# Instruction Manual

# Insatech A/S 2012

## How to calibrate using an

## insacal™

## Conductivity Master Meter


*People - Ideas - Solutions*

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*Insacal Conductivity Master Meter*

# How to calibrate using an insacal™ Conductivity Master Meter

The master meter is built using standard components, i.e. an industrial conductivity transmitter, a cell, a casing and in some cases a cable and a flow-fitting.

The calibration is done by comparing the reading of the reference meter system with the reading of the Unit Under Test (UUT).

## Preparing and undertaking the calibration

- Check whether the cell constant in the insacal is the same as the cell constant specified in the calibration certificate of the UUT (Unit Under Test).
- Check that the correct type of sensor is chosen (4 or 2 electrodes).
- Check that the temperature compensation algorithm, and reference temperature are the same in the insacal and the UUT (Unit Under Test). (Please note that algorithms having the same name, but from different manufacturers, not necessarily are the same algorithm!).

We recommend calibrating without temperature compensation to avoid errors caused by temperature compensation algorithms.

- Clean the insacal sensor and fittings. Remove any contamination such as deposits from fingerprints.

If necessary, the cell can be cleaned in a 2 % $HNO_3$ and a hot 2 % NaOH solution followed by multiple flushes in water having the same conductivity as the sample to be measured. (Especially at low values of conductivity).

- The UUT (Unit Under Test) as well as the insacal sensor must be fully immersed. Ensure no bubbles are trapped in the system.

*Insacal handy and easy in use.*

Flush for approx. 15 minutes to be sure the active surfaces are properly wetted and that the system has stabilised, both the temperature and conductivity.

The calibration is simply done by comparing the insacal reading with the reading of the UUT (Unit Under Test). However, some issues must be addressed, as explained below.

## Issues to be addressed to avoid sources of errors

**Readings**

1. The readings of the insacal have to be comparable with the UUT reading (apples are to be compared with apples).

In a conductivity context, this means:
A: Specific conductivity must be compared to specific conductivity. If it is only a question of the prefix value, the reading can be converted by the use of tables 1 and 2.

**Table 1**

| | |
|---|---|
| 1 S/cm | = 1000 mS/cm |
| 1 mS/cm | = 1000 µS/cm |
| 1 µS/cm | = 1000 nS/cm |
| 0.051 µS/cm | = 51 nScm, and |
| 10 mS/m | = 100 µS/cm |

