

Mechanical temperature measuring instruments

WIKA data sheet IN 00.07

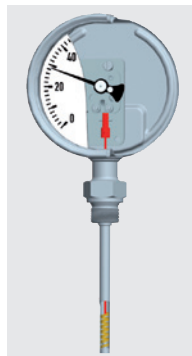
Temperature is an indicator of the thermal condition of a homogenous material or body. It expresses the energy of motion that is contained in the molecules of the material. Transmission of temperature from one body to another, e.g. process medium and thermometric sensor, requires close physical contact 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

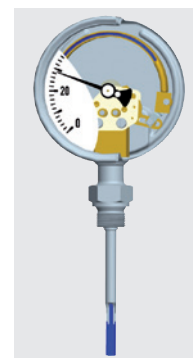
change the shaft and pointer connected to the tube rotate and the temperature value is indicated on the scale. With capillary lengths available between 500 and 10,000 mm, it is also possible to measure temperatures at remote measuring points.

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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Wake frequency calculation

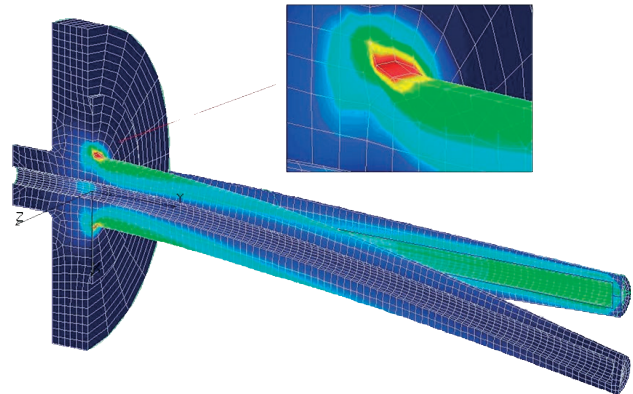
WIKA data sheet IN 00.15

Applications

- Minimisation of the risk of dynamic damage through vortex shedding of a Kármán vortex street (Vortex Induced Vibration; VIV)
- Calculation of the static loads due to inflow and process pressure
- Can be used in pipelines and process vessels

Special features

- Calculation of thermowells per ASME PTC 19.3 TW-2016
- Calculation of thermowells and protection tubes in accordance with Dittrich/Klotter
- If the permissible calculated load limits are exceeded, WIKA can, as an engineering service (subject to a charge), provide suggestions for modification of the thermowell design.



FEM representation of a thermowell within a flow with stress representation at the tip and in the root

Description

The wake frequency calculation in accordance with ASME PTC 19.3 TW-2016 is applicable for thermowells in tapered, straight or stepped design.

Protection tubes in accordance with DIN 43772 or comparable designs are calculated in accordance with Dittrich/Klotter.

All calculations are valid for non-corrosive or non-abrasive media, unless otherwise specified. The end users are responsible for the conformity of the process data with the calculation bases.

As a result of the pipeline design, a vibration excitation is also possible, which is not the subject of the wake frequency calculation.

A warranty by WIKA cannot be given.

Required process data for the wake frequency calculation

Process data	SI unit	Imperial	Others
Flow rate	m/s	ft/s	-
Medium density	kg/m ³	lb/ft ³	-
Temperature	°C	°F	-
Pressure	bar	psi	-
Dynamic viscosity ¹⁾	mm ² /s	ft/1000s	cP

1) ASME PTC 19.3 TW-2016 selectable, not required for Dittrich/Klotter

In accordance with ASME PTC 19.3 TW-2016, chapter 9-1, the designer of the system in which the thermowell is installed is responsible for specifying the process data used for the calculation (temperature, velocity, density, pressure).

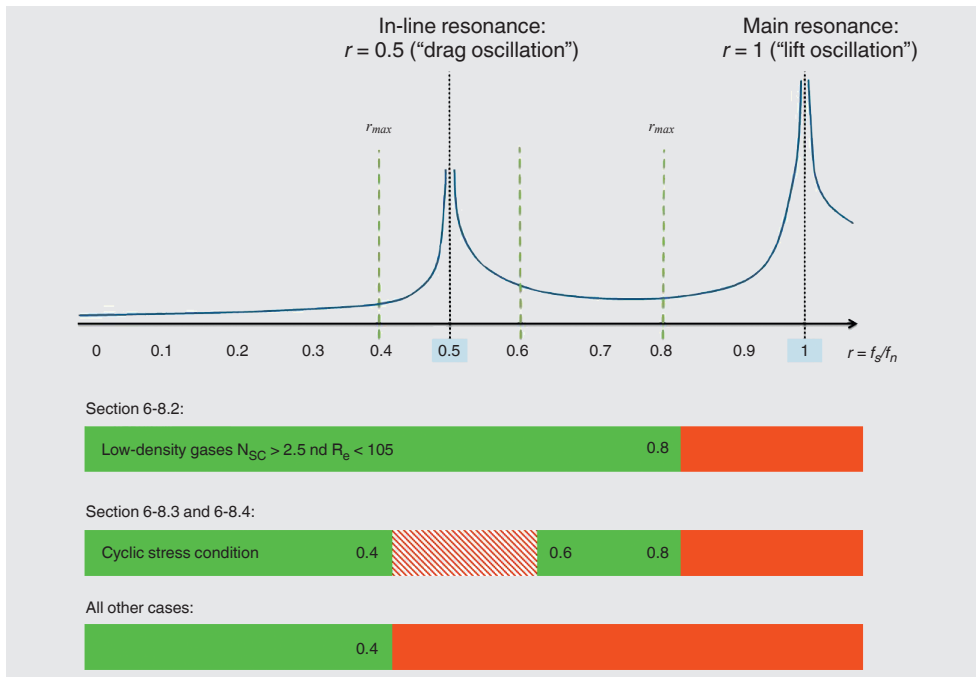
If several process data are provided to WIKA (e.g. min. / process / max. / design), in accordance with 6-3.3 of the standard, the highest value is always used for the calculation.

This procedure is applied to each wake frequency calculation, regardless of the standard.

ASME PTC 19.3 TW-2016

ASME PTC 19.3 TW-2016 is divided into dynamic and static calculation results and is exclusively applicable to thermowells installed in pipes or process vessels. Applications in process or industrial furnaces are thus outside the scope of the calculation.

For low-density gases, the frequency limit is typically $r_{max} = 0.8$. With other gaseous media, constant operation in the range between $r = 0.4 \dots 0.6$ around the in-line resonance is not permissible. For liquid media, in many applications, the limit frequency $r_{max} = 0.4$ for the in-line resonance is typically used.



The evaluation of the dynamic results is made using the damping factor N_{SC} (N_{SC} , the Scruton number, is directly related to the permissible frequency ratio r_{max} of the excitation frequency f_s to the natural frequency f_n). In simplified terms, for gaseous media, a characteristic value is $N_{SC} > 2.5$; liquids typically have an $N_{SC} < 2.5$.

The values mentioned must not be considered as absolute in any calculation and are calculated individually by the program.

The Scruton number N_{SC} depends on the intrinsic damping factor, the density of the thermowell material, the process medium and the tip and bore diameter of the thermowell.

Whether the frequency ratio $r < 0.8$ can also be used as an evaluation limit for liquid process media is decided by considering the permissible stresses in the thermowell material compared to the actual stresses in the event of resonance. In addition, the strength of the thermowell material is evaluated with respect to the fatigue stress in the area of installation of the thermowell. The static results of ASME PTC 19.3 TW-2016 are based on the maximum permissible process pressure (depending on the process temperature and the geometry data of the thermowell) and the bending stress in the area of the thermowell root. The bending stress caused by the incident flow on the thermowell is, among other things, dependent on the shielded length resulting from the flange nozzle.

In addition to the VIV, vibration excitation of thermowells in all designs can be caused, for example, by the following factors:

- pulsating or turbulent flows
- Vibrations of the pipeline system (e.g. caused by pumps)
- Excitation through acoustic/flow-induced vibrations (AIV/FIV)
- The pipeline geometry itself (e.g. after T-pieces, dead legs or pipe elbows)
- Thermowell mounting with too little distance to interrupters or other thermowells (e.g. “2oo3 installation”), whereby other causes are also conceivable.

These vibration excitations cannot be calculated by the calculation methods in accordance with ASME, Dittrich/Klotter or using CFD (Computational Fluid Dynamics), but must also be evaluated by the end user in the design of the measuring location. The calculation results of the aforementioned methods are not directly comparable with each other.

Dittrich/Klotter

The static calculation of thermowells for thermometers is based on the formulae published by P. Dittrich in 1954 in the technical journal “Allgemeine Wärmetechnik” (“General Heating Technology”). These formulae were considered in DIN 43763, a predecessor standard of the current DIN 43772 from 2000.

Around 1990, WIKA supplemented the static calculation in accordance with Dittrich with the dynamic calculation in accordance with Klotter, which originates from the textbook “Das Ingenieurwesen - Hütte” (“Engineering - Metallurgy”) in the chapter “Kinetik der Schwinger” (“Kinetics of oscillators”). This combination enables the calculation of protection tubes and the estimation of the loads in the operating case, caused by the vortex shedding of the Kármán vortex street. The in-line resonance introduced in 2010 by ASME PTC 19.3-TW is not considered in the calculation in accordance with Dittrich/Klotter.

The static evaluation is made via the “comparative stress”. The pressure loading at the thinnest wall thickness near the tip of the thermowell is combined with the combined bending load at the root of the flow and axial pressure loading, whereby a representative stress value, $S_{\text{comp}} = \max + \min/3$, is formed. In addition, a safety number S is calculated via the quotient of S_{comp} with the permissible stress $0.7 \times R_{p(T)}$.

For the dynamic consideration, the excitation frequency is calculated with the Strouhal number $St = 0.21$ and compared with the natural frequency in accordance with Klotter. The frequency ratio in accordance with ASME PTC 19.3-1974 should not exceed the limit value $r_{\text{max}} = 0.8$.

