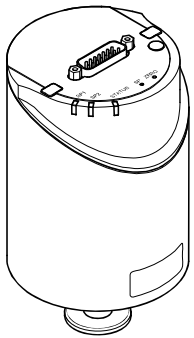
A PASSION FOR PERFECTION

PFEIFFER VACUUM



CCR 371 … CCR 375

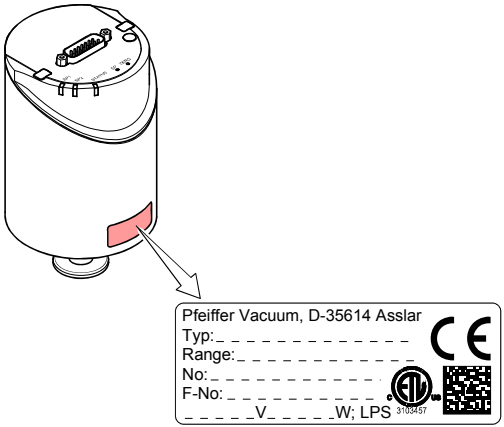
Ceramic Capacitance Gauge

Operating Instructions

BG 5139 BEN / A (2012-11)

Product Identification

In all communications with Pfeiffer Vacuum, please specify the information given on the product nameplate. For convenient reference copy that information into the space provided below.



Validity

This document applies to products with the following part numbers:

Type	Part number	Flange	Torr	Pascal	mbar
CCR 371	PT R28 100	½" Rohr	10^{-1} … 1000 (F.S.)	1.33×10^{1} … 133'322 (F.S.)	1.33×10^{-1} … 1333 (F.S.)
	PT R28 101	DN 16 ISO-KF			
	PT R28 102	DN 16 CF-R			
	PT R28 103	8 VCR®			
CCR 372	PT R28 110	½" Rohr	10^{-2} … 100 (F.S.)	1.33×10^{0} … 13'332.2 (F.S.)	10^{-2} … 133 (F.S.)
	PT R28 111	DN 16 ISO-KF			
	PT R28 112	DN 16 CF-R			
	PT R28 113	8 VCR®			
CCR 373	PT R28 120	½" Rohr	10^{-3} … 10 (F.S.)	1.33×10^{-1} … 1'333.22 (F.S.)	10^{-3} … 13.3 (F.S.)
	PT R28 121	DN 16 ISO-KF			
	PT R28 122	DN 16 CF-R			
	PT R28 123	8 VCR®			
CCR 374	PT R28 130	½" Rohr	10^{-4} … 1 (F.S.)	1.33×10^{-2} … 133.322 (F.S.)	10^{-4} … 1.3 (F.S.)
	PT R28 131	DN 16 ISO-KF			
	PT R28 132	DN 16 CF-R			
	PT R28 133	8 VCR®			
CCR 375	PT R28 140	½" Rohr	10^{-5} … 0.1 (F.S.)	1.33×10^{-3} … 13.3322 (F.S.)	10^{-5} … 0.13 (F.S.)
	PT R28 141	DN 16 ISO-KF			
	PT R28 142	DN 16 CF-R			
	PT R28 143	8 VCR®			

The part number (No) can be taken from the product nameplate.

If not indicated otherwise in the legends, the illustrations in this document correspond to CCR 37X gauges with the DN 16 ISO-KF vacuum connection. They apply to other vacuum connections by analogy.

We reserve the right to make technical changes without prior notice.

All dimensions in mm.

Intended Use

The temperature controlled Capacitance Diaphragm Gauges of the CCR 37X series are intended for absolute pressure measurement of gases in their respective pressure ranges (→ 🗎 3).

Functional Principle

A ceramic diaphragm is deflected by pressure. The deflection is measured capacitively and converted into an analog linear output signal by the digital electronics.

The output signal is independent of the gas type.

Very accurate pressure measurement is achieved by heating the sensor to a constant temperature of 45°C which results in a compensation of changes in the ambient conditions and a reduced deposition of process products and by-products in process applications.

Trademark

VCR® Swagelok Marketing Co.

Patents

EP 1070239 B1, 1040333 B1

US Patents 6528008, 6591687, 7107855, 7140085

Scope of Delivery

1× gauge CCR 37X in clean room packaging
1× pin for adjusting settings via buttons
1× Calibration Test Report
1× Operating Instructions German
1× Operating Instructions English

Contents

For cross-references within this document, the symbol (→ 🗎 XY) is used.

