

High-temperature pressure sensor for combustion engine measurements

Type 6052C...

Patent No. US 6,105,434



High-temperature pressure sensor with very small dimensions are ideal for use in internal combustion engines with complex structural geometry of the cylinder head. The sensor is installed with front sealing in an M5x0.5 bore. Type 6052C can be used in applications with classic fuels as well as with alternative fuels including hydrogen.

- Good temperature stability of the sensitivity
- High sensitivity
- Low thermal shock error
- Long service life due to front seal
- Suitable for use in hydrogen combustion engines

Description

Type 6052C... uses a piezoelectric crystal which achieves high sensitivity in conjunction with an extremely small sensor structure. This sensitivity varies by not more than $\pm 0.5\%$ in the temperature range from 150 ... 250°C. The passive acceleration compensation patented by Kistler keeps the influence of engine vibrations to a minimum.

The front seal provides very good heat transfer and keeps the sensor at a save operating temperature. The optimized diaphragm produces good measuring results and ensures a long service life.

Application

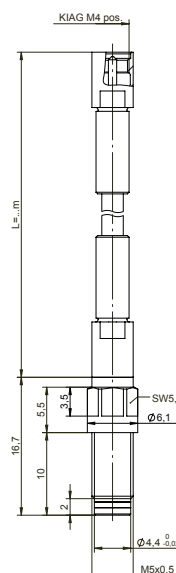
The sensor Type 6052C... is an excellent all-rounder. Its rugged construction makes it suitable for measurements at the knock limit as well as for thermodynamic investigations. This sensor is used mainly for complex cylinder head geometry. As well as for motor cycles and other small engines and for combustion analysis in vehicles.

For applications mainly in the knocking range or at very high peak pressures, use of Type 6052C...U20 with reinforced diaphragm (heavy duty version) is recommended.

Type 6052C...U40 is provided with additional damping and is suitable for applications on engines with extremely high vibrations, e.g. racing engines, but with a limited temperature range.

For standard applications, a rugged metal braided PFA cable is recommended. If the sensor plug is directly exposed to the engine oil, e.g. when installing through the valve cover, the oil-tight FPM cable is recommended.

Massbild / Dimension drawing
Sensor Type 6052C-3-
6052CU_6-3-...



Technical data

Type 6052C...

Measuring range	bar	0 ... 250
Calibrated partial ranges	bar	0 ... 50, 0 ... 100, 0 ... 150, 0 ... 250
Overload	bar	300
Sensitivity	pC/bar	≈ -20
Natural frequency (measuring element)	kHz	≈ 160
Linearity, all ranges (at 23°C)	%/FSO	$\leq \pm 0.3$
Acceleration sensitivity		
axial	mbar/g	< 0.8
radial	mbar/g	< 0.5
Operating temperature range	°C	-20 ... 350
Temperature min./max.	°C	-50 ... 400
Sensitivity change		
200 °C $\pm$ 50°C	%	$\leq \pm 0.5$
23 ... 350°C	%	$\leq \pm 2$
Thermal shock error		
(at 1 500 1/min, IMEP = 9 bar)		
Δp (short-term drift)	bar	$\leq \pm 0.5$
Δp_{mi}	%	$\leq \pm 2$
Δp_{max}	%	$\leq \pm 1$
Insulation resistance at 23°C	Ω	$\geq 10^{13}$

Technical data, continuation

Shock resistance	g	2 000
Tightening torque	N·m	1.5
Capacitance, without cable	pF	5
Weight with cable	grams	2
Connector, ceramic insulator	–	M4x0.35

Type 6052C...U20 (other specifications as for Type 6052C...)

Measuring range	bar	0 ... 300
Calibrated partial ranges	bar	0 ... 100, 0 ... 200, 0 ... 300
Overload	bar	350
Sensitivity	pC/bar	≈ -18
Linearity, all ranges (23°)	%/FSO	≤ ±0.5
Acceleration sensitivity		
axial	mbar/g	< 0.8
radial	mbar/g	< 0.5
Sensitivity change		
23 ... 350°C	%	≤ ±3
Thermal shock error		
(at 1 500 1/min, pmi = 9 bar)		
Δp (short time drift)	bar	≤ ±0.7
Δp _{ni}	%	≤ ±3
Δp _{max}	%	≤ ±1.5

Type 6052C...U40 (other specifications as for Type 6052C...)

