Permanent measurement and control system PK

Pressure and temperature gauges
System for pressure and temperature measurements in deep wells, surface display and data logging or remote transmission to SCADA systems
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The PK system implements measurement and control tasks at and in mineral oil and natural gas wells and underground storages as well as water wells including geothermal wells.

Apart from pure measurement tasks, such as measuring pressure in the borehole or pressure and temperature at the wellhead and other parameters such as pipeline pressure, liquid levels and a lot more process parameters can be measured, stored and evaluated.

The PK system features enhanced applications, compared to conventional pressure and temperature transmitters.

Examples are:

- Storage of measured values at site and remote transmission of data
- Analysis of optimum production and storage capacity
- Monitoring of and automatic response to alarm situations
- Continuous monitoring of fluid level in the well
- Pump operation control according to fluid level for deep well sucker rod pumps, electric submersible pumps and screw pumps
- Measuring data acquisition, communication and evaluation

For the measurement data processing further customer specific solutions are possible. Optionally the PK system can be powered by solar energy or batteries respectively. The PK controller can be delivered completely mounted in weatherproof boxes or cabinets.
Component overview and signal flow chart PK system

Gauges and accessories
Pressure/temperature measurement

Wellhead gauges
- Wellhead pressure gauge
- Temperature transmitter

Accessories
- Stuffing boxes
- Spacer with discharge valve
- Preventer

Downhole gauges
- Standard pressure gauge
- Pressure and temperature gauge
- Fast response temperature gauge

Accessories
- Wire line cable
- Gauge clamp
- Sinker bar, adapter
- Feed-through mandrel

Measuring data processing
Display, Storage, Evaluation

Gauge supply
- Intrinsically safe current repeater or 24 V power supply
- Voltage surge protection

Displays
- Display 4 ... 20 mA as current loop panel meter without power supply

Display, Storage and Evaluation
- Data logger
- MemoryCard (FlashCard)
- MemoryCard Reader
- Software
- Laptop/PC

Mains supply 24 V DC respct. 90 ... 260 V AC
Permanent measurement and control system PK

Gauges and accessories
Pressure/temperature measurement

Measuring data processing
Display, Storage, Evaluation

Junction box
Gauge supply

Stuffing box
Preventer

Display
Data logger

Permanently or free hanging installed pressure/temperature gauges

PC software
Types of gauge installation

Installation freely suspended

- Signal cable
- Junction box
- Cable clamp
- Stuffing box
- Spacer with discharge valve
- Preventer
- Christmas tree*)
- Fitting*)
- Tubing*)
- Wire line cable
- Cable head
- Pressure/temperature gauge
- Adapter
- Sinker bar
- Bullnose

*) no Leutert product
<table>
<thead>
<tr>
<th>Installation freely suspended</th>
<th>Types of gauge installation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of installation</strong></td>
<td>free hanging (inside tubing)</td>
</tr>
<tr>
<td><strong>Function</strong></td>
<td>Pressure and temperature measurement in gases and liquids</td>
</tr>
</tbody>
</table>
| **Components**              | • Pressure/temperature gauge  
                             | • Cable head  
                             | • Sinker bar, adapter  
                             | • Wire line cable  
                             | • Preventer  
                             | • Spacer with discharge valve  
                             | • Stuffing box  
                             | • Cable clamp  
                             | • Junction box  
                             | • Signal cable |
Types of gauge installation

Tandem installation freely suspended

- Signal cable
- Junction box
- Cable clamp
- Stuffing box
- Spacer with discharge valve
- Preventer
- Christmas tree*)
- Fitting*)
- Tubing*)
- Wire line cable
- Wire line cable
- Pressure gauge
- Bullnose
- Gas water contact
- Cable head
- Pressure gauge
- Adapter
- Pressure gauge
- Bullnose

(*) no Leutert product
**Tandem installation freely suspended**

<table>
<thead>
<tr>
<th>Type of installation</th>
<th>freely suspended (inside tubing)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Determination of the gas water contact in aquifer storages</td>
</tr>
<tr>
<td><strong>Components</strong></td>
<td>2 x Pressure gauge</td>
</tr>
<tr>
<td></td>
<td>2 x Cable head</td>
</tr>
<tr>
<td></td>
<td>Sinker bar, adapter</td>
</tr>
<tr>
<td></td>
<td>Wire line cable</td>
</tr>
<tr>
<td></td>
<td>Preventer</td>
</tr>
<tr>
<td></td>
<td>Spacer with discharge valve</td>
</tr>
<tr>
<td></td>
<td>Stuffing box</td>
</tr>
<tr>
<td></td>
<td>Cable clamp</td>
</tr>
<tr>
<td></td>
<td>Junction box</td>
</tr>
<tr>
<td></td>
<td>Signal cable</td>
</tr>
</tbody>
</table>
Installation in annular space

