

Application Note

Density/relative density (Specific gravity) / API gravity measurements of lubricating oil

Industry	Petroleum
Instrument	Density/Specific gravity meter + Auto Sampler
Measurement method	Resonant frequency oscillation
Standards	ASTM D4052

1. Scope

ASTM D4052 prescribes a method for measuring the density, relative density and API gravity of petroleum products (liquid samples) by a digital density meter. The KEM density/specific gravity meter used in this measurement conforms to this standard and can be used to make measurements automatically in combination with an Auto Sampler.

This application shows an example of the measurement of density (specific gravity) / API of lubricating oil using an Auto Sampler (Note 1).

2. Precautions

The correct values will not be obtained if there are bubbles in the sample. Remove any bubbles by heating the sample or using ultrasonic cleaning equipment before placing the sample in Auto Sampler.

3. Apparatus

Equipment	Density/Specific gravity meter
Option	Auto Sampler

4. Reagents

Rinse liquid 1	Toluene
Rinse liquid 2	Acetone

Using toluene as Rinse liquid 1 increases the rinsing efficiency by dissolving any lubricating oil adhering to the cell.

5. Procedure

- Calibration -

- Place a sample vial containing pure water in Auto Sampler and perform the calibration.

- Measurement -

- Place a sample vial containing the sample in Auto Sampler, and perform the measurement.

To perform calibration followed by sample measurement automatically, set both the pure water for calibration and the sample.

The Auto Sampler can also automatically sampling, measurement (calibration), rinse and dry the cell.

6. Example

— Parameter —

The measurement parameters are set by the customer (see the table below).

< Measurement parameter >		< Sequence >		
method	API	Sequence name	Lubricant	
Set temperature	60.0 °F	1	Sampling	Auto, Rate 50%, Time 20s
Stability sense	1	2	Measurement	
Limit time	1200s	3	Drain	Auto, Rate 100%
Viscosity correction	on	4	Rinse 3(Toluene)	70s, Liquid Ratio 25%
Calibration material	air and water	5	Drain	On, 5s
		6	Rinse 2(Acetone)	20s, Liquid Ratio 25%
< Sample file >		7	Drain	On, 5s
Sample mode	File mode	8	Purge	On, 120s
Number of samples	20	9	Cell Test	On, Density Deviation 50
Next sample No.	1			

(The measurement parameters are examples for using KEM's Density/Specific gravity meter.
They may vary depending on the model.)

— Measurement results —

n	Density (g/cm ³)	API gravity
1	0.8173	41.47
2	0.8173	41.47
3	0.8173	41.47
4	0.8173	41.47
5	0.8173	41.47
6	0.8173	41.47
7	0.8173	41.47
8	0.8173	41.47
9	0.8173	41.47
10	0.8173	41.47
11	0.8173	41.47
12	0.8173	41.47
13	0.8173	41.47
14	0.8173	41.47
15	0.8173	41.47
16	0.8173	41.47
17	0.8173	41.47
18	0.8173	41.47
19	0.8173	41.47
20	0.8173	41.47

7. Summary

The density and specific gravity of lubricating oil can be measured stably by the combination of density/specific gravity meter and Auto Sampler according to ASTM D4052 (Note 2).

8. Notes

Note 1) Oscillating type density/specific gravity meters produce a positive measurement error if the sample is highly viscous. The instrument used in this experiment has a viscosity correction function, and the measurements obtained are corrected for the effect of viscosity.

Note 2) ASTM D4052 notes that when the same sample with a density between 0.80 and 0.88 g/cm³ is measured by the same operator using the same instrument under constant conditions, the density repeatability value would only exceed 0.00016 g/cm³ once in 20 trials.

9. References

ASTM D4052, Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter.