Technical Specification, Installation and Calibration

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1. Instructions

The Hydraulic Pressure Seal **SATRON HPS** is used in pressure measurement applications where the process medium is aggressive and it is necessary to protect the wetted parts of measuring transmitters. Processes' hygienic requirements may also necessitate the use of the pressure seal.
In addition, the pressure seal has to be used when the process temperature exceeds the transmitter's specifications.

The hydraulic pressure seal helps to solve many installation problems caused, for instance, by high temperatures, sedimentation and crystallization. Toxicity of the process medium or some other effect that can be harmful to the environment may also require the isolation of the process from its surroundings. DN50, DN80 and ANSI3 hydraulic pressure seals are suitable for pressure measure-ments in open and closed vessels.
Make sure that there are good reasons for using a pressure seal. The best way to connect pressure measurement to process is impulse piping.
We recommend applying the following general instructions:
- protect capillary tubes and flanges (see Protecting the equipment and Temperature effect)
- use the same size of seal flanges for both (+) and (-) flanges
- use the same lengths of capillary tubes for differential pressure measurements
- check the zero point after installation

By observing these instructions you can avoid many factors of inaccuracy caused by the seal principle; a liquid in sealed state undergoes volume and viscosity changes when its temperature changes.

Choosing the suitable equipment
The factors to be considered when choosing the measuring device and hydraulic pressure seal include volumetric displacements, negative pressure limitations and temperature effect.
The volumetric displacement capacity of the hydraulic pressure seal must be sufficient. The magnitude of volumetric displacements can be calculated by summing the measuring device's volumetric displacement with that caused by thermal expansion of the fill fluid. The result must not exceed the hydraulic pressure seal's volumetric displacement capacity. More information can be found in the technical specifications of measuring devices and hydraulic pressure seals.

Connecting the measuring device to the hydraulic pressure seal
Pressure gauge or limit switch is connected to the hydraulic pressure seal with an adapter base or capillary tube. When using an adapter connection, the temperature of the process medium must not exceed 60°C.
Differential pressure transmitter is always connected through capillary tube.
The connection between hydraulic pressure seal and measuring device must be made with correct methods. When deciding on the connection method you should take into account the fact that gaseous media and moisture normally absorbed in the fill fluid will exit the fluid. It is recommendable to have the hydraulic pressure seals filled and connected by SATRON INSTRUMENTS INC.

Protecting the equipment
Hydraulic pressure seals, capillary tubes and measuring device should be protected against low temperatures and temperature variations. Low ambient temperatures will cause a lag in the measurement, while temperature variations will change the zero setting.
Capillary tubes can be protected with thermal insulation. Electric resistance elements or steam heating can also be used as protective methods.

Temperature effect on measuring speed and accuracy
Stiffening and thermal expansion of the fill fluid limit the permissible ambient temperature range. The properties of fill fluids determine the ambient temperatures that suit the hydraulic pressure seal connection.
Temperature effect is defined as combined zero and span effect. 95% of total effect consist of zero effect and the remaining 5 % of span effect.

$T_{proc.}$ °C	Minimum pressure for different fill fluids (kPa, abs.)	
	DC200 100 cSt	Inert oil
20	5	8
40	8	10
80	10	28
120	15	53
160	25	90
200	40	-

Recommended minimum process pressure for vacum applications

2. Technical specifications

Process connection
• ANSI 14" (ANSI B16-5)

Process pressure
• 1 MPa (10bar)

Measurement ranges
Above 25 mbar span, depending on the measuring diaphragm's size and the process pressure.

Materials
HPS body: Wnr. 1.4404 (AISI 316L)

Capillary tube
• Capillary: AISI 316
• Casing: AISI 316
Length selectable between 2 and 20 m.
Recommendation: As short as possible.
The capillary's minimum permissible bending radius is 51 mm.

We recommend capillaries of equal length for differential pressure measurements in varying temperature conditions.

