NINVA™ TSP341-N

Sensor for non-invasive temperature measurement

Measurement made easy

TSP341-N

Introduction

The temperature sensor TSP341-N allows for reliable temperature measurement without intervention in the process.
Plant safety is clearly increased as a result.
Thanks to the quick and easy surface mounting and by eliminating the thermowell and the need to open the process, substantial cost reductions are achieved.

* The temperature sensor TSP341-N belongs to ABB's product family SensyTemp TSP. It is listed in the related type examination certificates for explosion protection as SensyTemp TSP341-N.

Additional Information

Additional documentation on TSP341-N is available for download free of charge at www.abb.com/temperature.
Alternatively simply scan this code:

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1 Safety

General information and instructions

These instructions are an important part of the product and must be retained for future reference.
Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.
For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.
The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.
Modifications and repairs to the product may only be performed if expressly permitted by these instructions.
Information and symbols on the product must be observed. These may not be removed and must be fully legible at all times.
The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

Warnings

The warnings in these instructions are structured as follows:

⚠ DANGER

The signal word '**DANGER**' indicates an imminent danger. Failure to observe this information will result in death or severe injury.

⚠ WARNING

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

⚠ CAUTION

The signal word '**CAUTION**' indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

NOTICE

The signal word *'**NOTICE**'* indicates possible material damage.

Note

'**Note**' indicates useful or important information about the product.

Intended use

Temperature sensor to enable non-invasive measurement of temperature of a flowing fluid in a pipe by accurately measuring the surface temperature.
The device is designed for use exclusively within the values stated on the name plate and in the specifications (see **Specifications** in the operating instruction or data sheet).

- The permissible ambient temperature range may not be up-scaled or down-scaled.
- The IP rating must be observed during operation.
- For use in potentially explosive atmospheres, follow the respective guidelines.

Improper use

The following are considered to be instances of especially improper use of the device:

- For use as a climbing aid, for example for mounting purposes.
- For use as a bracket for external loads, for example as a support for piping, etc.
- Material application, for example by painting over the housing, name plate or welding/soldering on parts.
- Material removal, for example by spot drilling the housing.

Warranty provisions

Using the device in a manner that does not fall within the scope of its intended use, disregarding this manual, using underqualified personnel, or making unauthorized alterations releases the manufacturer from liability for any resulting damage. This renders the manufacturer's warranty null and void.

Cyber security disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).
Operator shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information.
ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

Software downloads

By visiting the web pages indicated below, you will find notifications about newly found software vulnerabilities and options to download the latest software. It is recommended that you visit this web pages regularly:
www.abb.com/cybersecurity

ABB-Library – NINVA TSP341-N – Software Downloads

Manufacturer's address

ABB AG
Measurement & Analytics
Schillerstr. 72
32425 Minden
Germany
Tel: +49 571 830-0
Fax: +49 571 830-1806

Service address

Customer service center
Tel: +49 180 5 222 580
Email: automation.service@de.abb.com

2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

General

The temperature sensor TSP341-N belongs to ABB's product family SensyTemp TSP. It is listed in the related type examination certificates for explosion protection as SensyTemp TSP341-N.

Special regulations must be observed in potentially explosive atmospheres as regards the power supply, signal inputs / outputs and ground connections. The information relating specifically to explosion protection that appears within the individual chapters must be observed.

All parts must be installed in accordance with the manufacturer's specifications, as well as relevant standards and regulations. For commissioning and operation, the respectively applicable regulations, especially for the protection of employees, should be complied with.

IP rating

The connection parts of the temperature sensor must be installed so that at least the IP rating of the type of protection used can be achieved.

Temperature classes

If the temperature sensor is identified with temperature class T6 only, the following will apply:

- If the existing explosive gas atmosphere is to be assigned a temperature class of T5, T4, T3, T2, or T1, the temperature sensors can be used at correspondingly higher process temperatures, according to the specifications of the temperature class.

Notice on the 'Ex i – Intrinsic safety' type of protection declaration

Type examination certificates for the '**Ex i – Intrinsic safety**' type of protection of the TSP341-N cover the complete device, including the integrated transmitter and an optional LCD indicator.

Therefore, the transmitter and the indicator in the TSP341-N **do not require a separate** type examination certificate.
The PTB 01 ATEX 2200 X and IECEx PTB 11.0111 X type examination certificates of the TSP300 do not apply to the TSP341-N.

The certification was carried out on the basis of the following standards:

- IEC 60079-0:2011 Ed. 6, modified + Cor.: 2012 + Cor.: 2013
- EN 60079-0:2012+A11:2013
- IEC 60079-11:2011 Ed. 6 + Cor.: 2012
- EN 60079-11:2012

Ex marking

'Ex i – Intrinsic safety' type of protection

Model TSP341-N-D2 in zone 0, 1, 2	
ATEX	
Type examination certificate:	PTB 18 ATEX 2002 X
Ex marking	ATEX II 1 G Ex ia IIC T6...T1 Ga
	ATEX II 2 G Ex ib IIC T6...T1 Gb

Table 1: ATEX Ex marking, 'Ex i – intrinsic safety' type of protection

Model TSP341-N-J2 in zone 0, 1, 2	
IECEx	
Type examination certificate:	IECEx PTB 18.0041 X
Ex marking	Ex ia IIC T6...T1 Ga
	Ex ib IIC T6...T1 Gb

Table 2: IECEx Ex marking, 'Ex i – intrinsic safety' type of protection

'Ex i – intrinsic safety' type of protection in accordance with the NAMUR recommendation

Model TSP341-N-N3 in zone 0, 1, 2	
ATEX	
Type examination certificate:	PTB 18 ATEX 2002 X
Ex marking	NE24 and ATEX II 1 G Ex ia IIC T6...T1 Ga
	NE24 and ATEX II 2 G Ex ib IIC T6...T1 Gb

Table 3: NE24 and ATEX Ex marking, 'Ex i – intrinsic safety' type of protection

'Ex d - flameproof (enclosure)' type of protection

Model TSP341-N-D7 in zone 1, 2	
ATEX	
Type examination certificate:	PTB 99 ATEX 1144 X
Ex marking	ATEX II 2 G Ex db IIC T6/T4 Gb

Table 4: ATEX Ex marking, 'Ex d – flameproof (enclosure)' type of protection

Model TSP341-N-J7 in zone 1, 2	
IECEx	
Type examination certificate:	IECEx PTB 12.0039 X
Ex marking	Ex db IIC T6/T4 Gb

Table 5: IECEx Ex marking, 'Ex d – flameproof (enclosure)' type of protection

General information

Thermal resistance

In addition to measurement of the contact temperature, a temperature measurement at a reference test point at small physical distance is made to improve measuring accuracy. For this, the measuring inset has two temperature sensors in two separate mineral insulated cables.

The following data applies for both temperature sensors, see also **Temperature rise in the event of a fault**.

Heat resistance R_{th} for mineral insulated cable Ø 3 mm (0.12 in)	
Δt = 200 K/W × 0.038 W = 7.6 K	
Resistance thermometer without thermowell	200 K/W

K/W = kelvin per watt

Note

The specified thermal resistance R_{th} should be indicated under the conditions ‘stationary gas (environment)’ and ‘mineral insulated cable without thermowell’.

Temperature rise in the event of a fault

In the event of a fault, the temperature sensors will exhibit a temperature rise Δt as appropriate for the applied power. This temperature rise Δt must be considered when determining permissible temperature classes, see **Permissible ambient temperature** on page 8.

Note

A dynamic short-circuit current that occurs in the measurement circuit for a matter of milliseconds in the event of a fault is irrelevant with regard to heating.
The temperature rise Δt can be calculated using the following formula:

$$\Delta t = R_{th} \times P_o \quad \left[K/W \times W\right]$$

Δt Temperature rise

R_{th} Thermal resistance

P_o Output power of the integrated transmitter

Example:

Resistance thermometer diameter approximately 3 mm (0.12 in) without thermowell:

R_{th} = 200 K/W,
P_o= 38 mW
Δt = 200 K/W × 0.038 W = 7.6 K

For a transmitter output power P_o = 38 mW, a temperature rise of approx. 8 K results in the event of a fault.
In consideration of this temperature rise, the maximum possible surface temperatures $T_{surf.}$ arise for temperature classes T1 to T6, as presented in Table 6 .

… 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Type of protection Ex i, intrinsic safety

Permissible ambient temperature

The following table shows the permissible ambient temperature $T_{amb.}$ for the corresponding equipment protection levels Ga (zone 0) and Gb (zone 1) as a function of the material of the connection head (aluminum or stainless steel), the thermal insulation at the measuring point and the surface temperature $T_{surf.}$ at the measuring point.

