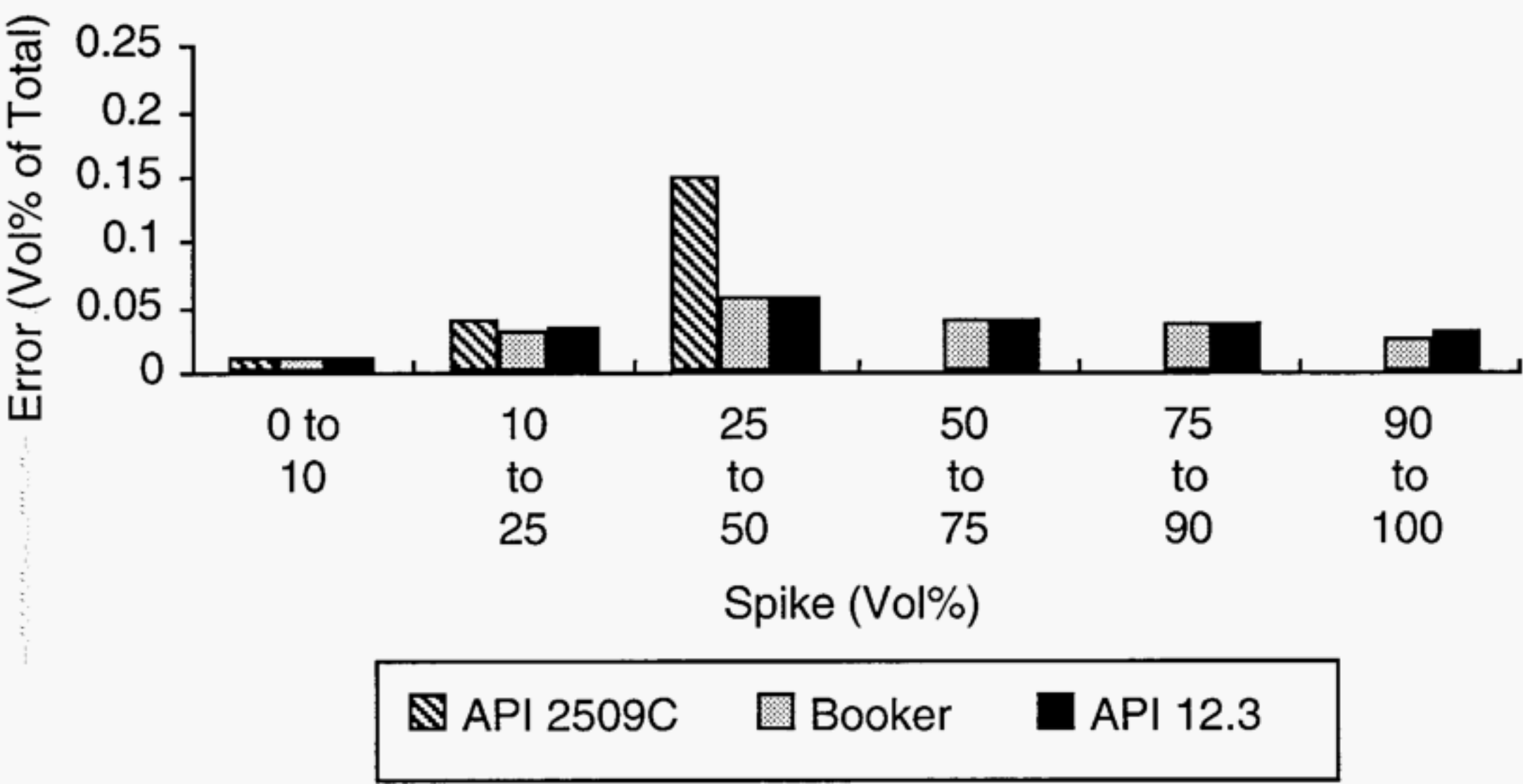


Figure B-6—Volumetric Shrinkage Error Average Absolute Error—All Data

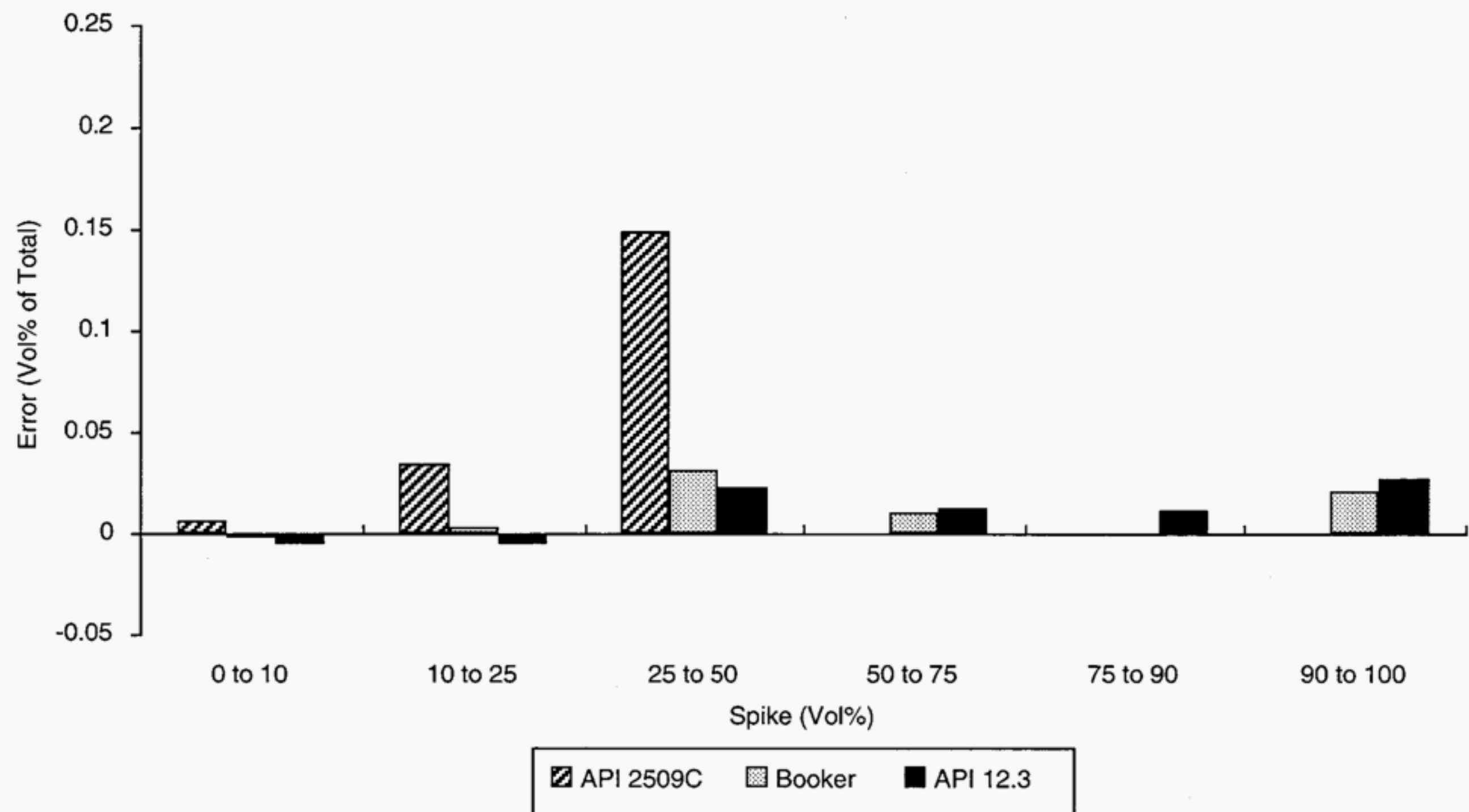


Figure B-7—Volumetric Shrinkage Error Average Bias Error—All Data

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APPENDIX C—TEST METHODS FOR DETERMINING VOLUMETRIC SHRINKAGE

C.1 Shrinkage Determination from Density and Volume Measurements Made Using a Pycnometer

C.1.1 SUMMARY

This method provides a simple, low-cost method for determining shrinkage resulting from hydrocarbon blending. It involves measurements of mass and volume of each component, and of the resulting blend volume, using a large volume pycnometer. With careful technique, excellent precision can be obtained on suitable hydrocarbon blends.

C.1.2 EQUIPMENT

The method uses a custom-designed double-neck pycnometer, of nominal 1000 cubic centimeters volume, with etched markings on one of the necks, as shown in Figure C-1. This design allows air to escape from the vessel as the second component is added. Temperature of the fluids in the pycnometer must be carefully controlled and measured during volume measurements.

A thermostat-controlled bath of sufficient size to allow submersion of the pycnometer, and capable of maintaining the temperature stable to $\pm 0.01^{\circ}\text{F}$ ($\pm 0.006^{\circ}\text{C}$) is recommended. A balance capable of weighing about 800 grams with a resolution of 0.01 gram is required.

C.1.3 CALIBRATION

The pycnometer is calibrated using air-free distilled water. Readings of the neck calibrations are made for several different masses of water, equilibrated at the temperature of interest. The exact volumes of water coinciding with the measured masses are calculated using the known density of water at the calibration temperature. Care should be taken to wipe all water