GEFRAN

PRESSURE SENSORS FOR HIGH TEMPERATURE "SIL2" VERSION

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INDEX

1. GENERAL INFORMATION

1.1. General information

This manual refers to the following products:

M, W, K SIL2, in compliance with the requirements of IEC/EN62061 and IEC/EN 61508 standards and must be kept near the equipment for easy reading and consultation.

It must be read, understood, and strictly follow in order to avoid and prevent accidents and/or malfunctions.

Gefran will not be liable for any injury to people and/or damage to property deriving from disregard of this manual.

1.2. Copyright

1.3. Correct use

Gefran Melt pressure sensors are designed and built to measure the pressure and temperature variable of melted plastic at different temperatures according to the filling fluid used.

The correct temperature range is:

- Up to 315°C, for W sensors series
- Up to 400°C, for M sensors series
- Up to 538°C, for K sensors series

If the sensors are used as a safety component in accordante with the Machinery Directive, the equipment builder must take all necessary precautions to ensure that any malfunctions of the Melt pressure sensor do not injury to people and/or damage to property.

Installation and maintenance must only be carried out by suitably skilled and qualified personnel.

2. MELT SENSOR AND THE MODELS

2.1. Melt Sensor

Gefran Melt sensors are pressure/temperature transducers and transmitters designed for use in high-temperature environments.

They read media pressure up to a temperature of 538°C, and resist such high temperatures thanks to the ir special mechanical construction, in which the measurement element is isolated from the Melt.

The constructive principle is based on hydraulic transmission of pressure; mechanical strain is transferred by means of a non-compressible transmission liquid.

The liquid used in these sensors may be mercury (series M), FDA-approved oil (series W) or NaK (series K). Strain gauge technology translates the physical quantity (pressure) into an electrical signal.

Four different designs are available: rigid rod, flexible sheathing, flexible plus thermocouple, and exposed tip. Gefran Melt sensors satisfy all installation and field requirements.

The sensors can read an extremely wide range of pressures: from a version with minimum range of 0-17 bar up to a version with a scale of 0-2000 bar.

All models in the catalog can be supplied in two different classes of accuracy: class M, with accuracy of 0.5% FS, and class H, with accuracy of 0.25% FS.

Current and voltage output signals (different outputs available, see datasheet) allow the connection of all architectures now utilized for plastics processing machines.

2.2. Models

4-20mA
CURRENT OUTPUT

Rigid stem	*Flexible stem*	*Flexible stem+Thermocouple*	*Exposed tip*
ME0 (Mercury)	ME1 (Mercury)	ME2 (Mercury)	ME3 (Mercury)
WE0 (Oil)	WE1 (Oil)	WE2 (Oil)	WE3 (Oil)
KE0 (NaK)	KE1 (NaK)	KE2 (NaK)	KE3 (NaK)




0.5-10.5V/0.1-10.1V/0.1-5.1V
VOLTAGE OUTPUT

Rigid stem	*Flexible stem*	*Flexible stem+Thermocouple*	*Exposed tip*
MN0 (Mercury)	MN1 (Mercury)	MN2 (Mercury)	MN3 (Mercury)
WN0 (Oil)	WN1 (Oil)	WN2 (Oil)	WN3 (Oil)
KN0 (NaK)	KN1 (NaK)	KN2 (NaK)	KN3 (NaK)




3. TECHNICAL DATA

MELT PRESSURE TRANSDUCERS

ME0/ME1/ME2/ME3 series

Main features

- Pressure ranges: from 0-17 to 0-2000 bar / from 0-250 to 0-30000 psi
- Accuracy: < ±0.25% FS (H); < ±0.5% FS (M)
- Fluid-filled system for temperature stability
- Mercury filled volume: ME0 series (30mm^3) - ME1/ME2/ME3 series (40mm^3)
- 1/2-20UNF, M18x1.5 standard threads, other types availbale on request
- Other diaphragms available on request
- Autozero function on board / external option
- Drift Autocompensation function (SP version)
- Standard diaphragm is 15-5PH stainless steel with GTP+ coating
- 17-7PH corrugated diaphragm with GTP+ coating for ranges below 100bar (1500psi)

Accuracy (1)	H <±0.25%FS (100...2000 bar) M <±0.5%FS (17...2000 bar)
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Resolution	Infinite
Measuring ranges	0…17 to 0…2000 bar 0…250 to 0...30000 psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 1000 bar/ 15000 psi
Measurement principle	Extensimetric (thick film)
Power supply	10...30 Vdc
Maximum current absorption	32 mA
Output signal Full Scale FS	20 mA
Zero balance (tolerance ± 0.25% FS)	4 mA
Zero signal adjustment (± 0.25%FS)	“Autozero” function
Maximum allowed load	See diagram to pag. 23
Electronic response time (10...90% FS)	1 ms
Output noise (RMS 10-400Hz)	< 0.025% FS
Calibration signal	80% FS
Reverse polarity protection on power supply	YES
Compensated temperature range (housing)	0...+85°C
Operating temperature range (housing)	-30...+105°C
Storage temperature range (housing)	-40...+125°C
Diaphragm maximum temperature	23…400 °C / 750 °F (M)
Stem drift (zero)	< 0.02 bar/°C
Zero drift temperature for Autocompensated version (SP) within the temperature range 20-400°C inclusive the drift temperature of the housing	< 0.003 bar/°C 100 p < 500 bar ≤ 0.0014 %FS/°C p ≥ 500 bar
Thermocouple (model 2)	STD: type “J” (isolated junction)
Standard material in contact with process medium	Diaphragm: • 15-5PH with GTP+ coating • 17-7 PH corrugated diaphragm with GTP+ coating for ranges <100 bar (1500psi) Stem: • 17-4 PH
Protection degree (with 6-pole female connector CON300)	IP66 (EN 60529)
Insulation resistance (at 50Vdc)	>1000 Mohm
Electromagnetic compatibility – Emission	EN 61326-1 EN 61326-2-3 EN61326-3-1

Electromagnetic compatibility – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1
FS = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).	
Sensors are manufactured in compliance with: - EMC compatibility directive - RoHS directive - Machinery directive Electrical installation requirements and Conformity certificate are available on our web site: www.gefran.com	

MELT PRESSURE TRANSDUCERS

M_0/M_1/M_2/M_3 Series

Main features

- Pressure ranges: from 0-17 to 0-2000 bar / from 0-250 to 0-30000 psi
- Accuracy: < ±0.25% FS (H); < ±0.5% FS (M)
- Fluid-filled system for temperature stability
- Mercury filling volume: M_0 series (30mm^3) - M_1 M_2 M_3 series (40mm^3)
- 1/2-20UNF, M18x1.5 standard threads, other types available on request
- Other diaphragms available on request
- Autozero function on board / external option
- Drift Autocompensation function (SP version)
- Standard diaphragm is 15-5PH stainless steel with GTP+ coating
- 17-7PH corrugated diaphragm with GTP+ coating for ranges below 100bar (1500psi)

Accuracy (1)	H <±0.25%FS (100...2000 bar) M <±0.5%FS (17...2000 bar)
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Resolution	Infinite
Measuring ranges	0..17 to 0..2000bar 0..250 to 0..30000psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 1000bar/15000psi
Measurement principle	Extensimetric (thick film)
Power supply	15...30Vdc (output C and 7) 10...30Vdc (output B)
Maximum current absorption	25mA
Output signal Full Scale FS	5.1Vdc (B) – 10.1Vdc (C) – 10.5 Vdc (7)
Output signal at Zero (tolerance ± 0.25%FS)	0.1Vdc (B, C) – 0.5 Vdc (7)
Zero signal adjustment (± 0.25%FS)	“Autozero” function
Maximum allowed load	1mA
Electronic response time (10...90% FS)	1ms
Output noise (RMS 10-400Hz)	< 0.025% FS
Calibration signal	80% FS
Reverse polarity protection on power supply	YES
Compensated temperature range (housing)	0...+85°C
Operating temperature range (housing)	-30...+105°C

Storage temperature range (housing)	-40...+125°C
Diaphragm maximum temperature	23…400 °C / 750 °F (M)
Stem drift (zero)	< 0.02 bar/°C
Zero drift temperature for Autocompensated version (SP) within the temperature range 20-400°C inclusive the drift temperature of the housing	< 0.003 bar/°C 100 p < 500 bar ≤ 0.0014 %FS/°C p ≥ 500 bar
Thermocouple (model 2)	STD: type “J” (isolated junction)
Standard material in contact with process medium	Diaphragm: • 15-5PH with GTP+ coating • 17-7 PH corrugated diaphragm with GTP+ coating for ranges <100 bar (1500psi) Stem: • 17-4 PH
Protection degree (with 6-pole female connector CON300)	IP66 (EN 60529)
Insulation resistance (at 50Vdc)	>1000 Mohm
Electromagnetic compatibility – Emission	EN 61326-1 EN 61326-2-3 EN61326-3-1
Electromagnetic compatibility – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1
FS = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).	
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OIL-FILLED MELT PRESSURE TRANSDUCERS

WE0/WE1/WE2/WE3 Series

Main features

- Pressure ranges: from 0-17 to 0-1000 bar / from 0-250 to 0-15000 psi
- Accuracy: < ±0.25% FS (H); < ±0.5% FS (M)
- Fluid-filled system for temperature stability
- Oil filling meets FDA requirements CFR 178.3620 and CFR 172.878
- Oil filling volume: WE0 series (30mm^3) - WE1/WE2/WE3 series (40mm^3)
- 1/2-20UNF, M18x1.5 standard threads, other types available on request
- Other diaphragms available on request
- Autozero function on board / external option
- Drift Autocompensation function (SP version)
- 17-7PH corrugated diaphragm with GTP+ coating

Accuracy (1)	H <±0.25%FS (100...2000 bar) M <±0.5%FS (17...2000 bar)
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Resolution	Infinite
Measuring ranges	0…17 to 0…2000 bar 0…250 to 0...30000 psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 1000 bar/ 15000 psi
Measurement principle	Extensimetric (thick film)
Power supply	10...30 Vdc
Maximum current absorption	32 mA
Output signal Full Scale FS	20 mA
Zero balance (tolerance ± 0.25% FS)	4 mA
Zero signal adjustment (± 0.25%FS)	“Autozero” function
Maximum allowed load	See diagram to pag. 23
Electronic response time (10...90% FS)	1 ms
Output noise (RMS 10-400Hz)	< 0.025% FS
Calibration signal	80% FS
Reverse polarity protection on power supply	YES
Compensated temperature range (housing)	0...+85°C
Operating temperature range (housing)	-30...+105°C
Storage temperature range (housing)	-40...+125°C
Diaphragm maximum temperature	23…315 °C / 600 °F (W)
Stem drift (zero)	<0.04bar/°C
Zero drift temperature for Autocompensated version (SP) within the temperature range 20-400°C inclusive the drift temperature of the housing	< 0.005 bar/°C p < 500 bar ≤ 0.0022 %FS/°C p ≥ 500 bar
Thermocouple (model 2)	STD: type “J” (isolated junction)
Standard material in contact with process medium	Diaphragm: • 15-5PH with GTP+ coating • 17-7 PH corrugated diaphragm with GTP+ coating for ranges <100 bar (1500psi) Stem: • 17-4 PH
Protection degree (with 6-pole female connector CON300)	IP66 (EN 60529)
Insulation resistance (at 50Vdc)	>1000 Mohm
Electromagnetic compatibility – Emission	EN 61326-1 EN 61326-2-3 EN61326-3-1

Electromagnetic compatibility – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1
FS = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).	
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OIL-FILLED MELT PRESSURE TRANSDUCERS
W_0/W_1/W_2/W_3 Series

Main features

- Pressure ranges: from 0-17 to 0-1000 bar / from 0-250 to 0-15000 psi
- Accuracy: < ±0.25% FS (H); < ±0.5% FS (M)
- Fluid-filled system for temperature stability
- Oil filling meets FDA requirements CFR 178.3620 and CFR 172.878
- Oil filling volume: W_0 series (30mm^3) - W_1 W_2 W_3 series (40mm^3)
- 1/2-20UNF, M18x1.5 standard threads, other types available on request
- Other diaphragms available on request
- Autozero function on board / external option
- Drift Autocompensation function (SP version)
- 17-7PH corrugated diaphragm with GTP+ coating

