

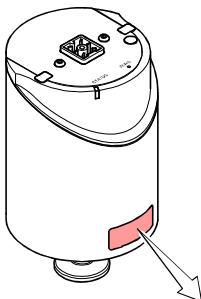
CMR 371 ... CMR 375



Ceramic Capacitance Gauge

Operating Instructions

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.



Pfeiffer Vacuum, D-35614 Asslar		CE
Typ:		
Range:		 
No:		
F-No:		
.....VW; LPS	

Validity


This document applies to products with the following part numbers:

Type	Part number	Flange	Measurement range		
			min. (1 V) [mbar] [Pascal]	F.S. (9 V) [mbar] [Pascal]	max. (9.8 V) [mbar] [Pascal]
CMR 371	PT R25 100	½" tube	10 ⁻¹ 10 ¹	1000 100'000	1100 110'000
	PT R25 101	DN 16 ISO-KF			
	PT R25 102	DN 16 CF-R			
	PT R25 103	8 VCR®			
CMR 372	PT R25 110	½" tube	10 ⁻² 10 ⁰	100 10'000	110 11'000
	PT R25 111	DN 16 ISO-KF			
	PT R25 112	DN 16 CF-R			
	PT R25 113	8 VCR®			
CMR 373	PT R25 120	½" tube	10 ⁻³ 10 ⁻¹	10 1'000	11 1'100
	PT R25 121	DN 16 ISO-KF			
	PT R25 122	DN 16 CF-R			
	PT R25 123	8 VCR®			
CMR 374	PT R25 130	½" tube	10 ⁻⁴ 10 ⁻²	1 100	1.1 110
	PT R25 131	DN 16 ISO-KF			
	PT R25 132	DN 16 CF-R			
	PT R25 133	8 VCR®			
CMR 375	PT R25 140	½" tube	10 ⁻⁵ 10 ⁻³	0.1 10	0.11 11
	PT R25 141	DN 16 ISO-KF			
	PT R25 142	DN 16 CF-R			
	PT R25 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 CMR 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 compensated Capacitance Diaphragm Gauges of the CMR 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 CMR 37X in clean room packaging
- 1× pin for adjusting settings via buttons
- 1× Calibration Test Report
- 1× Operating Instructions German
- 1× Operating Instructions English

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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

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 R25 100 ... PT R25 133	0.0025% F.S./ °C
PT R25 140 ... PT R25 143	0.005% F.S./ °C
Temperature effect on span	0.01% of reading / °C
Resolution	0.003% F.S.
Gas type dependence	none
<hr/>	
Output signal analog (measuring signal)	
Voltage range	0 ... +11 V
Measuring range	+1.0 ... +9.8 V
Relationship voltage-pressure	linear
Error signal	<0.4 V (no supply, sensor error)
	>9.8 V ("overrange")
Output impedance	0 Ω (short-circuit proof)
Loaded impedance	>10 kΩ
Response time ²⁾	
PT R25 100 ... PT R25 133	30 ms
PT R25 140 ... PT R25 140	130 ms
<hr/>	
Gauge identification	Resistance 13.2 kΩ refer- enced to supply common
Voltage	≤5 V
<hr/>	


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.

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.

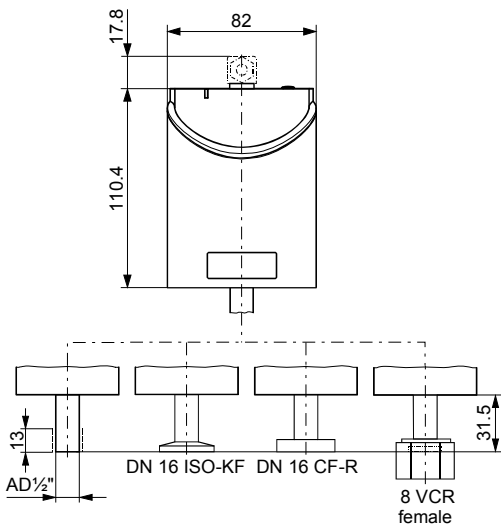
Supply voltage	Class 2 / LPS
at the gauge	+14 ... +30 VDC
Ripple	$\leq 1 V_{pp}$
Power consumption	
while being heated	$\leq 12 W$
at operating temperature	$\leq 8 W$

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

Electrical connection	Hirschmann compact connector, type GO 6, 6-pin, pins
Sensor cable	5-pin plus shielding
Cable length	
Supply voltage 15 V	$\leq 15 m$ (0.25 mm ² /conductor)
Supply voltage 24 V	$\leq 75 m$ (0.25 mm ² /conductor)
Supply voltage 30 V	$\leq 135 m$ (0.25 mm ² /conductor)
For longer cables, larger conductor cross-sections are required ($R_{cable} \leq 1.0 \Omega$).	