Types of gauge installation

- Signal cable
- Measurement data processing
- Junction box
- Christmas tree
- Stuffing box
- Fitting
- Tubing
- Banding
- Protector
- Wire line cable
- Cable head
- Gauge clamp
- Pressure/temperature gauge

*) no Leutert product
### Installation in annular space

<table>
<thead>
<tr>
<th>Type of installation</th>
<th>permanent (in annular space)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Pressure and temperature measurement in gases and liquids</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure/temperature gauge</td>
</tr>
<tr>
<td>Cable head</td>
</tr>
<tr>
<td>Wire line cable</td>
</tr>
<tr>
<td>Gauge clamp</td>
</tr>
<tr>
<td>Protectors</td>
</tr>
<tr>
<td>Banding</td>
</tr>
<tr>
<td>Stuffing box</td>
</tr>
<tr>
<td>Junction box</td>
</tr>
<tr>
<td>Signal cable</td>
</tr>
</tbody>
</table>
Types of gauge installation

Installation in annular space - for pump monitoring

- Signal cable
- Junction box
- Christmas tree*)
- Connector*)
- Stuffing box
- Fitting*)
- Tubing*)
- Banding
- Protector
- Wire line cable
- Cable head
- Gauge clamp
- Pressure/temperature gauge
- Pump*)
- Power supply cable*)
- Motor*)

*) no Leutert product
### Installation in annular space - for pump monitoring

<table>
<thead>
<tr>
<th>Type of installation</th>
<th>permanent (in annular space)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td>Pump monitoring</td>
</tr>
<tr>
<td>Components</td>
<td></td>
</tr>
<tr>
<td>• Pressure/temperature gauge</td>
<td></td>
</tr>
<tr>
<td>• Cable head</td>
<td></td>
</tr>
<tr>
<td>• Wire line cable</td>
<td></td>
</tr>
<tr>
<td>• Gauge clamp</td>
<td></td>
</tr>
<tr>
<td>• Protectors</td>
<td></td>
</tr>
<tr>
<td>• Banding</td>
<td></td>
</tr>
<tr>
<td>• Stuffing box</td>
<td></td>
</tr>
<tr>
<td>• Junction box</td>
<td></td>
</tr>
<tr>
<td>• Signal cable</td>
<td></td>
</tr>
</tbody>
</table>
**Types of gauge installation**

**Installation in annular space - to measure the tubing pressure**

- Signal cable
- Junction box
- Christmas tree*)
- Stuffing box
- Fitting*)
- Tubing *)
- Banding
- Protector
- Wire line cable
- Cable head
- Gauge clamp
- Pressure/temperature gauge
- Tube fitting
- Tube
- Tube fitting
- Feed-through mandrel
- Feed-through bore
- Packer *)

*) no Leutert product
### Installation in annular space - to measure the tubing pressure

#### Type of installation
permanent (in annular space)

#### Function
Measurement of tubing pressure

#### Components
- Pressure/temperature gauge
- Cable head
- Wire line cable
- Gauge clamp
- Protectors
- Banding
- Stuffing box
- Junction box
- Signal cable
- Tube fittings
- Tube
- Feed-through mandrel
- Packer
Types of gauge installation

Gauge inside tubing - measuring tubing pressure

* no Leutert product

1. Signal cable
2. Measurement data processing
3. Junction box
4. Christmas tree
5. Stuffing box
6. Fitting
7. Tubing
8. Banding
9. Protector
10. Wire line cable
11. Tubing sub with pressure connection:
   - Cable clamp
   - High pressure connector system
   - Pressure sensor with transmitter electronics
12. Packer

*) no Leutert product
### Gauge inside tubing - measuring tubing pressure

<table>
<thead>
<tr>
<th><strong>Type of installation</strong></th>
<th>permanent (in annular space)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Function</strong></td>
<td>Measuring of tubing pressure up to 200 bar (3000 psi) for holes with small casing diameter</td>
</tr>
<tr>
<td><strong>Components</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pressure/temperature gauge</td>
</tr>
<tr>
<td></td>
<td>• Cable head</td>
</tr>
<tr>
<td></td>
<td>• Wire line cable</td>
</tr>
<tr>
<td></td>
<td>• Gauge clamp</td>
</tr>
<tr>
<td></td>
<td>• Protectors</td>
</tr>
<tr>
<td></td>
<td>• Banding</td>
</tr>
<tr>
<td></td>
<td>• Stuffing box</td>
</tr>
<tr>
<td></td>
<td>• Junction box</td>
</tr>
<tr>
<td></td>
<td>• Signal cable</td>
</tr>
<tr>
<td></td>
<td>• Tubing sub with pressure connection:</td>
</tr>
<tr>
<td></td>
<td>- Pressure sensor with transmitter electronics</td>
</tr>
<tr>
<td></td>
<td>- high pressure connector system</td>
</tr>
<tr>
<td></td>
<td>- cable clamp</td>
</tr>
<tr>
<td></td>
<td>• Packer</td>
</tr>
</tbody>
</table>
**Description**

The downhole pressure gauge is a part of the PK system and is used for pressure monitoring in deep wells of oil, natural gas and water production and also in observation wells. The gauge contains a 2-wire transmitter with a 4 – 20 mA signal and it is offered in two different operating temperature ranges.