Accuracy (1)	H <±0.25%FS (100...2000 bar) M <±0.5%FS (17...2000 bar)
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Resolution	Infinite
Measuring ranges	0..17 to 0..2000bar 0..250 to 0..30000psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 1000bar/15000psi
Measurement principle	Extensimetric (thick film)
Power supply	15...30Vdc (output C and 7) 10...30Vdc (output B)
Maximum current absorption	25mA
Output signal Full Scale FS	5.1Vdc (B) – 10.1Vdc (C) – 10.5 Vdc (7)
Output signal at Zero (tolerance ± 0.25%FS)	0.1Vdc (B, C) – 0.5 Vdc (7)
Zero signal adjustment (± 0.25%FS)	“Autozero” function
Maximum allowed load	1mA
Electronic response time (10...90% FS)	1ms
Output noise (RMS 10-400Hz)	< 0.025% FS
Calibration signal	80% FS
Reverse polarity protection on power supply	YES
Compensated temperature range (housing)	0...+85°C
Operating temperature range (housing)	-30...+105°C
Storage temperature range (housing)	-40...+125°C
Diaphragm maximum temperature	23…315 °C / 600 °F (W)
Stem drift (zero)	< 0.02 bar/°C
Zero drift temperature for Autocompensated version (SP) within the temperature range 20-400°C inclusive the drift temperature of the housing	< 0.003 bar/°C 100 p < 500 bar ≤ 0.0014 %FS/°C p ≥ 500 bar
Thermocouple (model 2)	STD: type “J” (isolated junction)
Standard material in contact with process medium	Diaphragm: • 15-5PH with GTP+ coating • 17-7 PH corrugated diaphragm with GTP+ coating for ranges <100 bar (1500psi) Stem: • 17-4 PH
Protection degree (with 6-pole female connector CON300)	IP66 (EN 60529)
Insulation resistance (at 50Vdc)	>1000 Mohm

Electromagnetic compatibility – Emission	EN 61326-1 EN 61326-2-3 EN61326-3-1
Electromagnetic compatibility – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1
FS = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).	
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MELT PRESSURE TRANSDUCERS

KE0/KE1/KE2/KE3 Series

Main features

- Pressure ranges: from 0-17 to 0-1000 bar / from 0-250 to 0-15000 psi
- Accuracy: < ±0.25% FS (H); < ±0.5% FS (M)
- Hydraulic transmission system for pressure signal guarantees stability at working temperature (NaK). Liquid conforming to RoHS Directive. NaK is defined as a safe substance (GRAS)
- Quantity of NaK contained: KE0 series (30mm^3) [0,00183 in^3] - KE1/KE2/KE3 series (40mm^3) [0,00244 in^3]
- 1/2-20UNF, M18x1.5 standard threads, other types available on request
- Autozero function on board / external option
- Stem drift Autocompensation function (SP version)
- Inconel 718 diaphragm with GTP+ coating for temperatures up to 538°C (1000°F)
- 15-5PH diaphragm with GTP+ coating for temperatures up to 400°C (750°F)
- Hastelloy C276 diaphragm for temperatures up to 300°C (570°F)
- 17-7PH corrugated diaphragm with GTP+ coating for ranges below 100bar (1500psi)
- Stem material: 17-4PH

Accuracy (1)	H <±0.25%FS (100...2000 bar) M <±0.5%FS (17...2000 bar)
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Resolution	Infinite
Measuring ranges	0…17 to 0…2000 bar 0…250 to 0...30000 psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 1000 bar/ 15000 psi
Measurement principle	Extensimetric (thick film)
Power supply	10...30 Vdc
Maximum current absorption	32 mA
Output signal Full Scale FS	20 mA
Zero balance (tolerance ± 0.25% FS)	4 mA
Zero signal adjustment (± 0.25%FS)	“Autozero” function
Maximum allowed load	See diagram to pag. 23
Electronic response time (10...90% FS)	1 ms
Output noise (RMS 10-400Hz)	< 0.025% FS
Calibration signal	80% FS
Reverse polarity protection on power supply	YES
Compensated temperature range (housing)	0...+85°C
Operating temperature range (housing)	-30...+105°C
Storage temperature range (housing)	-40...+125°C
Diaphragm maximum temperature	23…538°C / 1000°F (K) 23…400 °C / 750 °F (M) 23…315 °C / 600 °F (W)
Stem drift (zero)	< 0.02 bar/°C
Zero drift temperature for Autocompensated version (SP) within the temperature range 20-400°C inclusive the drift temperature of the housing	< 0.005 bar/°C 100 ≤ p < 500 bar 0.0022 %FS/°C p ≥ 500 bar
Thermocouple (model 2)	STD: type “J” (isolated junction)
Standard material in contact with process medium	Diaphragm: • 15-5PH with GTP+ coating • 17-7 PH corrugated diaphragm with GTP+ coating for ranges <100 bar (1500psi) Stem: • 17-4 PH

Protection degree (with 6-pole female connector CON300)	IP66 (EN 60529)
Insulation resistance (at 50Vdc)	>1000 Mohm
Electromagnetic compatibility – Emission	EN 61326-1 EN 61326-2-3 EN61326-3-1
Electromagnetic compatibility – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1
FS = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).	
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MELT PRESSURE TRANSDUCERS

K_0/K_1/K_2/K_3 Series

Main features

- Pressure range: from 0-17 to 0-1000 bar / from 0-250 to 0-15000 psi
- Accuracy: < ±0.25% FS (H); < ±0.5% FS (M)
- Hydraulic transmission system for pressure signal guarantees stability at working temperature (NaK). Liquid conforming to RoHS Directive. NaK is defined as a safe substance (GRAS)
- Quantity of NaK contained: K_0 series (30mm^3) [0,00183 in^3] - K_1 K_2 K_3 series (40mm^3) [0,00244 in^3]
- 1/2-20UNF, M18x1.5 standard threads, other types available on request
- Autozero function on board / external option
- Stem drift Autocompensation function (SP version)
- Inconel 718 diaphragm with GTP+ coating for temperatures up to 538°C (1000°F)
- 15-5PH diaphragm with GTP+ coating for temperatures up to 400°C (750°F)
- Hastelloy C276 diaphragm for temperatures up to 300°C (570°F)
- 17-7PH corrugated diaphragm with GTP+ coating for ranges below 100bar (1500psi)
- Stem material: 17-4PH

Accuracy (1)	H <±0.25%FS (100...2000 bar) M <±0.5%FS (17...2000 bar)
Thermal drift in compesated range: Zero / Calibration / Sensibility	< 0.02% FS/°C
Resolution	Infinite
Measuring ranges	0..17 to 0..2000bar 0..250 to 0..30000psi
Maximum overpressure (without degrading performances)	2 x FS 1.5 x FS above 1000bar/15000psi
Measurement principle	Extensimetric (thick film)
Power supply	15...30Vdc (output C and 7) 10...30Vdc (output B)
Maximum current absorption	25mA
Output signal Full Scale FS	5.1Vdc (B) – 10.1Vdc (C) – 10.5 Vdc (7)
Output signal at Zero (tolerance ± 0.25%FS)	0.1Vdc (B, C) – 0.5 Vdc (7)
Zero signal adjustment (± 0.25%FS)	“Autozero” function
Maximum allowed load	1mA
Electronic response time (10...90% FS)	1ms
Output noise (RMS 10-400Hz)	< 0.025% FS
Calibration signal	80% FS
Reverse polarity protection on power supply	YES
Compensated temperature range (housing)	0...+85°C
Operating temperature range (housing)	-30...+105°C
Storage temperature range (housing)	-40...+125°C
Diaphragm maximum temperature	23…538°C / 1000°F (K)
Stem drift (zero)	< 0.02 bar/°C
Zero drift temperature for Autocompensated version (SP) within the temperature range 20-400°C inclusive the drift temperature of the housing	< 0.005 bar/°C p < 500 bar ≤ 0.0022 %FS/°C p ≥ 500 bar
Thermocouple (model 2)	STD: type “J” (isolated junction)

Standard material in contact with process medium	Diaphragm: • 15-5PH with GTP+ coating • 17-7 PH corrugated diaphragm with GTP+ coating for ranges <100 bar (1500psi) Stem: • 17-4 PH
Protection degree (with 6-pole female connector CON300)	IP66 (EN 60529)
Insulation resistance (at 50Vdc)	>1000 Mohm
Electromagnetic compatibility – Emission	EN 61326-1 EN 61326-2-3 EN61326-3-1
Electromagnetic compatibility – Immunity	EN 61326-1 EN 61326-2-3 EN61326-3-1
FS = Full scale output : (1) BFSL method (Best Fit Straight Line): includes combined effects of Non-Linearity, Hysteresis and Repeatability (according to IEC 62828-2).	
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4. WEIGHT AND MECHANICAL DIMENSIONS

4.1. Weight

Weight for versions standard to catalogue:

M_0 / W_0 / K_0 series	250 gr.
M_1 / W_1 / K_1 series	350 gr.
M_2 / W_2 / K_2 series	430 gr.
M_3 / W_3 / K_3 series	200 gr.

4.2. Specific filling liquid

MERCURY

- Maximum temperature range 400°C
- Mercury filling volume for M series model:

ME0 / M_0	30mm^3
ME1 / M_1	40mm^3
ME2 / M_2	40mm^3
ME3 / M_3	40mm^3

OIL

- Oil certified FDA (CFR 178.3620 and CFR 172.878)
- Maximum temperature range 315°C
- Oil filling volume for W series model:

WE0 / W_0	30mm^3
WE1 / W_1	40mm^3
WE2 / W_2	40mm^3
WE3 / W_3	40mm^3

NaK

- Sodium and potassium alloy (GRAS)
- Maximum temperature range 538°C
- NaK volume for K series model:

KE0 / K_0	30mm^3
KE1 / K_1	40mm^3
KE2 / K_2	40mm^3
KE3 / K_3	40mm^3

4.3. Mechanical dimensions

See the individual product data sheets for mechanical dimensions.

5. INSTALLATION, MOUNTING AND MAINTENANCE

Correct installation of the sensor is essential for good operation and long life.
The Melt sensor's special location and the type of material in which it works demand extreme care when mounting it in the machine.

Following advice for extending the sensors lifetime:

a) Avoid shocks and abrasions to the in contact diaphragm. Protect the transducer with its cover each time you remove it from its seat.

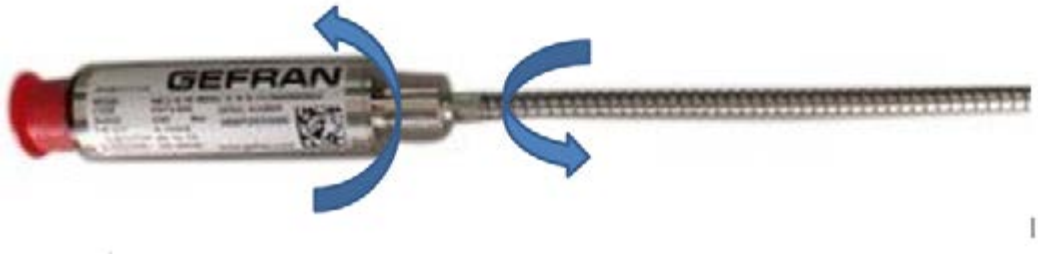
b) The seat must be prepared perfectly and with appropriate tools in order to respect the depth and axiality of the holes and tapping. Pay particular attention to the coaxiality of the holes to the thread, because diaxialities greater than 0.2mm will break the transducer during assembly. It is essential that hole depth guarantee the absence of chambers or air pockets in which extrusion material may be trapped.
To prevent contact with the extrusion screw or with tools used to clean the extrusion chamber, the front diaphragm must not extend from the inner wall of the extruder.

c) Before assembling the transducer in machines already in operation, make sure that the housing is clean. Remove any residual with the suitable cleaning device.

d) The transducer should be removed only with the machine empty (without pressure) but still hot.

e) The transducer should be cleaned with solvents for the material being processed. Any mechanical action on the contact diaphragm modifies its operation and could break it.

In case of configuration "2" with flexible stem, please do not apply high relative torque in between the housing and the flexible.



For this configuration, this is the right installation procedure:
first inserting the sensor securely into the hole and then fix the housing by using the specific bracket.
DO NOT TORQUE USING THE FLEXIBLE STEM.

For dismounting procedures, please avoid again high relative torque in between the housing and the flexible.

To make this easier, the product is supplied with full documentation on the dimensions of the installation hole and on procedures to be run before using the sensor.
An accessory drilling kit is also supplied, for exact copying of transducer rod dimensions.

5.1. Instruction and maintenance (Installation hole)

Drilling kit

A drilling kit with shaped tools for drilling, reaming and tapping is available to facilitate correct preparation of the assembly housing.
The assembly housing must be perfect to assure proper transducer function and long life.
Drilling kits are available in the following versions: **KF12, KF18**.

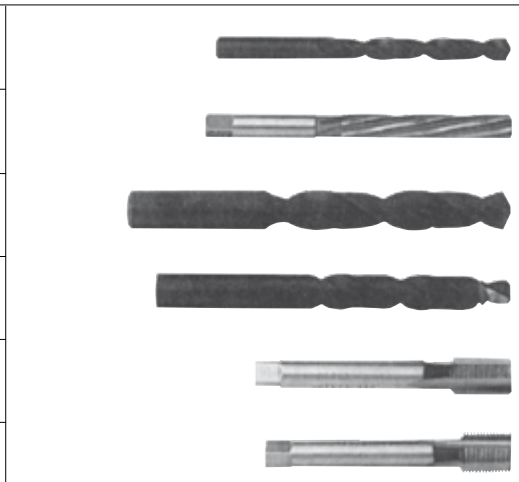
Drilling procedure

- Drill hole (d4) up to a distance from the hole equal to the sum of (a+b+c) (tool 3)
- Drill hole (d2) passing with the tip (tool 1)
- Create the seal housing at a distance from the hole equal to dimension (a) (tool 4)
- With a roughing tap, create threading 1/2-20UNF-2B (recognizable from the greater number of threads beveled at the mouth) (tool 5)
- With a finishing tap, go over threading 1/2-20UNF-2B up to a distance from the bottom equal to the sum of (a+b) (tool 6)
- Ream hole (d2) with reamer (tool 2).

