Sensor guide

You will find hereafter some definitions that are useful to read specifications enclosed in this catalog as well as advices for the use of our pressure sensors.

1/ SENSOR INPUTS

1-1 Range or Full Scale (FS)

The pressure level to which the sensor is designed to operate within its specifications, when applied to its pressure sensing element, is the Range or Full Scale (FS).

Nota : high cycling work

A sensor can be destinated to high cycling use. You have to be carefull because usual service life of standard pressure transducers is 10 to 50 millions cycles, 0 to 100% full scale.

In case of high cycling work, these figures can be quickly exceeded.

Example : 1 cycle per second means 1.080.000 cycles per 300 hours (approximatively 12 days). Please contact us for such applications. We can offer you some options.

1-2 Operational Mode

When pressure is measured, it is always relative to a reference pressure.

A sensor with **gage range** measure a pressure in relation to the atmospheric pressure. Then it should always be a connection between the atmospheric pressure and the sensing element of the sensor. Usually there is a pressure reference tube, located at the lead exit side (rear) of the sensor body, that vented to the external atmospheric pressure. Use this kind of sensors in dry, clean, non-conductive or non-corrosive environments, otherwise internal components should be damaged.

A sensor with **absolute range** measure a pressure in relation to vaccuum. The sensitive part is inside a permanent vacuum. In our sensor this vaccuum is 10-4 bar and sealed by electron beam solder. Such a sensor is water and airproof (sensitive part only). However the zero balance of the sensor is directly linked to the atmospheric pressure and change with it.

A sensor with **sealed gage range** measure a pressure in relation to a specific atmospheric pressure (the one at the time of sealing). For such a sensor, the reference pressure cavity is sealed (so air and waterproof) at a local atmospheric pressure at the time of manufacture (and not vaccuum).

1-3 Overpressure, Burst Pressure and Peaks

The **Overpressure** is the maximum pressure to which the sensor can be exposed without damage or modifications of its specifications. During manufacturing process, we do expose sensors to overpressure (usually 150% FS).

The **Burst Pressure** is the maximum pressure applied to a transducer sensing element or case without causing leakage.

If you face **Pressure Peaks** (a fast and accidentally spike of pressure), it exists some pressure snubbers that can be integrated in the pressure port in order to protect the sensor. However they are not efficient to stop an overpressure. A spike lasts only on the order of milliseconds and any overpressure for more than that.

1-4 Input Impedance (mentionned only for unamplified sensor)

The Input Impedance on an unamplified sensor is equal to the bridge resistance plus any series resistors which are in the thermal compensation network.

1-5 Excitation

The recommended voltage with which a standard sensor should be excited is indicated for each model. A high quality low noise constant voltage source or battery is advised.

A large choice of electrical outputs is available in our range of products.
To understand directly from the sensor reference the type of output and excitation, please find enclosed our codification.

Our Sensor Codification

The last digit of the sensor reference indicates the electrical output of the sensor which set also the recommended excitation.

Examples of transducers references : P624, P925, P512

Code	Output	Sensor Excitation
1	Unamplified output : 1 to 3mV/V	10Vdc stable and regulated excitation
2	Unamplified output : 5 to 10mV/V	10Vdc stable and regulated excitation
3	Ratiometric tension output : 0,5-4,5V	5Vdc ±0,05 stable & regulated excitation
4	Tension output : 0,5 to 4,5V, 0-5V or ±5V	9,5 to 27Vdc unregulated excitation
5	Current output : 4-20mA	12 to 27Vdc unregulated excitation
6	Tension output : 0-10V	15 to 27Vdc unregulated excitation
7	Tension output : 0,5 to 4,5V	8 to 16Vdc unregulated excitation

2/ SENSOR OUTPUTS

2-1 Output Impedance (mentionned only for unamplified sensor)

For unamplified sensors, the output impedance is the value of individual strain gages constituent the Wheatstone Bridge.

2-2 Zero Balance

The Zero Balance is the electrical output delivered by the sensor when it is excited by the recommended voltage and exposed to its pressure reference : atmospheric pressure for Gage Sensors and vaccuum for Absolute Sensors.