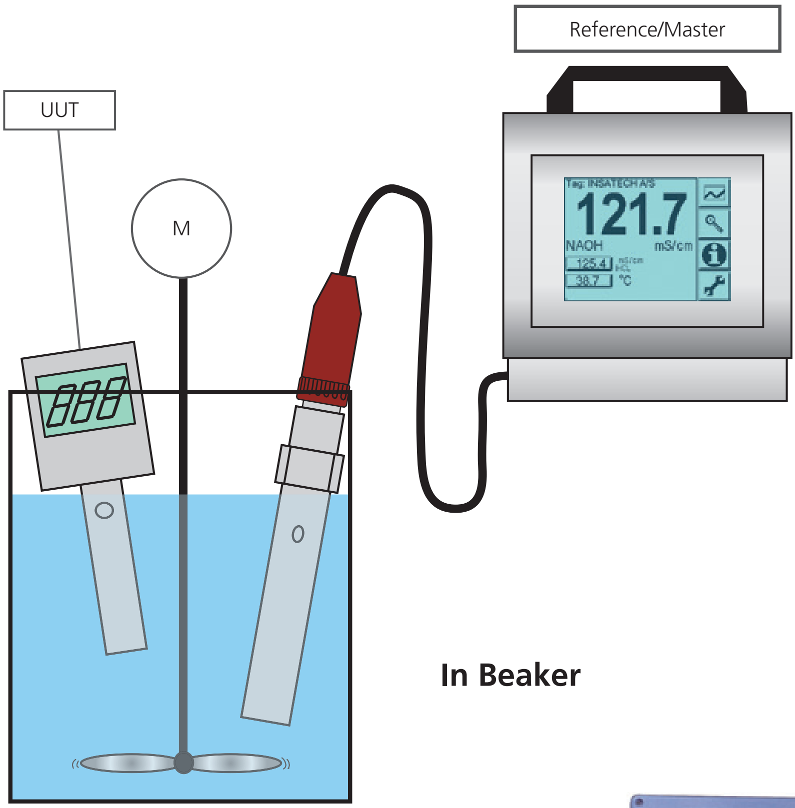
**Table 2**

| | |
|---|---|
| Siemens | = $Ohm^{-1}$, hence |
| $(Ohm \times cm)^{-1}$ | = Siemens x $cm^{-1}$ or Siemens/cm |
| e.g. | |
| 1 Mohm x cm | = $(1 \times 106)^{-1}$ Siemens = |
| $1 \times 10^{-6}$ Siemens/cm = 1 µS/cm | |

B: The UUT as well as the insacal reading must be temperature compensated in the same way.

Meaning: Temperature compensation algorithms and the reference temperatures used must be the same. Calibrating without the use of temperature compensation is recommended to avoid influence from temperature differences, except if calibrating using very hot liquids with long tubing between the insacal and UUT (Unit Under Test) (this will be explained later in detail).

2. Best results are achieved if both the insacal and UUT are at the same conditions, temperature and flow. This is easily achieved by placing the insacal sensor and UUT (Unit Under Test) in a stirred vessel, and wait for stable readings. This set-up is only advisable for conductivity values over 5 µS/cm.




**In Beaker**

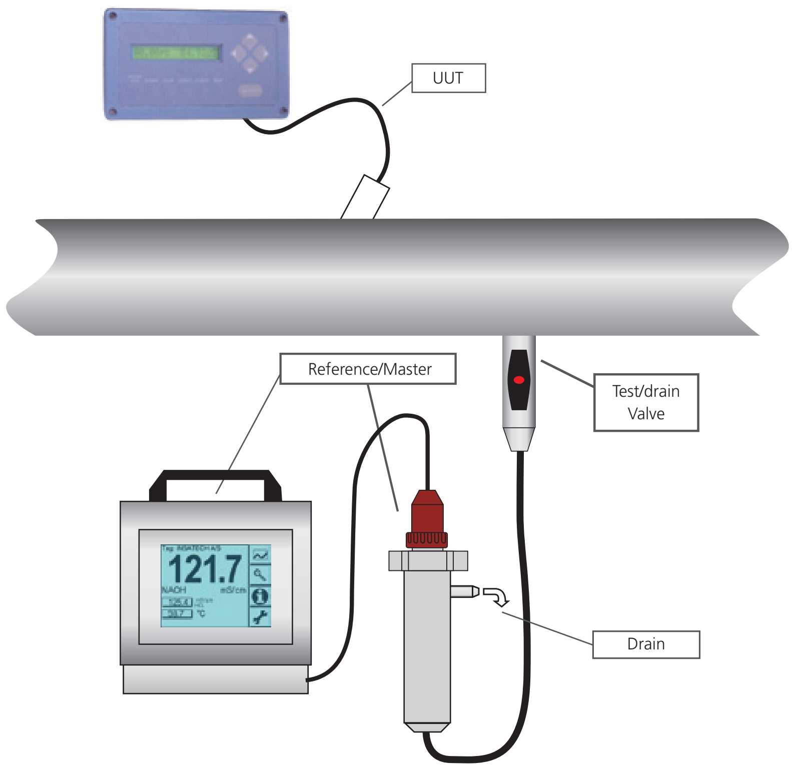
Or

By closed loop sampling, always recommended when measuring low conductivity values:

## Temperature deviation compensation

must be carried out as explained below. Please note that liquid temperature must be stable during the calibration.

