Industrial thermometers with replaceable measuring inserts.

Category
II 1/2 G
II 1 G
II 1 D
1.1 General notes

These additional "Ex" instructions apply to explosion-protected models of industrial thermometers with the marking II 1/2 G, II 1 G and II 1 D. They complement the standard documentation for non-explosion-protected models.

The information given in these Instructions contains only the data relevant to Category 1 explosion protection. The technical details given in the standard documentation for the non-explosion protected versions apply unchanged unless excluded or superseded by these Instructions.

1.2 EC conformity

The manufacturer declares with the EC Declaration of Conformity on his own responsibility conformity with the protection goals of Directive 94/9/EC for use in hazardous areas with gas.

The EC Type Test Certificate of the Physikalisch Technische Bundesanstalt (PTB) forms the basis of the EC Declaration of Conformity:

PTB 10 ATEX 2017 X

The "X" after the certificate number refers to special conditions for safe use of the device as described in these Instructions.

You can download the EC Type Test Certificate from the manufacturer’s website as needed.

1.3 Safety instructions

Assembly, installation, start-up and maintenance may only be performed by personnel trained in explosion protection!

CAUTION!

Should operating conditions and locations require the observance of further standards, guidelines and laws, this is the responsibility of the operator and/or those commissioned by him.
2.1 Device description

Industrial thermometers measure the temperature of flammable and non-flammable gases and liquids. They consist of a thermometer assembly comprising a connection head and usually a thermowell (only version TRA/TCA-P14 does not have a thermowell).

The thermometer assembly contains a measuring insert, which can have either a thermocouple or a Pt100 measuring resistor as sensor. The manufacturer offers measuring inserts with a terminal block, free connection wires or a directly fitted head-mounted transmitter.

**Standard version (straight thermowells)**

- TRA-P10 / TCA-P10
- TRA-S11 / TCA-S11
- TRA-S12 / TCA-S12
- TRA-F13 / TCA-F13

**With tapered tip**

- TRA-P40 / TCA-P40
- TRA-S41 / TCA-S41
- TRA-F42 / TCA-F42
- TRA-P14 / TCA-P14

**Without thermowell**

- TRA-P10 / TCA-P10
- TRA-S11 / TCA-S11
- TRA-S12 / TCA-S12
- TRA-F13 / TCA-F13
2.2 Description code

The safety description code of the measuring inserts is made up of the model name and the VGC key. The following are examples to help explain the composition of the model name and the VGC key:

Model name

<table>
<thead>
<tr>
<th>Model name</th>
<th>TRA-P10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sensor type: TCA = thermocouple, TRA = resistance thermometer</td>
</tr>
<tr>
<td>2</td>
<td>Type of process connection: P = insert version, S = threaded version, F = flange version</td>
</tr>
<tr>
<td>3</td>
<td>Internal manufacturer’s designation of thermowell version</td>
</tr>
</tbody>
</table>

**INFORMATION!**

In the following chapters of this manual the model names of the thermometers start with “TxA” to avoid using the full title “TRA/TCA”. Blanks in the VGC key can be omitted.
VGC key

<table>
<thead>
<tr>
<th>Designation</th>
<th>Variants</th>
</tr>
</thead>
</table>
| 1 Type of thermowell tip | VGC 1 = straight tip  
VGC 4 = tapered tip |
| 2 Abbreviation for full description of thermometer |  
For VGC1: 1 = TRA-P10 (insert version); 2 = TRA-S11 (threaded version); 3 = TRA-S12 (threaded version); 4 = TRA-F13 (flange version); A = TCA-P10 (insert version); B = TCA-S11 (threaded version); C = TCA-S12 (threaded version); D = TCA-F13 (flange version); L = TRA-P14 (without thermowell); T = TCA-P14 (without thermowell)  
For VGC4: 1 = TRA-P40 (insert version); 2 = TRA-S41 (threaded version); 3 = TRA-F42 (flange version); A = TCA-P40 (insert version); B = TCA-S41 (threaded version); C = TCA-F42 (flange version)  |
| 3 Ex-Approval | 0 = without; 2 = ATEX-Ex-i |
| 4 Type of connection head | 3 = BUZ-T; 5 = BUZ-H |
| 5 Sensor circuit type | 0 = without; 1 = 1xPt100 2-wire; 2 = 1xPt100 3-wire; 3 = 1xPt100 4-wire;  
A = 1xthermocouple type J; B = 1xthermocouple type K |
| 6 Sensor class | 4 = class A, Mi, WW; A = Class 1, thermocouple |
| 7 Thermowell material | 0 = without; 1 = 1,4571, 316Ti; 2 = 1,4841, 314 |
| 8 Not Ex-relevant | |
| 9 Insertion length |  
For VGC1: 0 = without; 1 = 75 mm / 2.95"; 2 = 100 mm / 3.94"; 3 = 115 mm / 4.53"; 4 = 140 mm / 5.51"; 5 = 225 mm / 8.86"; 6 = 225 mm / 9.21"; 7 = 250 mm / 9.84";  
B = 270 mm / 10.63"; A = 305 mm / 12.01"; C = 395 mm / 15.55"; D = 395 mm / 15.55";  
E = 440 mm / 17.32"; F = 445 mm / 17.52"; G = 480 mm / 18.90";  
H = 542 mm / 21.34";  
K = 545 mm / 21.46";  
Z = special length  
For VGC4: 0 = without; 1 = 140 mm / 5.51"; 2 = 220 mm / 8.66";  
3 = 225 mm / 8.86"; 4 = 280 mm / 11.02"; 5 = 285 mm / 11.22"; 6 = 307 mm / 12.06";  
7 = 340 mm / 13.39";  
8 = 345 mm / 13.58";  
A = 390 mm / 15.35";  
B = 395 mm / 15.55";  
C = 440 mm / 17.32";  
D = 445 mm / 17.52";  
E = 480 mm / 18.90";  
F = 542 mm / 21.34";  
G = 545 mm / 21.46";  
H = 607 mm / 23.86";  
K = 725 mm / 28.54";  
Z = special length |
| 10 Length of neck pipe |  
For VGC1: 0 = without; 1 = 80 mm / 3.15"; 2 = 145 mm / 5.71";  
Z = special length  
For VGC4: 0 = without; 1 = 80 mm / 3.15"; 2 = 82 mm / 3.23"; 3 = 145 mm / 5.71";  
4 = 167 mm / 6.57" |
| 11 Connection type (head-mounted transmitter) | 0 = without; 2 = head-mounted transmitter TT10C; 7 = head-mounted transmitter TT30C; D = head-mounted transmitter TT50C; E = head-mounted transmitter TT51C; F = head-mounted transmitter TT60C  |
| 12 Connection type (rail-mount transmitter) | 0 = without; 6 = rail-mount transmitter TT30R; 7 = rail-mount transmitter TT31R (1channel); 8 = rail-mount transmitter TT31R (2channel)  |
| 13 Not Ex-relevant (14th to 20th position), not used (21st to 25th position) | |
2.3 Marking

