Diaphragm seal systems for vacuum processes

Vacuum

The word vacuum (from the Latin: vacuus - empty) means “(largely) empty or free space”.
Physics refers to a space that is completely free from molecules as a vacuum. In practice, this condition is never feasible.

Diaphragm seals

Diaphragm seals are used for pressure measurements when the process medium should not come into contact with the pressurised parts of the measuring instrument.
A diaphragm seal has two primary tasks:
1. Separation of the measuring instrument from the process medium
2. Hydraulic transfer of the pressure to the measuring instrument

(see also Technical information IN 00.06 “Diaphragm seals - Diaphragm seal systems, application, operating principle, designs”)

Differential pressure transmitter connected to two flange-type diaphragm seals via a capillary

Absolute pressure

Absolute pressure refers to the perfect vacuum. In this absolutely molecule-free space the zero point of the absolute pressure is defined. An example of a common “absolute” indicated value is the air pressure.
For the required differentiation from other types of pressure, it is denoted with the index “abs.”, which is derived from the Latin “absolutus”, meaning detached or independent.

Diaphragm seal systems in vacuum service

For application in vacuum, there are different diaphragm seal system fill fluids (KN 2, KN 17, KN 21, KN 32, KN 59 and KN 92) used. Each reacts differently in vacuum applications.
In terms of physics, the boiling point temperature of a liquid decreases with falling pressure.

In a liquid, at a temperature of greater than 0 K, the particles attempt to leave the liquid bond (transition from liquid to gaseous).
The vapour pressure increases with increasing temperature and is dependent on the substance or mixture present.
Thus the operating limits for the individual measuring assemblies drop with a process pressure < 1 bar abs. WIKA has developed three manufacturing processes for this (Basic, Advanced and Premium), which are described below.
This technical information should assist in assessing the limits of the measuring instruments.

Vacuum in the process industry

In the meantime, vacuum processes have established themselves in many industrial and biotechnology plants. Many processes are no longer conceivable without vacuum processes. An example for a vacuum process in an industrial operation is a distillation column or rectification column in crude oil production.
Crude oil is the base. It is introduced to the process, and the products are then distilled from it separately according to the individual boiling point ranges (also known as fractions). The products are then subjected to further processing.

This occurs in two steps:
Initially, the easily evaporated substances can be separated at “normal” pressure (≥ 1,013 mbar abs.). In a second step, the hard-to-evaporate substances are distilled in a vacuum (< 1,013 mbar abs.). In a vacuum, the boiling point of individual compounds can be lowered significantly without destroying them through too high temperatures.
The temperature increases during the course of the process, while the pressure decreases.

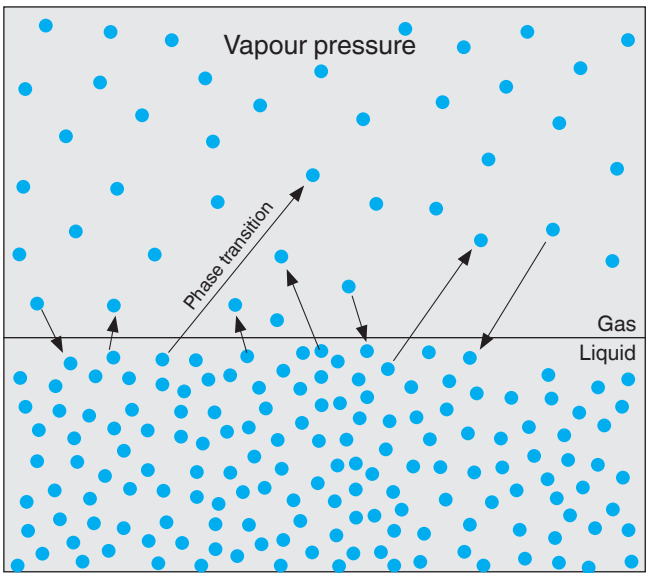


Illustration of the vapour pressure of liquid particles at their transition to the gaseous phase

Diaphragm seal systems in vacuum service

The following basically applies: The higher the temperature and the smaller the corresponding process pressure, the more difficult it is to design a functioning measuring assembly.
In terms of physics, there are different types of vacuum. From low vacuum, fine vacuum, high vacuum through to ultra-high vacuum. The process pressure in industrial plant is generally ≥ 5 mbar abs. (low vacuum range).

