

Portable Density Meter Procedure

vs.

Gravimetric Tests Procedures for Non-Viscous Liquids

This paper is to show the equivalence between the current Chapter 3, Section 3, 3.2. Gravimetric Test Procedure for Non-Viscous Liquids and the direct comparison between the laboratory digital density meter and the portable digital density meter.

Laboratory Digital Density Meter (0.0001)			Portable Digital Density Meter (0.001)				Diff
	Ref T, °C	ρ	Meas, °C	ρ	Alpha	ρ_{ref}	
Motor Oil 5W-30 Syn	15	0.8521	25.4	0.8450	API D @15°C	0.8518	-0.0003
Paint Thinner	15	0.7860	23.8	0.7794	API B @15°C	0.7861	0.0001
Olive Oil	20	0.9131	24.7	0.9103	0.00067	0.9133	0.0002
Acetone	20	0.7909	24.6	0.7859	0.00112	0.7910	0.0001
vodka (40%)	15.56	0.9511	22.4	0.9483	0.00068	0.9510	-0.0001
Milk, 2%	4	1.0349	21	1.0315	0.00022	1.0353	0.0004

The above table is a comparison between a laboratory model digital density meter with an accuracy of ± 0.0001 g/cc and a portable digital density meter with an accuracy of ± 0.001 g/cc. Laboratory digital density meters are designed to measure the density of liquids to a preset temperature (i.e., reference temperatures can be found in Chapter 3, Table 3-1 HB133) by a built-in cooler/heater. The portable digital density meters lack a cooler/heater but has an integrated accurate electronic thermometer. The thermometer captures the temperature with the density measurement. Using a correction value (alpha), the density at the reference temperature can be calculated from the measured density. Alpha values can be stored in the instrument for specific products, or for petroleum products, built-in ASTM/IP/API density correction factors can be used.

Uncertainty of measurements.

The temperature variation allowed in Chapter 3, Section 3, 3.2. Gravimetric Test Procedure for Non-Viscous Liquids can be calculated by combining the tolerance allowed for the thermometer and the temperature range allowed for the product under test (± 2 °F thermometer and ± 5 °F for the product). This uncertainty can be more than 0.25% for some liquids in comparison with the same example of 0.13% uncertainty using the portable digital density meter.

Product	Skim Milk	Whole Milk	Mineral Spirits	Diesel Exhaust Fluid
Qty	128	128	128	320
Prod Net Wt, lb (Scale)	8.528	8.586	6.325	22.807
Reference Temp, °F	40	40	60	68
Flask Procedure				
Flask Size, fl oz	64	64	64	128
Meas Temp, °F	42.3	42.8	65	66.1
Flask Net, lb	4.317	4.312	3.1755	9.091
lb/fl oz	0.06745	0.06738	0.04962	0.07102
g/cc	1.0346	1.0334	0.7610	1.0893
Measured Vol of Pkg, fl oz	126.43	127.44	127.48	321.12
Density Meter Procedure				
Density (true), g/cc	1.0328	1.0307	0.7612	1.0892
Measured Temp, °C	20	20	20	20
Barometric Press, mmHg	743.45	743.45	743.45	743.45
Alpha, °C	0.00019	0.00025	0.00088	0.00022
Visc Corr	0	0	0	0
Reference Temp, °C	4.44	4.44	15.56	20
Density (apparent), g/cc	1.0346	1.0335	0.7640	1.0882
lb/fl oz	0.06746	0.06738	0.04981	0.07095
Measured Vol of Pkg, fl oz	126.42	127.43	126.97	321.45
Difference between Procedures				
	0.00%	-0.01%	-0.40%	0.10%
Flask Proc (adj to ref temp)				
	0.02%	0.03%	-0.08%	0.08%
MAV, fl oz				
	2.5	2.5	2.5	4.5
MAV, percent of total vol				
	1.95%	1.95%	1.95%	1.41%

This shows equivalence between current Gravimetric Test Procedure for Non-Viscous Liquids and the Digital Density Meter Procedure.