Solutions when the permissible frequency ratio r_{\max} is exceeded due to design changes

If the maximum permissible limit frequency r_{\max} for the in-line or main resonance is exceeded, the following design changes can be made:

a) Shortening of the insertion length

This is the most effective, and the design change recommended by all calculation methods, to improve the frequency ratio r .

b) Increasing the root diameter

By increasing the root diameter, the natural frequency f_n is reduced and thus the frequency ratio r is optimised.

c) Increasing the tip diameter

By increasing the tip diameter, the vortex shedding frequency f_s is reduced and thus the frequency ratio r is optimised

d) Support collar

Support Collars or other support devices are not included within the scope of ASME PTC 19.3 TW-2016 and are only offered on explicit customer request. The basics of the calculation in accordance with Dittrich/Klotter do not make any statements with regard to the support collar.

Supporting the thermowell with a support collar is not recommended, as a fixed support can only be achieved through an interference fit between the support collar and the flange nozzle (see ASME PTC 19.3 TW-2016, points 6-7-(e)).

The design of the thermowell below the support collar corresponds to the design and calculation criteria of ASME PTC 19.3 TW-2016 or Dittrich/Klotter.

Since each flange nozzle has individual dimensions, the support collar is delivered with an oversize. The operator is responsible for the interference fit of the collar in the nozzle, which makes it necessary to subsequently adapt the collar to the nozzle.

It should be noted that some nozzle designs are not suitable for use with support collars. A warranty for support collars is not provided.

→ Further information is described in the technical information IN 00.26.

e) ScrutonWell® design

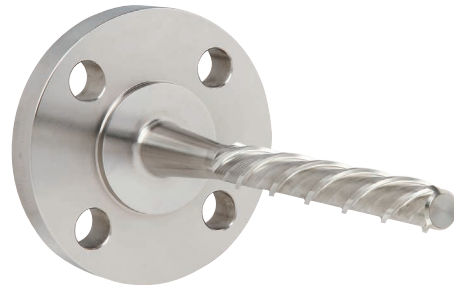
The ScrutonWell® design can be used for thermowells with flange connection, Vanstone design and also for welded or screwed process connections. This design enables the easy and quick mounting of the thermowell without the need for expensive and time-consuming adjustment on-site, as required for support collar.

The ScrutonWell® design reduces the vibration amplitude by more than 90 % with a vortex-induced excitation, which has been tested and proven by the independent laboratories TÜV SÜD NEL (Glasgow) and the Institute of Mechanics and Fluid Dynamics (Technische Universität Freiberg).

→ For further information, see data sheet SP 05.16

Strength calculation of the ScrutonWell® design using ASME PTC 19.3 TW-2016

- Maximum permissible pressure load with original stem dimensions
- Maximum permissible bending load with modified stem dimensions
- Due to the damping of the vibration amplitude by more than 90 %, no dynamic calculation is carried out



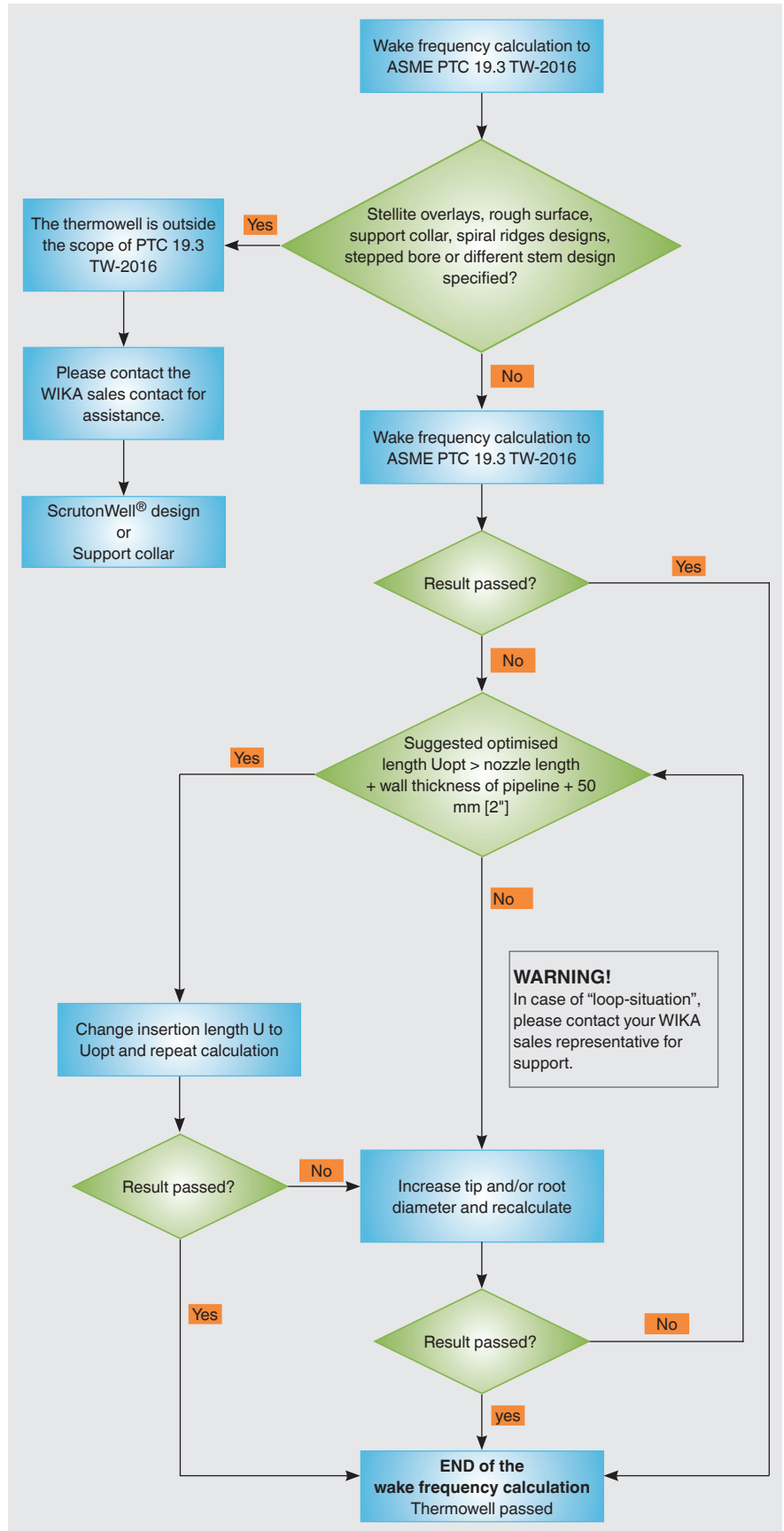
Thermowell model TW10 in ScrutonWell® design

Performing a standard wake frequency calculation in accordance with ASME PTC 19.3 TW-2016

This simplified flow diagram shows the procedure of performing a standard wake frequency calculation in accordance to ASME PTC 19.3 TW-2016 step-by-step. The diagram addresses a failed frequency ratio only.

Because of variation in thermowell designs in combination with various process parameters not all wake frequency calculations can follow this standard procedure.

If the procedure shown does not provide a satisfactory result, contact the manufacturer to get support. A specific technical solution might be needed.



Design details

ScrutonWell®: Calculation of Scruton length SL

The length of the helixes, the so-called Scruton length SL, must be designed so that they reach 25 mm [1 in] into the shielded length of the nozzle.

→ For further information, see data sheet SP 05.16

Support collar

- Determine 1st support collar location

The position of the thermowell support collar is calculated as follows: Nozzle length - 25.4 mm [1 in]

- Example:

Nozzle length 356 mm [14 in]. The 1st support collar is located 330 mm [13 in] from the flange sealing face.

The nozzle length is defined as the length from the outer diameter of the pipe / pipeline / vessel wall to the height of the nozzle (flange sealing face, etc.).

- Determine the number and position of the support collars

If the 1st support collar is less than 127 mm [5 in] from the flange sealing face, then only one support collar is required.

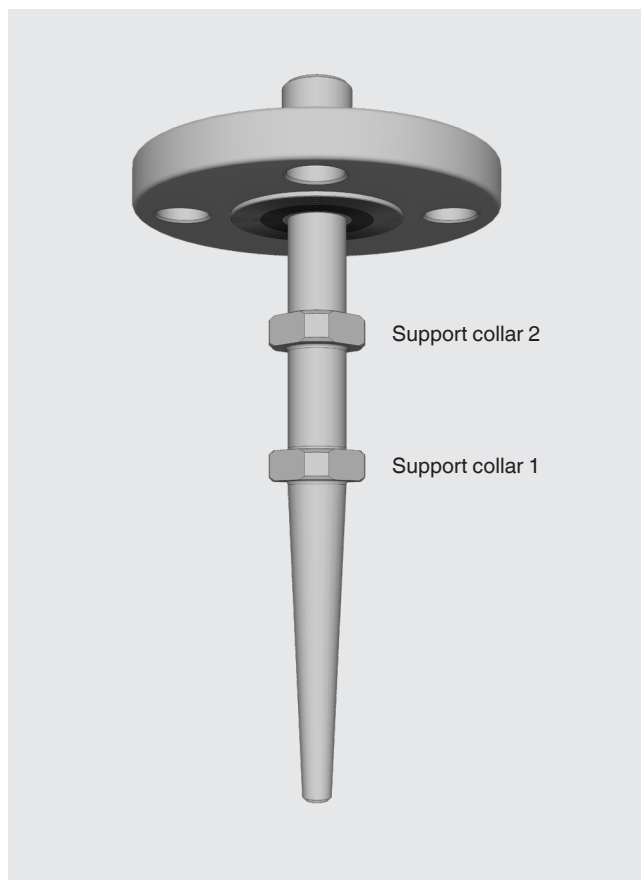
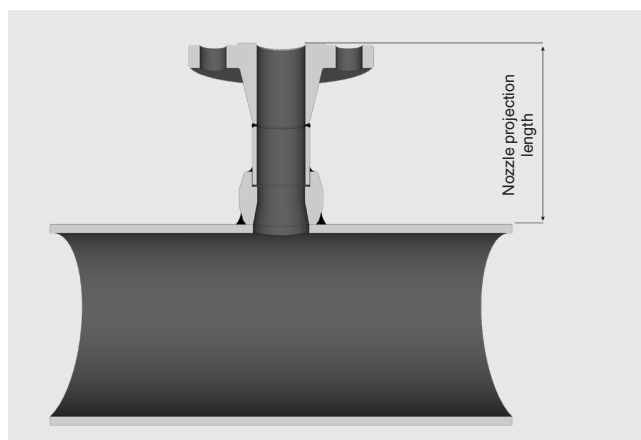
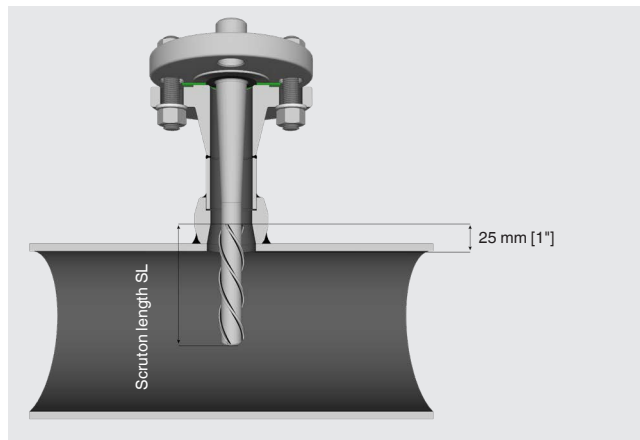
If the position of the 1st support collar is 127 mm [5 in] or more, then a 2nd support collar is required, at the point which is half the distance to the 1st support collar. For a nozzle projection length of more than 762 mm [30 in], please contact your WIKA sales representative.

