

Mechanical temperature measuring instruments

WIKA data sheet IN 00.07

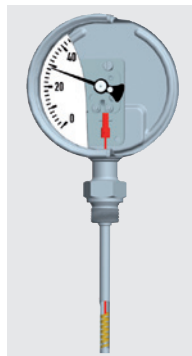
Temperature is an indicator of the thermal condition of a homogenous material or body. It expresses the energy of motion that is contained in the molecules of the material. Transmission of temperature from one body to another, e.g. process medium and thermometric sensor, requires close physical contact between both bodies to achieve thermal equilibrium. Conventional temperature measurement is based on the property of certain materials to alter their physical shape or volume proportional to the temperature applied. The most commonly used principles in the WIKA production are highlighted below.

Bimetal thermometers

Operating principle

The temperature is measured by means of a bimetal system inside the temperature sensor. The bimetal is made from two metal strips, permanently joined together, each metal having a different thermal expansion coefficient. This causes the strip to deflect in proportion to the temperature variation. The actual bimetal system consists of a bimetal strip that is either

- helically or
- spirally



wound, depending on the size of the sensor and the temperature range to be measured. Any temperature variation causes the bimetal to rotate an attached spindle. This rotation is indicated by a pointer on a dial scale. WIKA bimetal thermometers are available for temperature ranges from -70 to +600 °C with accuracies complying with Class 1 and 2 of EN 13190.

Expansion thermometers

Operating principle

The temperature is measured by a liquid-filled measuring system consisting of a temperature probe, a capillary and a bourdon tube. These three components form a sealed system. Any temperature variation causes a change in the internal pressure of this system. As a result of this pressure

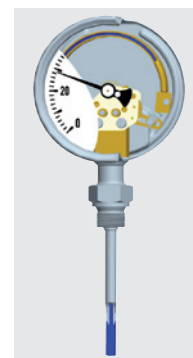
change the shaft and pointer connected to the tube rotate and the temperature value is indicated on the scale. With capillary lengths available between 500 and 10,000 mm, it is also possible to measure temperatures at remote measuring points.

WIKA expansion thermometers are available for temperature ranges from -40 to +400 °C with accuracies complying with Class 1 and 2 of EN 13190.

Gas actuated thermometer with or without capillary

Operating principle

Gas actuated thermometers consist of a stem, a capillary and a case containing the bourdon tube element. These components are connected to form a single system. The complete measuring system is filled with an inert gas under pressure. Any temperature variation causes a change in the internal pressure of the stem, leading to a deflection of the bourdon tube. A mechanical linkage (movement) transmits this deflection to the pointer.



Variations in the ambient temperature acting on the case are compensated for by a bimetal element mounted between the movement and the bourdon tube.

WIKA gas actuated thermometers are available for temperature ranges from -200 to +700 °C with an accuracy complying with Class 1 of EN 13190.

Conversion reference

How to calculate	From				
	K	°C	°F	°R	°Ré
K	x	$K = °C + 273.15$	$K = 5/9 (°F + 459.67)$	$K = 5/9 °R$	$K = 5/4 °Ré + 273.15$
°C	$°C = K - 273.15$	x	$°C = 5/9 (°F - 32)$	$°C = 5/9 °R - 273.15$	$°C = 5/4 °Ré$
°F	$°F = 9/5 K - 459.67$	$°F = 9/5 °C + 32$	x	$°F = °R - 459.67$	$°F = 9/4 °Ré + 32$
°R	$°R = 9/5 K$	$°R = 9/5 °C + 491.68$	$°R = °F + 459.67$	x	$°R = 9/4 °Ré + 491.68$
°Ré	$°Ré = 4/5 K - 218.52$	$°Ré = 4/5 °C$	$°Ré = 4/9 (°F - 32)$	$°Ré = 4/9 °R - 218.52$	x

