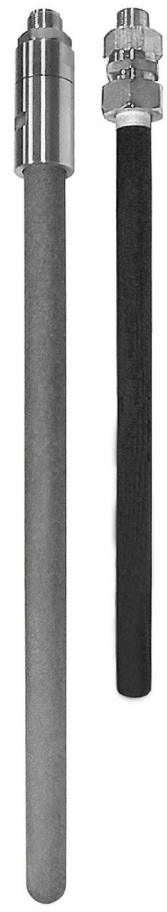
TI01015T/09/EN/02.25-00
71745049
2025-11-30

Technical Information
iTHERM FlameLine TWF11, TWF16

High-temperature thermowells



Metric metal/ceramic thermowells for applications in the primaries/metal industry and energy production

Application

iTHERM FlameLine TWF11
Applicable for steel treatment (annealing), in furnaces for raw materials and metals. Accessory for the iTHERM FlameLine TAF11 high-temperature thermometer.

iTHERM FlameLine TWF16
Applicable for cement production, steel treatment, in incinerators and fluidized bed furnaces. Accessory for the iTHERM FlameLine TAF16 high-temperature thermometer.

Process temperatures
- iTHERM FlameLine TWF11 up to 1 600 °C (2 912 °F)
- iTHERM FlameLine TWF16 up to 1 700 °C (3 092 °F)

Advantages

- Long operating life due to the use of innovative thermowell materials with increased wear resistance and chemical resistance
- Long-term stable measurement thanks to sensor protection with non-porous materials
- Replaceable parts

Endress+Hauser
People for Process Automation

Table of contents

Function and system design

Equipment architecture

Thermowell

- Metal thermowells made from pipe or barstock material
- Ceramic thermowells

The selection of thermowell materials depends primarily on the following material properties, which directly affect the operating life of the temperature sensor to be protected:

- Hardness
- Chemical resistance
- Maximum operating temperature
- Wear/abrasion resistance
- Brittleness
- Porosity to process gases
- Creep resistance

Ceramic materials are used for high-temperature ranges and - due to their hardness - in processes with high wear rates.

If these materials are subjected to significant mechanical stress in the process, pay particular attention to their brittleness. If porous ceramic materials are used as the outer protective sheath, an additional non-porous inner protective sheath is required. This protects the sensor elements from contamination, which could otherwise cause temperature drift and measurement errors as a result.

Metal alloys offer higher mechanical strength, but are less resistant to high temperatures and abrasion. Since metal alloys are non-porous, no additional internal protective sheath is required.

Metal sleeve and process connection

The ceramic thermowells of the iTHERM FlameLine TWF11 series are installed in a metal sleeve. Due to the higher mechanical strength, the process connection is attached to the metal sleeve. The sleeve dimensions and material type depend on the process temperatures and the immersion length of the ceramic thermowells.

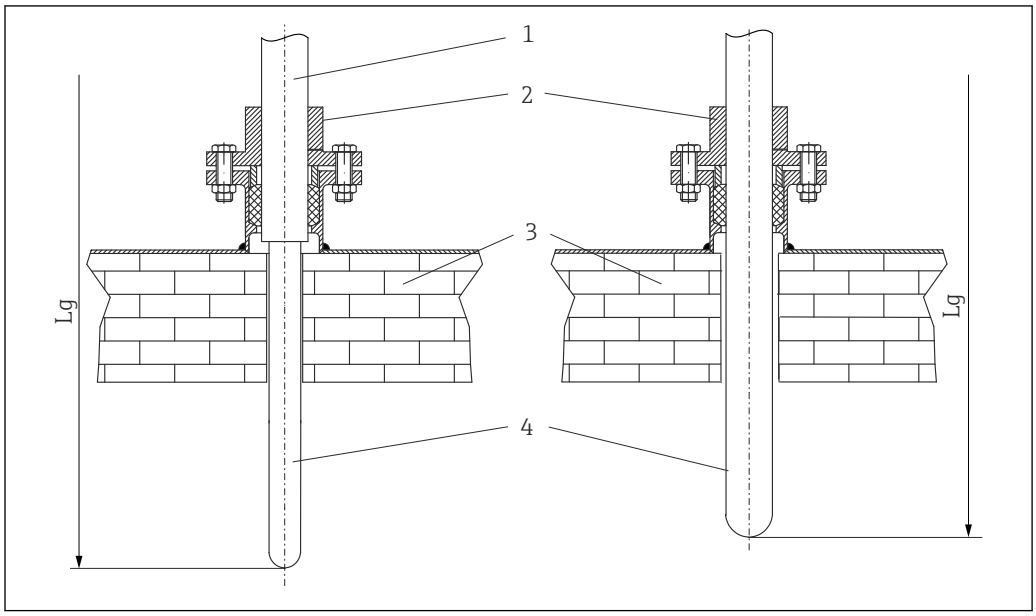
The thermowells are available with an adjustable flange, stop flange or gas-tight compression fittings as process connection.

