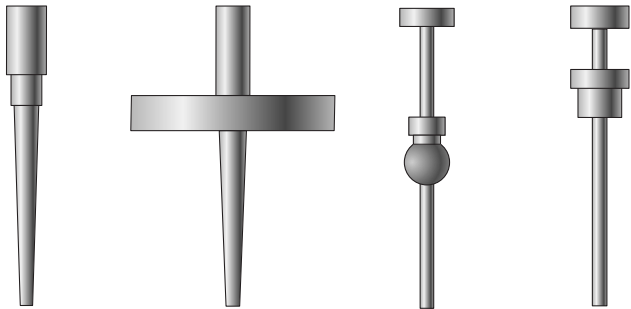


Operating Instructions

Thermowells for thermometers in industrial applications

Universal thermowells for thermometers in industrial applications





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1 About this document

1.1 Document function

These Operating Instructions provide all of the information that is required in various phases of the life cycle of the device including:

- Product identification
- Incoming acceptance
- Storage
- Installation
- Connection
- Operation
- Commissioning
- Troubleshooting
- Maintenance
- Disposal

1.2 Symbols used

1.2.1 Safety symbols

DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.





CAUTION









This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE




This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.

Symbol	Meaning
	Reference to documentation.
	Reference to page.
	Reference to graphic.
	Notice or individual step to be observed.
	Series of steps.
	Result of a step.
	Help in the event of a problem.
	Visual inspection.

1.2.3 Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3, ...	Item numbers		Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
	Hazardous area		Safe area (non-hazardous area)

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Are authorized by the plant owner/operator.
- ▶ Are familiar with federal/national regulations.
- ▶ Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

2.2 Designated use

The thermowells described here are suitable for temperature measurement in industrial applications in conjunction with the appropriate thermometers. The thermowells are used to protect the thermometer from the process conditions. They also enable the thermometers used to be replaced without interrupting the process.

The thermowell designs are configurable. However, the process parameters (e.g. temperature, pressure, density, flow velocity) must be taken into account. It is the responsibility of the operator to select the thermometer and thermowell combination, in particular the materials involved, to ensure safe operation of the temperature measuring point. Depending on the application, thermowells are subject to wear, e.g. corrosion, abrasion. They must be replaced accordingly.



The manufacturer is not liable for damage caused by improper or non-designated use.



The wetted materials of the thermowell must have an adequate level of resistance to the process fluids.

Incorrect use



The manufacturer is not liable for damage caused by improper or non-designated use.

With regard to special fluids and media used for cleaning, Endress+Hauser will be happy to assist in clarifying the corrosion-resistant properties of wetted materials but gives no guarantee or warranty as to the suitability of the materials.

Residual risks

⚠ CAUTION

Contact with surfaces presents a burn hazard! When in operation, the thermowell may reach a temperature close to the process temperature.

- ▶ At elevated process temperatures, protection against contact must be ensured in order to prevent burns.

2.3 Occupational safety

⚠ CAUTION

Contact with hazardous media, as well as extreme temperatures (hot or cold), may result in personal injury and damage to property and the environment. In the event of a fault, it is possible that aggressive media under extreme pressure and/or at extreme temperatures may be present at the thermometer and in the terminal head.

- ▶ The general guidelines for handling the substances, along with the relevant regulations and standards, must be observed. The appropriate protective equipment must be worn.

If working on and with the device with wet hands:

- ▶ Due to the increased risk of electric shock, gloves must be worn.

2.4 Operational safety

⚠ CAUTION

Risk of injury!

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers:

- ▶ If, despite this, modifications are required, consult with Endress+Hauser.

Repair

To ensure continued operational safety and reliability:

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use original spare parts and accessories from Endress+Hauser only.

Temperature

NOTICE

During operation, heat conduction or heat radiation may cause the temperature in the terminal head to rise.

- ▶ Exceeding the operating temperature of the transmitter or housing is not permitted and must be prevented using appropriate heat insulation or a suitably long extension neck.

NOTICE

Taking convection and heat radiation into account also, the thermometer may become damaged even during installation if the permitted operating temperature is not observed.

