



---

**Innovation, Precision  
and Quality – the  
Engines of  
the Future**

40 years experience in research, development and production of piezoelectric and piezoresistive pressure sensors are the foundation for another generation of top-quality products. In engine research and development, only real top performers advance. The Kistler philosophy!

---



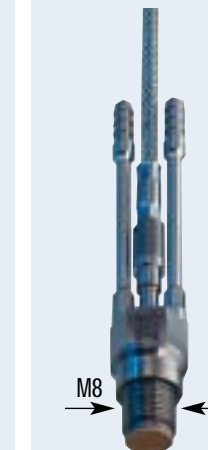
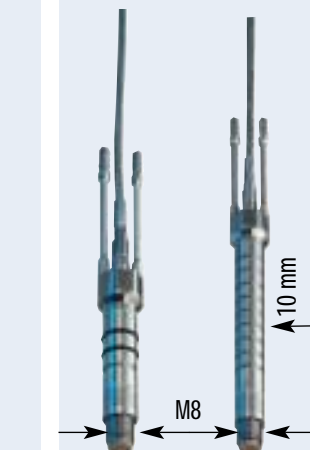


**KISTLER**

# Water-Cooled Precision Sensors

## Technical Data

Type	
Range	bar
Sensitivity	pC/bar
Natural frequency	kHz
Linearity, all ranges	% FSO
Sensitivity shift	
cooled 50 ± 35 °C	%
non-cooled 200 ± 150 °C	%
Thermal shock* Δp	bar
ΔIMEP	%
Δp <sub>max.</sub>	%
Data sheet	
Cable type	

ThermoCOMP® Quarz Pressure Sensor	ThermoCOMP® Quarz Pressure Sensor	ThermoCOMP® Quarz Pressure Sensor	ThermoCOMP® Quarz Pressure Sensor
			
M14	M10	M8	M8
7061B/7063A	6061B/6067C	6041A	6043A
0 ... 250	0 ... 250	0 ... 250	0 ... 250
≈ -80	≈ -25	≈ -20	≈ -20
≈ 45/≈ 30	≈ 90	≈ 70	≈ 70
<±0,5	<±0,5	<±0,5	<±0,5
<±0,5	<±0,5	<±0,5	<±0,5
<±2	<±2	<±2	<±2
<±0,1	<±0,2	<±0,25	<±0,25
<±0,5	<±1	<±2	<±2
<±0,5	<±1	<±1	<±1
3.7061B, 3.7063A	3.6061B, 3.6067C	3.6041A	3.6043A
1969A1	1919	1929A1	1929A1

\* Deviation from reference 7063A  
at 1500 min<sup>-1</sup>, 9 bar IMEP

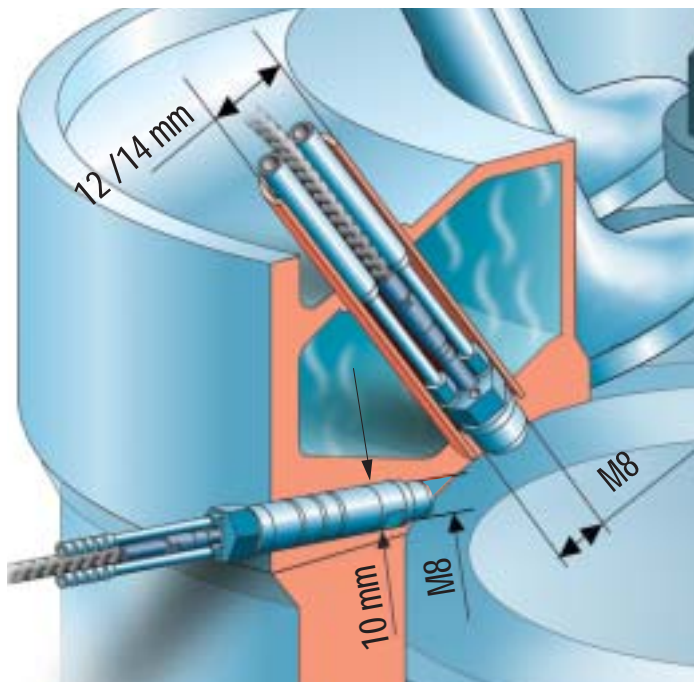
## Installation of Water-Cooled M8 Sensors, Type 6041A/6043Asp

Kistler has been specialising in water-cooled cylinder pressure sensors for precise engine monitoring for many years.

