

CALIBRATION

*To ensure your quality,
control your temperature*



- *Reference sensors*
- *Fixed-point temperature cells⁽¹⁾*
- *Calibration furnaces and baths*
- *Calibration of your temperature measurement sensors and instruments in our laboratory⁽²⁾*

⁽¹⁾ Manufactured under license from the 'Institut National de Metrologie' (INM)

⁽²⁾ Cofrac accreditation n° 2-1385- Comparison calibration
from - 20 °C to + 450 °C for Pt100 Ω probes
from - 20 °C to + 1550 °C for thermocouples

EQUIPMENT and SERVICES

Silver + 961.78 °C
1337.33 K

Aluminium + 660.323 °C
933.473 K

Zinc + 419.527 °C
692.677 K

Tin + 231.928 °C
505.078 K

Indium + 156.5985 °C
429.7485 K

Gallium + 29.7646 °C
302.9146 K

Water 0.01 °C / 273.16 K

Mercury - 38.8344 °C
234.3156 K

Argon - 189.3442 °C
83.8058 K



CONTENTS

TEMPERATURE SENSOR CALIBRATION METHODS	2	FIXED-POINT CELLS	5 - 7
SENSOR CALIBRATION IN OUR LABORATORIES	3	FURNACES FOR FIXED-POINT CELLS	8
STANDARD THERMOMETERS	4	CALIBRATION FURNACES	9
		CALIBRATION BATHS	10
		SURFACE TEMPERATURE REFERENCE	11

TEMPERATURE SENSOR CALIBRATION METHODS

Two methods are in current use:

■ *The comparison method*

■ *The fixed-points method*

It's not always easy to choose between these two methods. When great accuracy is necessary, equal or above 0.01 °C for instance, then the fixed-points method is necessary. When there are a large number of sensors to be studied, or if there is greater tolerance regarding accuracy, then the comparison method is preferable. However, even in this case, having one or several fixed- points enables reference sensors to be periodically checked and indicates when a complete re-calibration is called for.

Comparison method

Comparison calibration of a sensor consists of placing it in a well where the uniform, constant temperature is measured using a standard reference sensor.

The advantages of this method:

- Calibrate a large number of sensors at the same time
- Calibrate a wide range of sensor shapes and sizes
- Calibrate at different temperatures

The limitations of this method:

It is often difficult to be sure that the sensors to be calibrated and the reference sensor are at the same temperature. Wells that are both stable and uniform are difficult to achieve, especially at raised temperatures, and the accuracy of the results obtained is directly linked to the reference sensor's calibration and stability.

Pyro-Contrôle Chauvin Arnoux manufactures reference thermocouples and a surface sensor calibration device under licence from the BNM-LNE

Manufactured under licence from the BNM-LNE

Fixed-points method

Calibrating a sensor using the fixed-points method consists of placing it in a well whose uniform, constant temperature is defined by the thermodynamic equilibrium between different phases of a pure substance.

The main advantage of this method:

It enables highly accurate calibration at a known temperature, without being reliant on the characteristics of a reference sensor that are likely to drift with time. This method is that used to realise the International Temperature Scale (ITS-90).

The limitations of this method:

- Calibration can only be performed at a certain number of determined temperatures .
- During a change of phase, the number of sensors to be calibrated is limited depending on the duration of the temperature plateau .
- The geometry of the sensors has to fit.

The **BNM-INM** is responsible in France for setting the references of the International Temperature Scale (ITS-90).

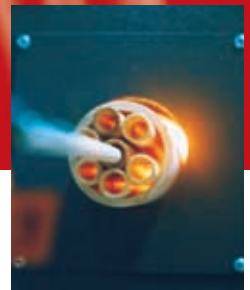
The **BNM-LNE** is responsible in France for the transfer of this scale to industry. The ITS-90 is founded on temperature values assigned to a certain number of states of equilibrium that may be reproduced in pure substances (fixed -points) and on specified instruments, calibrated at these temperatures. The ITS-90 is a precise scale whose use leads to the current best approximations of thermodynamic temperatures.

BNM: France's national metrology bureau - **INM:** France's national metrology institute - **LNE:** France's national test laboratory

Pyro-Contrôle Chauvin Arnoux develops complete assemblies intended for producing the ITS-90's fixed-points. The sealed-cells are manufactured under licence from the INM.

Manufactured under licence from the BNM-INM

SENSOR CALIBRATION IN OUR LABORATORY



PYRO-CONTRÔLE CHAUVIN ARNOUX carries out calibration according to two types of services.

COFRAC metrology service



The COFRAC Metrology Service (Accreditation N° 2-1385) carries out comparison calibration for which a certificate is given out (COFRAC: The French Accreditation Committee).

Calibration of Pt 100 Ω probes

For 2, 3 and 4-wire probe assemblies.