The surface temperatures ($T_{surf.}$) are determined as follows:

$T_{surf.}$ = T6 to T3 − 5°C − 8°C (Δt in the event of an error)

$T_{surf.}$ = T2 to T1 − 10°C − 8°C (Δt in the event of an error)

For Δt = 8 °C, see **Temperature rise in the event of a fault** on page 7.

Note

The ambient temperatures specified in the following table must be processed in accordance with EN 60079-14 for device protection level Ga (zone 0).

$T_{surf.}$	Maximum permissible ambient temperature $T_{amb.}$ for equipment protection levels Ga (zone 0) and Gb (zone 1)			
	Aluminum connection head		CrNi steel connection head	
	Without insulation	With insulation	Without insulation	With insulation
400 °C (T1)*	48 °C	67 °C	26 °C	50 °C
282 °C (T2)	62 °C	74 °C	49 °C	65 °C
187 °C (T3)	71 °C	78 °C	64 °C	74 °C
122 °C (T4)	77 °C	81 °C	75 °C	81 °C
72 °C (T6)	52 °C	55 °C	54 °C	57 °C

Table 6: Ambient temperature for equipment protection levels Ga (zone 0) and Gb (zone 1)

* Maximum measuring range of the device: 400 °C

Note

The standard supplied M20 × 1.5 plastic cable gland has a limited temperature range of −40 to 70 °C (−40 to 158 °F).
When using the supplied cable gland, make sure that the ambient temperature is within this range.

TSP341-N connection data

The integrated transmitter is based on the TTH300 HART from ABB.

The intrinsic safety type examination certificates PTB 18 ATEX 2002 X and IECEx PTB 18.0041 X apply to the complete temperature sensor TSP341-N with integrated transmitter, so the type examination certificates for the TTH300 are **not** applicable.

When connecting the TSP341-N to certified intrinsically safe circuits, the following maximum input values must be observed.

Max. voltage U_i	30 V
Short-circuit current I_i	130 mA
Max. power P_i	0.8 W
Internal inductance L_i	0.5 mH
Internal capacitance C_i	0.57 nF

Table 7: Electrical data

Type of protection Ex d - flameproof (enclosure)

With connection head, the TSP341-N can be used in 'Ex d – flameproof (enclosure)' type of protection in zone 1.

- The connection conditions listed in the type examination certificate PTB 99 ATEX 1144 X or IECEx PTB 12.0039 X must be observed.
- For the TSP341-N with 'Ex d – flameproof (enclosure)' type of protection, the self-heating of the sensor in the event of a fault should be considered, see **Thermal resistance** on page 7.
- The temperature class and maximum permissible surface temperature or the temperature at the reference test point should be determined accordingly.

Temperature Data

Maximum permissible ambient temperature $T_{amb.}$ on the connection head		
Temperature class	**$T_{amb.}$ with LCD indicator**	**$T_{amb.}$ without LCD indicator**
T1 to T4	−20 to 70 °C (−4 to 158 °F)	−40 to 85 °C (−40 to 185°F)
T6	−20 to 67 °C (−4 to 152 °F)	−40 to 67 °C (−40 to 152 °F)

Table 8: Ambient temperature on the connection head

Temperature class	Maximum surface temperature $T_{surf.}$ in Zone 1*
T1	400 °C** (752 °F)**
T2	288 °C (550 °F)
T3	193 °C (379 °F)
T4	128 °C (262 °F)
T5	93 °C (199 °F)
T6	78 °C (172 °F)

Table 9: Permissible surface temperature

* Also applies for the temperature at the reference test point

** Maximum measuring range of the device: 400 °C (752 °F)

Installation instructions

Avoid increases in the ambient temperature by ensuring equipment is at a sufficient distance from system components with excessively high temperatures. It must be ensured that heat dissipation can take place by means of unrestricted air circulation. You must avoid exceeding the maximum permissible ambient temperature as per the approved temperature class. The assembly and disassembly may only be performed by specialist personnel who have knowledge of the concept of the corresponding types of Ex protection. Compliance with the Ex temperature classes must be ensured through suitable measures.
It is essential to ensure compliance with the EC-type-examination certificates for the equipment, including the documents associated with these.
The temperature sensors must be integrated in the potential equalization of the installation location.

The installation, commissioning, maintenance and repair of devices in potentially explosive atmospheres must only be carried out by appropriately trained personnel. Works may be carried out only by persons, whose training has included instructions on different types of protection and installation techniques, concerned rules and regulations as well as general principles of zoning.
The person must possess the appropriate competences for the type of work to be conducted.
The safety instructions for electrical apparatus in potentially explosive areas must be in accordance with Directive 2014/34/EU (ATEX) and IEC 60079-14 (Installation of electrical equipment in potentially explosive areas).
Comply with the applicable regulations for the protection of employees to ensure safe operation.

Consider the following points when installing the TSP341-N in potentially explosive atmospheres:

- Operation in areas with flammable dust (dust explosion protection) is **not permissible**.

… 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

… Installation instructions

Type of protection Ex i, intrinsic safety

⚠ WARNING

Explosion hazard

Explosion hazard due to improper installation of devices with aluminum housing.

When using the device in areas that require the device safety level EPL "Ga" (Zone 0), the devices must be installed with aluminum housings, protected against strong mechanical impacts or friction.

Note

When operating the complete device in zone 0 (EPL 'Ga'), the compatibility of the device materials with the surrounding atmosphere must be ensured.

Encapsulation material used for the integrated transmitter:
Polyurethane (PUR), WEVO PU-417

Apart from that, no additional specific information needs to be observed for mechanical installation.

Installation notes for 'Ex d - flameproof (enclosure)' type of protection

If the temperature on the cable entries of the device is over 70° C (158 °F), connection leads with sufficient temperature resistance must be used.

Cable glands for type of protection 'Ex d'

Devices with type of protection 'Ex d' supplied without cable glands

For devices with 'Ex d - flameproof (enclosure)' type of protection supplied without cable glands, refer to the notes in **Type of protection Ex d - flameproof (enclosure)** on page 9.

When installing cable glands provided by the operator, observe the data sheet, instruction and approval notes of the cable gland.

Devices in 'Ex d' type of protection with cable gland

If devices in 'Ex d – flameproof (enclosure)' type of protection with cable gland are ordered, an Ex d certified cable gland is factory-installed.

This case occurs if the cable gland is not deselected in the order by entering the 'Cable input options – U1 or U2' order code.

Data on the factory-installed Ex d cable gland

- Thread: M20 × 1.5
- Temperature range: −40 to 85 °C (−40 to 185 °F)
- Cable outside diameter: 3.2 to 8.7 mm (0.13 to 0.34 in)
- Material: nickel-plated brass

Note

In such cases, the value 'U1' (thread M20 × 1.5) is provided on the additional plate for explosion-protected apparatus in the type designation in accordance with the approval.

The cable gland is only suited for fixed installations and non-reinforced cables with round and smooth plastic sleeves and suitable outside diameter. The cables must be attached appropriately in order to prevent them being pulled out or twisted.

The operating instruction and approvals supplied with the cable glands, as well as any applicable requirements in accordance with EN 60079-14 must be taken into account accordingly.

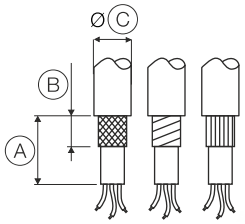
Installation instructions

The sealing rings of the cable glands harden at low temperatures.

- Before installation, bring the sealing rings to a temperature of at least 20 °C (68 °F) for at least 24 hours.
- Before inserting the sealing rings and fixing them onto the cable gland, knead the rings to make sure they are soft and flexible.

IP rating IP66 / 67 is only achieved by installing the black neoprene sealing ring between the cable gland and the housing and by observing the tightening torque of 3.6 Nm (Figure 2, item ②).

Cables must be protected against extreme mechanical loads (caused by tension, torsion, crushing, and so on). Even under operating conditions, it must be ensured that the cable entry remains hermetically sealed. The customer must provide a strain relief device for the cable.



(A) 40 mm (1.57 in)
(B) 12 mm (0.47 in)
(C) Ø 8.5 / 12 mm (0.33 / 0.47 in)

Figure 1: Stripping the connection cable

1. Check that cable used is suitable (i.e., check the mechanical resilience, temperature range, creep resistance, resistance to chemicals, outside diameter, and so on).
2. Strip the cable in accordance with Figure 1.
3. Check the outer sleeve for damage and soiling.
4. Insert the cable in the cable gland.

