Manual methods for density measurement
Manual methods like pycnometers and hydrometers are widely used for the determination of density and related values, e.g. specific gravity, alcohol%, BRIX°, API degrees, Baumé, Plato, etc. Though these methods are easy to use and quite inexpensive, they require expertise in every step of the manual operation protocols, which often affects the accuracy and reliability of the results. Most often, different operators will obtain different results for the same sample.

Advantages
- Straightforward method
- Inexpensive instruments

Disadvantages
- Operator dependent results
- Intense training required
- Limited and variability in accuracy
- Long and tedious temperature readings
- Manual calculations
- Breakable glassware

Digital methods for automatic density measurement
Digital density meters use the oscillation tube technology to measure very accurately the density of a sample in a short time. Benchtop digital density meters use in addition a built-in Peltier thermostat to control the temperature of the sample. The measurement is started by pressing a key, after a short time the result appears on the screen and can be printed, sent to a computer or exported to LIMS.

Advantages
- Small sample volumes (less than 2 mL)
- Fast measurement (less than 1 minute)
- Peltier thermostating (benchtop models)
- High accuracy (up to 0.00002 g/cm³)
- Measurement protocol (GLP)
- Automation (sample changer, computer, multi-parameter solutions)
- High throughput, short ROI*

Disadvantages
- Expensive instruments, but short ROI*
- New method, not yet widespread in some industries

Moving from manual to digital density measurement
Manual methods are being replaced by digital density meters for many critical reasons. Even though digital density meters are more expensive, it is a necessary investment. Some key advantages of automatic density measurements include time saving, higher accuracy and repeatability, and operator independent results. These lead to improved efficiency, higher throughput, and trustworthy data quality. In addition, modern labs have upgraded to electronic data management, requiring digital density meters for operation.
**Hydrometers**
The hydrometer (areometer) is a glass body which is dipped into the sample. After a short equilibration time it will swim at a certain level (when the mass of the hydrometer is equal to the buoyancy effect). The higher the density of the sample, the less the areometers will sink. The level of equilibration reads the density on the calibrated scale.

**Main applications:** Quick control of a “rough” density value, mainly for process control. Suitable for the measurement of the same kind of sample (wine, beer) due to the limited measuring range.

**Pycnometers**
A pycnometer is a glass beaker of defined volume. It is weighed without sample (M1), then filled with the sample and weighed again (M2). The difference between M1 and M2 (=Mass of the sample) divided by the volume of the beaker is the density of the sample.

**Main applications:** Educational: what is density, how to measure density. Production control: where more precision is required. Analytical labs: where GLP is not required.

**Handheld digital density meter**
Digital density meters use the oscillation tube technology to measure very accurately the density of a sample in a short time. The sample is injected into a U-shaped glass tube and put into oscillation, which stabilizes at a specific frequency. This frequency changes when the tube is filled with the sample: the higher the mass of the sample, the lower the frequency. This frequency is measured and converted into density.

**Main applications:** Calibration is carried out with distilled water. Incoming goods inspection. Quality control of final product. Concentration measurement. Purity check.

**Benchtop digital density meter**
Benchtop density meters use the same oscillation tube technology than the handheld digital density meters. In addition, a built-in Peltier thermostat controls the temperature of the sample up to 0.05 °C accuracy, in a range of 0 to 91 °C.

**Main applications:** Incoming goods inspection. Quality control of final product. Concentration measurement. Purity check. Expensive samples (flavors & fragrances). Alcohol measurement. Multi-parameter analysis (e.g. combined measurement of density, refractive index, pH and color or titration).

**Make the step into automatic density measurement**
Contact us to learn how you can save time, increase accuracy and improve repeatability with operator independent results. An investment in a digital density meter would probably result in a shorter payback than expected.