Cemagref

division génie des procédés frigorifiques

GROUPEMENT D'ANTONY
BP 121, 92185 Antony Cedex
Tél. 33 1 40 96 61 21 - Fax 33 1 40 96 60 75
E mai : raoul.bennahmias@cemagref.fr

Antony, July 21, 2000

PROGES PLUS
2 rue de la république
59780 WILLEMS

TEST REPORT NO. E42

- Determining temperature measurement error
- Influence of ambient temperature
- Testing temperature with the recorder under conditions of storage and transport
- Determining response times
- Determining error relative to time recordings

compliance with the NF EN 12830 standard

May 2000

COFRAC ACCREDITATION OF THE CEMAGREF D'ANTONY TEMPERATURE RECORDER TEST LAB OR THE TEST REPORT, WHICHEVER IT MAY BE, CANNOT BY THEMSELVES IN ANY WAY CONSTITUTE OR IMPLY APPROVAL OF THE PRODUCT BY THE ACCREDITATION BODY OR ANOTHER BODY.

DESCRIPTIVE TECHNICAL FORM

According to information provided by the test applicant

TEST APPLICANT:

PROGRES PLUS
2 rue de la république
59 780 WILLEMS

1 – GENERAL CHARACTERISTICS

Recorder trademark:	DALLAS
Type:	THERMOBUTTON
Serial No:	B5254

1.1. Measurement device:

- Nature and type of system:		Mechanical:	no
		Electronic:	yes
- Number of sensors:	1		
- Placement of sensors:		Internal:	yes
		External:	no

1.2. Recording device:

- Recording readout process:

Direct readout:	no
Delayed readout:	yes

- Material needed for the recording readout:
RS232 serial port interface, THERMO-TRACER software and IBM/PC type computer

- Maximum number of stored measurements:	2048
- Maximum duration of the recorder:	362 days
1.3. Dimensions (mm):	Ø 16
1.4. Weight (kg):	0.005
1.5. Attachment system for supplied apparatus:	no

2 – METROLOGICAL CHARACTERISTICS

2.1. Resolution (°C):	0.5
2.2. Exactness (°C):	+/- 1
2.3. Measurement range (°C):	-40 to +85°C
2.4. Response time:	5 minutes
2.5. Recording periods:	Programmable from 1 to 255 minutes
2.6. Time recording error:	2 minutes per month between 0°C and 45°C

3 – USAGE PROFILES

3.1. Adapt for mobile surroundings: For the recorder: yes

if YES, indicate the level of vibrations tolerated by the apparatus:

- vibration frequency: 5Hz
- transfer frequency: 8.6Hz
- extent of movement: 10 mm
- acceleration: 3 g

3.2. Nominal working range (°C):	-30 to +65
3.3. Working range limit (°C):	-40 to +70
3.4. Storage range (°C):	-40 to +85
3.5. Waterproof level expressed in IP (Protection Index)	IP68

4 – ADJUSTMENT SETTINGS

The operator can change the following:

4.1. recording start date and time:	no
4.2. reset to zero	no
4.3. measurement range adjustment:	no

5 – ELECTRICAL CHARACTERISTICS

Type of power source:

5.1. External power source:	no
Protection against brief outages:	no
5.2. Self-contained power source:	yes

DESCRIPTION OF THE TEST CELL

1 – GENERALITIES

The test lab is equipped with an air calibration drawer and a thermostatic bath for determining temperature measurement errors.
A heat exchanger and a freezer control the influences of the ambient temperature on the recorders. All temperature measurements are performed under measurement control according to national standards.

2 – TESTING DRAWER

Drawer function:
This drawer measures the recorder's temperature measurement errors for air temperatures.

Drawer description:
Includes:

- an isothermal enclosure equipped with an external refrigerant group.
- a measurement indicator, located inside the enclosure, into which the recorders are placed. Across this indicator flows air whose speed and temperature are regulated by high quality equipment that rigorously maintains the characteristics outlined below.
- an information command unit for the different test phases.

