# DENSITY, RELATIVE DENSITY, AND SPECIFIC GRAVITY

## GENERAL

Density is an important property of petroleum products being part of product specifications. Materials are usually bought and sold on that basis or if on volume basis then converted to mass basis via density measurements. This property is almost synonymously termed as density, relative density, gravity, and specific gravity, all terms related to each other. There are at least a dozen test method standards in D02 manuals that describe this determination (see Table 4). Usually a hydrometer, pycnometer or more modern digital density meter is used in all these standards. The plurality of the methods is because they are specifically written for different products. Some basic definitions:

*density*—The mass (weight in vacuo) of liquid per unit volume at 15°C.

*relative density*—The ratio of the mass of a given volume of liquid at 15°C to the mass of an equal volume of pure water at the same temperature.

*specific gravity*—Same as relative density.

## REAL DENSITY OF CALCINED PETROLEUM COKE: D 2638

Real density is obtained when the particle size of the specimen is smaller than 75 μm. It directly influences the physical and chemical properties of the manufactured carbon and graphite artifacts for which it is used.

## TEST SUMMARY

A sample is dried and ground to pass a 75-μm screen. The mass of the volume is determined directly, and the volume derived by the volume of helium displaced when the sample is introduced into a helium pycnometer. The ratio of the mass of the sample to the volume is reported as the real density.

## TEST PRECISION

The test has a repeatability of 0.018 and reproducibility of 0.025 g/cm$^3$.

Bias of this test method is not known.

**TABLE 4—**Comparison of Density Methods.

| Test Method | Property | Matrix | Technique | *r* | *R* | Bias |
|---|---|---|---|---|---|---|
| D 71 | Relative Density | Solid Pitch | Gravimetry | 0.005 | 0.007 | NA[a] |
| D 1217 | Density | Liquid Fuels | Bingham Pycnometer | 0.00002 | 0.00003 | NA |
| D 1298 | Specific Gravity | Liquid Fuels | Hydrometer | Variable | Variable | NA |
| D 1480 | Density and Relative Density | Viscous Liquids | Bingham Pycnometer | 0.00005 | 0.00014 | NA |
| D 1481 | Relative Density | Viscous Liquids | Lipkin Pycnometer | 0.00015 | 0.00035 | NA |
| D 1657 | Density | Light Hydrocarbons and LPG | Hydrometer | NA | NA | NA |
| D 2320 | Density and Specific Gravity | Solid Pitch | Pycnometer | 0.011(SG) | 0.001(SG) | NA |
| | | | | 0.007(D) | 0.011(D) | NA |
| D 2638 | Real Density | Calcined Petroleum Coke | Helium Pycnometer | 0.018 | 0.025 | NA |
| D 4052 | Density | Liquids | Digital Meter | 0.0001 | 0.0005 | 0.0006 |
| D 4292 | Bulk Density | Calcined Petroleum Coke | Helium Pycnometer | 0.014 | 0.046 | NA |
| D 4892 | Density | Solid Pitch | Pycnometer | 0.02 | 0.03 | 0.04 |
| D 5002 | Specific Gravity | Crude Oil | Oscillating Frequency | 0.00105X | 0.00412X | NA |
| D 5004 | Real Density | Calcined Petroleum Coke | Helium Pycnometer | 0.0067 | 0.0156 | NA |

[a]NA—Not available.