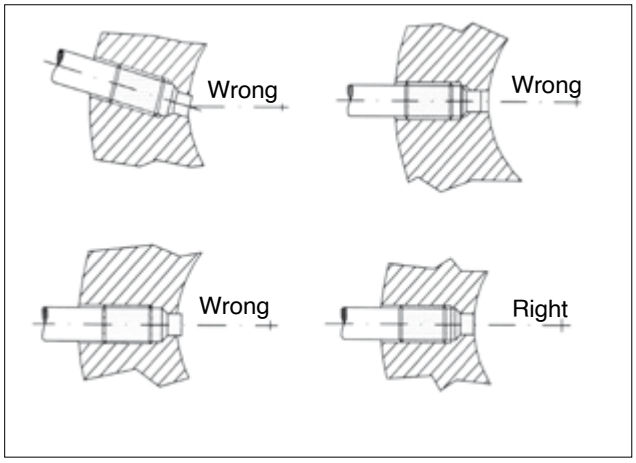
Check the dimensions of the assembly housing

The dimensions of the assembly housing have to be checked after preparation and before the transducer is installed.
To do this, use closing rod SC12/SC18 as follows:
1) Coat the end of the rod with the appropriate ink.
2) Lubricate the threaded part to prevent friction.
3) Insert the closing rod and screw it fully down.
4) Remove the rod and examine it. With the exception of 45° surfaces, the ink should be intact on the entire surface.

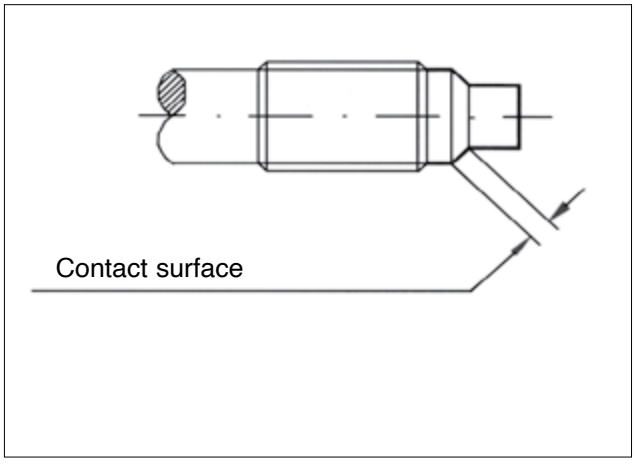
DRILLING TOOL KIT

Version code		KF12	KF18
Threading type		1/2-20UNF-2B	M18x1.5
1		Ø 7.6	Ø 9.75
2		Ø 7.95	Ø 10.1
3		Ø 13	Ø 20
4		Ø 11.5 with pilot guide	Ø 16 with pilot guide
5		1/2-20UNF-2B roughing	M18x1.5 roughing
6		1/2-20UNF-2B finishing	M18x1.5 finishing

CORRECT INSTALLATION



CORRECT CONTACT



5.2. Instruction and maintenance (Sensor installation procedure)

Installation procedure

1) Make sure the assembly drilling procedure was done correctly. If you install the sensor in a previously used hole, make sure the hole is completely clean and free of any plastic residue.
2) Remove the protective cap from the sensor point.
3) Lubricate the thread with non-grip grease such as Neverseez (Bostik), or C5A (Felpro), or equivalent.
4) Insert the sensor securely into the hole, first by hand and then with a wrench, / turn at a time.

Recommended torque wrench setting: 50 N-m; maximum: 56.5 N-m.

Calibration procedure

Bring the system to work temperature with the transducer installed and connected to the measurement instrument without any pressure applied.
The measurement chain connected to the transducer is calibrated as follows:

1) Reset the indication on the instrument to reset the temperature variation zero shift. In the series with amplified output (transmitter), you can use the Autozero function to run the reset.

   a) For correct zero resetting, run Autozero only after work temperature has been completely reached.

2) Calibrate the instrument and have it display the calibration value shown on the transducer data plate (80% of full scale).

3) If the instrument does not exactly indicate zero, repeat points 1 and 2. In this way, the instrument is calibrated t ogive the exact indication in the chosen engineering unit.

Removal (fig. 1)

To remove the transducer from its housing and continue the procedure, closing rods with identical mechanical dimensions are available. The closing rods differ by type of threading; applicable pressure is 2000bar for all rods.
The closing rod is available in the following versions: **SC12** 1/2-20UNF housing - **SC18** M18x1 housing.

Brackets (fig. 2)

Models with flexible sheathing require precise fastening of the protective housing of the measurement point. We recommend bracket (SF18) for fastening. Remember that the fastening point must be vibration-free (vibrations affect the measurement) and that temperatures must not exceed the maximum temperature for the strain gauge housing (as stated on the technical sheet for the transducer).

Extruder Start up

Bring the system to work temperature with the transducer installed and without any pressure applied. Wait until all the material is at the same temperature to prevent any parts that are still solid from damaging the transducer.

Transducer hole cleaning
Cleaning tool

As mentioned in the notes, the hole must be cleaned before the transducer installation.
The cleaning tool is a hard metal cutting tool specially designed to remove residual working materials.

Recommended procedure (fig. 3)

The procedure must be conducted with the material in fluid state.

1) Insert the tool in the housing and screw down the cutting rod (normally a 1/4 turn at a time).
2) Turn the pilot cutter clockwise until there is no resistance to cutting.
3) Repeat the procedure until the housing is completely clean.

For constructive reasons, the maximum torque applicable to the cutter is 5 Nm (1.5 Kgm). If the hole blockage requires higher torque for removal, use the drilling kit and follow the recommended procedure.

The cleaning tool is available in the following versions: **CT12** 1/2-20UNF housing - **CT18** M18x1,5 housing.

Fig 1

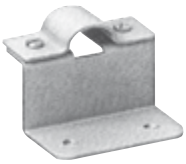


Fig 2

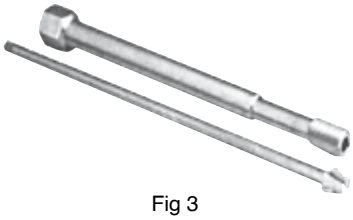
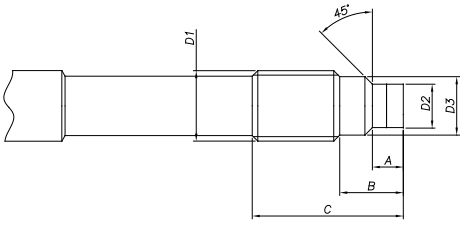
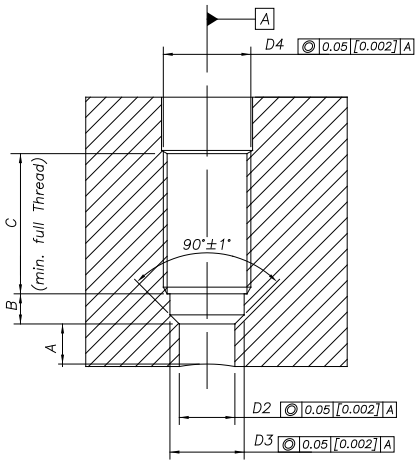


Fig 3

5.3. Instruction and maintenance (Mechanical dimensions of transducer / drilling)



D1	1/2-20UNF	M10x1.0	M14x1.5	M18x1.5
D2	.307/.305“ [7.80/7.75mm]	.236/.234“ [5.99/5.94mm	.307/.305“ [7.80/7.75mm]	.394/.392“ [10.01/9.96mm]
D3	.414/.412“ [10.52/10.46mm]	.336/.334“ [8.53/8.48mm]	.475/.470“ [12.07/111.94mm]	.630/.627“ [16.00/15.92mm]
A	.219/.209 “ [5.56/5.31mm]	.256/.246 “ [6.50/6.25mm]	.236/.226 “ [5.99/5.74mm]	.236/.226 “ [5.99/5.74mm]
B	.450“ [11.43mm]	.430“ [10.92mm]	.480“ [12.19mm]	.590“ [14.98mm]
C	1.07“ [27.2mm]	1.06“ [26.9mm]	1.28“ [32.5mm]	1.34“ [34.0mm]

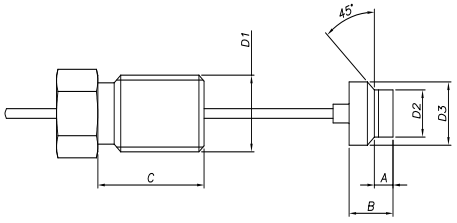


D1	1/2-20UNF	M10x1.0	M14x1.5	M18x1.5
D2	.313 ±0.001” [7.95 ±0.02mm]	.241 ±0.001” [6.12 ±0.02mm]	.319 ±0.001” [8.10 ±0.02mm]	.398 ±0.001” [10.10 ±0.02mm]
D3	.454 ±0.004” [11.53 ±0.1mm]	.344 ±0.004” [8.74 ±0.1mm]	.478 ±0.004” [12.14±0.1mm]	.634 ±0.004” [16.10 ±0.1mm]
D4	.515“ [13mm] min.	.515“ [13mm] min.	.630“ [16mm] min.	.790“ [20mm] min.
A	.225“ [5.72mm] min.	.263“ [6.68mm] min.	.240“ [6.10mm] min.	.240“ [6.10mm] min.
B	.17“ [4.3mm] max.	.11“ [2.8mm] max.	.16“ [4.0mm] max.	.16“ [4.0mm] max.
C	.75” [19mm]	.75” [19mm]	.75” [19mm]	.99” [25mm]

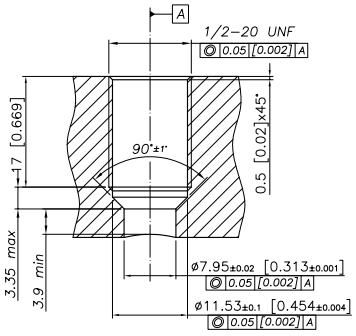
Exposed Capillary

Sensor tip dimensions

Mounting hole dimensions



D1	1/2-20UNF
D2	.307/.305“ [7.80/7.75mm]
D3	.414/.412“ [10.52/10.46mm]
A	.125/.120 “ [3.18/3.05mm]
B	.318/.312 “ [8.08/7.92mm]
C	81“ [20.6mm]



ATTENTION !
Incorrect working or shape of the hole can result in properties out of specification, bad behavior or damage to the sensor.

6. INSTALLATION AND ELECTRICAL CONNECTIONS

6.1. General precautions

The system must be used only in accordante with the requie protection level.
The sensor must be protected against accidental knocks and used in accordante with the instrument's ambient characteristics and performance levels.
The sensors must be powered with non-distributed networks and always at lengths of less than 30 mt.
In case of outdoor installations, follow the instructions in paragraph 6.5

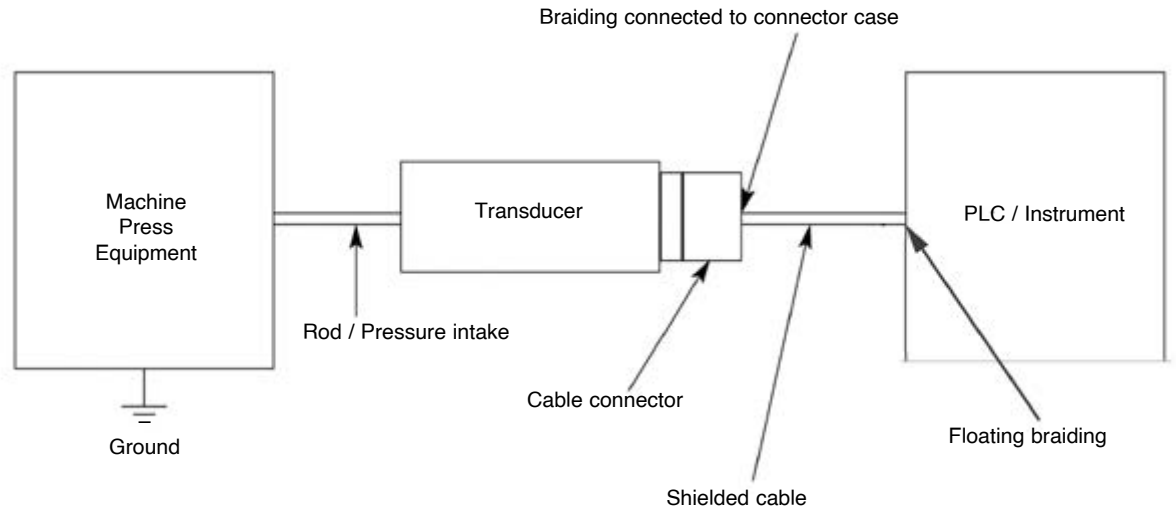
*In case of safety applications see further limitations in paragraph 10

6.2. Electrical installation

The interface with SRP/CS (Safety Related Part of a Control System) consists of multi-pole connectors shown in the following figures, which also indicate the connections in the case of amplified voltage output (3 wires) or current output (2 wires: the sensor is placed in series in the current loop); to these connections are added optionally contacts for the execution of external autozero / cal commands.
Installation notes

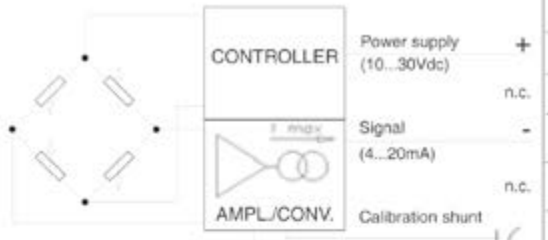
- The transducer must be gronde (normally through the machine body or equipment it is installed on).
- Use a shielded cable only. The braiding must be connected to the connector case.
  The braiding on instrument / PLC side must be left floating.
- To prevent interference, separate the power cables from the signal cables.