- Type designation
- Sensor designation
- Number of the EC Type Test Certificate
- Ex-marking for gas and dust
- Electrical sensor values (this information is different if a transmitter is used as the transmitter values then apply)
- Identification number of the notified body as per Directive 94/95, Appendix IV
- VDE key
- Unique serial number

2.4 Flammable products

Atmospheric conditions

An explosive atmosphere is a mixture of air and flammable gases, vapours, mists or dusts under atmospheric conditions. It is defined by the following values:

\[ T_{\text{atm}} = -20 \ldots +60^\circ \text{C} / -4 \ldots +140^\circ \text{F} \quad \text{and} \quad P_{\text{atm}} = 0.8 \ldots 1.1 \text{ bar} / 11.6 \ldots 15.9 \text{ psi} \]

Outside of this range, no key data are available as to ignition behaviour for most mixtures.

Operating conditions

Outside of atmospheric conditions you cannot apply explosion protection according to Directive 94/9/EC [ATEX] – regardless of the zone assignment – due to the lack of key safety data.

**DANGER!**

The operator is responsible for ensuring that the industrial thermometers are operated safely as regards the temperature and pressure of the products used. Include the thermometer assembly in the periodic pressure tests of the system when operating with flammable products.
2.5 Equipment category

Industrial thermometers are designed for use in zone 0 in category II 1 G, for use in zone 20 in category II 1 D. In category II 1/2 G all thermometers have a separator (thermowell) which separates zone 0 and zone 1.

**INFORMATION!**

Definition of Zone 0 according to EN 1127-1:
An area with a constant or long-term or frequent explosive atmosphere made up of a mixture of flammable substances in the form of gas, vapours or mist.

For more information see the chapter entitled "Flammable products".

**INFORMATION!**

Definition of Zone 20 according to EN 61241-0:
An area with a constant or long-term or frequent explosive atmosphere in the form of a cloud of flammable dust in air.

**INFORMATION!**

Definition of a device with separator as per EN 60079-26:
Devices which are installed in the wall to an area requiring EPL Ga or which are part of this wall and contain electrical circuits which do not meet the requirements of the Ga protection level, must, at minimum, comply with one of the protection types that an EPL Gb offers. In addition, they must feature an integrated mechanical separator to separate the device’s electrical circuits from the area requiring EPL Ga.

For further information refer to Flammable products on page 7.
2.6 Protection types

2.6.1 Protection type with zone separator for gas hazard areas

In protection type “intrinsic safety” the industrial thermometer meets the requirements of EN 60079-11. The explosion protection is guaranteed because the current and voltage are limited so that ignitable energy cannot occur.

If zone 0 and zone 1 are separated as per EN 60079-26, this will ensure that a thermowell is fitted properly. In such cases the thermometer marking is:

II 1/2G Ex ia IIC T6

Components of the Ex marking and what they mean

<table>
<thead>
<tr>
<th>II</th>
<th>Group II explosion protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>Equipment category 1/2</td>
</tr>
<tr>
<td>G</td>
<td>Gas explosion protection</td>
</tr>
<tr>
<td>Ex ia</td>
<td>Intrinsically safe equipment</td>
</tr>
<tr>
<td>IIC</td>
<td>Gas groups IIA, IIB, IIC</td>
</tr>
<tr>
<td>T6</td>
<td>Temperature classes T6...T1</td>
</tr>
</tbody>
</table>

II 1G Ex ia IIC T6

Components of the Ex marking and what they mean

<table>
<thead>
<tr>
<th>II</th>
<th>Group II explosion protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Equipment category 1</td>
</tr>
<tr>
<td>G</td>
<td>Gas explosion protection</td>
</tr>
<tr>
<td>Ex ia</td>
<td>Intrinsically safe equipment</td>
</tr>
<tr>
<td>IIC</td>
<td>Gas groups IIA, IIB, IIC</td>
</tr>
<tr>
<td>T6</td>
<td>Temperature classes T6...T1</td>
</tr>
</tbody>
</table>
2.6.3 Type of protection for dust hazard areas

