E-PHTM

Water Skid Manual

Pressure System for Testing GRP Pipes

TOPFIBRA

EFFECTIVE FILAMENT WINDING® PIONEERS

E-PHTM

WATER SKID MANUAL
PRESSURE SYSTEM FOR TESTING GRP PIPES

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1. INTRODUCTION

This as-built project is based on project for execution and previously on conceptual design.

The basic function of this system is pressure testing of GRP pipes in a GRP pipe production facility.

Pressure testing procedures of different diameters and lengths of pipes should be automated and on an elevated level of autonomy. Because of previously addressed requirements, essential equipment for pressure reading and flow indication is used. In accordance with the user's specifications regarding filling times and function, the equipment is chosen to satisfy these needs.

Because of the stationary location of the filling system and the dynamical location of filling pipes (moving part of testing rig TOPFIBRA), special design and pressure rating are taken into consideration.

2. PRESSURE CONDITIONS

Currently, the equipment is working with the following pressure conditions:

- Low pressure: 0-1,2 bar;
- Medium pressure: 2 – 9 bar;
- High pressure: 9 – 64 bar.

Calculations of pipe thickness can be found on P&ID and calculations attached to this document, see Item 5. ATTACHMENTS.

2.1. Materials used in execution

Pipe materials used for pressure pipes on this equipment are as follows (Figure 1):

			Design pressure [bar]	Design temperature [°C]	Design pressure [kPa]	Diameter [mm]	Design factor	Yeild strength [kPa]	Longitudinal factor	Thickness of pipe [mm]	Corrosion factor [mm]	Total thickness	Podatki za pripravo preliminarne ponudbe - Simon d.o.o.	
°N	Line number	Type of Steel	bar	t	P	D	F	S	E	t2	f1	mm	Chosen dimension	kg/m
1	MAW 301-250-P235GH-PN10	P235GH	10	24	1000	273	0,72	237600	1	0,79791	1	1,80	273x6,3	33,00
2	MAW 301-80-P235GH-PN10	P235GH	10	24	1000	88,9	0,72	237600	1	0,259832	1	1,26	88,9x3,2	
3	HPW 460-80-P235GH-PN10	P235GH	10	24	1000	88,9	0,72	237600	1	0,259832	1	1,26	88,9x3,2	6,76
4	HPW 456-25-P235GH-PN10	P235GH	100	24	10000	33,7	0,72	237600	1	0,984965	1	1,98	33,7x4,0	2,93
5	HPW 450-80-P235GH-PN100	P235GH	70	24	7000	88,9	0,72	237600	1	1,818825	1	2,82	88,9x5,0	10,3
6	HPW 430-25-P235GH-PN100	P235GH	100	24	10000	33,7	0,72	237600	1	0,984965	1	1,98	33,7x3,2	
7	MAW 420-32-P235GH-PN16	P235GH	6	24	600	42,4	0,72	237600	1	0,074355	1	1,07	42,4x2,9	2,82
8	MAW 420-50-P235GH-PN10	P235GH	6	24	600	60,3	0,72	237600	1	0,105745	1	1,11	60,3x2,9	4,11
9	MAW 401-250-P235GH-PN10	P235GH	10	24	1000	273	0,72	237600	1	0,79791	1	1,80	273x6,3	33
10	LPW 410-200-P235GH-PN16	P235GH	16	24	1600	219,1	0,72	237600	1	1,024598	1	2,02	219,1x6,3	23,8
11	DPW 490-250-P235GH-PN10	P235GH	10	24	1000	273	0,72	237600	1	0,79791	1	1,80	273x6,3	33
12	MPW 420-200-P235GH-PN10	P235GH	16	24	1600	219,1	0,72	237600	1	1,024598	1	2,02	219,1x6,3	23,8
13	MPW 440-250-P235GH-PN16	P235GH	16	24	1600	273	0,72	237600	1	1,276655	1	2,28	273x6,3	33
14	MPW 440-200-P235GH-PN16	P235GH	10	24	1000	219,1	0,72	237600	1	0,640374	1	1,64	219,1x6,3	
15	MAW 201-32-P235GH-PN10	P235GH	10	24	1000	42,4	0,72	237600	1	0,123924	1	1,12	42,4x2,6	2,82
16	MAW 425-32-P235GH-PN10	P235GH	10	24	1000	42,4	0,72	237600	1	0,123924	1	1,12	42,4x2,9	2,82
17	DPW 471-200-P235GH-PN10	P235GH	10	24	1000	219,1	0,72	237600	1	0,640374	1	1,64	219,1x6,3	23,8
18	DPW 110-25-P235GH-PN16	P235GH	16	24	1600	33,7	0,72	237600	1	0,157594	1	1,16	33,7x2,6	1,99
19	MAW 401-65-P235GH-PN10	P235GH	10	24	1000	76,1	0,72	237600	1	0,222421	1	1,22	76,1x2,9	5,24
20	DPW 470-250-P235GH-PN10	P235GH	6	24	600	273	0,72	237600	1	0,478746	1	1,48	273,0x6,3	33
21	MAW 421-50-P235GH-PN10	P235GH	10	24	1000	60,3	0,72	237600	1	0,176242	1	1,18	60,3x2,9	
Material:														
Tensile strength for:		P235GH	360	Mpa										
Safety factor:		P235GH	0,66	-										

Figure 1

Pipe standard according to DIN2448/17175/EN10216-2 with 3.1B certification or similar.

Flanges according to EN ISO1092-1 – different types.

2.2. WORKING PRINCIPLE OF THE SYSTEM

A drain water pit is foreseen on site. The drain water pit is filled with the Municipality water system.

Filling water should have similar properties to drinking water, according to local legislation and norms.

Water is filled in the drain pit with a working volume of 120m^3. There are three levels of working heights of drain pit – B300: Heights and volumes are indicated in Figure 2:

Type of work	Volume [m^3]	Height: [m]	Abbreviation:
Maximum volume	120	3,4	-
Working volume	84	1,36	-
Minimal volume	35	0,56	-

Figure 2: Volumes and heights of B300 – Drain pit

In the drain pit, a low-level switch for the protection of pumps is foreseen – LSLL300.10.

The water level should be maintained between working volume and height, and maximum volume and height.

Levels below the working level are not recommended because of the NPSH of the Low-pressure pump – this must be taken into consideration when putting the system into operation.

Suction lines of low and medium-pressure pipe are dimensioned accordingly to the required volume flow and NPSH.

The entire pumped volume is transferred via flexible pipe DN200 to the testing rig, air is drained through another flexible line – DN 80. Air is released into the drain pit and pipe. The pipe should not be immersed to water – due to air release.

While air is replaced with water pressure, the reading of gauge PT.430.31 should indicate 2 bar, while pump P410 is working.

The low-pressure pump fills the pumps up completely until the operator decides to proceed to the medium pump.

Medium and high-pressure pumps are adding pressure to the testing pipe. While the process of filling is underway, we are constantly receiving information from the pressure transmitter.

Working sequences are described below in the following chapters.

Water for the high-pressure pump is filtered with a basic filter and fed into a reservoir. The preliminary volume of the reservoir is 0.75m3.

The filling of water and level maintenance is determined by a valve with the floating ball. An overflow line is foreseen, to drain into the drain pit. Also predicted connections are the manhole, drain valve DN25, and supply valve DN32.

The high-pressure pump is equipped with a safety release valve. The high-pressure line is separated from the low and medium-pressure lines with valve–splitting of pressure zones.

After the pumping zone, flow switches assure that medium pressure is flowing in the pipes – safety and confirmation function.

The emptying phase of the testing rig is started after a successful confirmation and/or failed testing procedure. Pressure is first released through the high-pressure valve, and after draining pressure from the testing rig, the air supply valve opens.

After this low-pressure pump starts to empty the tested GRP pipe, the valves on the lines open accordingly.

After the majority of water is pumped from the testing rig, clamps on the testing rig are released. Part of the water, which is still inside the pipe, gets released into the draining pit. After confirmation of all signals and checks, the process of another test can be started again.

3. STARTUP PROCEDURE OF THE SYSTEM

Before start-up of the system, check that all the pipes and fittings are connected and tested to minimal work pressure.

Before startup, the system must be filled with water – air must be let out of the system.

Before the startup of the pumps (P410, P420, P430), they should be filled with water.

Before startup of pump P410, mount the self-greasing lube that is attached to the pump.

Before the startup of pump P420, the pipes must be filled with water.

Before startup of the pump P430, water must be filled to reservoir B200. Valves must be opened to ensure the water is fed to the pump.

The system should not be operated by authorized personnel.

When personnel is in the proximity of this area, they should always wear PPE.

Do not stay in the working area of the machine when the pumps are working.

Figure 3

Figure 4

3.1. Working sequences

Below, the working sequences for the openings of the valves and starting of the pumps are described. The basic logic of working is taken from the URS documentation received from the customer.

We will use our abbreviation of valves - therefore client can prescribe their internal abbreviation for easier processing of automation of the system.

Working sequences:

1. Filling cycle low pressure;
2. Filling cycle medium pressure;
3. Filling cycle high pressure;
4. Test hold time:
    a) Additional filling – As required by Test hold time;
5. Pressure release;
6. Fast emptying.

3.1.1.Filling cycle low pressure

Valve designation TOPFIBRA	Valve designation TOPFIBRA	1.Filling cycle Low pressure
LSLL.300.10		OPENED
KD.401.01	26A	OPENED
P410		RUNNING
KD.410.20	26C	OPENED
KD.410.30	26B	CLOSED
P420		STOP
KD.420.10		CLOSED
P430		STOP
PT.430.31		PRESSURE READING
KD.430.20		CLOSED
FS.430.50		NO FLOW
KD.440.10	51A	OPENED
FS.440.20		FLOW READING
KD.450.01		OPENED
KD.455.01		CLOSED
KD.470.01	27	CLOSED

Figure 5

3.1.2.Filling cycle medium pressure

Valve designation TOPFIBRA	Valve designation TOPFIBRA	Filling cycle Medium pressure
LSLL.300.10		OPENED
KD.401.01	26A	OPENED
P410		STOP
KD.410.20	26C	CLOSED
KD.410.30	26B	CLOSED
P420		RUNNING
KD.420.10		OPENED
P430		STOP
PT.430.31		PRESSURE READING
KD.430.20		CLOSED
FS.430.50		NO FLOW
KD.440.10	51A	OPENED
FS.440.20		FLOW READING
KD.450.01		CLOSED
KD.455.01		CLOSED
KD.470.01	27	CLOSED

Figure 6

3.1.3.Filling cycle high pressure

Valve designation KontrolKem LJ	Valve designation TOPFIBRA	Filling cycle High pressure
LSLL.300.10		Not Applicable
KD.401.01	26A	CLOSED
P410		STOP
KD.410.20	26C	CLOSED
KD.410.30	26B	CLOSED
P420		STOP
KD.420.10		CLOSED
P430		RUNNING
PT.430.31		PRESSURE READING
KD.430.20		OPENED
FS.430.50		FLOW READING
KD.440.10	51A	CLOSED
FS.440.20		NO FLOW
KD.450.01		CLOSED
KD.455.01		CLOSED
KD.470.01	27	CLOSED

Figure 7

3.1.4.Test hold time

Valve designation KontrolKem LJ	Valve designation TOPFIBRA	Test hold time
LSLL.300.10		Not Applicable
KD.401.01	26A	CLOSED
P410		STOP
KD.410.20	26C	CLOSED
KD.410.30	26B	CLOSED
P420		STOP
KD.420.10		CLOSED
P430		STOP
PT.430.31		PRESSURE READING
KD.430.20		CLOSED
FS.430.50		NO FLOW
KD.440.10	51A	CLOSED
FS.440.20		NO FLOW
KD.450.01		CLOSED
KD.455.01		CLOSED
KD.470.01	27	

Figure 8

3.1.5.Additional filling as required by test hold time

Valve designation KontrolKem LJ	Valve designation TOPFIBRA	Additional filling As required by test hold time
LSLL.300.10		Not Applicable
KD.401.01	26A	CLOSED
P410		STOP
KD.410.20	26C	CLOSED
KD.410.30	26B	CLOSED
P420		STOP
KD.420.10		CLOSED
P430		RUNNING
PT.430.31		PRESSURE READING
KD.430.20		OPENED
FS.430.50		FLOW READING
KD.440.10	51A	CLOSED
FS.440.20		NO FLOW
KD.450.01		CLOSED
KD.455.01		CLOSED
KD.470.01	27	

Figure 9

3.1.6.Pressure release

Valve designation KontrolKem LJ	Valve designation TOPFIBRA	Pressure release
LSLL.300.10		Not Applicable
KD.401.01	26A	CLOSED
P410		STOP
KD.410.20	26C	CLOSED
KD.410.30	26B	CLOSED
P420		STOP
KD.420.10		CLOSED
P430		STOP
PT.430.31		PRESSURE READING
KD.430.20		CLOSED
FS.430.50		NO FLOW
KD.440.10	51A	CLOSED
FS.440.20		NO FLOW
KD.450.01		CLOSED
KD.455.01		OPENED
KD.470.01	27	

Figure 10

3.1.7. Fast emptying

Valve designation KontrolKem LJ	Valve designation TOPFIBRA	Fast emptying
LSLL.300.10		Not Applicable
KD.401.01	26A	CLOSED
P410		RUNNING
KD.410.20	26C	CLOSED
KD.410.30	26B	OPENED
P420		STOP
KD.420.10		CLOSED
P430		STOP
PT.430.31		PRESSURE READING
KD.430.20		CLOSED
FS.430.50		NO FLOW
KD.440.10	51A	OPENED
FS.440.20		FLOW READING
KD.450.01		OPENED
KD.455.01		CLOSED
KD.470.01	27	

Figure 11

4. CALCULATIONS

4.1. NPSH PUMP P410

4.1.1. Filling of pipe from drain pit – Sequence 1 – filling low pressure pump

Input data as follows in Figure 12 below:

TOPFIBRA PRESSURE TESTING SYSTEM CALCULATIONS OF PRESSURE DROPS - Project for execution

		1	2	3	4	5	6	7
⊟ 1. Flow medium								
Flow medium		Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	
Condition		liquid	liquid	liquid	liquid	liquid	liquid	
Volume flow	m3/h	380,000	380,000	380,000	380,000	380,000	380,000	
Mass flow	kg/h	379318,280	379318,280	379318,280	379318,280	379318,280	379318,280	
Volume flow branch.pipe	m3/h							
Density	kg/m3	998,206	998,206	998,206	998,206	998,206	998,206	
Dyn.Viscos.	10-6 kg/ms	1001,605	1001,605	1001,605	1001,605	1001,605	1001,605	
Kin.Viskosität	10-6 m2/s	1,003	1,003	1,003	1,003	1,003	1,003	
⊟ 2. Additional data for gases								
Pressure (inlet, abs.)	bar							
Temperature (inlet)	°C							
Temperature (outlet)	°C							
Norm volume flow	Nm3/h							
⊟ 3. Element of pipe								
Pipe identification		Inlet Swing valve		Inlet Pipe, DN250	Inlet pipe elbows	Valve before the pump	Vertical diference between suction inlet and height of pump	
Element of pipe		Check valve swing	Gradual contraction	circular	Circular bend	Gate valve	Vertical difference	
Number		1	1	1	2	1	1	
Dimensions of element	SI	Diameter of pipe D in mm: 300,000	Diameter of pipe D1 in mm: 300,00(	Diameter of pipe D in mm: 250,000	Diameter of pipe D in mm: 250,000	Diameter of pipe D in mm: 250,000	Vertical difference H in m: 2,000	
			Diameter of pipe D2 in mm: 250,00(	Length of pipe L in m: 2,300	Radius R in mm: 500,000	Height H in mm: 220,000		
			Angle w in degree: 10,000		Angle w in degree: 90,000			
⊟ 4. Result of calculation								
Veloc.of flow	m/s	1,493	1,493	2,150	2,150	2,150		
Reynolds number		4,465E+05	4,465E+05	5,358E+05	5,358E+05	5,358E+05		
Veloc.of flow2	m/s		2,150					
Reynolds number 2			5,358E+05					
Flow		turbulent	turbulent	turbulent	turbulent	turbulent	turbulent	
Absolute roughness	mm		1,000	1,000	1,000			
Pipe friction number			0,027	0,029	0,029			
Resistance coefficient		1,630	0,049	0,263	0,387	0,789		
Resistance coefficient branc								
Press. drop branch.pipe	Pa							
Pressure drop	Pa	1814,559	55,087	607,010	1786,479	1821,581	19584,802	
Pressure drop	m H2O	0,185	0,006	0,062	0,182	0,186	1,997	
Sum Pressure drop	m H2O	0,185	0,191	0,253	0,435	0,620	2,618	

Figure 12

Cumulative pressure drop on inlet side: 2,618 m.

Control for pump P410:

Type of pump	NPSH @380m³/h	Pump is suitable:
Victor S201 Self suction:	3,0m	YES
Johnson Combi bloc 200-160 CL/CI with impeller no2	3,8 m	YES

Figure 13

4.1.1.1. Pump curve Victor S201

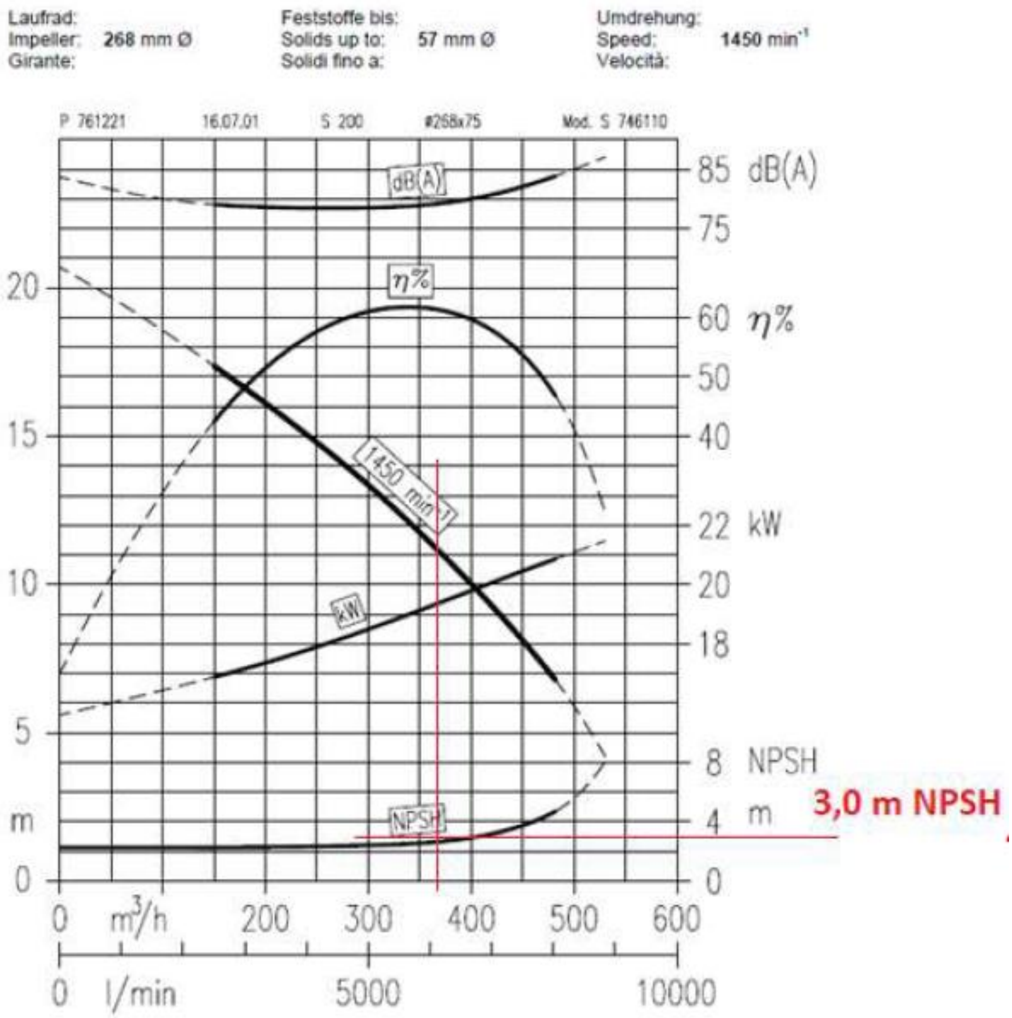


Figure 14

4.1.1.2. Pump curve CombiBloc 200-160 CL/CI

Johnson Pump

CombiBloc 200-160 CL / CI

	1	2	3	4	
impeller ø	205	189		175	mm
speed	1780	1780		1780	rpm
kin. viscosity	1.00	1.00		1.00	mm²/s (cSt)
dyn. viscosity	1.00	1.00		1.00	mPa s (cP)
density	1000.0	1000.0		1000.0	kg/m³
orifice ø					mm

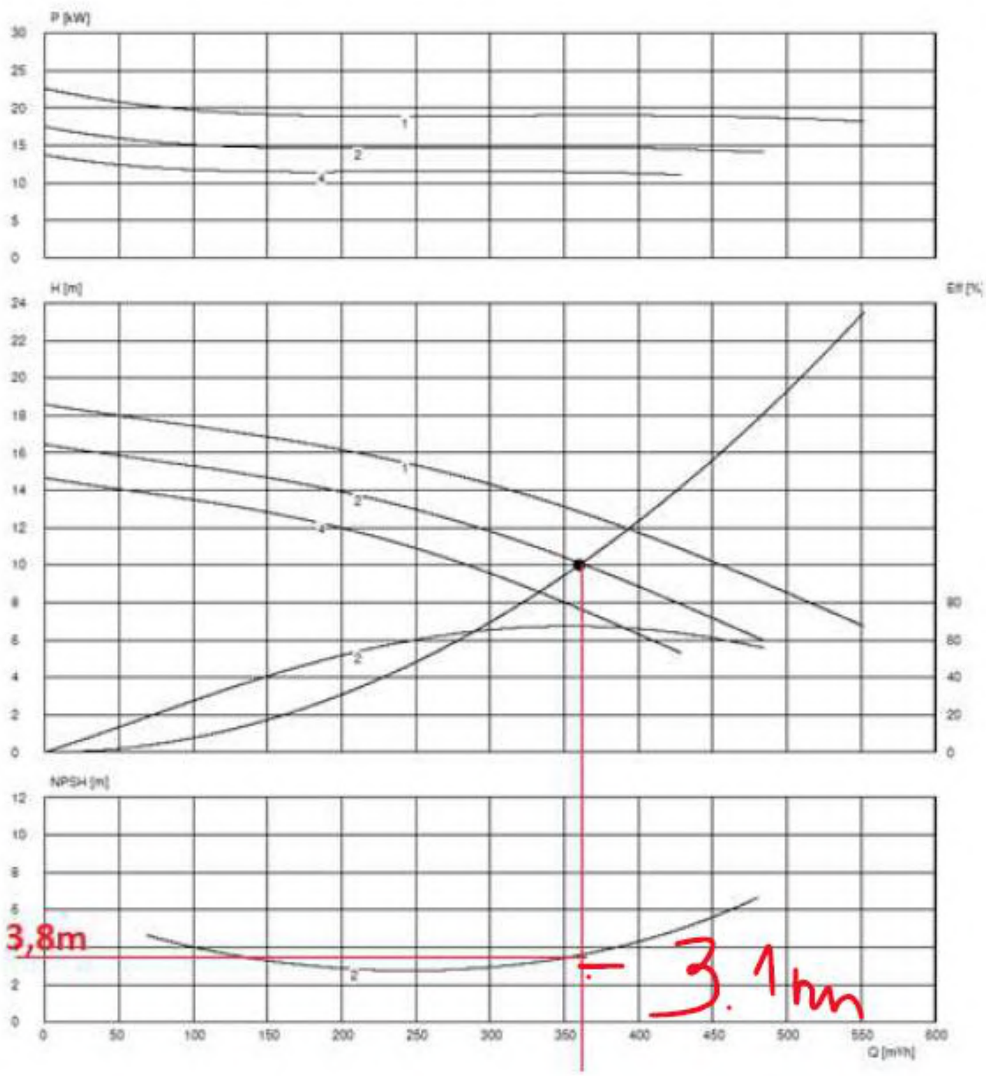


Figure 15

4.1.2.Suction of water from the filled pipe – Problematic phase

A problematic phase takes place in a situation where we have to empty the largest pipe with the help of the pump P410 – a low-pressure pump.

The determined model of the situation is shown below.

As you can see on the right, there will be no problem when emptying a big pipe. Overpressure of the water will remove all the possible air from the piping, therefore all water will be successfully pushed around the circuit, directly into the drain pit.

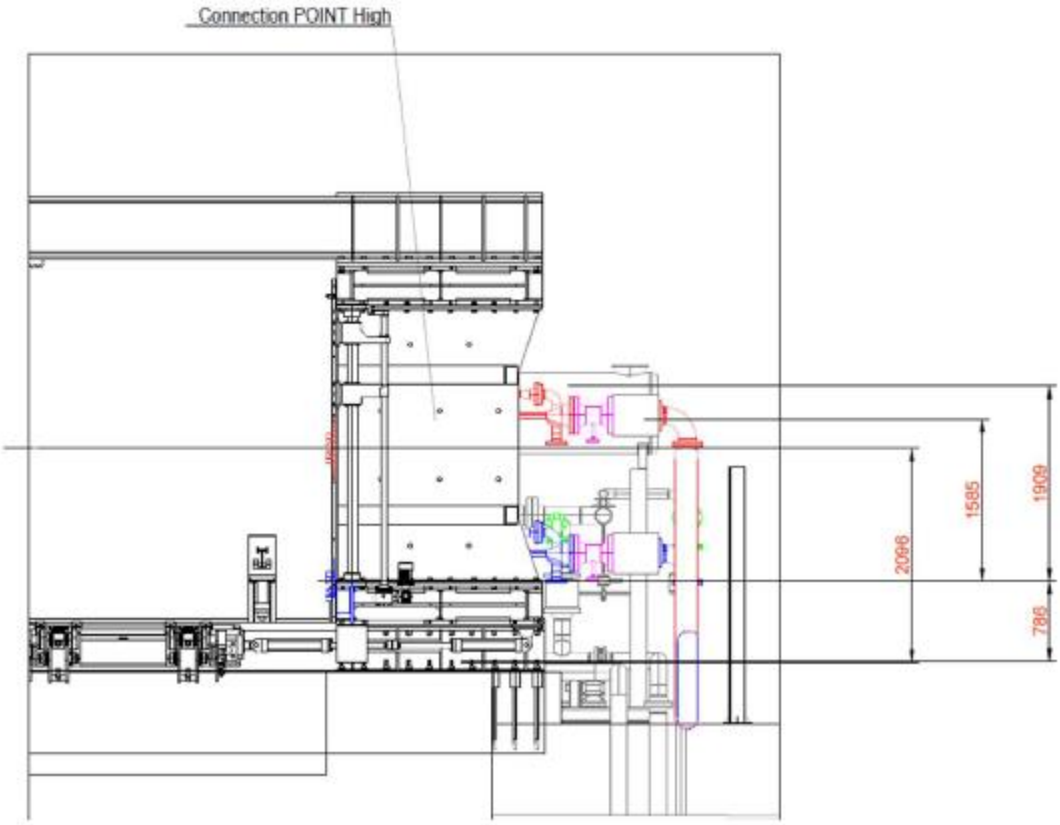


Figure 16

Regarding this issue, see the calculation below – 1st calculation is for the draining and pumping of big pipes.

TOPFIBRA

NPSH fpr pump P410 - Discharge of the pipe d 3200 mm

		1	2	3	4	5	6	7	8
1. Flow medium									
Flow medium		Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	
Condition		liquid	liquid	liquid	liquid	liquid	liquid	liquid	
Volume flow	m3/h	380,000	380,000	380,000	380,000	380,000	380,000	380,000	
Mass flow	kg/h	379318,280	379318,280	379318,280	379318,280	379318,280	379318,280	379318,280	
Volume flow branch.pipe	m3/h								
Density	kg/m3	998,206	998,206	998,206	998,206	998,206	998,206	998,206	
Dyn.Viscos.	10-6 kg/ms	1001,605	1001,605	1001,605	1001,605	1001,605	1001,605	1001,605	
Kin.Viskosität	10-6 m2/s	1,003	1,003	1,003	1,003	1,003	1,003	1,003	
2. Additional data for gases									
Pressure (inlet, abs.)	bar								
Temperature (inlet)	°C								
Temperature (outlet)	°C								
Norm volume flow	Nm3/h								
3. Element of pipe									
Pipe identification		Testing rig inlet	bend	flexible hose DN150					
Element of pipe		circular	Circular bend	circular	vertical difference	vertical difference	Circular bend	circular	
Number		1	1	1	1	1	3	3	
Dimensions of element	SI	Diameter of pipe D in mm: 150,000	Diameter of pipe D in mm: 150,000	Diameter of pipe D in mm: 150,000	Vertical difference H in m: -2,000	Vertical difference H in m: 1,000	Diameter of pipe D in mm: 250,000	Diameter of pipe D in mm: 200,000	
		Length of pipe L in m: 1,000	Radius R in mm: 200,000	Length of pipe L in m: 8,000			Radius R in mm: 350,000	Length of pipe L in m: 3,000	
			Angle w in degree: 90,000				Angle w in degree: 90,000		
4. Result of calculation									
Veloc.of flow	m/s	5,973	5,973	5,973			2,150	3,360	
Reynolds number		8,929E+05	8,929E+05	8,929E+05			5,358E+05	6,697E+05	
Veloc.of flow2	m/s								
Reynolds number 2									
Flow		turbulent	turbulent	turbulent			turbulent	turbulent	
Absolute roughness	mm	0,150	0,150	0,150			0,150	0,150	
Pipe friction number		0,020	0,020	0,020			0,018	0,019	
Resistance coefficient		0,133	0,406	1,064			0,324	0,283	
Resistance coefficient bran									
Press. drop branch.pipe	Pa								
Pressure drop	Pa	2369,372	7223,555	18954,972	-19.584,802	9792,401	2243,790	4783,878	
Pressure drop	m H2O	0,242	0,737	1,933	-1,997	0,999	0,229	0,488	
Sum Pressure drop	m H2O	0,242	0,978	2,911	0,914	1,913	2,141	2,629	

Figure 17

NPSH is at 2,629m – OK for both pumps.

