OPTITEMP TRA-H6X/-C6X Handbook

Temperature sensors for hygienic applications
Type TRA-H65, TRA-C65, TRA-H61, TRA-C61

KROHNE

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1.1 Intended use

⚠️ *CAUTION!*
Responsibility for the use of the measurement devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

ℹ️ *INFORMATION!*
This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

ℹ️ *INFORMATION!*
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The temperature sensors of the TRA-Hxx and TRA-Cxx series are used to measure the temperature of gases, liquids, vapour and solids in industrial and hygienic applications. The devices are particularly suited to the measurement of

- liquids with low viscosity,
- water and chemicals with low corrosiveness,
- saturated steam and superheated steam.

Type TRA-H65 is a standard hygienic sensor with clamp connection.
Type TRA-C65 is a compact hygienic sensor with clamp connection.
Type TRA-H61 is a standard hygienic sensor with G1/2 thread.
Type TRA-C61 is a compact hygienic sensor with G1/2 thread.

For further information about hygienic certifications refer to *EHEDG - Meaning and implementation* on page 6 and refer to *3-A - Meaning and implementation* on page 7.

1.2 Approvals certifications and conformities

1.2.1 CE

CE marking

The device fulfils all applicable statutory requirements of the EU directives:

- For devices with electrical installations: EMC directive

The manufacturer certifies successful testing of the product by applying the CE marking. An EU declaration of conformity regarding the directives in question and the associated harmonised standards can be downloaded from our internet site.

1.2.2 EHEDG - Meaning and implementation

TRA-H61 and TRA-C61 temperature sensors comply with EHEDG requirements EL Class I: suitable for CIP and SIP, cleaning in place and steam in place. If EL class I has to be maintained, TRA-H61 and TRA-C61 require a PEEK gasket at process side in addition, to avoid a steel-to-steel connection.

Meaning of EHEDG

The aim of EHEDG is to contribute to hygienic construction and design in all areas of food production and thus to ensure the safe production of food. EHEDG supports European legislation and its requirements for hygienic handling, processing and packaging of food products using hygienic machinery and in a hygienic environment (EC directive 2006/42/EC for machinery, EN 1672-2 and EN ISO 14159 for hygiene requirements).

Use of devices in accordance with EHEDG

The use of devices and components that bear the EHEDG logo is evidence that the design has been inspected. The certificate always applies to a combination of a sensor and process connection. Both components in this combination must conform to EHEDG standards.
It looks like this:

Figure 1-1: Example of EHEDG logo

Use in accordance with EHEDG entails enhanced or special requirements compared to standard applications. This applies in particular to:

- Housing design (e.g. easy to clean)
- Structure of the process connection (e.g. welded socket maximum as long as the pipe is wide)
- Only seals, which are listed on EHEDG position paper
- Installation position on the tank (e.g. self-draining)
- Cleaning, maintenance (intervals, methods)

1.2.3 3-A - Meaning and implementation

TRA-H65 as well as TRA-C65 is available with 3-A symbol authorisation.

Meaning of 3-A

The 3-A Sanitary Standards Incorporation publishes hygiene standards which contain guidelines for materials, design and manufacturing methods. The organisation verifies compliance to the hygienic design.

Compliance is inspected by an independent third body, the CCE (Certified Conformance Evaluator). Once compliance has been verified, the 3-A SSI (Sanitary Standards Incorporation) issues a symbol licence for the 3-A logo.

Use of devices in accordance with 3-A

The use of devices and components that bear the 3-A logo is evidence that the design has been inspected. The certificate always applies to a combination of a sensor and process connection. Both components in this combination must conform to 3-A standards. It looks like this:

Figure 1-2: Example of 3-A logo

Use in accordance with 3-A entails enhanced or special requirements compared to standard applications. This applies in particular to:

- Housing design (e.g. easy to clean)
- Process connection design (e.g. visibility of potential leaks)
- Gaskets (e.g. FDA or 3-A compliance, stability)
- Installation position on the tank (e.g. self-draining)
- Cleaning, maintenance (intervals, methods)

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This warning refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

• HANDLING
This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.
➲ RESULT
This symbol refers to all important consequences of the previous actions.

1.4 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

i *INFORMATION!*
Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

i *INFORMATION!*
Do a check of the packing list to make sure that you have all the elements given in the order.

i *INFORMATION!*
Look at the device nameplate to ensure that the device is delivered according to your order.

Standard scope of delivery:

- Device as ordered
- Optional transmitter
- Optional hygienic process adapter(s) in a separate carton
- Optional PEEK gasket for EHEDG versions with adapter

The manufacturer provides for all hygienic temperature sensors the relevant technical documentation. The following table illustrates which additional documentation is available for which temperature sensor.

Scope of order	HB for hygienic sensors	HB for measuring inserts	HB for temperature transmitters	DS for hygienic accessories
TRA-H6x sensors	X	(X)	-	-
TRA-H6x sensors + transmitter	X	(X)	X	-
TRA-H6x sensors + adapter	X	(X)	-	X
TRA-H6x sensors + transmitter + adapter	X	(X)	X	X
TRA-C6x	X	-	-	-
TRA-C6x + adapter	X	-	-	X
TRA-C6x + adapter + transmitter	X	-	-	X

Table 2-1: Available documentation related to hygienic temperature sensors

X: available; –: not available
(X) sensors are available with and without measuring insert, depending on tip design
HB: handbook / manual; DS: data sheet

2.2 Design of hygienic temperature sensors

A temperature sensor is called hygienic if its design follows certain hygienic guidelines and standards.

Main issue for hygienic design is always:

• good cleanability
• gap free constructions
• smooth wetted parts surfaces
• approved standardised process connections

Our concept for hygienic sensors is based on a hygienic G1/2 thread and additional adapters in order to adapt the sensors to the most common process connections like VARIVENT® and others.

For the US market and other markets with corresponding requirements the sensors are equipped with a welded clamp connection in different diameters complying with the 3-A standard.

2.2.1 Standard temperature sensor

A hygienic standard temperature sensor consists besides a process connection of a neck tube ending in a connection head, suitable to include a head-mounted transmitter.

Figure 2-1: Available types of standard temperature sensors
① Temperature sensor with G1/2 thread
② Temperature sensor with clamp connection

Both types are available in two versions:

- With a Ø6 mm / Ø0.24" thermowell reduced to Ø4 mm / Ø0.16, suitable to take a replaceable Ø3 mm / Ø0.12" Pt100 insert
- With a Ø6 mm / Ø0.24" sensor rod reduced to Ø3 mm / Ø0.12" including a completely sealed fast responding Pt100 RTD

To complete the hygienic temperature assembly, a connection head is required with an M24 x 1.5 mm thread.
The manufacturer recommends a stainless steel head for hygienic applications.
Temperature sensors with connection head allow to install several types of head-mounted temperature transmitters inside.

2.2.2 Compact temperature sensor

Beside the standard temperature sensors, compact sensor versions are available as well. Compact temperature sensors have a small form factor and are suitable for almost any application.

They are easy to commission and maintain. Compact temperature sensors don't use heads, head-mounted transmitters or replaceable inserts. Their solid mechanical design has no removable parts, which makes them highly resistant to mechanical stress and less cost intensive.

If a 4...20 mA output signal is selected, transmitter electronics is installed inside the Ø13.5 mm / Ø0.53" housing tube. If a bare Pt100 signal is required, the housing tube remains empty.
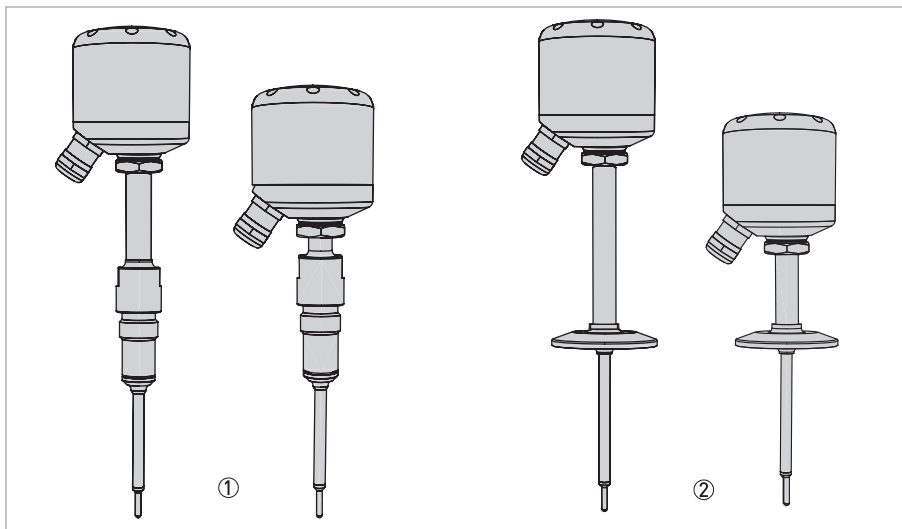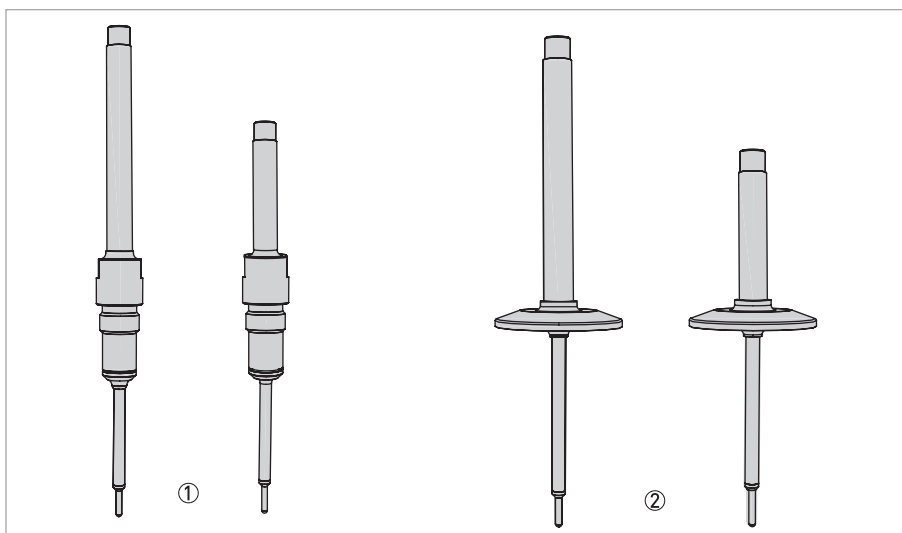

Figure 2-2: Available types of compact temperature sensors

① Temperature sensor with G1/2 thread
② Temperature sensor with clamp connection

2.3 Connection head

Connection heads protect the terminals and the temperature transmitter from environmental influences (e.g. dirt, dust and moisture). They have an M24 x 1.5 mm neck connection. It's lid features an oil-resistant rubber gasket.

Connection heads for the food and beverage industry are typically made from stainless steel.