**Technical Data**

<table>
<thead>
<tr>
<th>Pressure steps</th>
<th>0 – 50 bar</th>
<th>0 – 750 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 100 bar</td>
<td>0 – 1500 psi</td>
<td></td>
</tr>
<tr>
<td>0 – 200 bar</td>
<td>0 – 3000 psi</td>
<td></td>
</tr>
<tr>
<td>0 – 400 bar</td>
<td>0 – 6000 psi</td>
<td></td>
</tr>
<tr>
<td>0 – 1000 bar</td>
<td>0 – 15000 psi</td>
<td>1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter</th>
<th>26 mm</th>
<th>1,02” 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 mm</td>
<td>1,26”</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length</th>
<th>approx. 950 mm</th>
<th>37,8”</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
<th>approx. 2000 g</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Stainless steel 1.4462  H₂S-resistant optional Titanium</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Output signal</th>
<th>4 – 20 mA</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Gauge supply</th>
<th>13 – 28 V DC</th>
</tr>
</thead>
</table>

---

1) on request  
2) up to max. 200 bar  
3) The cable head does not belong to the scope of delivery of the gauge.
Downhole pressure gauge

Operating temperature range -20 °C – 120 °C

Accuracy characteristic values
Accuracy pressure signal: ± 1.0 % FSO (at 10 °C – 110 °C)
± 1.5 % FSO (at -20 °C – 120 °C)
± 0.1 % if calibrated at a specific temp.

Linearity/Hysteresis: ± 0.3 % FSO
Repeatability: 0.1 % FSO
Long-term offset drift: 0.1 % per year

Order-Numbers

<table>
<thead>
<tr>
<th>Pressure gauge</th>
<th>ø 26 mm</th>
<th>ø 32 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 50 bar</td>
<td>2701.0.25.00000</td>
<td>2700.1.25.00000</td>
</tr>
<tr>
<td>0 – 100 bar</td>
<td>2701.0.26.00000</td>
<td>2700.1.26.00000</td>
</tr>
<tr>
<td>0 – 200 bar</td>
<td>2701.0.27.00000</td>
<td>2700.1.27.00000</td>
</tr>
<tr>
<td>0 – 400 bar</td>
<td>2700.1.28.00000</td>
<td></td>
</tr>
</tbody>
</table>

Operating temperature range -20 °C – 170 °C

Accuracy characteristic values
Accuracy pressure signal: ± 1.0 % FSO (at 10 °C – 110 °C)
± 2.0 % FSO (at -20 °C – 170 °C)
± 0.1 % if calibrated at a specific temp.

Linearity/Hysteresis: ± 0.3 % FSO
Repeatability: 0.1 % FSO
Long-term offset drift: 0.1 % per year
Downhole pressure/temperature gauge

Description
The downhole pressure/temperature gauge is a part of the PK system and is used for pressure and temperature monitoring in deep wells of oil, natural gas and water production and also in observation wells. The gauge contains two 2-wire transmitters with output signals 4 – 20 mA and it is offered in two different operating temperature ranges.

Technical Data

<table>
<thead>
<tr>
<th>Pressure steps</th>
<th>0 – 50 bar</th>
<th>0 – 750 psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 100 bar</td>
<td>0 – 1500 psi</td>
<td></td>
</tr>
<tr>
<td>0 – 200 bar</td>
<td>0 – 3000 psi</td>
<td></td>
</tr>
<tr>
<td>0 – 400 bar</td>
<td>0 – 6000 psi</td>
<td></td>
</tr>
<tr>
<td>0 – 1000 bar</td>
<td>0 – 15000 psi</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter</th>
<th>26 mm</th>
<th>1,02” 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>32 mm</td>
<td>1,26”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length</th>
<th>approx. 1200 mm</th>
<th>47,2“</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
<th>approx. 3500 g</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>Stainless steel 1.4462 H₂S-resistant optional Titanium</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Output signal</th>
<th>2 x 4 – 20 mA</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Gauge supply</th>
<th>13 – 28 V DC</th>
</tr>
</thead>
</table>

1) on request
2) up to max. 200 bar
3) The cable head does not belong to the scope of delivery of the gauge.
Downhole pressure/temperature gauge

Operating temperature range -20 °C – 120 °C

Accuracy characteristic values
Accuracy temperature signal : ± 1.0 % FSO (at -20 °C – 120 °C)

Accuracy pressure signal : ± 1.0 % FSO (at 10 °C – 110 °C)
± 1.5 % FSO (at -20 °C – 120 °C)
± 0.1 % if calibrated at a specific temp.