- ▶ The maximum/minimum permitted temperature is based on various parameters: maximum/minimum temperatures are specified for thermowell materials, sensor versions, approvals, etc. in the technical documentation. The resulting limit values for the thermometer are based on the respective maximum/minimum permitted values of the individual components.

3 Incoming acceptance and product identification

3.1 Incoming acceptance

Proceed as follows on receipt of the device:

1. Check whether the packaging is intact.
2. If damage is discovered:
Report all damage immediately to the manufacturer.
3. Do not install damaged material, as the manufacturer cannot otherwise guarantee compliance with the safety requirements and cannot be held responsible for the consequences that may result.
4. Compare the scope of delivery against the contents of your order.
5. Remove all the packaging material used for transportation.

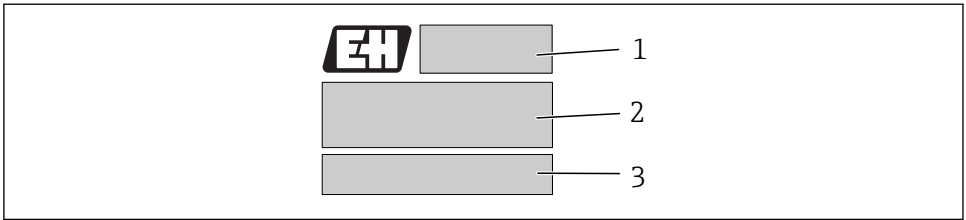
3.2 Product identification

The following options are available for identification of the measuring device:

- The device label
- Order code with breakdown of the device features on the delivery note
- Enter the serial number on the device label in *W@M Device Viewer* (www.endress.com/deviceviewer): all the information about the measuring device is displayed.
- Enter the serial number on the device label into the *Endress+Hauser Operations App* or scan the 2-D matrix code (QR code) on the measuring device with the *Endress+Hauser Operations App*: all the information about the measuring device is displayed.

3.2.1 Nameplate

Nameplate data: The nameplate shown below helps you to identify specific product information, such as the serial number, variables, configuration and device approvals:



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1 Nameplate (example)

Field no.	Description	Examples
1	Technical values	Material, immersion length U
2	Order code, (extended order code)	TT131-..., TT151-... (example)
3	Serial number	S/N: X1234567Y123

i Check the data on the nameplate of the device, and compare them against the requirements of the measuring point.

3.2.2 Name and address of manufacturer

Name of manufacturer:	Endress+Hauser Wetzler GmbH + Co. KG
Address of manufacturer:	Obere Wank 1, D-87484 Nesselwang or www.endress.com

3.3 Storage and transport

i Do not remove the packaging until just before installation.

i Devices for hygienic applications are sometimes specially cleaned and packed. When opening the packaging, the user must take care to avoid contaminating the device.

Permitted storage temperature:

-40 to +80 °C (-40 to +176 °F)

Avoid the following influencing factors:

- Direct sunlight or proximity to hot objects
- Mechanical loads (shocks, pressure, etc.)
- Contamination, steam, dust and corrosive gases
- Humidity