Applicable core factors for the required design of a functioning measuring assembly are given in the following points:

Influence quantities for the application process:
- Process temperature
- Process pressure

Influence quantities of the diaphragm seal system:

- Production process of the diaphragm seal system
- Vapour pressure curve of the selected system fill fluid
- The selected process connection with the corresponding diaphragm diameter

Below, the vacuum processes available from WIKA are described in more detail. The processes basically depend on the minimum process pressure at maximum temperature and the individual system fill fluids. This technical information applies for electronic process and industrial transmitters.

Section ① Basic service

Through ongoing and continuous advancements in WIKA's vacuum production processes, measuring ranges, for which specific conditioning of components is no longer necessary, are possible.

The basic service will be designated in the following illustration by section no. ① "Basic service".

Section ② Advanced service

For the more-demanding measuring points, WIKA has established the advanced service. The majority of all measuring assemblies which are intended for use in vacuum can be covered by the advanced service.
The illustration of this service will be designated below in section no. ② with "Advanced service".

Section ③ Premium service

For measuring points in lower vacuum ranges and/or with high process temperatures, the "Advanced service" is no longer sufficient.
For this, WIKA has developed the "Premium service" with specifically designed component conditioning and a refinement of the system fill fluid. The "Premium service" is designated in the illustration with the section no. ③.

Section ④ Customer support

If the application finds itself in section no. ④ "Customer support", our technical clarification will work out a solution for your application.
For this, precise information on the application process is required. For this reason, simply fill out this questionnaire and send it to your contact person at WIKA.