Cable entries
- PA cable gland IP66/67, optional with IP69
- Stainless steel cable gland IP66/67, optional with IP69
- M12 connector IP66/67
- M12 connector IP69 with IP69 cable connected
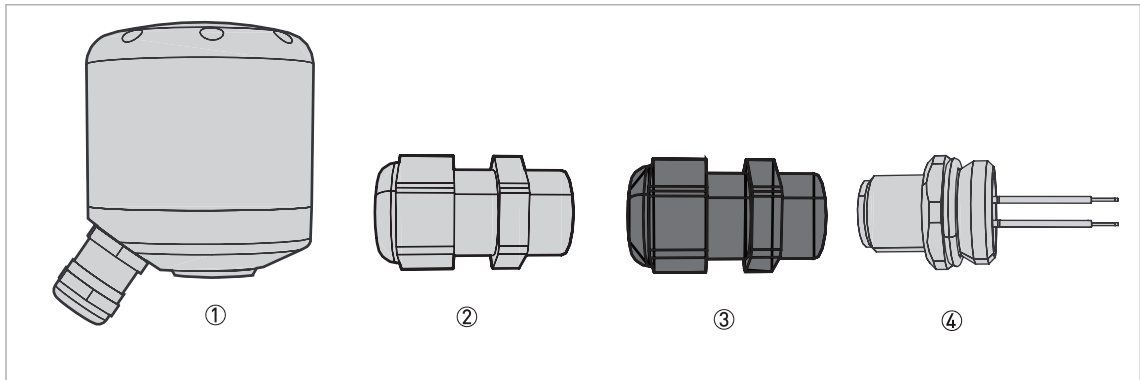
Figure 2-3: Available connection head and cable entries

① Hygienic head type BHY
② Stainless steel cable gland
③ PA cable gland
④ M12 connector

CAUTION!
During the assembly of temperature sensors with connection head it may be necessary to adjust the cable gland in order to connect the cable in a straight way. This is done by unlocking the cap nut ① at the bottom of the head and turning the head into the required direction:

- *Sensors without replaceable inserts, tip size Ø6 mm / Ø0.24" reduced to 3 mm / 0.12":*
  -> open nut until head gets loose, turn head ±180° max.
- *Sensors with replaceable insert, tip size Ø6 mm / Ø0.24" reduced to 4 mm / 0.16":*
  -> open nut until head gets loose, turn head as required.
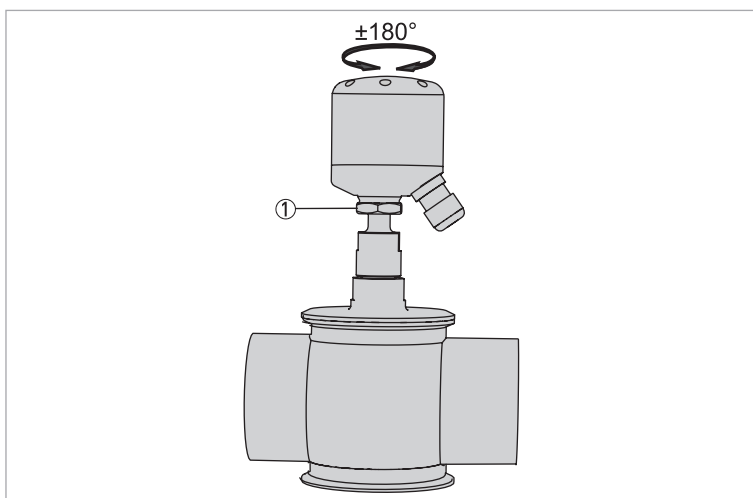
Figure 2-4: Turning of connection head to required position

① Cap nut

2.4 Sensors with replaceable measuring inserts

INFORMATION!
The general features of the measuring inserts are standardised in DIN 43735.

The Ø3 mm / Ø0.12" replaceable measuring insert contains the Pt100 sensing element which is used for hygienic temperature sensors. The measuring insert is inserted through the open connection head into the temperature assembly and attached using two spring loaded M4 screws, guaranteeing that the inserts tip is in constant contact with the bottom of the thermowell.

The following types of Ø3 mm / Ø0.12" Pt100 measuring insert are available for the hygienic temperature sensors:
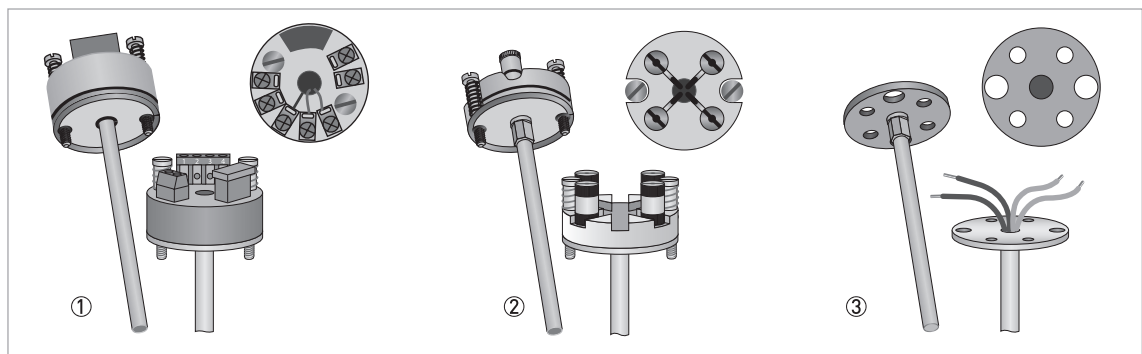
Figure 2-5: Available measuring insert versions

① Measuring insert with head-mounted temperature transmitter
② Measuring insert with ceramic terminal block
③ Measuring insert with flying wires

One distinguishing dimension of the measuring insert is its length. The length is measured from the bottom edge of the base to the tip of the immersion tube. For technical reasons hygienic sensor inserts length may differ from the length of the non-hygienic temperature sensors.
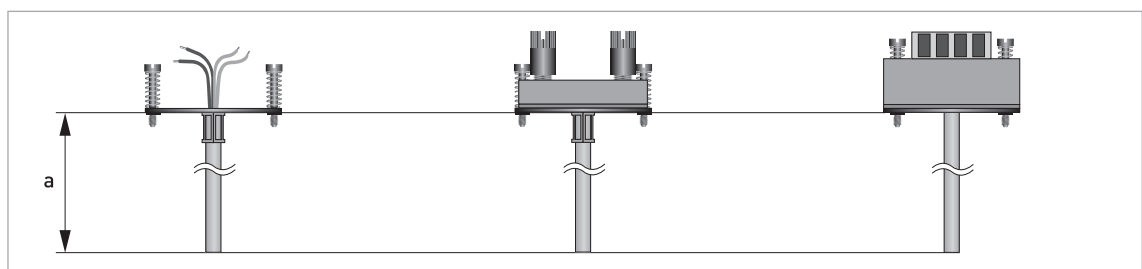
Figure 2-6: Measuring insert length "a"

INFORMATION!
Consult the handbook "OPTITEMP TR/TC 100" for more detailed information on the measuring inserts.

2.5 Types of temperature transmitters

In most cases head-mounted transmitters are used together with hygienic temperature sensors. Electrical thermometers have just one, weak, interference-prone output signal. If this signal has to travel a great distance or if a standard signal of 4...20 mA is required, the use of a temperature transmitter is recommended.

INFORMATION!
The manufacturer cannot make any general statement for the distance from which the use of a temperature transmitter is necessary as it depends on the specific interference associated with the installation site. The operator alone is responsible for this decision.

There are two types of temperature transmitters:

- **Head-mounted transmitter:**
  Located on the measuring insert and thus in the connection head of the temperature assembly during operation, recognisable by the "C" in the product name (e.g. TT 22 C).
- **Rail-mounted transmitter:**
  Located in the control cabinet or field housing, recognisable by the "R" in the product name (e.g. TT 22 R). They are usually used when the temperature in the connection head does not allow the use of a head-mounted transmitter.
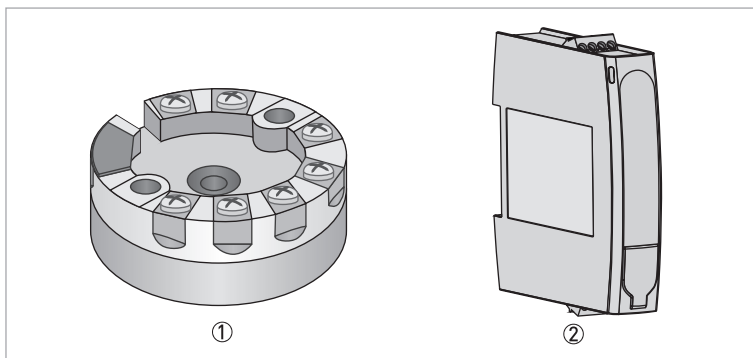
Figure 2-7: Types of temperature transmitters
① Head-mounted transmitter, "C" types
② Rail-mounted transmitter, "R" types

INFORMATION!
Consult the relevant transmitter handbook for more detailed information on the temperature transmitters.

2.6 Neck tubes for standard temperature sensors

Standard hygienic temperature sensors offer a neck tube keeping the head away from a hot process connection. If a pipe is thermally isolated, the neck tube allows to install the head outside of the isolation.

The neck tubes for standard temperature sensors are available in two different standard lengths, a short and a long variant:

• TRA-H61: 58 mm / 2.28" and 98 mm / 3.86"
• TRA-H65: 64 mm / 2.52" and 104 mm / 4.09"

The required neck length should be selected according to the process conditions.

2.7 Thermowells, sensor rods and different tip designs

The thermowell is designed to prevent external loads, e.g. static pressure and flow from damaging the measuring insert respectively the sensing element.

As a rule, thermowells are made of the same material as the system in which the measuring is done. For hygienic applications, it's typically stainless steel.

Depending on the required thermal response time, hygienic temperature sensors can be equipped with a protective thermowell or directly immersed into the medium if this is allowed. The thermowells advantage is that the temperature assembly is more rugged and that the sensing element, here the Pt100 insert, can be exchanged without opening the process.

However, a sensor with thermowell responds slower than a directly immersed sensor. To decrease response time, all sensors have a 15 mm / 0.59" reduced tip in general, either Ø4 x 15 mm / Ø0.16 x 0.59" or Ø3 x 15 mm / Ø0.12 x 0.59".
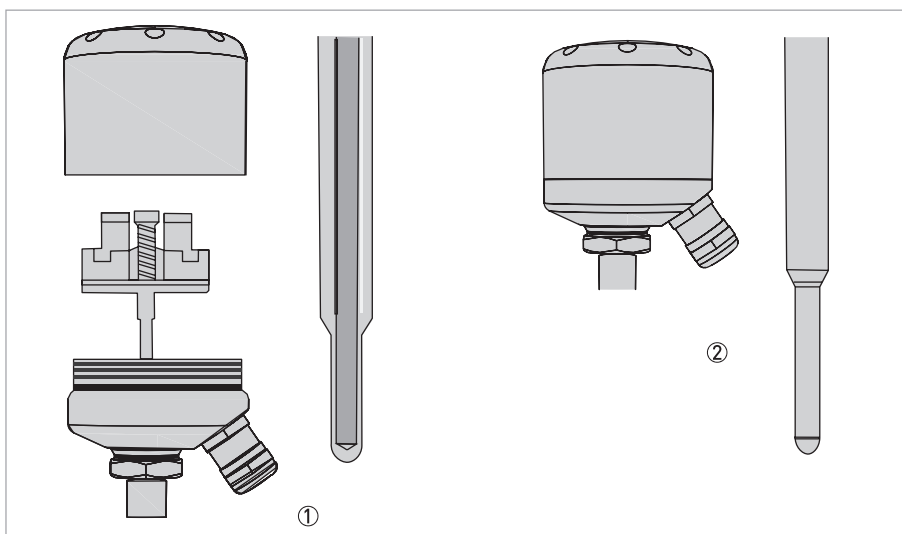
Figure 2-8: Different tip designs
① Ø4 mm / Ø0.16" sensor with replaceable Pt100 insert
② Ø3 mm / Ø0.12" sensor with fast responding Pt100 tip

2.8 Process connections

2.8.1 Clamp temperature sensor

Hygienic temperature sensors with welded thermowell - clamp flange connection are available as standard sensors with neck and head as well as in compact versions.

