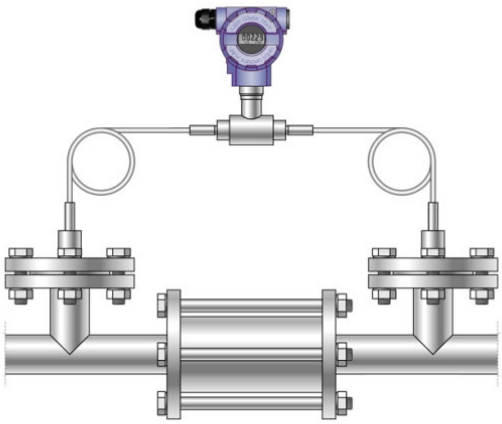
Technical **Datasheet**

delta-mobrey

D Series
SMART Differential Pressure Transmitter with Two Diaphragm Seals



Key **Features**

- ATEX - Flameproof and Intrinsically Safe
  UKEx - Flameproof and Intrinsically Safe
  IECEx - Flameproof and Intrinsically Safe
- High accuracy ±0.1%
- Fully HART ® compatible
- 4-20mA analogue with digital communications
- Fully welded sensor guarantees tightness of oil systems for long term usage
- Programmable range, zero shift, characteristic and damping ratio with local panel keys
- Linearisation of output signal on 20 point curve for specific application is available
- Write protection option through DKAP-03 communicator, 'D-Soft' program or software using library EDDL

Series **Overview**

The D35 is a D31 type Differential Pressure Transmitter, but with addition of chemical seals. The general performance and characteristics typical of the D-Series transmitters, are the same.

- The D-Series pressure, differential pressure and temperature transmitters offer customers reliable and accurate solutions to their individual process requirements.
- Available with a wide range of process connections and easily configurable via the D-Soft software, the D-Series can be used for a variety of applications when pressure, differential pressure, temperature, level or flow measurements are needed.

Other products in the series include:
- SMART Differential Pressure Transmitter
- SMART Differential Pressure Transmitter for low ranges
- SMART Pressure Transmitter

Product **applications**

The D Series SMART Differential Pressure Transmitter is suitable for a wide range of applications for measuring:

- Differential Pressure
- Level
- Flow

The choice of models available ensures that the Delta Transmitter is suitable for use in:

- Corrosive atmospheres
- Resistant to chemical attack

How can we **help you?**

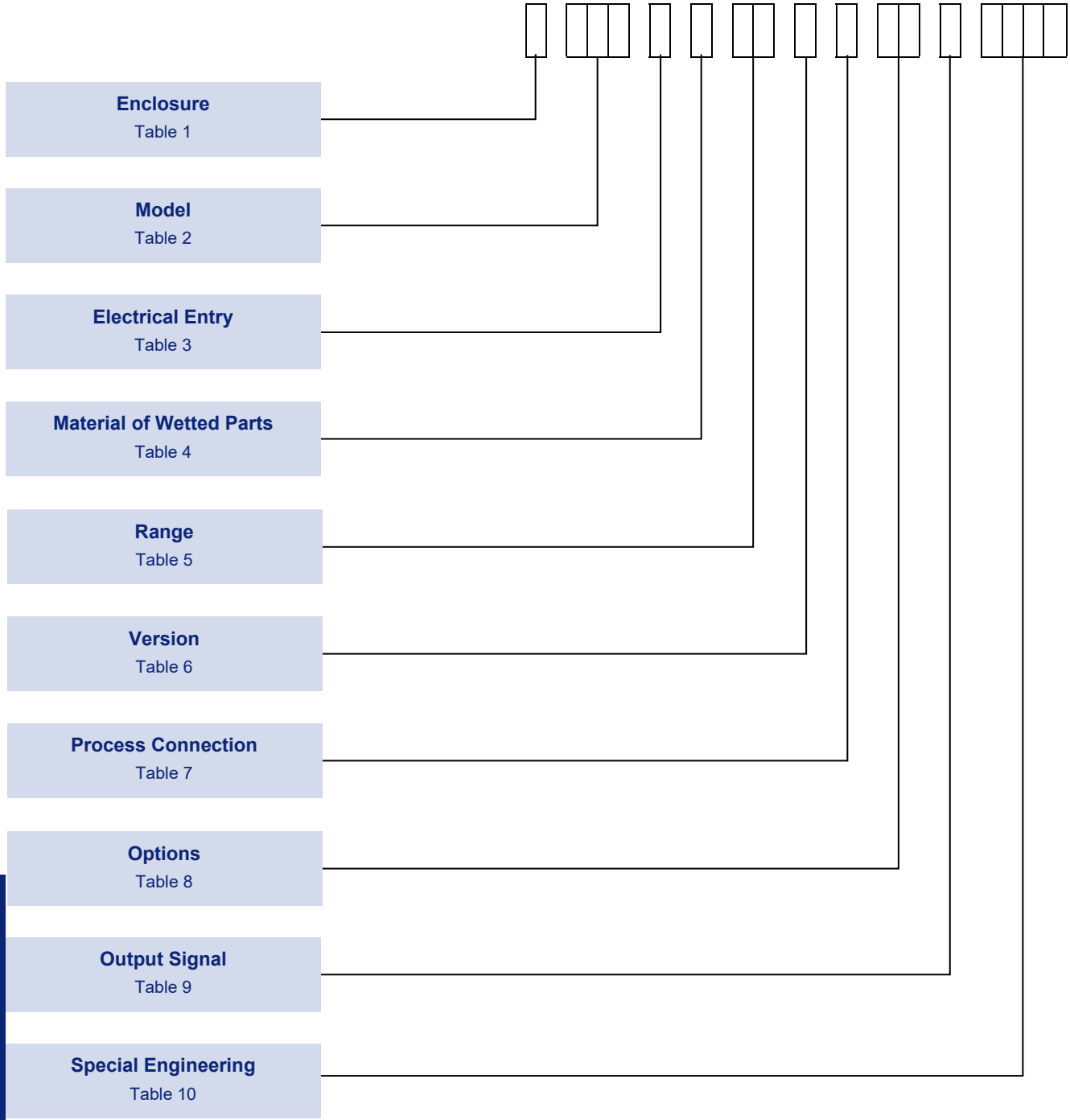
Delta Mobrey's offers fast, efficient and knowledgeable support when and where you need it. Please visit our web site at www.delta-mobrey.com to find your local support centre or call us on:

+44 (0) 1252 729140

D-Series
Model: D35

How to order

Transmitters can be configured by selecting codes representing the desired features from the tables that follow. The chart below, describes how the model code is built up. For assistance in configuring a transmitter that best suits your needs, please contact your local sales office.