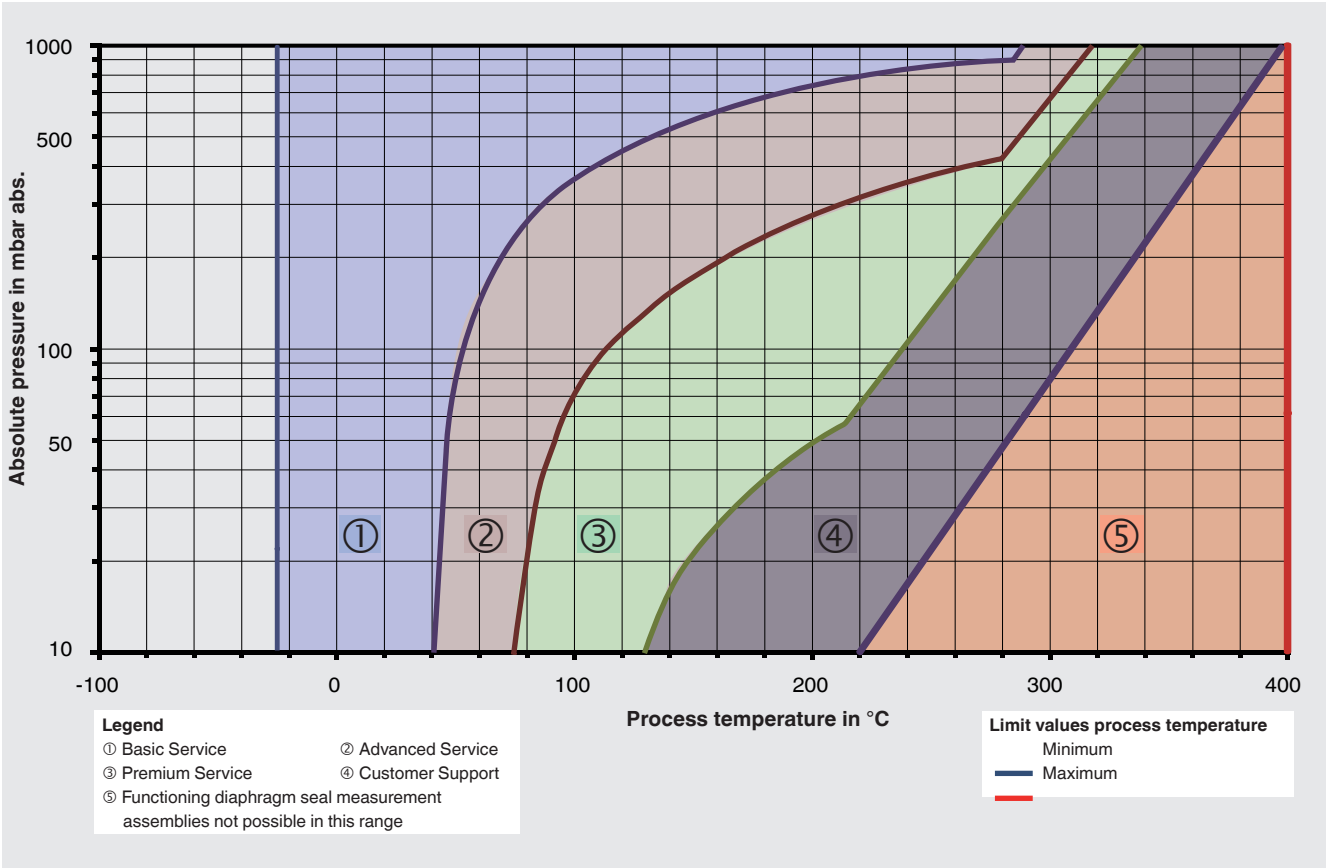
Questionnaire for diaphragm seals

http://de-de.wika.de/upload/DS_QuestionnaireDS_GB_5796.pdf

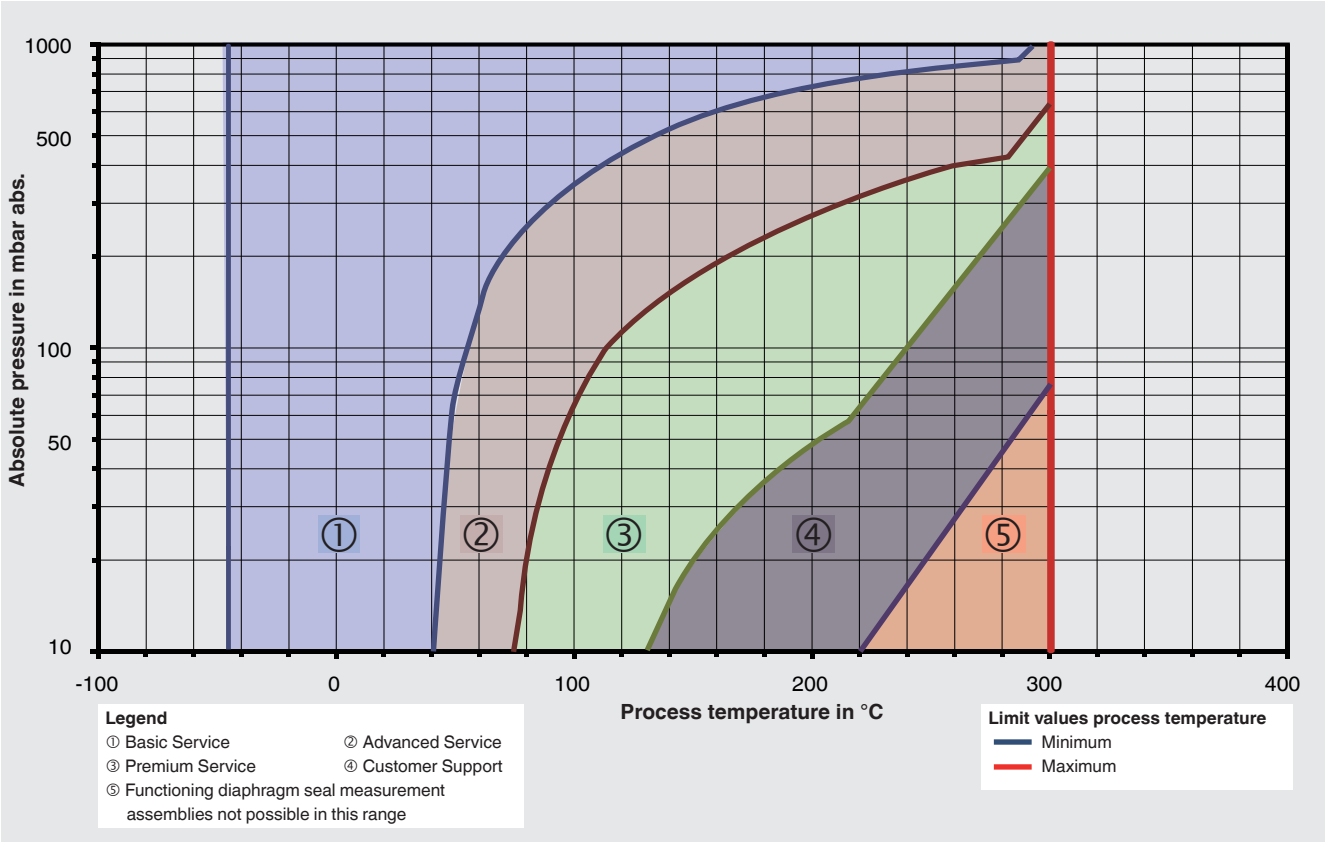