from the outside of the pycnometer and to allow it to equilibrate to room temperature when it is removed from the bath for weighing. Likewise, sufficient time must be allowed for temperature equilibrium each time the pycnometer is put into the bath. Temperature equilibrium can be confirmed by noting the constancy of the volume. Volume measurements should be made while the pycnometer is still mostly within the bath and should be recorded to the nearest 0.05 cubic centimeters.

C.1.4 SAMPLE SELECTION AND PREPARATION

Considerable thought and care must be taken in deciding where and how samples are collected, if the samples are to be truly representative of much larger hydrocarbon volumes. This is particularly true of crude oils, which often contain small amounts of gas, water, or solids dispersed unevenly throughout a large batch. Guidance on sampling of crude oils is available from API and other sources.

C.1.5 MEASUREMENT PROCEDURE

The densities of each of the components of the desired blend are first determined separately by filling the pycnometer with a measured mass, equilibrating at the measurement temperature, and recording the volume.

The desired blend is prepared by weighing the appropriate mass of each component into the pycnometer, such that the total volume after mixing and temperature equilibrium falls within the calibrated region of the graduations on the pycnometer. Mixing is achieved with a large magnetic stir bar, the mass of which is included with the pycnometer in the initial weighing. Care should be taken to ensure that all of the liquid has drained from the neck above the liquid meniscus, prior to final volume reading. Mixing must be sufficient to ensure homogeneity, but not so vigorous that air is drawn into the blend. The pycnometer should be thoroughly cleaned and dried between each measurement.