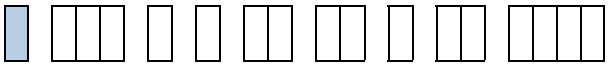
***NOTE**: Only the most common options are shown in this datasheet. Should you require a feature that is not shown, please contact your local sales office for further details.*

***NOTE:** The non-standard option code is shown by "X" in the part number. Should you require any clarification on this codes please contact your local sales office.*

***NOTE:** Please confirm before ordering if the backlight of the display is required to be settled differently from our standard. It cannot be successively settled in field.*

- *Instruments in Std, Exd, Exi construction are normally supplied with backlight ON.*
- *instruments in Safety and double certified construction, are supplied with backlight OFF*

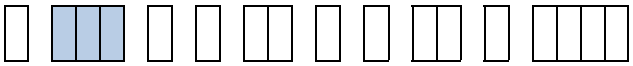
Enclosure

TABLE 1 

Refer to 'Approvals' section for details about the certification on Flameproof & Intrinsically Safe models .

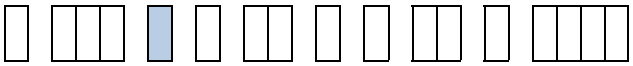
ENCLOSURES TYPES	Code
WEATHERPROOF ENCLOSURE	
General Purpose Aluminum housing, IP66, with display.	**W**
For Aggressive Atmosphere 316 Stainless steel housing, IP66, with display.	**A**
FLAMEPROOF ENCLOSURES (ZONE 1)	
Aluminum housing, IP66, with display. (Ex d)	**H**
316 Stainless steel housing, IP66, with display. (Ex d)	**R**
INTRINSICALLY SAFE ENCLOSURES (ZONE 0)	
Aluminum housing, IP66, with display. (Ex ia)	**5**
316 Stainless steel housing, IP66 with display. (Ex ia)	**4**

Model

TABLE 2 

	Code
SMART Differential Pressure Transmitter with Two Diaphragm Seals For applications up to 16 bar. Static pressure up to 160 bar. Refer Table 5.	**D35**

Electrical Entry

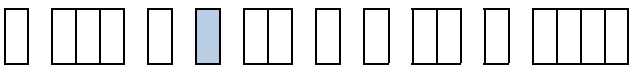
TABLE 3 

NOTE: Code 0
Available on Enclosure code H & R as standard.

NOTE: Code 1
Available on Enclosure code W, A, 5 & 4 as standard.

	Code
M20x1.5 thread	**0**
Packing gland M20x1.5	**1**
Electrical connection with thread 1/2NPT Female	**2**

Material of Wetted Parts

TABLE 4 

NOTE 1:
Please refer 'Process Connection' & 'Engineering Specials' section.

	Code
Not applicable. **(SEE NOTE 1)**	**0**

Range

TABLE 5

Code	Nominal measuring range (FSO)		Minimum set range	Vertical Spacing of diaphragm seals	Maximum set range width, considering the actual vertical spacing of the diaphragm seals (m)	Static Pressure Limit
A3	-160...160 mbar	(-16...16 kPa)	0.1 m H_2O	≤ 1.7 m	[1.6 + (vertical spacing of seals x 0.94)] m H_2O	40 bar
C3	-0.5...0.5 bar	(-50...50 kPa)	0.5 m H_2O	≤ 6 m	[5 + (vertical spacing of seals x 1.04)] m H_2O	40 bar
C6	-1.6...2 bar	(-160...200 kPa)	1.5 m H_2O	≤ 15 m	[20 + (vertical spacing of seals x 1.04)] m H_2O	40 bar
C7	-1.6...16 bar	(-160...160 kPa)	1 bar	≤ 15 m	16 bar	40 bar

CAUTION: The maximum vertical diaphragm seal spacing shown in the table applies to level measurement, ensuring that it is possible to set the zero point of the transmitter when the tank is empty. For measurement of density or phase boundaries (in the sugar, chemical or refinery industries) the vertical spacing of the diaphragm seals can be larger.

Version

TABLE 6

Combination of more than one option is available.

NOTE:
Surge arrester is available as standard for Ex d version.

	Code
Applies when no option is required	**0**
Surge arrester for Ex ia version	**1**
Protection class IP67	**6**
Static pressure 100 bar	**G**
Static pressure 160 bar	**H**

Process Connection

TABLE 7

NOTE 2:
Refers to the transmitter's wetted parts.

	Code
Stainless Steel 316L diaphragm and process connection. **(SEE NOTE 2)**	**A**

Options

TABLE 8

Combination of more than one option is available.
(i.e. Code 37 - combination of code 30 & 70)

	Code
Applies when no option is required	**00**
Stainless Steel rating label riveted to the housing	**20**
Stainless Steel Tag plate mounted on wire	**30**
Mounting bracket for 1" pipe, stainless steel	**70**
Stainless Steel plate riveted to the housing. Stainless Steel tag plate mounted on wire.	**A0**

Output Signal

TABLE 9

Note: Please refer to APPROVALS page for marking & protection.