Limit of error in °C per DIN EN 13190

Applicable for expansion and bimetal dial thermometers

Scale range in °C	Measuring range in °C	Limit of error in ± °C	
		Class 1	Class 2
-20 ... +40	-10 ... +30	1	2
-20 ... +60	-10 ... +50	1	2
-20 ... +120	-10 ... +110	2	4
-30 ... +30	-20 ... +20	1	2
-30 ... +50	-20 ... +40	1	2
-30 ... +70	-20 ... +60	1	2
-40 ... +40	-30 ... +30	1	2
-40 ... +60	-30 ... +50	1	2
-100 ... +60	-80 ... +40	2	4
0 ... 60	10 ... 50	1	2
0 ... 80	10 ... 70	1	2
0 ... 100	10 ... 90	1	2
0 ... 120	10 ... 110	2	4
0 ... 160	20 ... 140	2	4
0 ... 200	20 ... 180	2	4
0 ... 250	30 ... 220	2.5	5
0 ... 300	30 ... 270	5	10
0 ... 400	50 ... 350	5	10
0 ... 500	50 ... 450	5	10
0 ... 600	100 ... 500	10	15
0 ... 700	100 ... 600	10	15
50 ... 650	150 ... 550	10	15
100 ... 700	200 ... 600	10	15

Basic points of thermo-dynamic temperature scales

Unit	Symbol	Reference value	
		absolute zero	triple point of water
Kelvin	K	0	273.16
Grad Celcius	°C	-273.15	0.01
Grad Fahrenheit	°F	-459.67	32.01
Grad Rankine	°R	0	491.68
Grad Réaumur	°Ré	-218.52	0

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Temperature sensors, connection designs and thermowells for mechanical and mechatronic expansion thermometers

WIKA data sheet IN 00.20

Applications

- Determining the temperature sensor design
- Determining the required minimum length
- For all expansion thermometers

Versions

- Plain design
- Designs with screw connections
- Designs with thermowells

Description

Temperature sensors

The various temperature sensors can be combined with all expansion thermometers. They differ from each other with their various connection designs and wetted parts.

In addition to the standard designs, there are also special solutions for the widest variety of measuring point constructions.

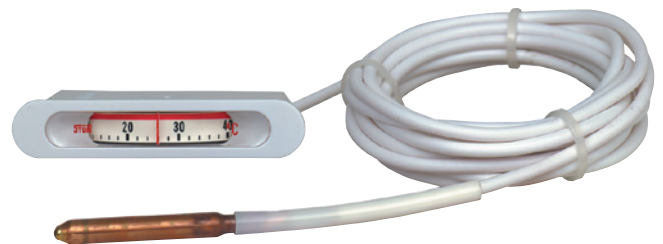
The respective minimum required stem length, ET, for the various designs and display ranges are presented in a table.

Thermowells

The fast-response designs, in order to optimise the response characteristics, have both a reduced wall thickness and a minimised air gap between the thermowell inner wall and the fitted temperature sensor.



SB15 safety temperature limiter with an SF91/SV20 temperature sensor



Expansion thermometer model TF59 with a plain SF94 temperature sensor

Connection design

Connection rotatable with sealing cone, SF91/SV20

Available for models IFC, SB-, SC-, SW15 and TF58/59 expansion thermometers

Model SF91 temperature sensor

Process connection

G = G ¼ B; G ⅝ B; G ½ B; M14 x 1.5

Stem diameter

D = 5; 6; 8; 8.5; 10 mm

Stem material

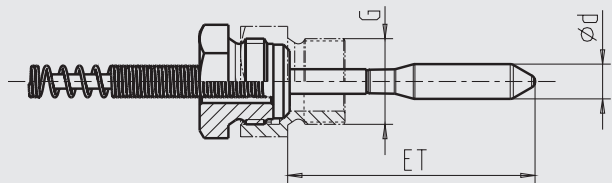
Brass (2.0401); Copper (Cu)
1.4571 stainless steel

Fitting

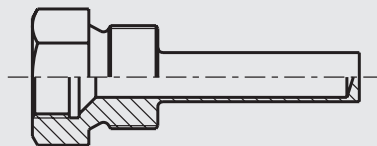
Brass (2.0401)

Length is automatically determined from the required control volume for the respective measuring range
For minimum sensor length, ET, see tables on page 3

Model SF91 temperature sensor



Model SH16 thermowell



Model SH16 thermowell

Process connection

G = G ⅝ B; G ½ B (for others see page 9)