1 Safety

1.1 Symbols Used

DANGER

Information on preventing any kind of physical injury.

WARNING

Information on preventing extensive equipment and environmental damage.

Caution

Information on correct handling or use. Disregard can lead to malfunctions or minor equipment damage.

Notice

<…> Labeling

1.2 Personnel Qualifications

Skilled personnel

All work described in this document may only be carried out by persons who have suitable technical training and the necessary experience or who have been instructed by the end-user of the product.

1.3 General Safety Instructions

- Adhere to the applicable regulations and take the necessary precautions for the process media used.

  Consider possible reactions with the product materials.
- Adhere to the applicable regulations and take the necessary precautions for all work you are going to do and consider the safety instructions in this document.
- Before beginning to work, find out whether any vacuum components are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Communicate the safety instructions to all other users.

1.4 Liability and Warranty

Pfeiffer Vacuum assumes no liability and the warranty becomes null and void if the end-user or third parties

- disregard the information in this document
- use the product in a non-conforming manner
- make any kind of interventions (modifications, alterations etc.) on the product
- use the product with accessories not listed in the product documentation.

The end-user assumes the responsibility in conjunction with the process media used.

Gauge failures due to contamination or wear and tear are not covered by the warranty.

2 Technical Data

Measurement range	→ "Validity"
Accuracy [1]	0.15% of reading
Temperature effect on zero	
PT R28 100 … PT R28 133	0.0025% F.S./ °C
PT R28 140 … PT R28 143	0.0050% F.S./ °C
Temperature effect on span	0.01% of reading / °C
Resolution	0.003% F.S.
Gas type dependence	none
Output signal analog (measuring signal)	
Voltage range	0 … +10 V
Measuring range	–5 … +10.24 V (limited to +10.24 V)
Relationship voltage-pressure	linear
Output impedance	0 Ω (short-circuit proof)
Loaded impedance	>10 kΩ
Response time [2]	
PT R28 100 … PT R28 133	30 ms
PT R28 140 … PT R28 140	130 ms
Gauge identification	
Resistance R_{ident}	Resistance 13.2 kΩ referenced to supply common
Voltage	≤5 V

[1] Non-linearity, hysteresis, repeatability in the calibrated range at 25 °C ambient operating temperature without temperature effects after operation of 2 h.

[2] Increase 10 … 90 % F.S.R.

Switching functions	SP1, SP2
Setting range	0 … 99% F.S. (0 … 9.9 V)
Hysteresis	1% F.S.
Relay contact	30 VDC/ ≤0.5 ADC floating (n.o.)
closed	$p \leq p_{SP}$ (LED on)
open	$p \geq p_{SP}$ (LED off)
Switching time	≤50 ms

Status relay	
closed	measurement mode warning
open	no supply voltage warming up error

Supply

DANGER

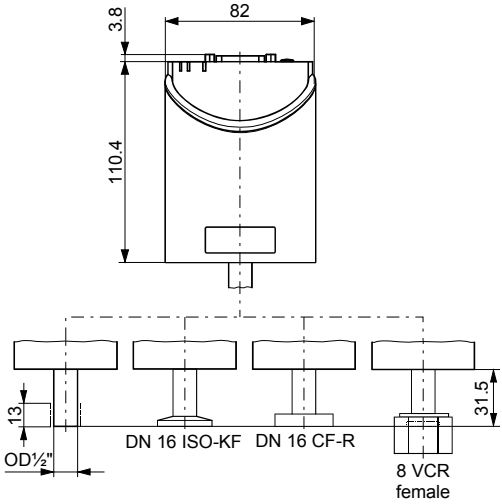
The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

Supply voltage	
at the gauge	+14 … +30 VDC or ±15 V (±5%) Class 2 / LPS
Ripple	≤1 V_{pp}
Power consumption	
while being heated	≤12 W
at operating temperature	≤8 W

The gauge is protected against reverse polarity of the supply voltage and overload.