Standard installation (recommended)



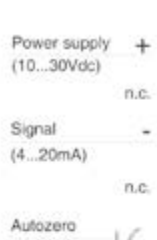
Electrical connections

Current output (4...20mA, 2 wires)



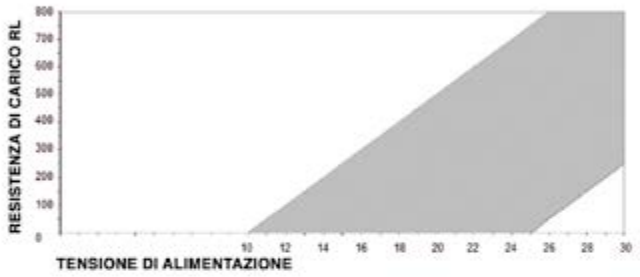
MAGNETIC AUTOZERO	
6-pin	8-pin
A	B
C	A
B	D
D	C
E - F	E - F
	G - H

EXTERNAL AUTOZERO	
6-pin	8-pin
A	B
C	A
B	D
D	C
E - F	E - F
	G - H



Shield drain wire is tied to connector via cable clamp

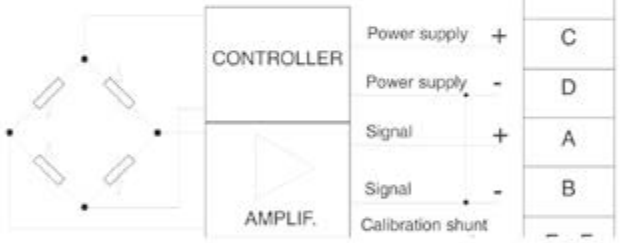
LOAD DIAGRAM (Current output)



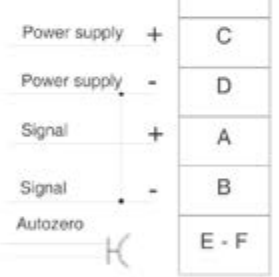
RL = < (VSUPPLY -10V)/0.02A

The diagram shows the optimum ratio between load and power supply for transmitters with 4…20mA output.
For correct function, use a combination of load resistance and voltage that falls within the shaded area

Voltage output (B, C, 7)



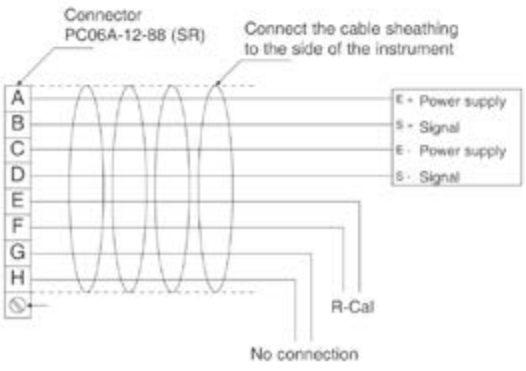
MAGNETIC AUTOZERO
6-pin
C
D
A
B
– –



EXTERNAL AUTOZERO
6-pin
C
D
A
B
E - F

lamp

8-pin connector



Magnetic Autozero version
A = Excitation + (white)
B = Signal + (red)
C = Excitation - (green)
D = Signal - (black)
E = R-Cal (blue)
F = R-Cal (brown)
G = no connection
H = no connection

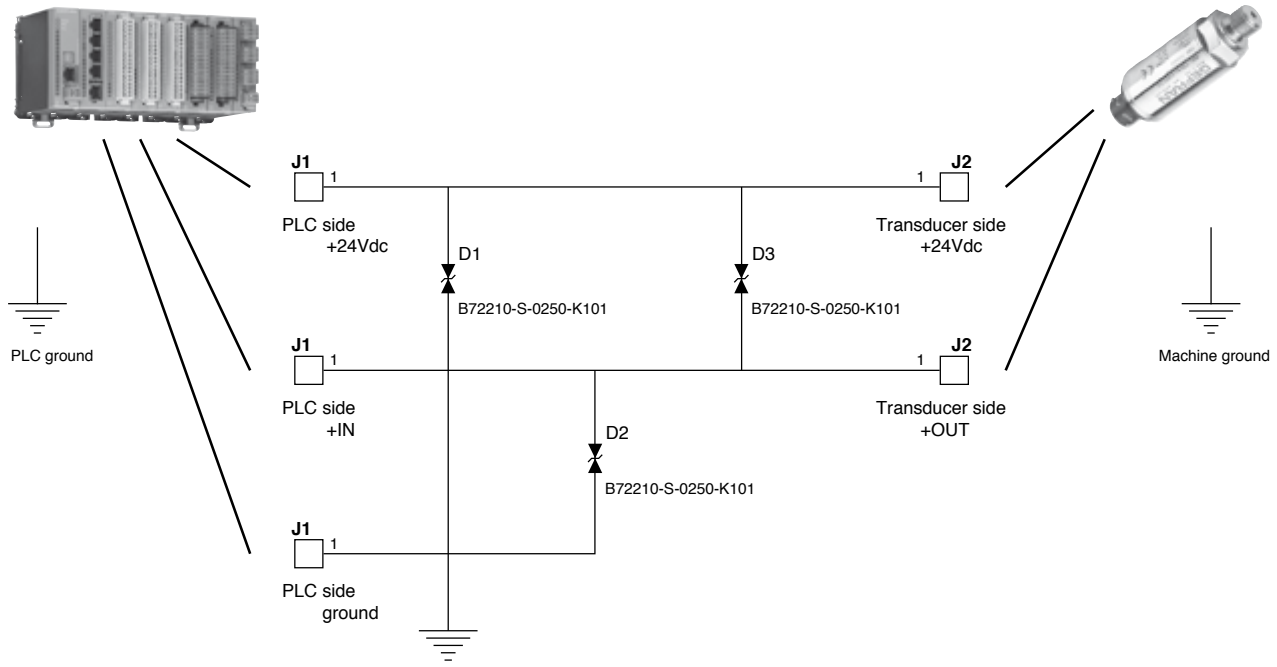
External Autozero version
A = Excitation + (white)
B = Signal + (red)
C = Excitation - (green)
D = Signal - (black)
E = Autozero (blue)
F = Autozero (brown)
G = no connection
H = no connection

6-pin connector
VPT07RA10-6PT2
(PT02A-10-6P)

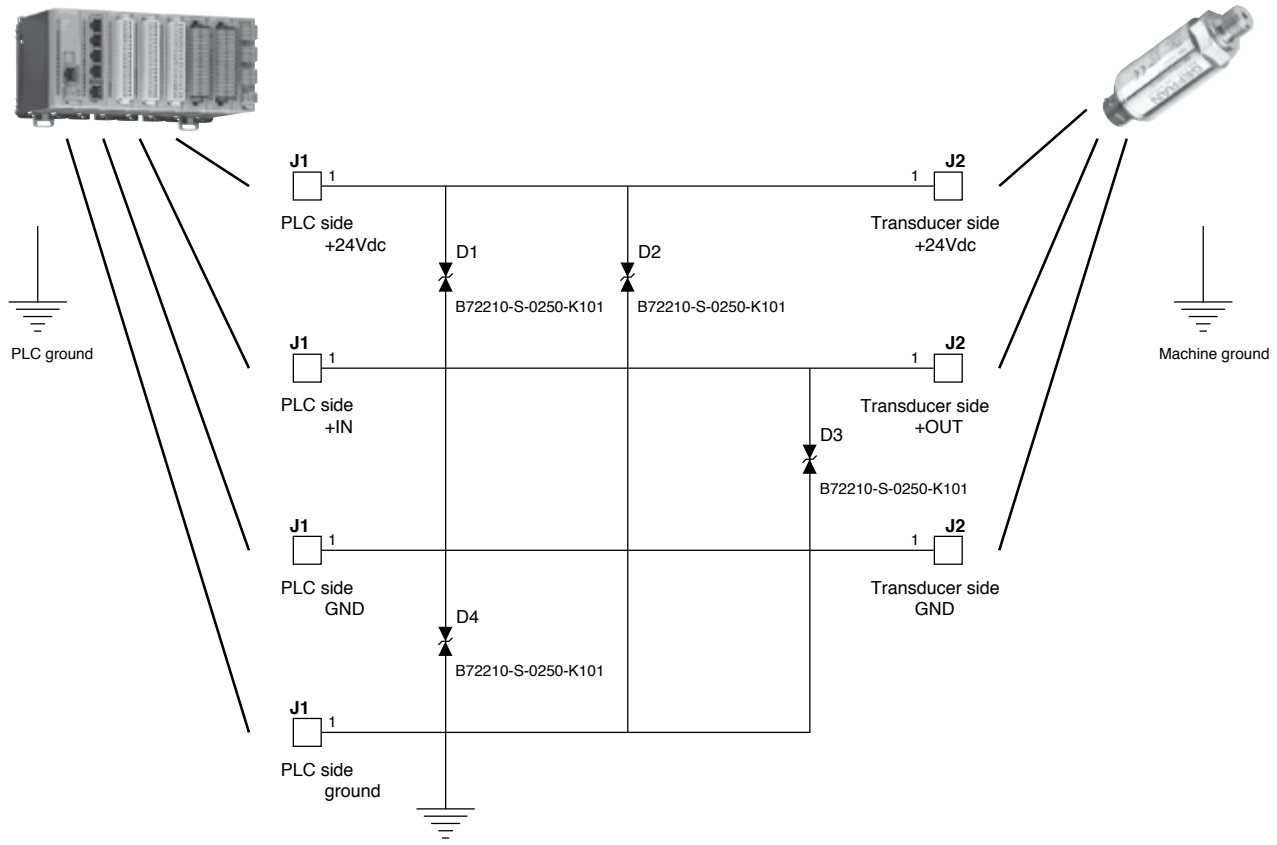
8-pin connector
PC02E-12-8P Bendix

6.3. Protection for outdoor installations of analog sensors

Pressure / Analog Melt current output
CAL signals if any do not require protection



Pressure / Analog Melt voltage output
CAL signals if any do not require protection



6.4. Standard reference

Gefran products, described in this manual, are compliant to the European Directive 2014/30/EU.
They are tested according to the standard EN 61326-1 “Electrical equipment for measurement, control and laboratory use - EMC requirements”, Part 1 “general requirements and EN 61326-2-3 “Electrical equipment for measurement, control and laboratory use - EMC requirements”, Part 2-3: Particular requirements - Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning.

Note
In accordance with IEC/EN 62061 and IEC/EN 61508, transducers of the M, W, K SIL2 series also comply with EN 61326-3-1 “Electrical equipment for measurement, control, and laboratory use - immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications”.

6.5. EMC and RoHS Requisites

Gefran Melt transducers and transmitters are built in conformity with the following EMC directives: EMC 2014/30/EU and RoHS 2011/65/EU.

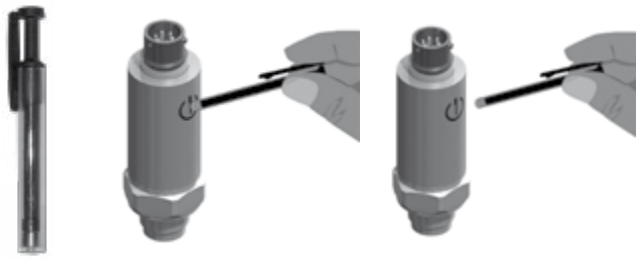
7. ON-BOARD FUNCTION

The ON BOARD functions are command modes available to the user only for the purpose of periodic recalibration of the system in the process and can be operated in two ways:
√ CAL pin
√ Magnetic sensor

7.1. Autozero function

AUTOZERO

All signal variations in the absence of pressure can be eliminated by using the Autozero function.
The function is activated by closing a magnetic contact located in the transmitter housing (function cannot be activated when machine is in operation).
The device used for the reset control is a magnet located on the outside of the housing, attached to it by a plastic support. This system provides total reliability and easy use.
On sensors configured in a dedicated manner, the Autozero function can be activated externally by short-circuiting pins E and F on the connector.
By using the reset control, setting the Zero signal with a trimmer becomes obsolete; the same is true for the Span signal, for which the sensor can be recalibrated via software



1: machine pressure = 0 bar and transducer powered
2: put magnetic pointer on marked spot (1…10sec)
3: remove magnetic pointer
4: ready !