Characteristics of the measurement indicator:

- Usage temperature:	-35°C / +40°C
- Stability of the air temperature:	+/- 0.05°C
- Differences in air temperature:	+/- 0.2°C
- Adjustable air speed:	0 to 5 m/s
- Air speed dispersion:	< 0.2 m/s
- Dimensions:	0.55 x 0.55 x 0.45 m

3 – CALIBRATION BATH

Calibration bath function:
This drawer measures the recorder's temperature measurement errors in a liquid environment.

Characteristics of the calibration bath:

- Usage temperature:	-40°C / +110°C
- Stability of temperature:	+/- 0.01°C
- Differences in temperature:	+/- 0.02°C
- Capacity:	25 liters

4 – TEMPERATURE MEASUREMENT CHAIN

Measurement chain function:
This temperature measurement chain records all thermometric measurements that occur in the laboratory.

Characteristics of the temperature measurement chain:
The system includes ten Pt100 thermometric probes that are connected to the AOIP SA32 measurement control unit. This unit has been calibrated to the temperature measurement standard of the GPAN unit. This temperature measurement standard is regularly standardized by the LNE. After calibration, the discovered error, for the measurement chain unit and for a temperature scale between –40°C and +70°C, is set to a maximum of more or less 0.02°C of the reference device values for the error measurement of the temperature and to a maximum of +/-0.15°C for the temperature measurement of the heat exchanger and freezer.

4 – HEAT EXCHANGER

Heat exchanger function:
This heat exchanger which is used simultaneously with the test drawer controls the ambient temperature influences on the tested materials.

Characteristics of the heat exchanger:

- Usage temperature:	+25°C / +200°C
- Stability:	+/- 0.2°C

4 - FREEZER

Freezer function:
This freezer which is used simultaneously with the test drawer controls the ambient temperature influences on the tested materials.

Characteristics of the freezer:

- Usage temperature:	-45°C / -10°C
- Stability:	+/- 0.5°C

TEMPERATURE RECORDER CONTROL
In conformance with the NF EN 12830 standard

DATE:

TRADEMARK:	DALLAS
TYPE:	DS1921-F51
Serial No.:	B5254

1 – TEMPERATURE MEASUREMENT ERROR

The measurement error is the result of the control recorder measure minus that of the reference measurement chain. Each error value reported below is an average of at least ten values.

Level	Measurement Error	Uncertainty
-30	0.5	0.32
0	0.2	0.32
30	-0.3	0.32
0	0.0	0.32
-30	0.4	0.32

2 – INFLUENCE OF AMBIENT TEMPERATURE

The recorder was tested for 4 hours at 70°C and 4 hours at –40°C.

MEASUREMENT ERROR
At the conclusion of the test, the temperature measurement error is determined after a period of 4 hours of returning to room temperature.

The measurement error is the result of the control recorder measure minus that of the reference measurement chain. Each error value reported below is an average of at least ten values.

Level	Measurement Error	Uncertainty
-30	1.0	0.32
0	0.2	0.32
30	-0.2	0.32
0	0.5	0.32
-30	0.9	0.32

All values are expressed in Celsius degrees.

3 - TESTING TEMPERATURE WITH THE RECORDER UNDER CONDITIONS OF STORAGE AND TRANSPORT

The recorder underwent 5 cycles of temperature variation between –40°C and +85°C.
The recorder was deactivated. The temperature variation speed was 1°C/min
The time of stabilization to storage temperature was 3 hours.

MEASUREMENT ERROR

At the conclusion of the test, the temperature measurement error was determined after a period of 2 hours of returning to room temperature.

The measurement error is the result of the control recorder measure minus that of the reference measurement chain. Each error value reported below is an average of at least ten values.

Level	Measurement Error	Uncertainty
-30	0.5	0.32
0	0.2	0.32
30	-0.2	0.32
0	0.0	0.32
-30	0.4	0.32

4 – RESPONSE TIME DETERMINATION

The recorder underwent a sudden temperature variation of 20 K.
The response time was determined in a 1 m/s air flow.
The control unit measurement interval was set to its minimal value (1 min).