Tri-Clamp	ISO 2852	DIN 32676
1 1/2"	25/38 mm	DN25/40
2"	40/51 mm	DN50

Table 2-2: Available clamp flange sizes

For information on dimensions refer to *Standard hygienic sensors with clamp connection* on page 45 and refer to *Compact hygienic sensors with clamp connection* on page 46.

2.8.2 Threaded temperature sensors

Hygienic temperature sensors with threaded thermowells are availible with a G1/2 hygienic process connection.

The temperature sensors can be screwed into corresponding weld-in sleeves or can be equipped with different hygenic process adapters as well.

INFORMATION!
Only dedicated combinations of adapters and sensors fulfil together the EHEDG requirements.

For information on dimensions refer to *Standard hygienic sensors with G1/2 thread* on page 47 and refer to *Compact hygienic sensors with G1/2 thread* on page 48.

2.8.3 Adapter solutions

Fitted to the G1/2 hygienic thread, a broad variety of different hygienic process adapters is available.
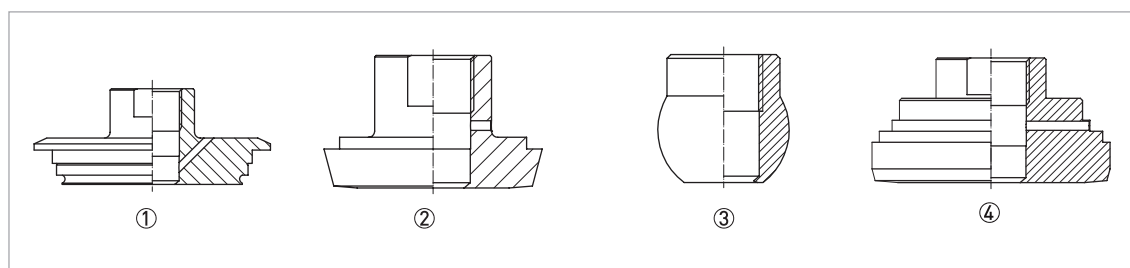
Figure 2-9: Examples of hygienic process adapters

① Clamp connection, VARIVENT® type N
② Threaded connection, according to DIN 11851
③ Weld connection, angular mounting (ball)
④ Threaded connection, according to DIN 11851

For information on dimensions refer to *Hygienic adapters* on page 49.

2.8.4 Steel to steel and steel to PEEK adaptions

Using the G1/2 hygienic thread and adapters is a very common solution to reduce variants on stock and to adapt sensors fast to the requested process connection.
However, with respect to common hygienic approvals like 3-A and EHEDG, steel to steel connections are no longer allowed e.g. for EHEDG cleaning EL class I, which means cleaning in process without dismantling.

If a steel to steel connection is opened and closed more than one time, it is not guaranteed, that the tightening surfaces are still intact which means without any deformation. For this reason, we are offering an optional PEEK gasket, specially tailored to our adapter concept.
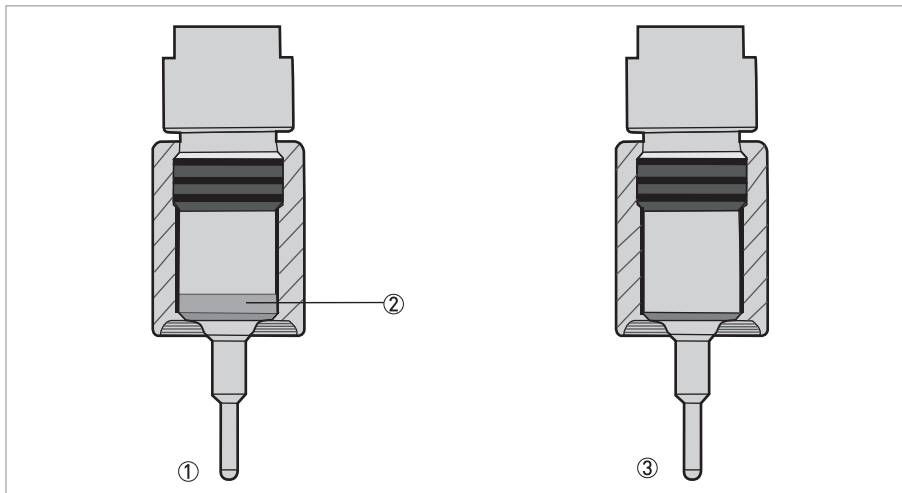
Figure 2-10: Steel to PEEK vs steel to steel
① Hygienic G1/2 thread: steel to PEEK
② PEEK gasket
③ Hygienic G1/2 thread: steel to steel

The PEEK gasket (②) is designed in a way that it will always stick on to the thread and never remains inside of the nozzle. That makes the connection safe and sensor replacement easy. Please consider that the PEEK gasket is mandatory for EHEDG EL class I compliance.

According to the corresponding guidelines these connections should be tightened only one time for best safety and tightness. In case of steel to PEEK, only the gasket has to be replaced in case of dismounting and remounting the sensor assembly. Using the PEEK gasket reduces maximum permissible pressure and temperature of this process connection.

Type of connection	Limits		Required torque
	metric	imperial	
Steel to steel	40 bar at 200°C	580 psi at 392°F	10 Nm
Steel to PEEK	10 bar at 140°C	145 psi at 284°F	20 Nm

Table 2-3: Limits of adapters

2.9 Nameplate

> **INFORMATION!**
> *Look at the device nameplate to ensure that the device is delivered according to your order.*

2.9.1 Nameplate for compact sensors

The nameplate of a compact sensor is located on the sensor housing.
The dimensions are: 47 mm x 39 mm / 1.85 x 1.54".

Figure 2-11: Example of a nameplate with a transmitter

① Type designation
② Serial number
③ Product configuration code and production order number
④ Temperature range and output data
⑤ Material and IP protection class
⑥ China RoHS marking
⑦ WEEE marking
⑧ 3-A marking
⑨ Manufacturing year

Figure 2-12: Example of a nameplate with a 4-wire Pt100 output

① Type designation
② Serial number
③ Product configuration code and production order number
④ Temperature range and output data
⑤ Material and IP protection class
⑥ China RoHS marking
⑦ WEEE marking
⑧ 3-A marking
⑨ Manufacturing year

2.9.2 Nameplate for standard sensors

The nameplate of a standard hygienic temperature sensor is located on the connection head. The dimensions are: 34 mm x 30 mm / 1.34 x 1.18".
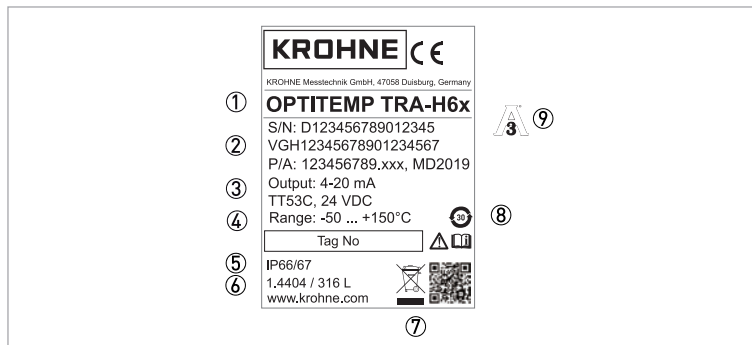
Figure 2-13: Example of a nameplate with a transmitter

① Type designation
② Serial number, product configuration code and production order number
③ Output data and information about installed transmitter
④ Temperature range
⑤ IP protection class
⑥ Material
⑦ WEEE marking
⑧ China RoHS marking
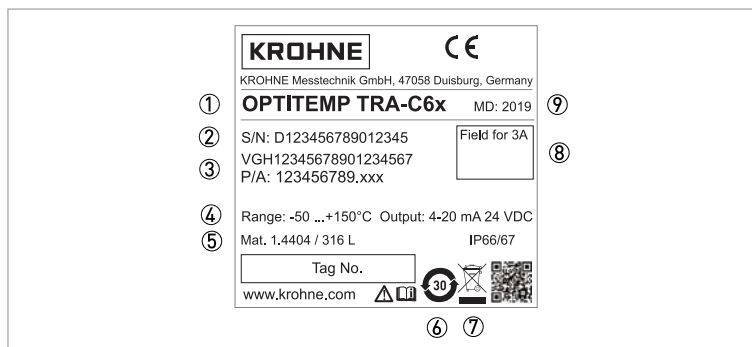⑨ 3-A marking (is separate next to the nameplate)

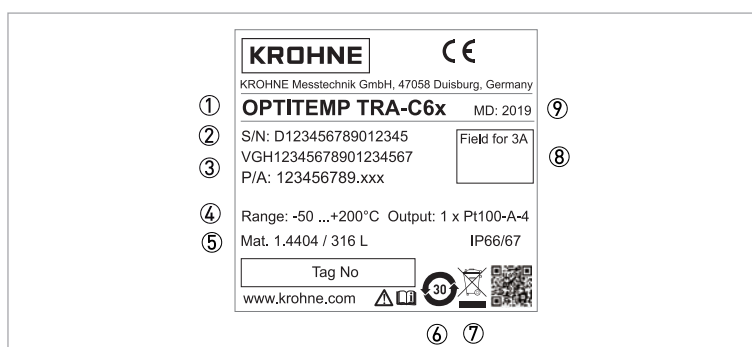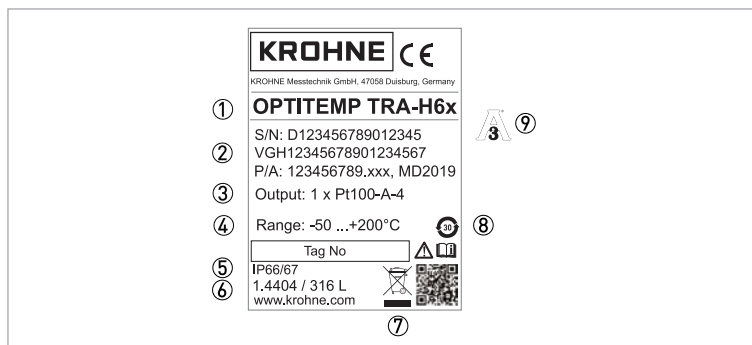Figure 2-14: Example of a nameplate with a 4-wire Pt100 output

① Type designation
② Serial number, product configuration code and production order number
③ Output data
④ Temperature range
⑤ IP protection class
⑥ Material
⑦ WEEE marking
⑧ China RoHS marking
⑨ 3-A marking (is separate next to the nameplate)

3.1 General notes on installation

⚠ *CAUTION!*
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

ℹ *INFORMATION!*
Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

ℹ *INFORMATION!*
Do a check of the packing list to make sure that you have all the elements given in the order.

ℹ *INFORMATION!*
Look at the device nameplate to ensure that the device is delivered according to your order.

ℹ *INFORMATION!*
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- Store the device in its original packing.
- Storage temperature is depending on sensor design. For further information refer to *Technical data tables* on page 40.

3.3 Transport

- Always transport the devices in their original packaging.
- Do not expose the devices to moisture or vibration during transport.
- The information that applies to storage also applies to transport.