Material

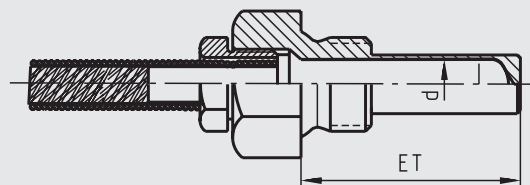
Brass (2.0401)
1.4571 stainless steel

Standard lengths

40, 50, 75, 80, 100, 150 mm

Immersion depth, ET = variable up to ET 80 mm one-piece,
from 100 mm two-piece, soldered or welded
Immersion depth, ET = variable

Model SF91 temperature sensor with model SH16 thermowell



Connection rotatable with sealing cone, SF91/SV19

Available for models IFC, SB-, SC-, SW15 and TF58/59 expansion thermometers

Model SF91 temperature sensor

Process connection

G = G ¼ B; G ⅜ B; G ½ B; G ¾ B; G 1 B;
M14 x 1.5; M16 x 1.5; M18 x 1.5;

SV19 fitting

Brass (2.0401)
Stainless steel

Stem diameter

D = 5; 6; 8; 8.5; 10 mm

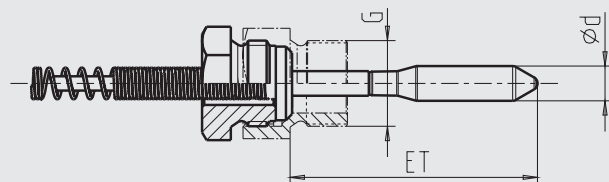
Stem material

Brass (2.0401)
Copper (Cu)
1.4571 stainless steel

Immersion depth, ET = variable

Length is automatically determined from the required control volume for the respective measuring range

Model SF91 temperature sensor



Model	Material	Sensor diameter in mm	Appli- cable for model	Minimum sensor length = ET min. X mm									
				Scale range in °C	-40 ... +40 0 ... 80	0 ... 40	0 ... 120	50 ... 150 50 ... 200	0 ... 200	0 ... 250	0 ... 300	0 ... 350	50 ... 250
SF91 SV20	Copper (Cu) BR (2.0401)	5	IFC SB15 SC15 SW15	250	-	200	150	100	100	100	50	100	
		6		150	300	100	100	70	100	100	50	100	
		8		100	150	50	50	50	50	50	50	50	
		8.5		100	100	50	40	35	35	30	25	35	
		10		70	100	50	50	50	40	50	50	40	
	Stainless steel	6		250	-	200	150	100	100	100	50	100	
		8		150	300	100	100	70	50	50	50	50	
		10		50	150	50	50	50	50	50	50	50	

Plain stem (without thread), SF94

Available for models IFC, MFT, SB-, SC-, SW15 and TF58/59 expansion thermometers

Model SF94 temperature sensor

Stem diameter

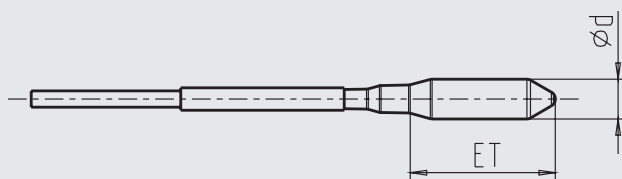
D = 6; 8; 8.5; 10 mm

Immersion depth, ET = variable

Length is automatically determined from the required control volume for the respective measuring range

For minimum sensor length, ET, see table

Model SF94 plain temperature sensor



Model SH22 thermowell

Process connection

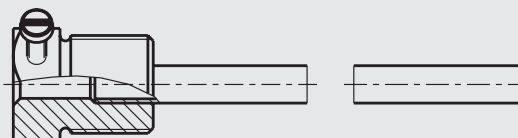
G = G ¼ B, G ⅜ B; G ½ B

Standard lengths

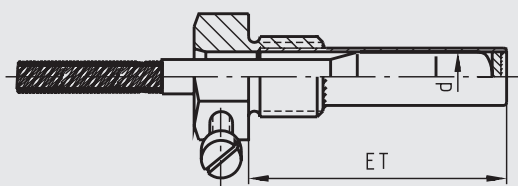
50, 70, 100, 150 mm (for others see page 9)

Immersion depth ET = variable up to ET 80 mm one-piece,
from 100 mm two-piece, soldered or welded