Linearity/Hysteresis : ± 0.3 % FSO
Repeatability : 0.1 % FSO
Long-term offset drift : 0.1 % per year

Order-Numbers

<table>
<thead>
<tr>
<th>Pressure gauge</th>
<th>ø 26 mm</th>
<th>ø 32 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 50 bar</td>
<td>2701.0.25.00000</td>
<td>2700.1.25.00000</td>
</tr>
<tr>
<td>0 – 100 bar</td>
<td>2701.0.26.00000</td>
<td>2700.1.26.00000</td>
</tr>
<tr>
<td>0 – 200 bar</td>
<td>2701.0.27.00000</td>
<td>2700.1.27.00000</td>
</tr>
<tr>
<td>0 – 400 bar</td>
<td>2701.0.28.00000</td>
<td>2700.1.28.00000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperature gauge</th>
<th>ø 26 mm</th>
<th>ø 32 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>2701.0.72.01000</td>
<td>2700.0.72.01000</td>
<td></td>
</tr>
</tbody>
</table>

Operating temperature range -20 °C – 170 °C

Accuracy characteristic values
Accuracy temperature signal : ± 1.0 % FSO (at -20 °C – 170 °C)

Accuracy pressure signal : ± 1.0 % FSO (at 10 °C – 110 °C)
± 2.0 % FSO (at -20 °C – 170 °C)
± 0.1 % if calibrated at a specific temp.

Linearity/Hysteresis : ± 0.3 % FSO
Repeatability : 0.1 % FSO
Long-term offset drift : 0.1 % per year
**Description**

The downhole quick temperature gauge is a part of the PK system and is used for pressure and temperature monitoring in deep wells of oil, natural gas and water production and also in observation wells. Due to the fast response of the sensor the gauge can determine a temperature profile during run in or find leaks. The gauge contains a 2-wire transmitter with a 4 – 20 mA output signal.

**Technical data**

- **Temperature range**: -40 °C – 150 °C | -40 °F – 300 °F
- **Accuracy**: ± 0,1 °C FSO
- **Diameter**: 32 mm | 1,26” (Cable head and gauge) 36 mm | 1,42” (Gauge housing)
- **Length**: approx. 950 mm | 37,8”
- **Weight**: approx. 2000 g
- **Material**: Stainless steel 1.4462  H₂S-resistant optional Titanium
- **Output signal**: 4 – 20 mA
- **Gauge supply**: 13 – 28 V DC

1) The cable head does not belong to the scope of delivery of the gauge.
Description
The cable head provides a pressure tight connection between the cable and the down hole gauge. The cable head connection can either be done by the LEUTERT service or by sufficiently qualified customer’s personnel according to the instruction manual.

Technical data
- Diameter: 26 mm | 1,02” (up to max. 200 bar) 1) 
  32 mm | 1,26”
- Length: 400 mm | 15,75”
- Weight: approx. 2000 g
- Material: Stainless steel 1.4462 H₂S-resistant
  optional Titanium
- Operating conditions: -40 °C – 170 °C | -40 °F – 338 °F
  0 - 1000 bar | 0 – 15000 PSI

Artikel-Nummern
- Cable head, 2-pole, triaxial, ø 26 mm 2851.0.02.00000
- Cable head, 1-pole, triaxial, ø 32 mm 2850.1.01.00000
- Cable head, 4-pole, triaxial, ø 32 mm 2850.1.05.00000

1) on request
### Gauges / accessories (downhole)

#### Freely suspended installation, combination gauge - sinker bar

<table>
<thead>
<tr>
<th>Component</th>
<th>Diameter 1</th>
<th>Diameter 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable head</td>
<td>Ø 26 mm</td>
<td>1,02&quot;</td>
</tr>
<tr>
<td>Pressure/temperature gauge</td>
<td>Ø 26 mm</td>
<td>1,02&quot;</td>
</tr>
<tr>
<td>Adapter</td>
<td>M 22 x 1,5 (PIN)</td>
<td>15/16&quot; - 10UN (PIN)</td>
</tr>
<tr>
<td>Sinker bar</td>
<td>Ø 32 – 50 mm</td>
<td>1,26 – 1,97&quot;</td>
</tr>
<tr>
<td>Bullnose</td>
<td>Ø 26 mm</td>
<td>1,02&quot;</td>
</tr>
</tbody>
</table>
Sinker bars, Adapter

Description
The sinker bar is part of the PK system. It provides the necessary increase of weight in connection with a freely suspended gauge. Several sinker bars can be coupled. Depending on the required load sinker bars made of solid steel or filled with lead can be supplied.