Magnetic pointer 1.0,10 sec remove  marked spot

ACTIVATION OF AUTOZERO AFTER THE FIRST INSTALLATION

The Autozero function makes it much easier to run calibrations after the first installation.
With the sensor installed and with the extruder at work temperature, wait 1 minute before running Autozero.
This delay is requie to allow the system temperature to stabilize.
If the transmitter is kept powered, additional Autozero activations can ber un immediately; on the other hand, you will have to wait 1 minute each time the system is switched on again.

AUTOZERO FUNCTION

Application mode	Limits	Result
The Autozero function is activated by: 1) positioning the magnet near the Autozero label on the shell of the sensor. 2) Short-circuiting the pin E-F (external Autozero version). The magnet has to be maintained on the Autozero position for a time within 1 to 10 sec.	The whole Zero unbalancement in comparison to the zero done by the manufacturer, has to be ± 10% FS (*)	The Autozero effect will be visible after waiting 2 sec after the start of the function. The precision of the zero value will be defined by the accuracy class of the sensor. The Autozero function doesn't work outside the defined limits.

NOTE:
(*): This value has to be considered typical. Higher limits value will be allowed for different range.
During the Autozero phase, the current output for the ME/WE transmitter series, will increase around 7mA.
That's a short variation only visible during the Autozero phase; it won't have any effects on the final signal.

7.2. Fine-Autozero function

Fine-Autozero Procedure

Application mode	Limits	Result
The Fine-Autozero function is activated by: 1) positioning the magnet near the Autozero label on the shell of the sensor. 2) Short-circuiting the pin E-F (external Autozero version). The magnet has to be maintained on the Autozero position for a time within 10 to 30 sec. After removing the magnet the signal will start changing the value step by step. Stop adjustment: touch the Autozero area with the magnet to stop the signal variation.	The whole Zero unbalancement in comparison to the zero done by the manufacturer, has to be ± 10% FS (*).	The output signal will change within a ±100mV value (±0,16mA for out 4-20mA) the change decreases in step of 6mV (12uA for 4-20mA output). Ex: 0..-6..-12..//-100..+100..+94..+88..0 The signal will be stopped without delay once the Autozero area is touched with the magnet. The Fine-Autozero function doesn't work outside the defined limits.

NOTE:

(*): this value has to be considered typical. Higher limits value will be allowed for different range

- The step duration time is 1 sec
- During the Autozero phase, the current output for the ME/WE transmitter series, will increase to around 7mA. Furthermore between the step variations it will be possible to have short overcurrent up to 7mA.
- That's an immediate variation only visible during the Autozero phase; it won't have any effects on the final signal.

7.3. Calibration function

Calibration procedure

Application mode	Limits	Result
Start cal: The Calibration function is activated by short-circuiting the pin E - F for a minimum time of 1 sec Stop cal: Release the E - F short-circuit	The whole Zero unbalancement in comparison to the zero done by the manufacturer, has to be ± 20%FS.	During the Calibration phase the signal will be unbalanced to the 80% FS. The calibration effect is visible 2 sec after short-circuiting E - F. The Calibration function doesn't work outside the defined limits.

NOTE:

- During the Calibration phase, the current output for the transmitter, will increase around 7mA. That's an immediate variation only visible during the Calibration phase; it won't have any effects on the final signal.
- Switching off the supply while the calibration function is activated, could be cause of calibration problems; the transmitter can be recalibrated to the initial value by activating the "partial reset function".
- **The Calibration function is not allowed for "external Autozero" version.**

7.4. Autospan

Application mode	Limits	Result
The Autospan function is activated in three steps as explained in the following. phase 1) pressure 0 bar: 1^ Autozero Activate the Autozero function phase 2) pressure = FS (***): Short-circuit pin E - F. Maintain the E - F short-circuit, after a minimum time of 1 sec., start the "Autozero function"; the magnet has to be maintained in contact for a period of 1 - 10sec. Than release the E - F shortcircuit. Wait a minimum time of 1sec before releasing the E - F short circuit. phase 3) pressure 0 bar: 2^ Autozero Activate the Autozero function.	The whole Zero unbalancement in comparison to the zero done by the manufacturer, has to be ± 10%FS (*). The whole span unbalancement which can be obtained must be within ± 5% of the FS of the transmitter	The transmitter will be calibrated at the new Zero and Span values, within the accuracy class of the sensor (**). The Autozero function doesn't work outside the defined limits.

NOTE:

(*): This value has to be considered typical. Higher limits value will be allowed for different range

(**): It is possible improve the calibration precision by doing several calibration (Autospan function).

(***): The FS has to be a pressure within ± 5 %FS

- The Autospan function is not allowed for "external Autozero" version.

7.5. Partial reset of the calibration values

Application mode	Limits	Result
The magnet has to be maintained on the Autozero position for a time within 30 to 60 sec.		The Zero of the transmitter will be recalibrated to the factory settings; furthermore an Autozero will be done automatically. The Span calibration will be maintained.

NOTE:

During the partial reset phase, the current output for the transmitter ME/WE series, will increase around 7mA.

7.6. Total reset of the calibration values

Application mode	Limits	Result
The magnet has to be maintained on the Autozero position for a time over 60 sec		The Zero and Span of the transmitter will be recalibrated to the factory settings.

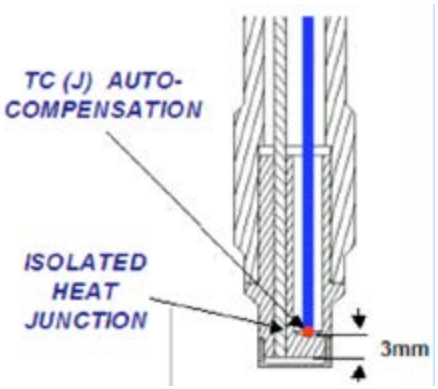
NOTE:

During the total reset phase, the current output for the ME/WE transmitter series, will increase around 7mA

8. AUTOCOMPENSATION FUNCTION

Autocompensation of temperature drift

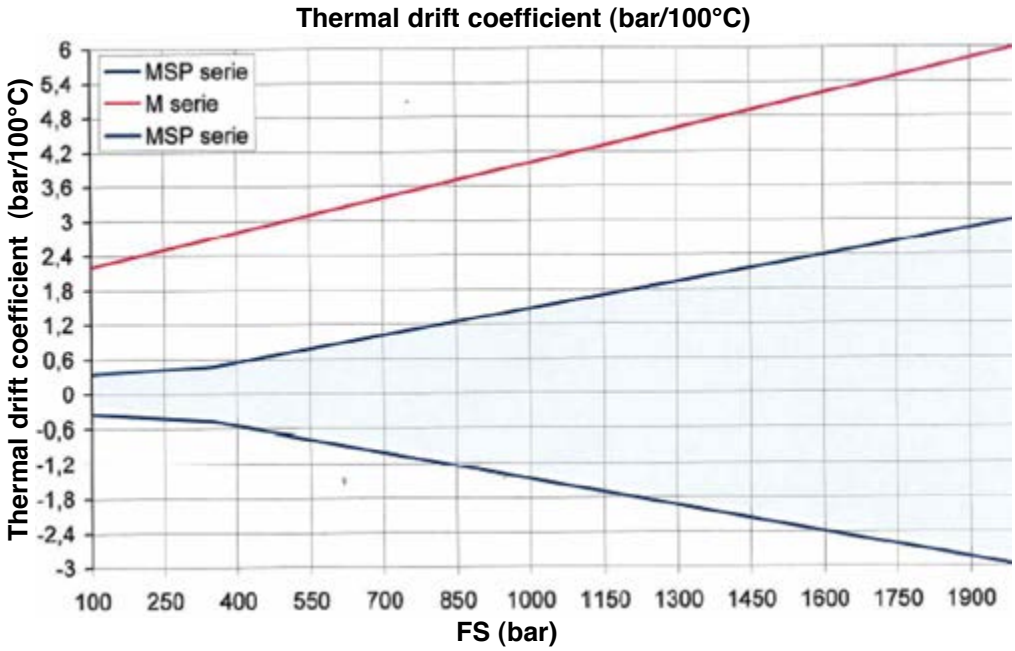
All sensors that use filled technology (i.e., that contain a pressure signal retransmission fluid) share the problem of fluid expansion at working temperature.
A negative consequence of expansion is the generation of pressure inside the sensor.
The transduction element senses this pressure as a pressure variation in the process, so the reading is affected by an error that averages about 2-4bar/100°C.
Thanks to “Autocompensation,” both drifts can be reduced until becoming practically negligible.
Fig. 2 shows the degrees of read error achieved, comparing a standard series M sensor to another in the same series but in SP configuration.
The graph shows that for a sensor with pressure range of 200 bar, the maximum read error is 0.003 bar/°C, meaning 1bar at 300°C, compared to 8 bar for an equivalent 2 00 bar sensor in standard version.
This result was achieved thanks to a temperature read system that reaches the “important” points of the sensor and constantly monitors every minimum temperature variation on board.
These signals are then transferred to the various stages of conditioning of the electronics until reaching the microprocessor, which performs compensation of the drift errors introduced.
Even the time in which the signal is corrected has been calculated to reduce the effects of temperature transition to a minimum.
This means that the values stated in specifications are always respected for every step of the process.



By means of a thermocouple in the signal stem compensated digitaly

8.1. Output signal trend as a function of temperature effect

Or written in table
100<p<500 ----> 0,003bar/°C
p>500 ----> 0,0014% FS./°C



9. MAINTENANCE

9.1. Maintenance

Melt pressure sensors must be installed and electrically connected by trained people, following all applicable recommendations, with zero pressure and voltage, and with the machine switched off.
The sensor must be removed with the plastic in Melt state and the machine in hot conditions.
Always remove the sensor before cleaning the machine, using steel brushes or similar tools.
Always wear protective gloves and always take adequate ESD precautions to prevent electrostatic discharges that could damage the sensor.
Always use the wrench for the hexagonal nut when installing and removing the sensor.
DO NOT force the electronics housing.
Once the sensor is removed, clean it gently with a soft cloth while the material is still malleable.

9.2. Transport, storage and disposal

Melt sensors are made with “Filled” technology and contain a pressure transmission fluid.
Low-compression fluids such as diathermic oil (FDA and USDA approved), NaK (GRAS substance) for food or medical applications, or mercury are used.
Fluid volumes depend on the mechanical structure of the sensor, and leaks can occur only if the contact diaphragm is broken.
Any other type of break will not cause emissions to the environment.
Never transport or store the sensors without the protective cap and without the original packaging.
In particular, as mercury is a hazardous material it must be disposed of in compliance with applicable law.
Gefran accepts its Melt sensors (defective or damaged by use) for disposal.

10. SAFETY

In case of contact or inhalation of the fluid contained in the Melt sensor, follow the instructions on the toxicology sheet for the related substance.
In particular, K series Melt sensors use NaK as filling fluid.
NaK, composed of Sodium and Potassium (22 Na / 78 K), is an eutectic alloy (i.e., a mixture of two or more substances with a lower melting point than that of its single components) with low compressibility and excellent resistance to high temperatures (up to 538°C).
Above all, it is a non-toxic liquid metal that is recognized as GRAS (Generally Regarded As Safe).
This allows K series Melt sensors to work in contact with materials used for foods (wrapping films, beverage containers, etc.) or for pharmaceuticals/cosmetics (drug containers, soaps, etc.).
In addition, it is totally compatible with the European RoHs (Restriction of Hazardous Substances) Directive with regard to electrical and electronic equipment.
If the contact diaphragm breaks due to the application, NaK tends to oxidize or to react with the contact medium (especially in the presence of water or dampness) by an exothermic reaction.
This generates a spark which, due to the scarcity of material contained (from 20 to 40mm^3 on the average), can last few seconds (maximum of 5).

Hg TOXICOLOGICAL SHEET

1 Elements identifying substance or preparation and company

· Product data
· Molecular formula: Hg
· Structura formula: Hg
· Commercial name: Mercury
· SDS No: CH0349
· Information supplied by: E.S. & Q. A.

2 Composition/information on ingredients
· Chemical characteristics:
CAS number
7439-97-6 mercury
· Identification number/s
· EINECS number: 2311067
· CEE number: 080-001-00-0

3 Indication of hazards
• Classification of hazard:
T Toxic
N Hazardous for the environment

• Indications of specific hazards for humans and the environment:
R 23 Toxic if inhaled
R 33 Danger of cumulative effects
R 50/53 Highly toxic for sea life, may cause long-term negative effects on the aquatic environment.

4 First aid
• General instructions:
Immediately remove clothing contaminated with product.
Remove protective mask only after removing contaminated clothing.
In case of irregular breathing or breathing failure, apply artificial respiration.
• Inhalation:
Take the victim to a well-ventilated area and administer oxygen.
CALL A DOCTOR.
If the victim has fainted, try to keep him in a stable position on his side as you move him.
• Contact with skin:
Wash immediately with soap and water, rinse thoroughly.
• Contact with eyes:
Wash will running water for several minutes, keeping the eyelids wide open. CALL A DOCTOR.:
• Ingestion:
Call a doctor if victim feels ill.