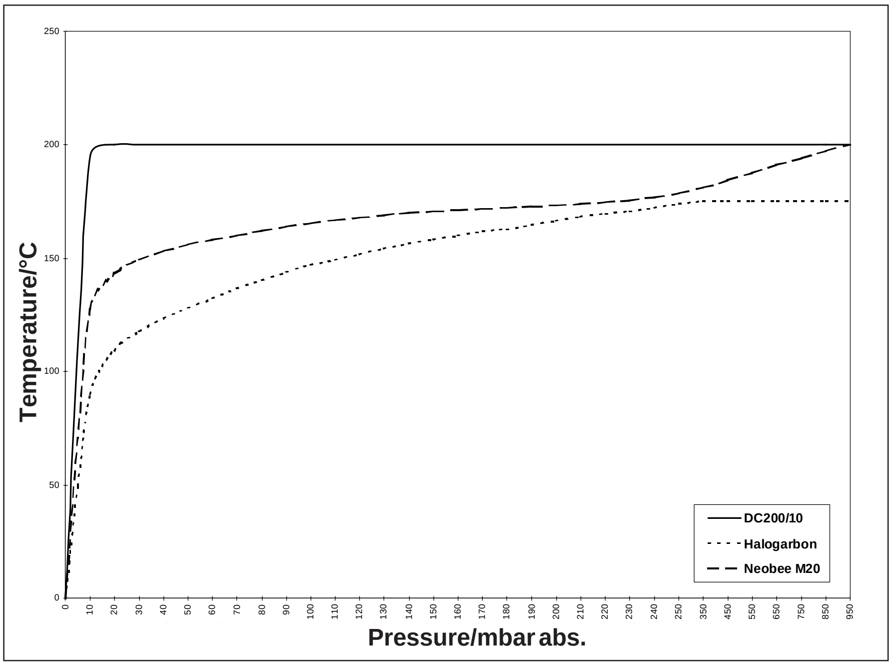
Diaphragm materials
Wnr. 1.4404 (AISI 316L), Duplex (Wnr. 1.4462)

Fill fluids
Silicone oil DC200
• for process and food industry applications
Neobee M20
• for food industry applications
Inert oil (e.g. Fomblin Y04 or Halocarbon)
• for oxygen and chlorine applications
Silicone oil DC705
• for high-temperature and vacuum measurement applications