Schwerstange aus Vollmaterial

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Length (mm)</th>
<th>Weight (approx. kg)</th>
<th>Connection</th>
<th>Order number</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mm</td>
<td>1800</td>
<td>25</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03001</td>
</tr>
<tr>
<td>38 mm (1½&quot;)</td>
<td>1500</td>
<td>13</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03001</td>
</tr>
</tbody>
</table>

Schwerstange mit Bleifüllung

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Length (mm)</th>
<th>Weight (approx. kg)</th>
<th>Connection</th>
<th>Order number</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 mm (1¼&quot;)</td>
<td>1000</td>
<td>8</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03100</td>
</tr>
<tr>
<td>32 mm (1¼&quot;)</td>
<td>500</td>
<td>4</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03200</td>
</tr>
<tr>
<td>38 mm (1½&quot;)</td>
<td>1000</td>
<td>10</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03300</td>
</tr>
<tr>
<td>38 mm (1½&quot;)</td>
<td>500</td>
<td>5</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03400</td>
</tr>
<tr>
<td>45 mm (1¾&quot;)</td>
<td>1000</td>
<td>12</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03500</td>
</tr>
<tr>
<td>45 mm (1¾&quot;)</td>
<td>500</td>
<td>6</td>
<td>15/16″-10UN</td>
<td>2700.0.99.03600</td>
</tr>
</tbody>
</table>

Other dimensions on request

Description
The adapter (cross over) is required to connect a sinker bar (thread 15/16″ – 10UN) to a gauge with 20 mm diameter (thread: M 22 x 1.5).
**Description**
The feed-through mandrel is part of the PK system. It serves for measuring the inner tubing pressure. Via the drilled feed-through and a special connection tube the pressure is lead to the pressure gauge.

**Technical data**
- Material: 42CrMo4
- Inner diameter 1): 2 7/8” (Tubing diameter)
- Outer diameter 1): 140 mm
- Length 1): 240 mm

**Order number**
Feed-through mandrel 2) 9000.0.00.87427

---

1) other dimensions on request
2) incl. tube fitting 1/4 NPT and connection tube, length adapted
Gauge clamp

Description
The gauge clamp is part of the PK system. It serves the attachment of the pressure/temperature gauge at the tubing.

Technical data
Material : Stainless steel 1.4462 H₂S-resistant
Height *) : 20 mm
Gauge diameter *) : 32 mm (d3)
Tubing | outer diameter *) : d2 | d1
  2 7/8" | 130 mm
  3 1/2" | 150 mm

Order numbers
Tubing diameter (d2) 2 7/8” 2840.0.26.00000
Tubing diameter (d2) 3 1/2” 2840.0.25.01000

*) other dimensions on request
Description
In onshore and offshore oil exploration wells single or multiconductor cables with double armour are being used to collect subsurface data. Due to this protection neither the alternating bending load during winch operation nor the tensile or torsional stress during the rough everyday operation can harm the cable.

Technical data

- **20 AWG copper**: 7/0.32 mm | 7/0.013”
- **Nominal EPC insulation**: 4.70 mm | 0.185”
- **Compressed diameter**: 2.11 mm | 0.083”
- **Inner armor**: 12/0.65 mm | 12/0.026”
- **Outer armor**: 18/0.65 mm | 18/0.026”

Electrical properties

- **DC resistant (at 20 °C | 68 °F)**
  - Conductor: 34 Ω/km | 10.4 Ω/kFt
  - Armor: 19 Ω/km | 6.0 Ω/kFt
- **Insulation resistance (at 500 V DC)**: 15000 MΩ/km | 50000 MΩ/kFt
- **Capacitance (at 1 kHz)**: 148 pf/km | 45 pf/Ft
- **Voltage rating**: 600 Vrms | 600 Vrms

Mechanical properties

- **Calculated weight**
  - In air: 94 kg/km | 63 Lbs/kFt
  - In fresh water: 77 kg/km | 52 Lbs/kFt
- **Temperature range**
  - Minimum: -40 °C | -40°F
  - Maximum: 150 °C | 300 °F
- **Breaking strength**
  - Ends fixed: 15 KN | 3440 Lbs
  - Ends free: 11 KN | 2560 Lbs
- **Maximum end to end variation**: 0.13 mm | 0.005 Inch
**Description**
In onshore and offshore oil exploration wells single or multiconductor cables with double armour are being used to collect subsurface data. Due to this protection neither the alternating bending load during winch operation nor the tensile or torsional stress during the rough everyday operation can harm the cable.