- Measurement range: - 20 °C to + 450 °C
- Usual calibration temperatures: 0 °C, 100 °C and 200 °C (Other temperatures on request)

Thermocouple calibration

- Measurement range: - 20 °C to + 1550 °C
- Usual calibration temperatures: 0 °C, 100 °C, 200 °C, 500 °C and 1000 °C (Other temperatures on request)

RANGE	UNCERTAINTY	METHOD	SENSOR DIMENSIONS
- 20 °C to + 30 °C	± 0.05 °C	Comparison with a standards platinum resistance thermometer	Ø ≤ 10 mm L ≥ 120 mm
+ 30 °C to + 90 °C	± 0.08 °C		
+ 90 °C to + 290 °C	± 0.12 °C	- Current generator - Channel searcher - Multimeter	Ø ≤ 11 mm L ≥ 400 mm
+ 290 °C to + 450 °C	± 0.39 °C		

RANGE	UNCERTAINTY	METHOD	SENSOR DIMENSIONS
- 20 °C to + 290 °C	± 0.40 °C	- Comparison with a standards platinum resistance thermometer - Multimeter	Ø ≤ 10 mm L ≥ 120 mm
+ 290 °C to + 450 °C	± 0.65 °C		Ø ≤ 11 mm L ≥ 400 mm
+ 450 °C to + 980 °C	± 1.3 °C	- Comparison with an 'S'-type standards thermocouple - Multimeter	Ø ≤ 11 mm Ø ≤ 8 mm L ≥ 550 mm L ≥ 350 mm
+ 980 °C to + 1200 °C	± 1.7 °C		Ø ≤ 11 mm Ø ≤ 8 mm L ≥ 800 mm L ≥ 350 mm
+ 1200 °C to + 1550 °C	± 2.7 °C		Ø ≤ 11 mm L ≥ 800 mm

Calibration laboratory

The calibration laboratory, attached to the BNM, and carries out comparison calibration using our standards thermometers and ITS-90 (International Temperature Scale) fixed-points, for which an official account of the calibration is given.

Comparison calibration of Pt 100 Ω probes

- Measurement range: - 20 °C to + 50 °C
- Usual calibration temperatures: 0 °C, 100 °C and 200 °C (Other temperatures on request)
- Possible to supply a table of the Resistance/Temperature relationship

Comparison calibration of thermocouples

- Measurement range: - 20 °C to + 1550 °C
- Usual calibration temperatures: 0 °C, 100 °C, 200 °C, 500 °C and 1000 °C (Other temperatures on request)
- Possible to supply a table of EMF/Temperature relationship

RANGE	UNCERTAINTY	METHOD	SENSOR DIMENSIONS
- 20 °C to + 90 °C	± 0.1 °C	Liquid thermostat controlled bath	Ø ≤ 11 mm L ≥ 120 mm
+ 90 °C to + 290 °C	± 0.2 °C		
+ 290 °C to + 450 °C	± 0.5 °C	Thermostat-controlled bath with fluid bed	Ø ≤ 11 mm L ≥ 400 mm

RANGE	UNCERTAINTY	METHOD	SENSOR DIMENSIONS
- 20 °C to + 290 °C	± 0.5 °C	Thermostat-controlled liquid bath	Ø ≤ 11 mm L ≥ 120 mm
+ 290 °C to + 450 °C	± 0.75 °C	Thermostat-controlled bath with fluid bed	
+ 450 °C to + 980 °C	± 2 °C	High temperature furnace with mass	Ø ≤ 11 mm Ø ≤ 8 mm L ≥ 500 mm L ≥ 350 mm
+ 980 °C to + 1200 °C	± 2.5 °C		Ø ≤ 11 mm Ø ≤ 8 mm L ≥ 800 mm L ≥ 350 mm
+ 1200 °C to + 1550 °C	± 3 °C		Ø ≤ 11 mm L ≥ 800 mm

ITS-90 fixed-points calibration of Pt 100 Ω probes and thermocouples

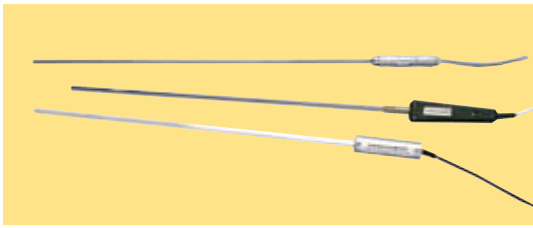
Pyro-Contrôle Chauvin Arnoux manufactures sealed cells for producing the ITS metals fixed-points (see pg.'s 5 to 7), under licence from France's national metrology institute (the INM).

Calibration of Pt 100 Ω probes and of thermocouples with the cells referenced on the table opposite.

ITS-90 FIXED POINTS	TEMPERATURE	UNCERTAINTY	SENSOR DIMENSIONS
GALLIUM (1)	29.7646 °C	± 0.02 °C	Ø ≤ 11 mm L ≥ 800 mm
INDIUM (2)	156.5985 °C	± 0.03 °C	Ø < 7.5 mm L > 465 mm For thermocouple wires: L > 1000 mm
TIN (2)	231.928 °C	± 0.05 °C	
ZINC (2)	419.527 °C	± 0.05 °C	
ALUMINIUM (2)	660.323 °C	± 0.05 °C	
SILVER (2)	961.78 °C	± 0.1 °C	

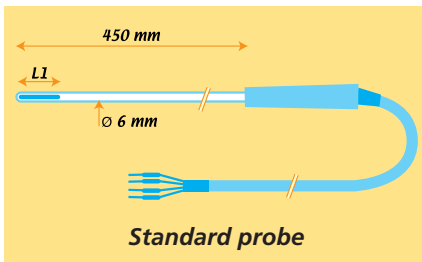
(1) Melting point ; (2) Freezing point

STANDARD THERMOMETERS



Transfer standard thermometers, used as a reference for comparison calibration in laboratories and in industry. For each sensor, different options are available depending on the number of calibration points and the relationship tables. Check with us for details.