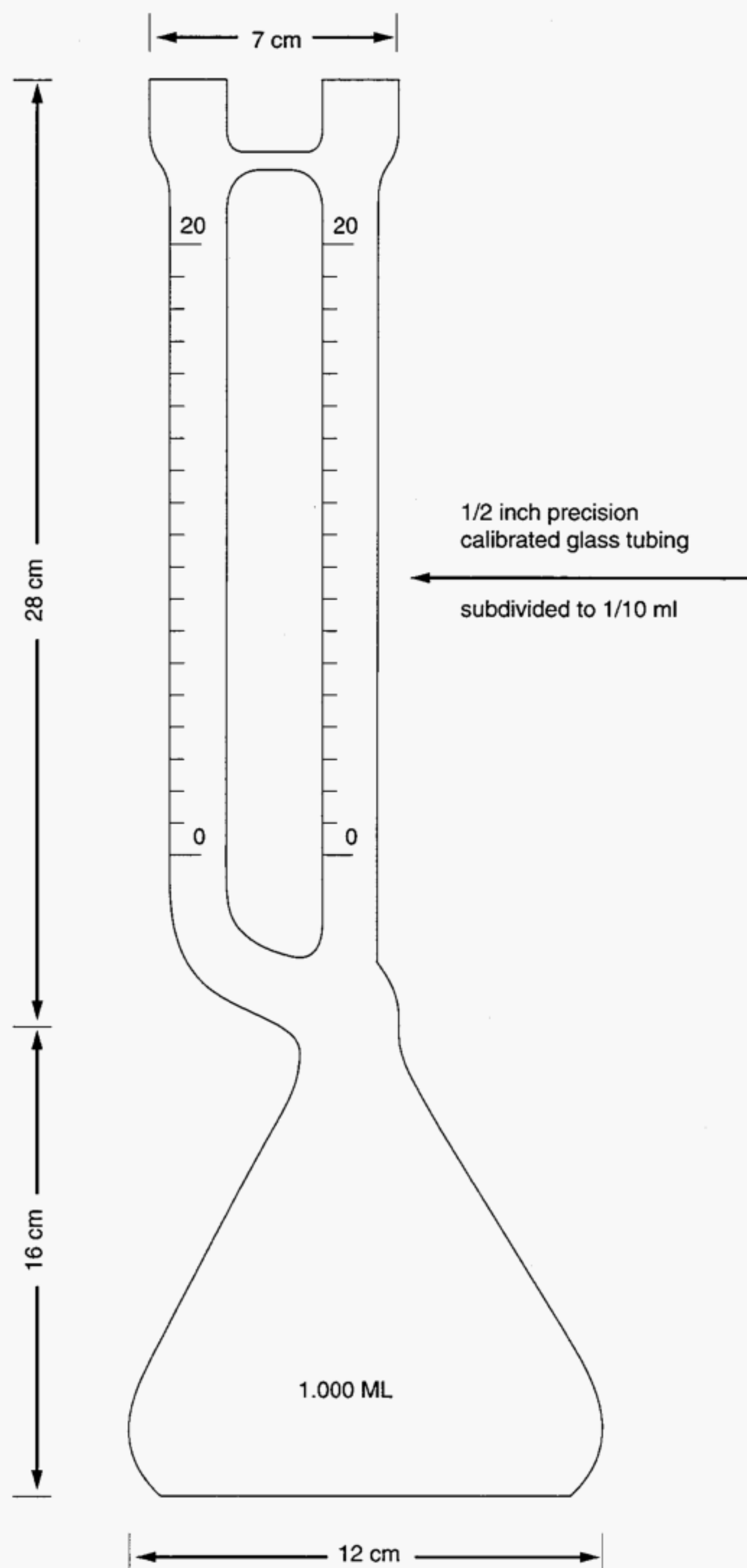


Figure C-1—Double-Neck Pycnometer

C.1.6 CALCULATIONS

The density of each component at the measurement temperature is calculated directly from its measured mass and volume. The volume fraction of component A in the blend is calculated from the masses of the components and the measured densities. The shrinkage factor can then be determined as the ratio of the measured blend volume to the sum of the calculated volumes of the individual components.

If the shrinkage factor is to be used for volumetric corrections, it should be determined at the temperature that corresponds with the metered volumes (in other words, if the meters are calibrated to read volumes corrected to 15°C, the shrinkage measurements should be made at 15°C). Alternatively, the densities and volumes can be corrected to standard temperature, using appropriate API correlations, and then the calculated shrinkage factor will apply to the standard temperature.

C.1.7 PRECISION AND ACCURACY

Based on a consideration of the measurement resolution and error propagation, values determined by this method will have a minimal error of ± 0.01 percent shrinkage. Actual experimental precision and accuracy are unknown.

C.2 Shrinkage Determination from Density Measurements Obtained with a Densitometer¹¹

C.2.1 SUMMARY

Precise measurements of the densities of the crude oil, the light hydrocarbon, and the desired blend are made at a fixed temperature and pressure, using an oscillating tube densitometer. The volumetric discrepancy (shrinkage or expansion) is calculated from the mixture composition and the density data.

C.2.2 EQUIPMENT

The density measurements are made using an oscillating (vibrating) tube densitometer. This instrument has a glass U tube into which a small sample is placed and allows measurement of the period of natural oscillation of the tube. Instruments of various precision are available; an instrument with six or seven digits is recommended.

Since the liquids of interest have relatively high temperature coefficients of expansion, the accuracy of the density measurements, and thus of the shrinkage factor, depends directly on the precision of temperature control of the sample in the U tube. Short-term temperature stability (about 15 minutes) of $\pm 0.001^\circ\text{C}$, at the desired temperature (usually 15°C), can be obtained by circulating fluid from a high precision temperature-controlled bath through the jacket around the U tube. Several designs of custom-built thermostat-controlled baths with this precision have been described in the literature.^{1,11} Some commercially available designs also meet the required specifications. The temperature stability and accuracy of the final configuration (bath plus densitometer) should be verified by mounting a temperature-sensing probe of suitable resolution (for example, a platinum resistance thermometer, with an appropriate electronic readout) into the center of the U tube jacket. Some instruments are designed with internal temperature control, eliminating the need for a separate bath, but checks of the temperature should still be included.