2nd calculation is for small pipe – there will be less overhead pressure from the water tower.

TOPFIBRA NPSH for pump P410 - Discharge of pipe d 320 mm - small pipe

		1	2	3	4	5	6	7	8
1. Flow medium									
Flow medium		Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	Water (1,013 bar, 20 °C)	
Condition		liquid	liquid	liquid	liquid	liquid	liquid	liquid	
Volume flow	m3/h	380,000	380,000	380,000	380,000	380,000	380,000	380,000	
Mass flow	kg/h	379318,280	379318,280	379318,280	379318,280	379318,280	379318,280	379318,280	
Volume flow branch.pipe	m3/h								
Density	kg/m3	998,206	998,206	998,206	998,206	998,206	998,206	998,206	
Dyn.Viscos.	10-6 kg/ms	1001,605	1001,605	1001,605	1001,605	1001,605	1001,605	1001,605	
Kin.Viskosität	10-6 m2/s	1,003	1,003	1,003	1,003	1,003	1,003	1,003	
2. Additional data for gases									
Pressure (inlet, abs.)	bar								
Temperature (inlet)	°C								
Temperature (outlet)	°C								
Norm volume flow	Nm3/h								
3. Element of pipe									
Pipe identification		Testing rig inlet	bend	flexible hose DN150					
Element of pipe		circular	Circular bend	circular	Vertical difference	Vertical difference	Circular bend	circular	
Number		1	1	1	1	1	3	3	
Dimensions of element	SI	Diameter of pipe D in mm: 150,000	Diameter of pipe D in mm: 150,000	Diameter of pipe D in mm: 150,000	Vertical difference H in m: -1,500	Vertical difference H in m: 1,000	Diameter of pipe D in mm: 250,000	Diameter of pipe D in mm: 200,000	
		Length of pipe L in m: 1,000	Radius R in mm: 200,000	Length of pipe L in m: 8,000			Radius R in mm: 350,000	Length of pipe L in m: 3,000	
			Angle w in degree: 90,000				Angle w in degree: 90,000		
4. Result of calculation									
Veloc.of flow	m/s	5,973	5,973	5,973			2,150	3,360	
Reynolds number		8,929E+05	8,929E+05	8,929E+05			5,358E+05	6,697E+05	
Veloc.of flow2	m/s								
Reynolds number 2									
Flow		turbulent	turbulent	turbulent			turbulent	turbulent	
Absolute roughness	mm	0,150	0,150	0,150			0,150	0,150	
Pipe friction number		0,020	0,020	0,020			0,018	0,019	
Resistance coefficient		0,133	0,406	1,064			0,324	0,263	
Resistance coefficient bran									
Press. drop branch.pipe	Pa								
Pressure drop	Pa	2369,372	7223,555	18954,972	-14.688,601	9792,401	2243,790	4783,878	
Pressure drop	m H2O	0,242	0,737	1,933	-1,498	0,999	0,229	0,488	
Sum Pressure drop	m H2O	0,242	0,978	2,911	1,413	2,412	2,641	3,128	

Figure 18

NPSH is at 3,128m.

Regarding the above-mentioned issues in Chapter 4.1.2, we can confirm that both pumps will be effectively operating.

The better pump for this situation is the VICTOR pump – because of the self-suction feature.

4.1.3. FLEXIBLE PIPE

Flexible piping is essential for connecting PUMPING SKID to the ports of the testing rig.

In the figure below, one can see how the testing rig is exiting from the connection port:

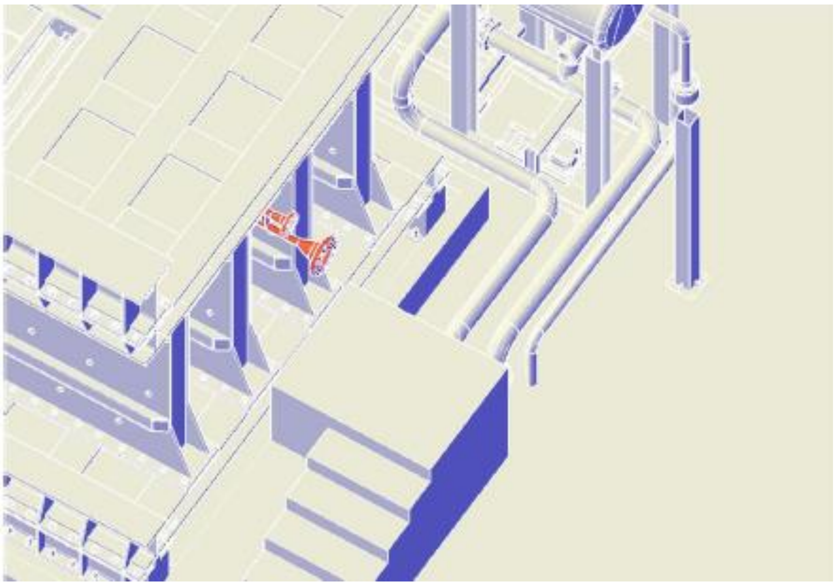


Figure 19

In the figure, below you can see how the flexible pipe should be installed. We recommend that an adequate solution is implemented by the customer to access the fitting for the pipe connections.

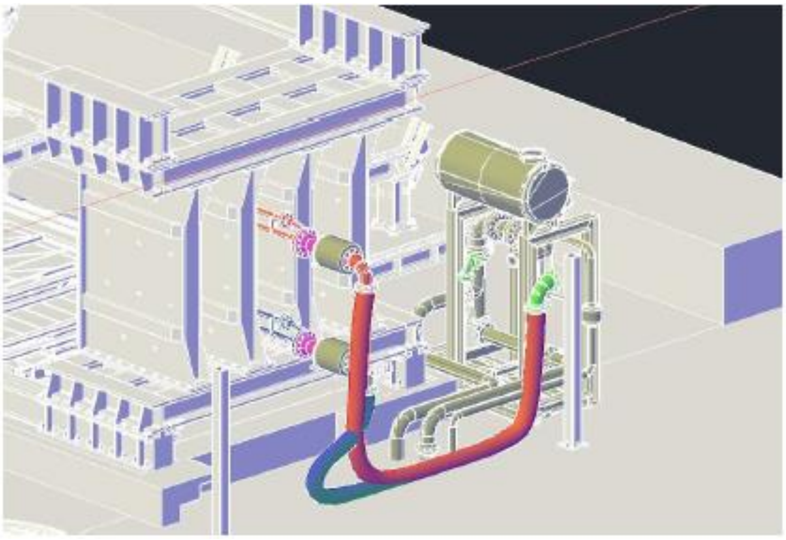


Figure 20

In the same figure above, the fixed point of the SKID connection is shown – necessary because of the workload on the pipe. The diameter of the pipe shown in the picture is D200.