In protection type “Protection through intrinsinc safety” the industrial thermometer meets the requirements of EN 61241-11. The dust protection is guaranteed by housing which provides appropriate protection against penetration by dust. Current and voltage are also limited so that ignitable energy cannot occur. All thermometers with these features have the following marking:

II 1D Ex iaD 20 IP65 T140°C

Components of the Ex marking and what they mean

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Group II explosion protection</td>
</tr>
<tr>
<td>1</td>
<td>Equipment category 1</td>
</tr>
<tr>
<td>D</td>
<td>Dust explosion protection</td>
</tr>
<tr>
<td>Ex ia D</td>
<td>Dust protection type intrinsinc safety “iaD”</td>
</tr>
<tr>
<td>20</td>
<td>Use in zone 20</td>
</tr>
<tr>
<td>IP65</td>
<td>Foreign bodies and water pollution control</td>
</tr>
<tr>
<td>T140°C</td>
<td>Maximum surface temperature of industrial thermometer without dust coating at ambient temperature 100°C / 212°F and product temperature 100°C / 212°F</td>
</tr>
</tbody>
</table>

DANGER!
As the TxA-P14 model does not have a thermowell, you must allow for a higher maximum surface temperature! The marking is therefore:

II 1D Ex iaD 20 IP65 T175°C

Components of the Ex marking and what they mean (TxA-P14)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>II</td>
<td>Group II explosion protection</td>
</tr>
<tr>
<td>1</td>
<td>Equipment category 1</td>
</tr>
<tr>
<td>D</td>
<td>Dust explosion protection</td>
</tr>
<tr>
<td>Ex ia D</td>
<td>Dust protection type intrinsinc safety “iaD”</td>
</tr>
<tr>
<td>20</td>
<td>Use in zone 20</td>
</tr>
<tr>
<td>IP65</td>
<td>Foreign bodies and water pollution control</td>
</tr>
<tr>
<td>T175°C</td>
<td>Maximum surface temperature of industrial thermometer without dust coating at ambient temperature 100°C / 212°F and product temperature 100°C / 212°F</td>
</tr>
</tbody>
</table>
2.7 Temperature classes

The permitted ambient temperature range of the industrial thermometer without temperature transmitter on the measuring insert ("head-mounted transmitter") is:

\[ T_{\text{amb}} = -40...+100^\circ\text{C} / -40...+212^\circ\text{F} \]

**DANGER!**

If you are using an industrial thermometer with head-mounted transmitter, refer to the Ex-documentation of the temperature transmitter for the permitted maximum values for the ambient temperature.

Due to the influence of the product temperature, no fixed temperature class is assigned to industrial thermometers. The temperature class of the devices is instead a function of the following parameters:

- Present product temperature (\(T_M\))
- Maximum value of sensor output of connected temperature transmitter (\(P_D\))
- Maximum permitted temperature at the process connection of the measuring point (\(T_P\))
- Surface temperature of the sensor (\(T_O\))

The classification for the respective model is outlined in the following subchapters.

**WARNING!**

The maximum permitted product temperatures and process connection temperatures in the tables of the following subchapters are only valid if you observe the following points:

- The industrial thermometer has been installed in accordance with the assembly instructions in these supplementary Ex instructions and the manual.
- There is no additional thermal radiation at the measuring point (solar radiation, adjacent equipment) which could heat up the industrial thermometer causing the maximum permitted ambient temperature to be exceeded.
- There is no additional convection from the container wall or adjacent pipes which could heat up the industrial thermometer and cause the maximum permitted ambient temperature to be exceeded.
- The connection head is adequately ventilated.
- All insulation measures only include the pipes, never the components of the industrial thermometer.
2.7.1 Maximum permitted product temperature

**DANGER!**

Regardless of the temperature class the various measuring inserts have the following lower limit values for the product temperature \( T_m \):

- **TC 100**: -40°C / -40°F
- **TR 100**: -200°C / -328°F

### Maximum permitted product temperature \( T_m \) [°C]

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>( T_m ) in °C</th>
<th>( P_0 \leq 50 \text{ mW} )</th>
<th>( P_0 \leq 100 \text{ mW} )</th>
<th>( P_0 \leq 200 \text{ mW} )</th>
<th>( P_0 \leq 500 \text{ mW} )</th>
<th>( P_0 \leq 650 \text{ mW} )</th>
<th>( P_0 \leq 750 \text{ mW} )</th>
<th>( P_0 \leq 800 \text{ mW} )</th>
<th>( P_0 \leq 1000 \text{ mW} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>450</td>
<td>436</td>
<td>432</td>
<td>425</td>
<td>402</td>
<td>391</td>
<td>383</td>
<td>380</td>
<td>365</td>
</tr>
<tr>
<td>T2</td>
<td>300</td>
<td>286</td>
<td>282</td>
<td>275</td>
<td>252</td>
<td>241</td>
<td>233</td>
<td>230</td>
<td>215</td>
</tr>
<tr>
<td>T3</td>
<td>200</td>
<td>191</td>
<td>187</td>
<td>180</td>
<td>157</td>
<td>146</td>
<td>138</td>
<td>135</td>
<td>120</td>
</tr>
<tr>
<td>T4</td>
<td>135</td>
<td>126</td>
<td>122</td>
<td>115</td>
<td>92</td>
<td>81</td>
<td>73</td>
<td>70</td>
<td>55</td>
</tr>
<tr>
<td>T5</td>
<td>100</td>
<td>91</td>
<td>87</td>
<td>80</td>
<td>57</td>
<td>46</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>85</td>
<td>76</td>
<td>72</td>
<td>65</td>
<td>42</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