- Example no. 1 – Two support collars

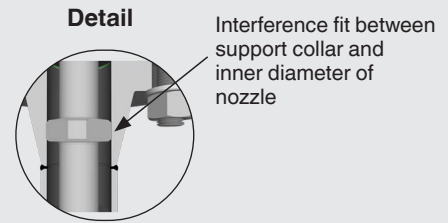
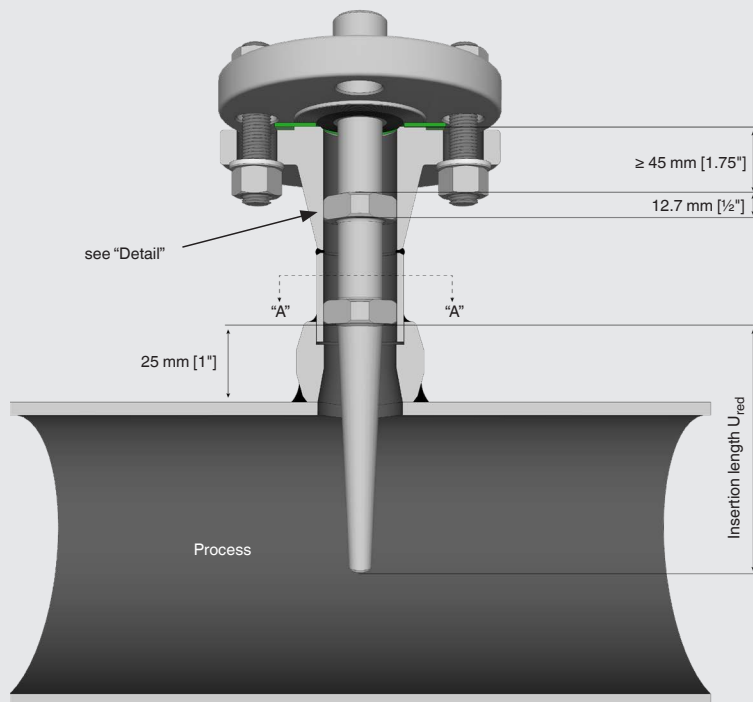
The nozzle length is 356 mm [14 in]. Support collar 1 is 356 mm [14 in] – 25.4 mm [1 in] = 330 mm [13 in]. Since this number is greater than 127 mm [5 in], two support collars are required. Thus, $330 \text{ mm [13 in]} / 2 = 165 \text{ mm [6.5 in]}$. Support collar 2 is at 165 mm [6.5 in].

- Example no. 2 – One support collar

The nozzle length is 114 mm [4.5 in]. Support collar 1 is at $114 \text{ mm [4.5 in]} - 25.4 \text{ mm [1 in]} = 89 \text{ mm [3.5 in]}$. Since this number is smaller than 127 mm [5 in], a support collar is required.



Typical installation through a nozzle



4-point support collar



Section "A"- "A"

Determine the support collar outer diameter from the pipe size and schedule

NPS	UOM	Outer diameter of the support collar						
		SCH.10	SCH.40	SCH.STD	SCH.80	SCH.XS	SCH.160	SCH.XXS
1"	in	1.107	1.059	1.059	0.967	0.967	0.825	0.609
	mm	28.1	26.9	26.9	24.6	24.6	21.0	15.5
1 1/2"	in	1.692	1.620	1.620	1.510	1.510	1.348	1.110
	mm	43.0	41.1	41.1	38.4	38.4	34.2	28.2
2"	in	2.167	2.077	2.077	1.949	1.949	1.697	1.513
	mm	55.0	52.8	52.8	49.5	49.5	43.1	38.4

Determine the suggested maximum root diameter based on nozzle size and schedule

NPS	UOM	Suggested root diameter at the support collar						
		SCH.10	SCH.40	SCH.STD	SCH.80	SCH.XS	SCH.160	SCH.XXS
1"	in	0.938	0.875	0.875	0.813	0.813	0.688	0.500
	mm	23.8	22.2	22.2	20.6	20.6	17.5	12.7
1 1/2"	in	1.500	1.375	1.375	1.250	1.250	1.125	1.000
	mm	38.1	34.9	34.9	31.8	31.8	28.6	25.4
2"	in	1.875	1.750	1.750	1.625	1.625	1.500	1.250
	mm	47.6	44.5	44.5	41.3	41.3	38.1	31.8

Design specifications in accordance with ASME PTC 19.3 TW-2016, Table 4-1-1, 4-2-1

Description	Tapered and straight designs		Stepped design	
	Minimum	Maximum	Minimum	Maximum
Insertion length L	63.5 mm [2.5 in]	609.6 mm [24 in] ¹⁾	127 mm [5 in]	609.6 mm [24 in]
Bore diameter d	3.175 mm [0.125 in]	20.9 mm [0.825 in]	6.1 mm [0.24 in]	6.7 mm [0.265 in]
Tip diameter B	9.2 mm [0.36 in]	46.5 mm [1.83 in]	-	-
Taper ratio B/A	0.58	1	-	-
Step ratio B/A for B = 12.7 mm	-	-	0.5	0.8
Step ratio B/A for B = 22.2 mm	-	-	0.583	0.875
Bore ratio d/B	0.16	0.71	-	-
Aspect ratio L/B	2	-	2	-
Length ratio Ls/L	-	-	0	0.6
Min. wall thickness (B-d)/2	3 mm [0.12 in]	-	3 mm [0.12 in]	-

1) Insertion lengths > 609.6 mm (24 in) are permissible, as long as a one-piece design of the thermowell without weld seams is used.

Marking	per ASME PTC 19.3 TW-2016	in WIKA data sheets
Insertion length	L	U
Bore diameter	d	B
Tip diameter	B	V
Root diameter	A	Q

If the thermowell dimensions, based on customer requirements or for specific applications, lie outside the requirements of ASME PTC 19.3 TW-2016, the calculation results can only be used for informative purposes. For this reason, no warranty can be given by the manufacturer.

Provision of calculation data

The table shows how process and geometry data should be provided electronically as an Excel spreadsheet for a chargeable thermowell calculation by WIKA engineering services.

Example for 6 measuring points in metric units:

Legend

Tag no.	Tag number	Ø Q	Root diameter
T	Temperature	Ø V	Tip diameter
P	Pressure	T _t	Tip thickness
v	Flow rate	N _{ID}	Inner diameter of nozzle
rho	Density of the process medium	N _L	Nozzle projection length
U	Insertion length	Model	WIKA thermowell model
Ø d	Bore size		

Tag no.	T		P	v	rho	Dyn. viscosity in cP	Model	Dimensions in mm [in]						Material
	in °C [°F]	in bar [psi]	in m/s	in kg/m ³	U			Ø d	Ø Q	Ø V	T _t	N _{ID}	N _L	
TW-0301	220 [428]	1.5 [21.76]	23.6	2.4	0.013	TW10	250 [10.04]	8.5 [0.34]	25 [0.98]	19 [0.75]	6.4 [0.25]	38.3 [1.51]	220 [8.66]	1.4435
TW-0303	220 [428]	1.5 [21.76]	25.7	2.0	0.017	TW10	250 [10.04]	8.5 [0.34]	25 [0.98]	19 [0.75]	6.4 [0.25]	38.3 [1.51]	220 [8.66]	1.4435
TW-0305	235 [455]	10 [145.04]	19.6	6.1	0.015	TW10	250 [10.04]	8.5 [0.34]	25 [0.98]	19 [0.75]	6.4 [0.25]	38.3 [1.51]	220 [8.66]	1.4435
TW-0307	220 [428]	10 [145.04]	13	8.9	0.014	TW10	250 [10.04]	8.5 [0.34]	25 [0.98]	19 [0.75]	6.4 [0.25]	38.3 [1.51]	220 [8.66]	1.4571
TW-0309	235 [455]	30 [435.12]	8.9	28.3	0.013	TW10	250 [10.04]	8.5 [0.34]	25 [0.98]	19 [0.75]	6.4 [0.25]	38.3 [1.51]	220 [8.66]	1.4571
TW-0311	400 [752]	31.5 [456.88]	31.9	10.1	0.017	TW10	250 [10.04]	8.5 [0.34]	25 [0.98]	19 [0.75]	6.4 [0.25]	38.3 [1.51]	220 [8.66]	1.4571

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WIKA standard documentation

WIKA data sheet IN 00.24

Requirements

Extensive processes require detailed documentation. For complex operations, data sheets and operating instructions are not sufficient anymore as documents accompanying the products.