Response time is the time required for the recorded value to reach 90% of the temperature's real variation.

Temperature at the beginning of the test:	-1°C
Temperature at the end of the test:	+19.5°C
Recorded duration at 90% of the temperature difference:	**300 seconds**
Recorder's measurable response time:	**5 minutes**
Measurement uncertainty:	**1.7 minutes**

5 –DETERMINATION OF RELATIVE TIME RECORDING ERROR

The recorder underwent a sudden temperature variation at the beginning and end of the test in order to demarcate duration time. The control unit measurement interval was set to its minimal value (3 minutes) to allow recording over 3 days. The time basis, controlled with the help of the talking clock, was set over a recording period of 1 second.

Recorder (s)	Reference (s)	Difference (s)	Uncertainty (s)	Percentage of the duration
259200	259199	1	102	0.004%

6 – MEASUREMENT UNCERTAINTY

6.1 Uncertainty of temperature measurements of the reference measurement chain

The relative uncertainty (k=2) of the reference measurement chain is equal to 0.1°C. This value is reproduced in accordance with the internal calibration certificate No.ETLOGE499.

6.2 Uncertainty of temperature measurements of the test lab

The overall uncertainty in determining temperature measurement error takes into account the following elements:

- the reference chain, Cemagref test averages
- the control unit (resolution, repeatability, etc.).

For the control unit, the uncertainty of repeatability is insignificant. Only the uncertainty linked to the resolution (b) of the unit is taken into account. ($u=b/2*\sqrt{3}$)

This overall uncertainty is equal to 0.15°C.

The uncertainty is calculated with a relative coefficient equal to two.

6.3 Uncertainty related to time recordings

Only the uncertainty from the recorder's minimal recording interval (5 min) is taken into account. Components linked to the reference time basis are insignificant.

CONCLUSIONS

1 – DETERMINATION OF TEMPERATURE MEASUREMENT ERROR
The observed error at the conclusion of the control cycle was between –0.3°C and +0.5°C.

Consequently, for a measurement range between –30°C and +30°C the control unit is in accordance with the requirements of **class 1** in relation to metrological characteristics defined by the **NF EN 12830** European standard.

2 – INFLUENCE OF AMBIENT TEMPERATURE

After testing the recorder at standard-approved ambient temperatures, the observed error was between –0.2°C and +1°C.

The unit has satisfied the ambient temperature influence tests, specific to type C and type D climatic environments, as defined by the standard, for internal probe temperature recorders.

Consequently, for a measurement range between –30°C and +30°C the control unit is in accordance with the requirements of **type C** and **type D** in relation to usage profiles defined by the **NF EN 12830** European standard for the influence of ambient temperature.

3 – RECORDER TEMPERATURE TEST UNDER CONDITIONS OF STORAGE AND TRANSPORT

After testing the recorder at standard-approved storage and transport temperatures, the observed error was between –0.2°C and +0.5°C.

The unit has satisfied the temperature test under conditions of storage and transport, specific to type C and type D climatic environments, as defined by the standard, for internal probe temperature recorders.

Consequently, for a measurement range between –30°C and +30°C the control unit is in accordance with the requirements of **type C** and **type D** in relation to usage profiles defined by the **NF EN 12830** European standard for temperature tests under conditions of storage and transport.

TEST REPORT E42
Page 10/10

4 – RESPONSE TIME DETERMINATION

Response time determined during the course of the test, at 90% of the temperature's real variation, was equal to 5 minutes.

Consequently, the control unit is in accordance with the requirements of the **NF EN 12830** European standard for response time of internal probe recorders.

5 – RELATIVE TIME RECORDING ERROR

The relative time recording error determined during the course of the test represents 0.004% of the recording duration time. The duration of this test was 72 hours.

Consequently, the control unit is in accordance with the requirements of the **NF EN 12830** European standard for maximum relative time error.

Completed in Antony on 05/07/00

Director of the LOGE Lab

J.GAHARTIAN

This test report concerns only the type of equipment submitted to the test.