### Maximum permitted product temperature \( T_m \) [°F]

<table>
<thead>
<tr>
<th>Temperature class</th>
<th>( T_m ) in °F</th>
<th>( P_0 \leq 50 \text{ mW} )</th>
<th>( P_0 \leq 100 \text{ mW} )</th>
<th>( P_0 \leq 200 \text{ mW} )</th>
<th>( P_0 \leq 500 \text{ mW} )</th>
<th>( P_0 \leq 650 \text{ mW} )</th>
<th>( P_0 \leq 750 \text{ mW} )</th>
<th>( P_0 \leq 800 \text{ mW} )</th>
<th>( P_0 \leq 1000 \text{ mW} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>842</td>
<td>816</td>
<td>809</td>
<td>797</td>
<td>755</td>
<td>725</td>
<td>721</td>
<td>716</td>
<td>689</td>
</tr>
<tr>
<td>T2</td>
<td>572</td>
<td>546</td>
<td>539</td>
<td>527</td>
<td>485</td>
<td>465</td>
<td>451</td>
<td>446</td>
<td>419</td>
</tr>
<tr>
<td>T3</td>
<td>392</td>
<td>375</td>
<td>368</td>
<td>356</td>
<td>314</td>
<td>294</td>
<td>280</td>
<td>275</td>
<td>248</td>
</tr>
<tr>
<td>T4</td>
<td>275</td>
<td>258</td>
<td>251</td>
<td>238</td>
<td>197</td>
<td>177</td>
<td>163</td>
<td>158</td>
<td>131</td>
</tr>
<tr>
<td>T5</td>
<td>212</td>
<td>195</td>
<td>188</td>
<td>176</td>
<td>134</td>
<td>114</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T6</td>
<td>185</td>
<td>168</td>
<td>161</td>
<td>149</td>
<td>107</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
2.7.2 Temperature at process connection (without temperature transmitter)

**DANGER!**

The maximum permitted temperature at the process connection for all industrial thermometers is 400°C / 752°F.

### Maximum permitted temperature at process connection for thermometers without temperature transmitter in °C

<table>
<thead>
<tr>
<th>Thermometer models</th>
<th>$T_a = 40°C$</th>
<th>$T_a = 60°C$</th>
<th>$T_a = 80°C$</th>
<th>$T_a = 100°C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ≤ 80mm</td>
<td>182</td>
<td>155</td>
<td>127</td>
<td>100</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>400</td>
<td>312</td>
<td>100</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ≤ 80mm</td>
<td>323</td>
<td>248</td>
<td>174</td>
<td>100</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>400</td>
<td>209</td>
<td>100</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≤ 80mm</td>
<td>323</td>
<td>248</td>
<td>174</td>
<td>100</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>400</td>
<td>209</td>
<td>100</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>400</td>
<td>339</td>
<td>100</td>
</tr>
</tbody>
</table>

### Maximum permitted temperature at process connection for thermometers without temperature transmitter in °F

<table>
<thead>
<tr>
<th>Thermometer models</th>
<th>$T_a = 104°F$</th>
<th>$T_a = 140°F$</th>
<th>$T_a = 176°F$</th>
<th>$T_a = 212°F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ≤ 80mm</td>
<td>361</td>
<td>311</td>
<td>261</td>
<td>212</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>752</td>
<td>594</td>
<td>212</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ≤ 80mm</td>
<td>613</td>
<td>479</td>
<td>345</td>
<td>212</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>752</td>
<td>554</td>
<td>212</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≤ 80mm</td>
<td>613</td>
<td>479</td>
<td>345</td>
<td>212</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>752</td>
<td>554</td>
<td>212</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>752</td>
<td>643</td>
<td>212</td>
</tr>
</tbody>
</table>
Temperature at process connection without temperature transmitter

1. Maximum permitted temperature at the process connection \( T_p \)
2. Ambient temperature at the measuring point \( T_a \)
3. TxA-P14, insert thermometer without thermowell; TxA-P10, insert thermometer with thermowell; TxA-S12/41, threaded thermometer; TxA-P13/42, flange thermometer; neck pipe length in each case \( \geq 80 \) mm
4. TxA-P16, insert thermometer without thermowell; TxA-P10, insert thermometer with thermowell; neck pipe length in each case \( \leq 80 \) mm / 3.15"
5. TxA-S11, threaded thermometer, neck pipe length \( \leq 80 \) mm / 3.15"
2.7.3 Temperature at process connection (with temperature transmitter)

**DANGER!**
The maximum permitted temperature at the process connection for all industrial thermometers is $T_p = 400^\circ C / 752^\circ F$. The maximum permitted ambient temperature is $T_a = 85^\circ C / 185^\circ F$.