1. Read temperature on insacal,
2. Switch to manual in the "temperature compensation menu",
3. See temperature error in the calibration sheet for the insacal,
4. Enter this value manually in the insacal, and the algorithm is now using the correct value when calculating the temperature compensation.




**Closed Loop**

## Flow

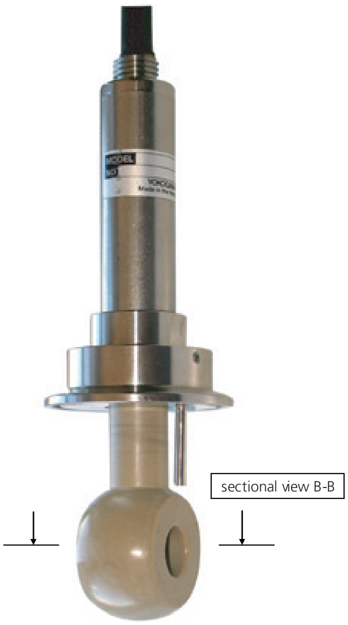
A sufficient flow is important to minimize pollution from tubing and fittings between the insacal and the sample point and also to minimize the temperature differences between the UUT (Unit Under Test) and the insacal. Insulated short pipe runs will also contribute to minimizing temperature differences, important to avoid as this is a source of difference in conductivity readings.

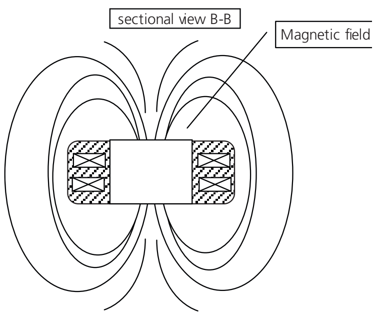
The media must be in the liquid phase and free of bubbles/gas enclosures. At temperatures over the boiling point, ensure that the valve used to control the sample flow is downstream of the insacal to avoid bubbles due to pressure drop. The conductivity readings must be stable.

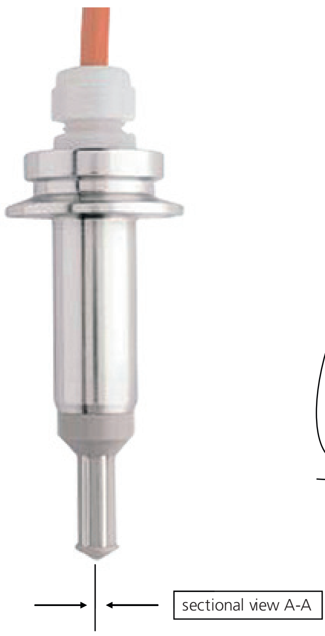
## Installation

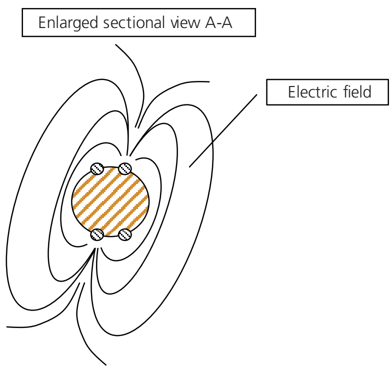
When calibrating conductivity sensors, the calibration method must represent the way the equipment is used on-site. E. g. the electric field of an open-cell, and the magnetic field of an inductive cell will be influenced by the surroundings.

In these cases, the calibration setup must be an exact copy of the field installation, or the sensors must be calibrated on-site in a closed loop, as shown above.



## Calibrating at high temperatures

Calibrating without temperature compensation is recommended. In the event of very high liquid temperature, a temperature drop between the UUT (Unit Under Test) and the insacal may be expected, and this difference must be compensated for.

Temperature compensation is not without risks of errors and great care must be taken.
The temperature of the media must be stable during calibration, and the temperature algorithms of the UUT (Unit Under Test) and the insacal must be the same. In practice, this means the equipment under test must be make Yokogawa.
If not, avoid the use of algorithms and use temperature coefficients instead.