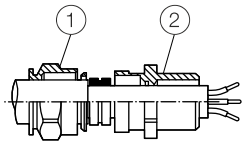


Figure 2: Tighten cable gland

5. Tighten the cable gland until the cable is firmly enclosed by the sealing ring (Figure 2, item (1)). Do not tighten more than 1.5--times of the specified torque on the cases (see assembly instructions)!

Maintenance
Check the cable glands during each scheduled maintenance. If the cable is slack, retighten the cap(s) of the cable glands.
If it is not possible to retighten them, the cable gland will need to be replaced.

Plastic cable gland M20 × 1.5 for 'Ex i' type of protection
The standard supplied M20 × 1.5 plastic cable gland has a limited temperature range.

Type examination certificate
IMQ 13 ATEX 010 X and IECEx IMQ 13.0003X,
Manufacturer code HIBM-MX2DSC.

Permissible ambient temperature range
The permissible ambient temperature range of the cable gland is −40 to 70 °C (−40 to 158 °F).
When using the cable gland, make sure that the ambient temperature is within this range.

Notes on installation
The cable gland has two gaskets to support a clamping area of 4 to 7 mm (0.16 to 0.28 in) and 7 to 13 mm (0.28 to 0.51 in).
Depending on the cable outside diameter, observe the following points:

- For a clamping area of 7 to 13 mm (0.28 to 0.51 in), the inner gasket should be carefully removed.
- For a clamping area of 4 to 7 mm (0.16 to 0.28 in) (both gaskets required), installation should be made with a tightening torque of 3.5 Nm.
- For a clamping area of 7 to 13 mm (0.28 to 0.51 in) (outer gasket only), installation should be made with a tightening torque of 4.5 Nm.

On the cable side, when installing the connection of the cable gland and cable, check for tightness to make sure that the required IP rating is correct.
The cable gland is not suited for use as a blind plug. Use suited blind plugs only!
The cable glands are suited for fixed installations only.
The cables must be attached appropriately in order to prevent them being pulled out or twisted.
The information in the instruction of the cable gland (Safety, Maintenance and Mounting Instructions) should be observed!

… 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Electrical connections

Grounding

Note

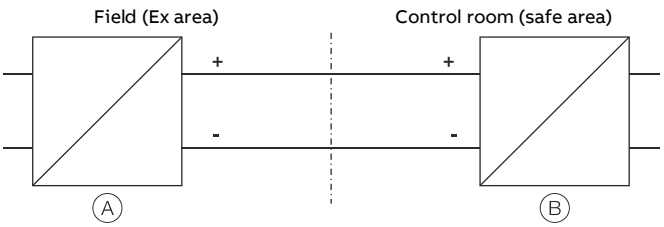
The device shall be included in the equipotential bonding system using the grounding terminal intended for this purpose.

If, for functional reasons, the intrinsically safe circuit needs to be grounded by means of a connection to the potential equalization, it may only be grounded at one point.

Intrinsic safety proof

If the temperature sensors are operated in an intrinsically safe circuit, proof that the interconnection is intrinsically safe must be provided in accordance with DIN VDE 0165/Part 1 (EN 60079-25 and IEC 60079-25).
The supply isolators / distributed control system (DCS) inputs must feature intrinsically safe input protection circuits to eliminate hazards (spark formation).
In order to provide proof of intrinsic safety, the electrical limit value must be used as the basis for the EC-type examination certificates for the equipment (devices); this includes the capacitance and inductance values of the cables.
Proof of intrinsic safety is said to have been provided if the following conditions are fulfilled when a comparison is carried out in relation to the limit values of the equipment:

Transmitter (intrinsically safe equipment)	Supply isolator / DCS input (related equipment)
	$U_i \geq U_o$
	$I_i \geq I_o$
	$P_i \geq P_o$
	$L_i + L_c$ (cable) $\leq L_o$
	$C_i + C_c$ (cable) $\leq C_o$



(A) Transmitter

(B) Supply isolator / DCS input with supply / Segment coupler

Figure 3: Intrinsic safety installation check

Type of protection Ex i, intrinsic safety

Ex marking

Model TSP341-N-D2

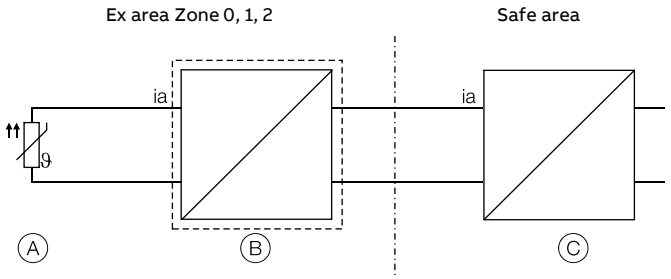
ATEX II 1 G Ex ia IIC T6...T1 Ga (zone 0, 1, 2)
ATEX II 2 G Ex ib IIC T6...T1 Gb (zone 1, 2)

Model TSP341-N-N3

NE 24 and ATEX II 1 G Ex ia IIC T6...T1 Ga (zone 0, 1, 2)
NE 24 and ATEX II 2 G Ex ib IIC T6...T1 Gb (zone 1, 2)

Model TSP341-N-J2

IECEx ia IIC T6...T1 Ga (zone 0, 1, 2)
IECEx ib IIC T6...T1 Gb (zone 1, 2)



(A) Sensors for surface and ambient temperature

(B) Transmitter in connection head, intrinsically safe to zone 0

(C) Ex ia supply isolator

Figure 4: Interconnection 'Ex i – intrinsic safety' type of protection

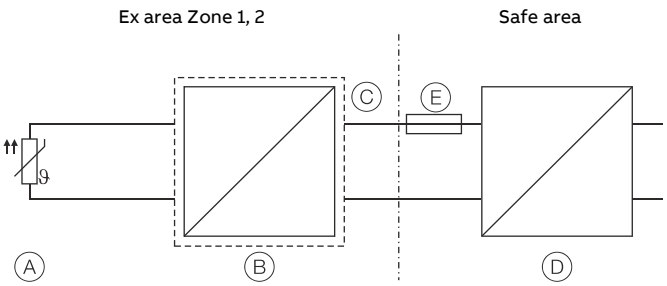
The TSP341-N is approved for use in zone 0 in 'Ex i – intrinsic safety' type of protection.
With this instrumentation, it must be ensured that the power feed only comes from an approved intrinsically safe electrical circuit of the appropriate category.
A supply isolator with 'Ex ia' type of protection is required for use in zone 0.

Electric and limit values must not be exceeded, see **TSP341-N connection data** on page 8 and **Permissible ambient temperature** on page 8.

Type of protection Ex d - flameproof (enclosure)

Ex marking

Model TSP341-N-D7:
ATEX II 2 G Ex db IIC T6/T4 Gb (Zone 1 und 2)
Model TSP341-N-J7:
IECEx db IIC T6/T4 Gb (Zone 1 and 2)



(A) Sensors for surface and ambient temperature
(B) Transmitter in connection head
(C) Ex d housing (IP 6X) with Ex d cable gland
(D) Supply isolator with voltage limit (30 V)
(E) Fuse 32 mA

Figure 5: Interconnection in 'Ex d – flameproof (enclosure)' type of protection*

The TSP341-N in Ex d – flameproof (enclosure) type of protection is supplied with a non-intrinsically safe transmitter.

Connection notes

- The power supply of the transmitter must be limited by an upstream fuse with a fuse current rating of 32 mA.
- Maximum input terminal voltage of the transmitter: 30 V DC
- The 'Ex d – flameproof (enclosure)' type of protection can only be achieved by correctly installing a specially certified cable gland with Ex d type of protection and a corresponding marking.
- As far as the installation and mounting of components is concerned (explosion-proof cable entries, connection parts), only those components are approved which at the least technically comply with the current version of the PTB 99 ATEX 1144 X type examination certificate and for which a separate examination certificate exists. At the same time, it is imperative that the operating conditions listed in the respective component certificates are complied with.
- For the connection, suited cable entries or piping systems must be used that satisfy the requirements of EN 60079-1 and for which separate examination certificates exist. If the transmitter is connected to pipeline systems, the relevant sealing device must be affixed directly to the housing.
- Cable entries (PG glands) and sealing plugs of simple design must not be used.
- Close off unused openings in accordance with EN 60079-1.
- The connection lead must be routed securely and in such a way to guarantee adequate protection against damage.

Commissioning

The commissioning and parameterization of the device may also be carried out in potentially explosive atmospheres using a handheld terminal that has been approved accordingly under consideration of an intrinsic safety installation check. Alternatively, an Ex modem can be connected to the circuit outside the potentially explosive atmosphere.