Maximum permitted temperature at process connection for thermometers with temperature transmitter in °C

<table>
<thead>
<tr>
<th>Thermometer models</th>
<th>$T_a = 40^\circ C$</th>
<th>$T_a = 60^\circ C$</th>
<th>$T_a = 75^\circ C$</th>
<th>$T_a = 80^\circ C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ≤ 80mm</td>
<td>135</td>
<td>107</td>
<td>86</td>
<td>80</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>292</td>
<td>133</td>
<td>80</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ≤ 80mm</td>
<td>228</td>
<td>154</td>
<td>98</td>
<td>80</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>270</td>
<td>127</td>
<td>80</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≤ 80mm</td>
<td>228</td>
<td>154</td>
<td>98</td>
<td>80</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>270</td>
<td>127</td>
<td>80</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ≥ 80mm</td>
<td>400</td>
<td>319</td>
<td>139</td>
<td>80</td>
</tr>
</tbody>
</table>

Maximum permitted temperature at process connection for thermometers with temperature transmitter in °F

<table>
<thead>
<tr>
<th>Thermometer models</th>
<th>$T_a = 104^\circ F$</th>
<th>$T_a = 140^\circ F$</th>
<th>$T_a = 167^\circ F$</th>
<th>$T_a = 176^\circ F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ≤ 80mm</td>
<td>275</td>
<td>225</td>
<td>188</td>
<td>176</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>558</td>
<td>271</td>
<td>176</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ≤ 80mm</td>
<td>443</td>
<td>309</td>
<td>209</td>
<td>176</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>518</td>
<td>261</td>
<td>176</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≤ 80mm</td>
<td>443</td>
<td>309</td>
<td>209</td>
<td>176</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>518</td>
<td>261</td>
<td>176</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ≥ 80mm</td>
<td>752</td>
<td>607</td>
<td>283</td>
<td>176</td>
</tr>
</tbody>
</table>
### DEVICE DESCRIPTION

**OPTITEMP TRA/TCA**

1. **Maximum permitted temperature at the process connection** \( T_p \)
2. **Ambient temperature at the measuring point** \( T_a \)
3. **TxA-P14**, insert thermometer without thermowell; **TxA-P10**, insert thermometer with thermowell; **TxA-S12/41**, threaded thermometer; **TxA-F13/42**, flange thermometer; neck pipe length in each case \( \geq 80 \) mm
4. **TxA-P14**, insert thermometer without thermowell; **TxA-P10**, insert thermometer with thermowell; neck pipe length in each case \( \leq 80 \) mm / 3.15”
5. **TxA-S11**, threaded thermometer, neck pipe length \( \leq 80 \) mm / 3.15”

---

**Temperature at process connection with temperature transmitter**

[Graph showing temperature ranges and maximum permitted temperatures]
2.7.4 Temperature at process connection (with temperature transmitter, classes T5 and T6)

As special restrictions apply to temperature classes T5 and T6, you must heed the information about the maximum ambient temperature in the temperature transmitter documentation. Calculate the maximum permitted temperature at the process connection for all thermometers with a temperature transmitter in temperature classes T5 and T6 as follows:

**DANGER!**

Always refer to your temperature transmitter documentation for the maximum permitted ambient temperature of the temperature transmitter ($T_{aTT}$).

\[
T_p = \frac{1}{k} (T_{aTT} - 5K) + T_a
\]

1. $T_p$ = process connection temperature
2. $k$ = coupling factor of thermometer versions (see table later in this subchapter)
3. $T_{aTT}$ = ambient temperature around the temperature transmitter (see transmitter documentation)
4. $T_a$ = ambient temperature at the measuring point

**DANGER!**

In order to prevent injury and material damage, always observe the limit values of the assigned temperature class. For further information refer to Maximum permitted product temperature on page 12

<table>
<thead>
<tr>
<th>Thermometer model</th>
<th>Coupling factor [k]</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ≤ 80mm</td>
<td>0.42</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ≥ 80mm</td>
<td>0.086</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ≤ 80mm</td>
<td>0.212</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ≥ 80mm</td>
<td>0.095</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≤ 80mm</td>
<td>0.212</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ≥ 80mm</td>
<td>0.095</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ≥ 80mm</td>
<td>0.077</td>
</tr>
</tbody>
</table>
### 2.7.5 Temperature at process connection for thermometers with connecting cable

**DANGER!**
The maximum permitted temperature at the process connection for all industrial thermometers is \( T_p = 400 ^\circ C / 752 ^\circ F \). The maximum permitted ambient temperature is \( T_a = 70 ^\circ C / 158 ^\circ F \). Always refer to the table below!

**DANGER!**
Always refer to the tables below. Always use heat-resistant connecting cables if the temperature at the process connection exceeds the values in the tables below.

#### Maximum permitted temperature at process connection for thermometers with connecting cable in \(^\circ C\)

<table>
<thead>
<tr>
<th>Thermometer models</th>
<th>( T_a = 40 ^\circ C )</th>
<th>( T_a = 55 ^\circ C )</th>
<th>( T_a = 60 ^\circ C )</th>
<th>( T_a = 65 ^\circ C )</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ( \leq 80 \text{mm} )</td>
<td>99</td>
<td>78</td>
<td>71</td>
<td>65</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ( \geq 80 \text{mm} )</td>
<td>330</td>
<td>171</td>
<td>118</td>
<td>65</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ( \leq 80 \text{mm} )</td>
<td>157</td>
<td>102</td>
<td>83</td>
<td>65</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ( \geq 80 \text{mm} )</td>
<td>303</td>
<td>140</td>
<td>112</td>
<td>65</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ( \leq 80 \text{mm} )</td>
<td>157</td>
<td>102</td>
<td>83</td>
<td>65</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ( \geq 80 \text{mm} )</td>
<td>303</td>
<td>140</td>
<td>112</td>
<td>65</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ( \geq 80 \text{mm} )</td>
<td>364</td>
<td>184</td>
<td>124</td>
<td>65</td>
</tr>
</tbody>
</table>

