TC05-04e

Thermo Electron Temperature Control Units for Fogging

Key Words

- Fogging Test
- DIN 75201
- ISO 6452/2000

Temperature Control Application Notes

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Abstract

"Fogging" refers to the evaporation of the volatile components of PVC, cloth, and leather used in motor vehicle interiors. Under high temperatures volatile components evaporate and condense on the windows and the windshield, which impairs the view and creates dangerous driving conditions. In addition, fogging causes materials to become more brittle, resulting in material fatigue and premature aging.

The Process

Two test procedures have been published in the DIN 75201 standard and adopted by ISO 6452/2000 to determine the amount of undesired evaporation.

The DIN work group defined a working procedure and a set of test conditions for fog testing to enable comparable results.

Fogging Behavior DIN 75201-R Process "A"

Fogging behavior can be determined by measuring the reflectometer value (R).

According to this procedure, a material sample is temperature controlled at 100°C for three hours. Volatile components condense on a glass plate cooled to 21°C. This produces a rapid simulation of the evaporation process that occurs in motor vehicles. The amount of fogging condensation on the glass plate is then recorded qualitatively by measuring the 60° reflection value. A 60° reflection value of the same glass plate without condensation serves as a control.

Fogging Behavior DIN 75201-G Process "B" (gravimetric method).

Fogging behavior can also be determined by weighing the condensed component. (G).

A material sample placed in a beaker is covered with aluminum foil that has been weighed. The amount of fogging condensation is determined by weighing the foil again after the test.

The Thermo Solution

The Fogging Test System is designed to determine the values as defined in the DIN and ISO standards. Thermo Electron Corporation supplies the complete test setup to measure fogging behavior by both Process "A" and Process "B".

Fogging Test System

The Fogging Test System consists of a number of components as advised by the DIN standard group. The key system component is a state-of-the-art HAAKE Phoenix II open-bath circulator fitted to a large volume stainless steel bath vessel. The modified outlet nozzle of the powerful circulation pump guarantees uniform circulation of the heat transfer liquid, FOG 150, throughout the entire bath.

Uniform circulation is validated before the system is shipped, and a test certificate is supplied with the unit. The use of FOG 150 at the required fluid level is essential for the repeatability of the test results as described on page 9 of the DIN standard.

Haake P2-FOG

The Phoenix II Unit

The HAAKE Phoenix II unit ensures a temperature accuracy of better than 0.5° C throughout the entire bath while maintaining the minimum necessary distance both between the beakers and bath wall and between the beakers and the bath vessel base. The bath frame accommodates six heat-resistant beakers to handle five fogging and/or gravimetric tests and one blank to ensure the ability to respond to production capacity testing needs.

System Set Up

The system can be set up in just a few minutes due to the Phoenix II unit's in-built leveling system and liquid level indicator. There is no need to conduct the standard RTA test because each Phoenix II unit undergoes a one-point temperature control test at 100° C before shipment.

Communication Features

The HAAKE Phoenix II unit can communicate via RS232 or RS485 ports to other instruments. Up to 10 different programs with a maximum of 30 segments can be set. All commands for the system are

entered via direct value setting at the display and in a choice of six different languages to allow for easy training and handling.

Precision Cooling

The DIN standard describes the importance of the precision of cooling the glass plates. A HAAKE DC30-K20 refrigerated circulator, a well-known standard in the industry, therefore is used to supply all six plates with cooled water. This ensures the best conditions for causing condensation. The temperature difference between the plate inlet and outlet is less than 1°C. A high degree of temperature accuracy is guaranteed due to the DC30's high pump and cooling capacity. The cooling plates are designed specifically for this system and are made from stainless steel with an aluminum contact surface to the glass.

Sample Preparation

For correct sampling techniques, please refer to DIN 53 302 and DIN 53 802. Plastics or leather samples can be cut into 80 mm diameter disks. A sample cutter, cutting board, and a set of spare blades are supplied with the system for this purpose. Material in powder form can also be used. When using powders, the test sample should be 10 +/- 0.1 g.

Great care has been taken to comply with the DIN group's standard for flat-bottomed, heat-resistant beakers. The beakers can be placed on a tabletop and filled easily with material samples. Material samples are placed on the base of the beakers or the beakers can be filled with the required quantities of raw material. Metal rings are supplied to keep the sample pressed to the base of the beakers, thus keeping the sample in the correct measurement position.

System Seals

Once the beakers are placed in the fogging test system, fluoroelastomer O-rings stretched around a support ring are used to create a tight seal between the glass plates and the beakers. This prevents by-passing of the vapors, which could influence the test results. Unwanted condensation of heat transfer liquid vapors on the glass plates is prevented by sealing off the surface of the bath and the holder openings.

The square glass plates that simulate a windshield have a variation range of +/- 2% from the permissible reflectometer value. Great care should be taken to properly clean these plates to ensure the best possible test results.

Testing and Measurement

If the test for reflection is selected, the condensed glass plates are placed in specially-designed, black, aluminum frames to prevent any possible influence on the values during measurement. The reflectometer (manufactured by Dr. Bruno Lange GmbH & Co. KG) measures the direct reflection of the sample within an angle of 60 degrees, which corresponds to internationally recognized standards. The reflectometer is supplied with a calibration standard.

In the case of gravimetric analysis, the aluminum foils supplied with the system are placed underneath the round glass plates. The disposable foils are weighed before and after testing, and the difference equates to the weight of the condensed volatile particles.

Key Data for HAAKE P2-FOG and HAAKE DC30-K20 units

Technical Data		HAAKE P2-FOG	HAAKE DC30-K20
Working Temp. Range	°C	45 to 280	-28 to 150
Heater capacity 230V / 115V	kW	3.0	2.0/1.2
Cooling capacity at 20°C	W	–	320
Pump: Pressure max.	mbar	560	300
Flow max.	l/min.	24	12.5
Suction max.	mbar	380	–
Flow max.	l/min.	22	–
Bath volume max.	l	40	4.5
Weight	Kg	43	30
Dimensions (W x L x H)	cm	60 x 42.5 x 59	23 x 46 x 58
Total wattage max. 230V / 115V	VA	3150	2400/1600
Mains connection	V/Hz	230 / 50 – 60	230V/50 Hz / 230V/60Hz / 115V/60Hz

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