Explanation of the vacuum processes

Our vacuum processes are clearly illustrated in the following diagrams.

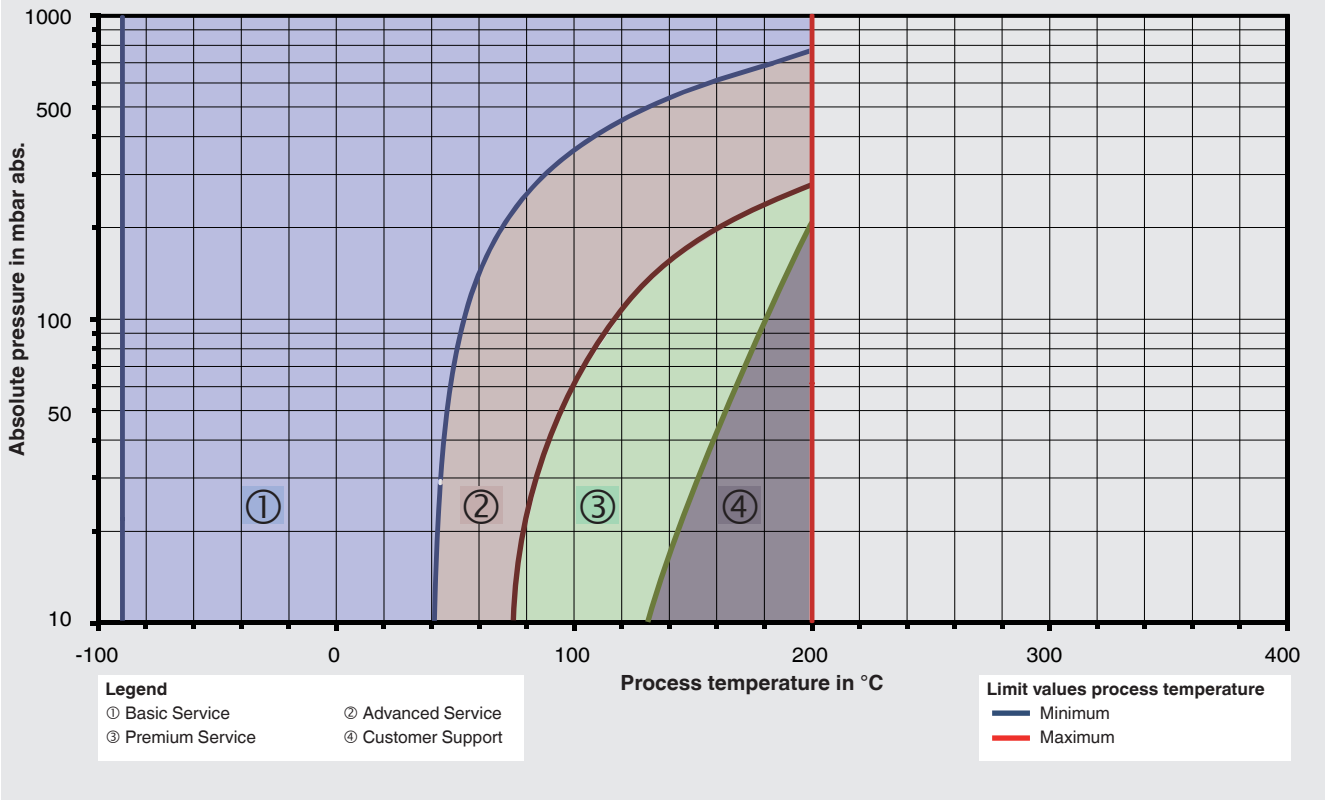
Vacuum application with system fill fluid KN 32