Temperature coefficients can be determined as follows:

1. Switch off temperature compensation.
2. Flush until the temperature of the reference cell is stable.
3. Read conductivity and temperature.
4. Stop the flow for a short time. Read temperature and conductivity.
5. Calculate the temperature coefficient, using the formula below.

$$\text{Temp. coef. } (\alpha) = \frac{(K_2 - K_1) \times 100}{K1(t_2 - 25) - K2(t_1 - 25)} \ [\%/°C]$$

6. The determined temperature coefficient is input into the insacal as well as the UUT (Unit Under Test).

## How long is it necessary to stop the flow?

The flow is discontinued for a period of time determined as per below two considerations.

Firstly, the temperature change has to be of a magnitude sufficient to eliminate inaccuracies of readings.

The Insacal display shows temperature with one decimal. i.e. a temperature change of less than 0.1°C may not be sufficient to alter the displayed temperature. In other words, the temperature change must be more than 0.1°C.

Secondly, as the ions from the surroundings creep into the water after the flow has been stopped, the conductivity will keep increasing for a period of time.
Stop the flow for a duration giving sufficient confidence in the temperature drop reading, but keep the stop as short as possible.

## Corrections

In cases with deviations between the UUT and the insacal, the UUT can be adjusted.

In cases applying old technology, the reading may be adjusted by means of a potentiometer in the indicator or in the cell.

Alternatively, if the cell constant value of the indicator is adjustable, then this may be adjusted using the formula below.

$$\text{New cell constant} = \frac{\text{reference value}}{\text{UUT}} \times \text{actual cell constant}$$

In some cases an installation factor (IF) is used instead of the cell constant. IF is corrected in the same way as a cell constant.

## Uncertainty

| | |
|---|---|
| Reference transmitter $U_t$ | ±0.5%. Distribution: square |
| Ambient temperature $U_{ta}$ | ±0.05% per °C. Distribution: square |
| Cell constant determination $U_{cc}$ | > ±0.4% when determined with a standard solution,<br>±1%. Interval 1.3 to 99.9 µS/cm when determined by comparison,<br>±0.5% Interval 0.1 to 239 mS/cm when determined by comparison,<br>Confidence interval: 2. See www.insacal.com |
| Transmitter calibration $U_{tc}$ | In short: ± (last significant digit +10%). Confidence interval: 2 |

Total $\sqrt{(U_t/\sqrt{3})^2 + (U_{ta}/\sqrt{3})^2 + (U_{cc}/2)^2 + (U_{tc}/2)^2 + (resolution/2/\sqrt{3})^2}$ x Coverage factor

Eg.
Master displays 100,0 µS/cm.
Ambient temperature = 30°C
Cell constant determined by a 100 µS/cm standard solution (Ucc = 0,36%)
Coverage factor =2 (level of confidence of approximately 95 %)
Total = 0,75%.

In cases with accept criteria having narrow tolerances, enhanced accuracy is required.
Below please find an example of how to calibrate the indicator on-site by a standard resistor prior
to the calibration.

Eg.
Master displays 100,0 µS/cm.
Ambient temperature = 30°C
Cell constant determined by a 100 µS/cm standard solution (Ucc = 0,36%)
Coverage factor =2 (level of confidence of approximately 95 %)
Standard resistor acc = 0,05% . Distribution: square
Calibration of standard resistor: 10 ppm. Confidence interval: 2.
Temperature influence of standard resistor 15 ppm. Distribution: square
Total= 0,37%.

## Calibration of the insacal Master Meter

Insatech A/S can offer accredited calibration of your master meter.
Insatech is accredited by DANAK (Danish Accreditation and Metrology Fund), according to ISO17025:2005, and internationally approved by the International Laboratory Cooperation ILAC.

# About us

In 2005 Insatech A/S became a part of the Addtech Group of companies – Addtech AB, Stockholm, and since the company was established in 1989, we have had a positive business development. Today we are >60 employees.