Installation

Orientation

Vertical and horizontal installation. Vertical installation is preferable as the metal thermowells may otherwise bend or the ceramic thermowells may be irreversibly damaged by falling parts due to the brittleness of the materials.

Installation instructions



1 *Examples of the recommended vertical installation*

1 Metal sleeve
2 Stop flange according to DIN EN 50446
3 Chamber wall of a combustion furnace
4 Thermowell
Lg Immersion length

In the case of horizontal orientation in a high-temperature environment, the thermowell may bend or break irreversibly under its own weight.

Recommended maximum immersion length Lg for horizontal installation:

- 1 500 mm (59 in) for diameter > Ø20 mm (0.8 in)
- 1 200 mm (47.3 in) for diameter < Ø20 mm (0.8 in)

Installation of ceramic sheaths

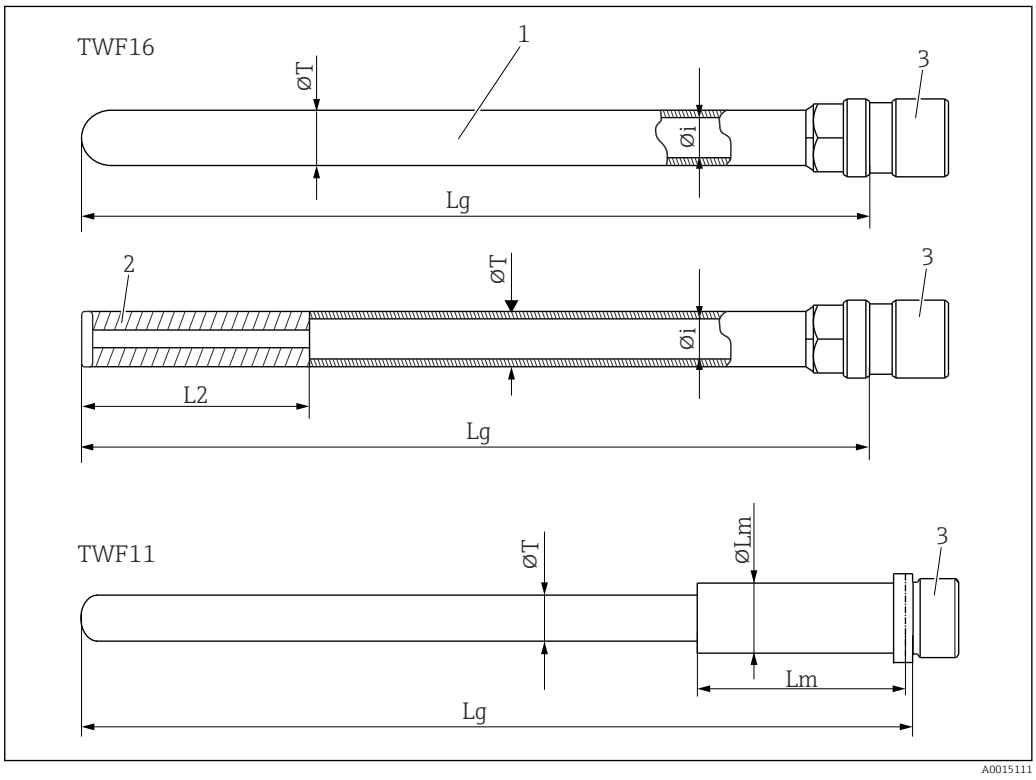
Gas-tight ceramic thermowells and inserts are sensitive to rapid temperature changes. To reduce the risk of thermal shock and to protect the ceramic materials from cracking, gas-tight ceramic sheaths must be preheated before installation. There are two possibilities to do so:

- Installation with preheating
  At process temperatures ≥ 1 000 °C (1 932 °F) preheat the ceramic part of the thermowell from room temperature to 400 °C (752 °F). Use a horizontal, cylindrical cross-section oven or cover the ceramic part with electric heating elements. Do not expose the ceramic sheath to direct flames. Preheat the ceramic sheath in situ and then proceed immediately with the insertion.
  Install the thermowell or insert carefully to avoid mechanical shocks, at an insertion speed of 100 mm/min. If preheating is not carried out near the system, the insertion speed must be reduced to 30 mm/min due to cooling during transport.
- Installation without preheating
  Install the insert at the process operating temperature in such a way that the ceramic sheath is inserted into the system to a depth corresponding to the wall thickness, including insulation material. Leave the insert in this position for two hours. Afterwards, fit the insert at an insertion speed of 30 mm/min, avoiding mechanical shocks.
  For process temperatures < 80 °C (176 °F) the insertion speed can be disregarded. Any kind of shock or collision between the ceramic sheath and system components must be avoided.