¹¹S.J. Ashcroft, et al. "Density Measurements by Oscillating Tube," J. Chem. Soc. Faraday Trans. 86(1), 145 (1990).

An electronic balance, with a resolution of 0.001 gram, and containers or syringes suitable for mixing about 50 cubic centimeters of blend are required.

C.2.3 CALIBRATION

The density of the fluid in the U tube of an oscillating tube densitometer is related to the period of oscillation of the tube. To quantify this relationship, the densitometer must be calibrated with two fluids of accurately known density. The density of the test fluid d can then be calculated from Equation C-1.

$$d = (d_2 - d_1) \frac{(\tau^2 - \tau_1^2)}{\tau_2^2 - \tau_1^2} + d_1 \quad (\text{C-1})$$

where d_1 , d_2 , τ_1 and τ_2 refer to the known densities and measured oscillation periods of the two calibration fluids respectively, and τ is the observed oscillation period of the U tube filled with the test fluid.

The most commonly used calibration fluids are water and air. These are chosen because densities of pure water and dry air are known with high precision and accuracy; data are usually provided in the instrument manual. Recommendations on calibration have been provided by Ashcroft et al.⁸ and by Fitzgerald et al.¹² The density obtained using an oscillating tube densitometer is affected by the viscosity of the fluid being measured. Correction for viscosity has been described in detail by Fitzgerald et al.

C.2.4 SAMPLE SELECTION AND PREPARATION

Isolating small samples of each of the two hydrocarbon liquids from much larger batches often requires considerable thought and effort. Stock tank crudes often contain small amounts of water and suspended solids, and gas bubbles may also be evolving. If the sample to be measured is to be truly representative, these "impurities" should be present in the measurement subsample.

However, water and solids are often heterogeneously distributed in crude oils, making it difficult to obtain a truly representative sample. In addition, samples containing dispersed solids, water droplets, and particularly gas bubbles usually give much less stable density readings. In order to improve the measurement stability, it may be necessary to remove or reduce these impurities. Gas bubbles may be removed by sonicating the sample for a few minutes.

The lighter hydrocarbon component may also contain dispersed water and solids, as well as dissolved and dispersed gases. As for the heavier component, a compromise must usually be made between representativeness of the sample and acceptable measurement precision.

There are a number of different possible approaches for preparing samples of the blended components. The best approach is the one that is most effective for the hydrocarbons of interest, and some initial optimization of the method may be required. Care must be taken to ensure that loss of volatile components is minimized during transfers and subsequent mixing, and that the resulting blend is homogeneously mixed, without addition of air bubbles.

One method that has proven effective in previous work involves the use of small glass or plastic syringes. Samples of each of the two hydrocarbon liquids are drawn into separate 25 cubic centimeter syringes. The amounts of each are adjusted to give the desired blend composition and determined exactly by weighing the syringe before and after drawing in the sample. The syringes are then connected together via a small Teflon coupling, care being taken to displace the air from the coupling before completing the connection to the second syringe.

¹²H. Fitzgerald, et al. "An Assessment of Laboratory Density Meters," Petroleum Review, November 1992, p. 544.

Mixing is then achieved by forcing all of the liquid from one syringe into the other and repeating this 5–10 times or until mixing is complete.

C.2.5 DENSITY MEASUREMENTS

Each sample to be measured is transferred via syringe to the glass U tube in the densitometer. A sufficient sample is injected to flush all of the air from the tube, and then the outlet end is capped. The sample is then allowed to come to temperature equilibrium, most easily judged by monitoring the stability of the density readout. Readings on three separate subsamples of the blend are recommended to verify that homogeneity has been achieved.

C.2.6 CALCULATIONS

Determination of the volumetric shrinkage requires the masses and densities of the two components and the density of the blend, all determined at the same known temperature. If the shrinkage is to be applied to volume data corrected to a standard temperature, then the densities should either be measured at the same standard temperature or corrected to the standard temperature using the appropriate API density-temperature correlation.

The volume fraction of the lighter component A is defined here as the ratio

$$F_A = \frac{V_A}{(V_A + V_B)} \quad (\text{C-2})$$

where V_A and V_B are the original volumes of the components A and B. F_A can be calculated from the masses and densities according to Equation C-3.

$$F_A = \frac{M_A d_B}{M_A d_B + M_B d_A} \quad (\text{C-3})$$

where M_A , M_B , d_A , and d_B refer to the masses and densities of components A and B, respectively.

The shrinkage factor is here defined as the ratio

$$S = \frac{(V_A + V_B) - V_{\text{MIX}}}{V_A + V_B} \quad (\text{C-4})$$

with symbols as defined above. Subscript MIX refers to the blended mixture. S can be calculated from F and the densities using Equation C-5.

$$S = 1 - \frac{d_B(1 - F_A) + d_A F_A}{d_{\text{MIX}}} \quad (\text{C-5})$$

Shrinkage factor is often expressed as a percentage by multiplying S by 100.

C.2.7 PRECISION AND ACCURACY

The precision of this method is limited directly by the stability of the density measurements. In applications with real crude oil-hydrocarbon blends, using the instrumentation described above, factors other than instrument resolution and temperature stability appear to limit precision in densities to about $\pm 2 \times 10^{-4}$ grams per cubic centimeter. This uncertainty in density measurements translates to a precision of 0.02 volume percent in calculated values of the shrinkage factor (for example, if S is calculated to be 0.45 percent, the 95 percent confidence limits are 0.43 to 0.47 percent).