Additional documents such as certificates, analyses or quality management procedures provide exact proof that the instruments are ideally suited for the particular application. In this way a detailed documentation conforming to the law contributes to plant safety.

WIKA standard documentation

The WIKA standard documentation complies with the legal conditions of acceptance (in paper format and/or as a navigable CD-ROM).

Our individual documents are constantly updated. They are subject to the “product lifecycle” (further development of the existing product). A unique attribution of the documents to the production order at the time of manufacture is ensured. WIKA provides these documents in many languages and in the desired quantity.

Customer-specific designs

Of course we can also provide the documentation according to your requirements:

- Customer logo
- Cover sheet layout
- Ring binders
- Sequence
- Further documents



WIKA standard documentation

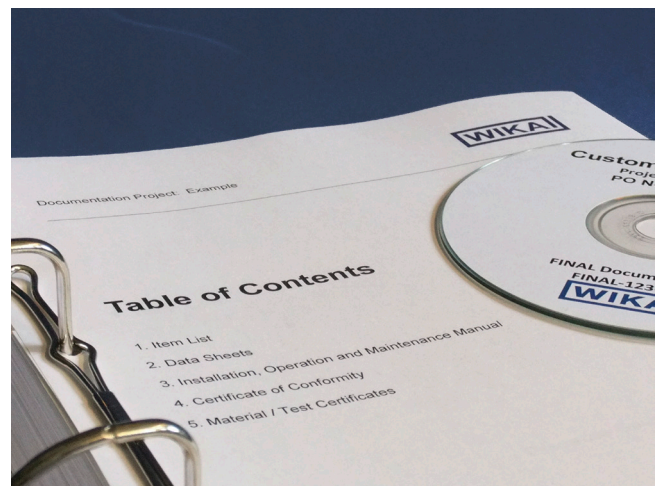


Table of Contents

WIKA standard documentation

This contains following documents:

Abbreviation	Description
TAG	Item list (Tag no. list)
CATL	Data sheets (catalogues)
IOM	Operating instructions (installation, operation and maintenance)
DOC	Declaration of conformity (EC, ATEX, EMC, PED)
ZGN	Certificates/Test reports
WFC	Wake frequency calculation (optional)
FLC	Flow calculation (optional)

These documents can be provided additionally:

Abbreviation	Description
DRWG	Drawings
QM	Quality management procedures
QT	Quality test procedures
CSP	Commissioning spare parts list
2SP	2 years spare parts list
NDE	Non-destructive examinations
SIP/RPP	Transport, packaging and storage instructions
MCOC	Manufacturer's certificates of compliance
PASS	Passport (import permit for instruments destined for Russia)

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File formats for customer logos on dials

WIKA data sheet IN 00.51

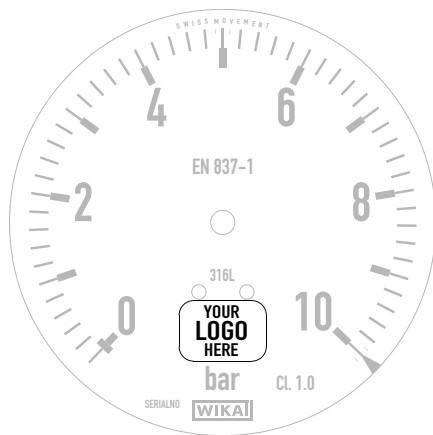
Technology

WIKA uses the latest technologies to custom print pressure gauge and thermometer dials. The high-quality printing features excellent UV resistance for long-lasting optimal readability of the measuring instruments.

The scale is defined using a specifically developed software tool and then drawn automatically using CAD software.

Trademark with customer logo

In pointer gauges, the dial is the component that permits the greatest variance for individual customer specifications. Since the dial is the focus of any measurement, WIKA is happy to fulfil the wish of many customers to have their own brand logo printed onto it.



Example of dial with customer logo

Requirements for the logo file

File format

For optimal representation of logos, they should be supplied in a vector format, as this allows scaling without losses.

Vector formats (preferred)

File type	Description
EPS / PS	Encapsulated Postscript / Postscript
AI	Adobe Illustrator
CDR	Corel Draw
DWG	Autodesk AutoCAD
DXF	Drawing Interchange File Format

Bitmap formats (if vector format not available)

File type	Description
TIFF / TIF	Tagged Image File Format
PNG	Portable Network Graphics
JPG / JPEG	Joint Photographic Experts Group

Size for bitmap formats

At least 1,200 pixels, width or height

Colour specifications

- Full-tone colours (RAL or Pantone)
- Colour space (CMYK or sRGB)

In the event that there is no colour specification, the correctness of custom colours cannot be guaranteed. Files in bitmap format are vectorised for further processing.

Data administration

For the correct processing of the logo file, it must be stated whether it replaces an existing logo. Ideally, the customer logo should be transmitted to the sales team contact via the [questionnaire](#) in the download area of the WIKA website.

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We reserve the right to make modifications to the specifications and materials.



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Switch contacts for pointer instruments

- Model 821, magnetic snap-action contact
- Model 831, inductive contact
- Model 830 E, electronic contact
- Model 851, reed contact

WIKA data sheet IN 00.48

Applications

- Control and regulation of processes
- Monitoring of plants and switching of circuits
- Indication of limit conditions
- Inductive contact for completely fail-safe switching, even in explosion hazardous areas
- Machine building, general plant construction, chemical industry, petrochemical industry, power plants, mining, on-/offshore and environmental technology

Special features

- High reliability and long service life
- Can be incorporated within all relevant pressure and temperature measuring instruments
- Up to 3 switch contacts per measuring instrument
- Optionally with liquid-filled case for high dynamic pressure loads and vibrations
- Inductive contact also available in safety version and electronic contact for PLCs

Description

Switch contacts make or break circuits dependent upon the pointer position of the indicating measuring instrument. The switch contacts are mounted predominantly below the dial, though also partly on top of the dial. DIN 16085 stipulates that the setting range for a contact test is between 10 % and 90 % of the span. Independent of the setting, the instrument pointer (actual value pointer) can move freely across the entire scale range. The set pointer for the switch point of circular instruments and square panel-mounted instruments can be adjusted using an adjustment key in the window. Contacts in flush panel-mounted instruments are adjustable using a screwdriver through the window.



Contact pressure gauge with switch contact model 821



Bimetal thermometer with inductive contact model 831

Contact actuation is made when the actual value pointer travels beyond or below the set switch point. Instruments with electrical switch contacts can also be delivered with optional special approvals. Depending on the instrument model, e.g. approvals for hazardous areas are available.

Model 821, magnetic snap-action contact

Application

These contacts can be used in almost all operating conditions, and even in liquid-damped instruments.

The set pointer has an adjustable permanent magnet attached, giving a snap-action characteristic to the contacts, which, furthermore, strengthens the contact pressure. This snap action widely protects the contacts against harmful arc influences, but increases the switch hysteresis to 2 % up to 5 % of the measuring span. The hysteresis is the difference of the displayed values, measured by reversing the direction of movement and leaving the switch point unchanged. The signal output is achieved either ahead of or behind the movement of the actual value pointer. The recommended setting range of the contacts is 25 ... 75 % of the scale.

Specifications and loading tables

If the specified data are observed, the switch contacts ensure perfect operation for many years.

For low switching voltages, to maintain reliability, the current to be switched should not be less than 20 mA. In order to ensure a high switching reliability of the contacts, even taking ambient influences into account, the switching voltage should not be below 24 V.

In accordance with DIN 16085, requirements on pressure measuring instruments with contacts for switching currents less than 24 V should be agreed specifically between the user and the manufacturer.

When switching inductive or capacitive loads, the usual contact protection measures against contact erosion should be made.

For programmable logic controllers (PLCs), the model 830 E electronic contact is recommended. → See from page 14.

Cable break monitoring with parallel resistor

If a fixed resistor is installed by the customer (e.g. 47.5kΩ) in parallel to the circuit, a defined, measurable current flows when the lines are intact.

If this circuit is interrupted, the resistance rises practically to infinity – then no current flows. This reliably detects the cable break.

→ See page 5

Specifications

Limit values for the contact load with resistive load	Model 821, magnetic snap-action contact			
	Unfilled instruments		Filled instruments	
	Switch version "S"	Switch version "L"	Switch version "S"	Switch version "L"
Rated operating voltage U_{eff}	≤ 250 V		≤ 250 V	
Rated operating current ¹⁾				
Switch-on current	≤ 1.0 A	≤ 0.5 A	≤ 1.0 A	≤ 0.5 A
Switch-off current	≤ 1.0 A	≤ 0.5 A	≤ 1.0 A	≤ 0.5 A
Continuous current	≤ 0.6 A	≤ 0.3 A	≤ 0.6 A	≤ 0.3 A
Switching power	≤ 30 W / 50 VA		≤ 20 W / 20 VA	
Contact material	Silver-nickel (80 % silver / 20 % nickel / gold-plated)			
Ambient temperature	-20 ... +70 °C [-4 ... +158 °F]			
Number of contacts max.	3			

1) Specification of the switch version in the data sheet of the instrument.

Recommended contact load with resistive and inductive loads

Voltage in V	Model 821, magnetic snap-action contact						Model 811, sliding contact		
(DIN IEC 38) DC / AC	Unfilled instruments			Filled instruments			Unfilled instruments		
	Resistive load		Inductive load	Resistive load		Inductive load	Resistive load		Inductive load
	Direct current	Alternating current	$\cos \varphi > 0.7$	Direct current	Alternating current	$\cos \varphi > 0.7$	Direct current	Alternating current	$\cos \varphi > 0.7$
	mA	mA	mA	mA	mA	mA	mA	mA	mA
220 / 230	100	120	65	65	90	40	40	45	25
110 / 110	200	240	130	130	180	85	80	90	45
48 / 48	300	450	200	190	330	130	120	170	70
24 / 24	400	600	250	250	450	150	200	250	100

Contact material

Depending upon the switching conditions, the switch contacts are subjected to greater or lesser erosion due to the effects of the unavoidable arcing and through mechanical stress.