	Code
4 to 20mA (Weatherproof or Hazardous Area with ATEX marking)	**O**
4 to 20mA (Hazardous Area with IECEx marking only)	**6**
4 to 20mA (Hazardous Area with UKEx marking)	**7**

Special Engineering

TABLE 10

Last 4 digits of model code will be allocated for specified diaphragm seal or any special requirements when required.

Please specify the requirement of the diaphragm seals,

1. Diaphragm seal type
2. Direct or remote diaphragm seal to be mounted on each side of transmitter.
3. Capillary length on each side of transmitter.

	Code
Please consult Delta sales engineering for special requirements	**TBA**

Application & Construction

The differential pressure transmitter is applicable to the measurement of pressure differences of: gases, vapours and liquids in cases where it is necessary to use seals and the pressure pulse source points may be several metres apart. Typical applications include the hydrostatic measurement of: levels in closed tanks, densities and phase boundaries, and the measurement of a filter loss, pressure differences between media in pasteurisers etc. The available range of the diaphragm seals allows measurement at great majority of media. The active element is a piezoresistant silicon sensor separated from the medium by a distance sealing system. The special design of the measuring units means that it can withstand pressure surges and overloads of up to 40 bar. The electronic circuits are enclosed in a casing with a degree of protection IP65 or IP66.

Configuration

The settings of the following metrological parameters can be changed:

- The units of pressure in which the range is configured.
- Start and end points of the range, time constant,
- Inverted characteristics (output signal 20 to 4 mA)

Communication

The transmitter is configured and calibrated using a DKAP-03 communicator, some other communications (HART) or a PC using and HART/USB converted and D-Soft configuration software.

The data interchange with the transmitters enables the users the transmitter identification, as well as reading of the currently measured differential pressure value, output current and percent of range width.

Technical Data

Metrological parameters

Accuracy ≤ ±0 .1% (FSO)

The other parameters as given in the technical datasheet for SMART Differentials Pressure Transmitter D31.

Sealing effect errors - as given in the relevant D Series Diaphragm seal's technical datasheets, concerning the distance seal.

NOTE: The additional absolute zero error due to ambient temperature can be compensated by configuring the transmitter, seals and capillaries in accordance with the recommendations on **'Example'** section.

Electrical Parameters

As given in the datasheet of D31 SMART Differential Pressure Transmitter.

Operating Conditions

Operating temperature range (ambient temperature) -25...85°C

D35/Exia -25...80°C

D35/Exd -25...75°C

Medium temperature range – as given in the appropriate diaphragm seal's technical datasheets (remote seal).

Special versions, certificates:

Exia - ATEX Intrinsic safety
Exd - ATEX Explosion proof

100 bar, 160 bar - static pressure 100 bar or 160 bar

Approvals

GLOBAL CERTIFICATION

IECEx Certified - output signal code 6 (see table 9)

INTRINSICALLY SAFE:

Certificate No.:I**ECEx FTZU 15.0027X**
IEC 60079-0, IEC 60079-11,

For Zone 0/1 models

Enclosure code 7 (refer Table 1)
Ex ia IIC T4/T5 Ga/Gb
Ex ia IIIC T105°C Da (version with PTFE shielded cable)

Enclosure code 8 (refer Table 1)
Ex ia I Ma
Ex ia IIC T4/T5 Ga/Gb
Ex ia IIB T4/T5 Ga/Gb (version with PTFE shielded cable)

Certificate No.: **KDB19ATEX006X**
EN IEC 60079-0, EN 60079-11, EN 60079-26, EN 50303

For Zone 0/1,20 models

Enclosure code 5 SIL version (refer Table 1)
Ex ia IIC T4/T5 Ga/Gb

Enclosure code 4 SIL version (refer Table 1)
Ex ia I Ma
Ex ia IIC T4/T5 Ga/Gb

Enclosure code 7 (refer Table 1)
Ex ia IIC T4/T5 Ga/Gb
Ex ia IIIC T105°C Da

Enclosure code 8 (refer Table 1)
Ex ia I Ma
Ex ia IIC T4/T5 Ga/Gb
Ex ia IIIC T105°C Da

FLAMEPROOF:

Certificate No**.: IECEx KDB 19.006X**
IEC 60079-0, IEC 60079-1, IEC 60079-11, IEC 60079-26, IEC 60079-31

For Zone 0/1, 20/21 models

Enclosure code H (refer Table 1)
Ex ia/db IIC T6/T5 Ga/Gb
Ex ia/tb IIIC T105°C Da/Db

Enclosure code R (refer Table 1)
Ex db ia I Mb
Ex ia/db IIC T6/T5 Ga/Gb
Ex ia/tb IIIC T105°C Da/Db

For Zone 1, 21 models

Enclosure code 2 (refer Table 1)
Ex ia/db IIC T6/T5 Gb
Ex ia/tb IIIC T105°C Db

Enclosure code 3 (refer Table 1)
Ex db ia I Mb
Ex ia/db IIC T6/T5 Gb
Ex ia/tb IIIC T105°C Db

INTRINSICALLY SAFE & FLAMEPROOF (*):

(*) According to the selection on the label

Certificate No.: **IECEx KDB 19.0006X**
IEC 60079-0, IEC 60079-1, IEC 60079-11, IEC 60079-26, IEC 60079-31

For Zone 0/1, 20/21 or 0/1, 20 models

Enclosure code 8 (refer Table 1)
Ex ia/db IIC T6/T5 Ga/Gb
Ex ia/tb IIIC T105°C Da/Db
Or

Ex ia IIC T5/T4 Ga/Gb
Ex ia IIIC T105°C Da

Enclosure code 9 (refer Table 1)
M2 Ex db ia I Mb
Ex ia/db IIC T6/T5 Ga/Gb
Ex ia/tb IIIC T105°C Da/Db
Or

Ex ia I Ma
Ex ia IIC T5/T4 Ga/Gb
Ex ia IIIC T105°C Da

Approvals

EUROPEAN DIRECTIVE)