100 Ω standard platinum thermometers

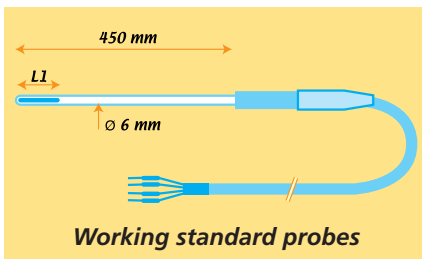


A "Pyro-Etalon 90-01" standard platinum resistance thermometer for laboratories and metrology services.

- ITS-90 fixed-points or comparison calibration
- Highly reliable - comes in its case

Two working standard platinum resistance thermometers, the "Pyro-Contrôle 90-02/400" and the "Pyro-Etalon 90-02/600" for metrology and workshop services.

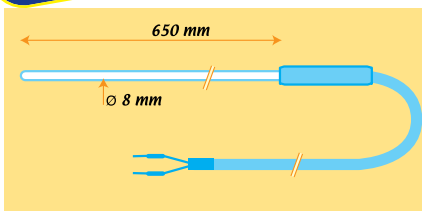
- Comparison calibration



MODEL	PYRO-ETALON 90-01	PYRO-ETALON 90-02/400	PYRO-ETALON 90-02/600
Range	- 100 °C to + 450 °C	- 100 °C to + 400 °C	- 100 °C to + 600 °C
Resistance at 0 °C	100 Ω ± 0.05	100 Ω ± 0.05	
Interchangeability Class	Class A	Class A (better class according to IEC 751)	
Reliability (R° over 1 Yr.)	≤ ± 10 m Ω (or ≤ ± 25 mK)	≤ ± 25 m Ω (or ≤ ± 50 mK)	
Alpha coefficient	0.003850 °C ± 4ppm	0.003850 °C ± 4 ppm	
Nominal current	1 mA	1 mA	
Sensitive length «L1»	50 mm	50 mm	
External connections	4-wire teflon isolated cable + ground, 2 mm length, 4 mm Ø banana plugs		

S-type thermocouples*

Manufactured under licence from the BNM-LNE

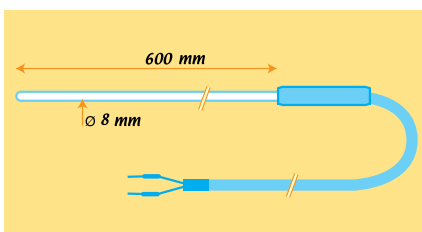


The standard thermocouple for laboratories and metrology services.

Model BNM - LNE S80: 0 °C to + 1554 °C

- Elements: platinum-rhodium 10 % / pure platinum
- Comes with BNM - LNE calibration certificate and EMF / Temperature relationship table for each degree (°C)
- ITS-90 fixed-points and PITS-68 secondary-points calibrated thermocouple
- Optional: mini monitoring cell, model BNM-INM manufactured under licence by Pyro-Contrôle Chauvin Arnoux

This silver melting / freezing (+ 961.78 °C) mini-cell enables the calibration periodicity of the sensor to be determined with accuracy.



A working standard for metrology services and workshops.

Model S 90-03: 0 °C to + 1600 °C

- Entirely in S-type platinum wires (Pt - Rh 10% / Pt)
- Comparison calibration

* It is possible to produce R or B standards thermocouples. Check with us for details.

FIXED-POINT CELLS

Before delivery, each fixed-point cell is checked in a BNM laboratory (INM or LNE).

Mini-cells

Manufactured under licence from the BNM-INM

Silver + 961.78 °C

Aluminium + 660.323 °C

Zinc + 419.527 °C

Tin + 231.928 °C

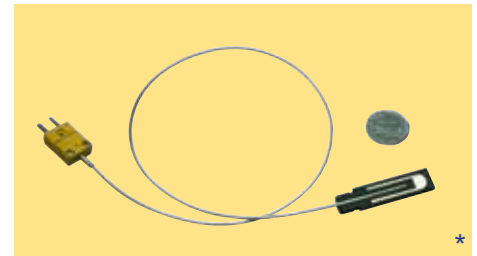
Indium + 156.5985 °C

Best price for fixed-points.

For rapid, practical and precise calibration, whether in the laboratory or on production sites. The mini-cell is made up of a pot and a graphite thermometer well. Inside the pot, around the thermometer well, there's 99.99 % pure metal.

- Temperature plateau: 1 to 15 minutes
- Repeatability: 0.1 °C
- Outside dimensions: Ø 12 to 15 mm - Length: 70 mm
- Inside dimensions: (thermometer well): Ø 1.5 to 6.5 mm and length: 50 mm

NB: for other dimensions, check with us.



Gallium cell

Gallium + 29.7646 °C

Manufactured under licence from the BNM-INM

Temperature plateau of 10 hours minimum.

A watertight cell, closed under an atmosphere of argon. The outside sheath and well are made of Teflon to account for Gallium's high coefficient of expansion.

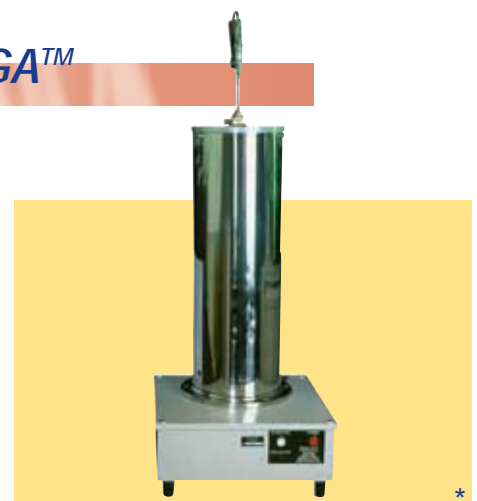
- 99.9999 % pure Gallium
- Cell is equipped with a valve to enable the triple-point to be produced
- Outside dimensions: Ø 50 mm - length: 400 mm
- Well dimensions: Ø 8.7 mm - length: 215 mm



Air furnace for Gallium cell: PYGA™

Electric furnace specially intended for the gallium cell, developed by the BNM-INM.