WIKA uses the following contact material:

Silver-nickel composite material

(80 % silver / 20 % nickel / gold-plated)

Material properties:

- Higher hardness and rigidity
- Good erosion resistance
- Low inclination to fuse together
- Low contact resistance

This connection was chosen because of its balanced properties and its wide range of applications.

Other versions

- Contacts with separate circuits
- Change-over contacts (normally closed or normally open simultaneously at the set point)
- Contacts fixed
- Contact adjustment lock leaved
- Contact adjustment key fixed
- Connector (instead of cable or cable socket)

Switching functions

For the switching functions of magnetic snap-action contact model 821 the following applies, as a general rule, with our standard settings:

- Index 1** behind the contact model no. means:
Contact makes the circuit when the set point is exceeded.
- Index 2** behind the contact model no. means:
Contact breaks the circuit when the set point is exceeded.
- Index 3** After the contact model no. the following applies:
 When the set value is exceeded, one circuit breaks and one circuit makes **simultaneously** (change-over contact).

For switch contacts with multiple contacts, the 1st contact is the one closest to the left start of scale value.

The switching function, as described in the following table, **is based on a rotary motion** of the instrument pointer **(actual value pointer) in the clockwise direction**.

If the actual value pointer moves **anticlockwise**, the **switching function is reversed!**

Note: If the switch contacts are to be set (adjusted) anticlockwise, the index figures in brackets must be used in accordance with DIN 16085. Combinations are possible.

Circuit diagram	Switching function on pointer movement in a clockwise direction	Contact model with index of the switching function
Single contact ¹⁾		
	Contact makes when the set point is exceeded	821.1 (.5)
	Contact breaks when the set point is exceeded	821.2 (.4)
	Contact changes over (change-over contact), i.e. 1 contact breaks and 1 contact makes when the set point is exceeded	821.3 (.6)
Double contact ¹⁾		
	1st and 2nd contact makes when the set points are exceeded	821.11 (.55)
	1st contact makes, 2nd contact breaks when the set points are exceeded	821.12 (.54)
	1st contact breaks, 2nd contact makes when the set points are exceeded	821.21 (.45)
	1st and 2nd contact breaks when the set points are exceeded	821.22 (.44)
Triple contact ¹⁾		
	1st contact breaks, 2nd contact makes, 3rd contact breaks when the set points are exceeded	821.212 (.454)

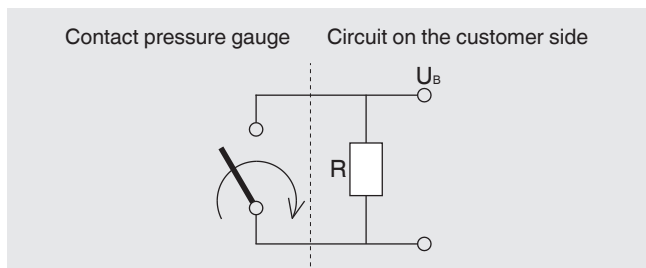
1) When ordering, attach the corresponding index of the required switching functions (note order 1st, 2nd, 3rd contact) to the contact model no., see example 821.212.

The **connection terminals** and **connection wires** are marked in accordance with the table above. Protective conductors are always yellow-green.

Cable break monitoring with parallel resistor

The installation of a defined resistor R (e.g. 47.5 kΩ) must be made on the customer side as shown below.

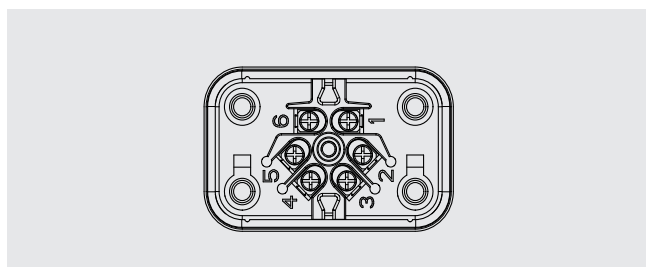
Circuit diagram, example normally open



Line break monitoring (e.g. with PLC)

Condition	Resistance of the circuit	Detection, e.g. with PLC
Contact closed	Approx. 0 Ω	Total current is flowing → no error
Contact open	R (e.g. 47.5 kΩ)	Defined current → no error
Line break	$\infty \Omega$	Current flow interrupted → error

Connector pin assignment



Resistance circuit depending on contact type

Type of contact	Switch the parallel resistor between these connections	
Single contact	4	1
Double contact	4	1
	4	2
Double contact, separate circuits	1	2
	3	4
Triple contact	4	1
	4	2
	4	3
Triple contact, separate circuits	1	2
	3	4
	5	6
Double contact, change-over	5	1
	5	2
	5	3
	5	4

Model 851, reed contact

Application

Reed contacts are often used for switching small voltages and currents, since their hermetically sealed design, in combination with contacts in inert gas, cannot become corroded on the contact surfaces.

Their high reliability and low contact resistance make them suitable for a large number of applications. They include, for example, PLC applications, signal conversion in measuring instruments, signal lights, acoustic signal transmitters and many more.

Their hermetically sealed design makes these contacts ideally suited for use at high altitudes. Reed contacts require no auxiliary power and are insensitive to vibrations due to their low mass. For 2 contacts, the individual switches are galvanically separated from each other.

Note

Due to its ability to simultaneously switch both the smallest currents and voltages as well as powers of up to 60 watts, this contact form is ideal for applications in which the signal has not yet been exactly defined in the planning phase.

Design and function

A reed contact consists of three contact blades (change-over contact, SPDT), made of a ferromagnetic material, which are fused in a glass body under an inert gas atmosphere.

To minimise wear and guarantee a low contact resistance, the contact blades are provided with a metal coating in the area of the contact surfaces. The reed contact is actuated by an external magnetic field, e.g., a permanent magnet.

The switching status is maintained until the magnetic field strength has fallen below a certain value.

WIKA predominantly uses bistable and magnetically biased reed contacts. The bias maintains the signal status until a magnetic field having the opposite magnetic polarity resets the contact.

Due to the hard coating of the contact surface with, for example, ferromagnetic rhodium, the reed contact achieves a very long service life. The number of possible switching cycles of a reed contact depends largely on the level of the electrical load, but, based on experience, is in the range of 10^6 to 10^7 .

If only signal loads or no loads are switched, then switching cycles in excess of 10^8 are easily achievable. With switching voltages below 5 V (arcing limit), switching cycles beyond 10^9 can be achieved. For capacitive or inductive loads, the use of a protective circuit is required since the resulting current or voltage spikes would destroy the reed contact or at least significantly reduce its service life. See chapter on contact protection measures on page 9.

If a magnetic field passes the reed contact, both contact blades attract each other and close the contact. The electrical current can flow.

If the magnetic field moves away, the field strength drops with increasing distance. The contact remains closed through the bistability. Only a new traverse of the reed contact with a magnetic field in the opposite direction opens the two contact blades again. The electrical current is interrupted.

As with other mechanical switches, the reed contact is also not bounce-free. However, the bounce times are shorter than most other mechanical contacts. Nevertheless, this physical property should be considered, especially in PLC applications (keyword: software debounce / button debounce).

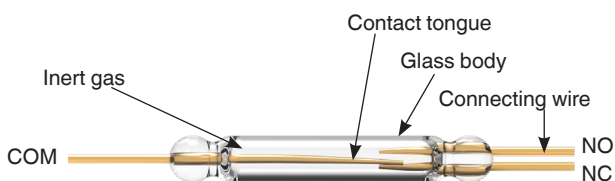
Example:

If the switch point for a 10 bar switchGAUGE is set, for example, to 1 bar and the instrument pointer sweeps this value with the magnet in the positive direction, the reed contact will change state and maintain it, even if the pointer continues to 10 bar.

The reed contact will only change its state again when the pointer passes 1 bar in the direction of 0 bar.

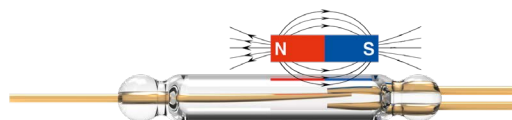
Functionality

Reed contact SPDT (change-over contact) not activated



COM = Common contact
NC = Normally closed
NO = Normally open

Reed contact SPDT (change-over contact) activated



Specifications for model 851, reed contact

Limit values for the contact load with resistive load	
Contact version	Change-over contact
Type of contact	Bistable
Max. switching voltage	AC 250 V / DC 250 V
Min. switching voltage	Not required
Switching current	≤ 1 A
Min. switching current	Not required
Transport current	≤ 2 A
cos ϕ	1
Switching power	60 VA/W
Contact resistance (static)	100 m Ω
Insulation resistance	10 ⁹ Ω
Breakdown voltage	DC 1,000 V
Switching time incl. bouncing	4.5 ms
Contact material	Rhodium
Switch hysteresis	3 ... 5 %

- The limit values presented here must not be exceeded independently of each other.
- When using two contacts, these cannot be set to the same point. In this case, a minimum clearance of approx. 30° is required.
- The adjustment range of the contacts is 10 ... 90 % of the scale.
- The switch hysteresis can be set in manufacturing such that the reed contact will actuate exactly at the required switch point. When ordering, please specify the switching direction.
- In other pressure gauges, e.g. model 700.0x and 230.15 2", further reed contacts are used. For the specifications, please refer to the respective data sheet.

Operating limits for magnetic snap-action or reed contacts

General information

Each mechanical switch has 4 physical limits.

- Maximum electrical switching voltage
- Maximum electrical switching current
- Maximum electrical load to be switched
- Maximum mechanical switching frequency

Outside these specified physical limits, the switch should not be operated. Should even only one of these limits be exceeded during operation, the service life of the switch will be shortened. The further that one or more limits are exceeded, the greater the shortening of the service life of the switch, even as far as immediate failure.

Maximum electrical switching voltage

When switching an electrical load, an arc may arise, more or less visible, between the contact surfaces. Due to the resulting, locally limited, high heat, the contact material gradually evaporates during each switching process (material loss, erosion). The higher the voltage to be switched, the greater the arc and the more and faster the contact material evaporates.