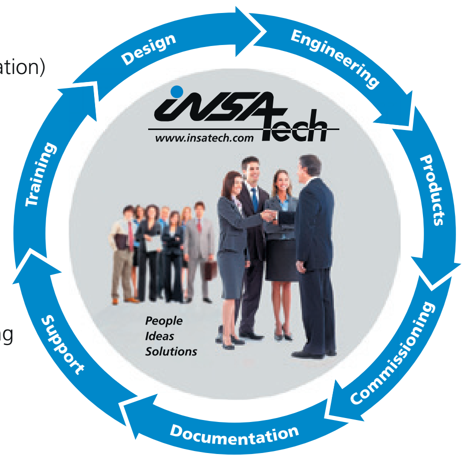
Our mission is to be a trustworthy and competent partner, who supply technical solutions and engineering within process automation.


As a result of our longstanding partnership with some of the world's leading manufacturers within instrumentation and automation, we are able to provide a global service.

We work as a professional partner for our suppliers and for our customers – we believe in long relationships.
Our main markets are in the Pharmaceutical, Food, Energy, Marine/Oil & Gas Industry, which means we have a strong knowledge of the special applications, as well as the requirements for documentation in these areas.

# Our main business areas:

- Process instrumentation and calibration equipment
- Automation, control and data aquisition
- System design, engineering and validation (DCS and Safety Systems)
- Service/maintenance and calibration (ISO 17025 accreditation)
- Site surveys and evaluation of process optimization based on better control practices
- Marine- and ship solutions, Cargo Management Systems
- Project Management
- Flow rigs/calibration rigs
- Special fittings
- Product enhancements
- Wireless solutions for monitoring and control
- Complete solutions including panels and commissioning
- Seminars and training




CAL Reg. Nr. 484
Conductivity calibration
Temperature calibration
Electrical calibration
Gas flow calibration



# Products and Services

**Accredited Calibration:**
Conductivity (Master meter)
Gas Flow

**Analysis of gases:**
Ammonia - $NH_3$
Moisture - $H_2O$
Oxygen - $O_2$
Carbon dioxide-$CO_2$
Carbon monoxide - CO
Methane - $CH_4$
Hydrochloric acid - HCl
Water - $HO_2$

**Analysis of liquids:**
Cell density
Density
Color
Conductivity
Concentration
Carbon dioxide - $CO_2$
Live Cells
Sound speed
NIR
Dissolved Oxygen
pH
Plato
Protein
Refractive index
TOC
Turbidity
Solids Viscosity

**Analysis of solids:**
Moisture
Fat
Protein

**Calibration:**
Flow
Temperature
Pressure
Simulators

**Control and Systems:**
DCS Systems
Shut Down & security systems
MES systems
Blending Systems
MID Solutions
SEEMP

**Controllers:**
Auto-tuning
Fuzzy-logic
Single- and multi-loop

**Flow Measurement:**
Bunker Control
Bunker Blending
Custody transfer
Coriolis mass flow
Differential - orifice/pitot tube
Flowswitch
Magnetic inductive
Mechanical
Rotameters V/A
Thermal mass flow
Ultrasonic (Clamp-on and in-line)
Vortex

**Flow Measurement Solids:**
Microwaves

**Level Measurement:**
Electromechanical
Displacement
Hydrostatic pressure
Capacitive
Conductive
Microwaves
Radar
Radiometric
Ultrasonic
Vibration

**Pressure Measurement:**
Absolute
Differential
Relative
Calibrators
Diaphragm seal
Level
Pressureswitch

**Registration & Data Collection:**
Data loggers
Data Acquisition Systems
GPRS - wireless transmission
Recorders
Paperless recorders

**Single Use Technology:**
Flow
Pressure
Temperature
UV
Conductivity
Live Cells
Turbidity

**Services:**
*Calibration:*
Flow - gases and liquids
Conductivity
pH
Temperature
Pressure
*Accredited Calibration:*
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Pressure
Temperature
UV
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Turbidity

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