Model SH22 thermowell



Model SF94 temperature sensor with model SH22 thermowell



Model	Material	Sensor diameter in mm	Appl- cable for model	Minimum sensor length = ET min. X mm									
				Scale range in °C	-40 ... +40 0 ... 80	0 ... 40	0 ... 120	50 ... 150 50 ... 200	0 ... 200	0 ... 250	0 ... 300	0 ... 350	50 ... 250
SF94	Copper (Cu) BR (2.0401)	6	TF 58 TF 59 MFT		150	250	100	100	50	100	50	50	100
		8.5			80	-	65	60	60	60	60	55	70
		6	IFC SB15 SC15 SW15		150	300	100	100	70	100	100	50	100
		8			100	150	50	50	50	50	50	50	50
		8.5			100	100	50	40	35	35	30	25	35
	Stainless steel	10			70	100	50	50	50	40	50	50	40
		6			250	-	200	150	100	100	100	50	100
		8			150	300	100	100	70	50	50	50	50
		10			50	150	50	50	50	50	50	50	50

Connection rotatable with compression spring and fitting, SF95

Available for models IFC, SC15 and TF58/59 expansion thermometers

Model SF95 temperature sensor

Process connection

M10 x 1

Fitting

Brass (2.0401)

Stem diameter

D = 8.5 mm

Stem material

Brass (2.0401)

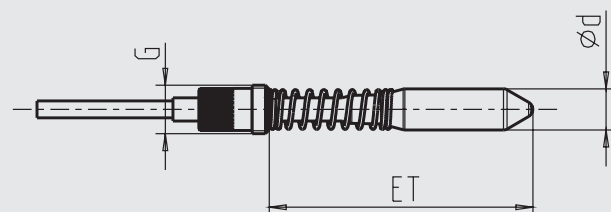
Copper (Cu)

1.4571 stainless steel >300 °C

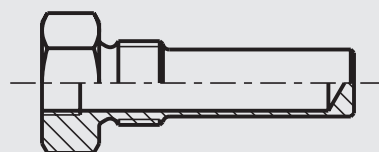
Immersion depth, ET = variable

Length is automatically determined from the required control volume for the respective measuring range

Model SF95 temperature sensor



Model SB18 thermowell



Model SB18 thermowell

Process connection

G = G ¼ B, G ⅜ B, G ½ B

Material

Brass (2.0401)

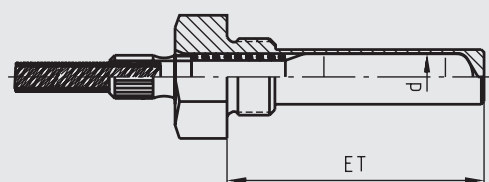
1.4571 stainless steel

Standard lengths

29, 32, 45, 75, 100, 150 mm (for others see page 9)

Immersion depth, ET = variable up to ET 80 mm one-piece, from 100 mm two-piece, soldered or welded

Model SF95 temperature sensor with model SB18 thermowell



Model	Material	Sensor diameter in mm	Applicable for model	Minimum sensor length = ET min. X mm									
				Scale range in °C	-40 ... +40	0 ... 40	0 ... 120	50 ... 150	0 ... 200	0 ... 250	0 ... 300	0 ... 350	50 ... 250
SF95	Brass	8.5			65	120	50	50	35	35	30	30	35

Connection rotatable with straight sealing ring, SF96/SV20

(identical to BF2)

Available for models IFC, SC15, SB15 and SW15 expansion thermometers

Model SF96 temperature sensor

Process connection

G = G ¼ B; G ⅜ B; G ½ B; G ¾ B; M14 x 1

SV20 fitting

Brass (2.0401)

Stainless steel

Stem diameter

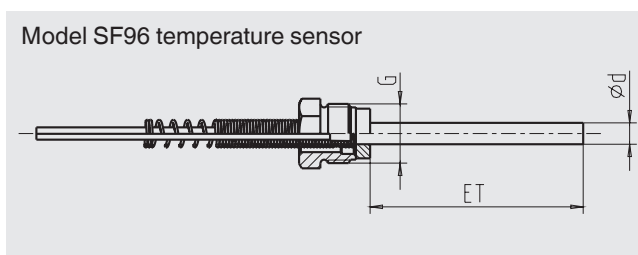
D = 5; 6; 8; 10 mm

Stem material

Brass (2.0401)