The contact will be permanently damaged.

Maximum electrical switching current

When switching an electrical current, the contact surface will be heated through the charge carrier flow (contact resistance). If the maximum permissible switching current is exceeded, the contacts begin to fuse together. This can lead to the welding or sticking of the two contact surfaces. The contact will be permanently damaged.

Maximum electrical power

The maximum electrical power which a contact can switch is defined as the switching voltage multiplied by the switching current. This electrical power heats the contact and should not be exceeded (welding, sticking).

The contact will be permanently damaged.

Maximum mechanical switching frequency

The maximum possible switching frequency depends on the wear of the bearing points and on material fatigue.

Minimum electrical values

Each mechanical contact has a contact resistance due to impurity layers (impurity-film resistance R_F). This impurity-film resistance is caused by oxidation or corrosion on the contact surface and increases the electrical resistance of the switch. When switching small loads, this layer is not penetrated. It is only destroyed when higher voltages and currents are switched. This effect is known as fritting, and the required minimum voltage is the fritting voltage. If this voltage is not reached when switching, the impurity-film resistance will continue to increase and the switch will cease to work. This effect is reversible.

Further notes

Such electrical overloads can be caused, for example, by the following:

- Filament lamps draw up to 15 times more current at switch-on than during operation (nominal value).
- Capacitive loads cause a short circuit at switch-on (long control lines, parallel-running cables).
- Inductive loads (relays, contactors, solenoid valves, rolled cable drums, electric motors) generate very high voltages when switched off (up to 10 times the rated voltage).

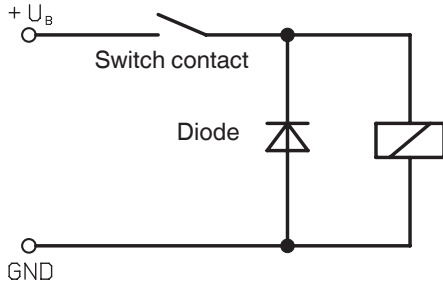
Contact protection measures

Mechanical contacts must not exceed the specified electrical values for switching current and switching voltage, not even for a short time.

For capacitive or inductive loads we recommend one of the following protective circuits.

1. Inductive load with DC voltage

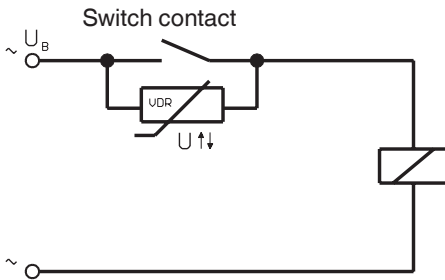
With DC voltage, contact protection can be achieved by a free-wheeling diode connected in parallel with the load. The polarity of the diode must be arranged so that it blocks when the operating voltage is applied.



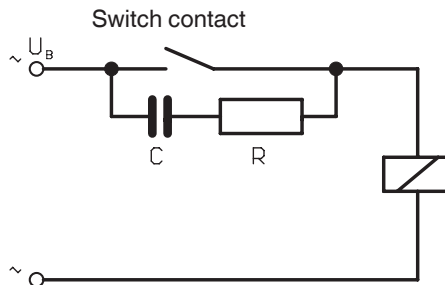
Example: Contact protection measure with free-wheeling diode

2. Inductive load with AC voltage

With AC voltage, two protection measures are possible.



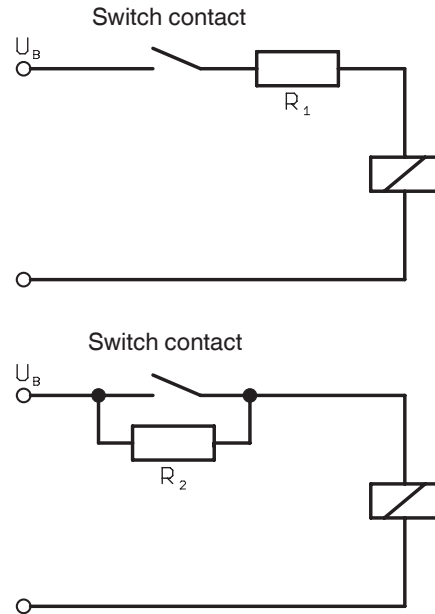
Example: Contact protection measure with voltage-dependent resistor VDR



Example: Contact protection measure with RC element

3. Capacitive load

Capacitive loads cause increased switch-on currents. These can be reduced by placing resistors in series in the supply line.



Example: Contact protection measure with current-limiting resistor

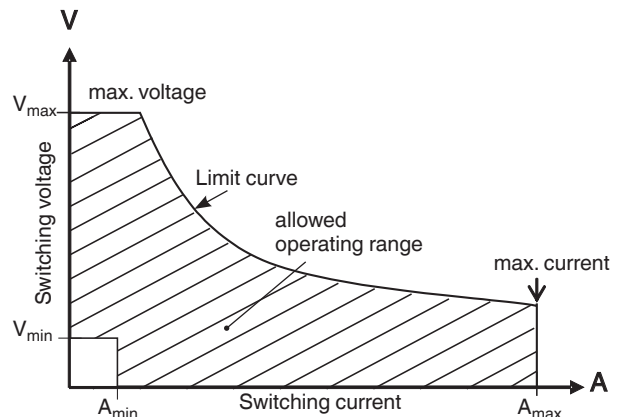
Contact curve

The hatched area of the contact curve shows the permissible electrical values for the respective contact.

The voltage to be switched must neither be above the maximum nor below the minimum switching voltage ($V_{\max} \leq U_s \leq V_{\min}$).

The current to be switched must neither be above the maximum nor below the minimum switching current ($A_{\max} \leq I_s \leq A_{\min}$).

The power to be switched may only lie below the limit curve.



Model 831, inductive contact

Application

Measuring instruments with WIKA inductive contacts may be used in zone 1 and 2 hazardous areas. Provided that they are supplied from a suitable and certified control circuit (e.g. WIKA model 904.28 control unit).

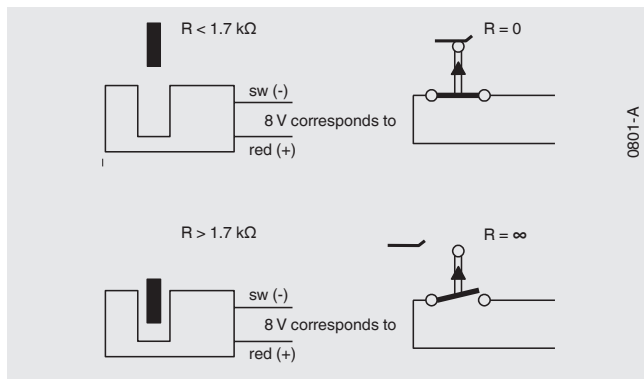
Outside of hazardous areas, these WIKA inductive contacts are primarily used where particularly safe switching at higher switching rates is important. Since the contacts also work in liquid filling, such instruments can even be used in very specific operating conditions. Some typical application areas are in chemical, petrochemical and nuclear plants.

Functional principle

The WIKA inductive contact works in a non-contact way. Essentially, it consists of the control head (initiator), attached to the set pointer, with its fully potted electronics and the mechanical assembly with the moving flag. The flag is moved by the instrument pointer (actual value pointer).

The control head is supplied with a DC voltage. When the flag enters the slot in the control head, this then increases its internal resistance (= damped condition / the initiator has high impedance). The subsequent change in the current acts as the input signal for switching amplifiers of the control unit.

Functional diagram



The control unit effectively works without influence on the measuring system. The non-contact "contact system" produces no wear within the electrical system. The assembly dimensions correspond to the model 821 contacts. Setting of the set points is carried out as for these contacts.

Ambient temperature: $-25 \dots +70 \text{ }^\circ\text{C}$ [$-13 \dots +158 \text{ }^\circ\text{F}$] ¹⁾

Control head used (slot sensor): Model 831

Advantages of the WIKA inductive contact

- Long service life due to non-contact switching
- Low influence on the display
- Universal application, even with filled instruments
- Insensitive to aggressive environments (potted electronics, non-contact switching)
- Explosion-protected, can be used in zone 1 and 2

Design concept of the WIKA inductive system

The WIKA inductive system includes the inductive contact installed in the measuring instrument (as described above) and a model 904 control unit. → See data sheet AC 08.04.

The **control unit** consists of

- Power supply unit
- Switching amplifier
- Output relay

The power supply unit converts the mains voltage for the control unit. The switching amplifier supplies the control head and switches the output relay. Via the output relay, high electrical powers can be switched.

There are two **versions of control unit**:

- **Non-intrinsically safe version** (non-Ex version)
- **Intrinsically safe version** (Ex version), see page 13

¹⁾ With use in hazardous areas, the prescribed upper limit values for the ambient temperature must be observed! These are dependent upon the voltage, current, power and temperature class.

Switching functions

The following applies, as a general rule, to the switching functions of the model 831 inductive contacts in connection with our standard settings:

Index 1 behind the inductive contact model no. means: **Contact makes** the control circuit when the set point is exceeded (flag moves **out of the control head**).

Index 2 behind the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded (flag moves **into the control head**).

For inductive contacts with multiple contacts, the 1st contact is the one closest to the left start of scale value or end value (be careful with vacuum gauges).

The switching function, described in the following table, follows the **clockwise rotary motion** of the instrument pointer (actual value pointer). If the actual value pointer moves **anticlockwise**, the **switching function is reversed!**

Note: If the inductive contacts are to be set (adjusted) anticlockwise, the index figures in brackets must be used in accordance with DIN 16085. Combinations are possible.

Circuit diagram 2)	If the pointer of the measuring instrument moves clockwise, it operates the flag when the set point is exceeded:	Switching function (illustration of the principle)	Inductive contact model with index of the switching function
Single contact ¹⁾			
	out of the control head	Contact makes	 831.1 (.5)
	into the control head	Contact breaks	 831.2 (.4)
Double contact ¹⁾			
	of the 1st and 2nd contact out of the control head	1st and 2nd contact makes	 831.11 (.55)
	of the 1st contact out of the control head, the 2nd contact into the control head	1st contact makes, 2nd contact breaks	 831.12 (.54)
	of the 1st contact into the control head, the 2nd contact out of the control head	1st contact breaks, 2nd contact makes	 831.21 (.45)
	of the 1st and 2nd contact into the control head	1st and 2nd contact breaks	 831.22 (.44)
Triple contact ¹⁾			
A number of instruments can be fitted with up to 3 inductive contacts. → For technical notes, see page 12. Switching and switch behaviour in principle as in the previous table.			