5 Fire prevention measures
• Approved fire extinguishers:
CO2, powder or nebulized water. Extinguish large fires with nebulized water or alcohol-resistant foam.
• Specific risks due to the substances, its combustion products, or released gases: If heated or in case of fire, the product may generate toxic fumes. Fumes contain metal oxides.
• Specific means of protection:
Wear an all-service mask in closed rooms.

6 Measures in case of accidental spill
• Measures to protect people:
In case of vapors/dust/aerosol, use respiratory protections
• Measures to protect environment:
In case of infiltration in bodies of water or sewers, notify the competent authorities.
Prevent filtration in sewers/surface waters/groundwater.
• Cleaning/absorption methods:
Aspirate liquid in suitable container and absorb the rest with porous material (tripoli, acid binder, universal binder, etc.)
Dispose of contaminated material in conformity to point 13.
Ventilate the area completely.

7 Handling and storage
Handling
• Instructions for safe handling:
Keep containers hermetically sealed.
Good ventilation/aspiration in workplaces.
Open and handle containers with care.
Avoid formation of aerosol.
• Instructions for preventing fires and explosions:
Keep all-service mask handy
Storage
• Requirements for warehouses and containers: Provide floor tank without discharge.
· Instructions for mixed storage: not necessary.
· Additional instructions regarding storage conditions:
Keep containers hermetically sealed.
· Storage class:
· Class VbF (ordinance regarding combustible substances):
Not applicable.

8 Exposure control/personal protection
• Additional instructions regarding structure of technical systems:
No additional data. See point 7
· Component whose limits must be kept under control in workplaces:
Mercury TLV: 0,025 mg/m^3
· Additional instructions:
Lists valid on the date of compilation were used as basis
· Means of personal protection:
· General rules for protection and hygiene at the workplace:
Keep away from food, drink, and forage.
Immediately remove contaminated clothing.
Wash hands before taking a break and at end of shift.
Store protective gear separately.
· Protective mask:
Use the mask in case of brief, slight exposure; for heavier and longer exposure, wear a self-contained breathing apparatus.
Use all-service mask only in case of formation of aerosol or mist.
· Protective gloves: Neoprene gloves
· Goggles:
Wear goggles while pouring..

Hg TOXICOLOGICAL SHEET

9 Physical and chemical properties
· Molecular weight: 200,59 g
· Form: Liquid
· Color: Silver
· Odor: None
· Unit value/Method:
· Change of state
· Melting temperature: -38,86°C
· Boiling temperature: 356,73°C
· Flash point: not applicable
· Danger of explosion: product not explosive
· Vapor voltage: a 20°C 0,00163 hPa
· Density: a 20°C 13,54 g/cm³
· Solubility in/Mixability with water: slightly and/or not mixable
· Organic solvents: insoluble

10 Stability and reactivity
· Thermal decomposition/conditions to be avoided:
the product does not decompose if correctly used.
· Substances to be avoided: acetylene
· Hazardous reactions:
Reactions with peroxides and other substances forming radicals.
Decomposition of hydrogen peroxide.
· Hazardous products of decomposition:
No hazardous products of decomposition are known

11 Toxicological information
· Acute toxicity:
Significant LD/LC50 values for classification:
Mercury.
For inhalation: LCLo: (30h) 0,03 mg/l (rabbit)
· Primary irritability:
- on the skin: has no irritating effects.
- in the eyes: not particularly irritating.
Sensitization: no sensitizing effects are known
· Subacute to chronic toxicity:
Cumulative effects in case of repeated exposure.

12 Ecological information
· Behavior in ecological context:
· Mobility and potential of bioaccumulation:
possible biomethylation
· Toxic effects on environment: Aquatic toxicity:
Mercury
LC50 aq.: (Hg++ 96h) 0,06 mg/l (daphnia)
· Additional information:
Hazard for class 3 waters (WGK German) (Classif. on lists): very hazardous. Do not put in groundwater, rivers, or sewers, even in small doses. Hazard for drinking water even in case of minimum leaks of product in sub soil. Toxic for fish and plankton.

13 Information on disposal
· Product:
· Recommendations:
Do not dispose of the product together with domestic waste. Do not put in sewers. Recycle if possible; other wise, contact a company authorized to dispose of industrial waste.
· Soiled packing:
· Recommendations:
Dispose of in conformity to government regulations.
Wash with water to be purified and disposed of.

14 Information on transport
Road/rail transport ADR/RID (beyond border)
· ADR/RID-GGVS/E class: 8 corrosive substances
· Number/letter: 66c
· Kemler number: 80
· ONU number: 2809
· Description of brand: 2809 Mercury
Sea transport IMDG
· IMDG class: 8
· Page: 8191
· ONU number: 2809
· Packing group: III
· EMS number: 8-12
· MFAG: -
· Exact technical name: Mercury
Air transport ICAO-TI and IATA-DGR
· ICAO/IATA class: 8
· ONU/ID number: 2809
· Packing group: III
· Exact technical name: Mercury

Hg TOXICOLOGICAL SHEET

15 Information on regulations	**16 Other information**
• Classification according to CE directives: The product is classified and coded in conformity to CE directives / rules on hazardous products / dir. 67/548 25° updat e / dir. 88/379 4° update • Label code for product hazardousness: T Toxic N Hazardous for the environment • Nature of specific risks (R phrases): 23 Toxic if inhaled 33 Danger of cumulative effects 50/53 Highly toxic for aquatic organisms, may cause long-term negative effects on the aquatic environment. • Recommendations of prudence (S phrases): 7 Keep container completely closed 45 In case of accident or malaise, call a doctor immediately (if possible, show him/her the label) 60 This material and its container must be disposed of as hazardous waste 61 Dispose of properly. See the special instructions / data sheet on safety • National regulations • Classification according to VbF: Not applicable. • Class of hazardousness for waters: Hazard for class 3 waters (WGK3) (Classif. on lists): very hazardous Additional regulations, limitations and prohibitive decrees: Maximum concentration in waste water (DPR 319/76 - Merli Law): 0,005 mg/l	The above data are based on our current knowledge. Nevertheless, they do not represent any guarantee of product characteristics and are not the basis for any legal and/or contractual relationship. • Data sheet issued by: E.S. & Q. A. • Contact: Emergency Ph. 0039 2 95231 • Bibliographic references: ECDIN (Environmental Chem. Data and Information Network) IUCLID (International Uniform Chemical Information Database) NIOSH – Registri of Toxic Effects of Chemical Substances Roth – Wassergefährdende Stoffe Verschueren – Handbook of Environmental Data on Organic Chemicals ChemDAT – Safety Data Sheets from E.Merck on CD-ROM Merian – Metals and their compounds in the environment.

11. FUNCTIONAL SAFETY NOTES

11.1. Application

The pressure sensors M, W, K SIL2 perform the following safety function:

correct reading and transduction of pressure to individuate overpressure. Reading and transduction are considered correct when they are within the specifications declared in this Operating Manual.

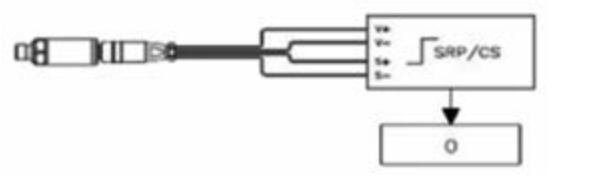
The SIL parameters of the transducer are shown in the table below:

Parameter	Value	Measuring Unit
Architecture	1oo1	--
HFT	0	--
β Factors	0,05 (when using the product in 1oo2 architecture)	--
λ_{DD}		
Current output	7,83E-07	1/h
Voltage output	7,83E-07	1/h
λ_{DU}		
Current output	1,51E-07	1/h
Voltage output	1,51E-07	1/h
SFF		
Current output	93,70	%
Voltage output	93,66	%
PFH / PFH_D		
Current output	1,51E-07	1/h
Voltage output	1,51E-07	1/h
Systematic Capability	2	--
SILCL (IEC 62061) SIL (IEC 61508)	2	--

The pressure sensors of the M, W, K SIL2 series can be part of a pressure detection system which, when a threshold value is exceeded, deactivates all the pressure generation elements through the control system.

The diagram in the figure shows a possible application: the sensor detects the pressure and converts it into an analogue electrical signal proportional to the value of the measurand; the SRP/CS compares the signal with that set as alarm threshold: if the threshold is exceeded, it deactivates the pressure generation elements.

VOLTAGE OUTPUT



CURRENT OUTPUT

11.2. Restrictions of use

The device must only be used in accordance with these operating instructions for mechanical installation, electrical connection, environmental conditions and use in order to maintain the declared SIL degree. The sensors must be powered by non-distributed networks and in any case with a length of less than 30 m.

11.3. Maintenance and periodic checks

The periodic maintenance to be carried out to ensure the permanence over time of the declared Failure Rates are:

- Visual inspection of the state of electrical and mechanical connections

  Maintenance is aimed at assessing any problems due to situations of incorrect assembly over time or particular aggressiveness of the processed material.

  Periodicity: every two years

  Visual inspection of the condition of the process membrane and stem threads.
  Maintenance is aimed at assessing any abnormal abrasions or wear due to incorrect assembly situations over time. (see par. 5)

  Periodicity: every year

- Checking the sensor installation seat
  Maintenance is aimed at assessing the correctness of the profile and dimensions and the absence of material residues or occlusions of the pressure channel.

  Periodicity: every two years.

- Electronic calibration test (**Reduced Proof Test**)

  The purpose of the test is to verify the correct functioning of the electronics.
  It is carried out by performing the CAL procedure

  Periodicity: every **6 months**

- Sensor calibration test (**Proof Test**)

  The purpose of the test is to verify the correctness of the transduction curve of the sensor.
  It is carried out by applying known pressure points to the transducer and checking the values reported by the probe.

  Periodicity: every two years
- For each new installation or re-installation use anti-seize paste on the thread of the stem.

11.4. Mean Time to Restoration

The MTTR (mean time of restoration) is calculated considering travel time, device location, maintenance contracts, environmental restrictions, warehouses and the technical time of replacement of the device (not its repairing).

In particular in the MTTR is included:

- The time required to replace and reset the device
- Travel time and any maintenance contracts

The MTTR calculation does NOT include:

- Any administrative delays on the part of the end user
- The unavailability of spare parts

Under these conditions the MTTR will be equal to 5 working days.

Considering instead only the technical time for replacement and restoration of the device (i.e. the spare part is already available from the user) the MTTR is equal to approx. 4h

11.5. Indication on response times

The response time to pressure transduction is 1 ms

11.6. Effects on the safety function of deviations in performance

The limit of acceptability in deviations of metrological performance in order not to induce loss of the safety function is ± 5 % of the value of span at room temperature.

11.7. Inhibition and suspension of the safety function

With the M, W, K SIL2 series sensors, it is not possible to bypass the safety function of the designated category.

Any inhibition of the safety function is at the charge (and responsibility) of the machine manufacturer.

11.8. Indications and alarms

The sensors of the M, W, K SIL2 series have a saturation output (positive HIGH or negative LOW) in case of specific faults.

The table shows the detected faults, their effect on the electrical outputs and how to reset the device.

Failure	Current Output	Voltage Output	
		FS <= 6V	FS >= 6V
Power supply cable broken	LOW < 3,8mA	LOW < 0,05 V	
Sensor not connected	LOW < 3,8mA	LOW < 0,05 V	
Power supply broken	LOW < 3,8mA	LOW < 0,05 V	
Broken bridge	*LOW < 3,8mA *LOW > 22mA	*LOW < 0,05 V	
		*HIGH > 7 V	*HIGH > 11,5 V
(*) variable according to the type of failure			

Note: Out of range values must be handled as invalid values by the downstream controller, which must take appropriate action.

12. RESOLUTION PROBLEMS

All Gefran sensors are built in conformity to UNI EN ISO 9001: 2000
In case of malfunction, you can run a series of simple checks to identify the type of fault. If the problem is caused by a sensor malfunction, the sensor MUST be returned to Gefran.
Only Gefran personnel are permitted to open the sensor.
Any repair attempted without Gefran's authorization will cause the warrantee expiry.