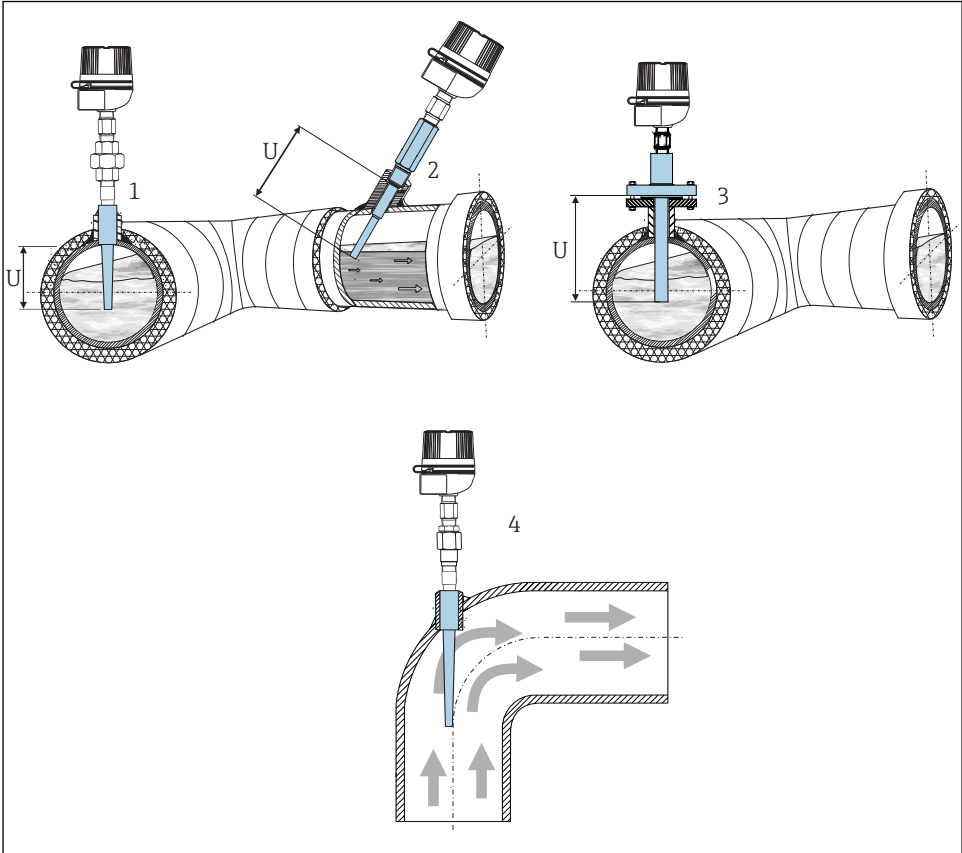
i Preservation

The preservation of thermowells is recommended if they are being put into longterm storage following removal from the measuring point. It is important here to completely remove any residue from the process fluid from the wetted surface of the thermowell and also to remove any internal oil residue. Covers should then be installed for better protection.

4 Installation

4.1 Installation conditions

Depending on the process connection selected, thermowells can be installed in three positions in pipes or storage vessels. There are no restrictions with regard to orientation. Self-draining in the process must be guaranteed. If there is an opening to detect leaks at the process connection, this opening must be at the lowest possible point.



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2 Installation examples

- 1 General orientation. In pipes with a small cross-section, the sensor tip should reach or extend slightly past the axis of the pipe ($= L$).
- 2 Slanted orientation
- 3 Straight orientation
- 4 Orientation in pipe elbow

The immersion length of the thermowell and thermometer may affect the accuracy. If the immersion length is too small then errors in the measurement are caused by heat conduction via the process connection and the container wall. If installing in a pipe, the immersion length should ideally correspond to half of the pipe diameter. Another possibility is to install the thermometer at an angle (see 2 and 4). When determining the immersion length, all the parameters of the thermowell or thermometer and of the process to be measured must be taken into account (e.g. flow velocity, process pressure).

- Installation possibilities: Pipes, tanks or other plant components
- Recommended minimum immersion depth: 80 to 100 mm (3.15 to 3.94 in)
The immersion length should be at least eight times the thermowell diameter. Example: thermowell diameter 12 mm (0.47 in) x 8 = 96 mm (3.8 in).
- ATEX certification: Observe the installation instructions in the Ex documentation!



If using the thermowell in combination with a thermometer in a hazardous area, the relevant national standards and regulations as well as the safety instructions or installation regulations must be observed.



Other types of installation are possible. Endress+Hauser will advise on the correct design of the measuring point.

4.2 Installing the thermowell



Prior to installation, the device must be checked for any damage that may have occurred in transit. Obvious damage must be reported immediately.

To install, proceed as follows:

- The permitted loading capacity of the process connections can be found in the relevant standards.
- The process connection and compression fitting must comply with the maximum specified process pressure at the process temperature.
- Make sure that the device is installed and secured before applying the process pressure.
- The thermowell and its loading capacity must be designed in such a way that it is capable of withstanding the process conditions over a long period. It may be necessary to calculate the static and dynamic loading capacity.