- Pulsated air furnace
- Light alloy enclosure, Stainless wells
- Automatic regulation system
- Safety system in case of over heating
- Dimensions: 310 x 310 x 610 mm
- Power supply: 230 V (50 Hz)
- Power: 640 W



*Pictures: C. Le Toquin/Studio photo CNAM

Quartz-sheathed cells

5 to 10 hour temperature plateaux.
mK accuracy.

Manufactured
under licence from
the BNM-INM

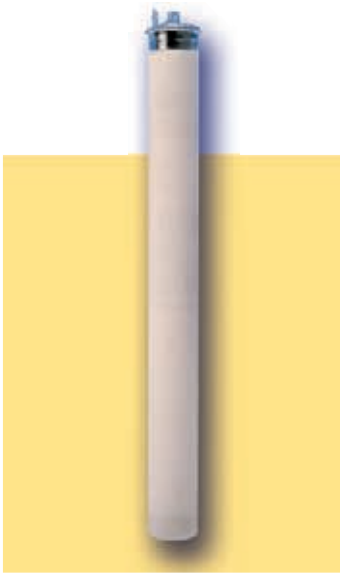
Silver + 961.78 °C

Aluminium + 660.323 °C

Zinc + 419.527 °C

Tin + 231.928 °C

Indium + 156.5985 °C



Principle

A pure metal melts and solidifies at a single temperature that is specific to that metal. When the environmental temperature conditions are correct and there is a sufficient amount of metal, then the latent heat absorbed or given out during the changing of phase maintains the metal and the thermometer at a constant temperature for several hours.

Construction

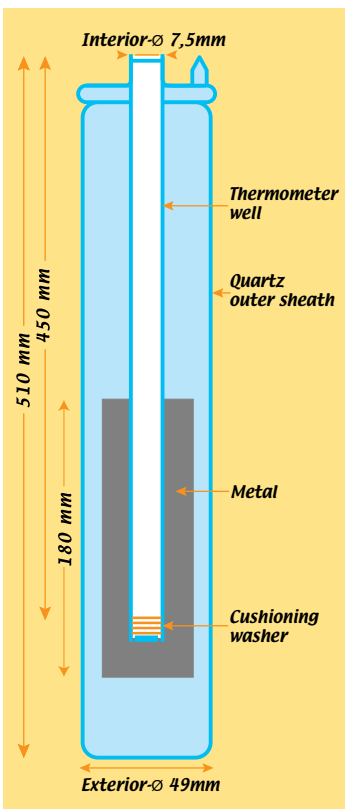
These cells are made of highly pure materials and sealed under argon atmospheres to protect the metal (whose phase change serves as the thermometric reference) from any external pollution that could otherwise cause the reference temperature to drift.

The metal, (approximately 110 cm³ and 99.999 % purity) is contained in a high purity graphite pot. Before the definitive sealing, the cell is filled with pure argon, at such a pressure that it equals 101325 Pa at the metal's melting point. The cell's quartz sheath is deployed outside so as to avoid losses through total reflection along the lengths of the walls.

Utilisation

The cell is introduced into the furnace and is first of all heated at a temperature slightly higher than the melting temperature of the metal in question. Once stable, the reference temperature is fixed at several degrees below the freezing point. When the temperature becomes close to the freezing point, freezing is initiated by introducing a stainless steel rod into the well, or by momentarily removing the cell from the furnace. The thermometer to be calibrated is set beforehand by a thermostat to a temperature several tens of degrees less than that of the freezing point so as to avoid a thermal shock.

A freezing temperature plateau is observed that may last several hours, with a well adapted furnace and regulation.



Furnaces and equipment adapted to producing temperature fixed-points

CELL	MANUFACTURED UNDER LICENCE	TEMPERATURE	FURNACE OR REFRIGERATING SYSTEM
ARGON ⁽¹⁾	BNM-INM	- 189.3442 °C	Comes with its refrigerating system
MERCURY ⁽¹⁾	BNM-INM	- 38.8344 °C	Overflow bath
WATER ⁽¹⁾		0.01 °C	Overflow bath
GALLIUM ⁽²⁾	BNM-INM	+ 29.7646 °C	PYGA™ furnace (see pg. 5)
INDIUM ⁽³⁾	BNM-INM	+ 156.5985 °C	PYMT™ furnace (see pg. 8)
TIN ⁽³⁾	BNM-INM	+ 231.928 °C	PYMT™ furnace (see pg. 8)
ZINC ⁽³⁾	BNM-INM	+ 419.527 °C	PYMT™ furnace (see pg. 8)
ALUMINIUM ⁽³⁾	BNM-INM	+ 660.323 °C	PYHT™ furnace (see pg. 8)
SILVER ⁽³⁾	BNM-INM	+ 961.78 °C	PYHT™ furnace (see pg. 8)

(1) triple point; (2) melting point; (3) freezing point

Water Cell

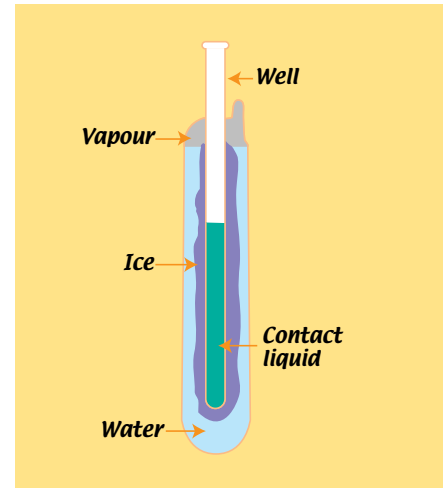
Water + 0.010 °C

*At the triple point of pure water, the solid, liquid and gas phases coexist in thermal equilibrium.
This unique temperature is equal to 0.010 °C and 273.16 K.*

The triple point of water holds a special place in metrology since the Kelvin is defined as the fraction 1/273.16 of the temperature of water's triple point.