C.3 Shrinkage Measurement Utilizing Specific Gravity Method

The shrinkage is determined for mixtures of two components by comparing the experimentally determined specific gravity of the mixtures with the theoretical specific gravities

that the same components should have shown under conditions of ideal mixing. Tests using this method must be conducted under constant-temperature conditions. The crude oil or heavier component is poured into a glass-stoppered graduated cylinder. To this is added, from a buret, the measured volume of the lighter component. The buret must be extended beneath the surface of the heavier component to minimize evaporation loss. The graduated cylinder is stoppered and inverted repeatedly to ensure mixing of the two components. Equilibrium temperature is determined with the aid of a thermometer. The gravity of both components and the resulting mixture is determined by the use of precise equipment such as hydrometers and pycnometers.

The theoretical specific gravity of each ensuing blend is calculated from the volume percent of each component and the specific gravity of the original samples. Comparison of the theoretical and experimentally determined gravity of the mixture is a measurement of the volume shrinkage.

Because the technique and equipment used in this method preclude a high degree of accuracy, it should not be expected that the results will be as reliable as those from the two methods previously described. Temperature control of $\pm 1^\circ\text{F}$ and basic volumetric measurement accurate to approximately 0.4 percent make this procedure unsuitable for use when the proportion of the lighter component in a mixture is small. Data obtained by this method were among the first results that indicated the existence of shrinkage when petroleum components were mixed. Better control equipment and instrumentation would improve the procedure.

C.4 Shrinkage Measurement Utilizing Modified P-V-T Apparatus

C.4.1 DESCRIPTION OF EQUIPMENT

The equipment for this test consists of two pressure-volume cells and a calibrated mercury pump interconnected, as shown in Figure C-2, and placed in a constant-temperature water bath.

The temperature of the bath should be controlled with ± 0.001 of 60°F (or other selected test temperature). A suggested method of controlling the temperature of the water bath is to combine a constant output refrigeration system with an extremely sensitive electrical heating system. The refrigeration system when operated alone should provide a bath temperature of approximately 58°F or approximately 2°F lower than the selected test temperature. Current to the resistance coils of the electrical heating system should be controlled by an electronic relay activated by a highly precise mercury-type thermoregulator. Temperatures should be read with a precision-grade thermometer or the equivalent. This equipment, operating properly, should have little trouble in maintaining a constant bath temperature within the $\pm 0.001^\circ\text{F}$.

All measurements should be made at a constant pressure of 100 pounds per square inch gauge (or other selected test pressure). The test pressure should exceed the vapor pressure of the most volatile component to prevent the formation of gases in the test system with resulting errors. It is suggested that a 200 pounds per square inch gauge test gauge, with 1 pound per square inch divisions, be used. This gauge should be calibrated to 0.1 pound per square inch accuracy by comparison with a deadweight tester. A hairline should be scribed on the gauge face at the 100 pounds per square inch point (or other selected test pressure) and all readings should be made at that point. The gauge should be rechecked with deadweight tester after each analysis.

Only compression-type fittings should be used to connect Valve 1 with Line D. This type of fitting has been found to reduce the possibility of errors resulting from trapped air or valve holdup.

C.4.2 PROCEDURE DURING PREPARATION AND FILLING OF EQUIPMENT FOR SHRINKAGE TEST

For purposes of clarity in this procedure, the terms “heavier component” (for example, crude oil) and “lighter component” (pentane, butane, etc.) are defined as follows: the heavier component is the petroleum product contained in Cell A at the beginning of the test; the lighter component is the petroleum product contained in Cell B, a portion of which is to be transferred into Cell A and mixed with the heavier component.

1. With Valve 1 removed and Valve 5 closed, pour approximately 400 milliliters of mercury into Cell A. Next, fill the remainder of space in Cell A with a weighed quantity of the heavier component, approximately 1,100 milliliters. The volume of this heavier component is calculated by dividing its weight by its specific gravity. Replace and close Valve 1.
2. Before Cell B is connected to the apparatus, fill it with the lighter component to be tested. This lighter component floats on a layer of mercury in the cell. Filling the cell is accomplished by the technique normally used in subsurface sample analyses, whereby fluids are transferred under pressure from one container to another by displacement with mercury. At the end of the transfer, sufficient mercury is left in Cell B to maintain a seal above Valve 6 at all times. This prevents entrance of the lighter component into Valve 6 or Line F. With Valves 2 and 6 closed, Cell B is then connected into the system shown in Figure C-2. Open Valves 3 and 4.
3. Evacuate lines between Mercury Pump C and closed Valves 5 and 6. Fill these evacuated lines with mercury by means of Mercury Pump C.
4. Open Valve 6. With Pump C inject sufficient mercury into Cell B to raise the cell pressure to 100 pounds per square inch gauge (or other selected base pressure) at bath temperature.
5. Open Valve 2. Slightly loosen the Line D connection at closed Valve 1. By mercury displacement at 100 pounds per square inch gauge, slowly purge the lighter component through Line D allowing trapped air and some lighter component to be vented at the loosened Line D connection at Valve 1. Tighten the loosened Line D connection and close Valve 4. Valves 2 and 6 are now left open.