#### Maximum permitted temperature at process connection for thermometers with connecting cable in \(^\circ F\)

<table>
<thead>
<tr>
<th>Thermometer models</th>
<th>( T_a = 104 ^\circ F )</th>
<th>( T_a = 131 ^\circ F )</th>
<th>( T_a = 140 ^\circ F )</th>
<th>( T_a = 149 ^\circ F )</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxA-S11, threaded thermometer, neck pipe length ( \leq 80 \text{mm} )</td>
<td>211</td>
<td>173</td>
<td>161</td>
<td>149</td>
</tr>
<tr>
<td>TxA-S12/41, threaded thermometer, neck pipe length ( \geq 80 \text{mm} )</td>
<td>627</td>
<td>340</td>
<td>244</td>
<td>149</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell TxA-P10, neck pipe length ( \leq 80 \text{mm} )</td>
<td>316</td>
<td>215</td>
<td>182</td>
<td>149</td>
</tr>
<tr>
<td>TxA-P10/40, insert thermometer with thermowell, neck pipe length ( \geq 80 \text{mm} )</td>
<td>577</td>
<td>320</td>
<td>234</td>
<td>149</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ( \leq 80 \text{mm} )</td>
<td>316</td>
<td>215</td>
<td>182</td>
<td>149</td>
</tr>
<tr>
<td>TxA-P14, insert thermometer without thermowell, neck pipe length ( \geq 80 \text{mm} )</td>
<td>577</td>
<td>320</td>
<td>234</td>
<td>149</td>
</tr>
<tr>
<td>TxA-F13/42, flange thermometer, neck pipe length ( \geq 80 \text{mm} )</td>
<td>688</td>
<td>364</td>
<td>256</td>
<td>149</td>
</tr>
</tbody>
</table>
Temperature at process connection for thermometers with connecting cable

1. Maximum permitted temperature at process connection (T_p)
2. Ambient temperature at measuring point (T_a)
3. TxA-P14, insert thermometer without thermowell; TxA-P10, insert thermometer with thermowell; TxA-S12/41, threaded thermometer; TxA-P13/42, flange thermometer; neck pipe length in each case ≥ 80 mm / 3.15''
4. TxA-P14, insert thermometer without thermowell; TxA-P10, insert thermometer with thermowell; neck pipe length in each case ≤ 80 mm / 3.15''
5. TxA-S11, threaded thermometer, neck pipe length ≤ 80 mm / 3.15''
2 DEVICE DESCRIPTION

2.8 Electrical data

**DANGER!**
Connect the sensor circuit of an industrial thermometer only to intrinsically safe circuits as well as separate transmitters certified as intrinsically safe or zener barriers. Observe the following maximum values when connecting a measuring insert without temperature transmitter:

- \( U_i = 30 \text{ V} \)
- \( I_i = 140 \text{ mA} \)
- \( P_i = 1.0 \text{ W} \)

**DANGER!**
When connecting a thermometer to an electricity supply please observe the maximum values for the effective capacities and inductances in the following table:

<table>
<thead>
<tr>
<th>Sensor length</th>
<th>Sensor output Po</th>
<th>( C_i = [\text{nF}] )</th>
<th>( L_i = [\text{\mu F}] )</th>
</tr>
</thead>
<tbody>
<tr>
<td>TR100 with Pt100 wire wound</td>
<td>up to 5 m / 16.4 ft</td>
<td>3.5</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>up to 30 m / 98.4 ft</td>
<td>21</td>
<td>390</td>
</tr>
<tr>
<td>TC100 type K</td>
<td>up to 5 m / 16.4 ft</td>
<td>2.5</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>up to 30 m / 98.4 ft</td>
<td>14</td>
<td>150</td>
</tr>
<tr>
<td>TC100 type J</td>
<td>up to 5 m / 16.4 ft</td>
<td>2</td>
<td>48.5</td>
</tr>
<tr>
<td></td>
<td>up to 30 m / 98.4 ft</td>
<td>11.5</td>
<td>289.5</td>
</tr>
</tbody>
</table>

**DANGER!**
Always observe the maximum values of the transmitter used with industrial thermometers featuring a measuring insert with head-mounted transmitter. These maximum values can be found on the transmitter nameplate. The sensor output \( P_o \) is one of the the deciding factors when assigning to a temperature class. For further information refer to Temperature classes on page 11.
3.1 Selecting the right thermometer and calculating limit values

**DANGER!**

In order to prevent injury and material damage, always ensure that the process conditions do not exceed the permitted limit values of the thermometer. Ask yourself the following questions when planning a measuring point:

- What are the temperatures (ambient temperature, product temperature, process connection temperature) at the measuring point?
- Do the process conditions necessitate heat-resistant feed lines?
- Which industrial thermometer model would you like to use with which process connection?
- Which type of sensor would you like to use?

Answering the above questions will help you deduce the following parameters and necessary device properties:

- Whether or not you need a temperature transmitter
- Sensor output \( P_0 \)
- Product temperature \( T_M \)
- Ambient temperature \( T_a \)
- Process connection temperature at the measuring point \( T_P \)

**INFORMATION!**

The temperature at the process connection of an industrial thermometer depends on how the device is installed. The diagram below shows possible installations (\( T_P \) is the point at which the temperature at the process connection is measured):

Possible installations
Once you have calculated the specified parameters and device properties, you must determine the maximum permitted temperatures for your specific measuring point in three steps. Use the tables in the previous subchapters to do this:

- Determine the maximum permitted product temperature (refer to Maximum permitted product temperature on page 12).
- Determine the maximum permitted temperature at the process connection (refer to Temperature at process connection (without temperature transmitter) on page 13, refer to Temperature at process connection (with temperature transmitter) on page 15 or refer to Temperature at process connection (with temperature transmitter, classes T5 and T6) on page 17).
- Find out whether the thermometer requires a heat-resistant connecting cable; if so ensure that the connecting cable can withstand the process conditions (refer to Temperature at process connection for thermometers with connecting cable on page 18).