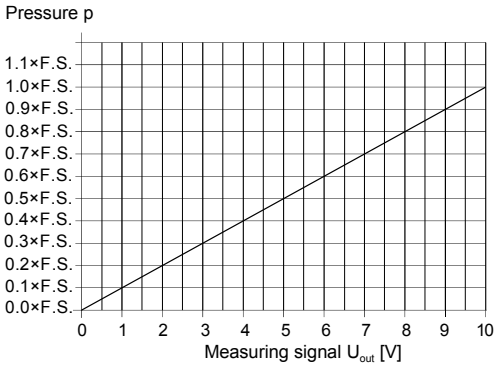
Power connection	15-pin D-Sub, male
Sensor cable	15-pin plus shielding
Cable length	
Supply voltage 15 V	≤ 8 m (0.14 mm²/conductor) ≤15 m (0.25 mm²/conductor)
Supply voltage 24 V	≤43 m (0.14 mm²/conductor) ≤75 m (0.25 mm²/conductor)
Supply voltage 30 V	≤88 m (0.14 mm²/conductor) ≤135 m (0.25 mm²/conductor)
For longer cables, larger conductor cross-sections are required (R_{cable} ≤1.0 Ω).	
Grounding concept	→ "Power Connection"
Materials exposed to vacuum	ceramics (Al_2O_3 ≥99.5%), stainless steel AISI 316L
Internal volume	≤4.2 cm^3
Admissible pressure (absolute)	
1000 F.S.	300 kPa
1 / 10 / 100 F.S.	200 kPa
0.1 F.S.	130 kPa
Bursting pressure (absolute)	600 kPa
Admissible temperatures	
Storage	–40 °C … +65 °C
Operation	+10 °C … +40 °C
Bakeout (not in operation)	≤110 °C at the flange
Relative humidity	≤80% at temperatures ≤+31 °C decreasing to 50% at +40°C
Use	indoors only, altitude up to 2000 m NN
Degree of protection	IP 40

Dimensions [mm]



Weight	837 … 897 g

Analog Measuring Signal vs. Pressure



$$p = (U_{out} / 10\ V) \times p\ (F.S.)$$

Conversion Torr ↔ Pascal

	Torr	mbar [3]	Pa [3]
c	1.00	1013.25 / 760 = 1.3332…	101325 / 760 = 133.3224…

Example: Gauge with 10 Torr F.S.
Measurement signal U_{out} = 6 V

$$p = (6\ V / 10\ V) \times 10\ Torr$$
$$= 0.6 \times 10\ Torr = \mathbf{6\ Torr}$$

[3] Source: NPL (National Physical Laboratory)
Guide to the Measurement of Pressure and Vacuum,
ISBN 0904457x / 1998

3 Installation

WARNING

WARNING: fragile components

The ceramic sensor may be damaged by impacts.

Do not drop the product and prevent shocks and impacts.

3.1 Vacuum Connection

DANGER

DANGER: overpressure in the vacuum system >1 bar

Injury caused by released parts and harm caused by escaping process gases can result if clamps are opened while the vacuum system is pressurized.

Do not open any clamps while the vacuum system is pressurized. Use the type clamps which are suited to overpressure.

DANGER

DANGER: overpressure in the vacuum system >2.5 bar

KF flange connections with elastomer seals (e.g. O-rings) cannot withstand such pressures. Process media can thus leak and possibly damage your health.

Use O-rings provided with an outer centering ring.

DANGER

DANGER: protective ground

Products that are not correctly connected to ground can be extremely hazardous in the event of a fault.

Electrically connect the gauge to the grounded vacuum chamber. This connection must conform to the requirements of a protective connection according to EN 61010:

- CF and VCR flanges fulfill this requirement.
- For gauges with a KF flange, use a conductive metallic clamping ring.
- For gauges with a ½" tube, take appropriate measures to fulfill this requirement.

Caution

Caution: vacuum component

Dirt and damages impair the function of the vacuum component.

When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages.

Caution

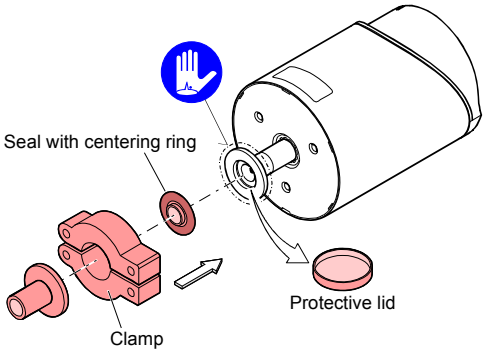
Caution: dirt sensitive area

Touching the product or parts thereof with bare hands increases the desorption rate.