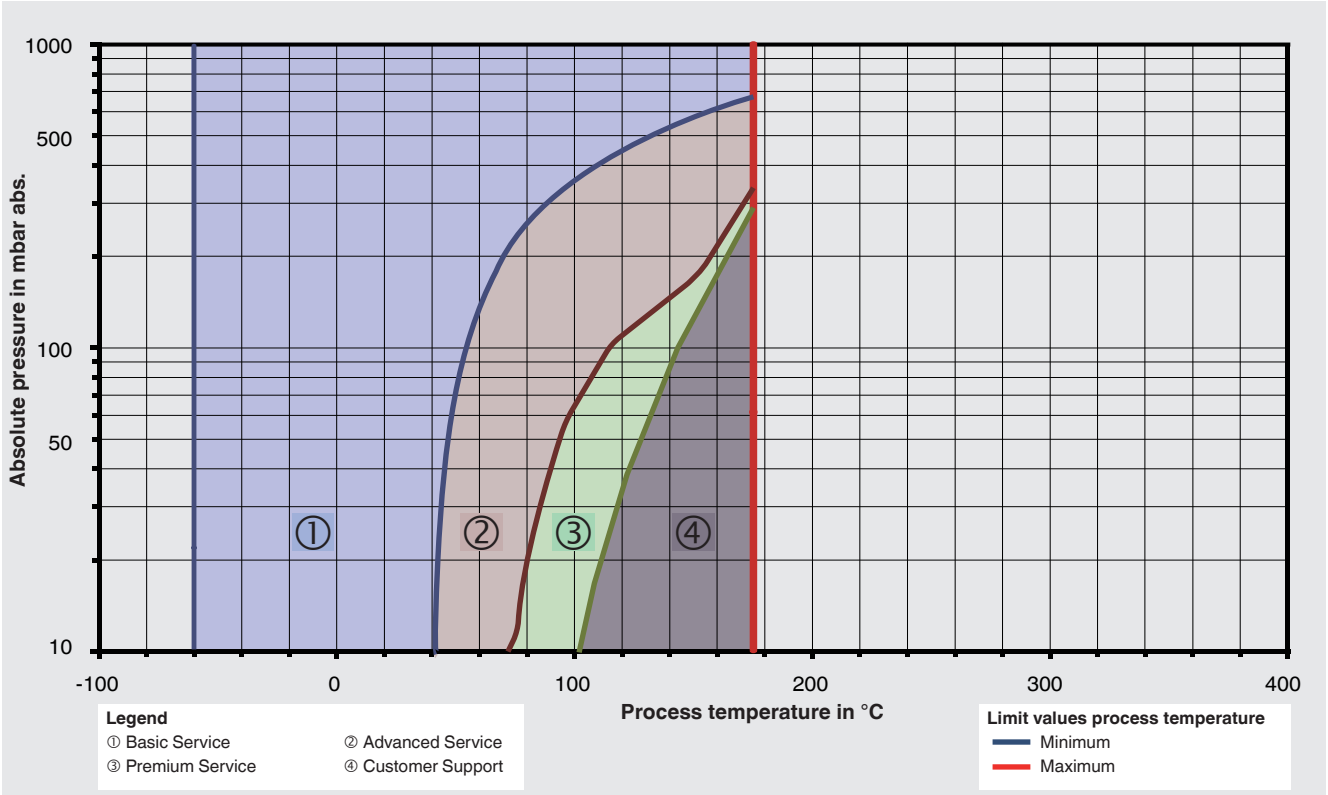
Vacuum application with system fill fluid KN 2