Grounding concept	→ "Power Connection"
Materials exposed to vacuum	ceramics ($\text{Al}_2\text{O}_3 \geq 99.5\%$), stainless steel AISI 316L
Internal volume	$\leq 4.2 \text{ cm}^3$
Admissible pressure (absolute)	
PT R25 100 ... PT R25 103	300 kPa
PT R25 110 ... PT R25 133	200 kPa
PT R25 140 ... PT R25 143	130 kPa
Bursting pressure (absolute)	600 kPa
Admissible temperatures	
Storage	$-40 \text{ }^\circ\text{C} \dots +65 \text{ }^\circ\text{C}$
Operation	$+10 \text{ }^\circ\text{C} \dots +40 \text{ }^\circ\text{C}$
Bakeout (not in operation)	$\leq 110 \text{ }^\circ\text{C}$ at the flange
Relative humidity	$\leq 80\%$ at temperatures $\leq +31 \text{ }^\circ\text{C}$ decreasing to 50% at $+40 \text{ }^\circ\text{C}$
Use	indoors only, altitude up to 2000 m NN
Degree of protection	IP 40

Dimensions [mm]

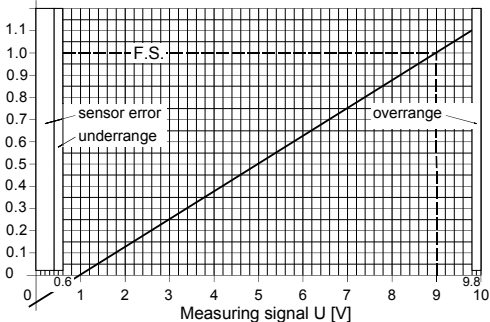


Weight

837 ... 897 g

Analog Measuring Signal vs. Pressure

Pressure p [mbar]



$$p = (U - 1) \times c \text{ (F.S.)}$$

	mbar	Pa	Torr
c	0.125	12.5	0.094

Example: Gauge CMR 371 with 1000 mbar F.S.
Measuring signal $U_{\text{out}} = 6 \text{ V}$

$$p = (6 \text{ V} - 1 \text{ V}) \times 0.125 \times 1000 \text{ mbar} \\ = 625 \text{ mbar}$$

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 1/2" 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

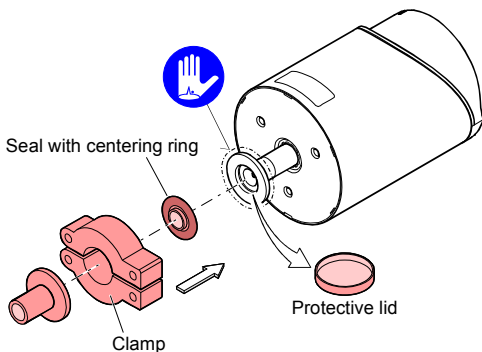
Touching the product or parts thereof with bare hands increases the desorption rate.

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 (→ 18).


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

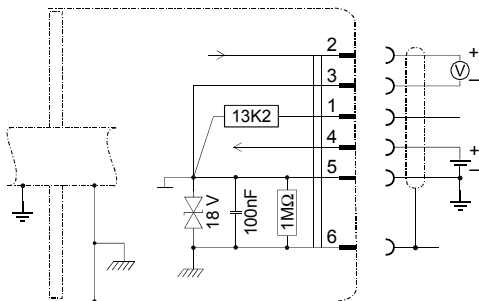
The gauge may only be connected to power supplies, instruments or control devices that conform to the requirements of a grounded protective extra-low voltage (SELV) and limited power source (LPS), Class 2. The connection to the gauge has to be fused.