Always wear clean, lint-free gloves and use clean tools when working in this area.

Mount the gauge so that no vibrations occur. The gauge may be mounted in any orientation. To keep condensates and particles from getting into the measuring chamber preferably choose a horizontal to upright position. If adjustment should be possible after the gauge has been installed, be sure to install it so that the buttons can be accessed with a pin.

Remove the protective lid and connect the product to the vacuum system.



Keep the protective lid.

3.2 Power Connection

Make sure the vacuum connection is properly made (→ 13).

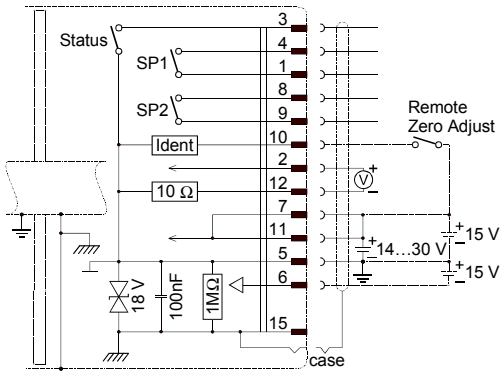
DANGER

The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.

Ground loops, differences of potential, or EMC problems may affect the measurement signal. For optimum signal quality, please do observe the following notes:

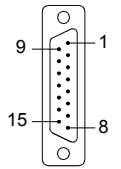
- Use an overall metal braided shielded cable. The connector must have a metal case.
- Connect the cable shield to ground at one side via the connector case. Make sure the connector case has direct contact to the cable's shield on its whole circumference. Do not connect the other side of the shield.
- Connect the supply common with protective ground directly at the power.
- Use differential measurement input (signal common and supply common conducted separately).
- Potential difference between supply common and housing ≤18 V (overvoltage protection).

❶ If no sensor cable is available, make one according to the following diagram (cable length and conductor cross-sections → 🗎 10).



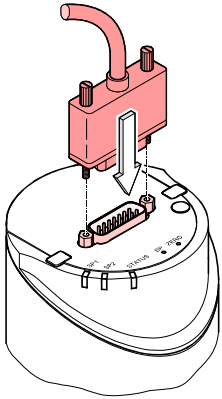
Electrical connection

Pin 1, 4	Relay SP1, closing contact
Pin 2	Signal ouput (measurement signal) or thresholds SP1/2
Pin 3	Status
Pin 5	Supply common
Pin 6	Supply (-15 V)
Pin 7, 11	Supply (+14 ... +30 V or +15 V)
Pin 8, 9	Relay SP2, closing contact
Pin 10	Gauge identification or Remote Zero Adjust
Pin 12	Signal common
Pin 15	Housing (Chassis Ground)
case	Connector case



15-pin
D-Sub female
soldering side

❷ Connect the sensor cable to the gauge and secure it using the lock screw.



❸ Connect the sensor cable to the controller.

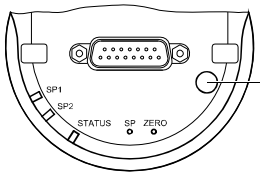
4 Operation

Put the gauge into operation.

A warm-up time of at least ½ hour should be allowed; for exact pressure measurements a warm-up time of at least 2 hours is required.

If the gauge is used for fast downstream pressure control we recommend setting its signal filter to "fast".

4.1 Status Indication



LED	LED status	Meaning
<STATUS>	off	no supply voltage
	lit solid green	measurement mode
	blinking green	
	short blinks	warning, over/underrange
	long blinks	warming up
	lit solid red	error
<SP1>	lit green green	p ≤ setpoint 1
	blinking green	waiting for setpoint 1 input
	off	p > setpoint 1
<SP2>	lit solid green	p ≤ setpoint 2
	blinking green	waiting for setpoint 2 input
	off	p > setpoint 2

4.2 Zeroing the Gauge

The gauge is factory calibrated while "standing upright" (→ "Calibration Test Report").

We recommend performing a zero adjustment, when the gauge is operated for the first time.

Due to long time operation or contamination, a zero drift could occur and zero adjustment may become necessary.