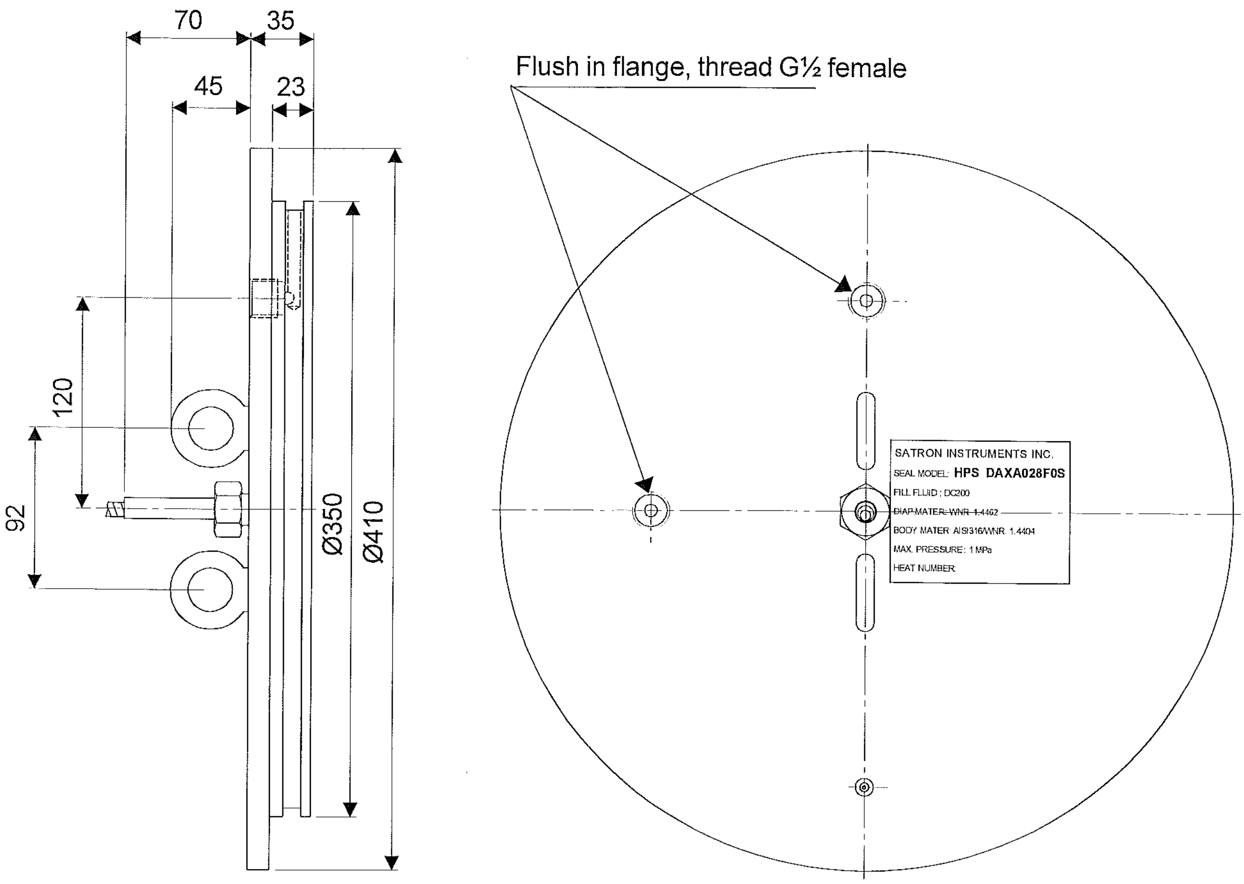
Fill fluid properties

Fill fluid	**Temperature range/**°C	**Density** g/cm^3	**Thermal expansion coefficient/** 1/°C	**Viscosity** (25°C) cSt(mm^2/s)
DC200 Silicone oil	-40...200	0.934	0.00108	9.5
DC705 Silicone oil	20...380	1.090	0.00080	175
Inert oil	-45...175	1.850	0.000864	6.5
Neobee M20	-17...200	0.917	0.001008	9.8

Fill fluid steam pressure curves (specified by manufacturers)



2.1 Dimensions (mm)



2.2 Selection table : Flanged Seal

HPS ☐☐☐☐☐☐☐☐☐☐ –

Process connection type

D Pancake

Process connection standad

A ANSI/ASME B16.5 (American National Standards Institute)

Process connection size

X 410 mm (14")

Maximum working pressure

A 1 MPa (10 bar)

Extension length

0 No extension (std.)

Flange material

2 Wnr. 1.4404 (AISI316L) (std.)
8 Duplex (Wnr. 1.4462)

Diaphragm material

2 Wnr. 1.4404 (AISI316L)
8 Duplex, Wnr. 1.4462 (std.)

Diaphragm thickness

E 0.05 mm
F 0.10 mm (std.)

Diaphragm coating

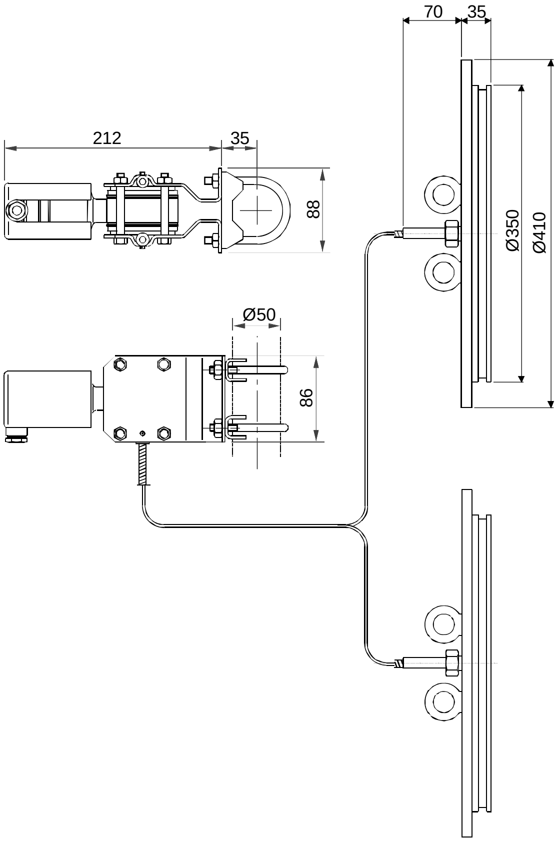
0 Ei pinnoitusta
Y Diamond

Fill fluid

S Silicone oil DC200 (std.)
A Neobee M20, oil for food industry
G Inert oil
D Silicone oli DC705