… 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Operating instructions

⚠ DANGER

Risk of explosion due to hot parts

Hot parts inside the device pose an explosion hazard.

- Never open the device immediately after switch-off.
- A waiting time of at least four minutes should be observed before opening the device.

⚠ DANGER

Explosion hazard when opening the device

Explosion hazard when opening the device with activated power supply.

- Before opening the device, switch off the power supply.

Damage to the 'Flameproof (enclosure)– Ex d' type of protection

The cover thread is used as a flameproof joint for the 'Flameproof (enclosure) – Ex d' type of protection.

- During assembly / disassembly of the device, make sure that the cover thread does not get damaged.
- Devices with damaged threads must no longer be used in potentially explosive atmospheres.

Protection against electrostatic discharges

The painted surface of the housing and the plastic parts inside the device can store electrostatic charges.

⚠ WARNING

Risk of explosion!

The device must not be used in areas in which process-related electrostatic charging of the housing may occur.

- The device must be installed, maintained and cleaned such that any dangerous electrostatic charge is avoided.

Repair

⚠ DANGER

Explosion hazard

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

3 Use in potentially explosive atmospheres in accordance with cFMus, FM and CSA

Note

- Further information on the approval of devices for use in potentially explosive atmospheres can be found in the explosion protection test certificates (at www.abb.com/temperature).
- Depending on the design, a specific marking in accordance with FM, CSA or cFMus applies.

Ex marking cFMus

cFMus Intrinsically Safe

Model TSP341-N-L1H for USA **Model TSP341-N- R1H for Canada**	
Control Drawing	TSP341-N-L1H
IS Class I,II,III, Div. 1,2 Group ABCDEFG T6, T4	
Zone 0 AEx/Ex ia IIC T6, T4 Ga	
Zone 1 AEx/Ex ia IIC T6, T4 Gb	
Ta= -40°C up to +81°C	

cFMus Non-Incendive

Model TSP341-N-L2H for USA **Model TSP341-N-R2H for Canada**	
Control Drawing	TSP341-N-L2H
NI Class I,II,III, Div. 2 Group ABCDEFG T6, T4,	
Zone 2 AEx/Ex nA IIC T6, T4 Gc	
Zone 2 AEx/Ex ec IIC T6, T4 Gc	
Ta= -40°C up to +81°C	

Installation instructions

The installation, commissioning, maintenance and repair of devices in areas with explosion hazard must only be carried out by appropriately trained personnel.
The operator must strictly observe the applicable national regulations with regard to installation, function tests, repairs, and maintenance of electrical devices. (e. g. NEC, CEC).

Warnings and instructions should be followed as per notes on the associated control drawing for installation in the associated hazardous area.

The control drawings are available for download under the following link. Just scan or click on the QR code:

ABB Library – TSP341-N – control drawings

… 3 Use in potentially explosive atmospheres in accordance with cFMus, FM and CSA

Electrical connections

Grounding

Transmitters can be installed in all kinds of industrial sectors. Potentially explosive systems are divided into zones, meaning that a wide range of different instruments are also required. For this, pay attention to the country-specific guidelines and certificates!

Note

When operating the transmitter in Zone 0, the compatibility of the device materials with the surrounding atmosphere must be guaranteed.
Encapsulation material used for the transmitter:
Polyurethane (PUR)

Installation in a potentially explosive atmosphere

Transmitters can be installed in all kinds of industrial sectors. Potentially explosive systems are divided into zones, meaning that a wide range of different instruments are also required. For this, pay attention to the country-specific guidelines and certificates!

Commissioning

The commissioning and parameterization of the device may also be carried out in potentially explosive atmospheres using a handheld terminal that has been approved accordingly under consideration of an intrinsic safety installation check. Alternatively, an Ex modem can be connected to the circuit outside the potentially explosive atmosphere.

Operating instructions

⚠ DANGER

Risk of explosion due to hot parts

Hot parts inside the device pose an explosion hazard.

- Never open the device immediately after switch-off.
- A waiting time of at least four minutes should be observed before opening the device.

⚠ DANGER

Explosion hazard when opening the device

Explosion hazard when opening the device with activated power supply.

- Before opening the device, switch off the power supply.

Protection against electrostatic discharges

The plastic parts inside the device can store electrostatic charges.
Make sure that no electrostatic charges can accumulate when handling the device.

⚠ WARNING

Risk of explosion!

The device must not be used in areas in which process-related electrostatic charging of the housing may occur.

- The device must be installed, maintained and cleaned such that any dangerous electrostatic charge is avoided.

Repair

⚠ DANGER

Explosion hazard

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

4 Design and function

Non-invasive temperature measurement

Classic temperature measurement in process technology is made by directly introducing the temperature sensor into the measuring medium.
The measuring medium (gaseous, liquid or paste-like) is usually in a vessel or piping and highly influences the selection of traditional invasive measurements.

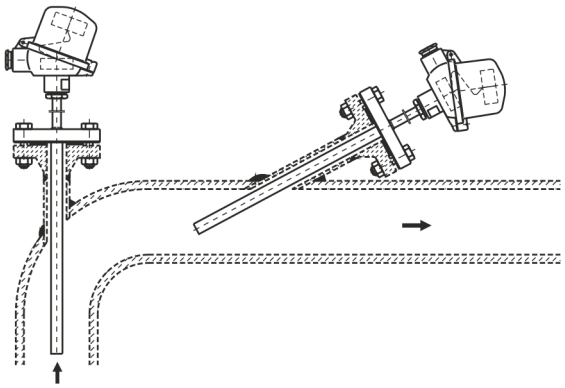


Figure 6: Classic installation of temperature sensors in piping

Depending on the process properties, the temperature sensor needs special protection to protect it from chemical and mechanical loads. For example, abrasive dust or sands, which move through the piping at high speeds, present a special challenge.

To protect the temperature sensor, the thermowells used must be inspected regularly and replaced as needed.
Chemically aggressive or abrasive media can lead to the erosion of thermowell material.
A thermowell placed in flowing media can also begin to vibrate due to vortex formation and in extreme cases it can break.
Therefore, guidelines and standards for the stability of thermowells have become more restrictive over time, and so the costs of maintenance and exchange have increased as well. In addition, to prevent potential catastrophic failure, thermowells used must be inspected regularly and replaced as needed in known critical conditions.

These life cycle costs are in addition to capital expenditure costs incurred during planning and designing temperature measurement points. Engineering costs for stability calculations, structural flanges to support and seal the thermowells, and welding and fabrications costs all add up to the total capital expenditure.

The costs mentioned above can be eliminated if the process temperature could be measured non-invasively. Using ABB's non-invasive approach, it is possible to get an accurate measurement of the process temperature without the need for a thermowell.

The TSP341-N (NINVA™) temperature sensor now combines non-invasive temperature measurement with the established HART® communications protocol in two-wire technology. Therefore, the device can be integrated seamlessly the vast majority of existing and future process facilities.

The 'N' in TSP341-N stands for non-invasive temperature measurement and can turn a metal pipe carrying a process media into a temperature sensor. Using model based algorithms in the transmitter electronics to compensate for ambient and surface contact conditions, a NINVA – T delivers an accurate measurement of the true surface temperature of the pipe. When coupled with process conditions, the sensor provides a non-invasive approach to measure the process temperature without the need for a thermowell for the vast majority of process conditions.

A non-invasive approach to temperature measurement is well suited for turbulent, liquid like flows in metal pipes where the surface temperature is well correlated with the bulk temperature of the process media. However, the sensor can be effectively used in the vast majority of process and piping conditions without any need for the input of process or piping specification. Please see more details in the 'how to effectively use a non-invasive measurement' section in the operating instructions.

* The temperature sensor TSP341-N belongs to ABB's product family SensyTemp TSP. It is listed in the related type examination certificates for explosion protection as SensyTemp TSP341-N.