It is possible to verify the mechanical loading capacity as a function of the installation and process conditions using the online TW Sizing Module for thermowells in the Endress+Hauser Applicator software. <https://portal.endress.com/webapp/applicator>

See also the 'Accessories' section. → 14

Cylindrical threads

Seals must be used for cylindrical threads. The system operator is required to verify the suitability of the copper seal provided with regard to the operating conditions. If it does not meet the requirements, this seal must be replaced with a suitable seal. In general, the seals must be replaced following disassembly. All threads must be firmly tightened using the appropriate torques.

Tapered threads

The operator must verify if additional sealing by means of PTFE tape, hemp or an additional welded seam, for example, is necessary in the case of NPT threads or other tapered threads.

Flange

When using flange connections, the flange of the thermowell must match the counterflange on the process side. The seals used must be suitable for the process and for the flange geometries. Flange seals are not included in the scope of delivery. Pay attention to the appropriate torques and screw connections when installing.

Weld-in thermowells

Weld-in thermowells can be welded directly into the pipe or vessel wall, or secured using a welding socket. The specifications on the relevant material data sheets and the applicable guidelines and standards regarding welding procedures, heat treatment, welding fillers, etc. must be observed.

CAUTION

Incorrectly designed, faulty or leaking welding seams can lead to uncontrolled discharge of the process medium.

- ▶ Welding activities must be performed by qualified technical personnel only.
- ▶ When designing the welded seam, the requirements arising from the process conditions must be taken into account.

Installation instructions for ceramic thermowells

NOTICE

Ceramic thermowell materials are usually only partially resistant to rapid changes in temperature. A temperature shock may lead to stress cracks in the thermowell.

- ▶ Higher process temperatures require a lower insertion speed. Thermocouples with ceramic thermowells must be pre-heated prior to installation in the hot process environment, and immersed slowly.
- ▶ Ceramic thermowells must be protected against mechanical loads.
- ▶ When installed horizontally, mechanical shocks or bending stress caused by the weight of the thermowell itself must be avoided.
- ▶ Depending on the material, diameter, length and design, an additional support must be provided when installed horizontally.

 In theory, problems with bending stress apply to metallic thermowells too. Vertical installation is generally preferable.

Once installation is complete, check the connection to ensure that it is leak-tight and secure.

5 Diagnostics and troubleshooting

Critical errors

Errors and possible causes	Remedial action
Leakage: Damage to welding seams between the wetted part of the thermowell and the process connection.	Replace the thermowell
Leakage at sealing points: worn seals and/or loosening of torque.	Apply the correct torque, and replace seals if necessary.
Corrosive or abrasive wear of the thermowell: damage, abrasion points, corrosion, pitting, or similar on the wetted part, caused by wear or selection of unsuitable material.	Replace thermowell, if possible with one made of a material that is better suited to the application in question.

6 Maintenance

Thermowells are subject to wear depending on the process conditions. Examples of signs of wear are corrosion or abrasion. Appropriate test and replacement intervals must be defined for this.

6.1 Cleaning

WARNING

Depending on the application, process medium that adheres to the thermowell may be harmful to health or the environment (e.g. flammable, toxic, corrosive, radioactive, biohazardous).

- ▶ Cleaning of the thermowell should be carried out **only** with the required safety measures in place.

7 Repair

7.1 Spare parts



Information on accessories and spare parts that are currently available for the product can be found online at: www.endress.com/spareparts_consumables → **access to specific device information** → enter serial number.

Depending on the version of the thermowell, the following spare parts are available:

- Compression fitting
- Slip-on flange
- Weld-in adapter

7.2 Disposal

When disposing of thermowells and when recycling materials, the contamination of air, soil and water with pollutants must be avoided. Dispose of materials and waste in accordance with local regulations.

8 Accessories

Various accessories, which can be ordered with the device or subsequently from Endress +Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress +Hauser website: www.endress.com.

