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PRESSURE TRANSMITTERS: IT'S CLASS THAT COUNTS

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KELLER would like to do away with DIN standards. The company is backing the introduction of an accuracy class, as it did for pressure gauges. The conditions under which the class is complied with are described in specifications.
The new EC standards make it more difficult for companies to manufacture their own transmitter electronics. Changing from OEM transducers to OEM transmitters is recommended for the good of the customer.

Series 10

Thirty years of Series 10 - a little history

In the 1970's, companies in areas such as hydraulics and water management were being confronted with increasing customer demands for low-cost electronic pressure measuring instruments. Pressure sensors such as thin-film and piezoresistive sensors were in a price range that could not be supported by this emerging market, and many companies launched their own development projects in an attempt to develop a low-cost sensor. In the majority of cases the electronics were developed quickly, but pressure transducers were more problematic.

This gap was filled by KELLER Series 10 transducers from 1978 onwards. That which followed was the beginning of the triumphant march of piezoresistive technology through all usage areas. Well-known companies in the industry, some of whom have now had their own sensor technology for quite some time, did not wish to wait any longer for their own developments and flooded the markets with this new piezoresistive Series 10 transducer.

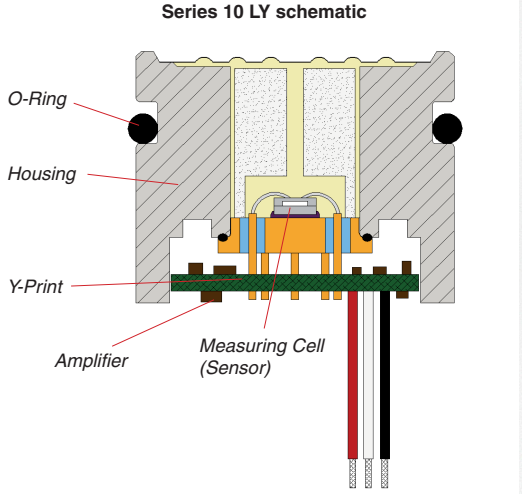
The range of OEM installation components has expanded considerably over the years. New technologies such as diaphragm high-temperature soldering and laser welding have introduced some significant improvements, making it possible to reduce the diameter to 9 mm without affecting the performance features.

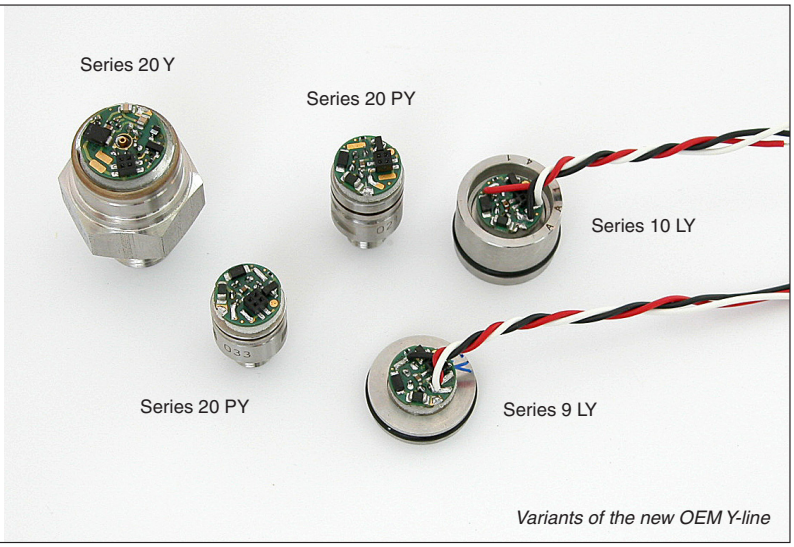
Although OEM-transmitters (OEM-transducers with electronics) have been in the product range for years, the proportion thereof in relation to OEM transducers is only about 2%. The success of CIO (Chip in Oil) technology, where the amplifier is located adjacent to the sensor on the glass feed through in the oil chamber, has also been limited.

This probably has to do with the fact that companies wish to have as much of their own manufacturing depth as possible. Plus the fact that the high output signal of piezoresistive transducers makes it relatively simple to realize the amplifier electronics. The compensating and trimming resistors in the circuit are therefore soldered on just like they were 30 years ago; resistors that are becoming increasingly difficult to obtain because they are rarely used elsewhere.