1) When ordering, attach the corresponding index of the required switching functions (note order 1st, 2nd, 3rd contact) to the inductive contact model no.

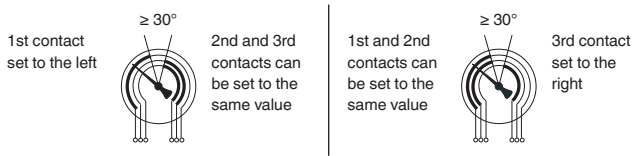
2) Thin line means: flag in control head, control circuit open. Thick line means: flag out of the control head, control circuit closed

The **connection terminals** and **connection wires** are marked in accordance with the table above.

Triple contact

With standard inductive contacts in the triple design, the setting of all three contacts to the same set point is not physically possible. Either the left (= 1st contact) or the right contact (= 3rd contact) is hinged $\geq 30^\circ$ to the left or to the right of the two set pointers, which can be set to coincide:

Examples



Combination of all triple contacts

The 1st set pointer is set approx. 30° to the left

The 3rd set pointer is set approx. 30° to the right

Model
831.1.11
831.1.12
831.1.21
831.1.22
831.2.11
831.2.12
831.2.21
831.2.22

Model
831.11.1
831.11.2
831.12.1
831.12.2
831.21.1
831.21.2
831.22.1
831.22.2

Safety inductive contacts

Safety inductive contact, model 831 SN and 831 S1N

For safety-critical applications, such as for the construction of self-monitoring controls, type-tested components must be used. Corresponding certifications are available for the model 831 SN and model 831 S1N safety inductive contacts. The prerequisite is operation together with a certified control unit (isolating amplifier) in safety technology. → See data sheet AC 08.04.

Measuring instruments with safety inductive contacts may be used in zone 1 hazardous areas. Control head used (SN/S1N slot sensor): Model 831 from Pepperl + Fuchs.

Switch behaviour, model 831 SN

If the flag is in the slot sensor, then the output of the downstream control unit (0 signal) is **inhibited**, i.e. the output relay is **de-energised** (= safe state).

For the index of the switching functions, the emergence or dipping of the flag into the control head, as well as the installation options, the same statements apply as for the model 831 inductive contact.

Switch behaviour, model 831 S1N

If the flag is not in, but rather **outside** the slot sensor, then the output of the downstream control unit (0 signal) is inhibited, i.e. the output relay is **de-energised** (= safe state).

For the index of the switching functions, the same information applies as for model 831 inductive contacts with the following difference:

- Index 1** behind the inductive contact model no. means: **Contact makes** the control circuit when the set point is exceeded in the clockwise direction (flag moves **into the control head**).
- Index 2** after the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded in the clockwise direction (flag moves **out of the control head**).

Special version

Triple contact NS 160, settable to one set point

If the setting of 3 contacts to a single set point is absolutely required, this can be achieved with NS 160 by using smaller control heads. This must be defined on ordering.

Model 831, Ex version

Depending on the power applied to the switching amplifier, a distinction is made between different power types (PT2, PT3, PT4). The following tables combining the contact design specified on the product label and the power type of the switching amplifier are relevant for the safety regulations of the instruments.

Safety-related characteristic values (Ex)

Safety parameters	Combination of contact version and power type of the switching amplifier						
	831	831-N, 831-SN, 831-3.5N, 831-3.5S1N			831-3.5SN		
		PT2	PT3	PT4	PT2	PT3	PT4
Max. input voltage U_i	20 V	16 V	16 V	16 V	16 V	16 V	16 V
Max. input current I_i	60 mA	25 mA	52 mA	76 mA	25 mA	52 mA	76 mA
Max. input power P_i	130 mW	64 mW	169 mW	242 mW	64 mW	169 mW	242 mW
Effective internal capacitance C_i	250 nF	30 nF	30 nF	30 nF	50 nF	50 nF	50 nF
Effective internal inductance L_i	350 μ H	100 μ H	100 μ H	100 μ H	250 μ H	250 μ H	250 μ H

Permissible temperature ranges

Contact version	Power type	T6	T4 ... T1	T95°C	T135°C
831	-	-20 ... +60 °C	-20 ... +70 °C	-20 ... +60 °C	-
831-N, 831-SN	PT2	-20 ... +60 °C	-20 ... +70 °C	-	-20 ... +70 °C
	PT3	-20 ... +30 °C	-20 ... +63 °C	-	-20 ... +44 °C
	PT4	Not permissible	-20 ... +36 °C	-	Not permissible
831-3.5N, 831-3.5S1N, 831-3.5SN	PT2	-20 ... +60 °C	-20 ... +70 °C	-	-20 ... +70 °C
	PT3	-20 ... +30 °C	-20 ... +70 °C	-	-20 ... +56 °C
	PT4	Not permissible	-20 ... +53 °C	-	Not permissible

Model 830 E, electronic contact

Description, application

This inductive contact with integrated switching amplifier, model 830 E, factory-installed directly into the measuring instrument, allows direct switching of small power loads typically used with programmable logic controllers (PLCs).

The usual advantages of inductive contacts, such as fail-safe switching, no wear due to non-contact switching as well as practically no effect on the measuring system, also apply here.

No additional control unit is required.

The electronic contact can be selected with 2- or 3-wire design and is implemented with PNP output. The operating voltage is DC 10 ... 30 V. The maximum switching current is 100 mA.

The model 830 E electronic contact is **not intrinsically safe** and therefore not suitable for applications in hazardous areas!

For the index of the switching functions, the same statements apply as for model 831 inductive contacts with the following difference:

Index 1 behind the inductive contact model no. means: **Contact makes** the control circuit when the set point is exceeded in the clockwise direction (flag moves **into the control head**).

Index 2 after the inductive contact model no. means: **Contact breaks** the control circuit when the set point is exceeded in the clockwise direction (flag moves **out of the control head**).

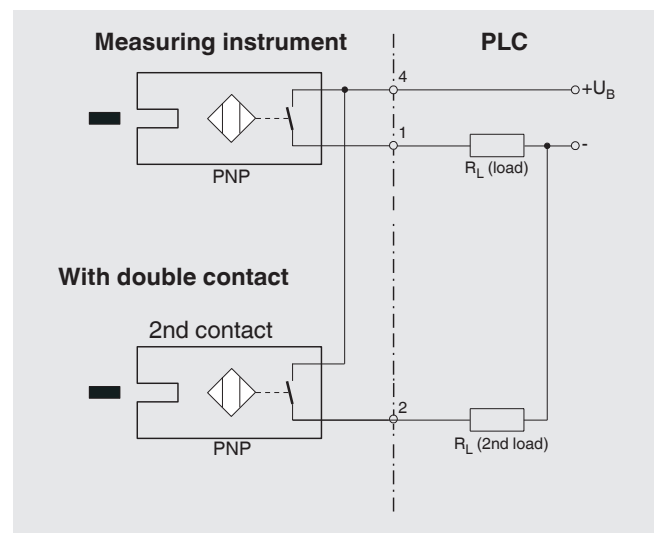
Note: The direction of action of the flag is reversed compared with model 831.

Electrical connection

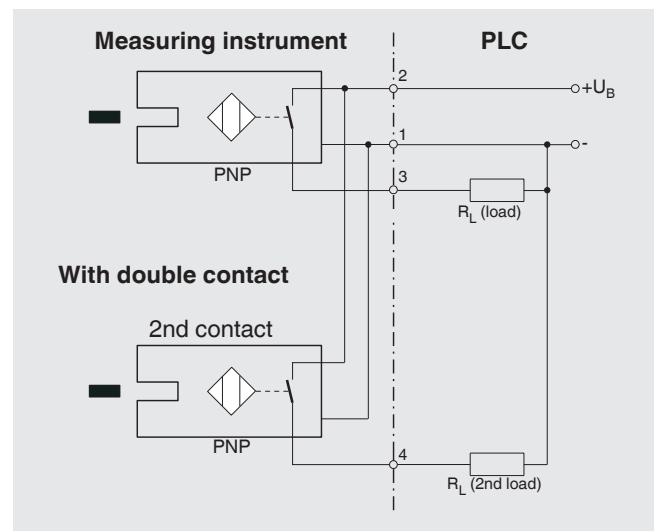
Control and switching electronics in the sensor, electrical connection via cable socket

- To connect a PLC control unit or for direct switching of small capacities
- PNP transistor
 - With PNP switching apparatus, the switched output is a connection towards PLUS. The load R_L between the switched output and minus must be chosen so that the maximum switching current of 100 mA is not exceeded.
- Flag emerges from slot sensor: Contact open (output not active)
- Flag retreats into slot sensor: Contact closed (output active)

2-wire system (standard)



3-wire system



Specifications for model 830 E, electronic contact

Specifications	
Auxiliary power	DC 10 ... 30 V
Residual ripple	max. 10 %
No-load current	≤ 10 mA
Switching current	≤ 100 mA
Residual current	≤ 100 μ A
Function of switching element	Normally open
Type of output	PNP transistor
Voltage drop (with I _{max.})	≤ 0.7 V
Reverse polarity protection	conditional U _B (the switched output 3 or 4 must never be connected directly to minus)
Anti-inductive protection	1 kV, 0.1 ms, 1 k Ω
Oscillator frequency	Approx. 1,000 kHz
EMC	Per EN 60947-5-2
Installation	Direct in measuring instrument, maximum 2 inductive contacts possible

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Scale ranges of thermometers

Scale spacing and numbering per EN 13190

WIKA data sheet IN 00.56

General information

Scale range, nominal size (NS, case diameter) and accuracy class of a thermometer determine the design of the scale. The European EN 13190 standard contains the specifications about the layout of dials with concentric scales. In addition to the scales in accordance with EN 13190, all internationally common scale ranges, double and multiple scales, coloured scales etc. are, of course, also available.