Mechanical construction

Design, dimensions

All dimensions in mm (in). [1].



1 iTHERM FlameLine TWF16 with thermowell made from pipe material
2 iTHERM FlameLine TWF16 with thermowell made from pipe and barstock tip
3 Connection to terminal head with M24x1.5 thread or groove for DIN A terminal head
Lg Thermowell length
L2 Length of barstock tip
ØT Thermowell outer diameter
Øi Thermowell inner diameter
Lm Sleeve length for iTHERM FlameLine TWF11
ØLm Sleeve diameter for iTHERM FlameLine TWF11

In the Product Configurator, the thermowell inner diameter is specified in combination with the thermowell outer diameter for the iTHERM FlameLine TWF16. Example: Feature 20 thermowell diameter, option A2: 17.2x14.2 mm

Weight

The weight depends on the product and configuration. Some examples:

Configuration	Weight
iTHERM FlameLine TWF11	
Material of thermowell SiC or SiN, sleeve material AISI 310 ØT = 17 mm (0.7 in) Lg = 800 mm (31.5 in) Lm = 300 mm (11.8 in)	**0.8 kg (1.8 lb)**
iTHERM FlameLine TWF16	
Thermowell material SiN ØT = 26 mm (1.02 in)	**1.4 kg (3.1 lb)**

1) Due to manufacturing tolerances in the kanthal sheath, the thermowell length Lg may vary in this version (±5%)

Configuration	Weight
Lg = 800 mm (31.5 in)	
Kanthal AF material Lg = 1 000 mm (39.4 in)	**0.6 kg (1.3 lb)**
NiCo material ØT = 26.7 mm (1.05 in)x20.96 mm (0.83 in) (¾" schedule 40s) Lg = 1 000 mm (39.4 in)	**1.9 kg (4.2 lb)**

Materials

Thermowell and ceramic sheath

The temperatures for continuous operation specified in the following table are intended as reference values for use of the various materials in air and without any significant mechanical load. The maximum operating temperatures can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L/ 1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1 200 °F) [1]	▪ Austenitic stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content
AISI 310/ 1.4841	X15CrNiSi25-20	1 100 °C (2 012 °F)	▪ Austenitic stainless steel ▪ Generally good resistance to oxidizing and reducing atmospheres ▪ Due to the higher chromium content, good resistance to oxidizing aqueous solutions and neutral salts melting at higher temperatures ▪ Only low resistance to sulfur-containing gases
AISI 304/ 1.4301	X5CrNi18-10	850 °C (1 562 °F)	▪ Austenitic stainless steel ▪ Suitable for use in water and slightly contaminated wastewater ▪ Only resistant to organic acids, salt solutions, sulfates, basic solutions, etc., at relatively low temperatures
AISI 446/ ~1.4762/ ~1.4749	X10CrAl24 / X18CrNi24	1 100 °C (2 012 °F)	▪ Ferritic, heat resistant, high-chromium stainless steel ▪ Very high resistance to sulfurous and low-oxygen gases and salts ▪ Very good corrosion resistance under both constant and cyclic temperature stress, and against combustion ash, copper, lead, and zinc smelting ▪ Low resistance to gases containing nitrogen
INCONEL® 600/ 2.4816	NiCr15Fe	1 100 °C (2 012 °F)	▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water, and much more ▪ Prone to corrosion in ultrapure water ▪ Not to be used in sulfur-containing atmospheres
INCONEL®601 / 2.4851	NiCr23Fe	1 200 °C (2 192 °F)	▪ Enhanced corrosion resistance at high temperatures due to aluminum content ▪ Resistant to oxidation and carburization under stress caused by temperature changes ▪ Good resistance to corrosion from molten salts ▪ Particularly sensitive to sulfidation
INCOLOY® 800HT / 1.4959	X8NiCrAlTi32-21	1 100 °C (2 012 °F)	▪ A nickel/chromium/iron alloy with the same base composition as INCOLOY ® 800, but with improved long-term temperature resistance due to restricted carbon, aluminum and titanium content ▪ Excellent strength and resistance to oxidation and carburization in high-temperature environments ▪ Good resistance to stress corrosion cracking, sulfur, internal oxidation, boiler scale formation and corrosion in a wide range of industrial environments. Suitable for sulfur-containing environments

