

CRYETTE™ Cryoscopes

From Precision Systems Inc.◦

Freezing Point and Molecular Weight Measurements



Cryette Cryoscopes are capable of:

- Precise measurements of freezing point depressions of solutions with freezing points from -10 to $+10^{\circ}\text{C}$
- Fast, accurate molecular weight determinations
- Measuring concentration in less than 2 minutes
- Precision of $.001^{\circ}\text{C}$, 1% for concentration and molecular weight
- Simple operation minimizing operator technique

Use a freezing point Cryoscope to:

- Differentiate Petroleum Distillates or Cracking Fractions — in minutes
- Identify Environmental Pollutants
- Grade Polyethylene Glycol
- Check for Adulteration of Milk
- Quality Control reagents, beverages, and pharmaceuticals

And More!

CRYETTE Cryoscopes

A Versatile Analytical Tool

The Precision Systems Cryoscopes are precision instruments that automate the measurement of freezing point depression of solutions. A simple adjustment of the cooling bath temperature of the Wide Range Cryette implements the measurement of freezing point depression of solutions with freezing points in the range of -10 to $+10^{\circ}\text{C}$. Depression of the freezing point of a solvent is directly proportional to solute particle concentration, and is generally independent of the chemical nature of the dissolved material. As a result, an accurate measure of freezing point depression presents a powerful analytical tool in many application areas.

Molecular Weight Determinations

Since the freezing point of a solution is depressed from the freezing point of the solvent in direct proportion to the concentration of the solute, an accurate measurement of solution freezing point depression permits a simple calculation of molecular weight. A solution is prepared with accurately weighed portions of solvent and solute, chosen to produce a suitably dilute specimen. After measuring freezing point, the solute average molecular weight can be calculated using this equation:

$$\text{MW} = \frac{1000 \cdot K \cdot U}{\Delta T \cdot V}$$

Where...
K= Molal freezing point depression constant
U= Weight of solute in grams
 ΔT = Freezing point depression in degrees C
V= Weight of solvent in grams

When the solute consists of a mixture of two substances of known molecular weight, the freezing point depression data enables the user to determine the relative proportion of each substance.

Concentration Measurements

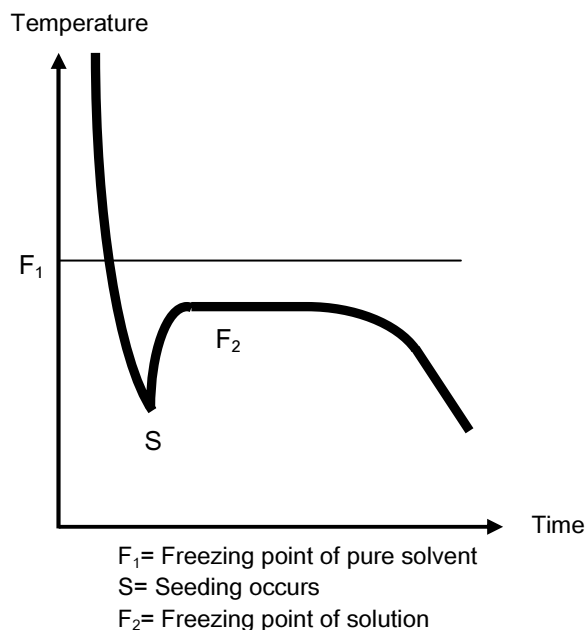
When calibrated with solutions of known concentration, the cryoscope can give a rapid, precise digital reading of solution concentration. This measurement is a convenient way to verify accuracy of a variety of different solutions in the lab, including reagents, pharmaceuticals, beverages and milk.

Principle of Operation

The CRYETTE cryoscopes use supercooling and the heat of fusion to measure freezing point. Supercooling occurs when the temperature of a liquid is lowered below the freezing point without the occurrence of freezing. When a supercooled liquid is agitated, crystallization occurs without contamination to the sample. Crystal formation lowers the molecular energy, releasing heat, known as the heat of fusion. In the CRYETTE, a liquid sample is supercooled and remains liquid below its freezing point (F) — see diagram below — until the liquid is agitated, or “seeded,” (S), initiating freezing. The resultant heat of fusion tends to warm the solution. The phase change from liquid to solid continues to warm the sample until there is a small amount of frozen solvent in temperature equilibrium with the remaining solution. With the sample thermally isolated adequately, this temperature equilibrium, or plateau, at the freezing point will last long enough to make a measurement to 0.001°C , and will continue until more solvent is frozen.