Operating temperature range	°C	-20 ... 200
Temperature min./max.	°C	-50 ... 250
Calibrated partial ranges	bar	0 ... 100, 0 ... 200, 0 ... 250
Sensitivity change 23 ... 200°C	%	≤ ±2

Mounting

Direct mounting:

Sensor Type 6052C... can be mounted directly in the cylinder head, see Fig. 2. Machining of the bore must correspond exactly to the bore specifications shown in Fig. 1.

The Kistler tools:

Step drill	Type 1300A51
Special tap	Type 1357A
Finishing tool for bore	Type 1300A79

must be used in order to comply with the tolerances required. The bore must be machined in one clamping. Before mounting the sensor, the sealing surface in particular must be checked; use of the finishing tool (reamer) Type 1300A79 is mandatory. When mounting the sensor, it is essential to comply with the tightening torque of 1.5 N·m. The sensor should be mounted with the cable attached and the appropriate mounting tool and torque wrench. You will find additional information for machining the bore and mounting in the instruction manual. Your Kistler distributor will provide you with information, for example concerning the preferred position of the indicating bore in the combustion chamber.

Mounting sleeve:

When space allows or if the water jacket of the cylinder head will be breached, a mounting sleeve is recommended. Mounting sleeves are manufactured to customer requirements; Fig. 3 shows a version with M7x0,75 thread. An additional advantage of mounting sleeves is that the actual sensor bore in the sleeve can be very precisely machined. On request, Kistler will provide custom made adapters for your particular mounting situation.

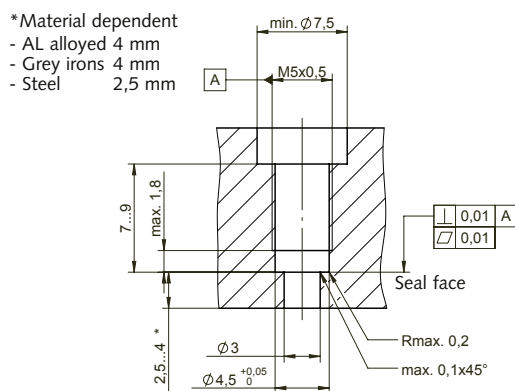


Fig. 1: Mounting bore

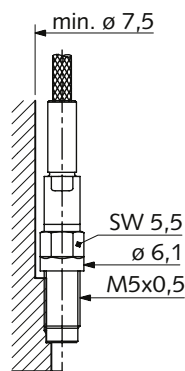


Fig. 2: Direct mounting

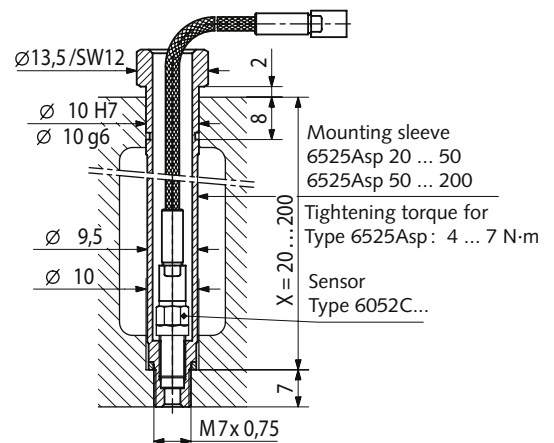


Fig. 3: Using the mounting sleeve

Maintenance, calibration and repair

Careful handling and regular inspections will ensure precise and reliable measurement results. The sensors should be cleaned after each use, checked for possible damage, and the electrical insulation resistance must be tested.