Copper (Cu)

1.4571 stainless steel



Standard lengths l1 (ET)

80, 140, 180, 230 mm, consistent with thermowells in accordance with DIN 16179 Form BD, BE, BS

Immersion depth, ET = variable

Length is automatically determined from the required control volume for the respective measuring range

Model	Material	Sensor diameter in mm	Applicable for model	Minimum sensor length = ET min. X mm									
				Scale range in °C	-40 ... +40 0 ... 80	0 ... 40	0 ... 120	50 ... 150 50 ... 200	0 ... 200	0 ... 250	0 ... 300	0 ... 350	50 ... 250
SF96	Brass Copper (Cu)	6	IFC SB15		150	300	100	100	70	100	100	50	100
		8			100	150	50	50	50	50	50	50	50
		10			70	100	50	50	50	40	50	50	40
	Stainless steel	6	SC15 SW15		250	-	200	150	100	100	100	50	100
		8			150	300	100	100	70	50	50	50	50
		10			50	150	50	50	50	50	50	50	50

Connection with union nut, SF97/SV21

(similar to Form 3, union nut)

Available for models IFC, SB-, SC-, SW15 expansion thermometers

Model SF97 temperature sensor

Process connection

G = G ¼ B; G ⅜ B; G ½ B; G ¾ B; G 1 B;
M12 x 1; M14 x 1.5; M18 x 1.5

SV21 fitting

Brass (2.0401)

Stainless steel

Stem diameter

D = 6, 8, 10 mm

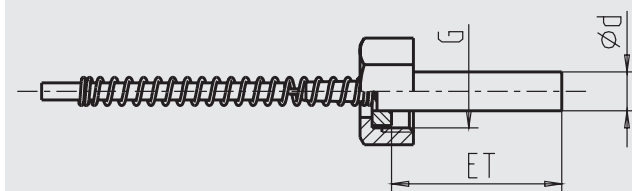
Stem material

Brass (2.0401)

Copper (Cu)

1.4571 stainless steel

Model SF97 temperature sensor



Standard lengths l1 (ET)

89, 126, 186, 226, 276 mm consistent with thermowells in accordance with DIN 16179 Form CD, CE, CS

Immersion depth ET = variable from minimum length (active part to the end of the stem extension)

Model	Material	Sensor diameter in mm	Applicable for model	Minimum sensor length = ET min. X mm									
				Scale range in °C	-40 ... +40 0 ... 80	0 ... 40	0 ... 120	50 ... 150 50 ... 200	0 ... 200	0 ... 250	0 ... 300	0 ... 350	50 ... 250
SF97	Brass Copper (Cu)	6			150	300	100	100	70	100	100	50	100
		8			100	150	50	50	50	50	50	50	50
		10			70	100	50	50	50	40	50	50	40
	Stainless steel	6			250	-	200	150	100	100	100	50	100
		8			150	300	100	100	70	50	50	50	50
		10			50	150	50	50	50	50	50	50	50

Compression fitting sliding along the stem, SF98

(similar to BF4)

Available for models IFC, SB-, SC- and SW15 expansion thermometers

Model SF98 temperature sensor

Process connection

G = G ¼ B; G ⅝ B; G ½ B; G ¾ B; G 1 B;
 M12 x 1; M14 x 1.5; M18 x 1.5

SV19 fitting

Brass (2.0401)
 Stainless steel

Stem diameter

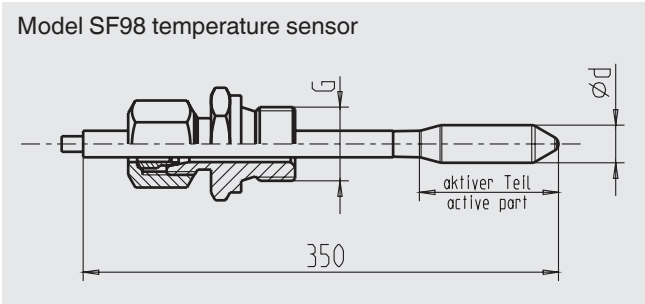
D = 8.5 mm (extension D = 6 mm)