ATEX Directive 2014/34/EU - output signal code O (see table 9)

INTRINSICALLY SAFE:

Certificate No.: **FTZU 19ATEX0111X**
EN IEC 60079-0, EN 60079-11, EN 50303

For Zone 0/1 models

Enclosure code 5 (refer Table 1)
II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1D Ex ia IIIC T105°C Da (version with PTFE shielded cable)

Enclosure code 4 (refer Table 1)
I M1 Ex ia I Ma
II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1D Ex ia IIIC T105°C Da (version with PTFE shielded cable)

Certificate No.: **KDB19ATEX0045X**
EN IEC 60079-0, EN 60079-11, EN 60079-26, EN 50303

For Zone 0/1,20 models

Enclosure code 5 SIL version (refer Table 1)
II 1/2G Ex ia IIC T4/T5 Ga/Gb

Enclosure code 4 SIL version (refer Table 1)
I M1 Ex ia I Ma
II 1/2G Ex ia IIC T4/T5 Ga/Gb

Enclosure code 7 (refer Table 1)
II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1D Ex ia IIIC T105°C Da

Enclosure code 8 (refer Table 1)
I M1 Ex ia I Ma
II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1D Ex ia IIIC T105°C Da

FLAMEPROOF:

Certificate No.**: KDB19ATEX0045X**
EN IEC 60079-0, EN 60079-1, EN 60079-11, EN 60079-26, EN 60079-31, EN50303

For Zone 0/1, 20/21 models

Enclosure code H (refer Table 1)
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db

Enclosure code R (refer Table 1)
I M2 Ex db ia I Mb
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db

For Zone 1, 21 models

Enclosure code 2 (refer Table 1)
II 2G Ex ia/db IIC T6/T5 Gb
II 2D Ex ia/tb IIIC T105°C Db

Enclosure code 3 (refer Table 1)
I M2 Ex db ia I Mb
II 2G Ex ia/db IIC T6/T5 Gb
II 2D Ex ia/tb IIIC T105°C Db

INTRINSICALLY SAFE & FLAMEPROOF (*):

(*) According to the selection on the label

Certificate No.: **KDB19ATEX0045X**
EN IEC 60079-0, EN 60079-1, EN 60079-11, EN 60079-26, EN 60079-31, EN50303

For Zone 0/1, 20/21 or 0/1, 20 models

Enclosure code 2 (refer Table 1)
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db
Or
II 1/2G Ex ia IIC T5/T4 Ga/Gb

II 1D Ex ia IIIC T105°C Da

Enclosure code 3 (refer Table 1)
M2 Ex db ia I Mb
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db
or

I M1 Ex ia I Ma
II 1/2G Ex ia IIC T5/T4 Ga/Gb
II 1D Ex ia IIIC T105°C Da

EMC Directive 2014/30/EU

Conformity assessment procedure: module A
The following standards were applied: EN 61326-1:2013; EN61326-2-3:2013

2014/68/EU Pressure Equipment Directive

For Nameplate Parameter **PS>200 bar**: The transmitters in PED version according to Module A of Directive 201/68/EU have specified on the nameplate parameters PS>200bar, P(range).....T(amb.).....

For Nameplate Parameter **PS< 200bar**, P(range),.....T(amb.).... are manufactured on the basis of Article 4, Clause 3 of Directive 2014/68/EU in accordance with the sound engineering practice

Restriction of hazardous substances (RoHS 2) 2011/65/EU
Compliant to RoHS. The folloing stabdard was applied: EN IEC 63000:201

Approvals

UK REGULATIONS

Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016
Output signal code 7 (see table 9)

INTRINSICALLY SAFE:

Certificate No.: **ExVeritas 22UKEX1416X**
EN IEC 60079-0, EN 60079-11, EN60079-26 , EN 50303

For Zone 0/1, 20 models

Enclosure code 5 SIL version (refer Table 1)
II 1/2G Ex ia IIC T4/T5 Ga/Gb

Enclosure code 4 SIL version (refer Table 1)
I M1 Ex ia I Ma
II 1/2G Ex ia IIC T4/T5 Ga/Gb

Enclosure code 7 (refer Table 1)
II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1D Ex ia IIIC T105°C Da

Enclosure code 8 (refer Table 1)
I M1 Ex ia I Ma
II 1/2G Ex ia IIC T4/T5 Ga/Gb
II 1D Ex ia IIIC T105°C Da

FLAME-PROOF:

Certificate No**.: 22UKEX1416X**
EN IEC 60079-0, EN 60079-1, EN 60079-11, EN 60079-26, EN 60079-31, EN50303

For Zone 0/1, 20/21 models

Enclosure code H (refer Table 1)
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db

Enclosure code R (refer Table 1)
I M2 Ex db ia I Mb
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db

For Zone 1, 21 models

Enclosure code 2 (refer Table 1)
II 2G Ex ia/db IIC T6/T5 Gb
II 2D Ex ia/tb IIIC T105°C Db

Enclosure code 3 (refer Table 1)
I M2 Ex db ia I Mb
II 2G Ex ia/db IIC T6/T5 Gb
II 2D Ex ia/tb IIIC T105°C Db

INTRINSICALLY SAFE & FLAMEPROOF (*):

(*) According to the selection on the label

Certificate No.: **22UKEX1416X**
EN IEC 60079-0, EN 60079-1, EN 60079-11, EN 60079-26, EN 60079-31, EN50303

For Zone 0/1, 20/21 or 0/1, 20 models

Enclosure code 2 (refer Table 1)
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db
or