**Technical data**

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification 1</th>
<th>Specification 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 AWG copper</td>
<td>7/0,20 mm</td>
<td>7/0.008”</td>
</tr>
<tr>
<td>EPC insulation</td>
<td>1,00 mm</td>
<td>0.039”</td>
</tr>
<tr>
<td>Fillers rod, filler compound and tape binder</td>
<td>2,49 mm</td>
<td>0.098”</td>
</tr>
<tr>
<td>Compressed diameter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inner armor</td>
<td>18/0,48 mm</td>
<td>18/0.019”</td>
</tr>
<tr>
<td>Outer armor</td>
<td>18/0,65 mm</td>
<td>18/0.025”</td>
</tr>
<tr>
<td>Nominal</td>
<td>4,72 mm</td>
<td>0.186”</td>
</tr>
</tbody>
</table>

**Electrical properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification 1</th>
<th>Specification 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC resistant (at 20 °C</td>
<td>68 °F)</td>
<td></td>
</tr>
<tr>
<td>- Conductor</td>
<td>26 Ω/km</td>
<td>85 Ω/kFt</td>
</tr>
<tr>
<td>- Armor</td>
<td>6,7 Ωkm</td>
<td>22 Ω/kFt</td>
</tr>
<tr>
<td>Insulation resistance (at 500 V DC)</td>
<td>5000 MΩ/km</td>
<td>15000 MΩ/kFt</td>
</tr>
<tr>
<td>Capacitance (at 1 kHz)</td>
<td>148 pf/km</td>
<td>45 pf/Ft</td>
</tr>
<tr>
<td>Voltage rating</td>
<td>600 Vrms</td>
<td>600 Vrms</td>
</tr>
</tbody>
</table>

**Mechanical properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification 1</th>
<th>Specification 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculated weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- In air</td>
<td>91 kg/km</td>
<td>61 Lbs/kFt</td>
</tr>
<tr>
<td>- In fresh water</td>
<td>74 kg/km</td>
<td>50 Lbs/kFt</td>
</tr>
<tr>
<td>Temperature range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Minimum</td>
<td>-40 °C</td>
<td>-40°F</td>
</tr>
<tr>
<td>- Maximum</td>
<td>150 °C</td>
<td>300 °F</td>
</tr>
<tr>
<td>Breaking strength</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ends fixed</td>
<td>11 KN</td>
<td>2580 Lbs</td>
</tr>
<tr>
<td>- Ends free</td>
<td>8 KN</td>
<td>1580 Lbs</td>
</tr>
<tr>
<td>Maximum end to end variation</td>
<td>0,13 mm</td>
<td>0.005 Inch</td>
</tr>
<tr>
<td>Minimum static dia of curvature</td>
<td>188 mm</td>
<td>7.44 Inch</td>
</tr>
<tr>
<td>Minimum dynamic dia of curvature</td>
<td>236 mm</td>
<td>9.300 Inch</td>
</tr>
<tr>
<td>Torque</td>
<td></td>
<td>0.322 m.daN</td>
</tr>
</tbody>
</table>
Description
The wellhead pressure gauge is a part of the PK system and is used for the surface pressure monitoring of deep wells of oil, natural gas and water production and also in observation wells. The gauge contains a 2-wire transmitter with a 4 – 20 mA signal. Optionally a temperature transmitter can be added to the gauge.

Technical Data
Pressure ranges : 0 – 25 bar | 0 – 360 psi
0 – 60 bar | 0 – 870 psi
0 – 160 bar | 0 – 2300 psi
0 – 250 bar | 0 – 3600 psi
0 – 400 bar | 0 – 5800 psi
0 – 600 bar | 0 – 8700 psi
0 – 700 bar | 0 – 10150 psi

Operating temperature : -30 °C – 120 °C | -22 °F – 250 °F
Diameter : 55 mm | 2.16”
Length : approx. 240 mm | 9.5”
Weight : approx. 2000 g
Material : Stainless steel 1.4462 H₂S-resistant
Degree of protection : IP 68
Connections : R 1/2”, 1/2” NPT, Leutert-Quick-Coupling
Accuracy : ± 0.05 % – 0.5 % FSO depending on temperature and operating conditions
Long-term offset drift : 0.1 % per year at constant operating conditions
Output signal : 4 – 20 mA
Gauge supply : 9 – 30 V DC
Intrinsically safety : EEx i a II T4