If the cooling is accomplished rapidly, and the seeding performed by a strong, systematic agitation at the point of supercooling, a time temperature curve like this will result.

Typical Cooling Curve



The point “S” is where seeding occurs. Solution freezing point temperature is measured at the plateau.

The Technology

The CRYETTE cryoscopes use a thermo-electric refrigerator and coolant in an insulated well to supercool the sample. The measuring head contains the thermistor temperature measuring element and a stirring wire which is vibrated to seed the sample. State-of-the-art solid state electronic circuitry is employed in the refrigerator, thermometer and digital readout.

Petroleum Cryoscope CRYETTE A

Precision Systems originally developed the Petroleum CRYETTE as a means of applying the freezing point and molecular weight measurement automation technology to the petroleum industry.

Using water-saturated benzene solutions, users can measure molecular weight with sufficient accuracy to differentiate hydrocarbon fractions in a matter of a couple of minutes. A front panel switch enables the choice of a bath cooling range suitable for use with either water or benzene solutions.

Wide Range CRYETTE WR

The CRYETTE WR was developed for applications using solvents with different freezing points that fall outside the freezing point ranges of water and benzene solutions. Frequently, there is a desire to use a solvent other than benzene with petroleum. Cyclohexane is often selected as a suitable alternative.

The solid state refrigerator of the Wide Range CRYETTE provides for adjustment of the cooling bath temperature to permit freezing point measurements of solutions in the -10 to $+10^{\circ}\text{C}$ range. This accommodates a wide range of solvents. Precision Systems can provide a list of such solvents upon request.

The digital reading is in millidegrees Celsius, representing the depression of freezing point introduced by the solute. For many applications this value provides definitive information, particularly for quality control, or for differentiating among expected results of a synthesis.

When actual molecular weight is required, a simple calculation yields results consistently within 1% of theoretical values.



Milk CRYETTE A

In the 1920s, Julius Hortvet determined that milk freezing points fall between -0.525°C and -0.555°C . Freezing point testing with the Milk CRYETTE enables monitoring for added water in milk. Precision Systems' milk cryoscope has been designed to display answers in millidegrees Hortvet, the industry standard. The Milk CRYETTE A is a quick, easy way to QC milk samples.

A Base Freezing Point may be established by state agriculture and health departments or other government agencies, universities, dairy producers, etc. The user's manual provides a table of calculated added water based on a sample's freezing point, where the base freezing point is -0.540°H . Other tables can be calculated for easy reference as well. The Precision Systems Milk Cryette meets specifications outlined by the AOAC and APHA regulator agencies' methods.

CRYETTE™ Family Product Specifications

	CRYETTE WR	DUAL RANGE Petroleum CRYETTE A	Milk CRYETTE A
Model:	<u>5009</u>	<u>5008</u>	<u>5006</u>
Application:	Wide Range	Petroleum	Milk
Solvents:	Multiple Solvents	Water and Benzene	Water
Sample Size:	2.0 mL	2.0 mL	2.0 mL
Range:	-10 to +10°C <58 to 1200 Daltons 12 position switchable	-2.0 to 0.0°C, +2.5 to +5.5°C <58 to 1200 Daltons 2 position switchable	0 to -2.0°H (indicate if °C is preferred)
Calibration:	2 non-interacting controls	2 non-interacting controls	2 non-interacting controls
Precision:	0.001°C	0.001°C	0.001°H
Cool Down Time:	10-15 minutes	10-15 minutes	10-15 minutes
Test Time:	< 2 minutes	< 2 minutes	< 2 minutes
Power*:	110V or 220V, 50/60Hz	110V or 220V, 50/60Hz	110V or 220V, 50/60Hz
Dimensions:	15"Wx9"Dx10"H	15"Wx9"Dx10"H	15"Wx9"Dx10"H
Shipping Weight:	31 lbs	31 lbs	31 lbs

ABOUT THE COMPANY

Precision Systems was founded in 1963 to design and manufacture laboratory instrumentation. The Company is also a leader in developing and manufacturing quality engineered osmometers, cryoscopes and chemistry analyzers. All Precision Systems' products are manufactured within the United States.



16 Tech Circle, Natick, MA 01760
 Phone: 1 508-655-7010
 Fax: 1 508-653-6999
 Email: precisionsystems@msn.com
 Website: www.precisionsystemsinc.com