

Thermo Scientific Circulators for use with ABBE Refractometers

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- Refractometry
- ABBE refractometer
- Brix scale

Abstract

Accurate refractometric results can only be achieved by stabilizing the temperature during measurement. ABBE refractometers combined with a Thermo Scientific HAAKE DC10-K10 or Thermo Scientific HAAKE DC10-P5/U circulator deliver reliable results for Quality Control laboratories.

Refractometry in QC Labs

Refractometry, a common QC lab technique, is used to determine the concentration of solutions and to help identify unknown substances. Refractometers are widely used in food and beverage, agricultural, and industrial applications to measure the amount of dissolved substances in solutions that contain sucrose (sugar).

The relationship between the refractive index (“n”) and the amount of dry substance is well known for sucrose, thus it is the basis of the Brix scale, which is the measure of the number of grams of sucrose present per 100 grams of aqueous sugar solution.

This relationship holds for a large number of similar substances, which is why the Brix scale is used in the food and beverage industry to determine product consistency. In addition, governments also demand strict quality control at specific temperatures to ensure imported products conform to regulatory standards.

However, the main drawback to refractometry is that natural temperature variations in the substances being measured result in grossly inaccurate refractive readings.

The Importance of Controlling Temperature

Accurate refractive index results are very dependent on temperature. It is well known that materials expand when heated (becoming less dense) and contract when cooled (becoming denser), therefore the refractive index changes. The amount of error per °Celsius is different for every fluid and differs for different concentrations of the same fluid. Tap water can vary from season to season and from day to day.

Controlling a substance’s temperature eliminates the need for technicians to apply a correction factor when taking readings. Because most precision laboratory refractometers have water inlet and outlet ports, temperature can be precisely controlled to 0.1°C by connecting the refractometer to a circulating water bath. Once the reference temperature has been set, the refractometer will display accurate results.

Combining a precision ABBE refractometer with a compatible and accurate external liquid temperature control system from Thermo Fisher is an inexpensive solution for obtaining precise re-fractive index measurements. Refractometers are used in the following industries:

Food and Beverage Processing

Refractometers ensure product uniformity and stability. The required higher temperature accuracy allows users to manufacture a more uniform product for shipping, improve product standardization, or compare it to a competing product. Soluble solids, moisture, and fat content can also be accurately



A precision ABBE refractometer, combined with a compatible external liquid temperature control system, allows QC technicians to obtain precise refractive index measurements with minimal investment.

determined using refractometers.

Trends in the consumer market require this industry to report certain values that consumers can read and understand. For example, chemical sweeteners have established themselves on the consumer market and suppliers of soft drinks have to measure the beverage sweetness against these products.

Industry

Improvements in industry enhance corrosion reduction in cutting operations and lead to longer tool lifetimes. The Refractive Index of solid samples is measured to help develop new glass, film and plastic products. The coating of a car windshield is a typical example in this case.

Agriculture

The analysis of food products, such as oil contents of seeds, sweet corn maturity, and salinity is one example of how refractometry is used in agricultural applications.

Advanced Digital System

The Thermo Scientific HAAKE DC10-K10 unit (order no 426-1641 for 220V/ 50Hz, 426-1642 for 115V/ 60Hz) combines a DC10 circulator for working temperatures from -10 to 100°C, with a 3-liter K10 bath and features fast cooling with a cooling capacity of 240 W at 20°C. Temperature accuracy is $\pm 0.02^\circ\text{K}$. Temperature is set and displayed digitally.

The system is equipped with RTA software to compensate for possible differences between the temperature displayed and the actual temperature in the bath/refractometer. A second display shows the pre-set temperatures (3 fixed + 1 set temperature). All settings are easily made using the systems' front panel (options include push button or dials). In addition to a Ryton pump, the unit is equipped with a 2kW heating device at 220V (1.2kW heating

capacity at 115V) to compensate for fast lens-temperature reactions. The DC10 is equipped with an over-temperature alarm setting feature.

Simple Digital System

The Thermo Scientific HAAKE DC10-P5/U unit, (order no 426-1851 for 220V/ 50Hz, 426-1852 for 115V/ 60Hz) is a combination of a HAAKE DC10 digital circulator for working temperatures from 20°C to 100°C, with a 5-liter polyphenyleneoxide (PPO) bath, an external circulation set, tap water cooling coil and bath cover. Temperature accuracy is $\pm 0.02^\circ\text{K}$.



Thermo Scientific HAAKE DC10-P5/U Unit

Accessories

082-1215 Bath tubing 12 mm
I diameter, per meter
or
082-1214 Bath tubing 8 mm
I diameter, per meter



Thermo Scientific HAAKE DC10-K10 Unit

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