2.3 Hydraulic Pressure Seal Connections

Capillary connection



Same seal on both High and Low pressure sides of Differential Pressure Transmitter, code **L**

2.4 Selection table connections

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Capillary connection type

L Same seal on both High and Low pressure side of Differential Transmitter

Capillary length (m)

2...20

Mounting stand for transmitter

2 Mounting stand with clamp 51 mm (2")

Documentation

IE English
IF Finnish

Material certificate

0 No material certificate
MC1 SFS-EN 10204-2.1 (DIN50049-2.1)
MC2 SFS-EN 10204-2.2 (DIN50049-2.2)
MC3 SFS-EN 10204-3.1B (DIN50049-3.1B)

Specification example:
SATRON HPS DAXA028F0S-L22IEMC3

- Process connection type, pancake
- Size ANSI 14"
- Maximum working pressure 1 MPa (10 bar)
- No extension
- Material of body : Wnr. 1.4404 (AISI316L)
- Diaphragm material : Duplex, Wnr. 1.4462
- Diaphragm thickness : 0.10mm
- No diaphragm coating
- Fill fluid silicone oil
- Capillary type connection :
    - Seal on high pressure side of Pressure Transmitter
    - Capillary length 2m
    - Mounting stand with clamp 51 mm (2")
    - Documentation English
    - Material certification EN 10204-3.1B

3. Installation

3.1 Seals handling and installation considerations

Additional specialized hydraulic pressure seal are available. Contact Satron Instrument Inc. for installation information on these seals.

When unpacking or handling a transmitter / seal system, do not lift the seal or transmitter by gripping the capillaries.

Avoid sharply bending or crimping the capillary tubing. The minimum bending radius of the capillary tubing is two inches (51 mm), figure 3-1.

NOTE
Never attempt to disconnect the seals or capillaries from the transmitter. Doing so will result is loss of fill fluid and will void the product warranty.

The material of a hydraulic pressure seal is designed to withstand pressure and wear from process material, but outside of process connection conditions, hydraulic pressure seals are relatively delicate and should be handled with care.

The protective cover should remain on the seal until the moment before installation. Try to avoid touching the diaphragm with finger or object and refrain from setting the diaphragm side of the seal down on a hard surface. Even minor dents or scratches in the diaphragm material may impair the performance of the transmitter/ seal system.

When installing hydraulic pressure seal systems which employ a gasket, make sure the gasket is aligned properly on the gasket sealing surface.

Most importantly, make sure the gasket does not press down upon the diaphragm face. Anything pressing on the diaphragm will be read by the transmitter as pressure. A misaligned gasket may cause a false reading.

3.2 Marking

Each hydraulic pressure seal is marked, samle is shown below.

SATRON INSTRUMENTS INC.
SEAL MODEL: **HPS DAXA028F0S**
FILL FLUID : DC200
DIAP.MATER: WNR. 1.4462
BODY MATER: AISI316/WNR. 1.4404
MAX. PRESSURE : 1 MPa
HEAT NUMBER:

3.3 Bolt torquing

When connecting the process and support flange, the bolt should be torqued to the applicable flange requirements. Required torque is a function of the gasket material and surface treatment of the bolts and nuts which are customer supplied, figure 3-2.

3.4 Gasket installation

When connecting the hydraulic pressure seal and gasket, make sure the gasket is properly aligned on the gasket sealing surface, figure 3-2.