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

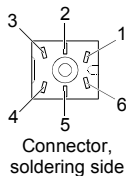
- Use an overall metal braided shielded cable. The connector must have a metal case.
- Connect the cable shield to ground at one side via the connector case. Make sure the connector case has direct contact to the cable's shield on its whole circumference. Do not connect the other side of the shield.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

- 1** If no sensor cable is available, make one according to the following diagram (cable length and conductor cross-sections → 9).



Electrical connection

- Pin 1 Identification
- Pin 2 Signal output (measuring signal)
- Pin 3 Signal common
- Pin 4 Supply
- Pin 5 Supply common
- Pin 6 Screening



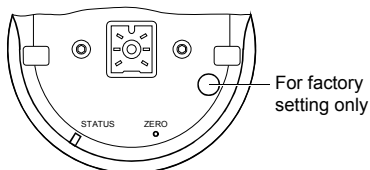
- 2** Connect the sensor cable to the gauge and secure it using the lock screw.
- 3** Connect the sensor cable to the controller.

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.

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

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.	$\Delta U / 90^\circ$
1000 Torr/mbar	$\approx 2 \text{ mV}$
100 Torr/mbar	$\approx 10 \text{ mV}$
10 Torr/mbar	$\approx 50 \text{ mV}$
1 Torr/mbar	$\approx 300 \text{ mV}$
0.1 Torr/mbar	$\approx 1.8 \text{ V}$



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




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

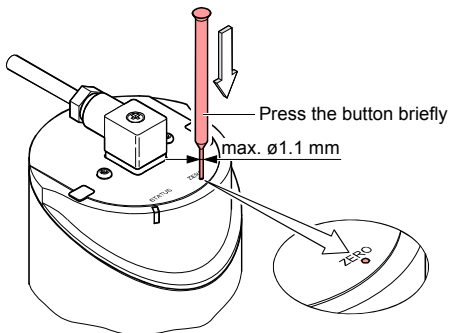


Evacuate the gauge to a pressure according to the table below:

F.S.	Recommended final pressure for zero adjustment	
1100 mbar	$<6.65 \times 10^0 \text{ Pa}$	$<5 \times 10^{-2} \text{ mbar}$
110 mbar	$<6.65 \times 10^{-1} \text{ Pa}$	$<5 \times 10^{-3} \text{ mbar}$
11 mbar	$<6.65 \times 10^{-2} \text{ Pa}$	$<5 \times 10^{-4} \text{ mbar}$
1.1 mbar	$<6.65 \times 10^{-3} \text{ Pa}$	$<5 \times 10^{-5} \text{ mbar}$
0.11 mbar	$<6.65 \times 10^{-4} \text{ Pa}$	$<5 \times 10^{-6} \text{ mbar}$

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 (\rightarrow  22).

- 2 Operate the gauge for at least 1 hour (until the signal is stable).
- 3 Briefly press the <ZERO> button with a pin (max. $\varnothing 1.1$ 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.

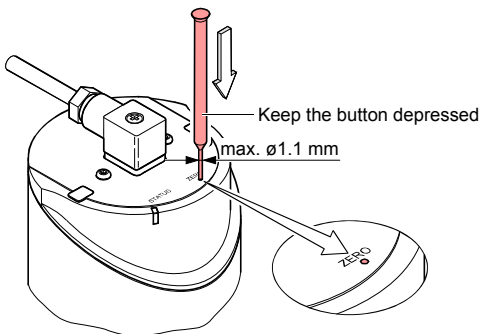
It also permits to adjust an offset of the characteristic curve in order to

- 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  19.

- 1** Operate the gauge for at least 1 hour (until the signal is stable).
- 2** Push the <ZERO> button with a pin (max. $\varnothing 1.1$ 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.



- 3** 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 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 (→  18).

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

$$1 \text{ Pa} = 1 \text{ N/m}^2$$

ETL Certification



ETL LISTED

The products CMR 371 ... CMR 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



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

CMR 371 ... CMR 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

Notes

Notes

**Vacuum solutions
from a single source**

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

**Complete range
of products**

From a single component to complex systems: We are the only supplier of vacuum technology that provides a complete product portfolio.

**Competence in
theory and practice**

Benefit from our know-how and our portfolio of training opportunities! We can support you with your plant layout and provide first-class on-site-service worldwide.

**You are looking for a
perfect vacuum solution?
Please contact us:**

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