For adjusting the zero, operate the gauge under the same constant ambient conditions and in the same mounting orientation as normally.

The output signal (measuring signal) is depending on the mounting orientation. The signal difference between the vertical and horizontal mounting orientation is:

F.S.	ΔU / 90°
1000 Torr	≈2 mV
100 Torr	≈10 mV
10 Torr	≈50 mV
1 Torr	≈300 mV
0.1 Torr	≈1.8 V

If the gauge is operated via a controller, the zero of the whole measuring system has to be adjusted on the controller: first, adjust the zero of the gauge and then, the zero of the controller.

4.2.1 <ZERO> Adjustment

The zero can be adjusted via

- the <ZERO> button on the gauge,
- the digital input "Remote Zero" (briefly apply the supply voltage (+14 … +30 V) to pin 10),
- a Pfeiffer Vacuum Gauge Controller.

While the gauge is being heated and/or under atmospheric pressure, the zeroing function is locked in order for operating errors to be prevented.

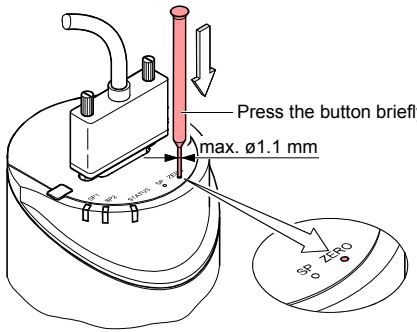
❶ Evacuate the gauge to a pressure according to the table below:

F.S.	Recommended final pressure for zero adjustment		
1000 Torr	$<5\times10^{-2}$ Torr	$<6.65\times10^{0}$ Pa	$<5\times10^{-2}$ mbar
100 Torr	$<5\times10^{-3}$ Torr	$<6.65\times10^{-1}$ Pa	$<5\times10^{-3}$ mbar
10 Torr	$<5\times10^{-4}$ Torr	$<6.65\times10^{-2}$ Pa	$<5\times10^{-4}$ mbar
1 Torr	$<5\times10^{-5}$ Torr	$<6.65\times10^{-3}$ Pa	$<5\times10^{-5}$ mbar
0.1 Torr	$<5\times10^{-6}$ Torr	$<6.65\times10^{-4}$ Pa	$<5\times10^{-6}$ mbar

If the final pressure is too high for zero adjustment (>25% of the F.S.), the zero cannot be reached and the <STATUS> LED blinks green. If this is the case, activate the factory setting and adjust the zero again (→ 🗎 28).

❷ Operate the gauge for at least 1 hour (until the signal is stable).

❸ Briefly press the <ZERO> button with a pin (max. ø1.1 mm). The zero adjustment runs automatically. The <STATUS> LED blinks until the adjustment (duration ≤8 s) is completed.



After zero adjustment the gauge automatically returns to measurement mode. The <STATUS> LED lit.

The <STATUS> LED blinks green if

- the signal output is negative (< -20 mV) when the final pressure has been attained
- the zero adjustment has failed.

4.2.2 <ZERO> Adjustment with Ramp Function

The ramp function allows to adjust the zero at a known reference pressure within the measurement range of the gauge.

It also permits to adjust an offset of the characteristic curve in order to

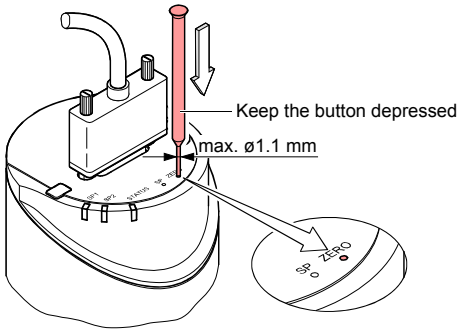
- compensate for the offset of the measuring system or
- obtain a slightly positive zero for a 0 … 10 V AD converter.

The offset should not exceed 2% of the F.S. (+200 mV). At a higher positive offset, the upper limit of the measurement range is exceeded.

Recommended procedure for adjusting the offset of a measuring system: → Notice 🗎 20.

❶ Operate the gauge for at least 1 hour (until the signal is stable).