2-3 Rated Output

The Rated Output is the electrical output delivered by the sensor when it is excited by the recommended voltage and the range or full scale pressure is applied.

2-4 Accuracy

Non Linearity is the deviation of the sensor output signal from a theoretical Best Straight Line which has been fitted to the data points of an actual calibration. It is expressed as a percentage of Full Scale.

Hysteresis is the difference in sensor output signal at a specific pressure when applied in the increasing and then decreasing sectors of a single pressure cycle of short time duration at constant temperature. It is expressed as a percentage of Full Scale.

Non Repeatability is the deviation in sensor output signal levels when a specific pressure is applied in consecutive pressure cycles of short time duration under the same conditions, such as temperature and direction of increasing or decreasing pressure. It can be determined by performing two consecutive short time duration calibration cycles and can be expressed as percentage of full scale.

Non Linearity, Hysteresis and Non Repeatability can be combined as a static error band (NL+H+R), that is to say the error band applicable at room temperature.

2-5 Natural Frequency of the Diaphragm

It is the frequency at which the sensor's active pressure diaphragm will go into resonance and respond with the maximum movement for a specific applied pressure. Also called Resonant Frequency.

Exposing a sensor to pressures at a frequency greater than the Natural Frequency can cause damage to the sensor.

Natural Frequency of the diaphragm is linked to the technology and can be classified in 3 categories : static, slightly dynamic or dynamic.

Sensors with Thin Film Technology are considered as dynamic sensors.

For highly dynamic measurements, select an unamplified pressure sensor (our codifications 1 and 2) and with flush or semi-flush diaphragms (pages 21 to 25). Natural Frequency of the diaphragm are expressed in each datasheet and are variable according to the pressure ranges.

2-6 Response Time and bandwith

The response time represents the speed that will not excite the natural frequency and to which the sensor can respond accurately to a pressure change. Response time is usually expressed in ms.

For amplified transducers, the response time is limited by the electronic (including or not filters).

On our standard amplified transducers the response time is 10ms.

We can modify the response time on transducers with built-in electronic, on request, within the limits expressed in each datasheet : usually from 1 to 100 ms (10 to 1000 Hz) for analog electronic.

For transducers with analog output, the maximum bandwith is indeed about 1000 Hz whereas for digital output, it is limited at 100 Hz.

2-7 Insulation Resistance

The resistance measured between two insulated points on a transducer when a specific DC voltage is applied at room temperature.

3/ SENSOR ENVIRONMENT

Environnement of the sensor has to be defined and mentionned when ordering, in order to select the right product or even to adapt a standard item.

Different components, listed below, have to be taken in account before selecting and using a sensor.

3-1 Compensated and Using Temperatures

What is the maximum temperature range in which the sensor is expected to work **(using range)** and within it, what is the range in which the measurement has to be the most accurate **(compensated range)** ?

The Temperature range in which the sensor will meet the specifications for Zero and Sensitivity Thermal Shift is the Compensated Temperature. This compliancy of specifications is verified during the manufacturing process for each sensor. Compensated Temperature is then the range of temperature in which the sensor has to be the most accurate.

The sensor will continue to work within the Using Temperature Range (usually larger than Compensated Temperature Range); however outside Compensated Temperature, the sensor is not expected to be within specifications.

Fluid temperature

Sensor body can work at an moderate temperature (40 to 60°C for instance) whether the fluid can be at very colder or heater temperatures.

Please mention these two temperatures when ordering to ensure an accurate measurement.

Radiant heat

Sensor body can be subject to continuous or intermittent radiant heat or cold, that induces very quick changes of temperature for internal components. This is not compensable specially for miniature sensors. Protect sensors which can be subject to such phenomenon.

3-2 Thermal Shifts

The change in the Zero Offset as a function of temperature is the Thermal Zero Shift.

The change in Sensitivity of the sensor as a function of temperature is the Thermal Sensitivity Shift.

