The accuracy of SciLog® SciPres® single-use pressure sensors

A closer look at the performance of the SciLog® SciPres® single-use pressure sensors and how they can add an impressive degree of accuracy to a bioprocess.

When using sensors in a bioprocess, their levels of trueness, precision and accuracy are essential.

According to the International Standards Organization (ISO), 'trueness' indicates the closeness of a single measurement to a correct value, 'precision', indicates the variation in repeated measurements of a constant condition and 'accuracy' is a combination of both 'trueness' and 'precision'.

Parker domnick hunter's SciLog® SciPres® single-use pressure sensors are used in bioprocesses around the world. They are the only pre-calibrated, single-use pressure sensors with a gamma-stable memory device that stores data of all calibration, and sensor specific information for traceability.

Each SciLog® SciPres® sensor is pre-calibrated with a 2-point, a 3-point, or a custom procedure against a National Institute of Standards and Technology (NIST) traceable standard. Calibration information is provided on a certificate of calibration.

Selecting the appropriate sensor

Your choice of a 2-point or a 3-point sensor will depend on the accuracy you require and the pressure to which the sensors will be subjected to.

2-point SciLog® SciPres® sensors provide an accuracy of ± 0.30 psi (± 0.02 bar) at pressures between -5 to 30 psi (-0.34 to 2.07 bar), based upon individual sensor performance (Figure 1).

Customers with applications where pressures are below 30 psi (2.07 bar) should choose the 2-point calibrated sensor.

For those with applications where pressures are 40 psi (2.76 bar), the accuracy of the 2-point calibrated sensor has a range of -0.3 to +0.6 psi (-0.02 to +0.04 bar) and at 60 psi (4.13 bar), the accuracy has a range of -1.5 psi to +2.3 psi (-0.10 to +0.16 bar).

Therefore customers operating at higher pressures would benefit from the 3-point SciLog® SciPres® calibrated sensor, which retains an accuracy of ± 0.3 psi (0.02 bar) at 60 psi (4.14 bar). Custom calibrations are also possible.

Precision and sensor error

Sensor error is less critical for customers measuring differences in pressure. For some customers, though, the measurement of change in pressure is more important than

Figure 1: Sensor accuracy over operating range

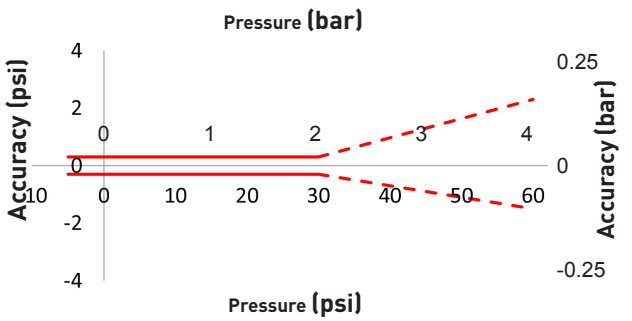
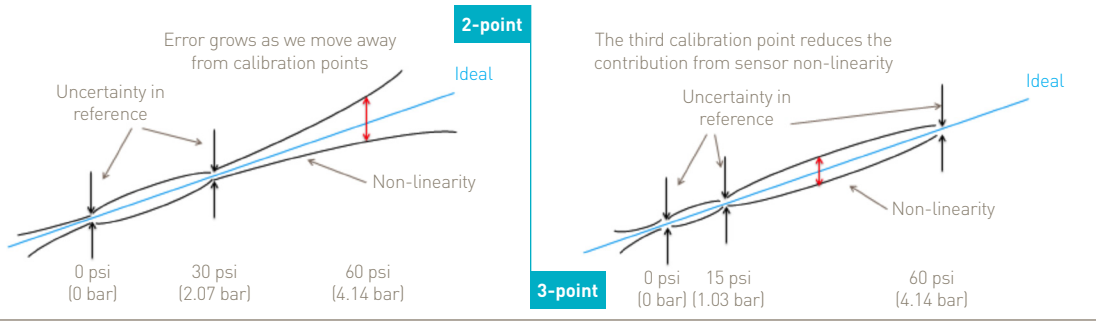


Figure 2: Accuracy in 2-point and 3-point calibration



the actual pressure value. A single sensor with a fixed systematic error (or bias) will report true changes in pressure if the error doesn't change. While specific claims about the precision of sensors are not made, data indicates precision is even better than accuracy.

For a SciLog® SciPres® sensor held at a constant pressure, repeated sensor readings over a short time interval do not vary by more than 0.02 psi (0.001 bar). While for a SciLog® SciPres® sensor brought to the same pressure many times (e.g. change of pressure back and forth from 0 to 30 many times), the sensor readings will be within 0.02 psi (0.001 bar).

Because the sensors are so precise, pressure changes calculated from sensor readings are very close to the true pressure changes.

For a sensor with constant accuracy and a precision of 0.02 psi (0.001 bar): a change from 5 to 10 psi (0.34 to 0.69 bar) would be reported with an error of ~1%, a change from 20-30 psi (1.38 -2.07 bar) would be reported with an error of less than 0.5-1%, while a change from 0-30 psi (0-2.07 bar) would be reported with an error of less than 0.1%.

In general, the accuracy of any calibration decreases as you move away from the calibration points (for both 2- and 3-point calibration prcedures). This is because the reference measurement (pressure gauge) is not perfect; even instruments traceable to NIST have some error in measurement. Also, the shape of the sensor output is not exactly predicted by the calibration equation (Figure 2). The term 'non-linearity' often refers to this phenomenon.

It is a mathematical certainty that sensor measurements far from the calibration points will be less accurate than near the calibration points. This is true for any sensor from any manufacturer. What separates the better performing sensors from the competition is the understanding of the error sources and the methods used to compensate for them.

SciLog® SciPres® competitors' claims

If you look at the accuracy of the SciLog® SciPres® compared to the claims of its competitors' sensors (Figure 3), the SciLog® SciPres® consistently outperforms its rivals. Even when subjected to the highest doses of gamma-irradiation (45 kGy), the accuracy of the 2-point calibrated sensor is still +/- 0.6 psi (+/- 0.04 bar) – far better than its competitors (at minimum doses of gamma-irradiation, the accuracy is unaffected).

This confirms SciLog® SciPres® single-use pressure sensors as industry leaders and the sensor of choice for any bioprocess looking for an unrivalled level of accuracy, trueness and precision. ■

Figure 3: SciLog® SciPres® accuracy versus competitor sensor

Competitor Accuracy Claims*	Conversion to psi (bar)	SciLog® SciPres® Claim
±2% up to 6 psi *(±2% up to 0.41 bar)*	±0.12 psi at 6 psi *(±0.008 bar at 0.41 bar)*	±0.3 psi below 30 psi *(±0.02 bar below 2.07 bar)* *(Accuracy drops below 0.03 psi (0.002 bar) at calibration point)*
±3% from 6 to 30 psi *(±3% from 0.41 to 2.07 bar)*	±0.9 psi at 30 psi *(±0.06 bar at 2.07 bar)*	±0.3 psi below 30 psi *(±0.02 bar below 2.07 bar)*
±5% from 30 to 60 psi *(±5% from 2.07 to 4.14 bar)*	±3.0 psi at 60 psi *(±0.21 bar at 4.14 bar)*	-1.5 / 2.3 psi at 60 psi *(-0.10/ 0.16 bar at 4.14 bar)*