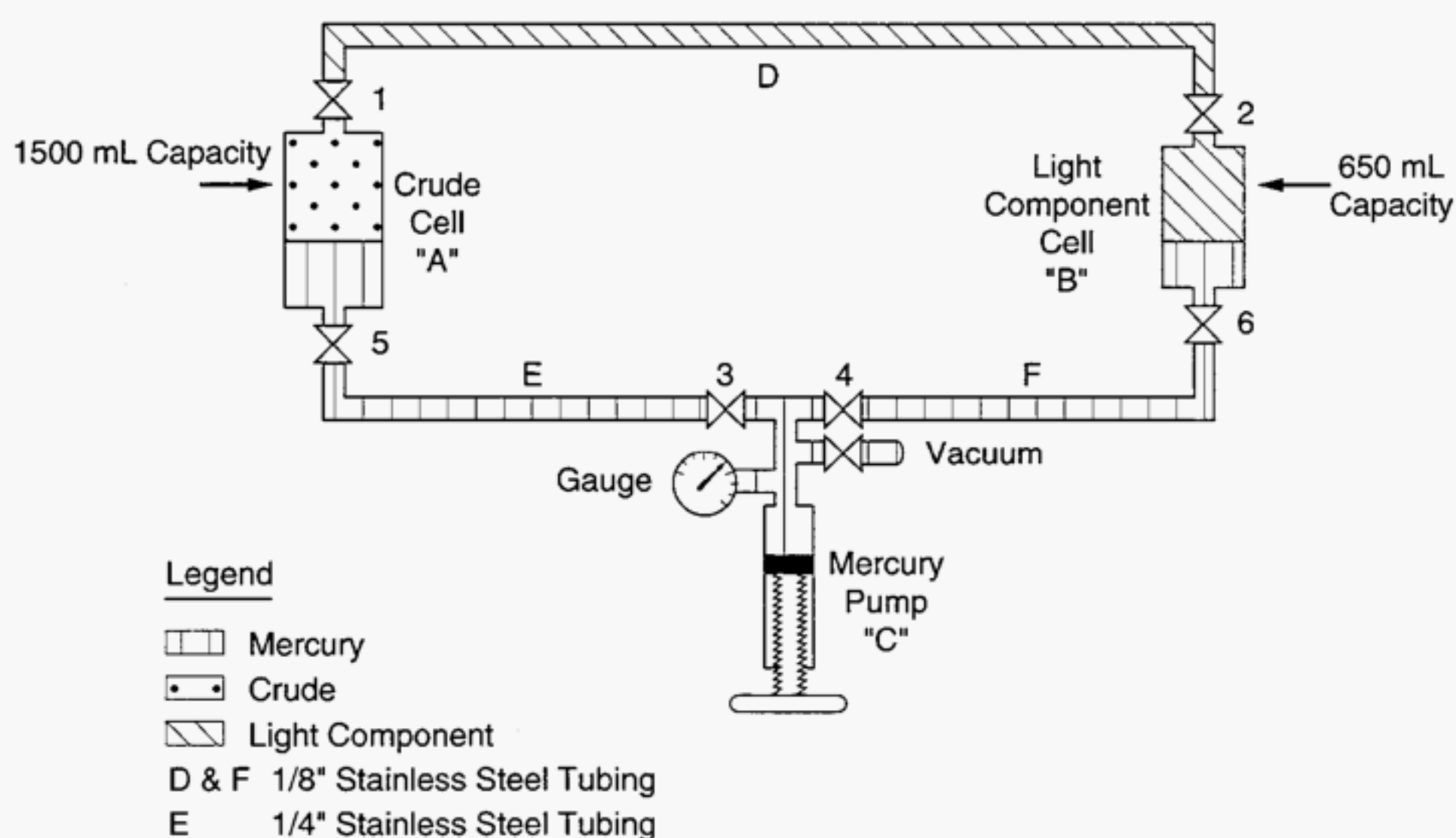


Figure C-2—Modified P-V-T Apparatus for Measuring Shrinkage of Petroleum Admixtures

6. Open Valve 5 into Cell A. By mercury injection with Pump C, raise the pressure in Cell A to 100 pounds per square inch gauge (or other selected base pressure) at bath temperature.
7. Open Valve 4 so that the pump is connected to both Cells A and B with only Valve 1 closed. The system is now checked for leaks by allowing it to stand at constant 100-pounds per square inch gauge pressure for 1 hour or longer. Any leakage would cause a pressure drop in the constant-volume system and constant-temperature system.
8. After the system is proven to be free of leaks as described in Step 7, the system constitutes a closed constant-volume unit consisting of Mercury Pump C, Cells A and B, and connecting valves and lines. In this system, maintained at constant temperature, only actual change in volume of fluids in the system will cause a change in pressure. Thus, any shrinkage occurring upon mixing of heavier and lighter components will be reflected in pressure drop. The volume of mercury that must be injected to prevent pressure drop during component mixing measures the amount of shrinkage that occurred.

C.4.3 PROCEDURE DURING SHRINKAGE TEST

At this point in the procedure, the valves should be positioned as follows:

1. Valves 2, 5, and 6 remain open and undisturbed throughout the remainder of the test.
2. Valves 3 and 4 hereafter are closed or are opened only to fixed positions. Thus, variations in the volume of the system resulting from changes in valve positions are controlled. All volumetric measurements are made with Valve 1 closed, thus preventing further addition of the lighter component to Cell A.

Determination of shrinkage occurring upon mixing heavier and lighter components requires that the lighter component be transferred from Cell B to Cell A, which already contains the heavier component. In Cell A, the two components are mixed. The resulting shrinkage is measured as the volume of mercury that must be injected into Cell A to maintain a pressure of 100 pounds per square inch gauge in the constant-temperature system. The procedure is as follows:

1. Close Valve 4 and record initial pump reading with Valve 3 open and Valve 1 closed. With Mercury Pump C, withdraw mercury from Cell A. Close Valve 3 and open Valve 4. Record the reading of the mercury pump at 100 pounds per square inch gauge. Open Valve 1 and displace a measured volume of the lighter component into Cell A. Close Valve 1 and take another reading of the mercury pump at 100 pounds per square inch gauge. The difference in pump readings measures the volume of the lighter component injected into Cell A.
2. Close Valve 4 and open Valve 3. Mix the contents of Cell A by repeatedly inverting the cell, meanwhile maintaining 100 pounds per square inch gauge pressure in the cell by the addition of mercury with Pump C. When the pressure becomes a constant 100 pounds per square inch gauge at a definite pump position, regardless of continued agitation, no further shrinkage is occurring and the final pump reading is recorded. The shrinkage that has occurred is calculated as the volumetric difference between the initial pump reading (see preceding step) and the final 100 pounds per square inch gauge pump reading just obtained. This volumetric shrinkage is calculated to a percentage basis by dividing by the total volume of the lighter component added and multiplying by 100.