II 1/2G Ex ia IIC T5/T4 Ga/Gb
II 1D Ex ia IIIC T105°C Da

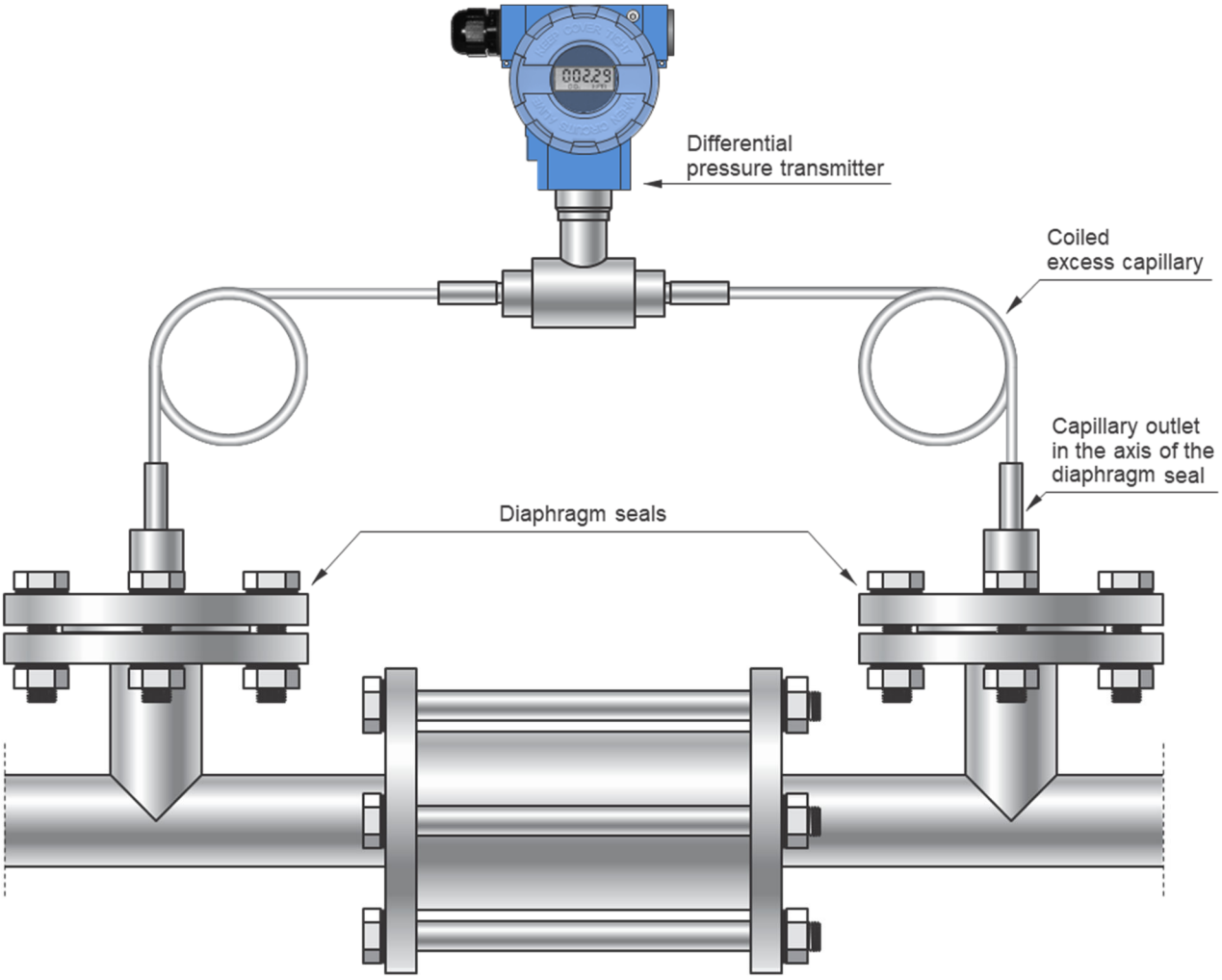
Enclosure code 3 (refer Table 1)
M2 Ex db ia I Mb
II 1/2G Ex ia/db IIC T6/T5 Ga/Gb
II 1/2D Ex ia/tb IIIC T105°C Da/Db
or