The sealed cell is made of borosilicate glass. By introducing a contact liquid in the cell's well, the thermal contact with the thermometer undergoing calibration is improved.

CELL	SMALL MODEL	LARGE MODEL
Total length	160 mm	380 mm
Outside diameter	30 mm	40 mm
Inside diameter (well)	8.5 mm	12 mm
Uncertainty	± 0.001 °C	± 0.0001 °C



Mercury Cell

Mercury - 38.8344 °C

Temperature plateau of at least 4 hours at mercury triple point.

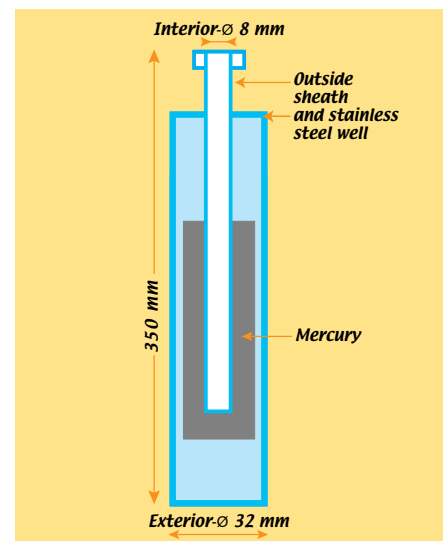
Manufactured under licence from the BNM-INM

The mercury cell is composed of a sheath and a stainless steel thermometer well.

It contains around 1440 grams of high purity mercury (6N).

- Outside dimensions: Ø 32 mm - Length: 350 mm
- Inside dimensions (thermometer well): Ø 8 mm - Length: 300 mm

The thermometer to be calibrated is placed in the mercury cell. To operate, the whole lot has to be placed in a refrigerated bath set to around - 39 °C. At the triple point temperature, an equilibrium between solid, liquid and gas phases is observed. This equilibrium gives a temperature plateau lasting at least 4 hours.



Argon Cell

Argon - 189.3442 °C

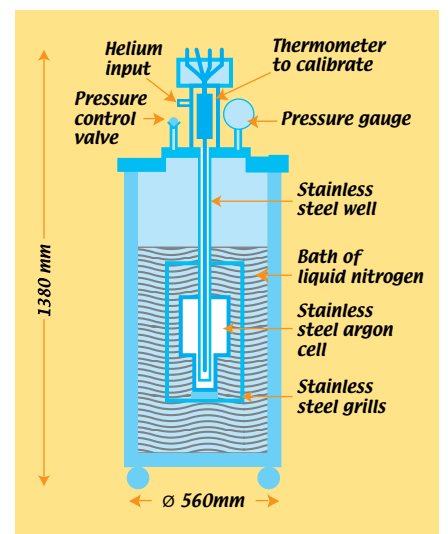
4 hour temperature plateau.

Manufactured under licence from the BNM-INM

The argon triple point cell is a complete ensemble that includes the cell and a liquid nitrogen-filled cryostat system. By controlling the pressure, the temperature of this bath is fixed at 84 K.

The cell's body and its well are in stainless steel.

The head of the thermometer to undergo calibration is protected in a sheath that is lightly pressurised with helium to avoid any condensation.



FURNACES FOR FIXED-POINT CELLS

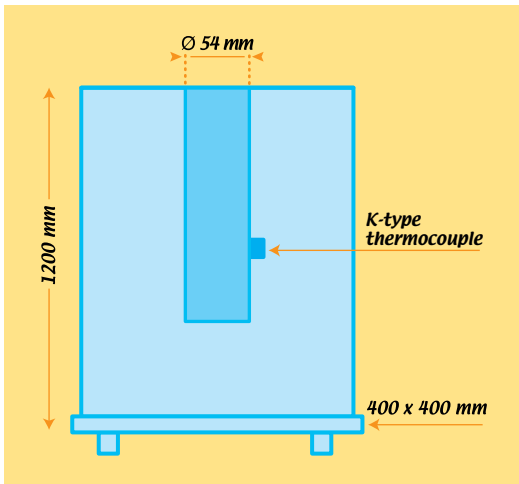
PYMT™-type medium temperature furnace*

Specially designed for producing the temperature fixed-points for Zinc, Tin and Indium cells. The controls and the power supply are mounted in an independent unit from the furnace.