Our sensors type 7061 (M14) and 6061 (M10) have become standard tools in engine development world-wide. Kistler is once again setting new standards:

Type 6041 is the world's smallest water-cooled sensor with only 8 mm front diameter (M8 thread).

This water-cooled sensor is particularly suitable for precise thermo-dynamic examinations in small combustion engines. The trend towards smaller engines demands sensors with correspondingly smaller dimensions and with the lowest possible thermal shock error.



The sensor head of the new type 6041 fits into a M8 x 0.75 mounting hole. Because the measuring element withstands high temperatures, the sensor is not damaged if the water cooling cycle is interrupted – a major practical advantage!

The sensor can be fitted into a 12 mm diameter access hole.

The precision probe type 6043 is the special version of type 6041 with customer-specified length. The required mounting hole is only 10 mm diameter.

# Non-Cooled Sensors – Shoulder Sealing ( $\varnothing 6,2$ mm)

## Technical Data

### Type

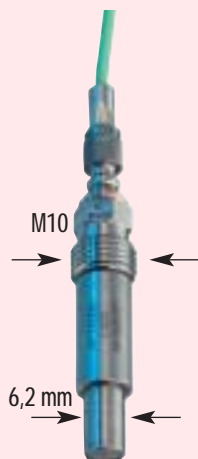
Range	bar	0 ... 250
Sensitivity	pC/bar	$\approx -16$
Natural frequency	kHz	$\approx 100$
Linearity, all ranges	% FSO	$< \pm 0,5$
Sensitivity shift		
200 $\pm$ 150 °C	%	$< \pm 3$
200 $\pm$ 50 °C	%	$< \pm 1$
Thermal shock* $\Delta p$	bar	$< -1,5$
$\Delta$ IMEP	%	$< -10$
$\Delta p_{max}$	%	$< -3$

\* Deviation from reference 7063A  
at 1500 min<sup>-1</sup>, 9 bar IMEP

Data sheet

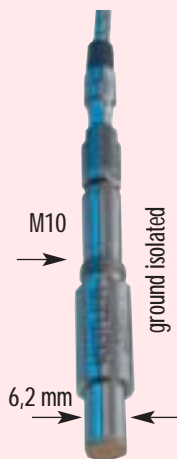
Cable type

### Quartz Pressure Sensor



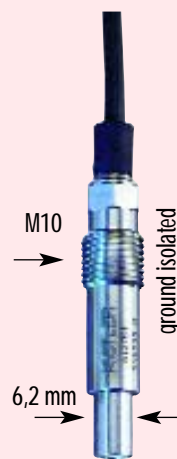
6123A

### ThermoCOMP® Quartz Pressure Sensor



6125A

### EconoSens Pressure Sensor



6127B

### New Measuring Spark Plug



6117B

0 ... 200

$\approx -15$

$\approx 130$

$< \pm 0,6$

-

$< \pm 1,5$

$< \pm 0,8$

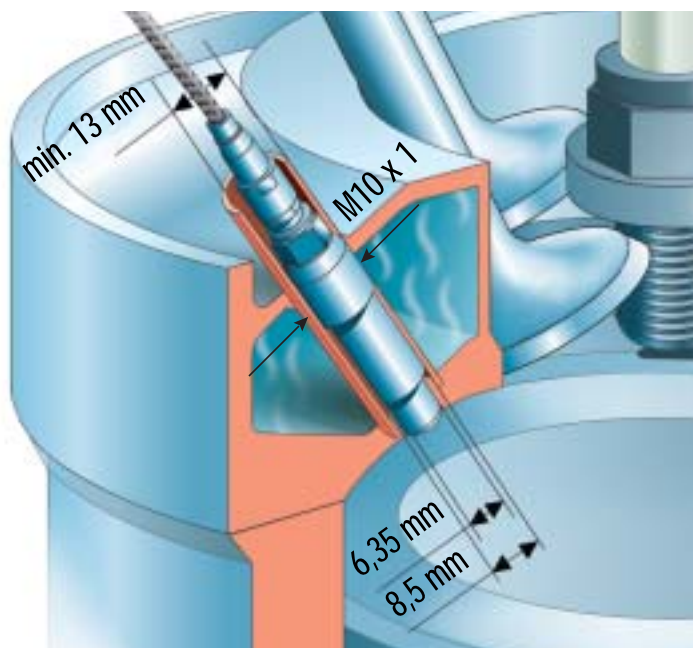
$< \pm 4$

$< \pm 2$

3.6117B

1927A1

## Fitting Hole



Fitting hole for types 6123/25/27

## EconoSens Type 6127

The increasing significance of on-board diagnostics, engine mapping and long-term examinations such as knock-identification produces a new requirement for medium cost sensors: the EconoSens!