8.1 Service-specific accessories

Accessories	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> ■ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ■ Graphic illustration of the calculation results <p>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.</p> <p>Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator</p>
Configurator	<p>Product Configurator - the tool for individual product configuration</p> <ul style="list-style-type: none"> ■ Up-to-the-minute configuration data ■ Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language ■ Automatic verification of exclusion criteria ■ Automatic creation of the order code and its breakdown in PDF or Excel output format ■ Ability to order directly in the Endress+Hauser Online Shop <p>The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.</p>
W@M	<p>Life cycle management for your plant</p> <p>W@M supports with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.</p> <p>The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records.</p> <p>W@M is available: Via the Internet: www.endress.com/lifecyclemanagement</p>

9 Technical data

9.1 Environment

9.1.1 Ambient temperature range

Extension neck	Temperature in °C (°F)
If applicable: Quick-fastening iTHERM QuickNeck	-50 to +140 °C (-58 to +284 °F)

9.1.2 Storage temperature

-40 to +80 °C (-40 to +176 °F)

9.1.3 Process pressure range

The maximum possible static process pressure depends on various factors, such as the design, process connection and process temperature. Maximum possible process pressures for the individual process connections.

The operator is responsible for selecting the process connection for the respective application to ensure the safe operation of the temperature measuring point. For the process connection, the temperature, flow rate and fluctuations in the temperature and flow rate must be considered in addition to the process pressure.



See Technical Information for the relevant thermowell, "Process connection" section.

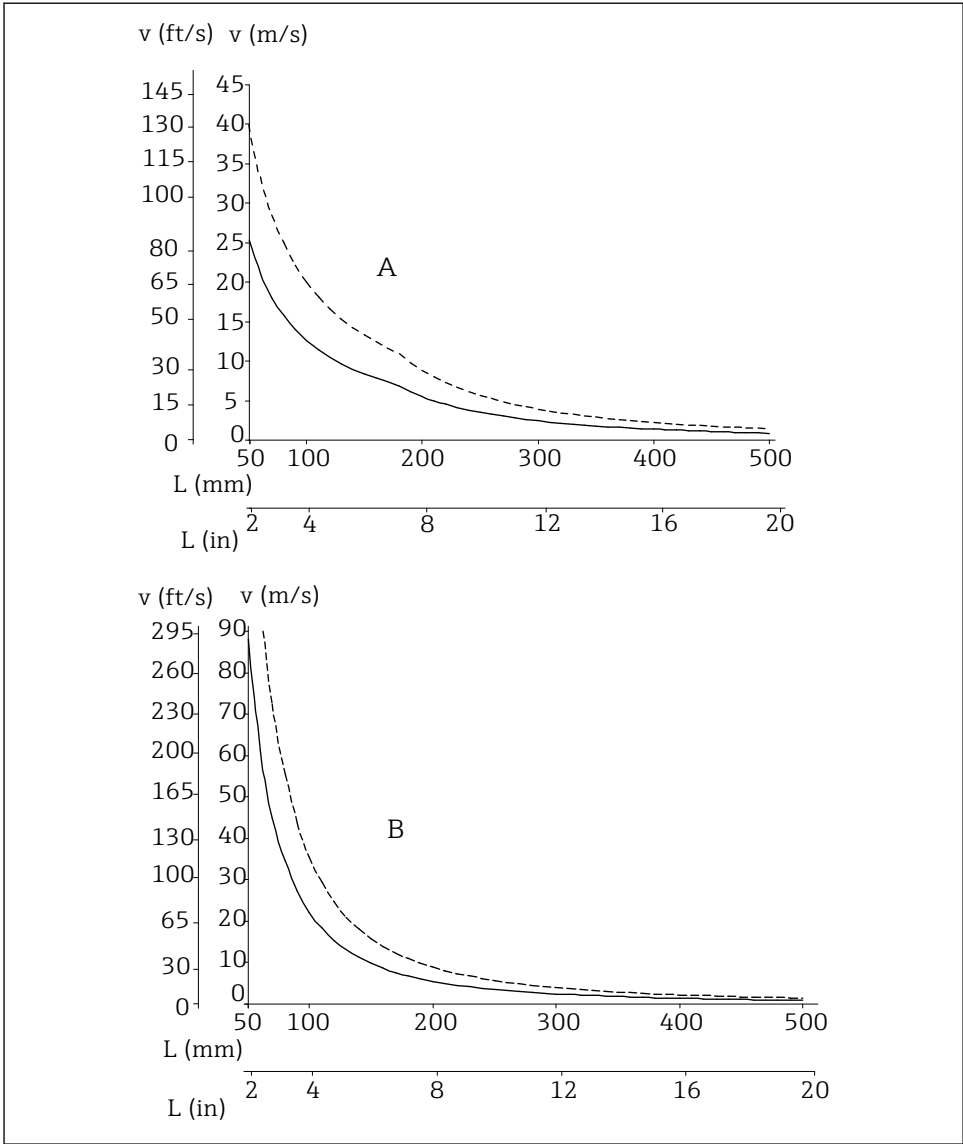
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It is possible to verify the mechanical loading capacity as a function of the installation and process conditions using the online TW Sizing Module for thermowells in the Endress+Hauser Applicator software. <https://portal.endress.com/webapp/applicator>