❷ Push the <ZERO> button with a pin (max. ø1.1 mm) and keep it depressed. The <STATUS> LED starts blinking. After 5 s, the zero adjustment value, starting at the current output value, keeps continually changing (ramp) until the button is released or until the setting limit (max. 25% F.S.) is reached. The corresponding output signal is delayed by about 1 s.



❸ Push the <ZERO> button again:

Fine adjustment within 0...3 s:	the zero adjustment value changes by one unit (push <ZERO> button in intervals of 1 s)
Change of direction within 3...5 s:	the zero adjustment changes its direction (the blinking frequency of the <STATUS> LED changes briefly)

If the <ZERO> button is released for more than 5 s, the gauge returns to the measurement mode.

The <STATUS> LED blinks green if the signal output is negative (< -20 mV).

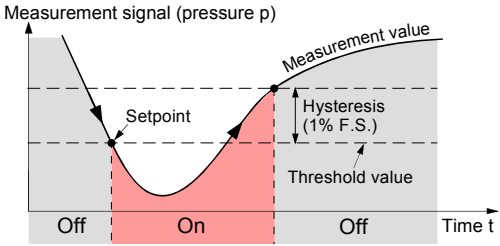
4.3 Switching Functions

The two switching functions can be set to any pressure within the measurement range of the gauge (→ 🗎 12).

The current setpoint setting

- can be read/written via the diagnostic port,
- is output at the D-Sub connector instead of the measurement signal (→ 🗎 17) and can be measured with a voltmeter after the <SP> button is pressed, or
- can be read/written via the RS232C interface.

If the pressure is lower than the setpoint, the corresponding LED (<SP1> or <SP2>) is lit solid and the corresponding relay (→ 🗎 17) is energized.



4.3.1 Adjusting the Setpoints

DANGER

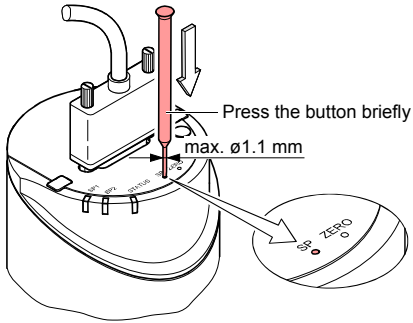
DANGER: malfunction

If processes are controlled via the signal output, keep in mind that by pushing the <SP> button the measurement signal is suppressed and the corresponding threshold value is output instead. This can cause malfunctions.

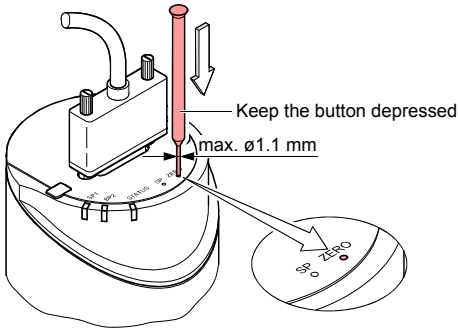
Push the <SP> button only if you are sure that no damages can arise from a malfunction.

Adjusting Setpoint <1>

❶ Push the <SP> button with a pin (max. ø1.1 mm). The gauge changes to the switching function mode and outputs the current threshold value at the measurement value output for about 10 s (LED <1> blinks).



❷ For changing the threshold value, push the <ZERO> button and keep it depressed. The threshold keeps changing from the current value (ramp) until the button is released or until the limit of the setting range is reached.



❸ Push the <ZERO> button again:

Fine adjustment within 0...3 s:	the zero adjustment value changes by one unit
Change of direction within 3...5 s:	the zero adjustment changes its direction (the blinking frequency of the <STATUS> LED changes briefly)

If the <ZERO> button is released for more than 5 s, the gauge returns the measurement mode.

The upper threshold is automatically set 1% F.S. above the lower one (hysteresis).

Adjusting Setpoint <2>

Push the <SP> button twice (the LED <2> blinks). The adjustment procedure is the same as for setpoint <1>.

4.4 Activating the Factory Setting (Factory Reset)

All user defined parameters (e.g. zero, filter) are restored to their default values.

Loading of the default parameters is irreversible.

Loading the default parameters:

1. Put the gauge out of operation.
2. Keep the <ZERO> button depressed for at least 5 s while the gauge is being put into operation (Power ON).

5 Deinstallation

WARNING

WARNING: fragile components

The ceramic sensor may be damaged by impacts.