Calibration

Kistler recommends a regular calibration of cylinder pressure sensors after each use - or at the latest - one year after the last calibration. For cylinder pressure sensors, the following calibration services are available:

- 9961P-SC-07-10-3-1:
Service calibration (2 temperatures / 3 pressure ranges)
- 9961P-SC-07-10-4-1:
EOL calibration (All temperature- and pressure ranges)
- 9961P-AC-02-2-1-1-0:
Traceable Calibration according to ISO 17025

Repair

If damaged, certain components of the sensor can be replaced. The following repair services are available for cylinder pressure sensors:

- 9964R01-10-02-0-1-0-0-000:
Cable replacement
- 9964R01-10-02-0-0-0-0-010:
PiezoSmart replacement
- 9964R01-10-02-0-0-0-0-001:
Cooling pipe replacement

For further information refer to the instruction manual or contact your Kistler representative.

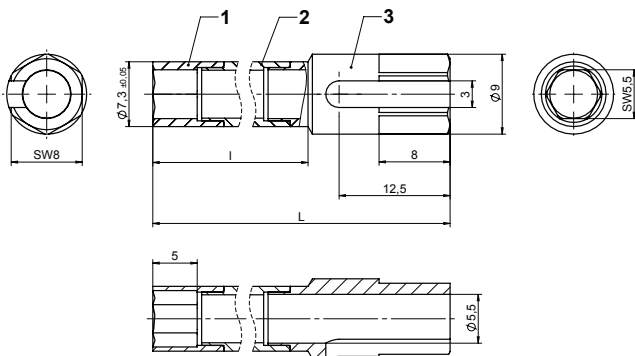


Fig. 4: Mounting key SW 5.5
Type 1300A9 with $l = 204/L = 220$
Type 1300A9Q02 with $l = 239/L = 255$

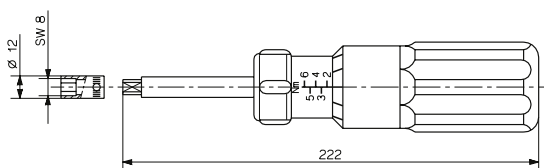


Fig. 5: Torque wrench 1 ... 6 N·m Type 1300A17

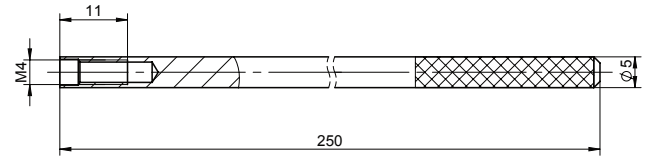


Fig. 6: Extraction tool for dummy sensor Type 1319

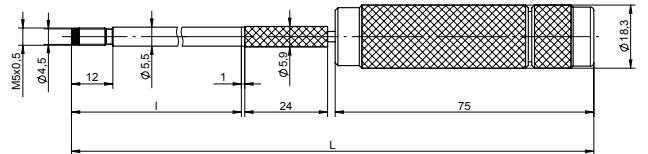


Fig. 7: Finishing tool for bore
Type 1300A79 with $l = 60/L = 162$
Type 1300A79Q01 with $l = 170/L = 273$
Type 1300A79Q02 with $l = 220/L = 323$