This new non-cooled sensor is compatible with the known types 6121/23/25, the very successful Kistler sensor family.

Type 6125 is still the industry standard in respect of non-cooled pressure sensors and is used predominantly for monitoring in modern multi-valve engines.

The new EconoSens will, in the long-term, replace the tried and tested type 6123 as the sensor to be used when «knocking» occurs.

Its rigid design and knock-resistant feature sets the EconoSens apart from the competition. This low-cost sensor, which has an integrated cable, offers a long operating life and is fail-safe under extreme conditions in respect of contamination (oil), temperature etc.

A typical application is with cost-effective monitoring systems for training and education.

- Cost-effective sensor for long-time measurements and on-board diagnostics.
- Grounded sensor with integrated cable.
- Mounting compatible with types 6121, 6123 and 6125.

# Miniature Sensors for Precision Monitoring – Front Sealing

## Technical Data

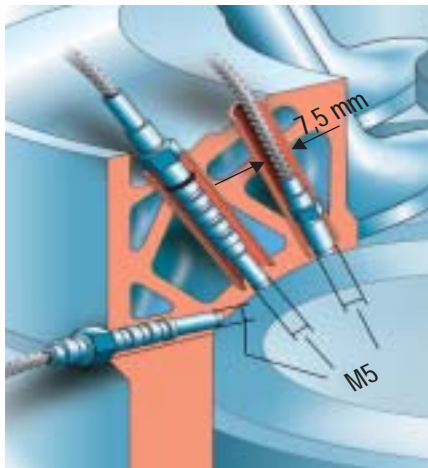
	M5-Miniature Pressure Sensor	M5-Miniature Pressure Sensor	M5-Miniature Pressure Probe	Miniature Pressure Probe $\varnothing$ 4,4 mm ( $\varnothing$ 4,0 mm)	
Type	6051B	6052A	6053C	6055B	6057A
Range	0 ... 250	0 ... 250	0 ... 250	0 ... 250	
Sensitivity	$\approx -6$	$\approx -19$	$\approx -19$	$\approx -19$	$\approx -15$
Natural frequency	$\approx 120$	$\approx 130$	$\approx 130$	$\approx 130$	$\approx 130$
Linearity, all ranges	$< \pm 0,5$	$< \pm 0,4$	$< \pm 0,4$	$< \pm 0,4$	$< \pm 0,6$
Sensitivity shift					
200 $\pm$ 150 °C	$< \pm 2$	$< \pm 3$	$< \pm 3$	$< \pm 3$	$< \pm 3$
200 $\pm$ 50 °C	$\approx \pm 1$	$\approx \pm 1$	$\approx \pm 1$	$\approx \pm 1$	$< \pm 1,5$
Thermal shock* $\Delta p$	$< \pm 0,5$	$< \pm 0,5$	$< \pm 0,5$	$< \pm 0,5$	$< \pm 0,8$
$\Delta$ IMEP	$< \pm 2$	$< \pm 2$	$< \pm 2$	$< \pm 2$	$< \pm 4$
$\Delta p_{max}$	$< \pm 2$	$< \pm 2$	$< \pm 2$	$< \pm 2$	$< \pm 2$
* Deviation from reference 7063A at 1500 min <sup>-1</sup> , 9 bar IMEP					
Data sheet	3.6051B	3.6052A	3.6053C	3.6055B	
Cable type	1929A1	1929A1	1957A1	1957A1	

## M5 Sensor Group

The M5 sensor family including front-sealing types 6051/52/53/55/57 represents the smallest group of high-temperature pressure sensors. A new piezoelectric crystal is used which

provides a sensitivity of 19 pC/bar in M5 sensors. Whilst sensor type 6052 is usually installed with a fitting sleeve, the M5 probe types 6053 and 6055 can be mounted directly through the water channel. This reduces the effective area required to a 5 mm hole diameter. These probes are also especially suitable for use in glow plug adapters.

The M5 sensor family is also available in a piezotron version for on-board measurements (type 6651 etc.).