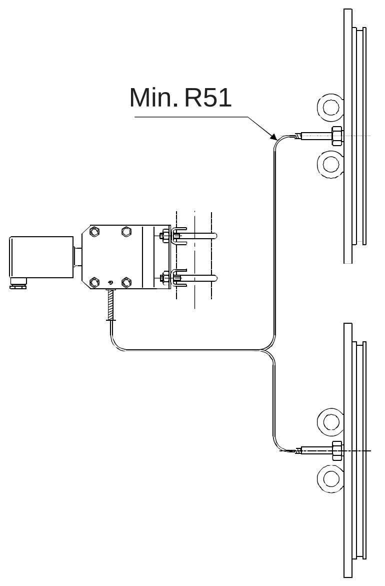

Figure 3-1: Transmitter with two seal

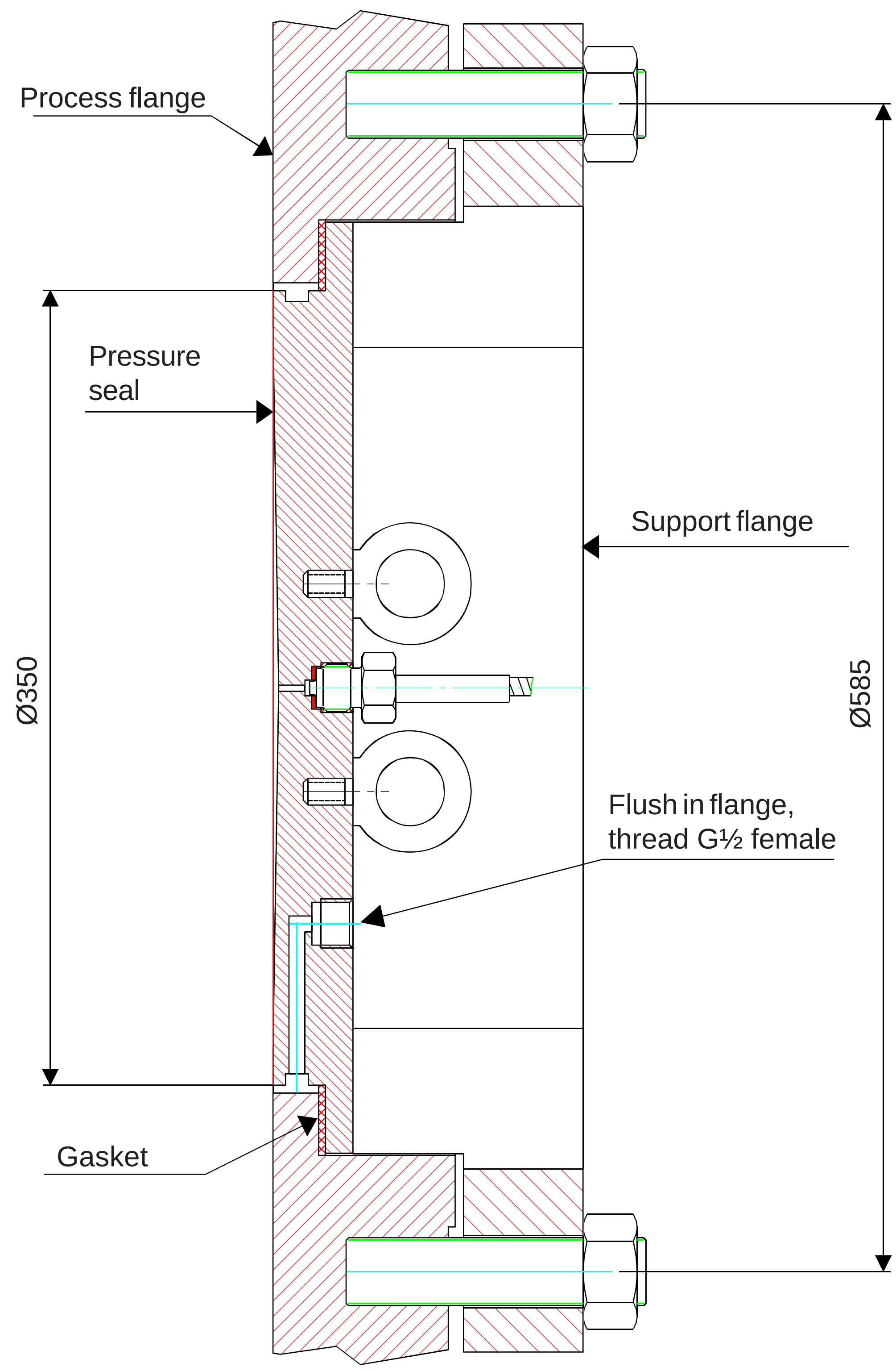

Figure 3-2: Mounted between two flanges

4. Calibration

Factory-filled hydraulic pressure seal assemblies are adjusted for the values specified by the customer. During the adjustment procedure the pressure seals and transmitters are at equal height. The calibration temperature is 20°C.

When defining the calibration values you must take into account the difference in height between seal flanges and transmitter, because the hydrostatic pressure of the fill fluid affects the zero adjustment. Zero suppression and elevation can be determined as shown in examples 1 and 2.

The temperatures of capillary tubes, transmitter and pressure seal flanges affect the zero. The coefficients given in the technical specifications can be utilized when defining the calibration values for a specific temperature distribution.