Order numbers
0 – 25 bar | 0 – 360 psi 2700.0.31.0 x 000
0 – 60 bar | 0 – 870 psi 2700.0.32.0 x 000
0 – 160 bar | 0 – 2300 psi 2700.0.33.0 x 000
0 – 250 bar | 0 – 3600 psi 2700.0.34.0 x 000
0 – 400 bar | 0 – 5800 psi 2700.0.35.0 x 000
0 – 600 bar | 0 – 8700 psi 2700.0.36.0 x 000
0 – 700 bar | 0 – 10150 psi 2700.0.37.0 x 000
Connection R 1/2“ 1
Connection 1/2” NPT 2
Connection Leutert-Quick-Coupling 3
Stuffing box

Description
The stuffing box is a part of the PK system. It serves for the sealing of the wire line cable. This model is suitable for 3/16” wire line cable and designed for a maximum pressure of 100 bar.

Technical data
- Operating conditions: max. 100 bar | 1500 PSI
- Diameter: 85 mm | 3.35”
- Length: 295 mm | 11.6”
- Connecting thread: 2” line pipe
- Material: Stainless steel 1.4305

Order numbers
- Stuffing box, complete: 2840.0.99.00600
- Clamp screw: 2840.0.99.00103
- Clamp: 2840.0.99.00102
- Line wiper: 9000.0.00.59337
Gauges / accessories (surface)  Wellhead seal

1. Stuffing box
2. Spacer with discharge valve
3. Threaded flange
4. Spacer
5. Spacer
6. Flange adapter

- Wire line cable
- Cable clamp
- Preventer (BOP)
**Description**
The illustrated wellhead seal is an example for a freely suspended installation. Depending of the stuffing box, it is suitable for a head pressure of up to 100 bar. For higher pressure, please contact us. The height of this complete unit is approximately 1500 mm.

<table>
<thead>
<tr>
<th>No.</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Stuffing box</td>
<td>2” line pipe male</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part-No. 2840.0.99.00600</td>
</tr>
<tr>
<td>(2)</td>
<td>Spacer</td>
<td>Adapter 2” line pipe female to 3” line pipe male API 3000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part-No. 280333.155</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Discharge valve 1/2” NPT female</td>
</tr>
<tr>
<td>(3)</td>
<td>Threaded flange</td>
<td>3 1/8” API 3000-R31 with 3” line pipe female</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part-No. 280333.150_01</td>
</tr>
<tr>
<td>(4)</td>
<td>Spacer</td>
<td>Adapter 3” line pipe male to 3” line pipe male API 3000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part-No. 280333.145</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preventer 3” line pipe, 3000 psi</td>
</tr>
<tr>
<td>(5)</td>
<td>Spacer</td>
<td>Adapter 3” line pipe female to 3” line pipe male API 3000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Part-No. 280333.135</td>
</tr>
<tr>
<td>(6)</td>
<td>Flange adapter</td>
<td>at the wellhead with 3” line pipe female, provides by customer or Leutert</td>
</tr>
<tr>
<td></td>
<td></td>
<td>manufacturing according to customer specifications</td>
</tr>
</tbody>
</table>
**Measurement data processing**

**Display of measured data (without storage)**

- **Gauge supply**
  - Signal cable (inputs 4 ... 20 mA)

- **Display**
  - Current loop panel meter
  - 4 ... 20 mA LED display
  - without power supply
  - intrinsically safe
  - EEx ia/ib IIIC T6 (T5)

- **Connection to SCADA-system**
  - (outputs 4 ... 20 mA)
Permanent measurement and control system PK

Display, storage and evaluation of measured data

Measurement data processing

Gauge supply

Data logger MDH100

Connection to SCADA system
(outputs 4 ... 20 mA)

RS 232 interface for:
PC, SPS, Modem, Radio,
GSM or TCP/IP

optional: Transmission of the
configuration file from PC to the
logger by MDP100 software

optional: Display of
actual measured data
from logger on the PC

Transmission of the
measured data from the
Memory Card to the PC by
LeutertCardUtility

Compilation of the configuration file
by the MDP100 software,
numeral display in MS Excel or
graphical display in GreenEye Writer

Link via parallel port

Signal cable
(inputs 4 ... 20 mA)

Plug in the Memory Card
in the data logger to run
the recording

Plug in the Memory Card
in the data logger to run
the recording

Memory Card
Type FlashCard

Plug in the Memory Card in the
Card-Reader to retrieve the
measurement data

Memory Card-Reader

Transmission of the
measured data from the
Memory Card to the PC by
LeutertCardUtility

Formatting and configuring the
Memory Card in the Card-Reader
on the PC by LeutertCardUtility
**Measurement data processing**

### Data logger MDH100

#### Function
The data recorder serves the tasks of acquiring, storing and evaluating the following parameters:
- 8 multifunctional, analog inputs for current, voltage, resistance (thermocouples, RTDs)
- 6 digital I/O-ports
- 16 bit resolution
- Sampling rate selectable 1 sec to 1 h
- Sophisticated signal conditioning by means of individual linearisation, scaling and formatting
- Autonome limit control
- Mathematical functions and links between the channels

The loggers function depends on the application specific configuration.