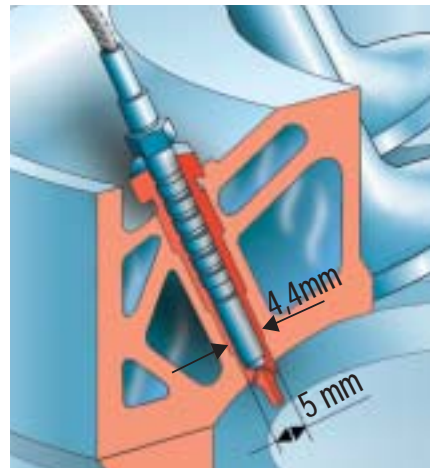
M5 - Front-sealing miniature sensor

## Pressure Probe for Glow Plug Adapter

With a front diameter of only 4.4 mm (4.0 mm with type 6057) and the re-set assembly thread (M5 x 0.5), this very small sensor type 6055 has an extremely short gas channel in the glow lamp

adapter. This means that the full frequency range can be measured. The front seal has excellent head dispersion characteristics, which enable the sensor to withstand short-term temperatures of

up to 400 °C. In small engines only minor changes to the cylinder head are necessary for direct mounting of this sensor without the requirement for additional assembly sleeves. A Viton O-ring seal on the shank of the probe prevents cooling water from escaping. (data sheet IN4.6531/6535)

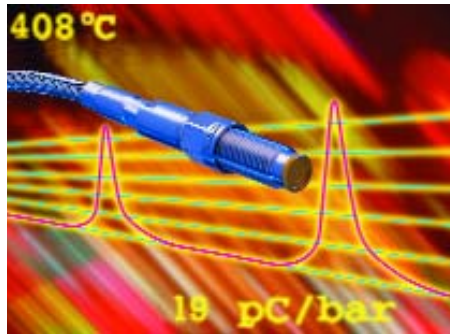


Miniature sensor type 6055 in the glow plug adapter

# Piezoelectric Sensors in Engine Development

Piezoelectric sensors are characterised predominantly by their excellent linearity over a wide temperature range.

In a combustion engine, a short-term flame effect occurs (known as thermal shock); this causes short-term drift. When the load changes (part load – full load), a temperature change occurs in the sensor housing which causes a zero line drift of the pressure signal (mid-term drift).



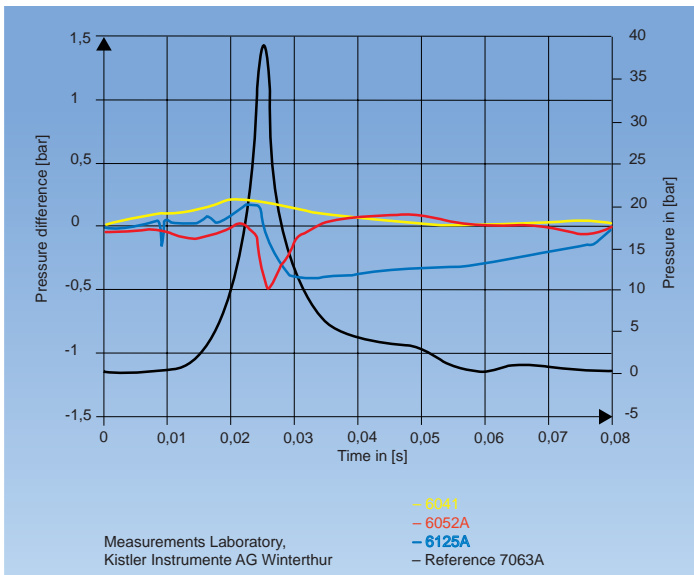
The best but the most costly method of reducing the mid-term drift is to incor-

porate a water cooling system in the sensor housing. This guarantees a stable zero line of the sensor signal over long operating periods and varying operating conditions (see fig. «mid-term drift»).

The short-term drift occurs due to the heat flow through the sensor housing during the combustion process. The sensor is locat-

ed in the cylinder head or wall at an average temperature of 150 °C. The flame temperature can be as high as 2000 °C. This thermal shock gives rise to short-term drift which is minimised by a special optimised membrane (Kistler ThermoComp Membrane).

## Thermal Shock



The reference signal was recorded by sensor type 7063 (operating point 1500 U/min, IMEP = 9 bar).

The other curves show the difference between the measured pressures of each examined sensor and the reference sensor.

- The near-perfect stability of the **water-cooled sensor type 6041** is apparent. Despite the drastically reduced assembly dimension (M8 thread), the thermal shock of this sensor is barely discernible.
- The **non-cooled sensor type 6052** has a relatively greater pressure drop, which recovers rapidly and therefore makes only a minor contribution to the subsequent evaluation of the pressure signal – e.g. calculation of IMEP or heat release.