4.1.4.Acceptable load and calculation of the length of flexible pipes

Acceptable working conditions and loads of pipe: see Figure 21:

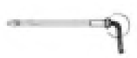
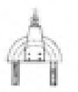
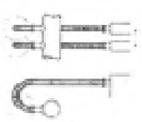
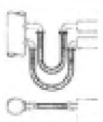
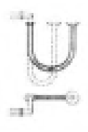
Incorrect		Correct		
Too strong bending stress right behind connection		When using fixed pipeline is heading right down		Pict. 1
Too strong bending stress right behind place of bending		The bending stress is transferred only to the middle part of the hose when using solid arches before connecting tube		Pict. 2
As in case pict. 2		As in case pict. 2		Pict. 3
Alternating bending stress and too strong bending on connections		No variable bending and little stress right behind connection if used fixed arches		Pict. 4
Alternating bending stress and too intensive bending of hose fittings		Alternating movement and bending stress fall off when using fixed arches		Pict. 5
Adverse torsional movements and torsional stress		Use at the same time moving roller carrier removes alternating movements and stress		Pict. 6
Too strong stress in bend		Reduced bending stress at acceptable level		Pict. 7
Coiled hose in any way should not by straighten by pulling one end		Straightening of hose by un-twisting from wound position		Pict. 8
Torsional stress and too strong bend right behind left connection		Remove torsion and favorable stress bending when using the fixed arches		Pict. 9
Torsional stress		In those cases, if not eliminate torque loads should be used swivel joints, that capture the torsional stress, so the hose will be stressed only in bending		Pict. 10
Torsional stress, as both connection are not in one axis		Remove stress by using fixed double arch		Pict. 11

Figure 21

The dimensioning of the pipe is calculated in order to have workload no. 2 and 11.

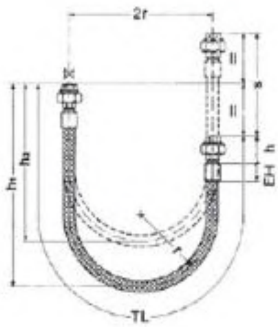
The length of flexible pipes should be according to the specification of the producer: ALFAGOMMA.

Rules for calculation of total length of hose

90° - angle at simple bend and for small movements

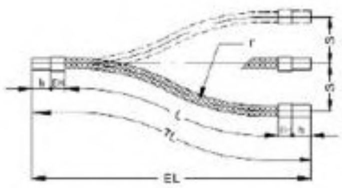
Total length TL	= 2r + 2(h + 2 EH)
Length of side a	= 1,215r + h + 2 EH
r	= bending radius at simple bend
h	= length of fitting (see "Standard range of fittings")
EH	= length of ferrule (see "Standard range of fittings")
a	= length of side
TL	= total length of hose

180° - angle for vertical movement



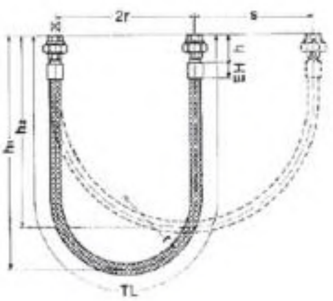
Total length TL	= 4r + 0,5s + 2(h + 3EH)
h_1	= 1,43r + 0,5s + h+ 3EH
h_2	= 1,43r + h + 3EH
r	= dynamic bending radius (tab. of individual types of hoses)
h	= length of fitting
EH	= length of ferrule
S	= movement of hose
h_1	= max. high for 180° angle
h_2	= min. high for 180° angle
TL	= total length of hose

At absorbing of side expansion



L	$= \sqrt{20rS}$
TL	= L + 2(h+EH)
EL	$= \sqrt{L^2 - S^2} + 2(h+EH)$
L	= effective length of hose
TL	= total length of hose
EL	= building length of hose
r	= dynamic bending radius
S	= side movement from the middle of axis (max. only 25% from dynamic bedning radius)
h	= length of fitting (see "Standard range of fittings")
EH	= length of ferrule (see "Standard range of fittings")