Do not drop the product and prevent shocks and impacts.

DANGER

DANGER: contaminated parts

Contaminated parts can be detrimental to health and environment.

Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Caution

Caution: vacuum component

Dirt and damages impair the function of the vacuum component.

When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages.

Caution

Caution: dirt sensitive area

Touching the product or parts thereof with bare hands increases the desorption rate.

Always wear clean, lint-free gloves and use clean tools when working in this area.

1. Vent the vacuum system.
2. Put the gauge out of operation.
3. Unfasten the lock screw and disconnect the sensor cable.
4. Remove the gauge from the vacuum system and install the protective lid.

6 Maintenance, Repair

Under clean operating conditions, the product requires no maintenance.

Gauge failures due to contamination or wear and tear are not covered by the warranty.
We recommend checking the zero at regular intervals (→ 20).

Pfeiffer Vacuum assumes no liability and the warranty becomes null and void if any repair work is carried out by the end-user or third parties.

7 Returning the Product

WARNING

WARNING: forwarding contaminated products

Contaminated products (e.g. radioactive, toxic, caustic or microbiological hazard) can be detrimental to health and environment.

Products returned to Pfeiffer Vacuum should preferably be free of harmful substances. Adhere to the forwarding regulations of all involved countries and forwarding companies and enclose a duly completed declaration of contamination *).

*) Form under www.pfeiffer-vacuum.com

Products that are not clearly declared as "free of harmful substances" are decontaminated at the expense of the customer.

Products not accompanied by a duly completed declaration of contamination are returned to the sender at his own expense.

8 Disposal

DANGER

DANGER: contaminated parts

Contaminated parts can be detrimental to health and environment.

Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

WARNING

WARNING: substances detrimental to the environment

Products or parts thereof (mechanical and electric components, operating fluids etc.) can be detrimental to the environment.

Dispose of such substances in accordance with the relevant local regulations.

Separating the components

After disassembling the product, separate its components according to the following criteria:

- Contaminated components

  Contaminated components (radioactive, toxic, caustic or biological hazard etc.) must be decontaminated in accordance with the relevant national regulations, separated according to their materials, and disposed of.

- Other components

  Such components must be separated according to their materials and recycled.

Conversion Table

	mbar	bar	Pa	hPa	kPa	Torr mm HG
mbar	1	1×10^{-3}	100	1	0.1	0.75
bar	1×10^{3}	1	1×10^{5}	1×10^{3}	100	750
Pa	0.01	1×10^{-5}	1	0.01	1×10^{-3}	7.5×10^{-3}
hPa	1	1×10^{-3}	100	1	0.1	0.75
kPa	10	0.01	1×10^{3}	10	1	7.5
Torr mm HG	1.332	1.332×10^{-3}	133.32	1.3332	0.1332	1

1 Pa = 1 N/m^2

ETL Certification

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ETL LISTED

The products CCR 371 … CCR 375 comply with the requirements of the following Standards:
UL 61010-1, Issued: 2004/07/12 Ed: 2 Rev: 2005/07/22
CAN/CSA C22.2#61010-1, Issued: 2004/07/12

EC Declaration of Conformity

CE

We, Pfeiffer Vacuum, hereby declare that the equipment mentioned below complies with the provisions of the Directive relating to electromagnetic compatibility 2004/108/EC and the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2011/65/EU.

Ceramic Capacitance Gauge

CCR 371 … CCR 375

Standards

Harmonized and international/national standards and specifications:

- EN 61000-6-2:2005 (EMC: generic immunity standard)
- EN 61000-6-3:2007 (EMC: generic emission standard)
- EN 61010-1:2001 (Safety requirements for electrical equipment for measurement, control and laboratory use)
- EN 61326-1:2006 (EMC requirements for electrical equipment for measurement, control and laboratory use)

Manufacturer / Signature

Pfeiffer Vacuum GmbH, Berliner Straße 43, D-35614 Asslar

19 December 2012

Manfred Bender
Managing director

19 December 2012

Dr. Matthias Wiemer
Managing director

Notes

Vacuum solutions from a single source

Pfeiffer Vacuum stands for innovative and custom vacuum solutions worldwide, technological perfection, competent advice and reliable service.

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Original: German BG 5139 BDE / A (2012-11)

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