- The influence of the various designs (**type 6052 – front sealing and type 6125 – shoulder sealing**) is also evident from the thermal shock curves. A front-sealed sensor type 6052 (red curve) recovers from thermal shock faster, since the heat dispersion is higher due to the front sealing.

**Ultimately, every application is a compromise between**

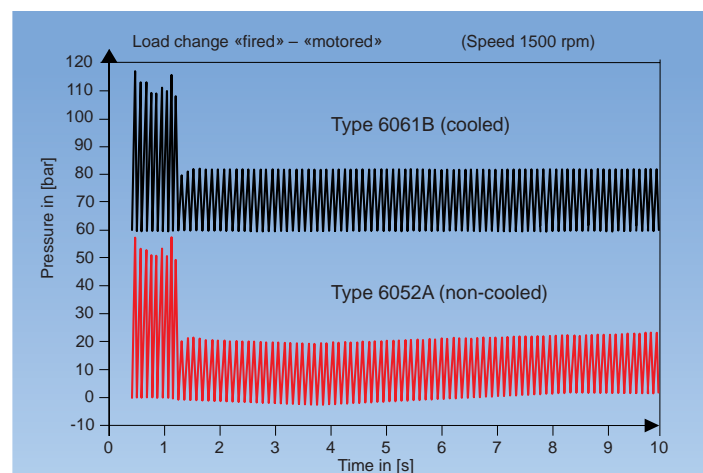
- the smallest possible mounting space whilst ensuring low thermal shock (types 6125, 6052) and
- minimum thermal shock with slightly higher space requirement (type 6041).

## Mid-Term Drift

The diagram shows the change between the zero line of sensor 6061B (water-cooled) and 6052A (non-cooled) following a variation in engine loading. The influence of the water-cooling process (stable zero line of type 6061) with a load change from «fired» to «motored» is clearly shown.

By using a charge amplifier with integrated drift compensation, type 5044, a stable zero line can also be achieved, when non-cooled sensors are used. This new 2-channel amplifier module can be used both in the «Indiset 620» and also

in stationary and portable housings (up to 16 channel). When combined with module type 4643 for piezo-resistive sensors, complete systems can be designed for both high and low pressure monitoring (see also «Pumping loop optimization by low pressure indication», Reprint 20.189).



# KISTLER System Accessories

Kistler produces a wide range of engine monitoring products in addition to our proven pressure sensors. Our product

range includes crank angle encoders, TDC transmitters and also a Multi Channel Amplifier System.

Expert applications support is readily from our subsidiary companies in all the major vehicle producing countries. With

agents in more than 40 countries we can guarantee a fast and competent customer support service worldwide.

## KISTLER Your partner for monitoring and measurement excellence – worldwide

TDC sensor type 2629:  
Capacitive sensor system with  
in-line electronics.



Multi Channel Measuring  
System type 5738/40:  
• Charge amplifier module (2 channel)  
with integrated drift compensation.  
• Piezoresistive amplifier module  
(2 channel).



Rigid crank angle transmitter  
type 2612C for fitting  
directly onto the crank-  
shaft. **NEW! Now with 0.1°  
resolution!**



Cooling system type 2621B for water-  
cooled cylinder pressure sensors and  
sensor adaptors.

## Fax for Further Information!

Please fill out in block lettering, copy and send by fax to your nearest Kistler distributor.

Name \_\_\_\_\_

First Name \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

Zip code, town \_\_\_\_\_

Country \_\_\_\_\_

Tel \_\_\_\_\_

Fax \_\_\_\_\_

Please send me information on:

**Engine measurement systems**

water-cooled sensors

non-cooled sensors

miniature sensors

amplifier systems

system accessoires

Common-Rail

low pressure indication

calibration

the entire Kistler range

Please send me customer publica-  
tion «KISTLER INFORMATION»  
on a regular basis

**UK**

**Kistler Instruments Ltd.**

Alresford House, Mill Lane  
Alton, Hampshire GU34 2QJ, GB

Tel (14 20) 54 44 77

Fax (14 20) 54 44 74

**USA**

**Kistler Instrument Corp.**

75 John Glenn Drive  
Amherst, NY 14228-2171

Tel (716) 691 51 00

Fax (716) 691 52 26

kicsales@kistler.com

**Switzerland (Parent Company)**

**Kistler Instrumente AG Winterthur**

PO Box 304, CH-8408 Winterthur

Tel + 41 - 52 - 224 11 11

Fax + 41 - 52 - 224 14 14

sales@kistler.ch, www.kistler.com