I M1 Ex ia I Ma
II 1/2G Ex ia IIC T5/T4 Ga/Gb
II 1D Ex ia IIIC T105°C Da

Examples

1. Example of a filter loss measurement

Transmitter with two remote diaphragm seals



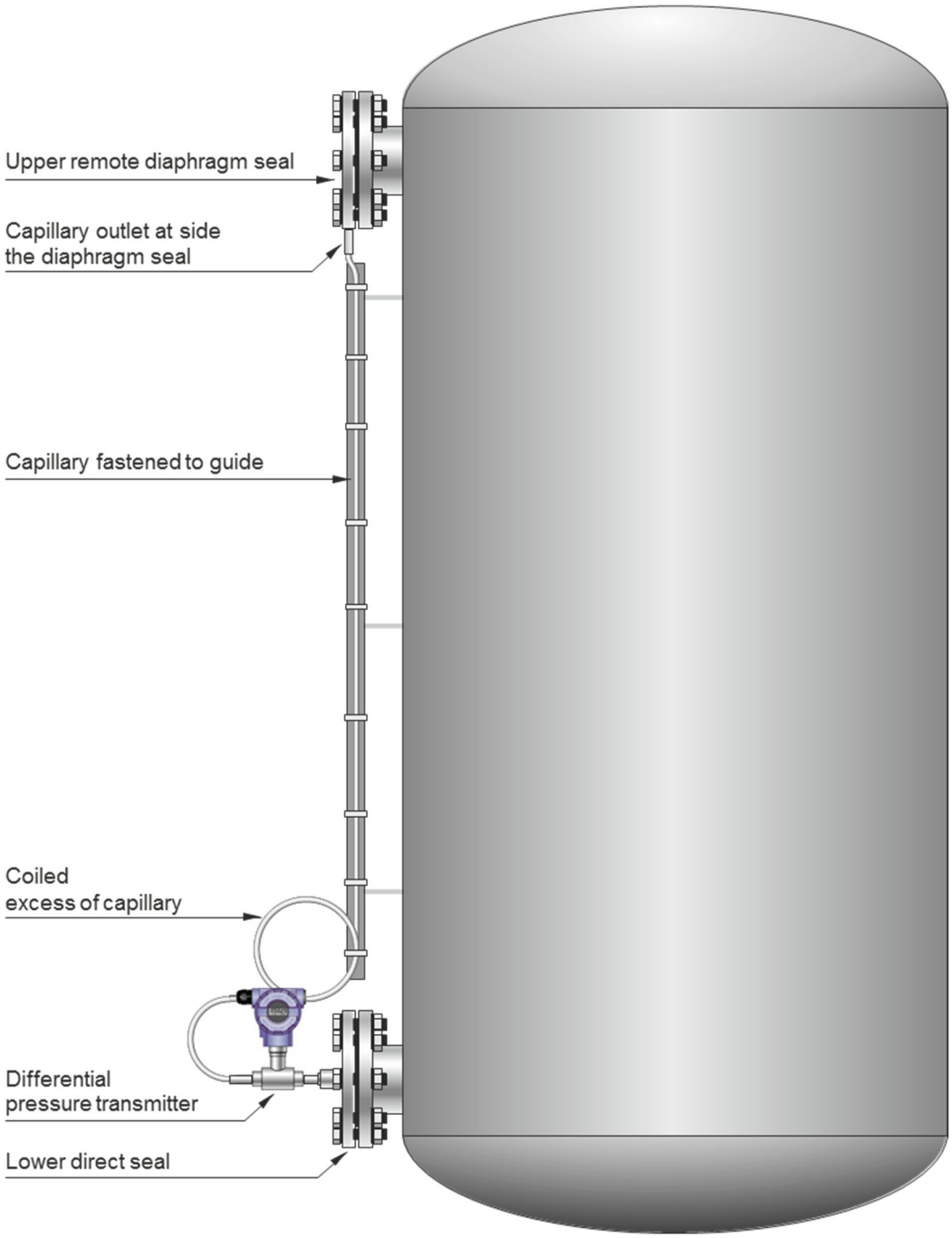
Recommendations

The version of the transmitter with two remote diaphragm seals is recommended for the measurement of pressure differences when the hydrostatic pressure of the manometric fluid in the capillaries (which depends on the vertical spacing of the seals) is significantly less than the measuring range of the transmitter.

The best metrological results are obtained when the applied capillaries are identical, as short as possible, and terminated with identical seals. At such a configuration additional temperatures errors, related to the remote sealing, affect both of the measurement chambers of the differential pressure transmitter in the same way, and thus cancel each other out.

2. Example of measurement of the level in a pressure tank

Transmitter with two types of diaphragm seal: one – direct diaphragm seal and the other – remote diaphragm seal



Recommendations

The transmitter with a direct diaphragm seal (connected to the positive measurement chamber) and a remote diaphragm seal (connected to the negative chamber) is recommended for hydrostatic measurements of: levels densities, phase boundaries and pressure differences (with differential height of pulse points*.)

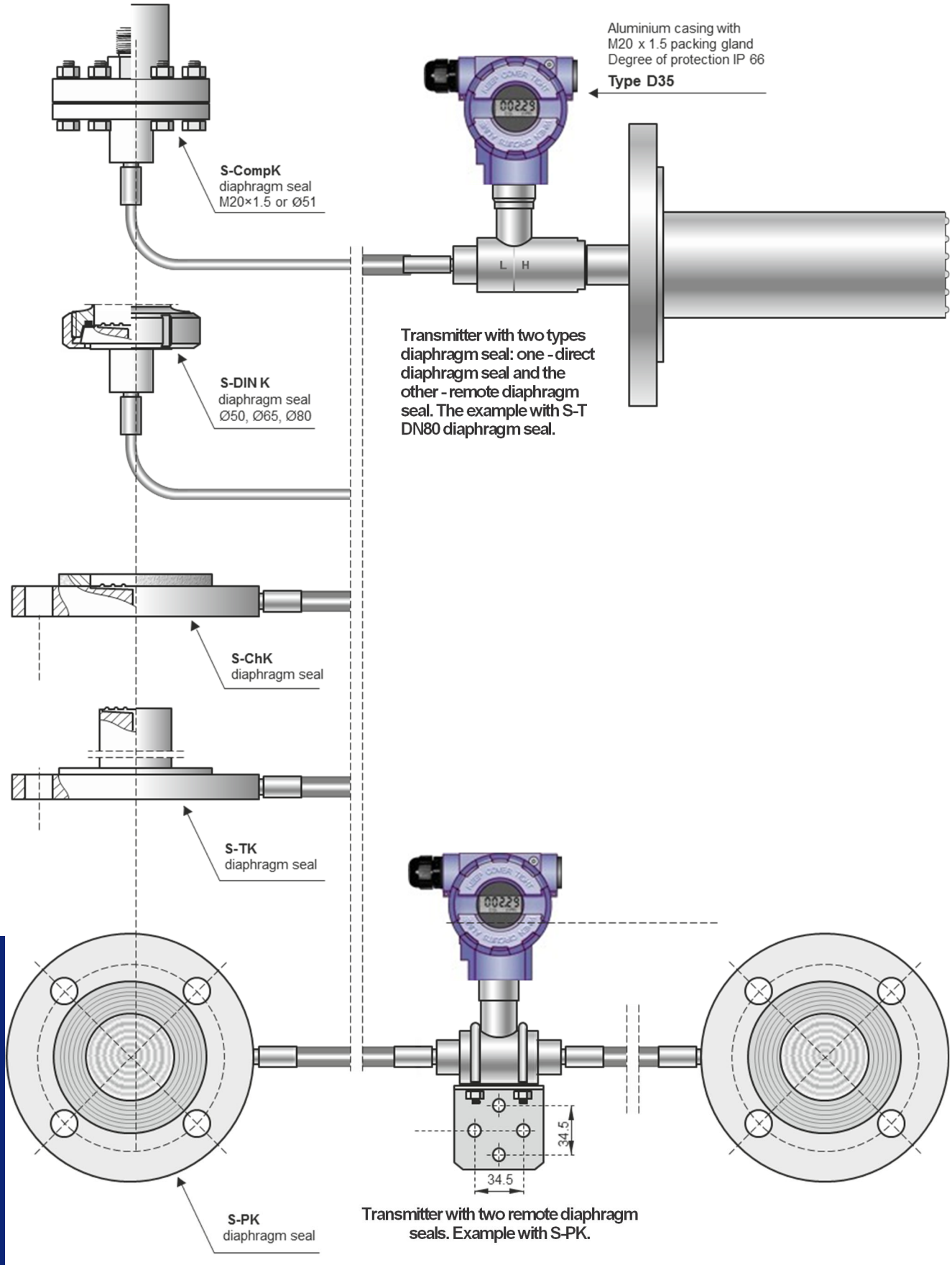
In such a configuration, at ambient temperature changes, two opposite phenomena appear concurrently.