ELECTROMECHANICAL PROBLEMS

MALFUNCTION	POSSIBLE CAUSE	POSSIBLE SOLUTION
NO SIGNAL	NO POWER SUPPLY CONNECTION FAILED	CHECK POWER SUPPLT / CONNECTIONS
NO SIGNAL VARIATION	BROKEN DIAPHRAGM PLUG FORMED	CHECK HOUSING AND DIAPHRAGM
EXCESSIVE SIGNAL IMBALANCE	OVERPRESSURE ELECTRONICS MALFUNCTION CALIBRATION ON	CHECK CALIBRATION
SIGNAL VARIATION AT TIGHTENING	INCORRECT INSTALLATION POINT	CHECK INSTALLATION HOLE
NO TEMPERATURE READ (SERIES 2)	BROKEN THERMOCOUPLE BROKEN TC WIRE	CHECK CONTINUITY

FAILURE	POSSIBLE CAUSES	MEANS OF RESEARCH
The sensor does not feel pressure and is not in alarm	Obstruction of pressure channel Fault on electronics output stage	1. Power down and remove the sensor 2. Verify eventual occlusion of the channel under pressure. Clean any residues and material caps 3. Power the probe off-line and press gently with the finger on the membrane; if the probe does not change output, send it to the Factory for repair 4 - Reduce the process pressure below the F.S. value
The sensor is in alarm mode type “HIGH”	Bridge broken Detachment of pins Failure on primary element	1. Power down and remove the sensor 2. Check for overheating of electronics housing. Remove the causes of overheating, wait until it cools down and power the sensor. 3. Powered the probe again, if the problem persists, you should send back the probe to the Factory for repair.
The sensor is in alarm mode type “LOW”	Power supply cable / connector broken Sensor not connected Sensor not powered Bridge broken	1. Power down and remove the sensor 2. Check that the power supply is connected. If necessary, restore the power supply. 3. Check for continuity between the pins of the connector and the power supply. If necessary, replace the cable and the connector. 4. Check if the power values are within the specifications indicated in this manual. If necessary, replace the power supply. 5. If the problem persists, you should send back the probe to the Factory for repair.
It’s not possible to carry out the operation of CALIBRATION	• Input pressure out of range of CAL activation • Power supply cable / connector broken • Broken electronics	1 - Stop the machine and make sure the pressure is zero 2 - Check the cable and connector and replace if necessary 3 - Do the following in sequence: • RESET PARAMETER • AUTOZERO • CALIBRATION 4 - If the problem persists, you should send back the probe to the Factory for repair.
It’s not possible to carry out the operation of AUTOZERO	• Input pressure out of range of AUTOZERO activation • Broken connector/cable (only external autozero version) • Wrong magnetic pen positioning • Broken electronics	1 - Stop the machine and make sure the pressure is zero 2 - Make sure you are doing the operation with pen and autozero mark correctly aligned. 3 - Run RESET PARAMETERS; if the difference in absolute value between the read and theoretical zero signal is greater than 40% FS, remove the sensor, check and clean its seat, reinsert the sensor and rerun AUTOZERO. 4 - If the difference in absolute value between the read and theoretical zero signal is less than 40% FS, check the cable and connector and replace if necessary 5 - If the problem persists, you should send back the probe to the Factory for repair.

13. APPENDIX A: OPERATING PRINCIPLE

13.1. Mechanical construction and operation

Filled-technology Melt sensor

The Melt probe is a pressure sensor that resists high temperatures. As can be seen on the diagram, the entire structure is built to transfer the pressure of the medium to the transducer part while keeping the transducer as far as possible from the heat source.

The hydraulic circuit built for this purpose consists of a tip with 0.1 mm inner diameter, at the ends of which are welded the contact diaphragm and the strain gauge diaphragm.

The sensor is filled with a liquid with low compression coefficient (mercury or FDA-approved oil for food applications) to transfer strain.

For both versions, the amount of liquid depends on sensor design: the rigid rod contains 30mm^3, while flex versions contain 40mm^3.

All parts have to be sized in accordance with the strains to which the system is subjected: pressures up to 2000 bar and work temperatures up to 400°C.

The Melt probe must be subjected to a “static” type of strain; “dynamic” applications compromise the product’s reliability.

In addition to a guarantee of long life, the sensor is built to guarantee reliable reads in line with the accuracy specifications stated in the technical data for every condition of use described in the instruction manual.

The diaphragm geometries are designed on the basis of volumes and pressures occurring during measurement.

In essence, the pressure that the medium exerts on the contact diaphragm must generate a precise deformation of the measurement diaphragm.

The measurement element (called strain gauge), which translates the physical quantity (pressure) in to an electrical signal, is glued to the measurement diaphragm.

13.2. Strain gauge

Melt pressure sensors with glued strain gauge function

By for the most popular system for measuring the deformation of materials, the strain gauge is used industrially to measure the elongation of metals, especially steel and aluminum.

Its versatility, reliability, and high accuracy in transducing the measured physical quantity makes this is one of the most often used technologies for building pressure sensors.

Thanks to years of experience in building sensors, Gefran offers a wide variety of products using strain gauge technology, including industrial and Melt pressure transducers.

By continuously developing and refining this technology, Gefran creates sensors with unbeatable performance.

Definition of strain gauge

The strain gauge is a device that transduces a physical quantity into an electrical quantity.
The strain gauge is a primary transducer, in that the physical quantity in input is directly transformed into an output quantity.

Secondary transducers include force, acceleration, and pressure sensors, which are based on strain gauge technology, and in which the output quantity is obtained indirectly from the input quantity.

In the second system, the input quantity is converted into an intermediate quantity, and this is converted into the output quantity.

How it's built

In essence, a strain gauge consists of a thin metal wire that is folded and contained in a flexible isolating material according to a special geometry.

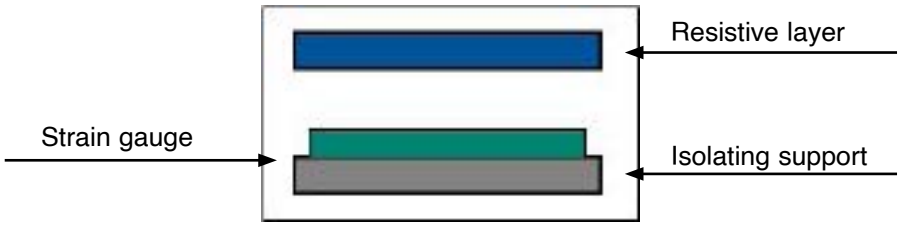
The metal wire (measurement element) is in fact made of an extra-thin leaf of metal alloy created by means of chemical incision.

This incision process produces metal grills with dedicated geometries that permit the material to modify its characteristics to the maximum as it changes shape.

The alloys used for the metal leaf are primarily Nickel-Chrome, Platinum-Tungsten, and Karma.

The next step in making a complete strain gauge is gluing the metal leaf onto an isolating support; some versions may have an additional isolating layer over the sensitive element.

These layers, made with polymer-based materials, electrically isolate the sensitive element and make it mechanically compatible to the body on which it will be placed.



Pressure transducer with glued strain gauge function

Taking measurement of strain in pressure transducers as an example, the typical behavior of a glued strain gauge (fig. 3) connected in Wheatstone bridge configuration is analyzed below at rest and at work.

Fig. 3

At rest, where the diaphragm is not subject to any strain (fig. 4) the strain gauge is in perfect resistive balance the bridge.

Here, the resistance is considered zero, the result only of the natural ohmic difference of the grilles making up the bridge.

At work (fig. 5), the strain gauge and, in particular, the center grilles (R1, R3 fig. 2) are strained in traction, while the two outer grilles (R2, R4 Fig. 2) work in compression.

As a result of the strain, the resistive values vary, producing an imbalance of the branches of the bridge. It is easy to see that if a voltage (V+, V-) is applied to the bridge (fig. 2) the voltage signal read in output by points (S+, S-) will vary in proportion to the resistive imbalance of the bridge.

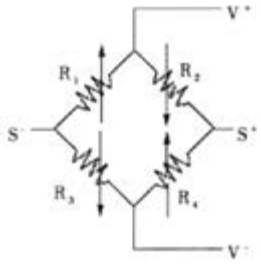


Fig. 2

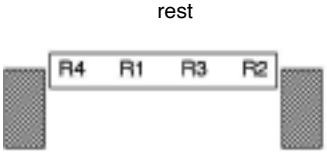


Fig. 4

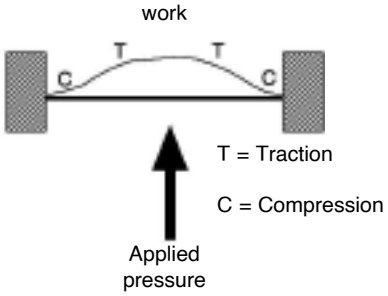


Fig. 5

14. APPENDIX B: IP PROTECTION

IP protection indexes indicate the protection level of a device against outside agents.

It consists of two numbers after the prefix IP: the first is the index of protection against solids and dust; the second is the index of protection against liquids.

Three numbers are used in some countries. In this case, the third number is the mechanical index of protection.

Example: the protection index IP45 indicates a protection level of 4 against solids and a protection level of 5 against liquids.
Attention: these indexes are valid under standard ambient conditions.
Gefran Melt transducers and transmitters are built with protection index IP65.

Protection against solid objects

1st number	Description	Definition
0	No protection	No special protection
1	Protection against solid objects larger than 50mm	A part of the body with large surface, such as a hand (protection does not include intentional access). Solid objects with diameter exceeding 50mm.
2	Protection against solid objects larger than 12mm	Finger or similar objects less than 80mm in length. Solid objects with diameter exceeding 12mm.
3	Protection against solid objects larger than 12mm.	Tools, wires, etc., with diameter or thickness exceeding 2.5mm. Solid objects with diameter exceeding 2.5mm.
4	Protection against solid objects larger than 1.0mm	Wires or strips with thickness exceeding 1.0mm. Solid objects with diameter exceeding 1.0mm
5	Protection against dust	**Dust is not completely blocked, but does not enter in amounts sufficient to prevent good operation of the device.**
6	High protection against dust	No entry of dust.

Protection against liquids

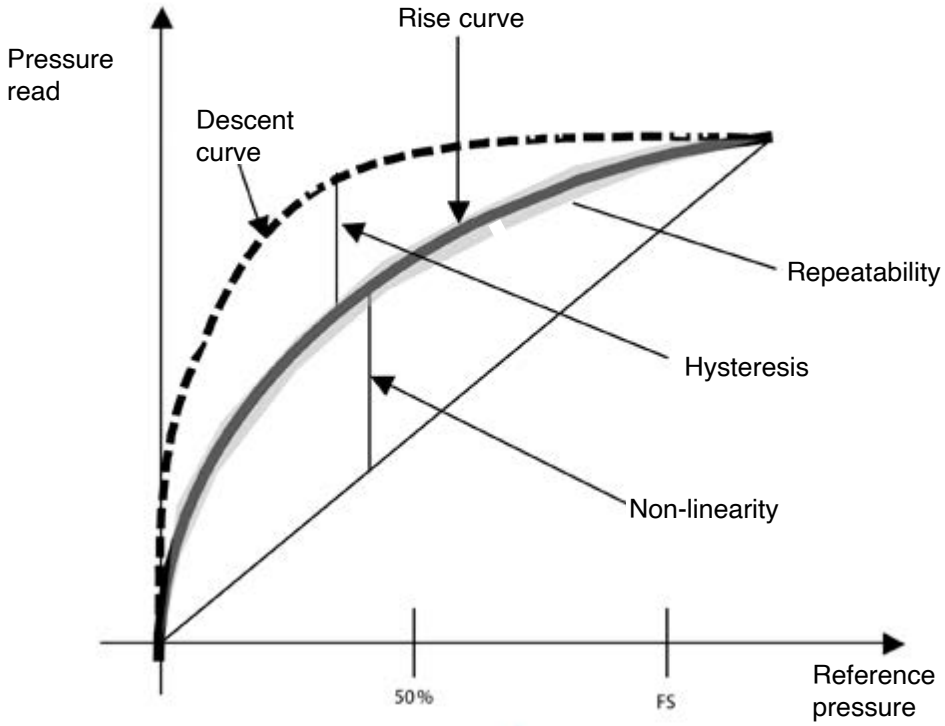
1st number	Description	Definition
0	No protection	No special protection
1	Protection against drops of water.	Vertically dripping water must not have harmful effects.
2	Protection against drops of water at angle up to 15°.	Vertically dripping water must not have harmful effects when the device is rotated vertically up to 15°.
3	Protection against water vapor.	Sprays of vapor that fall at an angle up to 60° from vertical must not have harmful effects.
4	Protection against sprays of water.	Water sprayed on the housing from any direction must not have harmful effects.
5	Protection against jets of water.	**A jet of water pumped from any direction must not have harmful effects.**
6	Protection against waves.	Water from sea waves or a strong jet of water from any direction must not have harmful effects.
7	Protection against immersion.	Entry of water in an amount sufficient to damage the device must not be possible when the device is immersed in water for a defined length of time under defined pressure conditions.
8	Protection against continuous immersion	The device may be immersed in water for an extended length of time under conditions specified by the manufacturer.