Zinc + 419.527 °C

Tin + 231.928 °C

Indium + 156.5985 °C



Furnace: + 50 °C to + 430 °C

- Air-ventilated electric furnace
- K-type thermocouple regulation
- Working volume: Ø 54 mm - 430 mm depth
- Dimensions: 400 x 400 x 1200 mm
- Weight: 60 kg

Control box

- PID regulation with alarm
- Insulation and power supply transformer
- Power supply: 230 V (50 Hz)
- Power: 3 kW
- Fuse protection device in case of overheating

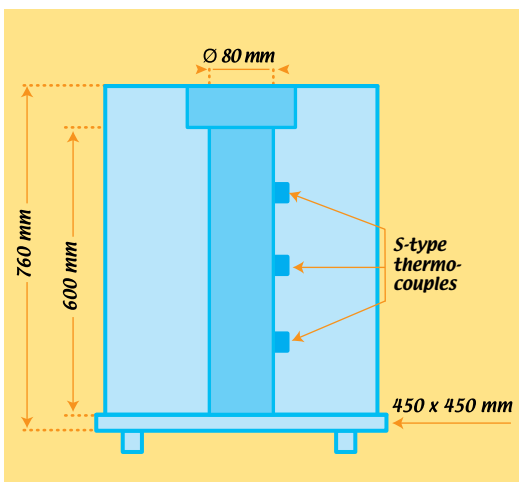
PYHT™-type high temperature furnace*

Specially designed for producing the temperature fixed-points for Silver, Aluminium and Zinc cells. The controls and power supply are mounted in an independent unit from the furnace.

Silver + 961.78 °C

Aluminium + 660.323 °C

Zinc + 419.527 °C



Furnace: + 300 °C to + 1100 °C

- Three electrical resistance-heated zones
- S-type thermocouple control in each zone
- Working volume: Ø 80 mm - 600 mm depth
- Dimensions: 450 x 450 x 760 mm
- Weight: 70 kg

Control unit

- Centre zone controller with ramp speed adjustable to 1 °C/ hour
- High and low zone controllers with feedback from central zone
- Adjustable safety on each controller, in case of overheating
- Three thyristor power units with fuse protection
- Insulation and power supply transformer
- Power supply: 230 V (50 Hz) - Power: 1.5 kW

CALIBRATION FURNACES

EXACAL laboratory furnace

Stability and precision from + 50 °C to + 1200 °C

A horizontally operating electric furnace with 3 heating zones. Calibration is done in the horizontal zone. Each zone has an S-type thermocouple connected to a high stability PID indicator. The separate unit contains the controllers and the thyristors.

- Working volume: Ø 50 mm - Depth: 900 mm
- Equalising mass adapted to sensors to be calibrated
- Homogeneity at 1000 °C (with mass):
 - Radial: ± 0.8 °C between the different wells
 - Longitudinal: ± 0.2 °C on 20 mm
- Stability at 1000 °C: ± 0.05 °C for 1 hour
- Power supply: 230 V (50 Hz)
- Power: 2.5 kW



Furnace

- Dimensions: 360 x 300 x 900 mm
- Weight: 40 kg

Control unit

- Dimensions: 200 x 500 x 500 mm
- Weight: 30 kg

TRANSCAL transportable furnaces

Easily transported for on-site calibration from + 50 °C to + 1100 °C

Three electric resistance furnace models with incorporated PID controller. The sensor penetration depth and the action of the PID controller enables exact calibration to be carried out.

A fan reduces cooling times and enables successive calibrations to be carried out in less time.

The sensor(s) to be calibrated are placed in the inserts, the reference thermometer is placed in the 8 mm Ø centre hole. The sensors are connected to a digital thermometer. The sensor temperatures are then compared to the values of the reference thermometer. The different reference points are directly programmed on the regulator or via a PC if using the RS485 (optional).

- Working volume: Ø 30 mm - Depth: 180 mm
- Equalising mass adapted to sensors to be calibrated
- Homogeneity ⁽¹⁾: ± 0.2 °C
- Stability ^{(1) (2)}: ± 0.15 °C for 10 min's
- Power supply: 230 V (50 Hz)
- Power: 1.6 kW or 1.9 kW depending on model



TRANSCAL 550: + 50 °C to + 550 °C

TRANSCAL 750: + 50 °C to + 750 °C

TRANSCAL 1100: + 50 °C to + 1100 °C

- Options:
 - RS 485 interface
 - Carrying case
- Dimensions: 200 x 265 x 335 mm
- Weight: 8 or 9 kg (depending on models)

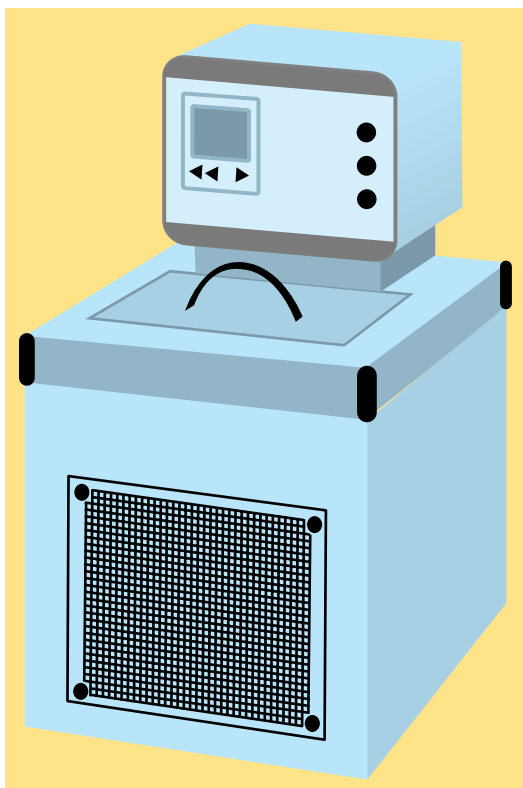
(1) at 500 °C for model T.550, 700 °C for T.750 and 1000 °C for T.1100

(2) Model T.1100, stability ± 0.3 °C for 10 min's

CALIBRATION BATHS

Comparison calibration of sensors of different shapes and diameters made easy. All the baths can be equipped with an equalising mass to improve their performance.