#### Operating element
- 1 push and dial button

#### Equipment
- LC display 2 x 16 characters
- 256 kB RAM for internal storage of data, extendable to 2 MB by PCMCIA-SRAM-Card or 8 MB by PCMCIA-Flash-Card
- Serial interface RS 232 for PC or modem connection
- Field bus interface RS 485 for module expansion

#### Memory Card
Storage media for
- Function controlling configuration file *.pro
- Measurement data file *.log

#### Software for data logger MDH100
- MDP100 software is used to compile the configuration file.
- LeutertCardUtility
- Evaluation software Greeneye-Writer

#### Power supply
- Supply voltage 10 to 30 VDC
- Power consumption
  - approx. 200 mW (sampling rate 1 h)
  - approx. 840 mW (sampling rate 1 s)

#### Mechanical
- Dimensions (189 x 90 x 83) mm
- Weight 742 g
- Protective system IP 20
- DIN EN-Rail mounting
- Connection plug-in screw terminals

#### Environmental
- Operating temperature -30°C to 60°C
- Storing temperature -30°C to 80°C
- Humidity 0 % to 95 % at 50°C

#### Electromagnetic Compatibility (EMC)
- Electro static discharge:
  - Level 2 acc. IEC 801-2: 4 kV
- Radiated electromagnetic fields:
  - Level 3 acc. IEC 801-3: 10 V/m
- Electrical fast transients:
  - Level 3 acc. IEC 801-3: 2 kV / 1 kV
- Radiated RFI/EMI:
  - Level B acc. VDE 0871-1/CISPR11
Software

MDP100 configuration software

The MDP100 is a 32-bit software for Windows® 95, 98, 2000, NT and XP. It is used to configure the data logger and adapt it to the requirements.

Main features:
- clear tabular structure of variables
- display of measured data and variables
- data base for commonly used sensors
- import and export functions for sensor parameters
- online measuring of characteristic curves and calibration data
- online functions such as taring, storing, deleting or status

Evaluation software

Greeneye-Writer

This software is used for the graphical display of the stored measurement data. The recorded channels are displayed in differently coloured lines.

Microsoft Excel

Tabular evaluation can be performed in MS Excel. Pay attention to the limitation of data sets by MS Excel!

optional: Software e-console

e.console is able to visualize the measured data offline or online. It convinces by it’s versatile analysis capabilities and simple link to external data bases.
But the main target is the periodical archiving of measurement data and reacting to alarm messages sent by the data logger.
Gauges and accessories

Equipment for freely suspended gauge installation

Equipment of the Leutert Company
1. Sinker bar
2. Pressure/temperature gauge
3. Cable head
4. Wire line cable
5. Preventer
6. Leutert service technician for cable head bonding

Equipment provided by customer or service provided by Leutert
7. Lubricator
8. Stuffing box with grease injection and pulley
9. Hay pulley
10. Winch with depth measuring counter
11. Wire line operator
### Questionnaire - Permanently installed gauges PK

#### Gauges and accessories

### General questions regarding the well(s)

1. Max. downhole pressure
2. Max. wellhead pressure
3. Max. downhole temperature/surface temperature
4. Depth of pressure/temperature gauge (sensor)
5. Aggressive media (H₂S, CO₂), (attach chemical analysis if available)
6. Production or observation well
7. Completion drawing for wellhead (attach as separate sheet)
8. Completion drawing downhole (attach as separate sheet)
9. Installation of gauge (sensor) in annular space
10. Cable- or pressure feedthrough required for packer or hanger.
   (If yes, attach drawings or dimensions)
11. Installation of gauge (sensor), suspended in tubing
12. Casing diameter
13. Tubing diameter
14. Deviated well
15. Special remarks

#### General questions measuring technology

1. Online- or memory measurement
2. Power supply of 230V AC, 24/12V DC available at wellsite
3. Cable for remote control or data transmission available
4. Surface installation with digital display or digital display and datalogger
5. Power supply by solar panel
6. Required height of mast for solar panel 1,7 m or 6 m
7. Pressure only or pressure and temperature required
8. Surface unit in:
   - weather proof housing (IP65)
   - rack mounted 19” panel (IP54)
   - desktop housing with 19” panel
   - mobile datalogger (IP65)
9. Suitable working range:
   - e.g. 4 ... 20 mA represent 0...300 bar
10. Other required parameters (e.g. flow)

This questionnaire was prepared by: _____________________________