15. APPENDIX C: GUIDE TO SELECTION OF THE DIAPHRAGM IN CONTACT WITH EXTRUDED POLYMER

SECTOR OF USE	MATERIAL WORKED	TEMPERATURE AND PROCESS PRESSURE	NOTES	SPECIAL VERSION
Heat insulation panels / Plexiglas; plastics for injection	PMMA (high viscosity), plexiglass	190-230°C	Standard diaphragm	000
Hydraulic tubes (drains, sewers, etc…)	PVC-U, UPVC, RPVC (high viscosity)	180-200°C	Standard diaphragm	026-109
Hydraulic tubes for heating, high pressure tubes, tubes for the chimica industry	PP (polypropilene)	200-230°C	Standard diaphragm	000
Rugs and carpets (moquettes)	PP (polypropilene)	200-230°C	Standard diaphragm	000
Plastic bags, wrapping films and tapes, low-cost laminates	PE-LD (low density) (o LO-PE)	170-190°C	Standard diaphragm	000
Bags for potato chips, reclosable bags (W/K/I series)	PP (polypropylène)	200-230°C	Use W series	000
Plastic bottles and other food applications (W/K/I series)	PET		Use W series	000
Nylon films and tapes for packaging; covers with high mechanical strength and resi stance to high temperatures (profiles, corners, etc…)	PA6 (Nylon 6)	210-260°C / P < 500bar	Special diaphragm with excel-lent resi stance to contact with adhesive materials	123
Films, monofilaments and misc. profiles	PA66 (Nylon 66, Polyamide 66) / PVDF	210-290°C / P > 500bar	Special diaphragm with excel-lent resi stance to contact with adhesive materials	110
Films for food (roast in a bag) (W/K/I series)	PA66 (Nylon 66, Polyamide 66)	265-290°C	Use W series	123
Packaging for food (DOMOPACK or “cheese paper”) (W/K/I series)	PE-HD-High Density (o HD-PE)	180-210°C	Use W series, with standard diaphragm	000
Building industry; mixers for tires	Highly abrasive plastics; extrusion at high flow rate; fiberglass, ceramics, mineral resins, rubber	up to 400°C - 200°C	Special diaphragm with high strength and resistance to abrasion and rot drift, accuracy and sensitivity	261 - B31
Insulating sheathing for electrical cables	PVC / Corrosive plastics	205-240°C 100-250bar	Special diaphragm, resistant to corrosive materials	109
Finishings (caravans, furniture, home appliances, freezers, formica, etc…)	ABS (Acrylonitrile Butadiène Styrène)		Special diaphragm, resistant to corrosive materials	109
Packing; building	Teflon, PC Polycarbonate-Makrolon, coloring agents; resin additives		Special diaphragm, resistant to corrosive materials	B31
Pharmaceutical use (W/K/I series)	Teflon, PC Polycarbonate-Makrolon, coloring agents; resin additives		K series with special diaphragm or W series with GTP+ standard	B31
Abrasive applications with moderate temperatures	Processes containing vi-treous materials or abrasive resins		Special diaphragm with resi stance to abrasion and rot drift, accuracy and sensitivity	B31
Abrasive applications	Processes containing vi-treous materials or abrasive resins		Special diaphragm with resi stance to abrasion and rot drift, accuracy and sensitivity	B31
Recycling of plastic materials	Bulk materials + solid impurities		Special diaphragm with resi stance to abrasion and rot drift, accuracy and sensitivity	B31
Plastics industry FDA approved			W/K/I series with FDA approved coating	B39

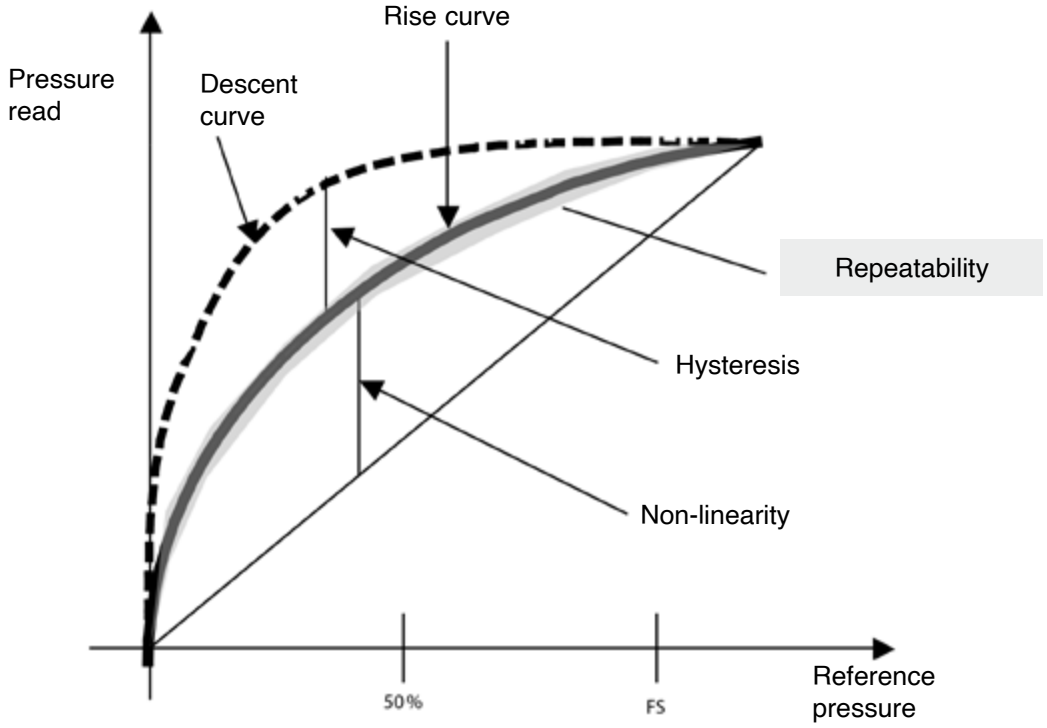
16. APPENDIX D: ACCURACY CLASS

16.1. Calibration curve



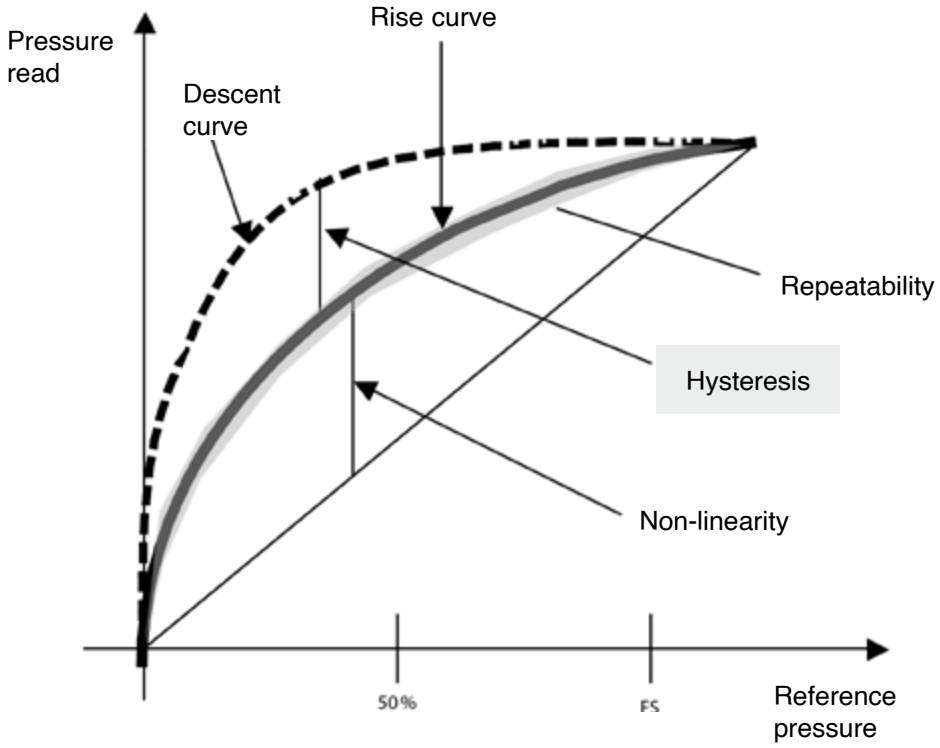
16.2. Repeatability

Repeatability is defined as the ability to reproduce reads in the same direction and under the same conditions when the same pressure is applied consecutively.
The maximum repeatability error of every Gefran sensor is 0.1% FS.



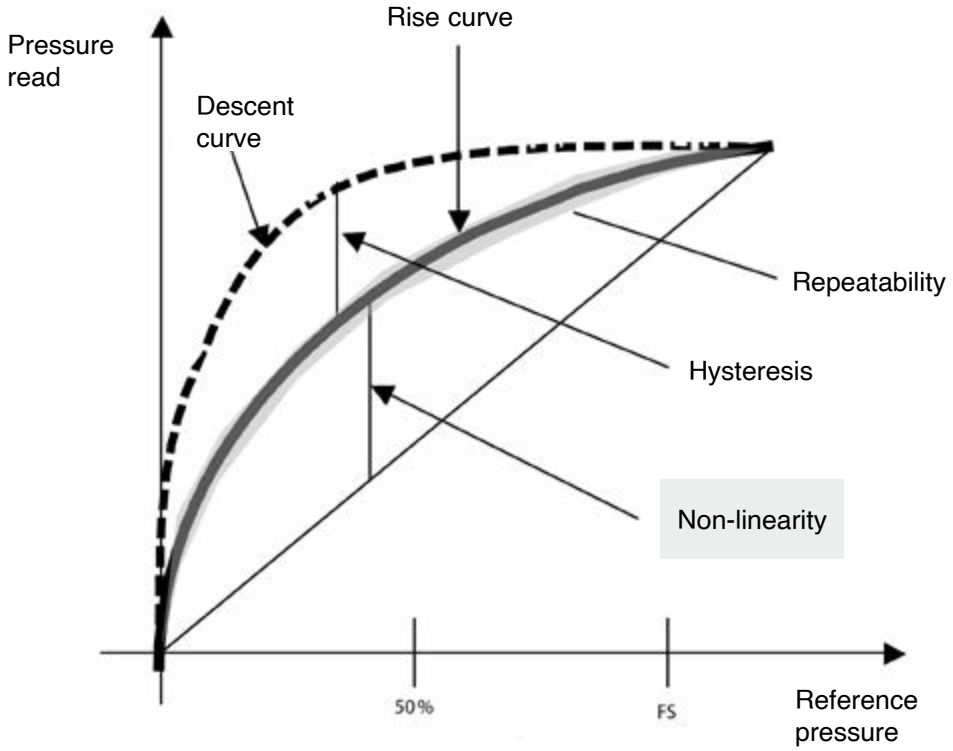
16.3. Hysteresis

The maximum read difference for each reading in a specific range when the value is reached, first in rise and then in descent.
The maximum hysteresis for every Gefran sensor is 0.1% FS.



16.4. Linearity

The maximum deviation of the calibration read curve for each calibration value, obtained by comparison to an ideal read curve.
Gefran uses the “BSFL” (best straight fit line) method.

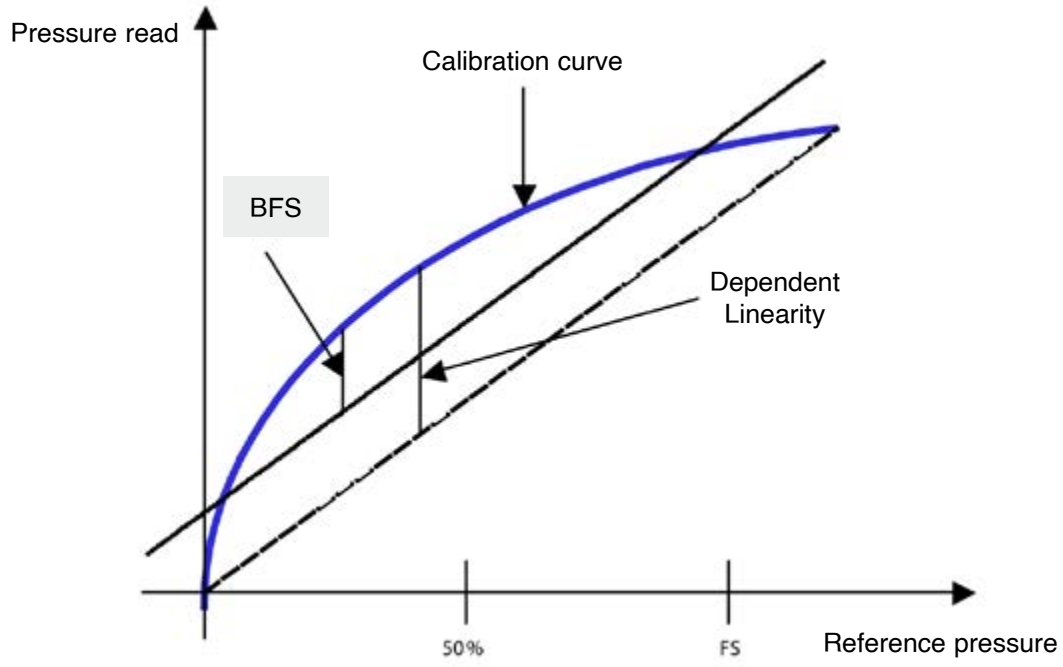


Dependent linearity error (End point)

Dependent linearity error is the deviation between the real characteristic of the transducer and the straight line passing through the two ends; expressed in % of FS.

Independent linearity error (BFSL)

Independent linearity error (BFSL) is the deviation between the real characteristic of the transducer and the straight line of minimum squares.
In practice, a straight line is formed that best approximates the real curve.



17. APPENDIX E: REGISTRATION MAINTENANCE

Date	DUT (model/SN)	Maintenance Done	Result	Pass/Fail	Operator	Notes

In accordance with IEC/EN 62061 and IEC/EN 61508, transducers of the M, W, K SIL2 series also comply with EN 61326-3-1 “Electrical equipment for measurement, control, and laboratory use - immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) - General industrial applications”.