… 4 Design and function

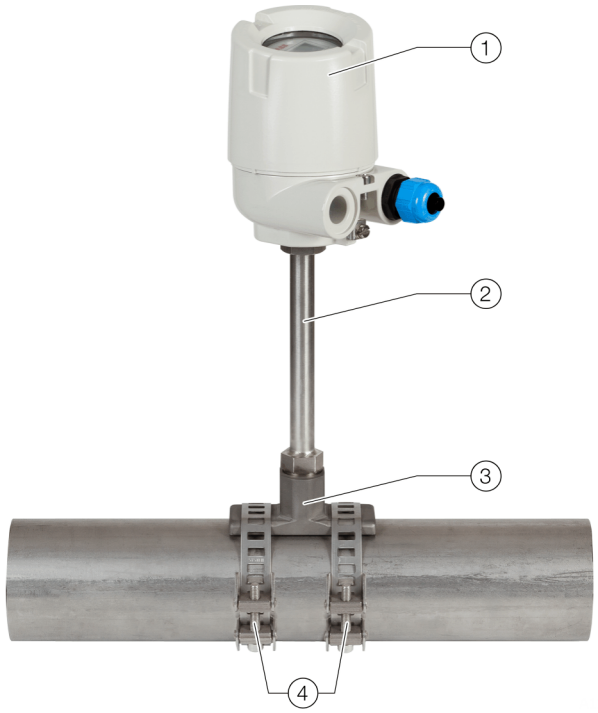
System structure

The TSP341-N temperature sensor contains a TTH300 temperature transmitter with integrated calculation algorithms for non-invasive temperature measurement. The transmitter has an analog 4 to 20 mA current output and supports communication through the HART 7® protocol. As an option, the type AS LCD indicator can be integrated.

The transmitter is connected to two connected temperature sensors. One sensor measures the contact temperature at the measuring point, while a second sensor measures the ambient temperature at a reference test point near the measuring point.

By using the algorithms for accurate non-invasive temperature calculation, a process temperature range of −40 to 400 °C (−40 to 752 °F) with an ambient temperature of −40 to 85 °C (−40 to 177 °F) is covered. In a remote configuration, measurement process temperature options up to 550 °C (1022 °F) can be realized as special designs with remote sensor apparatus being able to withstand ambient temperatures up to 116 °C (241 °F).

The transmitter can be configured using the software provided by ABB with TSP341-N-support (DTM and EDD) and tools such as Field Information Manager (FIM) in accordance with the current conditions of use.



1 Connection head with transmitter
2 Extension tube
3 Retaining plate
4 Clamp collars

Figure 7: TSP341-N

For non-invasive temperature measurement, the temperature sensor is fastened to a piping or vessel surface. Installation is made using two clamp collars, which fix the retaining plate to the foot of the sensor.

Clamps with different expansion coefficients are available to adapt to the piping or vessel material. For a good measurement, the surface under the retaining plate should be straight, and cleaned to remove any particles or dust. The presence of standard paint coatings (up to 300 µm) on a surface have a minimal effect on the absolute accuracy. For larger organic or non-thermally conductive coatings, please see more details in the section '**How to effectively use a non-invasive measurement**' in the operating instructions.

During installation, make sure that the measuring tip with the integrated sensor element has optimal contact with the measuring point.

In addition, insulation to minimize the effect of humidity (rain and ice) and wind on the pipe surface temperature is recommended.

5 Product identification

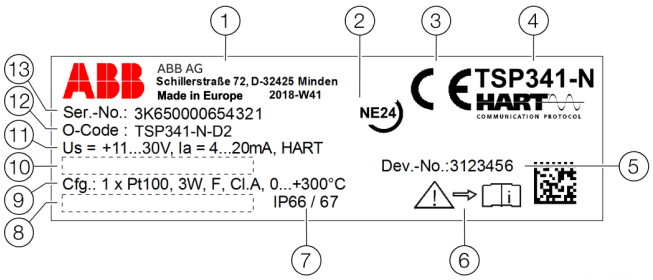
Name plate

Note

The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

Note

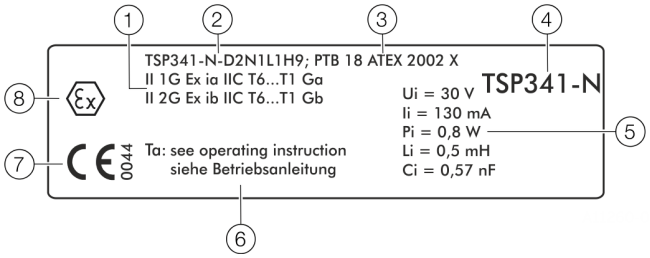
The values specified on the name plate are maximum values and do not take process-related stress into consideration. This should be taken into consideration when working with the instruments.



1. Manufacturer address, year / week of manufacture
2. NE24 conformity (optional)
3. CE mark (EU conformity), if not on additional plate
4. Type designation / model
5. 7-digit serial number of the transmitter device electronic unit
6. Note: Observe product documentation
7. IP rating of housing
8. Surface temperature range $T_{surf.}$, for Ex versions on additional plate
9. Sensor type and circuit type, accuracy class, set measuring range of the transmitter
10. Ambient temperature range $T_{amb.}$ (temperature on connection head), for Ex versions on additional plate
11. Specification of the transmitter
10. Coding of the type of protection of the device (in accordance with ordering information)
13. Serial number of the device (serial number in accordance with order)

Figure 8: TSP341-N name plate (example for 'Ex i – intrinsic safety' type of protection)

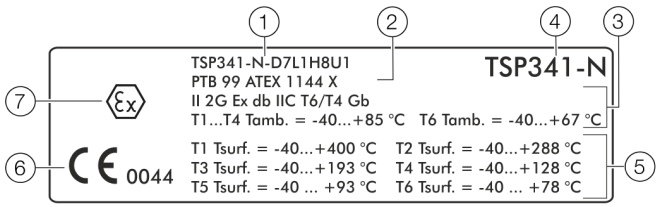
'Ex i – intrinsic safety' type of protection additional plate



1. Ex marking
2. Type designation in accordance with approval
3. Approval number
4. Type designation
5. Device connection data
6. Note on instruction for ambient temperature
7. CE mark (EU conformity) and notified body for quality assurance
8. Ex Mark

Figure 9: Additional plate for explosion-protected apparatus, example for Ex i – intrinsic safety type of protection

Additional plate for 'Ex d – flameproof (enclosure)' type of protection



1. Type designation in accordance with approval
2. Approval number
3. Ex marking
4. Type designation
5. Temperature range
6. CE mark (EU conformity) and notified body for quality assurance
7. Ex Mark

Figure 10: Additional plate for explosion-protected apparatus, example for 'Ex d – flameproof (enclosure)' type of protection

6 Transport and storage

Inspection

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents.
All claims for damages must be submitted to the shipper without delay and before installation.

Transporting the device

Observe the following instructions:

- Do not expose the device to humidity during transport. Pack the device accordingly.
- Pack the device so that it is protected against vibrations during transport, for example, by using air-cushioned packing.

Storing the device

Bear the following points in mind when storing devices:

- Store the device in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Avoid storing the device in direct sunlight.
- In principle, the devices may be stored for an unlimited period. However, the warranty conditions stipulated in the order confirmation of the supplier apply.

Ambient conditions

The ambient conditions for the transport and storage of the device correspond to the ambient conditions for operation of the device.
Adhere to the device data sheet!

Returning devices

For the return of devices, follow the instructions in **Repair** on page 32.

7 Installation

Safety instructions

⚠ DANGER

Explosion hazard
Improper installation and commissioning of the device carries a risk of explosion.

- For use in potentially explosive atmospheres, observe the information in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6!

⚠ CAUTION

Risk of burns due to hot measuring media
The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

Achieving IP rating IP 66 / IP 67

The user must take appropriate measures to ensure that the required IP rating according to the IEC 60529 standard is achieved.

The IP rating IP 66 / 67 is only achieved after the device has been correctly and fully installed, as described in this chapter.

- Suited cable glands should be used.
- Unused device inputs must be closed off using suited plugs.

See also **Cable gland** on page 23 and **Cable glands** on page 27.

How to effectively use a non-invasive measurement

A NINVA™ TSP341-N can be mounted on any process pipe or container to provide an accurate measurement of the process or surface temperature of the structure. Uniquely, by contacting the surface perpendicular to the primary axis of the pipe, a NINVA™ measurement can be handled and managed in a similar manner to any thermowell measurement.

However, the NINVA™ TSP341-N approach provides unprecedented abilities to estimate the complete performance of a temperature measurement point before installation. When considering a NINVA measurement, the following three steps should be followed:

Step 1: Verify the expected measurement performance
Input nominal process parameters and pipe dimensions into the **ABB performance predictor** to obtain an expected steady state result of a NINVA™ measurement. If the outcome is satisfactory for the application, proceed with the installation.

ABB performance predictor

Step 2: Mount in location
Follow the mounting instructions carefully ensuring to loosen the nut on the head before mounting the device (see **Figure 11** on page 24). This ensures that the contact sensor tip will not get damaged or bent and that a good and repeatable contact of the sensor is made once the final tightening of the head is completed.