3.4 Installation instructions

⚠ *CAUTION!*
Take the following points into consideration prior to installing the device:

- *The dimensions of the thermowell (length, diameter, wall thickness, type of tip) comply with the requirements of the measuring point. The mechanical load as a result of flowing media, vibration and resonances is the focus here. In addition, incorrect dimensions can lead to measurement errors.*
- *The thermowell is sufficiently resistant to chemically aggressive media (refer to the generally accessible corrosion tables). Otherwise, corrosion may occur or the medium may penetrate into the thermowell. When in doubt, select a thermowell made from the same material as your system.*

3.4.1 Possible installations

Installation site, angle and length

Installations include the parameters "installation site", "installation angle" and "insertion length". Depending on the space available and the diameter of the pipe, three installations are recommended for pipes with flowing product:

- Small pipe diameter: Installation directly against the direction of flow in a bend in the pipe (①).
- Small pipe diameter: Installation diagonally against the direction of flow, if a bend in the pipe is available (②).
- Large pipe diameter: Vertical installation, if flow-induced periodic vortex shedding does not cause the temperature assembly to vibrate in its resonance frequency (③).
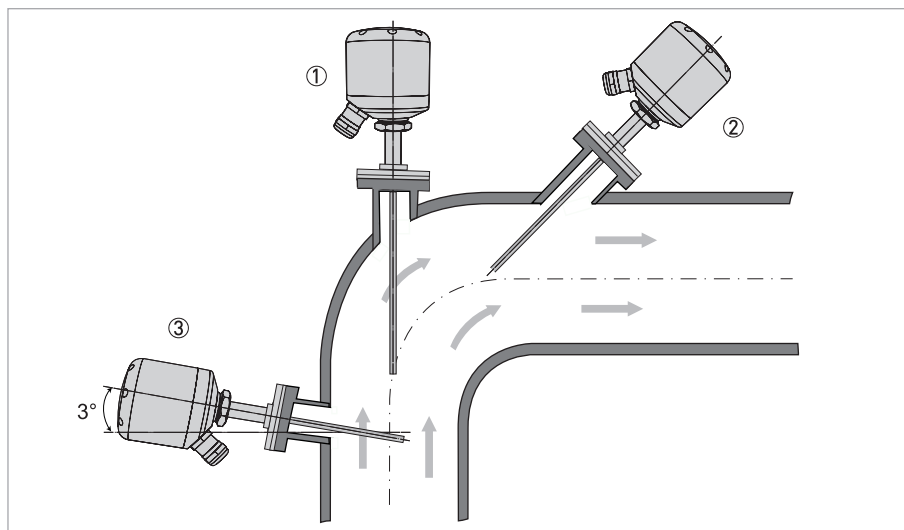
Figure 3-1: Recommended installations

Permitted insertion length of the thermowell or measuring insert

The insertion length (b) of the thermowell or measuring insert refers to the distance from the seal of the process connection or the bottom of the flange to the tip of the thermowell or sensor rod. This length determines how far the sensor projects into the measured medium.
To avoid measurement errors and fulfil hygienic requirements as well, ensure that the insertion length (b) meets the following requirements:

- Insertion length in pipelines: $b \geq L + 22$ mm / 0.87"
- Pipes with (a) < Ø200 mm / 7.87": sensor/thermowells tip should project past the middle of the pipe if possible
- The relation $L \leq (D - d)$ must be maintained for cleanability reasons
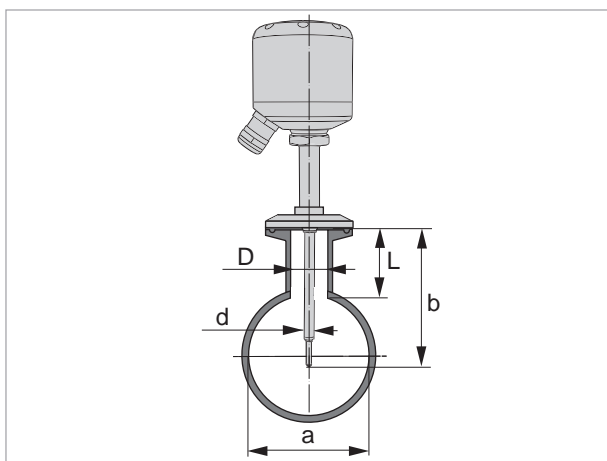
Figure 3-2: Recommended insertion length

L: length of the nozzle
b: insertion length into the pipe
D: inner diameter of the nozzle
a: inner diameter of the pipe
d: outer diameter of sensor rod/thermowell

Pipe size (a), min.	Pipe size (a), max.	Direct insertion length (b-L)	Flow velocity ①
DN25 / 1"	DN40 / 1 1/2"	22 mm / 0.87"	25 m/s
DN40 / 1 1/2"	DN65 / 2 1/2"	30 mm / 1.18"	22 m/s
DN80 / 3"	DN100 / 4"	50 mm / 1.97"	15 m/s
DN100 / 4"	DN125 / 5"	70 mm / 2.76"	10 m/s
DN125 / 5"	DN150 / 6"	80 mm / 3.15"	9 m/s
DN150 / 6"	DN200 / 8"	90 mm / 3.54"	8 m/s
DN200 / 8"	DN225 / 9"	100 mm / 3.94"	7 m/s
DN225 / 9"	DN250 / 10"	130 mm / 5.12"	6 m/s
DN250 / 10"	DN350 / 12"	150 mm / 5.91"	5 m/s
DN350 / 12"	DN400 / 16"	180 mm / 7.09"	4 m/s

Table 3-1: Examples for recommended sensor insertion length in pipes
① Maximum permitted flow velocity of water at ambient temperature

A sensors insertion length into a pipeline is also limited due to vortex shredding. Vortexes induce vibration into sensor rods and thermowells, leading sooner or later to breakage. Vortex frequency rises with flow velocity. The shorter the insertion length, the lower the risk of the well getting permanent into resonance and getting damaged. In tanks, where normally no stress through flow occurs, longer insertions are possible.

3.4.2 Other installation requirements

- A well-insulated pipeline or tank around the measuring point reduces thermal dissipation and the distorting influence of the ambient temperature.
- If sensors use measuring inserts, the insert must always be in contact with the bottom of the thermowell to avoid measurement errors caused by poor thermal dissipation.
  This is normally guaranteed by the spring-loaded design of the measuring insert.

3.5 Load limits

The load limits of hygienic temperature sensor depend on several factors:

- Dimensions and design of the thermowell (especially the insertion length)
- Thermowell material (hygienic sensors material: stainless steel)
- Mechanical conditions of the thermowell is subject due to the measured medium (pressure, temperature, flow velocity, viscosity, density)
- Sealable pressure of the process connection
- Vibration load due to vortex shredding

The sheer number of factors at play illustrates the difficulty in making universally valid statements about the load limits.
The table on the page before gives information about permissible flow velocity at ambient temperature and pressure in relation to pipe size and insertion depth.

3.6 Installation notes on the individual device classes

3.6.1 Threaded sensors with or without adapters

The device has to be installed in such a way that drainability and inspectability is ensured.
For the recommended installation refer to *Possible installations* on page 25.
Welding connection surface treatment should provide a roughness < 0.8 μm.

Observe the following for a measuring point in accordance with EHEDG standards:

- We recommend at least an angle of 3° (for further information refer to *Possible installations* on page 25).
- The device has to be installed in such a way that drainability is ensured.
- Center the clamp or VARIVENT® connection over the corresponding fitting and gasket.
- Use a suitable connection element (e.g. half ring or clamp ring connection) to attach the device according to the manufacturer´s specification.
- Weld in connections must be welded flush to the inside of the tank or pipeline.

Gaskets

Only gaskets which are listed on the EHEDG position paper are permitted.
The user is responsible for:

- Using a suitable material.
- The right dimension of the gasket.
- Defining adequate service intervals.

3.6.2 Clamp sensors with flange connection

The device has to be installed in such a way that drainability and inspectability is ensured.
For the recommended installation refer to *Possible installations* on page 25.
Welding connection surface treatment should provide a roughness < 0.8 µm.

Observe the following for a measuring point in accordance with 3-A standards:

• The wetted part materials agree with the latest version of "3-A Sanitary Standards for Sensors and Sensor fittings and Connections, no. 74-". Please be aware that the gasket corresponds to the product and the pressure limits.

• The device must be assembled according to the latest version of "3-A Sanitary Standards for Sanitary Fittings, no. 63-" using appropriate gaskets.

Gaskets

Only elastomer sealing material according to latest no. "3-A Sanitary Standards for Sensors and Sensor fittings and Connections, no. 74-" is permitted.
The user is responsible for:

• Using a suitable material.

• The right dimension of the gasket.

• Defining adequate service intervals.

4.1 Safety instructions

DANGER!
All work on the electrical connections may only be carried out with the power disconnected.
Take note of the voltage data on the nameplate!

DANGER!
Observe the national regulations for electrical installations!

WARNING!
Observe without fail the local occupational health and safety regulations.
Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.
Check for the correct supply voltage printed on the nameplate.

4.2 Grounding

The thermowells on the hygienic temperature sensors are grounded via the process connection. No additional grounding is required.

4.3 Ingress protection

The IP protection class of a temperature sensor depends on the type of connection head, sensor housing, cable gland or M12 connector. The following protection classes are available:

- IP66/67: for all hygienic sensors
- IP69: only if a suitable cable gland and O-ring or an M12 connector is used

4.4 Power supply, electrical connections

INFORMATION!
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

The only components of a temperature assembly that require a power supply are the measuring insert and any temperature transmitter used. Please consult the product-specific handbooks for information regarding the power supply of these components.
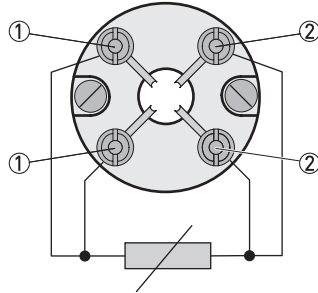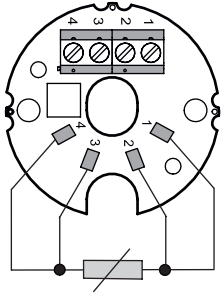
Measuring inserts socket	Printed board connector
Ø4 mm / Ø0.16" sensor with Ø3 mm / Ø0.12" insert, connection: 1 x Pt100-A-4W	Non-replaceable Ø3 mm / Ø0.12" sensor connection: 1 x Pt100-A-4W
① red; ② white	

Table 4-1: Standard sensors with clamp connection
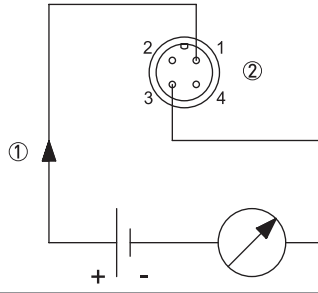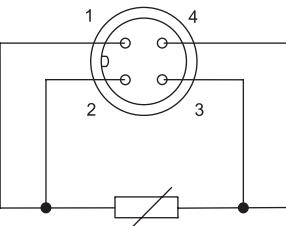
Integrated transmitter output	Pt100 output
M12 connector front view 4...20 mA transmitter output	M12 connector front view 1 x Pt100-4W output
① loop +; ② loop –	

Table 4-2: Sensors with M12 connectors

5.1 Start-up

⚠ *CAUTION!*
Double check the following things prior to starting up a temperature assembly in order to avoid measuring errors as well as damage to or the destruction of the temperature assembly:

- *Ensure that the thermowells have been properly installed according to the manufacturer's instructions.*
- *Ensure that the process connection has been successfully tested for leaks.*
- *Ensure that the measuring insert sits firmly on the bottom of the thermowell.*
- *Ensure that the measuring insert has been properly electrically connected according to the manufacturer's instructions (refer to measuring insert handbook).*

5.2 Normal operation

During the course of normal operation, it is not necessary to make any adjustments to the temperature assembly, measuring insert, temperature transmitter or temperature indicator.

⚠ *WARNING!*
Never touch the thermowell, neck tube or connection head in operation without protective gloves! These components can become very hot during operation and cause burns.