Scale ranges of EN 13190

Degree Celsius, abbreviated by °C, is the preferred unit for temperature measurement.

Not all thermometer versions can be used for the temperature ranges indicated below or on the right.

Nominal sizes

For dial thermometers, the following nominal sizes (NS) are defined: NS 40, 50, 63, 80, 100 and 160

Accuracy classes

The following accuracy classes are specified: class 1 and class 2. Class 1 is intended for nominal sizes from 63 to 160, class 2 for nominal sizes 40 to 160.

The reference value of the ambient temperature is 23 °C. Other reference values deviating from 23 °C or a reference range are permissible and must be specified by the purchaser.

Scale range °C	Measuring range °C	Error limits ± °C	
		Class 1	Class 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

Scale range in °F	Scale interval in °F
-100 ... +150	5
-80 ... +120	2
-80 ... +240	5
-40 ... +120	2
0 ... 140	2
0 ... 200	2
0 ... 250	5
30 ... 300	2
30 ... 400	5
50 ... 400	5
100 ... 800	10
150 ... 750	5
200 ... 1,000	10

Scale range °C	Measuring range °C	Error limits ± °C	
		Class 1	Class 2
-20 ... +40	-10 ... +30	1	2
-20 ... +60	-10 ... +50	1	2
-20 ... +120	0 ... 100	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

The measuring range must be equal to at least 2/3 of the scale range.

Start and end of the measuring range must be marked through triangles on the edge of the scale. The marking is omitted if the measuring range is equal to the scale range. Further display or measuring ranges may be agreed.

Scale angle



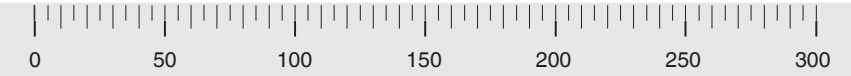

The scale angle is $270^\circ \pm 20^\circ$





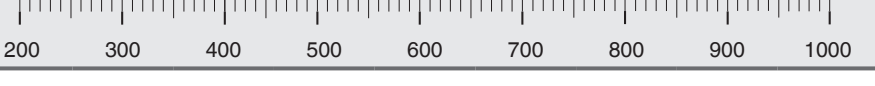

Scale interval

The scale interval must be selected from the following values: 1 °C, 2 °C, 5 °C and 10 °C

Examples for scale spacing and numbering of scales

Examples for accuracy class 1 to 2

Scale range °C	Measuring range °C	Order of scale marks and numbering for dial thermometers	Scale interval	Number of scale mark intervals
-40 ... +60 0 ... 100	-30 ... +50 10 ... 90		1 1	100
-20 ... 120	0 ... 100		2	70
0 ... 120	10 ... 110		2	60
-100 ... 60 0 ... 160	-80 ... +40 20 ... 140		2 2	80
0 ... 200	20 ... 180		2	100
0 ... 300	30 ... 270		5	60
0 ... 400	50 ... 350		5	80
0 ... 600	100 ... 500		10	60

Scale range °F	Measuring range °F	Order of scale marks and numbering for dial thermometers	Scale interval	Number of scale mark intervals
0 ... +140	20 ... 120		2	70
0 ... 200	20 ... 180		2	100
-80 ... +120	-60 ... +100		2	
50 ... 400	100 ... 350		5	70
150 ... 750	250 ... 650		10	60
200 ... 1000	300 ... 900		10	80

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Technical cleanliness of pointer measuring instruments of special versions

WIKA data sheet IN 00.58

Application area

This document describes manufacturing processes for special versions that require a very high technical cleanliness of the wetted parts.

This applies for mechanical and mechatronic pointer measuring instruments with stainless steel materials (e.g. 316L) and special materials (e.g. Monel, Hastelloy).



Instrument	Model
Bourdon tube pressure gauge	1, 2, 3
Diaphragm pressure gauge	4
Absolute pressure gauge	5
Capsule pressure gauge	6
Differential pressure gauge	7
Mechatronic pressure gauge	PGS, DPGS, PGT, DPGT, APGT
Bimetal thermometer	TG53, TG54, 55
Gas-actuated thermometer	73
Mechatronic thermometer	TGS55, TGS73, TGT73

Pointer measuring instruments with wetted parts from copper alloy (brass) and diaphragm seals are not considered in this technical information.

WIKA expertise

WIKA has decades of experience in the production of pressure gauges and thermometers guarantees a high level of cleanliness of the wetted parts. This is ensured, among other things, by the use of standardised processes and the support of the WIKA expert group for technical cleanliness.

For the pressure gauge version “Oil- and grease-free for oxygen”, WIKA confirms a hydrocarbon limit value of <math>< 550 \text{ mg/m}^2</math> for scale ranges $\leq 30 \text{ bar}$ [$\leq 400 \text{ psi}$] and <math>< 220 \text{ mg/m}^2</math> for scale ranges $> 30 \text{ bar}$ [$> 400 \text{ psi}$], based on periodically recurring tests (in line with ISO 15001:2012 and ASTM G93 level D/E).

Additional fundamental sampling tests (burn-out test when exposed to oxygen pressure surges) at external test centres confirm the basic suitability of the “Oil and grease-free for oxygen” version of pressure gauges for this medium.

These special versions, and the additional cleaning-related manufacturing processes carried out for them, are described below.

Version: “Silicone-free”

Silicone-free or silicone oil-free means that all components in contact with the atmosphere must be largely free of silicone. This requirement is often made for paint finishing systems (e.g. in the automotive industry). The smallest silicone residues can lead to painting defects (so-called silicone craters) and ruin the painting result.

However, for process and production reasons, it is not possible to provide general confirmation of the absence of paint wetting impairment substances (freedom from PWIS) by selecting this version.

Cleaning steps in the production process

- If necessary, thorough hand cleaning before starting production, without the use of skin care products (hand cream)
- Regular cleanliness checks and, if necessary, cleaning of equipment (test and adjustment benches)
- Avoidance of assembly aids with silicone-containing, paint wetting impairment substances, where possible
- No storage of silicone or lubricating materials in the vicinity of the production process, where possible
- Selected models (e.g. diaphragm pressure gauges) receive separate cleaning and drying of selected parts and assemblies before assembly (also for internal surfaces)
- 100% cleaning of the surrounding parts of the instrument before packaging
- Individual packaging in silicone-free, sealable or heat-sealed plastic bag

Marking “Silicone-free”



Version: “Oil- and grease-free”

The requirement for internal parts to be free of oil and grease is often made in the food and pharmaceutical industries. This requirement also exists in other sectors such as industrial gases, water and wastewater, machine building and automation.

Cleaning steps in the production process

- Regular cleanliness checks and, if necessary, cleaning of equipment (test and adjustment benches)
- The instruments are primarily adjusted using oil- and grease-free, dry compressed air or nitrogen. For higher pressure ranges, adjustment is only possible with water, followed by drying of all wetted parts in a vacuum oven.
- Particularly thorough visual inspection of the surfaces before shipping

Marking “Oil- and grease-free”



Version: “Oil and grease-free for oxygen”

The use of oxygen is very versatile and widespread. The demands are extremely high due to the easy flammability and high explosion risk of oxygen. Oil and grease are particularly dangerous in the presence of oxygen, as they can easily be an ignition source and burn with explosive ferocity. This ignition source is not always obvious in piping systems. A fire can be caused by friction, high flow rates, heating due to turbulence or adiabatic compression. For example, gas with a high flow rate can suddenly hit an obstacle, e.g. a closed valve. If pipe connections are contaminated with mineral oils or greases, oxidation reactions with the carbon components can easily occur. The resulting high temperatures can then lead to spontaneous combustion and trigger a chain reaction.

For oxygen applications, WIKA recommends the use of a restrictor in the process connection to reduce the rate of pressure increase in the measuring system.

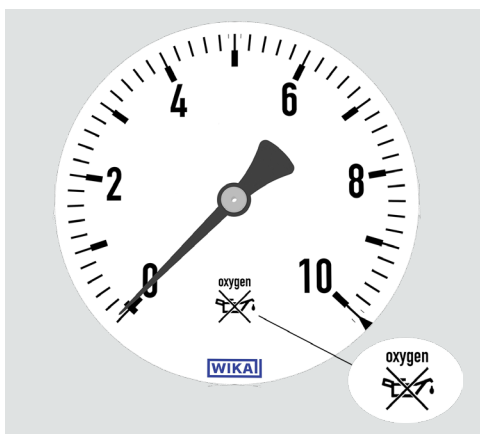
Applications of oxygen

- Breathing gas in medicine and aerospace
- Oxidising agents in combustion processes to achieve high temperatures
- Metallurgy, in pig iron and steel production and in copper refining
- Chemistry and biology
 - Olefin oxidation, partial oxidation of coal and heavy oil
 - Production of hydrogen and synthesis gas, sulphuric and nitric acid, acetylene
- Welding, cutting, separating, flame annealing
- Drinking water and wastewater treatment
- Semiconductor technology
- Fuel cells

Cleaning steps in the production process

- Regular cleanliness checks and, if necessary, cleaning of equipment (test and adjustment benches)
- The instruments are primarily adjusted using oil- and grease-free, dry compressed air or nitrogen. For higher pressure ranges, only adjustment with water is possible. In this case, the entire measuring system is then dried in a vacuum oven.
- Use of wetted materials, system fill fluids and casing fill fluids that are suitable or approved for use in conjunction with oxygen
- Before installation, the wetted parts are cleaned (e.g. in an ultrasonic bath) and then dried again. This also applies, in particular, to internal surfaces.
- After cleaning, internal transport is carried out in separately sealed and cleaned transport containers.
- The instruments are largely handled with gloves, so as not to contaminate internal parts
- Particularly thorough visual inspection of the surfaces
- The process connection is usually sealed with a protective cap for shipping
- Instruments are packed in sealed plastic bags (sometimes with desiccant)

Marking “Oil and grease-free for oxygen”



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