If the default or ordered preset measurement range does not match the requirement for the location, the lower (4 mA) and upper (20 mA) temperature range should be adjusted to the desired measurement range using a handheld terminal.

Step 3: Insulate if used on an outdoor location
NINVA™ turns the pipe into a sensor and measures the surface temperature of the pipe. If it rains or the wind is blowing strongly at the location, the true surface temperature of the pipe will be affected. The correlation with the process temperature will therefore deviate. Insulation will allow the pipe surface temperature to better correlate with the process temperature. However, in all cases, the NINVA™ will compensate the contact sensor measurement for ambient effects delivering the true surface temperature of the pipe under the sensor under all conditions.

Detailed background information on non-invasive temperature measurement can be found at:

… 7 Installation

General Notes

The sensor assembly is designed to ensure long term mechanical stability in mounting and performance. The sensor is mounted on to the pipe or vessel by means of at least 2 clamp collars. The collars are tensioned with a screw lock assembly where a torque of 10 Nm is specified in order to ensure that the mounting is stable in service.

When installing the temperature sensor using clamp collars, observe the following points:

- The temperature sensor must be firmly and securely installed in a way that conforms to the application.
- The temperature sensor must be installed at angle of 90° to the piping.
- The retaining plate of the temperature sensor must lie flat on the measuring point, with the sides of the plate parallel to the centerline of the pipe. Ensure that the contact surface is free of dirt or loose materials.
- The retaining plate of the temperature sensor must be installed on the piping using suited clamp collars. Select the length of the clamp collars and the material according to the installation position.
- The IP rating will no longer apply in the event of damage to the connection head or the threads, gaskets or cable glands on the connection head.
- The connection leads must be firmly connected to the terminals.
- After connecting the connection lines with a suited tool (screwdriver, wrench), securely close and seal the connection head. Be sure to observe here that the sealing rings of the connection heads are clean and undamaged.
- Insulation of the piping around the measuring point is recommended for any installation to ensure that the pipe surface temperature correlates to the process temperature without convective losses to the environment. Ambient conditions like rain will affect the pipe surface temperature and the corresponding relation to the true process temperature.

Temperature data

Ambient temperature at connection head

Note

During use in potentially explosive atmospheres, restrictions in permissible ambient temperature are possible which comply with additional data included in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 as well in declarations of conformity and type examination certificates!

Permissible ambient temperature range $T_{amb.}$ on the connection head	
Connection head without LCD indicator	−40 to 85 °C (−40 to 185 °F)
Connection head with LCD indicator	−20 to 70 °C (−4 to 158 °F)

Table 10: Ambient temperature on the connection head

When using a surface sensor, temperature measurement is performed in direct contact with the hot surface.
Without suited insulation of the measuring point, the permissible ambient temperature must be reduced to prevent an up-scale of limit values.
The following table shows as an example the maximum ambient temperature $T_{amb.}$ for the TSP341-N at different surface temperatures $T_{surf.}$ for the TSP341-N with integrated LCD indicator.

Surface temperature $T_{surf.}$	Maximum permissible ambient temperature $T_{amb.}$:
100 °C (212 °F)	66 °C (150.8 °F)
200 °C (392 °F)	61 °C (141.8 °F)
300 °C (572 °F)	58 °C (136.4 °F)
400 °C (752 °F)	55 °C (131.0 °F)

Table 11: Ambient temperature as a function of surface temperature

Note

The operator must make sure, with the help of measurements if needed, that the maximum permissible temperature **in the connection head** is not up-scaled in intrinsically safe devices.

For detailed information on insulating the measuring point, see **Selecting clamp collars** on page 24.

Cable gland

The plastic cable gland for cable outer diameters of 4 to 13 mm (0.16 to 0.51 in.) used as a standard is suited for a temperature range of −40 to 70 °C (−40 to 158 °F). For temperatures outside this range, an appropriate cable gland can be installed.

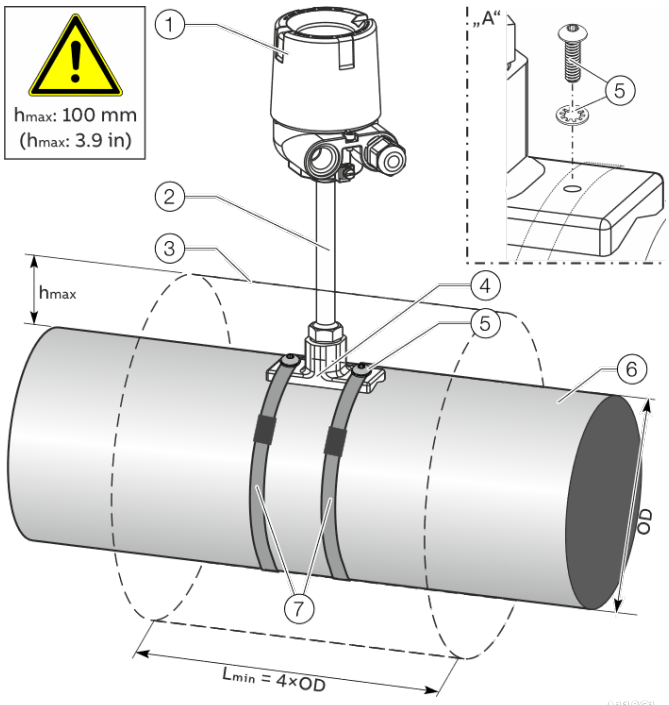
The metal cable gland for Ex d (flameproof enclosure) used as a standard for cable outer diameters of 3.2 to 8.7 mm (0.13 to 0.34 inch) covers a permissible temperature range of −40 to 85 °C (−40 to 185 °F).

Conductor material

If the temperature on the cable entries of the device is over 70° C (158 °F), connection leads with sufficient temperature resistance must be used.

… 7 Installation

Mounting



1 Connection head with transmitter
2 Extension tube
3 Insulation of the measuring point
4 Retaining plate
5 M5 screws with safety washers (Detail ‘A’)
6 Piping
7 Clamp collars
L_{min} minimum insulation length
OD Pipe outer diameter

Figure 11: Assembly on piping (example))

Selecting clamp collars

The minimum standard selectable pipe diameter for installation of the TSP341-N is DN 40. Special designs for smaller piping are available upon request. Clamp collars consist of universal bands that are cut to the appropriate length and associated clamp locks based on the selected diameter. Typically, the length of the bands are approximately 150 mm (6 in) longer than the required circumference.

The clamps sets are designed with a low thermal mass and with as much continuous contact to the pipe as possible. This ensures a fast thermal response of that keeps the sensor in strong mechanical mounting contact with the pipe even through dramatic temperature changes. To ensure good thermal expansion matching, two types of clamp materials are offered that depend on the expansion coefficients of the piping as follows:

The following materials are available:

- Chrome-steel 1.4016 (ASTM 430), $\alpha = 10 \text{ to } 10.5 \times 10^{-6}/K$
- Stainless steel 1.4301 (ASTM 304), $\alpha = 16 \text{ to } 17.5 \times 10^{-6}/K$

Clamp sets

Nominal diameter DN 40 to DN 80

Universal clamps type PG 174, width 10 mm (0.4 in)

Nominal diameter > DN 80

Universal clamps type PG 174, width 18 mm (0.7 in)

The selection of the pipe diameter for the clamp dictates the maximum pipe size that the clamp set can be used on. For example, a DN 600 Clamp set can be used for any piping from DN 80 to DN 600.

More information on the universal clamps is available at www.oetiker.com.

Assembly of the temperature sensor

NOTICE

Impairment of the device function

For trouble-free operation of the temperature sensor, the following points should be observed:

- If fluid accumulation in the extension tube can be expected at the installation location, install the temperature sensor with connection head above the horizontal line.
- The extension tube and retaining plate are tightened at the plant with a torque of 70 Nm, do not loosen this connection!
- Make sure that both sensor elements of the TSP341-N do not come into contact with each other at the ends.
- Make sure that no lateral forces (e.g. due to shifting of the retaining plate) are exerted on the protruding surface sensor during assembly.
- Make sure that both contact areas of the retaining plate are set level on the measuring point over their entire length.

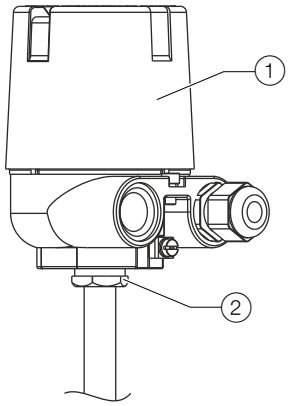
1. Remove the plastic transport protection on the retaining plate before assembly.
2. The measuring point must be flat and free of impurities and foreign substances. Clean the measuring point as needed.
3. Cut the clamp collar to the appropriate length, circumference + 150 mm (6 in).