5.3 Faults and damage: reason and remedies

⚠ *CAUTION!*
The most probable cause of a fault is the measuring insert itself and its electronic components (refer to the handbook for measuring inserts, chapter "Faults: Reasons and Remedies"). The following issues come into question here:

- *Short circuit or open circuit*
- *Insulation resistance too low*
- *Ageing, drift*

In addition, the following faults and damage may occur:

Liquid on the process connection

A damaged or incorrect seal can lead to a leak at the process connection. Should this occur, replace the seal and ensure that the new one meets the individual requirements of the measuring point (pressure, temperature and flow).
It is the sole responsibility of the operator of the device to select the right seal.

Temperature indication too high or too low

When reference measurements result in an incorrect temperature indication, three causes come into question:

- Severe thermal dissipation caused by too short insertion length of thermowell or measuring insert: the temperature assembly indicates a temperature that is too low when it is above the ambient temperature and one that is too high when it is below the ambient temperature.
- Severe thermal dissipation via the process connection, the pipeline or the tank wall due to a lack of insulation.
- Incorrect thermowell dimensions (diameter, wall thickness).

To keep the thermal dissipation to a minimum, either increase the insertion length of the temperature assembly or improve the insulation of the measuring point. You can implement these measures together or separately.

Slow response to changes in temperature

If the measuring insert is not resting firmly on the bottom of the thermowell, the response to any changes in temperature may be slowed. So, ensure that the measuring insert touches the bottom of the thermowell using the spring-loaded mounting.

Breaks or tears

It is possible for breaks or tears to occur due to the force of the media flowing against the thermowell. It is also possible for vibrations in the resonance range to damage or destroy the thermowell. Superimposition of the two causes or a combination of insufficient mechanical and chemical resistance is also possible. The following are starting points for troubleshooting:

- Selection of a thermowell with different dimensions
- Change in neck tube length at critical head resonances
- Selection of a different installation site

6.1 Replacing the electronics

When it comes to temperature assemblies, it is only possible to replace an electronic component if the measuring insert has a temperature transmitter ("head-mounted transmitter").
Consult the handbook for the temperature transmitter to learn what you need to take into consideration when replacing the electronics.

The electronics from the compact sensors can't be replaced. In a case of malfunction the whole sensor should be replaced.

6.2 Cleaning and maintenance

Cleaning

- Keep the sensor clean using validated state of the art cleaning processes.
- It is the user's responsibility to check the resistance of the gasket material and sensor as related to the product and the cleaning process.
- Use the resistance lists and the technical data for each sensor as a basis.
- The devices are suited for CIP and SIP procedures.

Maintenance

- It's within the liability of the user to choose a suitable sensor and gasket for his process.
- When replacing the seal, carefully clean the accessible surface.
- The user aligns the intervals according to the process conditions and the gasket materials.
- If components have to be replaced, e.g. hygienic adapters, Pt100 inserts or temperature transmitters make sure to use only original parts from the manufacturer.

Preventive maintenance

It is the responsibility of the user to ensure the hygienically sound condition of the sensor throughout the duration of its use. This includes the selection of a gasket in accordance with 3-A standards.

Leaks in a gasket pose a hygienic risk. In case of a damage, the gasket has to be replaced anyway. However, gaskets schould be inspected respectively replaced on a regular basis depending on process conditions and experience.

6.3 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.4 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local sales office.

6.5 Returning the device to the manufacturer

6.5.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

WARNING!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:
- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

WARNING!
If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:
- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

6.5.2 Form (for copying) to accompany a returned device

⚠️ *CAUTION!*
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:	Address:
Department:	Name:
Telephone number: Fax number:	Email address:
Manufacturer order number or serial number:	
The device has been operated with the following medium:	

This medium is:	
	radioactive
	water-hazardous
	toxic
	caustic
	flammable
	We checked that all cavities in the device are free from such substances.
	We have flushed out and neutralized all cavities in the device.

We hereby confirm that there is no risk to persons or the environment caused by any residual media contained in this device when it is returned.

Date:	Signature:
Stamp:	

6.6 Disposal

§ *LEGAL NOTICE!*
Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:

According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.
The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

6.7 Disassembly and recycling

6.7.1 Compact sensors, TRA-C61/-C65

Based on their compact design, these sensors don't have any removable parts. Due to this, they should be disposed completely.
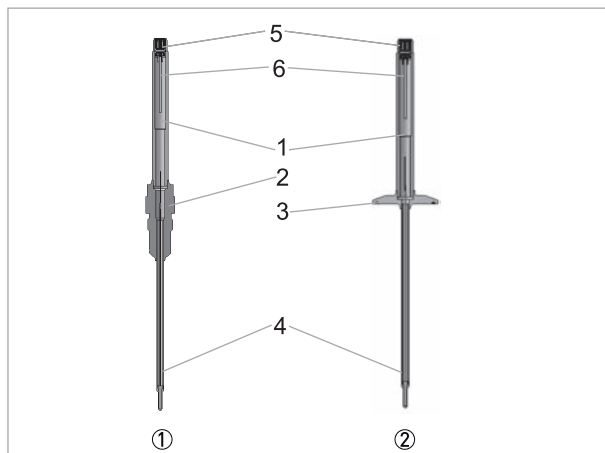
Figure 6-1: Examples of compact sensors
① TRA-C61
② TRA-C65

Approximate information		TRA-C61 (①)		TRA-C65 (②)	
		Material	Weight [g / lb]	Material	Weight [g / lb]
1	Housing rod, Ø14 x 72 or 122 mm / Ø0.55 x 2.8 or 4.8"	Stainless steel	36 or 76 / 0.08 or 0.17	Stainless steel	36 or 76 / 0.08 or 0.17
2	Threaded fitting, G1/2	Stainless steel	146 / 0.32	-	-
3	Clamp connection, 1.5" or 2"	-	-	Stainless steel	80 or 135 / 0.18 or 0.3
4	Sensor rod, per 100 mm / 3.9"	Stainless steel	16 / 0.04	Stainless steel	16 / 0.04
5	M12 connector	PA	1 / 0.002	PA	1 / 0.002
6	PCB, transmitter printed board, size < 4 cm²	FR4	2.5 / 0.006	FR4	2.5 / 0.006

Table 6-1: Information about material, dimensions and weight of components

> **INFORMATION!**
> *Based on their design, these temperature sensors don't have any removable parts. Due to this, they should be disposed completely.*

> **INFORMATION!**
> *The product does not contain harmful gases or liquids.*
> *The percentage of hazardous substances present in the components comply with RoHS.*

6.7.2 Standard sensors, TRA-H61/-C65

Standard hygienic temperature sensors consist of several parts which can be disassembled up to a certain extend. Following three drawings are examples and representative for the standard hygienic sensor family.
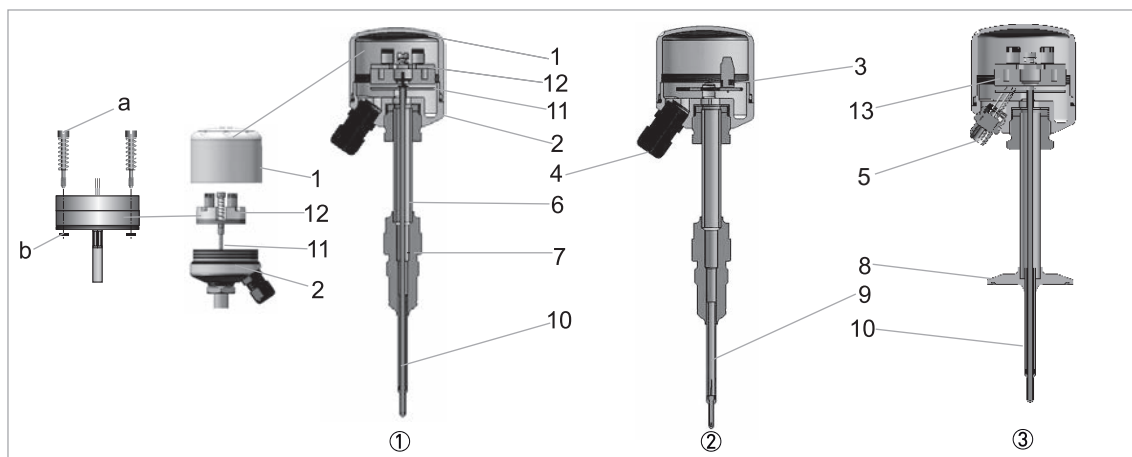
Figure 6-2: Examples of standard sensors

① TRA-H61 with measuring insert
② TRA-H61 with PCB
③ TRA-H65 with transmitter

Disassembling procedure

- Open the lid (1) by hand. If its closed very tight, use a strap wrench.
- Disconnect the wires and remove the cable gland (4) with a wrench.
- If a bare insert (11) is used, unscrew the two spring loaded screws (a).
- Remove the two snap rings (b) at the bottom of the disc and take screws (a) out.
- Separate ceramic socket from screws, springs and remaining insert.
- If a transmitter is installed instead of the socket, proceed as mentioned above.
- The transmitter is a sealed electronic component and should be disposed accordingly.
- Remove the head from the neck using a wrench.

Materials / components, which must be removed and treated separately

Approximate information		TRA-H61 (① + ②)		TRA-H65 (③)		Tool
		Material	Weight [g / lb]	Material	Weight [g / lb]	
1	BYH head, lid, Ø61 x 50 mm / Ø2.4 x 1.97"	Stainless steel	246 / 0.54	Stainless steel	246 / 0.54	Strap wrench
2	BYH bottom, Ø61 x 16 mm / Ø2.4 x 0.6"	Stainless steel	222 / 0.49	Stainless steel	222 / 0.49	-
3	PCB with terminals	FR4, PA	8 / 0.018	FR4, PA	8 / 0.018	Screwdriver
4	M16 cable gland	PA or stainless steel	6 or 16 / 0.013 or 0.035	PA or stainless steel	6 or 16 / 0.013 or 0.035	WS17 or WS19
5	M12 connector with 4 wires	Stainless steel, copper	26 / 0.057	Stainless steel, copper	26 / 0.057	-
6	M24 nut + neck short or long	Stainless steel	72 or 88 / 0.158 or 0.19	Stainless steel	74 or 91 / 0.163 or 0.2	WS24
7	Threaded fitting, G1/2	Stainless steel	146 / 0.32	-	-	-
8	Clamp connection, 1.5" or 2"	-	-	Stainless steel	80 or 135 / 0.18 or 0.3	-
9	Sensor rod, per 100 mm / 3.9"	Stainless steel	16 / 0.04	Stainless steel	16 / 0.04	-
10	Thermowell, per 100 mm / 3.9"	Stainless steel	13 / 0.029	Stainless steel	13 / 0.029	-
11	Measuring insert 1 x Pt100, Ø3 x125...345 mm / Ø0.12 x 4.9...13.58"	Stainless steel	≤40 / 0.088	Stainless steel	≤40 / 0.088	Screwdriver
12	Connection socket	Stainless steel or Al_2O_3	44 or 18 / 0.097 or 0.04	Stainless steel or Al_2O_3	44 or 18 / 0.097 or 0.04	-
13	Transmitter, optional ①	Sealed electronic component	32...42 / 0.07...0.09	Sealed electronic component	32...42 / 0.07...0.09	Screwdriver

Table 6-2: Information about material, dimensions and weight of components

① For further information refer to the coresponding transmitter manual.

INFORMATION!
The product does not contain harmful gases or liquids.
The percentage of hazardous substances present in the components comply with RoHS.

7.1 Measuring principle

All of the temperature assemblies described here belong to the class known as "contact temperature assemblies". Unlike "radiation temperature assemblies", these temperature assemblies come into direct contact with the medium whose temperature they are to measure.