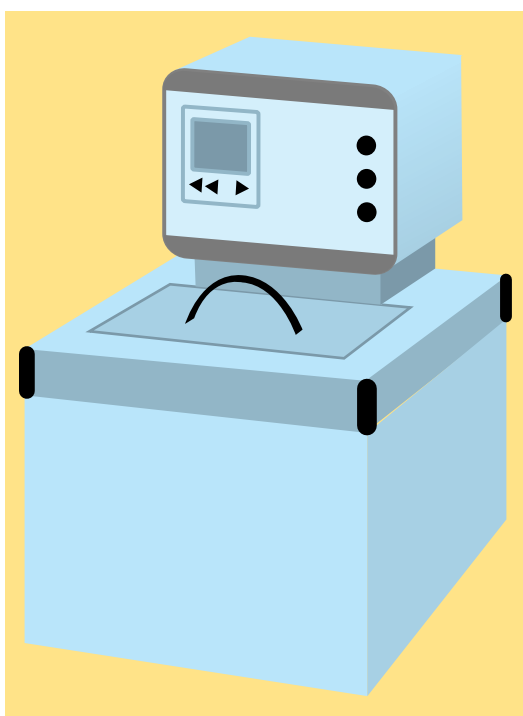
- 50 °C to + 200 °C Calibration baths



Sturdily constructed out of stainless steel for industrial environments.
4.5 litre to 15 litre bath volume.
Forcing / suction pump for closed or open circuit.
Fuzzy logic control. LCD graphic display.
RS 232C and RS 485 interfaces.

SPECIFICATIONS	ACCORDING TO MODELS
Nominal temperature	from - 30 °C... + 150 °C to - 50 °C... + 200 °C
Temperature stability	± 0.01 K
Heating power (230 V)	2 kW
Cryogenic power at + 20 °C at 0 °C at - 20 °C	300 W to 1 kW 200 W to 750 W 70 W to 500 W
Pump - Forcing/debit max.	300 mbar/20 l/min to 540 mbar/31 l/min
Pump - Suction/debit max.	210 mbar/15 l/min to 420 mbar/24 l/min
Bath opening (HxWxD)	13x10x15 cm to 29x15x20 cm
Bath capacity	4.5 l to 15 l
Dimensions (WxDxH)	23x46x60 cm to 38x46x75 cm
Weight	32 kg to 52 kg

+ 30 °C to + 300 °C Calibration baths



Sturdily constructed out of stainless steel for industrial environments.
3 litre to 12 litre bath volume.
Forcing / suction pump for closed or open circuit.
Fuzzy logic control. LCD graphic display.
RS 232C and RS 435 interfaces.

SPECIFICATIONS	ACCORDING TO MODELS
Nominal temperature	from + 30 °C...+100 °C to + 45 °C... + 300 °C
Temperature stability	± 0.01 K to 0.05 K
Heating power (230 V)	1 kW to 3 kW
Pump - Forcing/debit max.	300 mbar/12.5 l/min to 540 mbar/31 l/min
Pump - Suction/debit max.	210 mbar/15 l/min to 420 mbar/14 l/min
Bath opening (HxWxD)	13x10x15 cm to 22x14x20 cm
Bath capacity	3 l to 12 l
Dimensions (WxDxH)	20x30x37 cm to 32x38x46 cm
Weight	7 kg to 17 kg

SURFACE TEMPERATURE REFERENCE

Model BNM-LNE "SURFCAL": + 50 °C to + 400 °C

Manufactured
under licence from
the BNM-LNE

SURFCAL is a reference surface for calibrating your sensors in conditions identical to those experienced during use.

The "SURFCAL" method developed by the BNM-LNE

The calibration method is based on the comparison principle. The temperature read by the sensor undergoing calibration is compared with that of the reference surface temperature given by the device. Copper and stainless steel are the different surfaces proposed. Other materials can be produced on request so as to reproduce the conditions of use in the most reliable way. The operating range is from + 50 °C to + 400 °C.

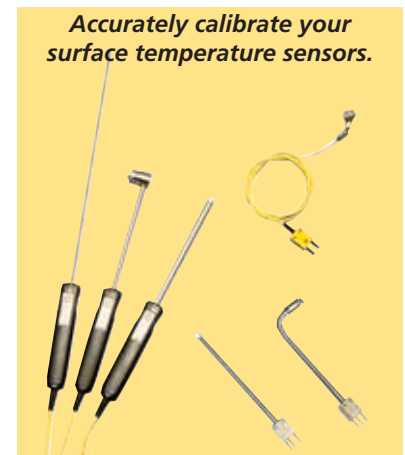
Types of sensors: Pt 100, 2, 3 or 4-wire, thermocouples and possibly thermistors. The sensitive element of these sensors is positioned right at the tip so as to ensure the best possible contact with the surface.

The old method

Surface temperature measurement sensors used to be calibrated in liquid baths or enclosures by comparison with a traditional reference sensor. This method was not at all representative of the applications for which the sensors are used. Calibration was done correctly, but the value given by the sensor during use was different to the real value of the surface being measured. The difference would sometimes have been as great as 20 or so degrees.