Both are expressed in percentage of full scale per degree C within the compensated temperature range.

The specifications provided concern thermal balance conditions for slow and stable changes of temperature (within the compensated temperature range of the sensor).

Our sensors are indeed compensated for equilibrium temperatures and not for fast temperature changes or thermal pulses. If a rapid change occurs, the sensor must be allowed to reach thermal equilibrium before it will meet the listed specifications.

3-3 Acceleration Sensitivity

Many sensors are exposed to « g » forces due to acceleration, vibrations and shock. It is particularly the case of miniature pressure transducers that are used in on-board applications (automotive, space...). Our sensors have been designed to support and to be extremely insensitive to acceleration inputs.

Acceleration Sensitivity is the change in ouput of a pressure sensor due to acceleration input to the pressure sensing diaphragm. It is expressed in percentage of full scale per g within a limited range of vibrations and for acceleration in the sensitive direction.

3-4 Long Term Drift

The change in output which is only due to time is called Long Term Drift. It is expressed in percentage of full scale for a period of time (usually 1 year).

4/ SENSOR INTERFACES

A large choice of mechanical threads and electrical connections are available. For each model we do specify all interfaces options available on standard.

From pages 48 to 52, you can select your options for each type of sensor and transducer (industrial, miniature, ultra miniature) and then define the dimensions of your complete sensor by adding :

- L1, the length of mechanical thread
- Length of sensor body (specify for each model)
- L2, the length of electrical connection

4-1 Mechanical Connection

In this catalog you will find many mechanical and electrical connections on option. For each sensor, we do mention in its datasheet available options. You can find from pages 48 to 52 the dimensions of our transducers with all these options.

Consult also our recommandations for installation of threaded pressure sensors : pages 53 to 55.

Quality of threads

The sensor thread has not to be tightened. Otherwise sensor may be subjected to thermal and mechanical damages.

Mounting torque and Sealing

For proper mounting, please follow the mounting torque which is recommended in the datasheet delivered with the sensor.
Mounting torque depends on the type of sealing, the thread and range of the sensor.
Follow our mounting torque recommandations, specified on datasheets.

O-Rings

Ensure a proper mounting of o-ring. It has to be of high quality and regularly changed.
Viton o-ring is often recommanded and supplied due to its thermal characteristics and compatibility with most fluids.

List of O-ring's materials with temperature characteristics and fluid compatibility

Material	Fluids	Temperature
Silicone	Hot air, oxygen, ozone, UV rays, vegetable oil, brake fluid.	-70°C to +230°C
Buna	Mineral and hydraulic oils, heating oils, diesel, kerosene, washing powder, gas, water, alkalines (-35° to +70°C), weaks acids (-35° to +50°C).	-35°C to +80°C
Neoprene	Cooling agent (Freon 12...), ammonia connections, vegetable oils, alcohols, air, ozone, chloride, oxygen at low pressure. Not mineral oil proof.	-40°C to +120°C
Viton	Mineral oils, fats, hydraulic fluids, petrol, kerovene, benzol, silicone oils, halogen-hydrocarbon connections, fertiliser, many acids and alkalines.	-18°C to +210°C
Fluoride-Silicone	Synthetic lubricant (DI-Ether base), silicon-ether fluid, fuel, hot air	-65°C to +180°C
Ethylene-Propylene	Steam, soap	-54°C to +135°C