Example of the dependency of the permitted flow velocity on the immersion length and process medium

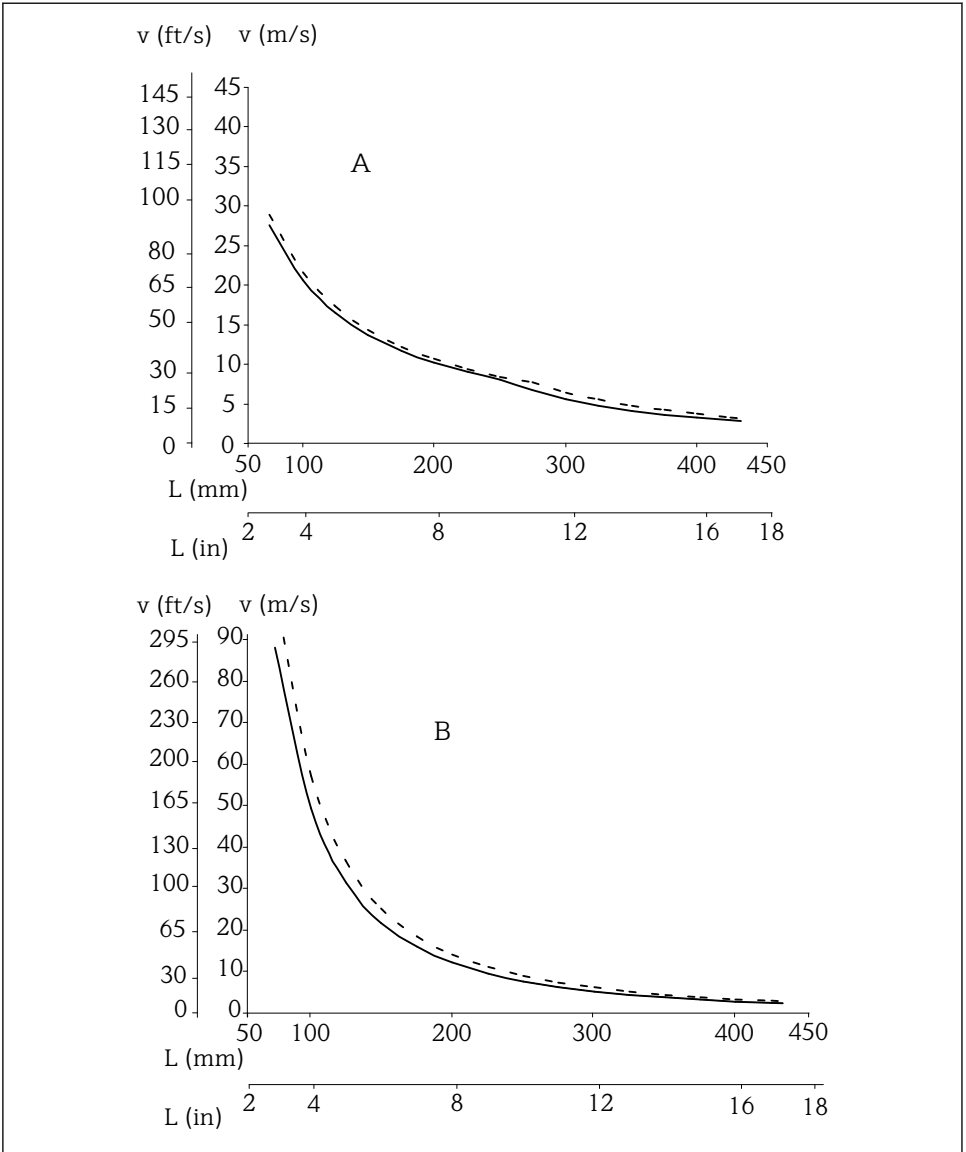
The maximum flow velocity tolerated by the thermowell diminishes with increasing thermowell immersion length exposed to the stream of the fluid. In addition, it is dependent on the diameter of the tip of the thermowell, the medium type, process temperature and process pressure. The following diagrams exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 50 bar (725 PSI).