The "OPTITEMP TR/TC 100" handbook goes into more detail regarding the various basic physical foundations of temperature measurement using measuring inserts with e.g. a Pt100 RTD.

7.2 Technical data tables

INFORMATION!
- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Application range	Measuring the temperature of gases, liquids and vapours in hygienic processes. The devices are particularly suited to liquids with low viscosity, water and substances with low corrosiveness as well as saturated steam.
Measuring principle	Contact temperature sensor
Measured value	Temperature

Design

Modular design	Standard hygienic temperature sensors consist of several components which form an assembly: • Measuring insert with sensing element • Thermowell with neck tube (short or long) or sensor rod • Hygienic connection head • Temperature transmitter
	Compact hygienic temperature sensors have no exchangeable parts and may include a sealed transmitter or not.
Transmitter	Temperature transmitters of the TT family as head-mount or rail-mount version.
	Integrated transmitter on compact sensors.
Temperature sensor	Thin film Pt100 RTD elements following IEC 60751.
	Type TRA-H65 is a standard hygienic sensor with clamp connection.
	Type TRA-C65 is a compact hygienic sensor with clamp connection.
	Type TRA-H61 is a standard hygienic sensor with G1/2 thread.
	Type TRA-C61 is a compact hygienic sensor with G1/2 thread.

Measuring accuracy

Reference conditions	Ambient temperature: +23°C / +73.4°F Fluctuations due to air pressure and density have no impact on measuring accuracy.
Maximum measuring error	The maximum measuring error depends on the type of sensor. Measuring insert with Pt100 RTD: measuring error in accordance with tolerance classes A and B according to IEC 60751
Accuracy of sensor	Class A from -30…+200°C ± (0.15 + 0.002 x abs[t])
	Class B from -50…-30°C ± (0.30 + 0.005 x abs[t])
Compact sensors with integrated 4…20 mA transmitter	±0.15°C or ±0.15% of span, whatever is more
For further information refer to *Measuring accuracy* on page 51.	

Operating conditions

Load limits	The load limits depend on several factors e.g. dimensions, design, material and process connections (e.g. used process adapters).
Temperature	
Process temperature	
TRA-H61, TRA-H65	With fast responding sensor tip: -50…+200°C / -58…+392°F
	With replaceable measuring insert: -50…+300°C / -58…+572°F
TRA-C61, TRA-C65	Without transmitter: -50…+200°C / -58…+392°F
	With transmitter: -50…+150°C / -58…+302°F
Ambient and storage temperature	
TRA-H61, TRA-H65 without transmitter	With cable gland: -40…+100°C / -40…+212°F
	With M12 connector: -30…+100°C / -22…+212°F
TRA-H61, TRA-H65 with transmitter	With cable gland: -40…+80°C / -40…+176°F
	With M12 connector: -30…+80°C / -22…+176°F
TRA-C61, TRA-C65 without transmitter	With M12 connector: -30…+100°C / -22…+212°F
TRA-C61, TRA-C65 with transmitter	With M12 connector: -30…+80°C / -22…+176°F
For further information refer to *Permissible temperatures* on page 52.	
Pressure	
Process pressure	0…40 bar / 0…580 psi, depending on used adapter
Other conditions	
Ingress protection	IP66/67 or IP69 according to DIN EN 60529, depending on cable gland and connector

Installation conditions

Insertion angle	90° to the flow, directly against or diagonally against the flow
Insertion length (recommended)	**Pipes ≥ DN25 /1":** DN25: 22 mm / 0.87"; DN40, DN50, DN65: 30 mm / 1.18"; DN80: 40 mm / 1.57"; DN100: 50 mm / 1.97"; DN125, DN150: 70 mm / 2.76"
	Vessels, tanks: 80…200 mm / 3.15…7.87"

Materials

Wetted parts, process connections	1.4404 / 316 L
Connection heads	1.4408
Neck tubes, extensions	1.4404 / 316 L or similar
Measuring inserts	1.4404 / 316 L or similar
Compact sensor housings	1.4404 / 316 L
Hygienic process adapters	1.4404 / 316 L (for details refer to *Hygienic adapters* on page 49)
Gaskets (optional)	PEEK

Process connections

Basic process connections	G1/2 hygienic thread
	Tri-Clamp 1...1 1/2" and 2"
	ISO 2852, 25 mm, 38 mm, 40 mm and 51 mm (standard rejected)
	DIN 32676: DN25, DN40 and DN50
G1/2 hygienic adapters	For detailed information refer to *Hygienic adapters* on page 49.

Sensor properties

Sensing element	1 x Pt100-4-wires according to IEC 60751
Thermal response time	Ø3 x 15 mm / Ø0.12 x 0.59" tip: t_{05}/t_{09}: 2 s / 6.1 s in water, 0.4 m/s
	Ø4 x 15 mm / Ø0.16 x 0.59" tip: t_{05}/t_{09}: 5.8 s / 22 s in water, 0.4 m/s with replaceable Ø3 mm / Ø0.12" Pt100 RTD insert
Isolation resistance	20°C ± 15°C / 68°F ± 27°F: > 100 MΩ
	200°C ± 15°C / 212°F ± 27°F: > 20 MΩ
Self heating error	Ø3 mm / Ø0.12" fast responding sensor: 0.07 K/mW
	Ø4 mm / Ø0.16" well with Ø3 mm / Ø0.12" insert: 0.23 K/mW

Connection head

Hygienic connection head	Type BHY
Design	Size B according to DIN EN 50446:2007-04
Dimensions	Ø61 x 66 mm / Ø2.40 x 2.60"
Weight	476 g / 1.05 lb
Process thread	M24 x 1.5
Cable thread	M16 x 1.5

Electrical connections

Electrical properties for standard sensors, optional with head-mounted transmitter	
Power supply	Only necessary when using a temperature transmitter and depends on transmitter type, typically 24 VDC
Power consumption	Relevant only when using a temperature transmitter; typically 550 mW
Cable entry	M16 x 1.5 or M12 connector, compact sensors always M12
Cable connection	Sensors with head: ceramic socket, replaceable Pt100 insert or printed boards with screw connector
	Compact sensors: M12 male connector
Current output	
Output range	Relevant only when using a temperature transmitter; typically 4...20 mA, HART®
Error signal	According to NAMUR NE 43; selectable: upper value $\geq$ 21.0 mA, lower value $\leq$ 3.6 mA
Load	Relevant only when using a temperature transmitter and then dependent on transmitter type; typically 700 Ω at 24 VDC
Other electrical characteristics	
Galvanic isolation	Relevant only when using a temperature transmitter (refer to handbook for transmitter).
Ambient temperature influence	Relevant only when using a temperature transmitter (refer to handbook for transmitter).
Inductance and capacitance	Ø3 x 15 mm / Ø0.12 x 0.59" with fast responding tip: L_i < 1 µH, C_i < 50 pF
	Ø4 x 15 mm / Ø0.16 x 0.59" with replaceable insert: L_i < 1 µH, C_i < 200 pF
Electrical properties for compact sensors with integrated 4...20 mA transmitter	
Load	750 Ω at 24 VDC
Cable entry	M12 connector
Error signal	According to NAMUR NE 43; selectable: upper value $\geq$ 21.0 mA, lower value $\leq$ 3.6 mA
Galvanic separation	Without
Long-term stability, drift	0.1% of span per year
Power supply, consumption	Nominal 24 VDC; range 7.5...32 VDC, 550 mW max.
Range	-50...+200°C / -58...+392°F, configurable

Approvals and compliance

CE	The device fulfils the statutory requirements of the EU directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Electromagnetic compatibility	TRA-H6x standard sensors: refer to temperature transmitter handbook
	TRA-C6x compact sensors: according to IEC 61326-1
ATEX, intrinsical safety	"Simple apparatus certificate" is available on request.
Functional safety	SIL 2 with temperature transmitter TT 51 C/R
EHEDG compliance	TRA-H61, TRA-C61: approval EL class I
3-A certification	TRA-H65, TRA-C65
RoHS, China RoHS	Declaration of conformity (DoC)
Regulation 1935/2004 EU	Declaration of conformity (DoC) Materials and articles intended to come into contact with food
Regulation 2023/2006 EU	Good manufacturing practise for materials and articles intended to come into contact with food

Regulation 10/2011 EU	On plastic materials and articles intended to come into contact with food
Vibration resistance	Compact sensors according to: IEC 60751, section 6.6.4, method IEC 60068-2-6: 10...500 Hz, 30 m/s²
	Standard sensors with stainless steel head according to: IEC TR 60721-4-4, class 4M5, method IEC 60068-2-6: 5...200 Hz, 10 m/s², ±3.5 mm IEC 61298-3: endurance, method IEC 60068-2-6: 10...1000 Hz, 20 m/s², ±0.15 mm
Shock resistance	All sensors according to: IEC TR 60721-4-4 class 4M5, method IEC 60068-2-27: 600 shocks, 25 g, 6 ms IEC 60751, section 6.6.5: drop test: 10 drops, 250 mm on 6 mm steel plate
Climate conditions	IEC 60654-1, class C

7.3 Dimensions

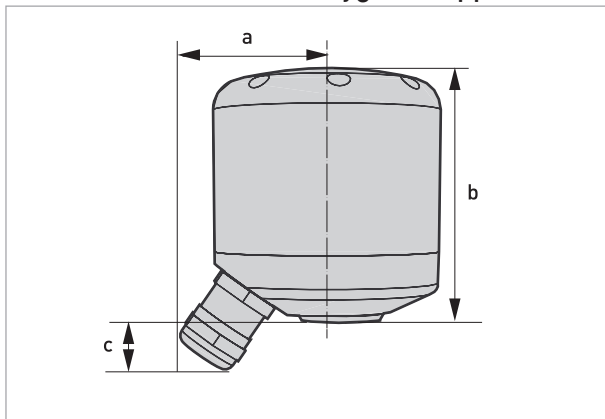### 7.3.1 Connection heads

Recommended head for hygienic applications

Figure 7-1: Hygienic connection headType BHY (stainless steel, IP66/67/69)

Dimensions	[mm]	[inch]
a	39	1.5
b	66	2.6
c	21	0.8

Table 7-1: Dimensions in mm and inch

INFORMATION!
The inside dimensions of the connection heads depicted here comply with DIN 43735.