Vibrations

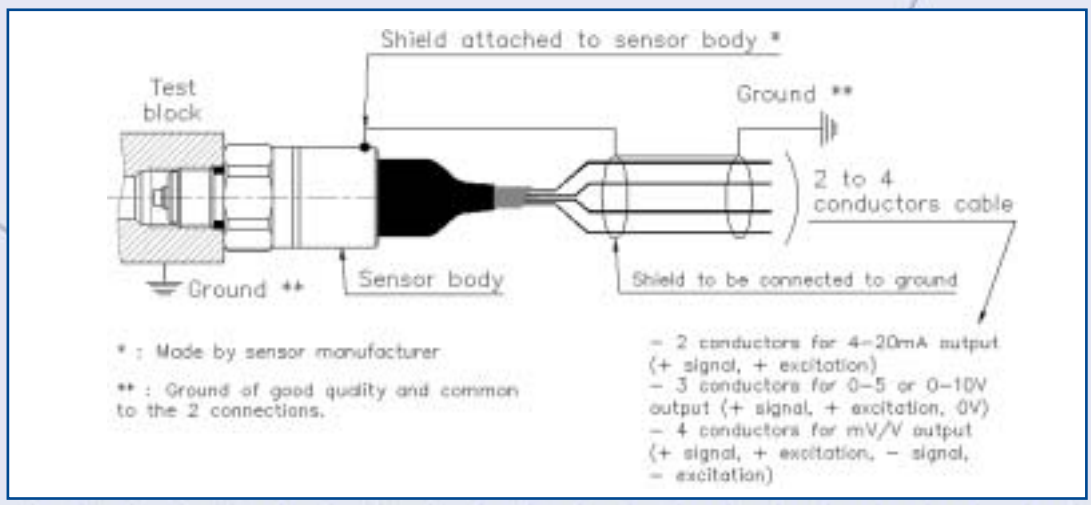
In case of high vibrations applications, we recommend to maintain the sensor and the cable in order to limit the stress at thread level.

In this case, please select one of the transducers listed in the « sensors designed for hard environment » category or one of miniature or ultra-miniature sensors which have been specially developped for such applications (on board measurements with high vibrations and temperature).

Vibrations and shock accepted by our pressure sensors are specified in datasheets.

4-2 Electrical Connection

Ensure a rigourous electrical connection of the sensor, including the shield of the sensor or the ground pin in case of connector.



4-3 Electromagnetic Compatibility (EMC)

Our transducers have been tested in accredited laboratories and are conform to CE norms (EN50081-1 and EN50082-2).

4-4 Material

We do specify the material for both diaphragm and body of the sensor, which are on standard Stainless Steel (17-4 PH and 316L) or Titanium (TA6V).

4-5 Enclosure Protection

Enclosure protection of our sensors are expressed in each datasheet. They are IP65 or IP67 specified according to the type of electrical connection.

Note that if you have to use a sensor longterm outside, a cable exit is more adapted to climatic changes and also more long term resistant than a connector. Except high quality connectors, which are usually expensive, long to supply and more difficult to mount on our sensors (even impossible for miniature sensors).

If you used sensor with connectors integrating O-rings (DIN 43650 for instance in our catalog), note to change regularly this internal O-ring to ensure the protection.

4-6 Internal O-ring

If it is specify that there is no internal O-ring that means that the diaphragm (sensing element) is welded to the pressure port. Otherwise we do specify the type of O-ring we do use. Please verify the compatibility of this o-ring with your fluid. In most of the cases, we can supply, on request, the sensor without any internal O-ring.

4-7 Compatibility of sensors with medias

The compatibility of sensors with fluids is essentially due to the technology, that is to say the type of diaphragm (sensitive element) in contact with the fluid /gas.

❶ Sensors with « thin film » technology

These sensors are all stainless steel or titanium, without any internal O-ring or separator between the diaphragm and the medium. Then this type of sensors are usable with all medias compatible with stainless steel or titanium, which is true in 99% of applications even for agressive fluids like Brake Fluid or Skydrol®.

To tighten against the medium O-ring (select the compatible material), or metallic seals are used. You can also install sensors without seals if you select a conical mechanical thread (prefer this option in case of agressive fluids).

As a conclusion, for Thin Film Pressure Transducers, there is a solution of media compatibility whatever your application.

❷ Sensors with « piezo-resistive » technology

These sensors are manufactured with a piezo-resistive pressure cell which can be associated to the pressure port using a Viton O-ring (please verify the compatibility of Viton with your fluid) or by soldering according to models.

In any case if your application, specially due to the compatibility of your medium, request no internal O-ring, please mention it on your order. It is available on all our sensors on option.

Installation is the same as for Thin Film Pressure Sensors.