There are two other reasons why changing to OEM transmitters should be considered:

A) The new compensating technology: the Y line
B) The new EC directives





Variants of the new OEM Y-line

A) The new compensating technology: the Y-line

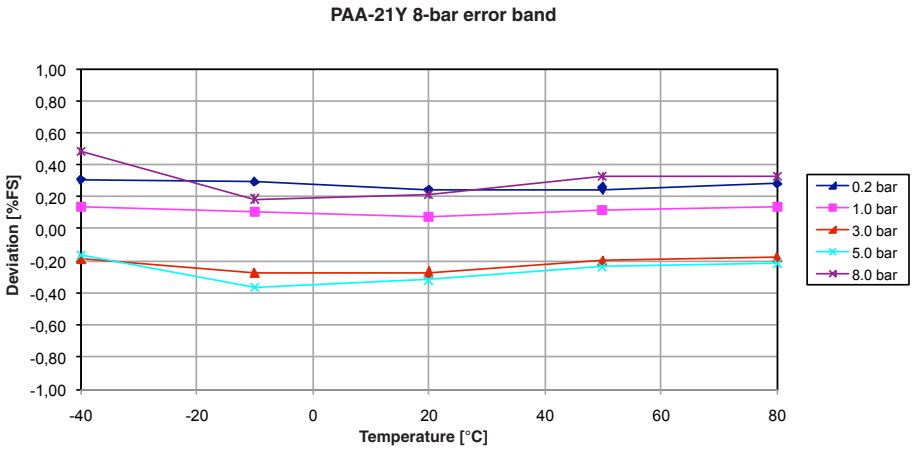
Compared to other model series that are not based on µP compensation, the Y-line transmitters have an extremely small temperature error. This is achieved using an additional circuit containing a temperature sensor that divides the temperature span into 1,5 Kelvin (K) sub-fields. The TK zero and TK gain compensation values are calculated for each field according to a mathematical model and are programmed into the supplementary circuit. These values are fed into the analogue signal path during operation, depending on the temperature. Each temperature is a “calibration temperature” for this transmitter. The accuracy thereof is mainly determined by linearity.

In theory, 120 fields are available, i.e. a maximum temperature span of 180 K. The wider the temperature span, the more expensive it becomes to perform testing and calibration in order to minimise the inaccuracies of the mathematical model.

Accuracy is essentially determined by linearity. Since typical linearities of 0,2 %FS are standard for modern pressure sensors, error bands of 0,25% above 100 K can be realized. This represents significant progress compared to the 30-year-old technology, and since these compensation values are supplied in parallel, it does not have to be at the expense of a lower frequency response.

Calibration in the factory: more efficient and more reliable:
Calibration and final inspection are performed in a single operation in automated systems that use state-of-the art technology. In these pressure/temperature calibration systems, the transmitter outputs and the programming line are routed in the furnace via an auxiliary connector on a PC board. The PC collects the information at different pressures and temperatures, calculates the compensation values for each temperature field for each transmitter and writes them into the EEPROMs in the transmitter circuit. The transmitters are then fully programmed.

The data from the programmed transmitters is tested at different pressures and temperatures using the same test set-up or testing process, and transmitted to the main computer. The data from each individual transmitter is displayed on the screen in error band format, which provides a full picture of the accuracy at a glance (see diagram „PAA-21Y 8 bar error band“).



This information can also be sent to the customer. This is a priceless tool for selecting the most suitable transmitters for the application depending on requirements, particularly for OEM customers who use the transmitters for different applications.

B) The new EC directives

The European electromagnetic compatibility (EMC) directives for electrical/electronic components first appeared in 1988. Compliance with the directives is a condition for applying the CE symbol, without which products cannot be sold in Europe.

Discussions took place in the pressure measuring technology area, mainly concerning the disturbance variable under the influence of magnetic fields (e.g. from mobile radio antennas), which are not specified in the directive from 1988. Only test lab strength of 10 V/m was specified. Since most of the pressure transmitters that came onto the market before 1988 were built without EMC protection and can have disturbance variables of 10% to 50% of the full range signal at 10 V/m, no further action was taken.