7.3.2 Standard hygienic sensors with clamp connection

Hygienic sensors with clamp connection and Ø3 mm / Ø0.12" replaceable insert, respectively sensors with fix installed Pt100 are available in following dimensions:

TRA-H65, Ø6 mm / Ø0.24" reduced to Ø4 mm / Ø0.16" respectively Ø3 mm / Ø0.12"
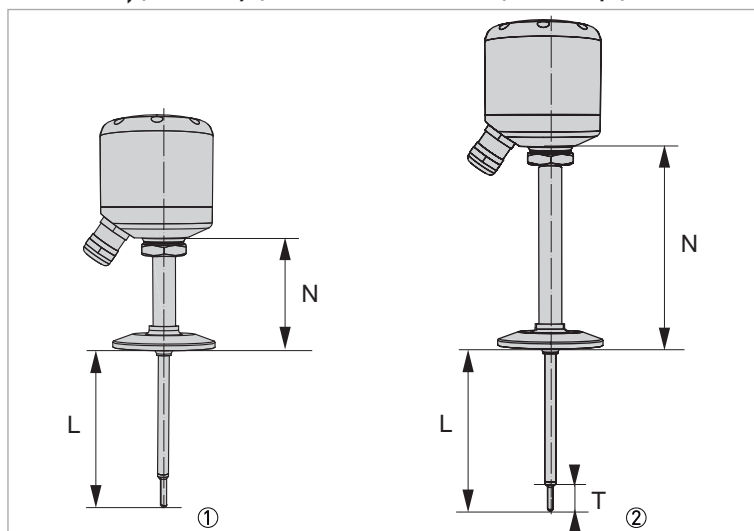
Figure 7-2: Dimensions of sensors with clamp connection

① Short neck
② Long neck

	Short neck ①	Long neck ②
N	50 mm / 1.97"	90 mm / 3.54"
T (replaceable)	Ø4 x 15 mm / Ø0.16 x 0.59"	Ø4 x 15 mm / Ø0.16 x 0.59"
T (fast responding)	Ø3 x 15 mm / Ø0.12 x 0.59"	Ø3 x 15 mm / Ø0.12 x 0.59"

Table 7-2: Dimensions of sensors with clamp connection

Insertion length, L		Pt100 measuring insert length, Li			
Tightening surface to tip		Short neck sensor		Long neck sensor	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
50	1.97	125	4.92	165	6.50
70	2.76	145	5.71	185	7.28
80	3.15	155	6.10	195	7.68
90	3.54	165	6.50	205	8.07
100	3.94	175	6.89	215	8.46
130	5.12	205	8.07	245	9.65
150	5.91	225	8.86	265	10.43
180	7.09	255	10.04	295	11.61
200	7.87	275	10.83	315	12.40

Table 7-3: Dimensions of well and insert

7.3.3 Compact hygienic sensors with clamp connection

Compact hygienic sensors don't contain a replaceable insert but a fast responding Pt100 sensing element sealed at the end of the tip. They are available in following dimensions:
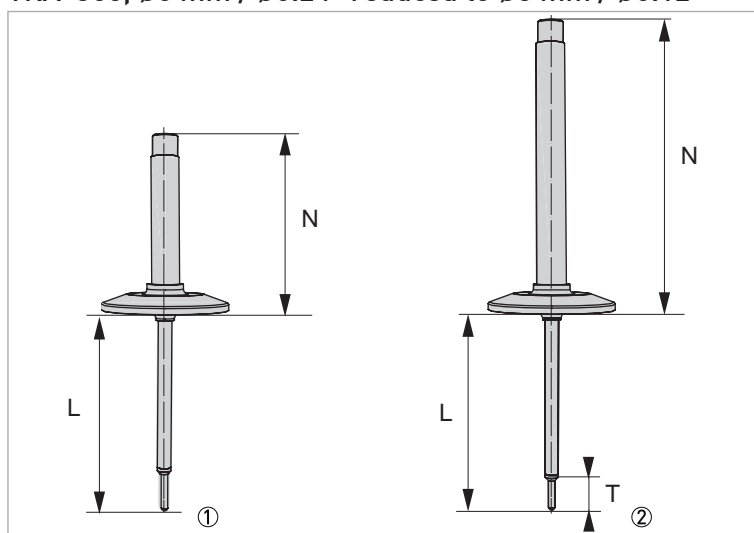
TRA-C65, Ø6 mm / Ø0.24" reduced to Ø3 mm / Ø0.12"

Figure 7-3: Dimensions of sensors with clamp connection

① Short neck
② Long neck

	Short neck ① without transmitter	Long neck ② with transmitter
N	79 mm / 3.11"	129 mm / 5.08"
Sensor tip T	Ø3 x 15 mm / Ø0.12 x 0.59"	Ø3 x 15 mm / Ø0.12 x 0.59"

Table 7-4: Dimensions of sensors with clamp connection

Compact clamp sensors insertion lengths, L corresponds to the insertion lengths of standard clamp sensors. For further information refer to *Standard hygienic sensors with clamp connection* on page 45.

ISO 2852	DIN 32676	Tri-Clamp
25/38 mm	DN25/DN40	1 1/2"
40/51 mm	DN50	2"

Table 7-5: Dimensions of clamp

7.3.4 Standard hygienic sensors with G1/2 thread

Hygienic sensors with 1/2 inch hygienic thread and Ø3 mm / Ø0.12" replaceable insert, respectively sensors with fix installed Pt100 are available in following dimensions:

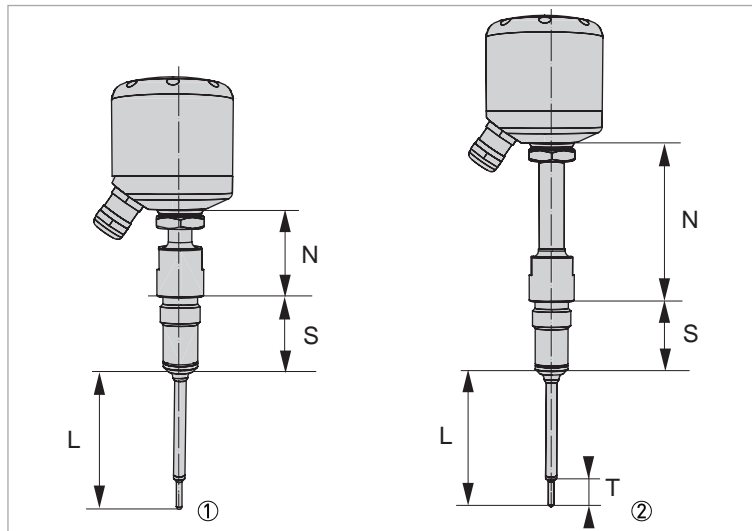**TRA-H61, Ø6 mm / Ø0.24" reduced to Ø4 mm / Ø0.16" respectively Ø3 mm / Ø0.12"**

Figure 7-4: Dimensions of sensors with G1/2 thread

① Short neck
② Long neck

	Short neck ①	Long neck ②
N	44 mm / 1.73"	84 mm / 3.31"
Nozzle S	36 mm / 1.42	36 mm / 1.42
T (replaceable)	Ø4 x 15 mm / Ø0.16 x 0.59"	Ø4 x 15 mm / Ø0.16 x 0.59"
T (fast responding)	Ø3 x 15 mm / Ø0.12 x 0.59"	Ø3 x 15 mm / Ø0.12 x 0.59"

Table 7-6: Dimensions of sensors with G1/2 thread

The sensors tip size depends on the selected variant. The fast responding sensors tip is Ø3 mm / Ø0.12" in diameter, the variant with replaceable insert measures Ø4 mm / Ø0.16".

Insertion length, L		Pt100 measuring insert length, Li			
Tightening surface to tip		Short neck sensor		Long neck sensor	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
22	0.87	127	5.00	167	6.57
30	1.18	135	5.31	175	6.89
50	1.97	155	6.10	195	7.68
70	2.76	175	6.89	215	8.46
80	3.15	185	7.28	225	8.86
90	3.54	195	7.68	235	9.25
100	3.94	205	8.07	245	9.65
130	5.12	235	9.25	275	10.83

Insertion length, L		Pt100 measuring insert length, Li			
Tightening surface to tip		Short neck sensor		Long neck sensor	
[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
150	5.91	255	10.04	295	11.61
180	7.09	285	11.22	325	12.80
200	7.87	305	12.01	345	13.58

Table 7-7: Dimensions of well and insert

7.3.5 Compact hygienic sensors with G1/2 thread

Compact hygienic sensors don't contain a replaceable insert but a fast responding Pt100 sensing element sealed at the end of the tip. They are available in following dimensions:
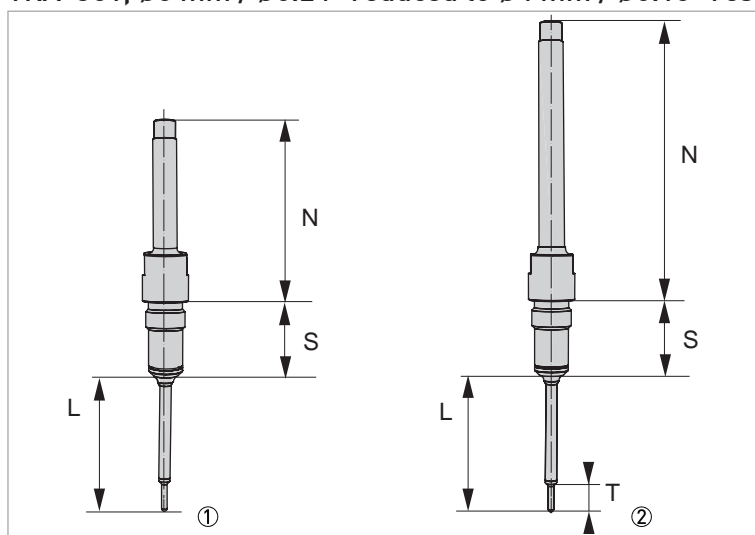
TRA-C61, Ø6 mm / Ø0.24" reduced to Ø4 mm / Ø0.16" respectively Ø3 mm / Ø0.12"

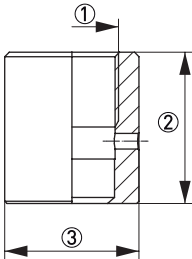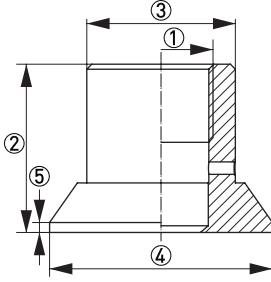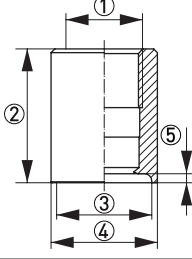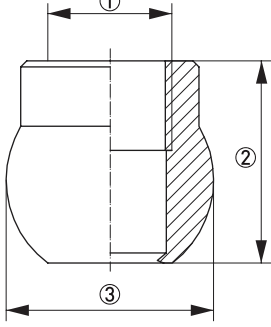Figure 7-5: Dimensions of sensors with G1/2 thread
① Short neck
② Long neck
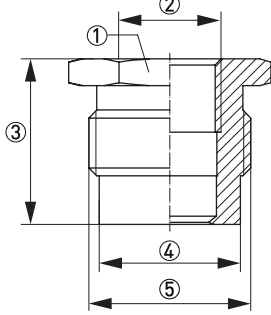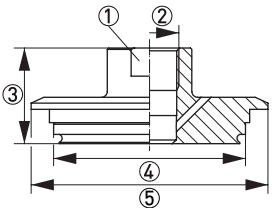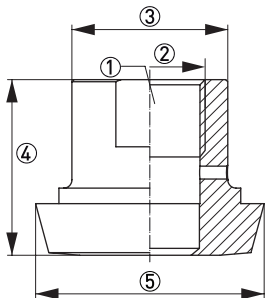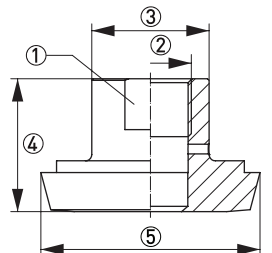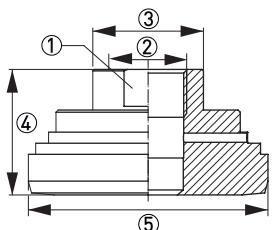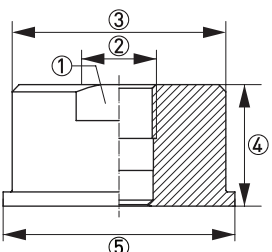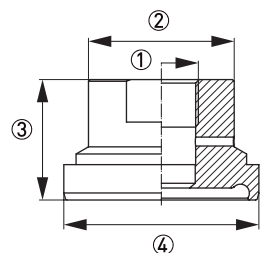
	Short neck ①	Long neck ②
N	96 mm / 3.78"	146 mm / 5.75"
Nozzle S	36 mm / 1.42	36 mm / 1.42
Sensor tip T	Ø3 x 15 mm / Ø0.12 x 0.59"	Ø3 x 15 mm / Ø0.12 x 0.59"

Table 7-8: Dimensions of sensors with G1/2 thread

Compact threaded sensors insertion lengths, L corresponds to the insertion lengths of standard threaded sensors. For further information refer to *Standard hygienic sensors with G1/2 thread* on page 47.