Stem material

Copper (Cu)
 1.4571 stainless steel

Stem extension tube

Brass (2.0401)
 1.4571 stainless steel



Immersion depth ET = variable from minimum length (active part to the end of the stem extension)

Model	Material	Sensor diameter in mm	Appli-cable for model	Minimum sensor length = ET min. X mm									
				Scale range in °C	-40 ... +40	0 ... 40	0 ... 120	50 ... 150	0 ... 200	0 ... 250	0 ... 300	0 ... 350	50 ... 250
SF98	Brass Copper (Cu)	8.5			50	-	35	26	20	25	20	20	30

Thermowells

In order to eliminate corruption of the display, the temperature sensors which are fitted into the thermowells, are matched. The play between the thermowell drilling and the temperature sensor diameter must not be more than 0.2 mm.

The SF94 and SF95 temperature sensors must touch the bottom of the thermowell. The SF91 temperature sensor must fill the entire thermowell. The spiral at the end of the sensors protects the capillary against buckling. To prevent buckling of the capillary on insertion of sensors with longer immersion depths, ET, the temperature sensor is supplied with an extension tube. In order to prevent corruption of the display, all temperature sensors must be immersed with their complete active part into the medium. The active part extends, for the minimum length, over the entire sensor length.

Lock nuts and washers can be delivered for thermowells mounted in through-holes. For applications for thermowells at pressures over 10 bar with immersion depths over 50 mm, please consult with us.

Ordering example

SH22 thermowell in BR for temperature sensor with 8.5 mm diameter and an immersion depth of 100 mm and G $\frac{3}{8}$ B mounting threads for temperatures under 120 °C.

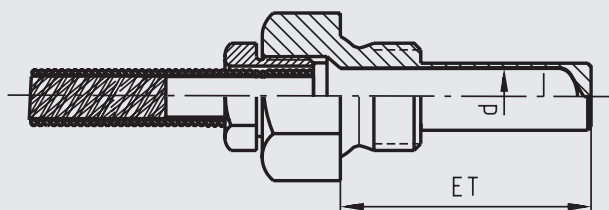
SH22-8.50-ET 100 G $\frac{3}{8}$ B-MS-under 120 °C

Thermowells for temperatures under 120 °C are soft soldered.

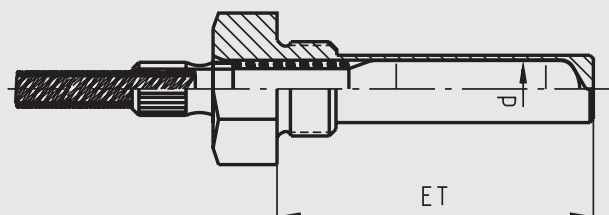
For special purposes V4A, chrome-plated BR and nickel-plated BR thermowells can be supplied.

Model	Mounting threads / process connection							Immersion depth in mm	Probe diameter			
	G $\frac{1}{4}$ B	G $\frac{3}{8}$ B	G $\frac{1}{2}$ B	G $\frac{3}{4}$ B	M14 x 1.5	M16 x 1.5	M18 x 1.5		6 mm	8 mm	8.5 mm	10 mm
SB18	X	X	X		X	X	X	29			X	
	X	X	X		X		X	32			X	
	X	X	X		X		X	45			X	
		X	X					60			X	
		X	X					75			X	
		X	X					90			X	
			X					100			X	
SH16			X					150			X	
	X	X						40		X	X	
	X	X	X					50	X	X	X	
	X	X						75	X		X	
	X	X	X					80			X	
	X	X	X	X	X	X		100	X	X	X	
	X	X						150	X	X	X	
	X	X						200	X	X	X	
SH22	X	X	X					250		X	X	
	X	X						45	X	X		
	X	X						50	X		X	
	X	X						60	X	X		
		X						75			X	X
	X	X						100	X	X	X	X
	X	X						150	X	X	X	
	X	X	X					200	X	X	X	
	X	X						250	X		X	
	X	X	X					300	X	X	X	

Model SF91 temperature sensor with model SH16 thermowell



Model SF95 temperature sensor with model SB18 thermowell



Model SF94 temperature sensor with model SH22 thermowell