The total effect of seal flange locations and temperature distribution on zero suppression can be determined by summing the partial effects . The signs must be taken into account in the calculations.

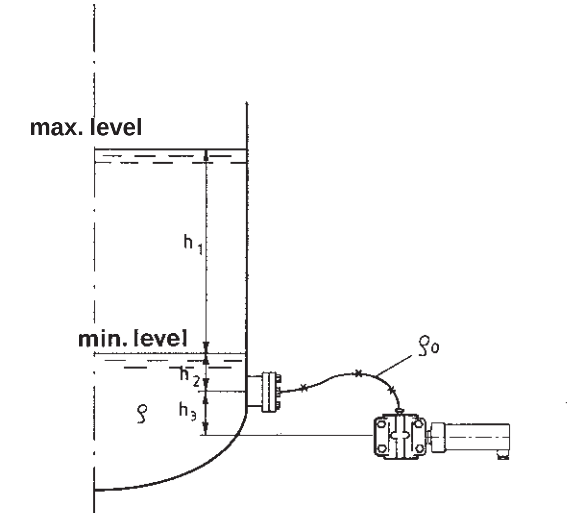

Figure 4-1: Level measurement in open vessel

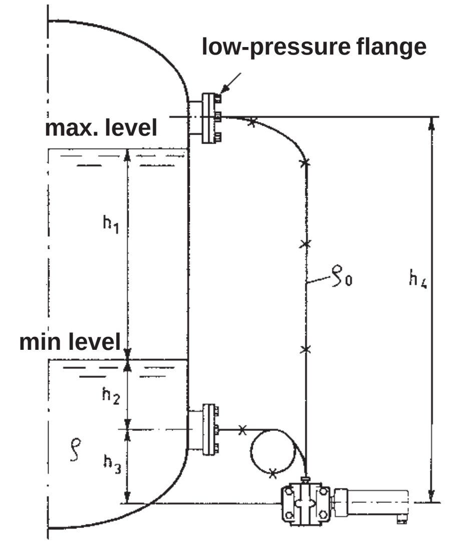

Figure 4-2: Level measurement in closed vessel

Example 1: Open vessel (Fig. 4-1)

Span p_1, is as follows:

$\mathbf{P_1} = h_1 \boldsymbol{\rho}\, \mathbf{g}$

$= 3.50 \text{ m} \times 980 \text{ kg/m}^3 \times 9.81 \text{ m/s}^2 = 33.6 \text{ kPa}$

Zero suppression p_2 is as follows:

$\mathbf{P_2} = (h_2\boldsymbol{\rho} + h_3\boldsymbol{\rho}_O) \times g$

$= (1.00 \text{ m} \times 980 \text{ kg/m}^3 + 0.90 \text{ m} \times 960 \text{ kg/m}^3 \times 9.81 \text{ m/s}^2$

$= 18.\ 1 \text{ kPa}$

Example 2: Closed vessel (Fig. 4-2)

Span p_1, is as follows:

$\mathbf{P_1} = h_1 \rho\, g$

$= 3.50 \text{ m} \times 980 \text{ kg/m}^3 \times 9.81 \text{ m/s}^2 = 33.6 \text{ kPa}$

Zero elevation (suppression) p_2 is as follows:

$\mathbf{P_2} = (h_3\text{-}h_4)\ \boldsymbol{\rho_O}\mathbf{g} + \mathbf{h_2\rho g} =$
$(0.90\text{-}6.00)\text{m} \times 960 \text{ kg/m}^3 \times 9.81 \text{ m/s}^2 + 1.00 \text{ m} \times 980 \text{ kg/m}^3 \times 9.81 \text{ m/s}^2$

$\mathbf{P_2}$ = -38.4 kPa (negative result = elevated-zero range)

h_1 = difference in height between maximum and minimum level (3.50 m)
h_2 = height of minimum level from (+) - flange (1.00 m)
h_3 = difference in height between (+)- flange and transmitter (0.90m)
h_4 = difference in height between (-)-flange and transmitter (6.00 m)
ρ = density of measured fluid (980 kg/m^3)
ρ_O = density of fill fluid (960 kg/m^3)
g = acceleration of gravity (9.81 m/s^2)

NOTE: If transmitter is higher than the (+)-flange, the difference h_3 will have a negative value.