The advantage of the "SURFCAL" method

- For a given surface, you know the difference between the temperature read and the actual temperature of this surface.
- Help the user to better understand and control their application/procedure.
- Meet with the ISO standard by maintaining the correct periodic calibration of sensors.



THE COMPLETE TEMPERATURE MEASUREMENT CHAIN PYRO-CONTRÔLE CHAUVIN ARNOUX

- **Temperature sensors:** industrial thermocouples, insertion pyrometers, specific sensors, Pt 100 RTD's, extension and compensation cables, accessories, etc.
- **Converters:** in-head or DIN rail-mounted, 2 or 4-wire assembly, analogue or digital processing, programmable, etc.
- **Temperature controllers:** analogue and digital, basic or advanced models, 24 x 48, 48 X 48, 72 x 72, 48 x 96, 96 x 96 - fixed or universal inputs, etc.
- **Solid-state relays and power switches:** thyristor power units, 25 A to 1900 A, single or three-phase, resistive or inductive loads, control functions, monitoring, etc.
- **Digital panel meters:** °C or °F on 2000, 10 000 or 20 000 count displays, 25 x 75 mm or 48 x 96 formats, alarms, analogue and digital outputs, etc.
- **Recorders:** Continuous-line or dot recorders, 1 to 12 simultaneous measurement channels, completed diagram, alarms, analogue and digital outputs, 96 x 96 or 192 x 96 mm formats, etc.

In the temperature measurement chain, the signal's path is much the same as in any measurement chain: from the sensor to the operating gear, the data moves successively between the converter's and the controller's terminals; often a panel meter and a graphic recorder go to complement the set-up. The range of these instruments is enormous, and the designer of the measurement chain can often find himself at a loss when faced with choosing the instruments best suited to his needs. Besides the intrinsic specifications of each instrument, they must also be adapted to each other, bearing in mind that a measurement chain is only as strong as its weakest link. When it comes to choosing, the designer won't forget either to take into account all the extra advantages offered by PYRO-CONTRÔLE CHAUVIN ARNOUX.

- Calibration in COFRAC accredited laboratory
- Advice and assistance
- After-sales service
- ISO 9001 certification/ AQAP 120 attestation
- Perenniality of the business

Chauvin Arnoux

is also:

TEST & MEASUREMENT DIVISION

**Hand-held, field,
and laboratory test
and measurement instruments**

Testers and multimeters

Current clamps

Electrical installations testers

Clamp-on multimeters

Power, energy, disturbances

Physical test and measurement

Laboratory and teaching

Microwaves measurement instruments

Accessories

Tel.: 33 1 44 85 44 86

Fax: 33 1 46 27 95 59

E.mail: export@chauvin-arnoux.fr

POWER MEASUREMENT & CONTROL DIVISION

**Systems and equipment
for measurement, control,
metering and monitoring
of electrical networks**

Analogue and digital panel meters

Converters and transducers

Power monitors

Energy meters

Current transformers

Shunts

Graphic recorders

Industrial relays

Fault signalling

LVDT displacement sensors

Programmable Logic Controllers

Meteorological measurements

Tel.: 33 1 47 46 78 00

Fax: 33 1 42 53 64 78

E.mail: info@enerdis.fr

SERVICE DIVISION

**Calibration, repair,
maintenance, qualification and
other services
to industry**

Repair and maintenance of all brands
of instruments

Metrology: verification and calibration

Measurement instrument
park follow-up

Electromagnetic compatibility
tests (EMC)

LVD (Low Voltage Directive) testing

Pollution control by testing
of atmospheric discharge

Maintenance and metrology
training sessions

Biomedical apparatus maintenance

Tel.: 33 2 31 64 51 00

Fax: 33 2 31 64 51 09

E.mail: info@manumasure.fr

Chauvin Arnoux on the Web:
www.chauvin-arnoux.com

TEMPERATURE MEASUREMENT & CONTROL DIVISION

Export Sales Department

Chauvin Arnoux subsidiaries

AUSTRIA

Tel. : (43) 1 616 19 61

Fax : (43) 1 616 19 61 61

E-mail : vie-office@chauvin-arnoux.at

DEUTSCHLAND

Tel. : (49) 78 51 99 260

Fax : (49) 78 51 99 26 60

E-mail : info@chauvin-arnoux.de

ESPAÑA

Tel. : (34) 93 459 08 11

Fax : (34) 93 459 14 43

E-mail : comercial@chauvin-arnoux.es

ITALIA

Tel. : (39) 039 2 45 75 45

Fax : (39) 039 48 15 61

E-mail : info@amra-chauvin-arnoux.it

SCHWEIZ

Tel. : (41) 1 727 75 55

Fax : (41) 1 727 75 56

E-mail : info@chauvin-arnoux.ch

UNITED KINGDOM

Tel. : (44) 1 628 788 888

Fax : (44) 1 628 628 099

E-mail : info@chauvin-arnoux.co.uk

U.S.A.

Tel. : (1) 617 451 0227

Fax : (1) 617 423 2952

E-mail : lchambers@aemc.com

Your distributor

for all other countries

FRANCE

Tel. : (33) 4 72 14 15 52

Fax : (33) 4 72 14 15 41

E-mail : robert.grumel@chauvin-arnoux.com

PYRO - CONTROLE
 CHAUVIN
ARNOUX

Temperature Measurement & Control Division of Chauvin Arnoux
244, avenue Franklin Roosevelt - 69516 VAULX-EN-VELIN Cedex - FRANCE
Tel. : (33) 04 72 14 15 40 - Fax : (33) 04 72 14 15 41 - E-mail : info@pyro-controle.tm.fr