**Example: Determining the maximum permitted temperatures**

This example is based on a TxA-F13 thermometer with head-mounted transmitter. It has the following features and is subjected to the following process conditions:

- Length of neck pipe: min. 80 mm / 3.15”
- Maximum ambient temperature of transmitter: 85°C / 185°F
- Sensor output: $P_o = 500$ mW
- Ambient temperature at measuring point: $T_a = 40°C / 104°F$
- Product temperature: $T_M = 70°C / 158°F$
- Temperature at process connection: $T_P = 50°C / 122°F$

**Step 1: Calculate the maximum product temperature**

- Refer to the table with the maximum permitted product temperatures (refer to Maximum permitted product temperature on page 12).
- Look along the header of the table until you come to the column with your sensor output $P_o$ (in this case: 500 mW).
- Look down this column and find the product temperature at your measuring point (in this case: $70°C / 158°F$).
- If you can’t find this figure, always look at the next figure up.
- The maximum permitted product temperature is $92°C / 198°F$ and the temperature class is T4.
Step 2: Calculate the maximum permitted temperature at the process connection

- You must always calculate the highest permitted temperature at the process connection for temperature classes T5 and T6 (refer to Temperature at process connection (with temperature transmitter, classes T5 and T6) on page 17); therefore go directly to the specified subchapter and omit the following steps.
- For all temperature classes except T5 and T6 refer to the tables with the maximum permitted temperatures at the process connection; these also differentiate between thermometers with and without a temperature transmitter (refer to Temperature at process connection (without temperature transmitter) on page 13, refer to Temperature at process connection (with temperature transmitter) on page 15).
- Find the model of thermometer used with the right neck pipe length in the first column of the table (in this case: TxA-F13, neck pipe ≥ 80 mm / 3.15\textquotedbl{}).
- Keep going to the right until you reach the column with the right ambient temperature $T_a$ (in this case: 40°C / 104°F).

\[
TP = 400°C / 752°F.
\]

Step 3: Calculate the maximum permitted temperature at the process connection with a thermometer connecting cable

- Refer to the table with the maximum permitted temperatures at the process connection with a thermometer connecting cable (refer to Temperature at process connection for thermometers with connecting cable on page 18).
- Calculate the maximum permitted temperature as explained above ("step 2").

\[
TP = 364°C / 687°F.
\]

In this example the selected industrial thermometer is suitable for the specified process conditions having checked all the maximum permitted temperatures. It falls into temperature class T4.
If the process conditions at your measuring point are outside of the values in the tables used in the example above, you will have to use charts. These can be found in the subchapters below following the tables. The charts also include less common temperatures.

The following sample chart shows you how to calculate the temperature at the process connection at an ambient temperature $T_a = 60^\circ C / 140^\circ F$:

1. Find the ambient temperature at your measuring point along the X-axis (in this case: $60^\circ C / 140^\circ F$).
2. From this point trace straight up until you reach the temperature curve of your thermometer.
3. From this intersection, move horizontally to the left until you reach the Y-axis.
4. At the intersection with the Y-axis read off the temperature at the process connection (in this case: $108^\circ C / 226^\circ F$).

**Example: Calculating the temperature at the process connection ($T_a = 85^\circ C / 185^\circ F$)**

1. Maximum permitted temperature at process connection ($T_p$)
2. Ambient temperature at the measuring point ($T_a$)
3. TxA-P14, insert thermometer without thermowell; TxA-P10, insert thermometer with thermowell; TxA-S12/41, threaded thermometer; TxA-F13/42, flange thermometer; neck pipe length in each case $\geq 80$ mm / 3.15”
4. TxA-P14, insert thermometer without thermowell; TxA-P10, insert thermometer with thermowell; neck pipe length in each case $\leq 80$ mm / 3.15”
5. TxA-S11, threaded thermometer, neck pipe length $\leq 80$ mm / 3.15”
3.2 Assembly

DANGER!
The manufacturer is not liable for any damage or injuries resulting from improper use or use other than the intended purpose. This applies in particular to hazards due to insufficient corrosion resistance and suitability of the materials in contact with products.

DANGER!
Installation and setup must be carried out according to the applicable installation standards (e.g. EN 60079-14) by qualified personnel trained in explosion protection. Observe the information contained in the manuals and the supplementary instructions. Assembly must always comply with the following requirements:

- There are no external forces on the thermometer assembly.
- The device is accessible for any necessary visual inspections and can be viewed from all sides.
- The nameplate is clearly visible.
- All seals are fit for purpose.

Installing an industrial thermometer with flange or thread connection

- Ensure that you use a seal suitable for the dimensions of the process connection (flange or thread) and the requirements of the measuring point.
- Align the seal precisely (for thermometers with flange connection this applies to the flange surface of the connection nozzle).
- Carefully lower the thermometer into the tank or the pipe.
- Observe all the relevant regulations and in particular the right torques and tighten the flange screws or the thread connection.
4.1 General notes

DANGEROUS!
In order to prevent injury and material damage, always take heed of the information about temperatures at the process connection before connecting an industrial thermometer to an electricity supply (on page 18). In addition, always observe the following points:

- Ensure that all connecting cables conform to the valid installation standards (e.g. EN 60079-14) and withstand the maximum operating temperature.
- Adjust the outer diameter of the connecting cables to the sealing range of the cable entries.
- Securely lay the connecting cables and sufficiently protect them against damage.
- Securely connect all the cores not in use with the ground potential of the explosive area or carefully insulate them from each other and from ground (test voltage ≥ 500V_{eff}).