Thermal expansion causes the change in the volume (and hence also the change in density) of the manometric fluid in the capillary, which results in a change of the hydrostatic pressure related to the vertical spacing of the seals.

This phenomenon in counteracted by the elastic reaction of the diaphragm of the upper diaphragm seal, which is displaced by the change in volume manometric fluid. Based on tests and experiments, the Delta-Mobrey Transmitters are provided with carefully selected seal diaphragms, which guarantee compensation of the errors resulted from the ambient temperature changes.

The best metrological results are obtained using assembly, which include DN 80, DN 100, A 109 and S-Comp diaphragm seals or S-Mazut, S-DIN and S-Clamp diaphragm seals with a diameter of at least 65mm, where the length of the capillary is (1...1.3) x (vertical spacing of seals). It is recommended using identical diaphragm seals at the both upper and lower connection points.

3. Example version



Transmitter with two types diaphragm seal: one - direct diaphragm seal and the other - remote diaphragm seal. The example with S-T DN80 diaphragm seal.

Transmitter with two remote diaphragm seals. Example with S-PK.

Note: The appropriate configuration of the complete set of pressure transmitter, diaphragm seals and capillaries, as well as the proper selection of manometric fluid depends on several factors such as: the physical and chemical properties; the temperature range of the medium; the vertical spacing of the diaphragm seals; the measuring range; the static pressure range; the range of ambient temperatures; the technical specification for the mechanical connection of the diaphragm seals to the pressure devices.

Direction for Use

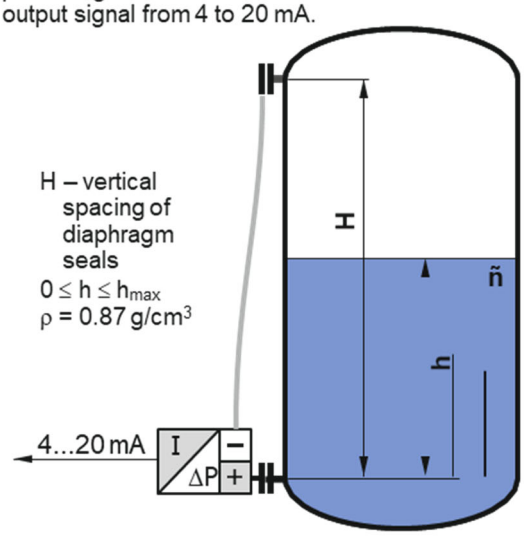
To simplify the mathematical operations, we introduce the density coefficient of the medium, Xρ.

$$X\rho = \frac{\rho_{medium}\,[g/cm]^3}{\rho_{water\ at\ 4\ ^\circ C}\,[g/cm^3]}$$

Since the density of water at 4°C is 1 g/cm^3, the **density coefficient Xρ is numerically equal to the density of the medium expressed in g/cm^3**. To determine the hydrostatic pressure of a column of liquid in mm H_2O, it is sufficient to multiply the height of the column h [mm] by the density coefficient of the liquid Xρ. Since it is easy to determine the hydrostatic pressure in mm H_2O and the transmitter can be configured in those units, in the descriptions of measurement methods given below we will make use of pressures expressed in mm H_2O and the density coefficient Xρ.

Configuration of the transmitter to measure the level of liquid in a tank

The measurement task:
To convert a variation in the level of a liquid with density ρ = 0.87 g/cm^3 between 0 and h_{max} to a variation in the output signal from 4 to 20 mA.



1. Install the transmitter in its working position on an empty tank.
2. Make the electrical connections of the transmitter, providing for the ability to use HART communication.
3. Connect the KAP-02 communicator, identify the transmitter and select the "configuration" function.
4. On the configuration menu select the "Reranging" procedure.
5. On the "Reranging" menu:
   a) change the units of measurement to mm H_2O at 4°C;
   b) enter the values for the start (Xρ × h_{min} [mm]) and end (Xρ × h_{max} [mm]) of the measurement range, namely 0 and (0.87 h_{max} [mm]) respectively;
   c) to compensate for the hydrostatic pressure of the manometric fluid, the start of the measurement range should be set using regulated pressure; when subject to the action of only the manometric fluid (empty tank) the transmitter will shift the start and end-points of the range, compensating for the value of that pressure.

When the transmitter has been configured in this way it is ready to be used to carry out the given measurement task.