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3 Maximum flow velocity with thermowell diameter 9 mm (0.35 in) (—) or 12 mm (0.47 in) (----)

- A Medium: water at T = 50 °C (122 °F)
- B Medium: superheated steam at T = 400 °C (752 °F)
- L Immersion length
- v Flow velocity



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4 Maximum flow velocity with thermowell diameter 14 mm (0.55 in) (—) or 15 mm (0.6 in) (----)

- A Medium: water at $T = 50\text{ }^{\circ}\text{C}$ ($122\text{ }^{\circ}\text{F}$)
- B Medium: superheated steam at $T = 400\text{ }^{\circ}\text{C}$ ($752\text{ }^{\circ}\text{F}$)
- L Immersion length
- v Flow velocity

9.2 Certificates and approvals

9.2.1 Material certification

The material certificate 3.1 (according to EN 10204) can be requested separately. The data related to the origin of the materials can subsequently be requested by the client if necessary.

9.2.2 Test on thermowell

Thermowell pressure tests are carried out in accordance with the specifications of DIN 43772. With regard to thermowells with tapered or reduced tips that do not comply with this standard, these are tested using the pressure rating of equivalent straight thermowells. In addition, sensors used in hazardous area are always subjected to an equivalent pressure during testing. Tests according to other specifications can be carried out on request. The dye penetration test verifies that there are no cracks in the welding seams of the thermowell.

Helium leak test as per EN 1779	Leak test for thermowells, welding seams and threaded joints. Depending on its design and size, the thermowell can be subjected to helium gas internally or externally. With inspection certificate.
Hydrostatic pressure test	External and internal pressure test with maximum 400 bar (5 801 psi) to check the pressure resistance and leak-tightness of thermowells, without flanges. Internal pressure test only possible for thermowells with an internal thread. With inspection certificate.
Positive material identification (PMI) test	Nondestructive material identification and testing of welded joints. Material identification check, X-ray fluorescence analysis. With inspection certificate.
Wake frequency calculation	In accordance with DIN 43772 or ASME PTC19.3 with calculation certificate.
Dye penetration test as per ASME V and EN571-1	Suitable for checking the surfaces of welding seams for cracks etc. With inspection certificate.
Bore concentricity test for thermowells	With inspection certificate.
Radiographic test as per ASME V, VIII, TW welding	With inspection certificate.

9.3 Supplementary documentation

Technical Information

iTHERM thermowells, barstock and welded thermowells, e.g.:

- Welded thermowell iTHERM TT131 (TI01442T)
- Thermowell made from barstock TT151 (TI01481T)
- Thermowell made from barstock TT511 (TI01135T)
- Thermowells for use in high-temperature range TWF11, TWF16 (TI01015T)
- Welded thermowell iTHERM TT411 for use in hygienic and aseptic applications (TI01099T)
- Thermowells made from barstock, series TA55x and TA57x



Detailed, up-to-date data for all available Endress+Hauser thermometer thermowells is available online on the following website: www.endress.com/thermowell



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www.addresses.endress.com