Name	Short form	Recommended max. temperature for continuous use in air	Properties
Kanthal AF	FeCrAl	1 300 °C (2 372 °F)	▪ A ferritic iron/chromium/aluminum alloy for high temperatures ▪ High resistance to sulfur-containing, carburizing and oxidizing environments ▪ Good hardness and weldability ▪ Good form stability at high temperatures ▪ Must not be used in chloride-containing atmospheres and nitrogenous gases (cracked ammonia)

Special nickel/cobalt alloy	NiCo	1 200 °C (2 192 °F)	▪ Excellent resistance to sulfidizing and chlorine-containing environments
			▪ Outstanding resistance to oxidation, high-temperature corrosion, carburization, metal dusting, and nitriding
			▪ Good creep resistance
			▪ Average surface hardness
			▪ High wear resistance
			Recommended applications
			▪ Cement industry
			  ▪ Gas riser pipes: Successfully tested with up to 20 times the operating life compared to AISI310
			  ▪ Clinker coolers: Successfully tested with up to 5 times the operating life compared to AISI310
			▪ Waste incineration plants: Successfully tested with up to 12 times the operating life of INCONEL®600 and C276
			▪ Fluidized bed reactors (biogas reactors): Successfully tested with up to 5 times the operating life of, for example, INCOLOY®800HT or INCONEL®600.

Ceramic materials as per DIN VDE0335			
C610		1 500 °C (2 732 °F)	▪ Al_2O_3 content approx. 60%, alkali content 3% ▪ Most cost-effective, non-porous ceramic material ▪ Highly resistant to hydrofluoric acid, thermal shock, and mechanical stress; use for internal and external thermowells as well as insulators
Sintered silicon carbide	SiC	1 600 °C (2 912 °F)	▪ High resistance to thermal shocks due to its porosity ▪ Good thermal conductivity ▪ Very hard and stable at high temperatures **Recommended applications** ▪ Glass industry: glass feeders, float glass fabrication ▪ Ceramic industry ▪ Industrial ovens
Kanthal Super	$MoSi_2$ with a glass-phase component	1 700 °C (3 092 °F)	▪ High resistance to thermal shocks ▪ Very low porosity (< 1%) and very high hardness ▪ Must not be used in environments containing chlorine or fluorine compounds ▪ Not suitable for applications where the material is exposed to mechanical impact ▪ Must not be used in powder applications

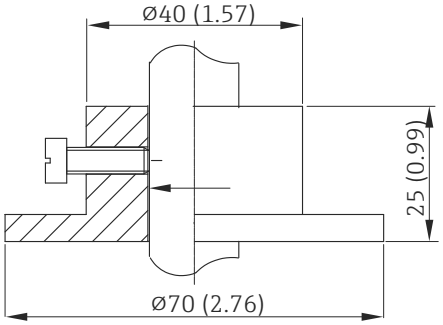
Special silicon nitride ceramic	SiN	1 400 °C (2 552 °F)	▪ Excellent wear resistance and resistance to thermal shocks
			▪ No porosity
			▪ Rapid heat reaction
			Recommended applications
			▪ Cement industry
			  ▪ Cyclone preheaters: Successfully tested with up to 5 times the operating life compared to AISI310
			  ▪ Secondary air ducts
			▪ In general, any application with extremely aggressive conditions, where mechanical impact/shock must be absorbed due to brittleness

1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Contact the manufacturer's sales department for further information.

Process connections

Type of fitting

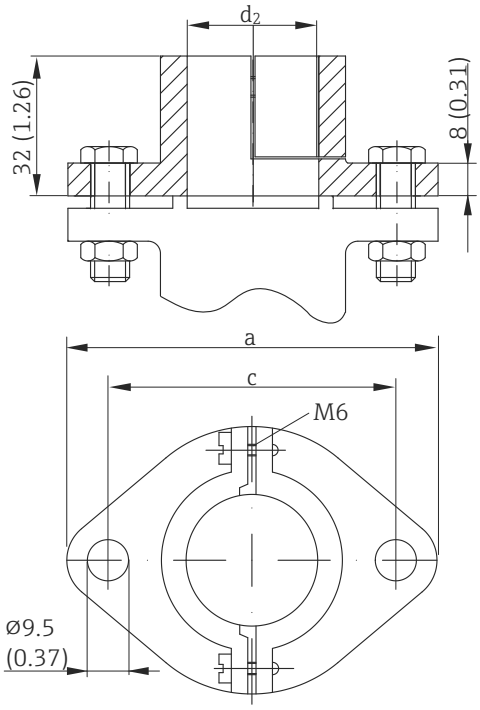
Adjustable flange



- Maximum temperature: 350 °C (662 °F)
- Material: Aluminum
- Inner diameter depends on diameter of metal sleeve or thermowell
- Not gas-tight