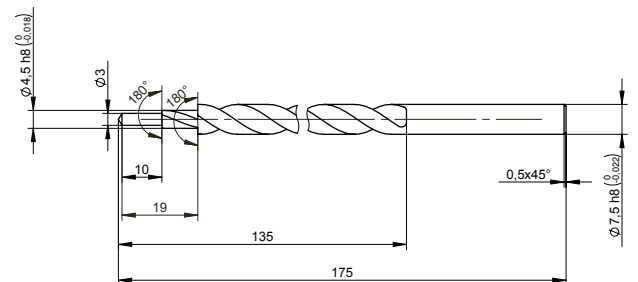


Fig. 8: Step drill Type 1300A51

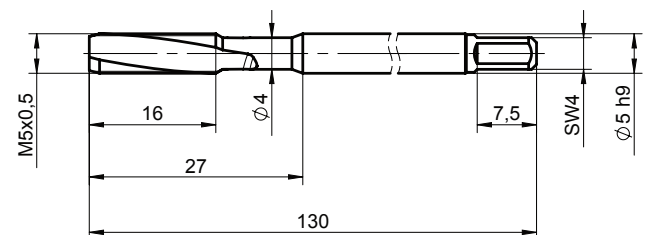


Fig. 9: Special tap M5x0.5 Type 1357A

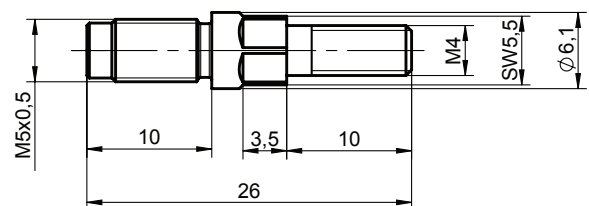


Fig. 10: Dummy sensor Type 6445 (for Type 6052...)

Scope of delivery

- Pressure sensor
- Connecting cable acc. to ordering key
- Calibration certificate
- Adapter M4 neg. – BNC pos.
(not for PiezoSmart)

Type/Art. No.
 6052C

1705

Optional accessories

- PiezoSmart extension cable
 - L = 1 m
 - L = 2 m
 - L = 10 m
- Connecting cables PFA steel braiding oil-tight IPx8
 - L = 1 m **
 - L = 2 m **
 - L = 3 m **
 - with PiezoSmart, L = 1 m *
 - with PiezoSmart, L = 2 m *
 - with PiezoSmart, L = 3 m *
- Connecting cables FPM oil-tight IPx8
 - L = 1 m **
 - L = 2 m **
 - L = 3 m **
 - with PiezoSmart, L = 1 m *
 - with PiezoSmart, L = 2 m *
 - with PiezoSmart, L = 3 m *
- Adapter M4 neg. – KIAG 10-32 neg.
- Dummy sensor
- Extrac. tool for dummy sensor Type 6445
- Mounting sleeve M7x0.25
(custom made)
- Adapter for pressure generator Type 6904
- Step drill
- Tap M5x0.5
- Mounting key SW 5.5 L = 220
- Mounting key SW 5.5 L = 255
- Torque wrench 1 ... 6 N·m
- Finishing tool for bore
 - bore depth ≤60 mm
 - bore depth ≤170 mm
 - bore depth ≤220 mm
- Engine adapter
 - M8x0.75
 - M10x1/SW12
 - M10x1/SW10
 - M14x1.25

Type/Art. No.

1987B1

1987B2

1987B10

1929B1

1929B2

1929B3

1985A1S311

1985A1S321

1985A1S331

1983BA1

1983BA2

1983BA3

1985A1S711

1985A1S721

1985A1S731

1700A13

6445

1319

6525ASP...

6585A

1300A51

1357A

1300A9

1300A9Q02

1300A17

1300A79

1300A79Q01

1300A79Q02

6595

6595A1

6595A1Q01

6585AQ01

Ordering key

Type 6052C

Version

Standard	
Reinforced diaphragm	U20
Additional damping	U40

PiezoSmart

Without PiezoSmart (standard)	-
With PiezoSmart (standard)	S

Cable version

PFA with steel braiding (standard)	3
FPM oil-proof	7

Cable length

1 m (standard)	-1
2 m (standard)	-2
3 m (standard)	-3

Ordering examples:

Standard sensor with PiezoSmart and 2 m FPM cable:

Type 6052CS7-2

Standard sensor without PiezoSmart and 1 m PFA steel braid cable: Type 6052C-3-1

* With factory calibration data, state SN with order

** Replaces cable type 1929A / 1983AA

Description of Icons

	H2 tested: Suitable for the use in hydrogen combustion engines		Anti Strain Design: Insensitive to mechanical strain effects
	Ready to Use: Easy installation - minimal modifications		High Thermal Stability: Temperature stable over measuring range
	Closed Loop Combustion Control: Suitable for closed loop control applications		High Robustness: High durability with good thermodynamic performance

6052C_000-552e-04_26