⚠ CAUTION

Risk of injury

Risk of injury due to sharp edges of the clamp collar band.

- To avoid injuries, deburr the sharp edges of the clamp collar band with a file and chamfer the corners of the clamp collar band.



① Connection head ② Mounting nut

Figure 12: Align connection head

4. Loosen the mounting nut of the screwed connection from the extension tube and connection head by 3.5 to 4 turns maximum.
5. Gently pull the connection head away from the extension tube.
6. Place the clamp collars around the piping to the left and right of the measuring point and loosely tighten.
7. Place the temperature sensor with the retaining plate on the measuring point and slide the clamp collars laterally over the retaining plate.
8. **18 mm clamp collar:**
   Secure the clamp collars in the threaded holes of the retaining plate using the supplied M5 screws and safety washers (alternatively also after tightening the collars).
   10 mm clamp collar:
   Push the clamp collars are far in as possible during assembly on the retaining plate.
   Then, place the supplied screws (M5) and safety washers in the threaded holes of the retaining plate to the left and right respectively to secure against slipping (alternatively also after tightening the collars).
9. Align the retaining plate level at the measuring point and tighten the clamp collars on the turnbuckle.
   Tightening torque:
   18 mm clamp collar: 10 Nm
   10 mm clamp collar: 3 Nm
   For clamp collar band lengths > 1 m (3.3 ft), for piping larger than DN 300, one or more clamp collar sets are provided. These sets have to be combined with each other to encircle the circumference of the pipe.
10. Turn the connection head to the desired position.
11. To fix the connection head in the desired position, tighten the mounting nut with a torque of 35 Nm.

… 7 Installation

… Mounting

Insulation of the measuring point

Insulation of the piping around the measuring point is recommended for any installation to ensure that the pipe surface temperature correlates to the process temperature without convective losses to the environment. Ambient conditions like rain will affect the pipe surface temperature and the corresponding relation to the true process temperature. Typical insulation should be at least 2 × outer diameter (OD) of the piping on either side of the sensor mounting position with a thickness of at least 3 cm (see **Figure 11**). Mineral wool or particle foam (PET) based insulations are typical forms of insulating material that can be used.

For high temperature applications, the insulation also protects the connection head from excessive temperatures due to heat radiation from the piping.

In all cases, the insulating material used must be suited for the process and ambient conditions that apply to the process and are the responsibility of the user.

NOTICE

Impact on measuring accuracy

Impairment of measuring accuracy due to improper insulation of the measuring point.

- Insulate measuring point to the height 'h_{max}' as presented in **Figure 11** only.
- The extension tube should not be insulated above the measuring point.

Electrical connections

Safety instructions

⚠ WARNING

Risk of injury due to live parts.

Improper work on the electrical connections can result in electric shock.

- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

The electrical connection may only be established by authorized specialist personnel.

Notices on electrical connection in this instruction must be observed; otherwise, electric safety and the IP-rating may be adversely affected.

Safe isolation of electric circuits which are dangerous if touched is only guaranteed when the connected devices fulfill the requirements of EN 61140 (basic requirements for secure separation).

To ensure safe isolation, install supply lines so that they are separate from electrical circuits which are dangerous if touched, or implement additional isolation measures for them.

Cable glands

The temperature sensor TSP341-N is supplied with a M20 × 1.5 cable gland. The supplied cable gland is suited for use under the following conditions.

Data of the supplied plastic cable gland

- Thread: M20 × 1.5
- Temperature range: −40 to 70 °C (−40 to 158 °F)
- Cable outside diameter: 5.5 to 13 mm (0.22 to 0.51 in)
- Material: polyamid

For differing temperatures, an appropriately specified cable gland must be installed.

Note

In devices for use in potentially explosive atmospheres, observe the information in **Devices in 'Ex d' type of protection with cable gland** on page 10 and **Plastic cable gland M20 × 1.5 for 'Ex i' type of protection** on page 11!

Alternatively, the temperature sensor can be supplied without cable glands, but with an M20 × 1.5 or ½ in NPT thread. In this case, the user must take appropriate measures to ensure that the necessary IP-rating is achieved, the temperature range maintained and that the cable gland used is approved in accordance with the standard on which our certificate is based.

To achieve the IP rating, the cable gland used must be approved for the cable diameter. The IP rating IP 66 / IP 67 or NEMA 4X of the used cable gland used must be checked. The operating temperature range of the cable gland used must not be up-scaled.
Observe tightening torque in accordance with information in the data sheet / operating instruction for cable gland used.

In practice, you may find the specified IP rating can no longer be achieved if certain cables and lines are used in conjunction with the cable gland. Deviations from the test conditions as set out in the IEC 60529 standard must be checked. Check the cables' concentricity, transposition, external hardness, sheath, and surface roughness.

Requirements for achieving the IP rating

- Only use cable glands in the specified clamping area.
- When using very soft cable types, do not use them in the lower clamping area.
- Only use round cables or cables with a slightly oval-shaped cross section.
- Frequent opening / closing is possible but may have a negative effect on the IP rating.
- If cables are demonstrating pronounced cold flow behavior, the cable glands will need to be retightened.
- Cables with VA wire mesh require special cable glands.

Conductor material

NOTICE

Danger of wire breakage

The use of conductive material with solid wires can lead to wire breakage.

- For the electrical connection of the temperature sensor, only use cable material with flexible conductors.

Power supply

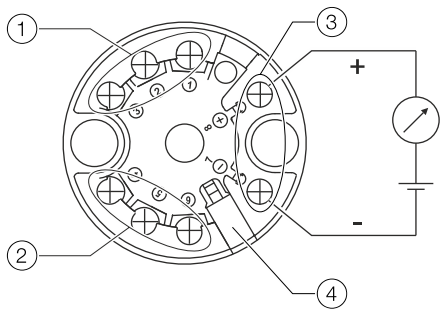
- Cable type: flexible standard cable material
- Maximum wire cross-section: 1.5 mm^2 (AWG 16)

… 7 Installation

… Electrical connections

Terminal layout

The transmitter used in the TSP341-N temperature sensor is based on the TTH300 from ABB.



① terminals 1 to 3 for sensor 1
① terminals 4 to 6 for sensor 2
③ terminals 8/+ and 7/– for current output of 4 to 20 mA and HART communication
④ LCD indicator interface

Figure 13: Pin assignment of the integrated transmitter

Terminals 1 to 6 are internally connected to the TSP341-N sensors.
The power supply and signal are routed in the same line and must be implemented as a SELV or PELV circuit in accordance with the relevant standard (standard version).

- For the explosion-proof design, the guidelines in accordance with the Ex standard must be adhered to.
- The cable wires must be provided with end sleeves.
- The user is responsible for ensuring EMC-compliant cabling.

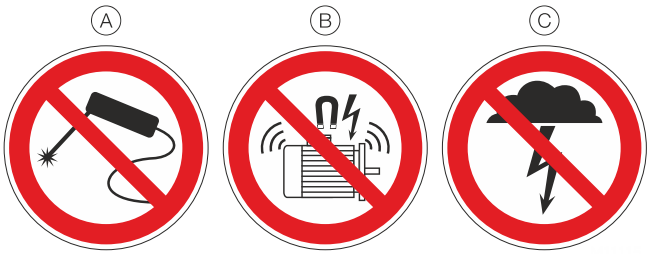
The power supply and signal are routed in the same line and must be implemented as a SELV or PELV circuit in accordance with the relevant standard (standard version).
For the explosion-proof design, the guidelines in accordance with the Ex standard must be adhered to.
- The cable wires must be provided with end sleeves.
- The user is responsible for ensuring EMC-compliant cabling.

Protection of the transmitter from damage caused by highly energetic electrical interferences

The transmitter has no switch-off elements. Therefore, overcurrent protective devices, lightning protection, or voltage disconnection options must be provided at the plant.

NOTICE

Temperature transmitter damage!
Overvoltage, overcurrent and high-frequency interference signals on the supply connection as well as sensor connection side of the device can damage the temperature transmitter.



Ⓐ Do not weld
Ⓑ No high-frequency interference signals / switching operations of large consumers
Ⓒ No overvoltage due to lightning

Figure 14: Warning signs

Overcurrent and overvoltage can occur through for example welding operations, switching operations of large electric consumers, or lightning in the vicinity of the transmitter, sensor, as well as connector cables.
Temperature transmitters are sensitive devices on the sensor side as well. Long connector cables to the sensor can encourage damaging interference. This can already happen if temperature sensors are connected to the transmitter during installation, but are not yet integrated into the system (no connection to the supply isolator / DCS)!