Industrial thermometers are connected to an electricity supply by connecting the sensor circuit in the connection head to the interchangeable measuring insert.

DANGEROUS!
Also refer to the transmitter’s Ex manual for all industrial thermometers with an explosion-proof transmitter.

4.2 Power supply

The supply voltage of an industrial thermometer specifically refers to the supply voltage of the measuring insert (for further information refer to Electrical data on page 20).

DANGEROUS!
If you are operating the measuring insert together with a transmitter, pay attention to the details of the power supply in the Ex documentation of the transmitter used. Also observe the maximum values of the sensor circuit.
4.3 Inputs / Outputs

The electrical connection of an industrial thermometer depends on the type of measuring insert used. The manufacturer offers measuring inserts with two different sensor types, either with Pt100 resistor (TR 100) or with thermocouple (TC 100).

4.3.1 Pt100 measuring inserts

A measuring insert with a Pt RTD is connected according to DIN EN 60751 in three different wiring variants (from left to right: 2, 3 and 4 wire switch):

**TR 100: Wiring [simple design]**

![Diagram of TR 100 wiring](image)

1. white
2. red

4.3.2 Thermocouple measuring inserts

Wiring of a thermocouple measuring insert is done in accordance with DIN EN 60584.

**TC 100: Wiring [simple design]**

![Diagram of TC 100 wiring](image)
4.4 Grounding and equipotential bonding

**DANGER!**
In order to prevent injury and material damage, always observe the following points regarding grounding and equipotential bonding:

- Always include the thermometer and its measuring insert as per EN 60079-14 in the equipotential bonding of the installation site (when installed correctly, the fixing screws guarantee this).
- If the thermometer is not connected to a grounded metal pipe system or a container through the process connection, you must include it in the equipotential bonding of the explosive area.
- The connection for equipotential bonding is via the PA terminals or the process connection.
- If there is a cable shield you must ground it according to EN 60079-14. A terminal in the connection head means that the cable shield can be grounded by the shortest route.

The manufacturer’s measuring insert connections withstand a test voltage of 500 VAC to earth.
5.1 Starting up for the first time

**DANGER!**
To prevent injury and material damage, only operate industrial thermometers under the following conditions:

- The equipment was installed and connected in accordance with the manufacturer’s instructions.
- At the operator’s request, a test was conducted prior to start-up to ensure the correct installation and connection.
- The check prior to start-up was in compliance with the national regulations for checks before start-up.

5.2 Operation

**DANGER!**
To avoid injury and material damage, only operate the measuring inserts under the following conditions:

- Temperatures, pressures and electrical limit values are in the manufacturer’s specified range.
- The equipment parts necessary for safety are effective in the long run, never disable them during operation!
- When using flammable products, the thermowell must be included in the periodic pressure tests of the system.

You can open the connection head when live (thanks to the “intrinsic safety” protection type) even in explosive areas to work on the electrical connections for measuring and setting purposes (e.g. to configure a temperature transmitter):

**CAUTION!**
When using the thermometer, and in particular after work to the connection head, ensure that it is closed properly. Otherwise the degree of IP protection is not guaranteed.
6.1 Maintenance

**DANGER!**
Maintenance measures of a safety-relevant nature within the meaning of explosion protection may only be carried out by the manufacturer, his authorised representative or under the supervision of authorised inspectors.

For systems in explosive areas, regular tests are required in order to maintain the proper condition. The manufacturer recommends the following maintenance measures:

- Check the housing, the cable entries and the feed lines for corrosion and/or damage.
- Check the process connection and the piping connections for leakage.
- Check the entire thermometer for dust deposits.

6.2 Dismantling

You can replace a separately certified intrinsically safe temperature transmitter or measuring insert with an identical device from the manufacturer:

**DANGER!**
In order to prevent injury and material damage when replacing components of the industrial thermometer, always observe the following points:

- To avoid electric shock, dismantle the measuring insert when it is de-energized where possible. If this is not possible, the basic conditions for intrinsic safety (e.g. no grounding or connection of different intrinsically safe circuits to one another) must be observed during dismantling.
- So as not to damage the cover of the connection head, only open it using a suitable tool (e.g. a screwdriver).
- When replacing both a separately certified intrinsically safe temperature transmitter and a separately certified intrinsically safe measuring insert with an identical device from the manufacturer, always refer to the Ex documentation for the devices. Ensure that the construction is the same by checking the nameplates.
As well as replacing individual components, it is also possible to replace the entire thermometer, however you as operator have sole responsibility for this:

**DANGER!**

In order to prevent injury or material damage when replacing components of the industrial thermometer, always observe the following points:

- Before dismantling the electrical connecting lines of the device, ensure that all the cables leading to the measuring insert are de-energised themselves and to the reference potential of the explosive area. This also applies to equipotential bonding conductors (PA).
- All the relevant process controls or containers must be depressurized before dismantling the thermowell.
- If the process cables or the container contain products that are harmful to the environment or to health, implement the appropriate safety measures before dismantling the thermowell.
- Replace all the seals when reinstalling the device in the process cable or container.
KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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