Vacuum application with system fill fluid KN 17



Vacuum application with system fill fluid KN 21

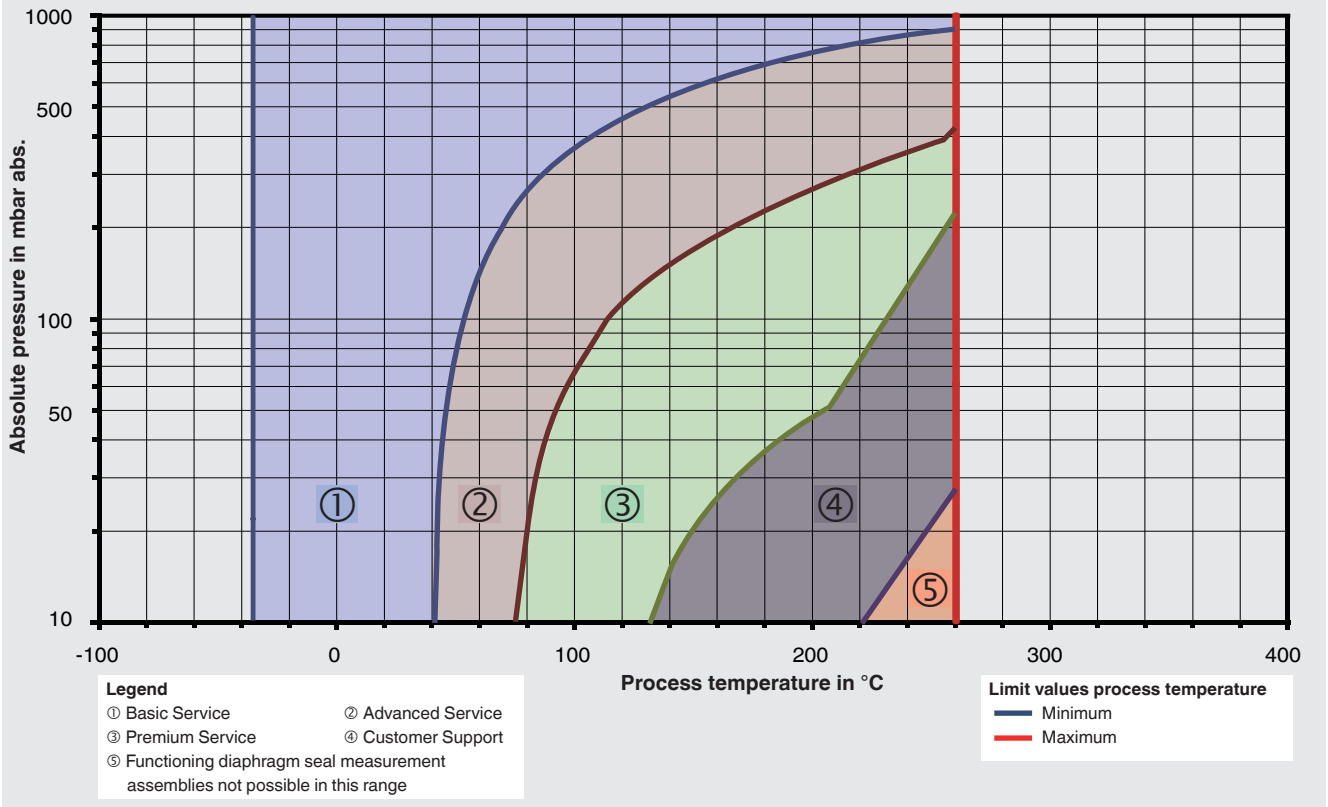


Oxygen applications

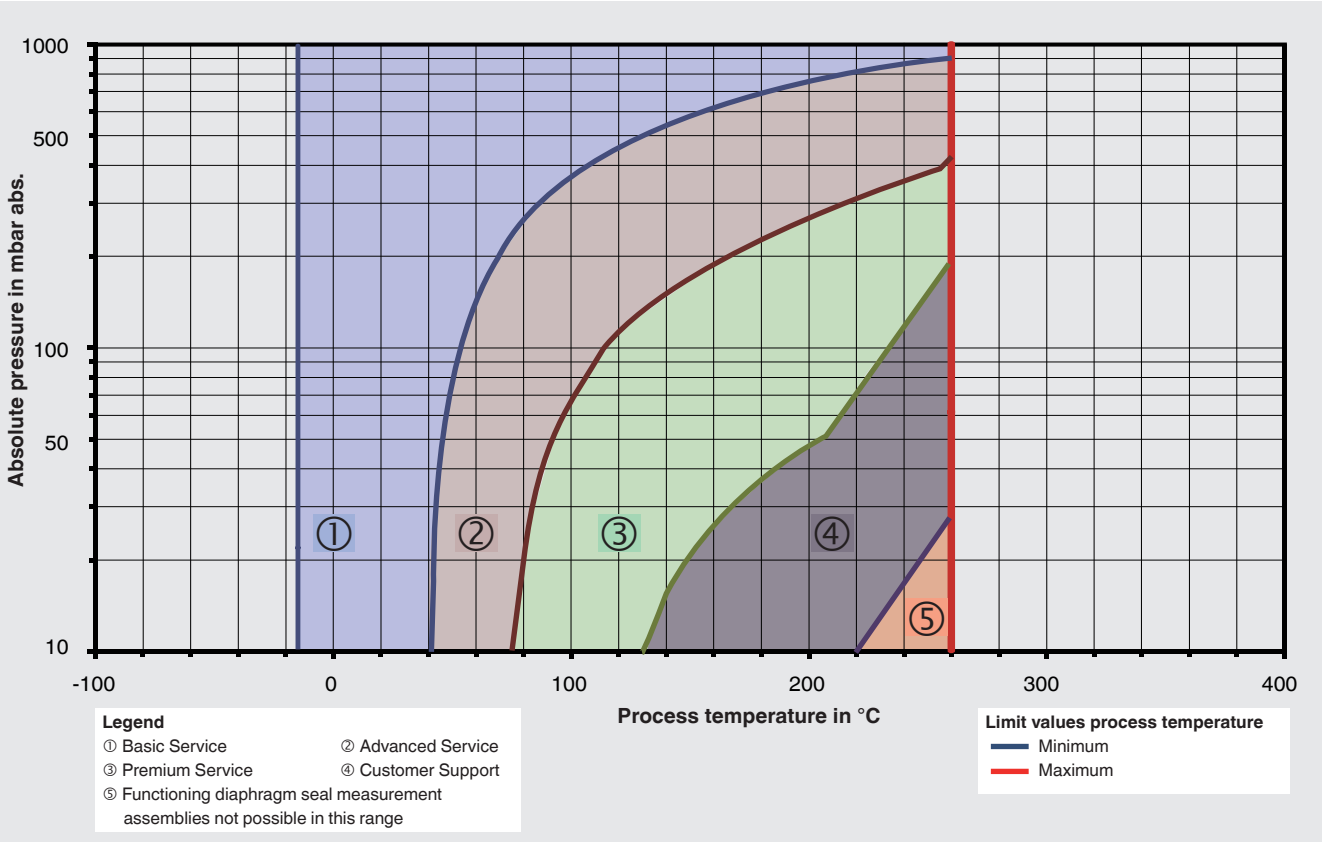
Per BAM test (Federal Institute for Materials Research and Testing) these table values apply.

Maximum temperature	Maximum oxygen pressure
to 60 °C	50 bar
> 60 °C to 100 °C	30 bar
> 100 °C to 175 °C	25 bar

Vacuum application with system fill fluid KN 59



Vacuum application with system fill fluid KN 92



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