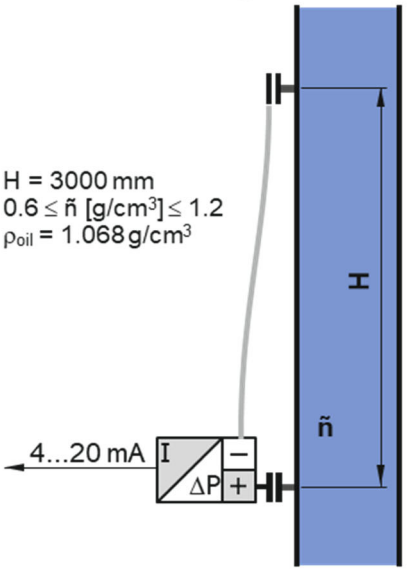
If it is not possible to empty the tank to configure the transmitter, the hydrostatic pressure of the manometric fluid should be calculated by multiplying the vertical spacing of the diaphragm seals by the density coefficient of the oil in the capillaries. This pressure should be taken into account when entering the values for the start and end of the range:

Start [mm H_2O] = –H [mm] × $X\rho_{oil}$

End [mm H_2O] =
= h_{max}[mm] × $X\,\rho_{measured\ liquid}$ – H [mm] × $X\rho_{oil}$

ρ_{oil} for DC-550 oil is equal to 1.068 g/cm^3
ρ_{oil} for AK-20 oil is equal to 0.945 g/cm^3

Configuration of the transmitter to measure density of liquids



The measurement task:
To convert a variation in liquid density from ρ_{min} = 0.6 g/cm^3 to $ñ_{max}$ = 1.2 g /cm^3 to a variation in the output signal from 4 to 20 mA, with the vertical spacing of the diaphragm seals equal to H = 3000 mm. The sealing system is filled with DC-550 oil with density ρ_{oil} = 1.068 g/cm^3.

1. Calculate the value o f the start of the range as follows:
   $H_{[mm]} \times (X\rho_{min} - X\rho_{oil}) =$
   = 3000 × (0.6 – 1.068) = –1404 [mm H_2O]
2. Calculate the value of the end of the range as follows:
   $H_{[mm]} \times (X\rho_{max} - X\rho_{oil}) =$
   = 3000 × (1.2 – 1.068) = 396 [mm H_2O]
3. Set the zero point of the transmitter with the diaphragm seals positioned at the same level.
4. Install the transmitter in its working position.
5. Make the electrical connections to the transmitter, providing for the possibility of using HART communication.

6. Connect the KAP-03 communicator, identify the transmitter and select the “configuration” function.

7. On the configuration menu select “Reranging” proce dure.

8. On the “Reranging” menu:

A) change the measurement units to mm H_2O at 4°C;

B) enter the calculated values for the start (–1404) and end (396) of the range.

When the transmitter has been configured in this way it is ready to be used to carry out the given measurement task.

Note: If it is possible to fill the space between the seals with a liquid whose density corresponds to the start of the measurement range, the start of the range of the transmitter can be set using regulated pressure.

Measurement of phase boundary

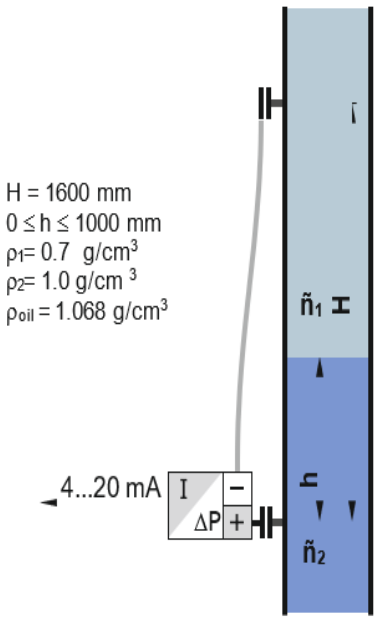
The height of the phase boundary of liquids of different densities is determined by measuring the average dens i- ty of the medium between the seals.

Example:

Calculate the measurement range start and end points for an D35 transmitter configured to measure phase boundary height in the range 0 –1000 mm between

liquids of density ρ 1 = 0.7 g/cm 3 and ρ 2 = 1.0 g/cm 3,

where the vertical spacing of the seals **H** = 1600 mm.
The sealing system uses DC -550 oil with a density of 1.068 g/cm3.



To determine the start of the measurement range, calculate the pressure difference at the transmitter when the tank is filled with the lighter liquid only:
1600 [mm] × (0.7 – 1.068) = –588.8 [mm H2O]

To determine the end-point of the range, add the increase in pressure resulting from the appearance of a 1 metre column of the heavier liquid:
–588.8 [mm H2O] + (1.0 – 0.7) × 1000 [mm] = –288.8 [mm H2O]

Additional remarks

The settings of the transmitter can be adjusted with reference to laboratory results from density measurements carried out on samples of the liquid being measured. This is most often necessary when the measurement takes place in a pipeline segment where the flow velocity of the measured liquid reaches several m/s.

Increasing the vertical spacing of the diaphragm seals widens the range and often improves measurement accuracy.

In planning the spacing of the diaphragm seals, ensure that the pressure difference at the transmitter lies within the basic range.

The maximum vertical spacing of the diaphragm seals

(H) depends on the transmitter’s basic range and the boundary values for the density of the measured liquid (ρ min; ρ max).

If ρ min < ρ oil < ρ max, the seal spacing H should satisfy the following conditions:

H [mm] Λ lower boundary of range [mm H2O]
Xρ min - Xρ oil

H [mm] Λ Upper boundary of range [mm H2O]
Xρ max- Xρ oil

Example:

Determine the maximum vertical spacing of the seals for the D35 / -10...10 kPa transmitter when measuring the density of liquid between 0.6 and 1.2 g/cm 3. The sealing system uses AK -20 silicone oil with a density of 0.945 g/cm3.

ρ The lower boundary of the range of the transmitter is **– 10 kPa = –1020 mm H2O**

H [mm] Λ $\frac{-1020}{0.6 - 0.945}$? **H [mm] Λ $\frac{-1020}{-0.345}$?**

H [mm] Λ 2957

ρ The upper boundary of the range of the transmitter is **+10 kPa = 1020 mm H2O**

H [mm] Λ $\frac{1020}{1.2 - 0.945}$? **H [mm] Λ $\frac{1020}{0.255}$?**

H [mm] Λ 4000

In the example, both conditions are satisfied when the spacing of the seals is not more than 2957 mm.

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