7.3.6 Hygienic adapters

Type of connection	Order code	Type / order code	Max. pressure	Drawing	Dimensions
Straight weld-in sleeve Ø30 mm / Ø1.2"	A	KPW3-321	100 bar / 1450 psi		① G1/2 ② 34 mm / 1.3" ③ Ø30 mm / 1.2" EHEDG certified
Collared weld-in sleeve	L	KPW3-322	40 bar / 580 psi		① G1/2 ② 34 mm / 1.3" ③ 10 mm / 0.4" ④ Ø45 mm / 1.8" ⑤ 2 mm / 0.08" EHEDG certified
Weld-in sleeve with shoulder DN25…50	K	KPW2-326	40 bar / 580 psi		① G1/2 ② 36.5 mm / 1.4" ③ 26 mm / 1" ④ Ø29 mm / 1.1" ⑤ 2.5 mm / 0.1"
Spherical weld-in sleeve Ø35 x 34 mm / Ø1.4 x 1.3"	G	KPW2-324	-		① G1/2 ② 34 mm / 1.3" ③ Ø35 mm / 1.4"
Hygienic G1 to G 1/2 adapter	F	KPH1-32CB	40 bar / 580 psi		① WS36 ② G1/2 ③ 34 mm / 1.3" ④ Ø29 mm / 1.1" ⑤ G1A

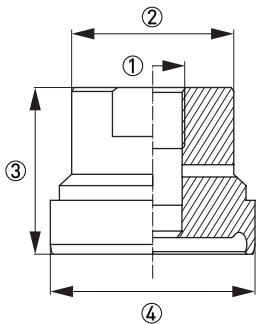| Type of connection	Order code	Type / order code	Max. pressure	Drawing	Dimensions
VARIVENT N (DN40/DN50) O-ring	B	KPH3-324E KPX2-323	10 bar / 145 psi		① WS27 ② G1/2 ③ 34 mm / 1.3" ④ Ø68 mm / Ø2.7" ⑤ Ø84 mm / Ø3.3" EHEDG certified
Dairy connection DIN 11851, DN25 Union nut Gasket	C	KPH3-3221 KPX4-140 KPX3-9110	40 bar / 580 psi		① WS27 ② G1/2 ③ Ø30 mm / 1.2" ④ Ø34 mm / 1.3" ⑤ Ø44 mm / 1.7"
Dairy connection DIN 11851, DN40 Union nut Gasket	D	KPH3-3224 KPX4-440 KPX3-9140	40 bar / 580 psi		① WS27 ② G1/2 ③ Ø30 mm / 1.2" ④ Ø34 mm / 1.3" ⑤ Ø56 mm / 2.2"
Dairy connection DIN 11851, DN50 Union nut Gasket	E	KPH3-3225 KPX3-9150 KPX4-540	10 bar / 145 psi		① WS27 ② G1/2 ③ Ø30 mm / 1.2" ④ Ø34 mm / 1.3" ⑤ Ø65 mm / 2.6"
SMS 1145 (DN51) Union nut Gasket	H	KPH1-3236 KPX4-630 KPX3-8160			① WS55 ② G1/2 ③ Ø60 mm / 2.4" ④ Ø34 mm / 1.3" ⑤ Ø65 mm / 2.6"
Hygienic adapters according to DIN 11864-1 Form A, DN40 Union nut Gasket	M	KPH3-3254 KPX4-440 KPX3-9140	40 bar / 580 psi		① G1/2 ② Ø41 mm / 1.6" ③ Ø34 mm / 1.3" ④ Ø54.9 mm / 2.16" EHEDG certified

Type of connection	Order code	Type / order code	Max. pressure	Drawing	Dimensions
Hygienic adapters according to DIN 11864-1 Form A, DN50 Union nut Gasket	N	KPH3-3255 KPX4-540 KPX3-9150	25 bar / 362 psi	② ① ③ ④	① G1/2 ② Ø53 mm / 2.1" ③ Ø34 mm / 1.3" ④ Ø66.9 mm / 2.6" EHEDG certified

Table 7-9: Available hygienic adapters

Union nuts and gaskets are not within the scope of delivery. In case they are needed as well, they can be ordered as a spare part. For further information on hygienic adapters please refer to the "Hygienic Accessories Data-Sheet" available from our website.

7.4 Measuring accuracy

The measuring accuracy depends largely on the following factors:

- The tolerance of the selected measuring insert, respectively sensor. For further information refer to *Technical data tables* on page 40.
- The sufficient insertion length of the thermowell, respectively sensor rod, for good thermal coupling to the process temperature. The longer the insertion depth, the better the thermal coupling and the smaller the heat conduction error. Recommended minimum insertion depth of these sensors is 22 mm / 0.87".
- The type of temperature transmitter used. If a transmitter is used, its uncertainty should be added to the sensor error respectively sensor tolerance.

INFORMATION!
Please consult the appropriate handbook for further information regarding the accuracy of the measuring inserts and the temperature transmitters.

The recommended temperature transmitters generate an analogue 4...20 mA output signal. For this reason, the following table indicates their measuring accuracy:

Type	Accuracy	Remarks
TT 12 C	0.15°C or 0.15% of span	Programmable, NFC, non-isolated
TT 22 C	0.10°C or 0.10% of span ①	Programmable, non-isolated
TT 33 C	0.08°C or 0.08% of span	Programmable, NFC, isolated, (Bluetooth®)
TT 51 C	0.10°C or 0.05% of span	HART® 6, dual input, SIL2
TT 53 C	0.08°C or 0.08% of span	HART® 7, single input, wireless, NFC, (Bluetooth®)

Table 7-10: Measuring accuracies of the temperature transmitters

① Compact sensor transmitter accuracy complies with TT 22

7.5 Process connections

Standard process connections are G1/2 hygienic and clamp connections (for details refer to *Standard hygienic sensors with clamp connection* on page 45). In addition, various G1/2 adapters with typical hygienic process connections are available as accessories (for details refer to *Hygienic adapters* on page 49).

7.6 Measuring range and permitted load

To prevent destruction or damage, never operate the temperature assembly outside of its permissible mechanical, thermal or chemical limits. For further information refer to the rest of this section and the "Technical data" section.

⚠️ *CAUTION!*
The information in this subsection is informative only and does not reflect the vibration load caused by flow-induced vibration. If necessary, prior to purchasing and installing an industrial temperature assembly, have a specific strength calculation performed.

7.7 Permissible temperatures

Depending on a sensor configuration, the permitted maximum temperature may differ.

Sensor	Design	$T_{min.}$		$T_{max.}$		Remarks
		[°C]	[°F]	[°C]	[°F]	
TRA-H61, TRA-H65	Standard with cable gland	-40	-40	+100	+212	Without transmitter
	Standard with M12 connector	-30	-22	+100	+212	
TRA-H61, TRA-H65	Standard with cable gland	-40	-40	+80	+176	With transmitter
	Standard with M12 connector	-30	-22	+80	+176	
TRA-C61, TRA-C65	Compact	-30	-22	+100	+212	Without transmitter
TRA-C61, TRA-C65	Compact	-30	-22	+80	+176	With transmitter

Table 7-11: Ambient temperatures

Sensor	Design	$T_{min.}$		$T_{max.}$		Remarks
		[°C]	[°F]	[°C]	[°F]	
TRA-H61, TRA-H65	Fast responding	-50	-58	+200	+392	With or without transmitter
TRA-H61, TRA-H65	With replaceable insert	-50	-58	+300	+572	
TRA-C61, TRA-C65	Compact	-50	-58	+200	+392	Without transmitter
TRA-C61, TRA-C65	Compact	-50	-58	+150	+302	With transmitter

Table 7-12: Process temperatures

ℹ️ *INFORMATION!*
When using sensors with EHEDG certified hygienic adapters maximum temperature is limited to +140°C / +284°F with respect to the mandatory PEEK gasket.

7.8 Sensor response times

Sensor response times are generally indicated as "50% time" (t_{05}) and "90% time" (t_{09}). "50% time" refers to the time needed for a temperature assembly signal to achieve 50% of its end value in the face of erratic temperature changes (this applies analogously to "90% time").

Following results had been archived with Pt100 sensors (without transmitter) in water at 0.4 m/s, according to VDI/VDE 3522-2014:

Sensor	Design	$t_{(50\%)}$	$t_{(63.2\%)}$	$t_{(90\%)}$	$t_{(95\%)}$
		[s]			
TRA-C61, TRA-C65	Compact design	2.0	2.7	6.1	8.0
TRA-H61, TRA-H65	With fast responding tip	2.0	2.7	6.1	8.0
TRA-H61, TRA-H65	With measuring insert Ø3 mm / Ø0.12"	5.8	8.1	22.0	34.0

Table 7-13: Sensor response times

7.9 Calibration

In general, all temperature sensors are drifting over the time, even the good ones. Depending on the load, to which they are exposed, the change of their characteristics will go on slower or faster.

To make sure a temperature sensor is still within its required tolerance class, regular calibrations should be carried out and deviations should be recorded over the time.

The frequency of recalibration depends on customer requirements and on the experience of the user. Temperature sensor manufacturers typically recommend annual calibrations. If a temperature sensor shows only little drift, recalibration intervals could be extended, if the drift is already unacceptable high after one year, calibrations must take place more often. However, it's up to the user to set a suitable interval.

At the state of delivery, our temperature sensors comply with tolerance A according to IEC 60751. In a calibration, the temperature sensor error is determined, i.e. by comparing it against a well-known reference standard thermometer. This reference thermometer typically is calibrated at a higher level of accuracy, traceable to national or international standards.

However, to carry out a calibration in a proper way, the temperature sensors insertion length must be enough for the required temperature and accuracy.

The higher the (calibration) temperature, to which the sensor is exposed to, the higher should its insertion depth be. Due to heat dissipation effects, short temperature sensors measure always too low temperatures if process temperature is above ambient.

For this reason, we classified temperature sensors insertion length into three groups and **recommend** calibrating sensors within the assigned temperature range.

① Group 1: 0...+50°C / +32...+122°F
② Group 2: -20...+100°C / -4...+212°F
③ Group 3: -20...+150°C / -4...+302°F

Insertion depth		TRA-H61		TRA-H65		TRA-C61	TRA-C65
[mm]	[inch]	Ø6/4 mm / Ø0.24/0.16" with insert	Ø6/3 mm / Ø0.24/0.12" fast response	Ø6/4 mm / Ø0.24/0.16" with insert > 90 mm / 3.54"	Ø6/3 mm / Ø0.24/0.12" fast response	Ø6/3 mm / Ø0.24/0.12" fast response	Ø6/3 mm / Ø0.24/0.12" fast response
22	0.87	②	①	②	①	-	-
30	1.18	②	①	②	①	-	-
50	1.97	②	①	②	①	①	①
70	2.76	③	②	③	②	②	②
80	3.15	③	②	③	②	②	②
90	3.54	③	②	③	②	②	②
100	3.94	③	②	③	②	②	②
130	5.12	③	③	③	③	③	③
150	5.91	③	③	③	③	③	③
180	7.09	③	③	③	③	③	③
200	7.87	③	③	③	③	③	③

Table 7-14: Insertion depth within temperature range

INFORMATION!
Calibrating outside the recommended range is possible, however, additional measuring errors, due to heat conduction over the sensor rod, respectively the thermowell, will occur. This leads to deviations which may exceed the values specified in tolerance class A.

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