Inner diameter in mm (in):
- 22 mm (0.87 in)
- 14.5 mm (0.57 in)

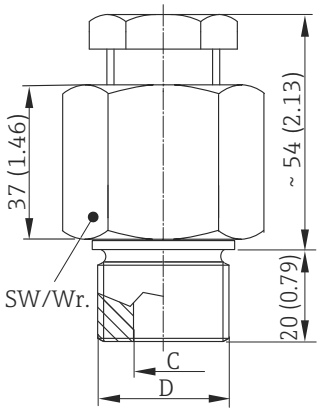
Stop flange according to DIN EN 50446



- Maximum temperature: 400 °C (752 °F)
- Material: cast iron
- Not gas-tight
- Counterflange and seal are not included in the delivery

d_2 in mm (in)	a in mm (in)	c in mm (in)	Clampable sleeve diameter in mm (in):
23 mm (0.91 in)	90 mm (3.54 in)	70 mm (2.76 in)	21 to 22 mm (0.83 to 0.87 in)
34 mm (1.34 in)	90 mm (3.54 in)	70 mm (2.76 in)	31 to 33.7 mm (1.22 to 1.33 in)
16 mm (0.63 in)	75 mm (2.95 in)	55 mm (2.16 in)	14 to 15 mm (0.55 to 0.59 in)
29 mm (1.14 in)	90 mm (3.54 in)	70 mm (2.76 in)	27 to 28 mm (1.06 to 1.1 in)

Gas-tight coupling



- Maximum temperature: 350 °C (662 °F)
- Material: AISI 316Ti
- Maximum process pressure ≤ 1 bar (14.5 psi)

Thread D	C in mm (in)	Clampable sleeve diameter in mm (in)	Width across flats AF (mm)
G ½	15.5 mm (0.61 in) 17.5 mm (0.69 in)	13.7 to 15 mm (0.54 to 0.6 in) 17 to 17.2 mm (0.67 to 0.67 in)	36
G ¾	15.5 mm (0.61 in) 18 mm (0.71 in) 19 mm (0.75 in) 22.5 mm (0.89 in)	13.7 to 15 mm (0.54 to 0.6 in) 17 to 17.2 mm (0.67 to 0.67 in) 17.5 to 18 mm (0.69 to 0.71 in) 21.3 to 22 mm (0.84 to 0.86 in)	36 36 36 41
G1	15.5 mm (0.61 in) 18 mm (0.71 in) 19 mm (0.75 in) 22.5 mm (0.89 in) 28 mm (1.1 in)	13.7 to 14 mm (0.54 to 0.55 in) 13.7 to 14 mm (0.54 to 0.55 in) 17.5 to 18 mm (0.69 to 0.71 in) 21.3 to 22 mm (0.84 to 0.86 in) 26.7 to 27 mm (1.05 to 1.06 in)	41 41 41 41 46
G 1¼	29 mm (1.14 in)	27.5 to 28 mm (1.1 to 1.06 in)	55

Type of fitting				
	G 1¼	32 mm (1.26 in)		
	G 1½	22.5 mm (0.89 in) 29 mm (1.14 in) 35 mm (1.38 in)	21.3 to 22 mm (0.84 to 0.86 in) 27.5 to 28 mm (1.1 to 0.86 in) 33.4 to 34 mm (1.32 to 1.34 in)	55

Process

Process temperature range

Depends on the material used, max.:
- iTHERM FlameLine TWF11 up to 1 600 °C (2 912 °F)
- iTHERM FlameLine TWF16 up to 1 700 °C (3 092 °F)

Process pressure range

High-temperature thermowells are designed for use in unpressurized processes. The available process connections are partially up to 1 bar (14.5 psi) gas-tight, see the "Process connections" section.

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the 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

Accessories

The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Online tools

Product information about the entire life cycle of the device is available at:
www.endress.com/onlinetools

Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**Guide that takes you quickly to the 1st measured value** The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	**Your reference document** The Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions. The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

www.addresses.endress.com

Endress+Hauser
People for Process Automation