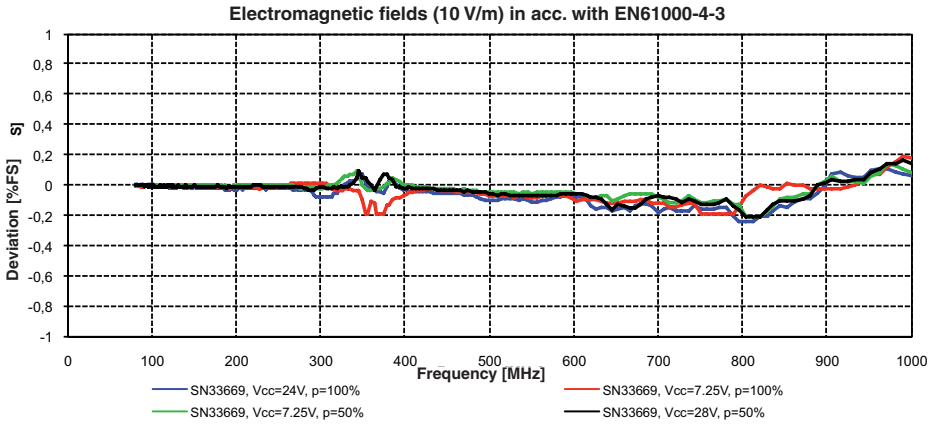
The new 2008 directives:
New directives have now arrived that have to be complied with from mid-2009 in order to achieve the CE symbol. These directives clearly define the permitted disturbance variable with electromagnetic radiation of 10 V/m.

Examples: The maximum disturbance variable for a transmitter error band of 0,1 %FS is ± 1,1 %FS, and it can be a maximum of ± 3 %FS with an error band of 0,5 %FS.

However, achieving values like this requires more specialised experience and a laboratory to check these values. The values for the new Y-line OEM transmitters are significantly less than this, meaning that they can be installed in any kind of housing, including housings made from non-conductive plastic.

Diagram on right:

KELLER has succeeded in placing the EMC radiation protection components on the print with the development of the new Y-print.
The measured radiation values are many times less than the allowed maximum values…



Accuracy the simple way: Classes

Mechanical pressure gauges are categorised into classes. Class 1% means accuracy of < ±1 %. If you asked the sales men about the temperature at which these accuracies are guaranteed, most of them would not know. It is clear that the temperatures that are required for mechanical pressure gauges are not as extreme as the temperatures for transmitters, since people still have to be in a position to read off the pressure.

In spite of this, confusion still reigns about the accuracy of pressure transducers and pressure transmitters. DIN standards NPW 16 NR: 19-90 DIN 16 086, which are intended to regulate this, list about 50 terms: estimating the accuracy or determining the error from these terms is a job for a well-trained metrology engineer. Many data sheets are still written in this way. Critics quite rightly claim that this is intended to camouflage “inaccuracies”.

The class of each individual transmitter can be quickly determined from the „PAA-21Y 8 bar error band” diagram. The class is the maximum difference between the target value and the actual value. The specification describes the conditions: supply, output signal, pressure range, temperature range, overpressure, maximum temperature, service life and whatever else is required.

Three-class society:

The Y-line filled the gap between transmitters that have been manufactured in the same way for 35 years (Series G in the list below, where the resistors are no longer soldered by hand, but machine-soldered resistors are lasered to the value), and the high-precision Series 30 X transmitters. The gap was therefore also problematic because Series 30 X can only be used up to a bandwidth of 200 Hz.

OEM-Products	Technology	Transmitter Series	0…50 °C Temp.-Range	-10…80 °C Temp.-Range	Bandwidth
Series 30 X	µP compensated	33 X / 35 X	**Class: 0,05 %**	Class: 0,1 %	200 Hz
Series 20 Y	PromComp07	21 PY / 23 (S)Y / 25 Y	**Class: 0,5 %**	Class: 0,7 %	2 kHz
		21 PY / 21 Y	**Class: 1,0 %**	Class: 1,5 %	2 kHz
Series 20 G	Laser-trimmed	21 G	**Class: 1,5 %**	Class: 2,0 %	1 kHz *

* optional up to 10 kHz

The accuracies for these two temperature ranges are specified in the Keller data sheets. These values are usually achievable without special provisions and with a high yield. Each technology also has ways of improving class accuracy by means of either sensor selection or a lower yield.

„*Data sheets should only be regarded as guides to take action",* as Dr. Schaudel of E+H put it 30 years ago. Particularly in projects where the transmitters are intended for the same application, the optimum technologies are selected and adapted, whereby the price is often the most important specification.