Recommended Practice for

VOLUME CALCULATIONS AND CORRECTIONS IN THE MEASUREMENT OF PETROLEUM AND PETROLEUM PRODUCTS[1]

ASTM Designation: D 1087 – 60

ADOPTED, 1960.[2]

This Recommended Practice of the American Society for Testing Materials is issued under the fixed designation D 1087; the final number indicates the year of original adoption or, in the case of revision, the year of last revision.

Scope

1. This recommended practice describes procedures for volume calculations and corrections in the measurement of petroleum and its liquid products.

Terminology

2. (*a*) *Measured Quantity* is the volume of material in a tank for a given gage at the temperature observed at the time of gaging.

(*b*) *Gross Quantity at 60 F.* is the measured quantity converted to the equivalent volume at 60 F. after deducting any free water and sediment (FW & S) which may be present.

(*c*) *Net Quantity at 60 F.* is the gross quantity at 60 F. corrected for any *deductible* suspended water and sediment (SW & S) which may be present. (All SW & S is deductible, unless otherwise specified by contract.)

NOTE.—In crude oil measuring and testing, "FW & S" and "SW & S" are frequently referred to as "BS & W," meaning respectively "Bottom" and "Basic" Sediment and Water.

(*d*) *Tables.*—All references in this standard to tables followed by a

[1] Under the standardization procedure of the Society, this recommended practice is under the jurisdiction of the ASTM Committee D-2 on Petroleum Products and Lubricants.

[2] Prior to adoption, this recommended practice was published as tentative from 1950 to 1960, being revised in 1952 and 1957.

In 1960, this recommended practice was adopted without revision.

number refer to the ASTM-IP Petroleum Measurement Tables (American Edition) (ASTM Designation: D 1250; IP 200).[3]

Use of Capacity Tables

3. Capacity tables showing quantities for either innage or outage gages shall be based on accurate tank calibration data. The calibrations should be checked periodically and whenever repairs or alterations are made to a tank or compartment.

BASIC CALCULATIONS

Basic Calculations

4. (*a*) *Measured Quantity.*—Obtain the measured quantity for each opening and closing gage directly from the capacity table. If the basis of the table, innage or outage, is not the same as that of the gage, convert the gage to the same basis as the table by deducting the gage reading from the reference depth (gaging height).

(*b*) *Free Water and Sediment Deduction.*—Obtain the quantities of free water and sediment, corresponding to each opening and closing water gage from the capacity table and deduct them from the respective opening and closing measured quantities.

(*c*) *Gross Quantity at 60 F.*—Calculate the gross quantity at 60 F. by multiplying the measured quantity, corrected for any free water and sediment, by the volume correction factor which corresponds to its gravity. Obtain this factor from Table 6 of Standard D 1250[3]; for liquefied petroleum gases obtain this factor from Table 34. The delivered or received gross quantity at 60 F. is the difference between the gross quantities at 60 F. calculated from the opening and closing gages.

(*d*) *Net Quantity at 60 F.*—Obtain the net quantity at 60 F. by subtracting any suspended water and sediment which may be present from the gross quantity at 60 F. When contracts make allowance for some SW & S, the deductible quantity is the difference between the total and the allowable quantities of SW & S.

(*e*) Tanks are usually calibrated in U. S. gallons or barrels. Convert gallons to barrels by dividing by 42.

(*f*) *Example.*—The following data and calculations illustrate the recommended procedure for calculating the gross and net quantities of product at 60 F. measured in or delivered from a tank:

Gaging Data:

Tank number	307
Product	West Texas crude oil
Vessel	Barge No. 16

[3] Published jointly by, and available from, the American Society for Testing Materials, 1916 Race St., Philadelphia 3, and the Institute of Petroleum, 26 Portland Place, London W-1. Companion volumes—the British Edition and the Metric Edition—are also available.

	Opening Gage	*Closing Gage*
Reference depth	28 ft. 8 in.	28 ft. 8 in.
Outage:		
Tape reading	10 ft. 4 in.	19 ft. 10 in.
Bob reading	0 ft. 3¾ in.	0 ft. 3⅛ in.
Outage gage	10 ft. 7¾ in.	20 ft. 1⅛ in.
Temperature, deg. Fahr.:		
Top	51	..
Middle	51	49
Bottom	48	..
Water outage	28 ft. 5¾ in.	28 ft. 5¾ in.
Date	3/15/49	3/15/49
Exact time	9:55 A.M.	3:15 P.M.

Laboratory Data:

Gravity at 60 F., deg. API	43.3
Suspended water and sediment, per cent	0.2

	Opening Gage	*Closing Gage*
Calculation:		
Measured quantity:		
Reference depth	28 ft. 8 in.	28 ft. 8 in.
Subtract outage gage	10 ft. 7¾ in.	20 ft. 1⅛ in.
Innage gage	18 ft. 0¼ in.	8 ft. 6⅞ in.
U. S. gal (capacity table)	954,238	457,982
Free water and sediment:		
Reference depth	28 ft. 8 in.	28 ft. 8 in.
Subtract outage gage	28 ft. 5¾ in.	28 ft. 5¾ in.
Innage gage	0 ft. 2¼ in.	0 ft. 2¼ in.
U. S. gal (capacity table)	10,020	10,020
Measured quantity less FW and S, gal	944,218	447,962
Average temperature, deg Fahr	50	49
Volume correction factor (Table 6)	1.0049	1.0054
Delivered Gross Quantity:		
Gross quantity at 60 F, or, U. S. gal	944,218 × 1.0049 = 948,845	447,962 × 1.0054 = 450,381
Subtracting	450,381	
Delivered gross quantity at 60 F, U. S. gal	498,464	

Delivered Net Quantity:

Suspended water and sediment:	
From laboratory, per cent	0.2
Subtract allowable, per cent	0.0
Deductible, per cent	0.2
Deductible quantity, U. S. gal	997

Net delivered at 60 F:	
U. S. gal (498,464 − 997)	497,467
Barrels calculated (497,467 ÷ 42)	11,844.45
Barrels to be reported	11,844

(*g*) *Significant Figures.*—For bulk deliveries, it is recommended that calculated values be rounded as follows:

Quantity	*Rounded to:*
Pounds	1 lb
Tons	0.01 ton
Gallons	1 gal
Barrels	0.01 bbl

To round, add 5 to the digit one beyond the last to be retained, and from the sum drop all digits beyond the one being retained.

SPECIAL CALCULATIONS

Floating Roof Tanks

5. (*a*) *Floating Roof.*—Under normal operating conditions the roof is in a floating position for both opening and closing gages. Therefore corrections for the weight of product displaced by the roof need not be made because it is the same for both opening and closing gages. If the roof is in a partially floating position, the measured quantity cannot be calculated accurately. Although it is not good operating practice for safety or loss control, it is sometimes necessary to draw the product away from the roof completely so that the roof rests on its supports. Where this condition occurs for either the opening or closing gage, a quantity equivalent to the roof displacement should be deducted from the measured quantity (Section 4 (*a*)), corresponding to the gage taken when the roof was floating. Use the following to calculate the quantity equivalent to the roof displacement:

$$Q = \frac{W}{P}$$

where:

Q = gallons equivalent to the roof displacement.
W = weight of the floating roof in pounds, and
P = pounds per gallon of product.

The weight of the roof is stamped on the roof manhole plate and printed on the capacity table. Obtain the pounds per gallon of the product from Table 8 of Standard D 1250.[3]

(*b*) *Example.*—The following illustrates the recommended procedure for calculating the quantity of product at 60 F, for the case where the floating roof is resting upon is supports at the opening gage: