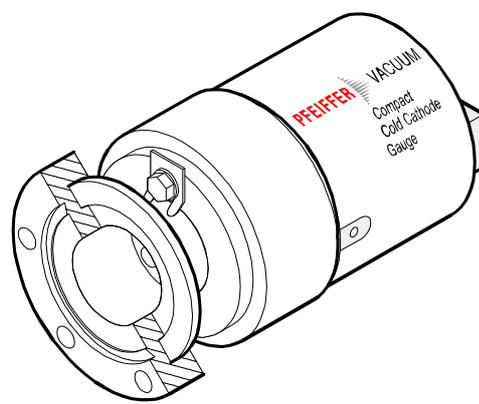


Compact Cold Cathode Gauge

FPM sealed

IKR 251



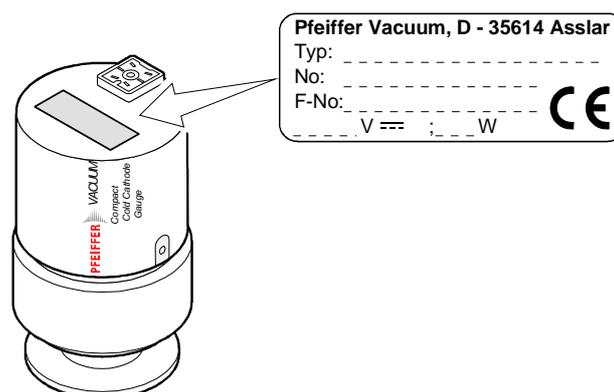
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For cross references within this document, the symbol (→  XY) is used, for references to other documents, the symbol (→  [Z]).

Product Identification

In all communications with Pfeiffer Vacuum, please specify the information given on the product nameplate.



Validity

This document applies to products with the following part numbers

PTR25500	(DN 25 ISO-KF flange)
PTR25501	(DN 40 ISO-KF flange)
PTR25502	(DN 40 CF-F flange)

The part number can be taken from the product nameplate.

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

Intended Use

The Compact Cold Cathode Gauge IKR 251 has been designed for vacuum measurement in a pressure range of 2×10^{-9} ... 1×10^{-2} mbar.

The IKR 251 can be used with a Pfeiffer Vacuum measurement unit for Compact Gauges or with another evaluation unit.

Functional Principle

Over the whole measurement range, the measuring signal is output as a logarithm of the pressure.

If functions with a cold cathode ionization measurement circuit (according to the inverted magnetron principle).

1 Safety

1.1 Symbols Used



Information on preventing any kind of physical injury.



Information on preventing extensive equipment and environmental damage.



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

1.2 Personnel Qualifications



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 custodian of the product.

1.3 Safety Information

- Adhere to the applicable regulations and take the necessary precautions for the process media used.
Consider possible reactions between the materials (→ 6) and the process media.
Consider possible reactions of the process media due to the heat generated by the product.
- Adhere to the applicable regulations and take the necessary precautions for all work you are going to do and consider the safety information in this document.
- Before you begin to work, find out whether any vacuum components are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts.

Pass on the safety information to other users.

1.4 Liability and Warranty

Pfeiffer Vacuum assumes no liability and the warranty becomes null and void if the custodian or third parties

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

The custodian assumes the responsibility in conjunction with the process media used.

2 Technical Data

Admissible temperatures	
Storage	-40 °C ... +65 °C
Operation	+5 °C ... +55 °C
Bakeout	+150 °C (without electronics unit and magnetic shielding)
Relative humidity	max. 80% at temperatures $\leq +31$ °C decreasing to 50% at +40 °C
Use	indoors only altitude up to 2000 m (6600 ft)

Measurement range (air, N ₂)	2×10 ⁻⁹ ... 1×10 ⁻² mbar
Accuracy	≈±30% in the range 1×10 ⁻⁸ ... 1×10 ⁻³ mbar
Reproducibility	≈±5% in the range 1×10 ⁻⁸ ... 1×10 ⁻³ mbar
Gas type dependence	→ Appendix B

Adjustment	The gauge is adjusted at the factory and requires no maintenance.
Type of protection	IP 40
Maximum pressure (absolute)	10 bar only for inert gases <55 °C

Supply



DANGER

The gauge may only be connected to supply or measurement units that conform to the requirements of a grounded protective extra-low voltage (SELV-E according to EN 61010). The connection to the gauge has to be fused.¹⁾

Voltage at the gauge	15.0 ... 30.0 VDC (max. ripple 1 V _{pp})
Power consumption	≤2 W
Fuse ¹⁾	≤1 AT

The minimum voltage of the power supply must be increased proportionally to the length of the measuring cable.

Voltage at the supply unit with maximum cable length	16.0 ... 30.0 VDC (max. ripple 1 V _{pp})
--	--

Electrical connection	Hirschmann compact connector type GO 6, 6 pins, male
Cable	5 poles plus screening
Maximum cable length	100 m (0.25 mm ² conductor) 150 m (0.34 mm ² conductor) 500 m (1.0 mm ² conductor)

Operating voltage (in the measuring chamber)	≤3.3 kV
Operating current (in the measuring chamber)	≤500 μA

¹⁾ Pfeiffer Vacuum measurement and control units for Compact Gauges fulfill these requirements.

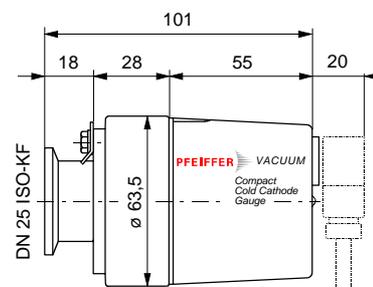
Output signal (measuring signal)	
Voltage range	≈ 0 V ... ≈ +10.5 V
Relationship voltage-pressure	logarithmic, increase 1 V / decade (→ Appendix A)
Error signals	<0.5 V (no supply)
Output impedance	2×10 Ω
Normal load	100 kΩ
Minimum load	10 kΩ, short-circuit proof
Response time	pressure dependent
p > 10 ⁻⁶ mbar	<10 ms
p = 10 ⁻⁸ mbar	≈ 1 s

Gauge identification	5.1 kΩ resistor referenced to supply common → Figure 2
Grounding concept	→ Figure 2
Vacuum flange-measurement common	connected via 10 kΩ (max. voltage differential with respect to safety ±50 V with respect to accuracy ±10 V)
Supply common-signal common	conducted separately; differential measurement recommended for cable lengths ≥10 m

PTR25500 (DN 25 ISO-KF)

Materials exposed to the vacuum	
Feedthrough isolation	ceramic (Al ₂ O ₃)
Internal seals	FPM75
Flange	stainless steel (1.4104)
Measuring chamber	stainless steel (1.4104)
Anode	Mo
Ignition aid	stainless steel (1.4310/AISI 301)
Internal volume	≈ 20 cm ³

Dimensions [mm]

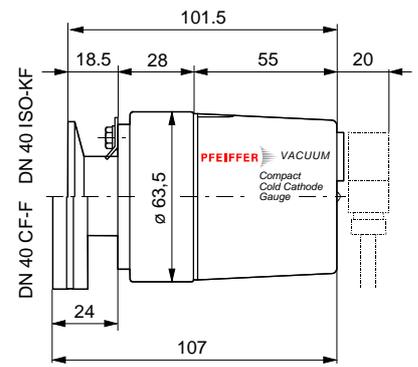


Weight	700 g
--------	-------

PTR25501 (DN 40 ISO-KF)
PTR25502 (DN 40 CF-F)

Materials exposed to the vacuum	
Feedthrough isolation	ceramic (Al ₂ O ₃)
Internal seals	FPM75
Flange	stainless steel (1.4306/AISI 304L)
Measuring chamber	stainless steel (1.4104)
Anode	Mo
Ignition aid	stainless steel (1.4310/AISI 301)
Internal volume	≈20 cm ³

Dimensions [mm]



Weight

700 g (DN 40 ISO-KF flange)
950 g (DN 40 CF-F flange)

3 Installation

3.1 Vacuum Connection



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.

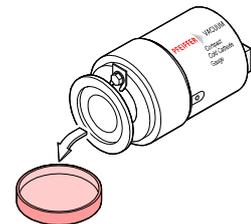
The gauge can be mounted in any orientation. However, it should be mounted so that any particles present cannot penetrate into the measuring chamber (→ 12). See "Technical data" (→ 5 ff.) for space requirements.

Procedure

- 1 Remove the protective cap.

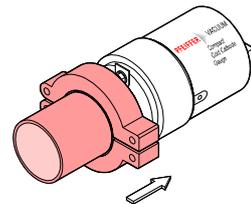


The protective cap will be needed for maintenance work.



- 2 Make the flange connection.

When making a CF flange connection, it can be advantageous to temporarily remove the magnet unit (→ section 3.1.1).



DANGER



Caution: overpressure in the vacuum system > 4 bar

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

Use sealing rings provided with an outer centering ring.



DANGER



Caution: overpressure in the vacuum system > 1 bar

If clamps are opened unintentionally injury can be caused by catapulted parts.

Use the type of clamps which can only be opened and closed by means of a tool (e.g. hose clip clamping ring).



DANGER



The gauge must be electrically connected to the grounded vacuum chamber. The connection must conform to the requirements of protective connection according to EN 61010:

- CF flanges fulfill this requirement
- For gauges with KF flanges, use a conductive metallic clamping ring.

3.1.1 Removing the Magnet Unit (Only for Gauges With CF Flanges)

Tools required

- Allen wrench 1.5 mm
- Open-end wrench 7.0 mm

Procedure

- Unfasten the hexagon socket set screw (1) on the side of the electronics unit (2) (→ Figure 1).
- Remove the electronics unit.
- Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.

Caution

The magnetic force and the tendency to tilt make it more difficult to separate the magnet unit and the measuring chamber (7).

- Make the flange connection between the gauge and the vacuum system.
- Remount the magnet unit and lock it with the hexagon head screw (3).
- Carefully mount the electronics unit (2).
- Push the electronics unit up to the mechanical stop and lock it with the hexagon socket set screw (1).

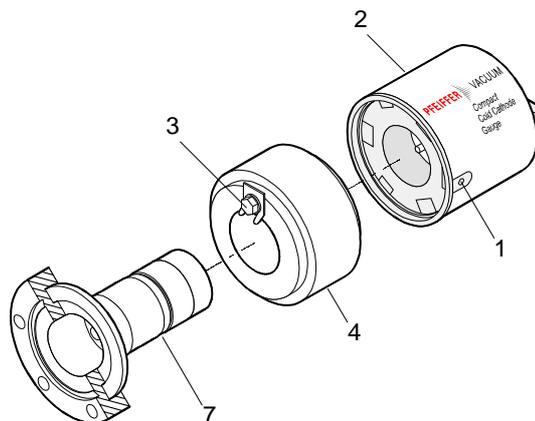


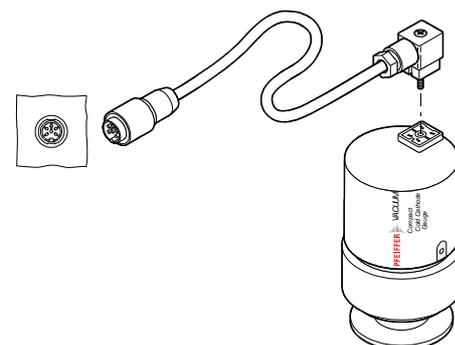
Figure 1

3.2 Power Connection

3.2.1 Use With a Pfeiffer Vacuum Measurement Unit

If the gauge is used with a Pfeiffer Vacuum measurement unit for Compact Gauges, a corresponding connection cable is required (→ 19).

- Secure the cable at the gauge with the screw.



3.2.2 Use With Another Evaluation Unit

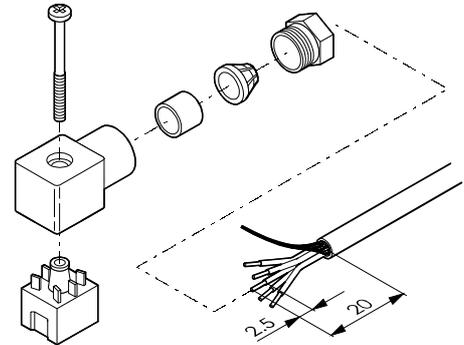
The gauge can also be operated with other evaluation units. In this case, an individual connection cable must be made.

For cable lengths up to 10 m (with a conductor cross-section of 0.34 mm²), the measuring signal can be read directly between the positive signal output (pin 2) and the supply common (pin 5) without the degree of accuracy being lowered. For longer measurement cable lengths, we recommend a differential measurement between the signal output and the signal common (pin 3) (as a result of the voltage drop along the supply cable ground lead, the common mode signal is approx. 1.0 V at the maximum permissible cable length).

Procedure



- 1 Prepare the connector (Ordering number → 19).



- 2 Solder the connection cable according to the diagram.

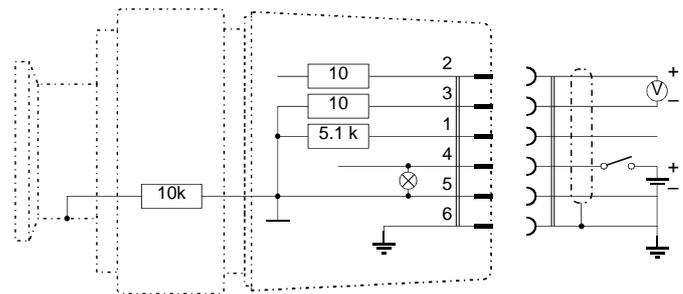
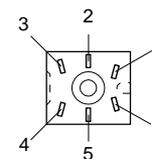


Figure 2: Power connection

- Pin 1 identification
- Pin 2 signal output (measuring signal)
- Pin 3 signal common
- Pin 4 supply
- Pin 5 supply common
- Pin 6 screen



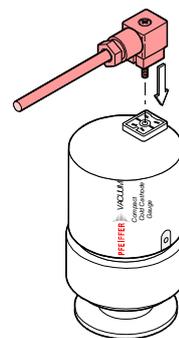
Connector, soldering side

WARNING

The supply common (pin 5) and screen (pin 6) must be connected to the supply unit with protective ground. Incorrect connection, incorrect polarity, or inadmissible supply voltages can damage the gauge.

- 3 Reassemble the connector.

- 4 Plug in the connector.
Secure the cable on the gauge
with the screw.



4 Operation

As soon as the required voltage is applied, the measuring signal is available between pins 2 and 3. (→ Appendix A for the relationship between the measuring signal and the pressure).

The green lamp on the gauge indicates the operating state:



Supply voltage present.



No supply voltage.



Caution



Turn on the gauge only at pressures $<10^{-2}$ mbar to prevent excessive contamination.

If you are using a Pfeiffer Vacuum measurement unit for Compact Gauges with at least two gauge connections, the cold cathode gauge can be controlled, for example, by a Pirani gauge.

Gas type dependence

The measuring signal depends on the type of gas being measured. The curves are accurate for dry air, N_2 , O_2 and CO. They can be mathematically converted for other gases (→ Appendix B).

If you are using a Pfeiffer Vacuum measurement unit for Pfeiffer Vacuum Compact Gauges, you can enter a calibration factor to correct the measurement value displayed (→ of that measurement unit).

Ignition delay

An ignition delay occurs when cold cathode gauges are switched on. The delay time increases at low pressures and is typically:

$$\begin{aligned} 10^{-7} \text{ mbar} &\approx 0.1 \text{ minute} \\ 10^{-8} \text{ mbar} &\approx 1 \text{ minute} \\ 2 \times 10^{-9} \text{ mbar} &\approx 5 \text{ minutes} \end{aligned}$$

Contamination



Caution



Gauge failures due to contamination are not covered by the warranty.

Gauge contamination is influenced by the process media used as well as any existing or new contaminants and their respective partial pressures. Continuous operation in the range of 10^{-4} mbar ... 10^{-2} mbar can cause severe contamination as well as reduced up-time and maintenance cycles. With constantly low pressures ($< 1 \times 10^{-6}$ mbar), the gauge can be operated for more than one year without cleaning (cleaning the gauge → 16).

In general, contamination of the gauge leads to deviations of the measured values:

- In the low pressure range ($p < 1 \times 10^{-3}$ mbar), the pressure indication is usually too low (as a consequence of the contamination of the cold cathode system). In case of severe contamination, instabilities can occur (layers of the measuring chamber peel off). Contamination due to isolating layers can even lead to a complete failure of the discharge.

Contamination can to a certain extent be reduced by:

- geometric protection (e.g. screenings, elbows) against particles that spread rectilinearly
- mounting the flange of the gauge at a place where the partial pressure of the pollutants is particularly low.

Special precautions are required for vapors deposited under plasma (of the cold cathode measuring system). It may even be necessary to temporarily switch of the gauge while vapors occur.

5 Maintenance



DANGER

Caution: contaminated parts

Contaminated parts can be detrimental to health.

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

5.1 Cleaning the Gauge / Replacing Parts



DANGER

Caution: cleaning agents

Cleaning agents can be detrimental to health and environment.

Adhere to the relevant regulations and take the necessary precautions when handling and disposing of cleaning agents.

Tools / material required

- Allen wrench 1.5 mm
- Allen wrench 3.0 mm
- Open-end wrench 7.0 mm
- Pliers for circlip
- Polishing cloth (400 grain) or Scotch-Brite
- Tweezers
- Cleaning alcohol
- Mounting tool for ignition aid
- Ignition aid
- FPM seal (11) for anode feedthrough

5.1.1 Disassembling the Gauge

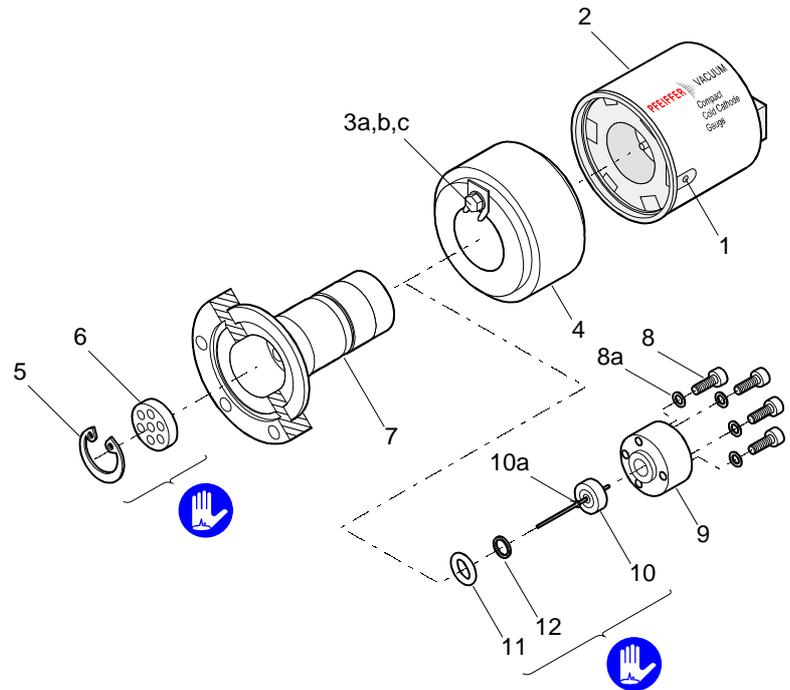


Figure 3

Procedure

- Remove the gauge from the vacuum system (→ 18).
- Unfasten the hexagon socket set screw (1) on the side of the electronics unit (2) (→ Figure 3).
- Remove the electronics unit.

Caution

The cover of the electronics unit cannot be removed.

- Unfasten the hexagon head screw (3) on the magnet unit (4) and remove the magnet unit.

Caution

The magnetic force and the tendency to tilt make it more difficult to separate the magnet unit and the measuring chamber (7).

- Remove the circlip (5) as well as the polarity insert (6) from the measuring chamber.
- Remove the four (or two) hexagon socket screws (8) incl. lock washers (8a) on the back of the measuring chamber.
- Carefully remove the following items in this order: pressure piece (9), complete anode (10), FPM seal (11) incl. support ring (12).

The parts can now be cleaned or replaced.

5.1.2 Cleaning the Gauge

Procedure

- a) Using a polishing cloth rub the inside walls of the measuring chamber and the polarity insert to a bright finish.

Caution

The sealing surfaces must only be worked concentrically.

- b) Rinse the measuring chamber and the polarity insert with cleaning alcohol.
- c) Allow both to dry.

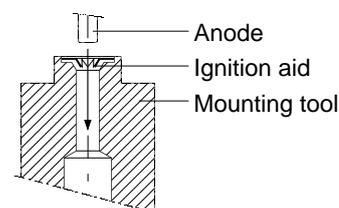
Cleaning or replacing the anode:

- a) Remove the old ignition aid (10a) with tweezers (→ Figure 3).
- b) Using a polishing cloth rub the anode pin to a bright finish.

Caution

Do not bend the anode. Do not carry out mechanical work on the ceramic part.

- c) Rinse the anode with cleaning alcohol.
- d) Allow the anode to dry.
- e) Insert a new ignition aid (10a) into the mounting tool.
- f) Carefully press the anode (clean or new) centered and parallel to the tool axis into the ignition aid and insert it to a depth of approx. 15 mm. The final positioning is established after the anode is installed.



5.1.3 Reassembling the Gauge

Procedure

- a) Insert the FPM seal (11) with the support ring (12) centered into the measuring chamber. The sealing surface, seal, and ceramic part must be clean (→ Figure 3).
- b) Carefully insert the anode (10) incl. ignition aid (10a) into the measuring chamber.
- c) Carefully place the pressure piece (9) on the measuring chamber and tighten it **uniformly** with the four (or two) hexagon socket screws (8) incl. lock washers (8a) until the stop position is reached.
- d) Position the ignition aid (10a) by pushing the mounting tool over the anode pin until the mechanical stop is reached.
- e) Remove the particles in the measuring chamber with dry nitrogen (be careful to hold the measuring chamber with the flange pointing downwards).
- f) Slide the polarity insert (6) into the measuring chamber up to the mechanical stop.

- g) Place the circlip (5) snugly fitting on the polarity insert.


Caution



Visually check that the anode pin is centered over the middle hole of the polarity insert (max. eccentricity = 0.5 mm).

- h) If possible perform a leak test (leak rate $<10^{-9}$ mbar l/s).
- i) Mount the magnet unit (4) and lock it with the hexagon head screw (3).
- j) Carefully slide the electronics unit (2) on the magnet unit until the mechanical stop is reached.
- k) Fasten the electronics unit (2) by means of the socket head set screw (1).

5.1.4 Adjusting the Gauge

The gauge is factory-calibrated and requires no maintenance. It must be replaced in the event of a defect (→ 20).

5.2 What to Do in Case of Problems

Problem	Possible cause	Correction
Measuring signal continually < 0.5 V and green lamp is OFF.	No supply voltage.	Turn on the power supply.
Measuring signal continually < 0.5 V and green lamp is ON	Supply voltage too low.	Increase the supply voltage (→ 5).
	Electronics unit defective.	Replace the electronics unit (→ 5).
Measurement signal continually in the range of 0.5 ... 1.8 V (underrange).	Vacuum chamber pressure $< 2 \times 10^{-9}$ mbar.	–
	Gas discharge has not ignited.	Wait until the gas discharge ignites (≈ 5 minutes at a pressure of 10^{-9} mbar).
Measuring signal unstable.	Gauge contaminated.	Clean the gauge (→ 16).

6 Removing the Gauge From the Vacuum System



DANGER



Caution: contaminated parts

Contaminated parts can be detrimental to health.

Before you begin 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

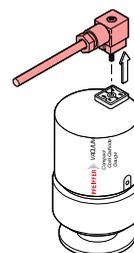
Dirt and damages impair the function of the vacuum component.

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

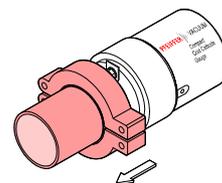
Procedure

1 Deactivate the gauge.

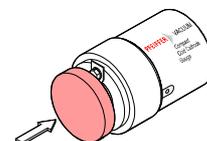
2 Unplug the connector.



3 Detach the gauge from the vacuum apparatus.



4 Place the protective cap.



7 Returning the Product



WARNING



Caution: forwarding contaminated products

Products returned to Pfeiffer Vacuum for service or repair should, if possible, be free of harmful substances (e.g. radioactive, toxic, caustic or microbiological). Otherwise, the type of contamination must be declared.

Adhere to the forwarding regulations of all involved countries and forwarding companies and enclose a completed contamination declaration.

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

8 Accessories

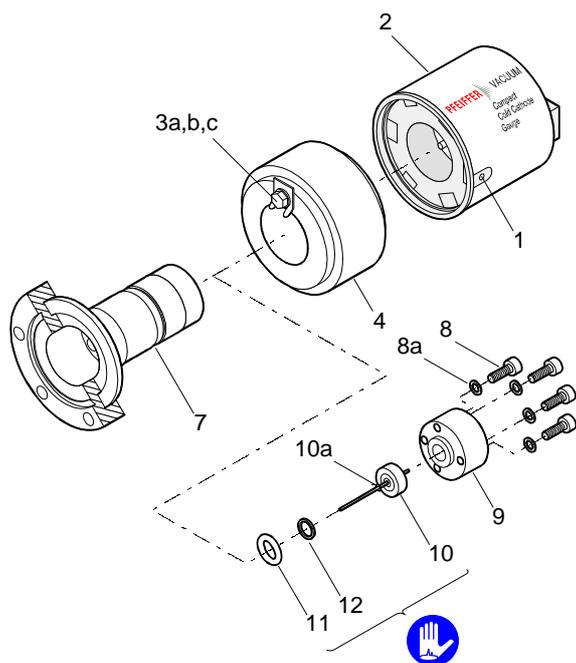
	Ordering number
Cable for connection to Pfeiffer Vacuum measurement unit for Compact Gauges	
3 m	BG44850-T
6 m	BG448251-T
10 m	BG448252-T
Socket Hirschmann GO 6 WF, 6 contacts, angled, female	B4707283MA
Magnetic shielding	PT443155-X

9 Spare Parts

Always include the following information with your spare parts order:

- Type of product
- Manufacturing number according to nameplate
- Position, description, and ordering number according to spare parts list

The following parts are available as spare parts sets:



Pos.	Description	Ordering number
12	Maintenance set, consisting of:	BN846239-T
11	1x support ring	
11	1x O-ring FPM75 10.82 x 1.78	
10a	3x ignition aid	
10a	1x O-ring FPM75 3.69 x 1.78 (not used with IKR)	
12	Repair set, including:	BN846252-T
11	1x support ring	
11	1x O-ring FPM75 10.82 x 1.78	
10	1x anode, complete	
10a	3x ignition aid	
10a	Set of ignition aids, including:	BN845995-T
10a	10x ignition aid	
	Mounting tool for ignition aid	BG510600
2	Electronics unit IKR 251	BN846461-T
	Measuring system, complete	
	DN 25 ISO-KF flange	BN846462-T
	DN 40 ISO-KF flange	BN846463-T
	DN 40 CF-F flange	BN846464-T
	Exchange gauge (return defective gauge to Pfeiffer Vacuum)	
	DN 25 ISO-KF flange	PTR25500-A
	DN 40 ISO-KF flange	PTR25501-A
	DN 40 CF-F flange	PTR25502-A

10 Disposal



WARNING



Caution: substances detrimental to the environment

Products, operating materials etc. may have to be specially disposed of.

For environmentally compatible disposal, please contact your nearest Pfeiffer Vacuum Service Center.

Appendix

A: Measuring Signal vs. Pressure

Conversion formulae

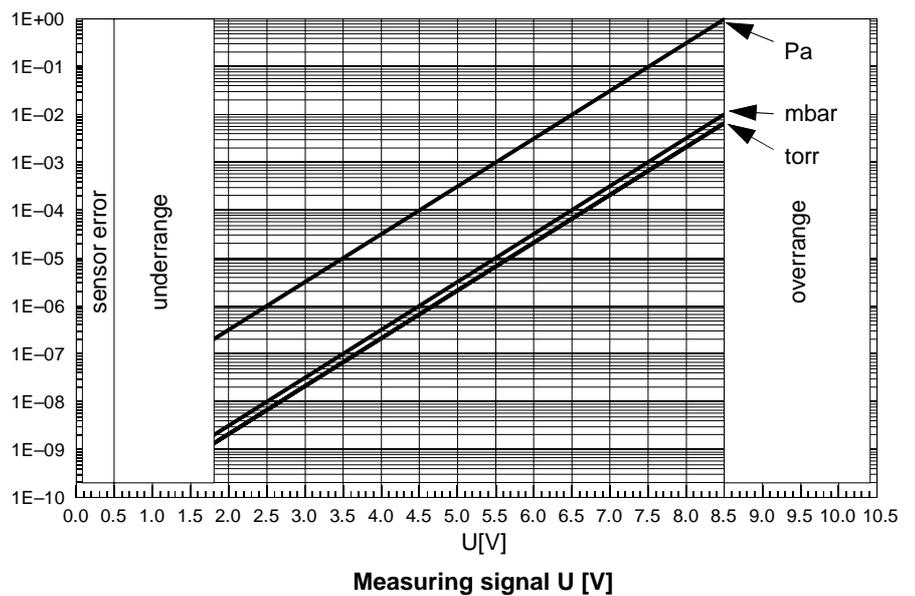
$$p = 10^{U-c} \Leftrightarrow U = c + \log_{10} p$$

p	U	c
[mbar]	[V]	10.5
[µbar]	[V]	7.5
[Torr]	[V]	10.625
[mTorr]	[V]	7.625
[micron]	[V]	7.625
[Pa]	[V]	8.5
[kPa]	[V]	11.5

where U Measurement signal valid in the range $2 \times 10^{-9} \text{ mbar} < p < 1 \times 10^{-2} \text{ mbar}$
 p Pressure $1.5 \times 10^{-9} \text{ Torr} < p < 7.5 \times 10^{-3} \text{ Torr}$
 c, d Constant (dependent on pressure unit) $2 \times 10^{-7} \text{ Pa} < p < 1 \text{ Pa}$