Accuracy:

1. Volume measurement: Pump accuracy = 0.001 turns = 0.00129 milliliters.
2. Temperature: Temperature controlled at 60°F ±0.001.
3. Sample weight: The heavier component is weighed into the pressure-volume cell with an accuracy of 0.1 grams in approximately 1,000 grams.
4. Specific gravity: The specific gravity of the heavier component should be measured on a precise balance to an accuracy of 0.0001. The specific gravity is used to convert the weight of the heavier component (see preceding paragraph) to its equivalent volume.

The overall measurement accuracy—including mercury pump accuracy, temperature bath variation, sample weight accuracy, and the specific gravity accuracy—is 0.002 milliliters for a total test volume of approximately 1,200 milliliters.

C.5 Shrinkage Measurement Utilizing Visual Volumetric Apparatus

The apparatus in Figure C-3, operated at constant temperature, permits visual measurement of volumetric shrinkage resulting from the mixing of two dissimilar petroleum components. When properly calibrated, the equipment is designed to give experimental data for concentrations as low as 2.5 percent by volume of the lighter component in a two-component system. Auxiliary equipment required is a Reid vapor pressure temperature bath, accurate to 0.1°F, and a pressure gauge (usually 0 to 100 pounds per square inch), accurate to 1 pound per square inch.

The overall measurement accuracy, including reading accuracy of the calibrated buret and temperature bath variation (assuming correct compressibility correction of the test liquids and equipment), is 0.036 milliliters for the smallest chamber combination (total test volume, 269 milliliters) and 0.051 milliliters for the largest chamber combination (total test volume, 626 milliliters), based on butane and a 40-degree API gravity crude oil mixture.

C.5.1 PROCEDURE

The apparatus shown in Figure C-3 is assembled using the appropriate parts. Flasks, bulbs, and sight glass are interchanged to obtain different percentages of blends. Table C-1 shows the combinations of flasks and bulbs used to obtain these various blend percentages.

To determine the shrinkage for a blend containing approximately 10 percent by volume of lighter components, use Flask 1 and Bulb 1 in the assembly. Force the heavier component via a vaportight line into the calibrated Flask 1 through Valve 1 until it is well above Valve 2.

Note: In order to minimize evaporation losses, the pressure in the apparatus should be higher than the vapor pressure of the components at the existing temperature.

After closing Valves 3 and 4, the apparatus is placed in the constant-temperature bath and Valve 2 is closed when the sample has reached test temperature (30 minutes). The excess heavier component is then drained from the apparatus at Valve 3. The lighter component is forced into the calibrated Bulb 1 through Valve 3 until the liquid level reaches Valve 4. The apparatus is then inverted, and the lighter component is forced out at Valve 4 by its own vapor pressure or by draining. The lighter component is again forced into Bulb 1 until the liquid level is near the center mark of the calibrated glass section. Valve 4 is then opened momentarily to allow the pressure in the upper chamber to reach the vapor pressure of the lighter component at the existing conditions. A small 0 pounds per square inch absolute to 100 pounds per square inch absolute gauge, or one of appropriate range, is attached to Valve 4.

The apparatus is again placed in the constant-temperature bath until both the lighter and heavier components have reached test temperature (30 minutes). Valve 4 is opened slightly, and the vapor pressure (P_1) and liquid level, both the upper level and lower meniscus, are read and recorded. The meniscus is used when possible but the meniscus of some dark blends cannot be read. The difference between the upper level before and after blending will then represent the shrinkage. Liquid levels are estimated to the nearest 0.02 milliliter, and the true vapor pressure is estimated to the nearest 1 pound per square inch absolute. The apparatus should not be removed from the constant-temperature bath. Valve 2, between the two components, is then opened completely. The apparatus is rocked gently to ensure that no gas bubbles have been trapped, and the liquid level in the calibrated section is again estimated as described previously.

Note: For use with high-vapor-pressure components, it is necessary to determine the volumetric expansion of the equipment at various anticipated pressures and temperatures and to know the approximate compressibility characteristics of the components and blends.

After reading and recording both the upper level and lower meniscus with Valve 2 open, the apparatus is removed from the bath, Valve 4 is closed, and the two components are mixed until a homogeneous blend results. This is done by alternately holding the apparatus upright and then in an inverted position and gently shaking. At least 15 to 20 cycles over a period of 10 to 15 minutes are required to obtain a homogeneous blend.