Suited protective measures

The following items should be observed to protect the transmitter from sensor-side damage:

- In the vicinity of the transmitter, sensor and sensor connector cable in case of a connected sensor, high-energy overvoltage, overcurrent and high-frequency interference signals due to welding operations, lightning, circuit breakers or large consumers of electricity among others should be absolutely avoided.
- The connection cable of the sensor on the transmitter should be disconnected when performing welding work in the vicinity of the installed transmitter, sensor, as well as supply lines from the sensor to the transmitter.
- This correspondingly also applies to the supply side, if there is a connection there.

8 Commissioning and operation

Safety instructions

⚠ CAUTION

Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.

General

When so ordered, the temperature sensor is ready for operation after assembly and installation of the connections.

The parameters of the integrated transmitter are preset at the factory. This default setting can be changed at any time through HART communication (DTM, EDD, FIM).

For more information about the transmitter, refer to the commissioning instruction CI/TTH300, the operating instruction OI/TTH300, as well as the data sheet DS/TTH300.

Checks prior to commissioning

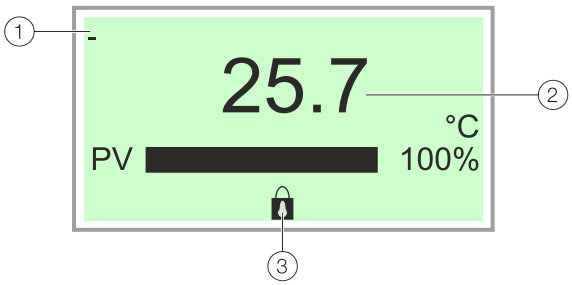
The following points must be checked before commissioning the device:

- Check the installation of the sensor for optimal contact with the measuring point and correct insulation.
- Correct wiring in accordance with **Electrical connections** on page 26.
- Potential equalization must be connected.
- The connected lines must be checked for firm seating. Only firmly seated lines ensure full functionality.
- The ambient conditions must correspond to the information given on the name plate and in the data sheet.
- If devices are to be used in potentially explosive atmospheres, the temperature and electric data in accordance with **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 must be maintained.

Operation / control

Process display

Only for devices with optional LCD indicator.



1 Measuring point tagging (Device TAG)
2 Current process values
3 'Parameterization protected' symbol

Figure 15: Process display (example)

The process display appears on the LCD display when the device is powered on. It shows information about the device and current process values.

From SW-Rev. 3.00, two process variables can also be optionally displayed: one is displayed on top of the other.

HART Device Type ID

TSP341-N: 0x1A0E

Parameterization

The device does not have operating elements for parameterization on site.
Parameterization takes place via the HART interface.

The following parameters are preset upon delivery:

Parameter	Factory setting
Insulation around the measuring point	provided
Characteristic behavior	Increasing 4 to 20 mA
Output behavior for error	Override / 22 mA
Damping output (T63)	Off

Note

- The measuring range of the device will be specified when the order is placed. The measuring range can also be adjusted, just like the parameters described above.
- Write protection is implemented through standard HART communication write protection or with the use of hardware write protection (local write protection, via DIP switch on the device).

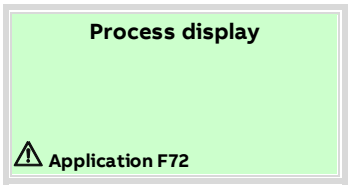
… 8 Commissioning and operation

… Operation / control

Error messages on the LCD display

Only for devices with optional LCD indicator.

In the event of an error, a message consisting of a symbol or letter (device status) and a number (DIAG NO.) will appear at the bottom of the process display.



The diagnostic messages are divided into the following groups in accordance with the NAMUR classification scheme:

ID code	Description
I	**OK or Information** Device is functioning or information is available
C	**Check Function** Device is undergoing maintenance (for example simulation)
S	**Off Specification** Device or measuring point is being operated outside of the specifications
M	**Maintenance Required** Request service to prevent the measuring point from failing
F	**Failure** Error; measuring point has failed

Additionally, the diagnostic messages are divided into the following areas:

Range	Description
Electronics	Diagnosis for device hardware.
Sensor	Diagnosis for sensor elements and connection lines.
Installation / Configuration	Diagnosis for communication interface and parameterization / configuration
Operating conditions	Diagnosis for ambient and process conditions.

Note

For a detailed description of errors and troubleshooting instructions, please see **Diagnosis / error messages** on page 31.

9 Diagnosis / error messages

Error messages

Note
For a detailed description of the errors and notices on troubleshooting, see transmitter operating instruction.

Malfunctions

The entire temperature measurement circuit should be tested routinely. The table below contains the most important errors together with their possible causes and suggestions for how to remedy them.

Failure	Cause	Repair
Measuring signal fault	• Electrical/magnetic interspersion	• Electrostatic shielding via on one point grounded foil/netting. • Twist wires (pairs) against magnetic interspersion.
	• Earth Fault	• Create only one grounding point in measuring loop or 'floating' measuring system (not grounded).
	• Decrease of insulation resistance	• Humidity has possibly penetrated into the temperature sensor or the measuring inset; dry if necessary and seal again. • Replace measuring inset. • Check whether the temperature sensor is thermally overloaded.
Response times too long, incorrect signals	Incorrect position of the measuring point. • In the area of influence of a heat source	• Select the position of the measuring point in such a way to make sure that the measurement of the surface temperature is not distorted by external influence. • Minimize environmental influence on the measuring point by using suited insulating materials
	Incorrect installation method: • Too much heat dissipation	• Guarantee thermal contact, above all during surface measurements through suited contact surfaces and/or thermal conducting material.
Interruptions in temperature sensor	Vibration	• Reinforced springs on the measuring inset. • Relocation of the measuring point (if possible).

10 Maintenance

Safety instructions

⚠ CAUTION

Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

The temperature sensor does not require any maintenance if it is used as intended under normal operating conditions. If wetted parts of the temperature sensor are exposed to the influence of abrasive or corrosive measuring media, periodic inspection by the operator must be performed.
No on-site repair or replacement of electronic parts by the user is required.

Cleaning

When cleaning the exterior of meters, make sure that the cleaning agent used does not corrode the housing surface and the seals.
To avoid static charge, a damp cloth must be used for cleaning.

11 Repair

Safety instructions

⚠ DANGER

Explosion hazard

Explosion hazard due to improper repair of the device. Faulty devices must not be repaired by the operator.

- The device may only be repaired by the ABB Service Department.
- Repairs on flameproof joints are not permitted.

Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.
Fill out the return form (see **Return form** on page 34) and include this with the device.
In accordance with the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:
All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Please contact Customer Center Service acc. to page 5 for nearest service location.

12 Dismounting and disposal

Dismounting

⚠ CAUTION

Risk of burns due to hot measuring media

The device surface temperature may exceed 70 °C (158 °F), depending on the measuring medium temperature!

- Before starting work on the device, make sure that it has cooled sufficiently.

Bear the following points in mind when dismantling the device:

- Switch off the power supply.
- Disconnect electrical connections.
- Allow device / piping to cool.
- Use suited tools to disassemble the device, taking the weight of the device into consideration.
- If the device is to be used at another location, the device should preferably be packaged in its original packing so that it cannot be damaged.
- Observe the notes in **Returning devices** on page 32.

Disposal

Note

Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).
They should be disposed of through separate collection of electric and electronic devices.

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.
- If there is no possibility to dispose of the old equipment properly, our Service can take care of its pick-up and disposal for a fee.

13 Specification

Note

The device data sheet is available in the ABB download area at www.abb.com/temperature.

14 Additional documents

Note

Declarations of conformity of the device are available in the download area of ABB at www.abb.com/temperature. In addition, these are also included with the device in case of ATEX-certified devices.

15 Appendix

Return form

Statement on the contamination of devices and components
Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.
Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company:	
Address:	
Contact person:	Telephone:
Fax:	Email:

Device details:

Type:	Serial no.:
Reason for the return/description of the defect:	

Was this device used in conjunction with substances which pose a threat or risk to health?

☐ Yes ☐ No

If yes, which type of contamination (please place an X next to the applicable items):

☐ biological	☐ corrosive / irritating	☐ combustible (highly / extremely combustible)
☐ toxic	☐ explosive	☐ other toxic substances
☐ radioactive		

Which substances have come into contact with the device?

1.
2.
3.

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date	Signature and company stamp

Trademarks

HART is a registered trademark of FieldComm Group, Austin, Texas, USA

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/temperature

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