Conversion curves

Pressure p

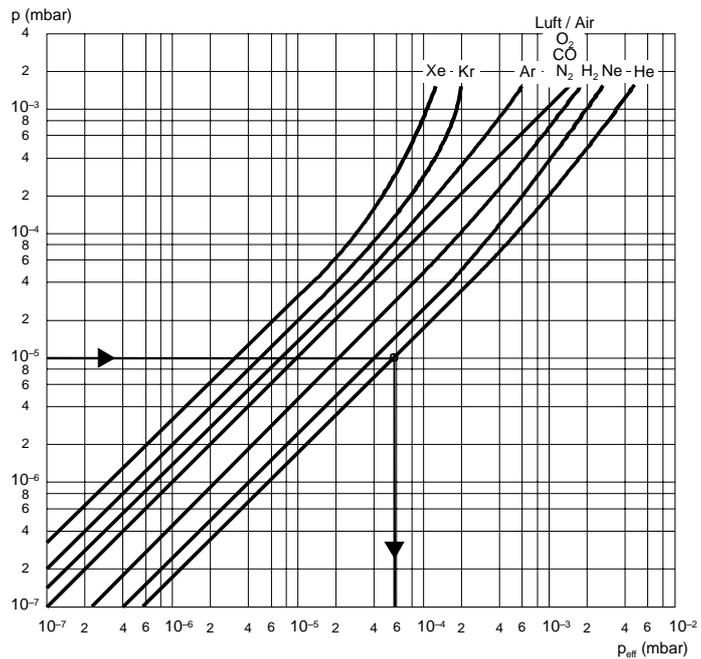


Conversion table

Measuring signal U [V]	Pressure p		
	[mbar]	[Torr]	[Pa]
< 0.5		Sensor error	
0.5 ... 1.8		Underrange	
1.8	2.0×10^{-9}	1.5×10^{-9}	2.0×10^{-7}
2.5	1.0×10^{-8}	7.5×10^{-9}	1.0×10^{-6}
3.5	1.0×10^{-7}	7.5×10^{-8}	1.0×10^{-5}
4.5	1.0×10^{-6}	7.5×10^{-7}	1.0×10^{-4}
5.5	1.0×10^{-5}	7.5×10^{-6}	1.0×10^{-3}
6.5	1.0×10^{-4}	7.5×10^{-5}	1.0×10^{-2}
7.5	1.0×10^{-3}	7.5×10^{-4}	0.1
8.5	1.0×10^{-2}	7.5×10^{-3}	1.0
8.5 ... 10.5		Overrange	

B: Gas Type Dependence

Indicated pressure (gauge calibrated for air)



Indication range below 10^{-5} mbar

In the range below 10^{-5} mbar, the pressure indication is linear. For gases other than air, the pressure can be determined by means of a simple conversion formula:

$$p_{\text{eff}} = K \times \text{indicated pressure}$$

where	gas type	K
	air (N ₂ , O ₂ , CO)	1.0
	Xe	0.4
	Kr	0.5
	Ar	0.8
	H ₂	2.4
	Ne	4.1
	He	5.9

These conversion factors are average values.

 **Caution**



A mixture of gases and vapors is often involved. In this case, accurate determination is only possible with a partial pressure measurement instrument, e.g. a quadrupole mass spectrometer.

Declaration of Contamination

The service, repair, and/or disposal of vacuum equipment and components will only be carried out if a correctly completed declaration has been submitted. Non-completion will result in delay.

This declaration may only be completed (in block letters) and signed by authorized and qualified staff.

1 Description of product

Type _____

Part number _____

Serial number _____

2 Reason for return

3 Operating fluid(s) used (Must be drained before shipping.)

4 Used in copper process

no yes **Seal product in plastic bag and mark it with a corresponding label.**

5 Process related contamination of product:

toxic	no <input type="checkbox"/> 1)	yes <input type="checkbox"/>	<p>2) Products thus contaminated will not be accepted without written evidence of decontamination.</p>
caustic	no <input type="checkbox"/> 1)	yes <input type="checkbox"/>	
biological hazard	no <input type="checkbox"/>	yes <input type="checkbox"/> 2)	
explosive	no <input type="checkbox"/>	yes <input type="checkbox"/> 2)	
radioactive	no <input type="checkbox"/>	yes <input type="checkbox"/> 2)	
other harmful substances	no <input type="checkbox"/> 1)	yes <input type="checkbox"/>	

1) or not containing any amount of hazardous residues that exceed the permissible exposure limits

The product is free of any substances which are damaging to health. yes

6 Harmful substances, gases and/or by-products

Please list all substances, gases, and by-products which the product may have come into contact with:

Trade/product name	Chemical name (or symbol)	Precautions associated with substance	Action if human contact

7 Legally binding declaration:

We hereby declare that the information on this form is complete and accurate and that we will assume any further costs that may arise. The contaminated product will be dispatched in accordance with the applicable regulations.

Organization/company _____

Address _____ Post code, place _____

Phone _____ Fax _____

Email _____

Name _____

Date and legally binding signature _____ Company stamp _____

This form can be downloaded from our website.

Copies: Original for addressee - 1 copy for accompanying documents - 1 copy for file of sender

Notes

Notes

Notes

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bg805151be/b

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