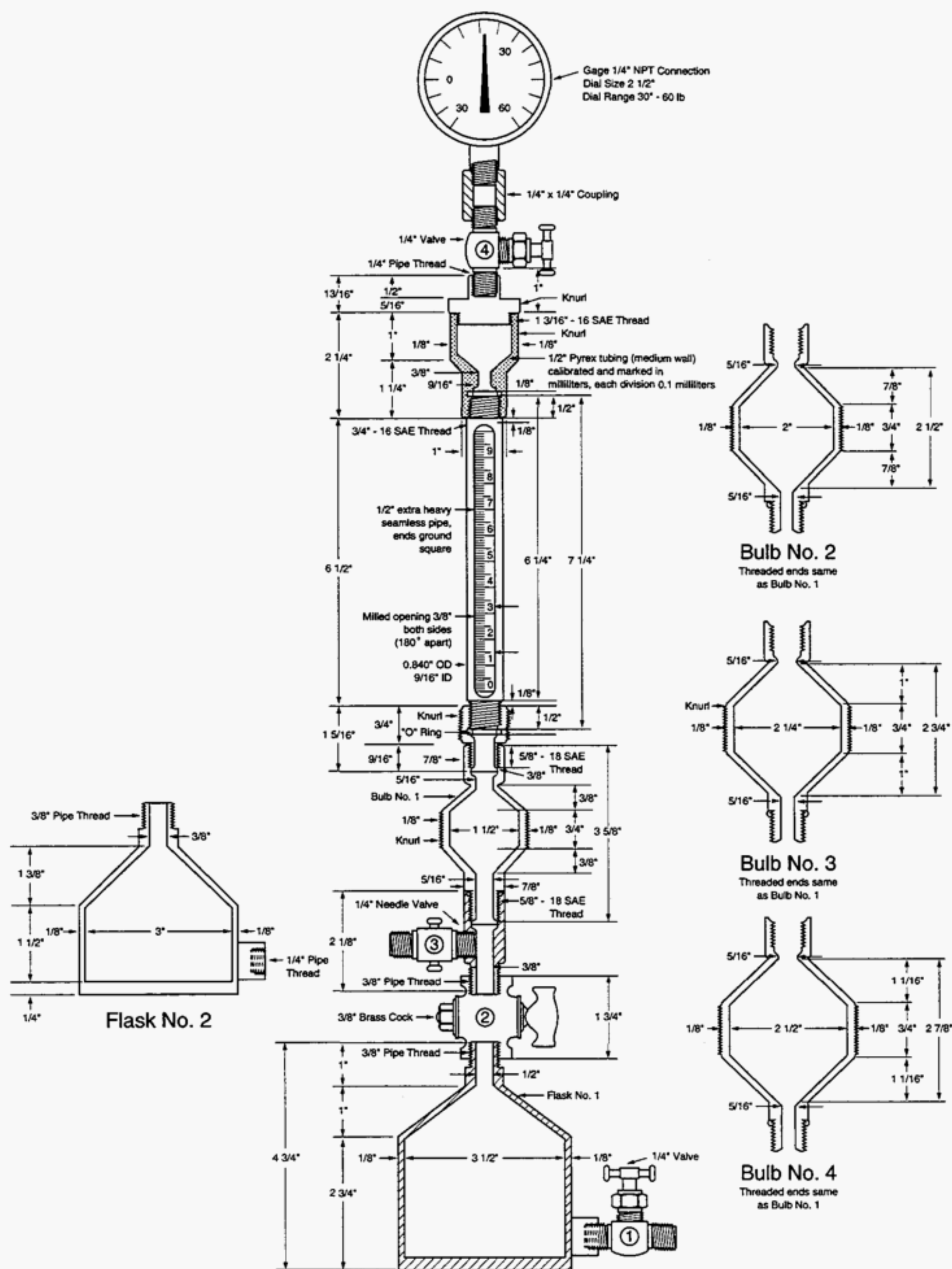


Figure C-3—Visual Volumetric Apparatus for Measuring Shrinkage of Petroleum Admixtures

Table C-1—Approximate Composition of Blends
When Various Combinations of Bulbs and
Flasks Are Used^a

Flask No.	Bulb No.	Lighter Component (Percent by Volume)
1	None	2 to 4
2	None	5 to 7
1	1	10
1	3	15
1	4	20
1	1,4	25
2	3	30
2	4	35
2	3,2	45
2	2,4	50

^aOther combinations will result in different percentage blends.

The apparatus is again returned to the constant-temperature bath until the blend has reached the test temperature. The volume and true vapor pressure (P_2) are read and recorded to the nearest 0.02 milliliter and 1 pound per square inch absolute, respectively. The shrinkage is noted from the volumetric change resulting from the blend of the two components.

C.5.2 CALCULATION

The increase in volume resulting from the dissolved vapors is calculated and added to the determined volume decrease by use of Table C-2 and the equation:

$$C = (F_1 - F_2) S$$

Where:

C = volume correction, in milliliters.

F_1 = pressure factor for P_1 .

F_2 = pressure factor for P_2 .

S = vapor space, in milliliters.

The increase in volume, in milliliters, resulting from the lower pressure is determined from previously prepared tables, based on the expansion of the equipment and the compressibility of the components, and added to the determined volume decrease:

$$\delta V = \frac{A}{H_v + L_v} (100)$$

Where:

δV = volume decrease as percent of total blend volume.

A = corrected volume change on mixing, in milliliters.

H_v = corrected volume of the heavier component, in milliliters.

L_v = corrected volume of the lighter component, in milliliters.

This method can be used under field conditions by qualified technical personnel, provided proper allowance is made for its range of accuracy and the conditions under which the data will be applied. The necessity of correct calibration of the test equipment and proper correction for the effects of compressibility is emphasized.

Table C-2—Pressure Factors for Hydrocarbon Vapors
(Correction for Liquid Contained in Vapor Space)

Pressure (<i>P</i>)		
Pounds per Square Inch Gauge	Pounds per Square Inch Absolute	Pressure Factor (<i>F</i>)
	0	0.0000
	5	0.0015
	10	0.0030
0	15	0.0045
5	20	0.0060
10	25	0.0075
15	30	0.0090
20	35	0.0104
25	40	0.0118
30	45	0.0133
35	50	0.0148
45	60	0.0174
55	70	0.0209
65	80	0.0240
75	90	0.0270
85	100	0.0300
105	120	0.0363
125	140	0.0425
145	160	0.0490
165	180	0.0556
185	200	0.0620

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