180° - angle at lateral movement

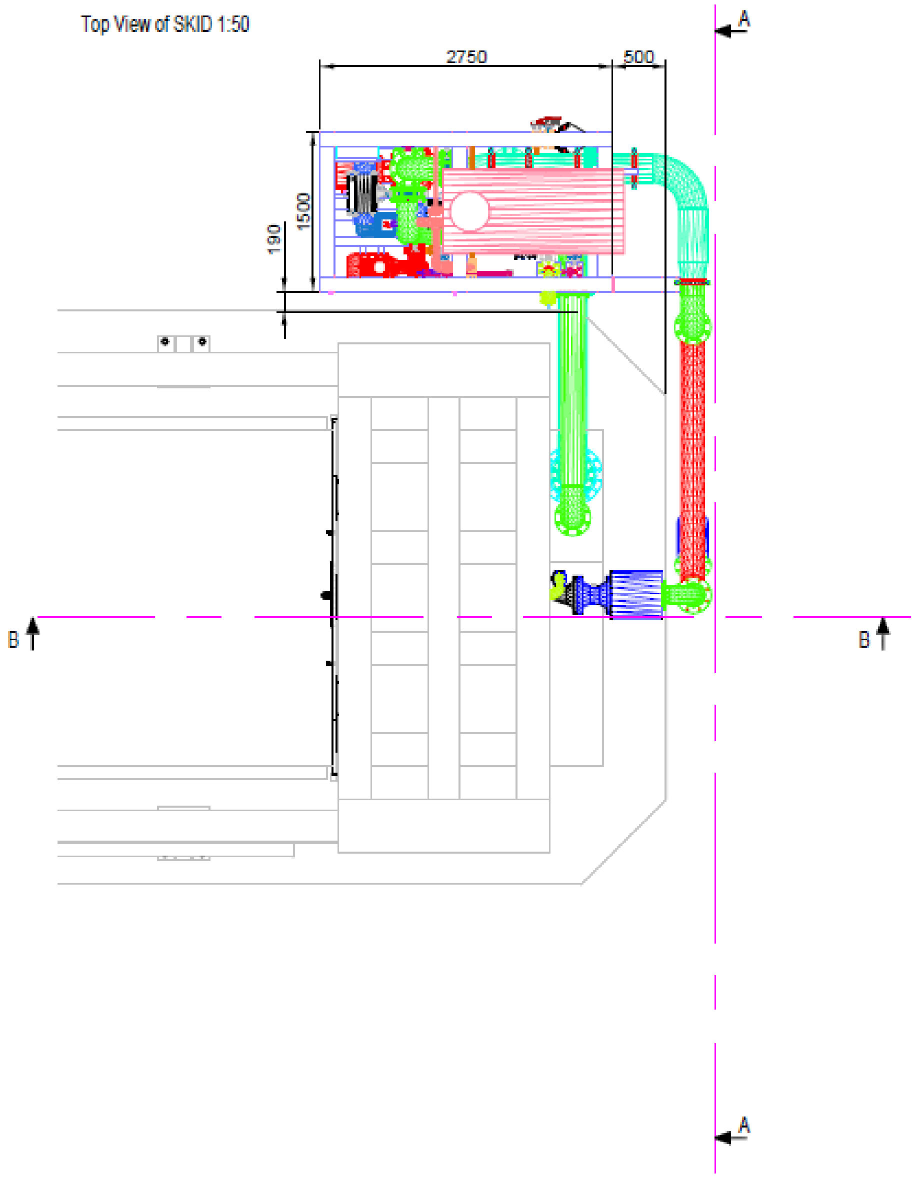


Total length TL	= 4r + 1,57s + 2(h + 3EH)
h_1	= 1,43r + 0,785s + h + 3EH
h_2	= 1,43r + 0,5s + h + 3EH
r	= dynamic bending radius (tab. of individual types of hoses)
h	= length of fitting
EH	= length of ferrule
S	= movement of hose
h_1	= max. high for 180° angle
h_2	= min. high of 180° angle
TL	= total length of hose

In case of requirement for other hose application, please contact technical department of Kohaflex and require design of optimal hose construction.

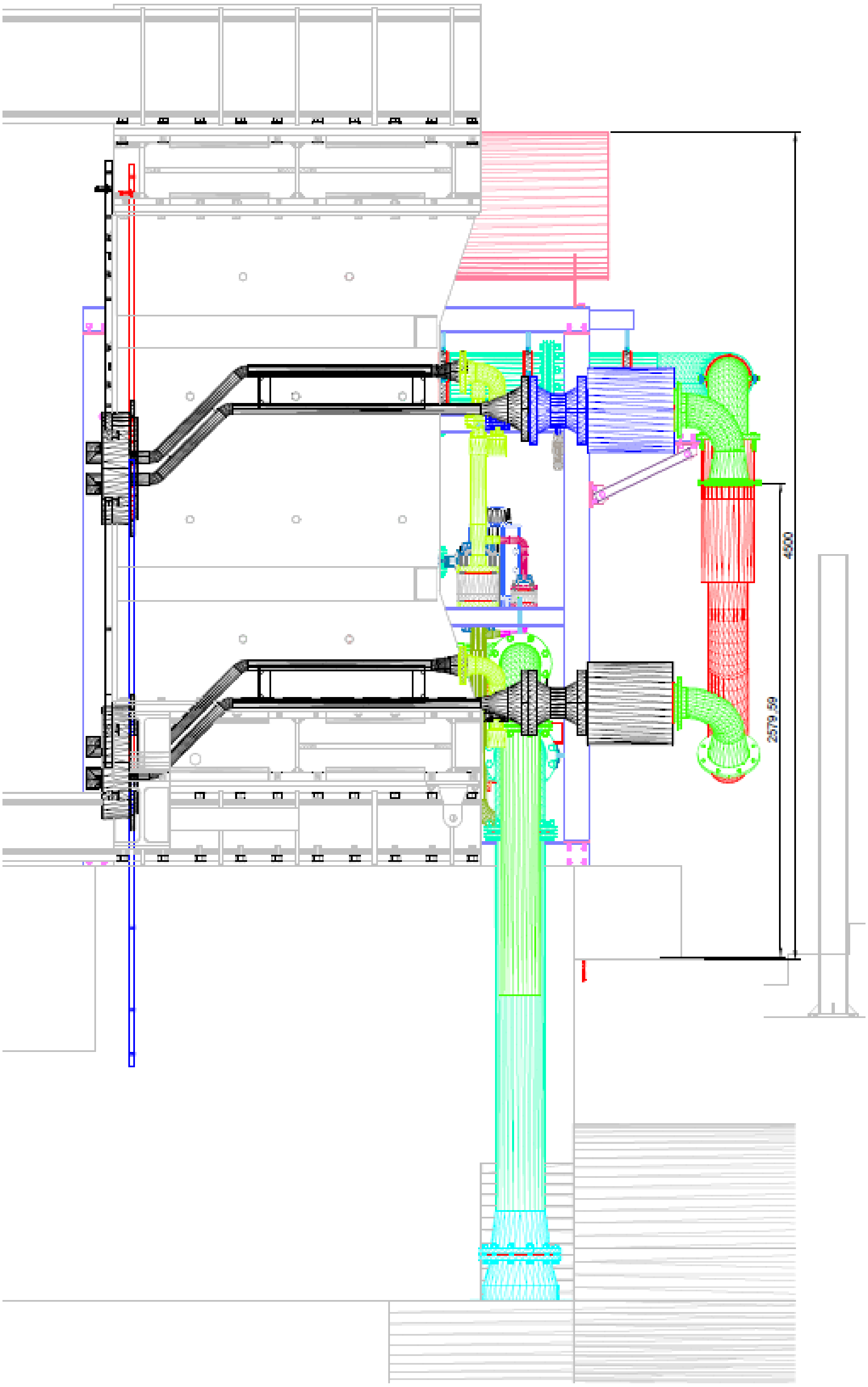
Figure 22

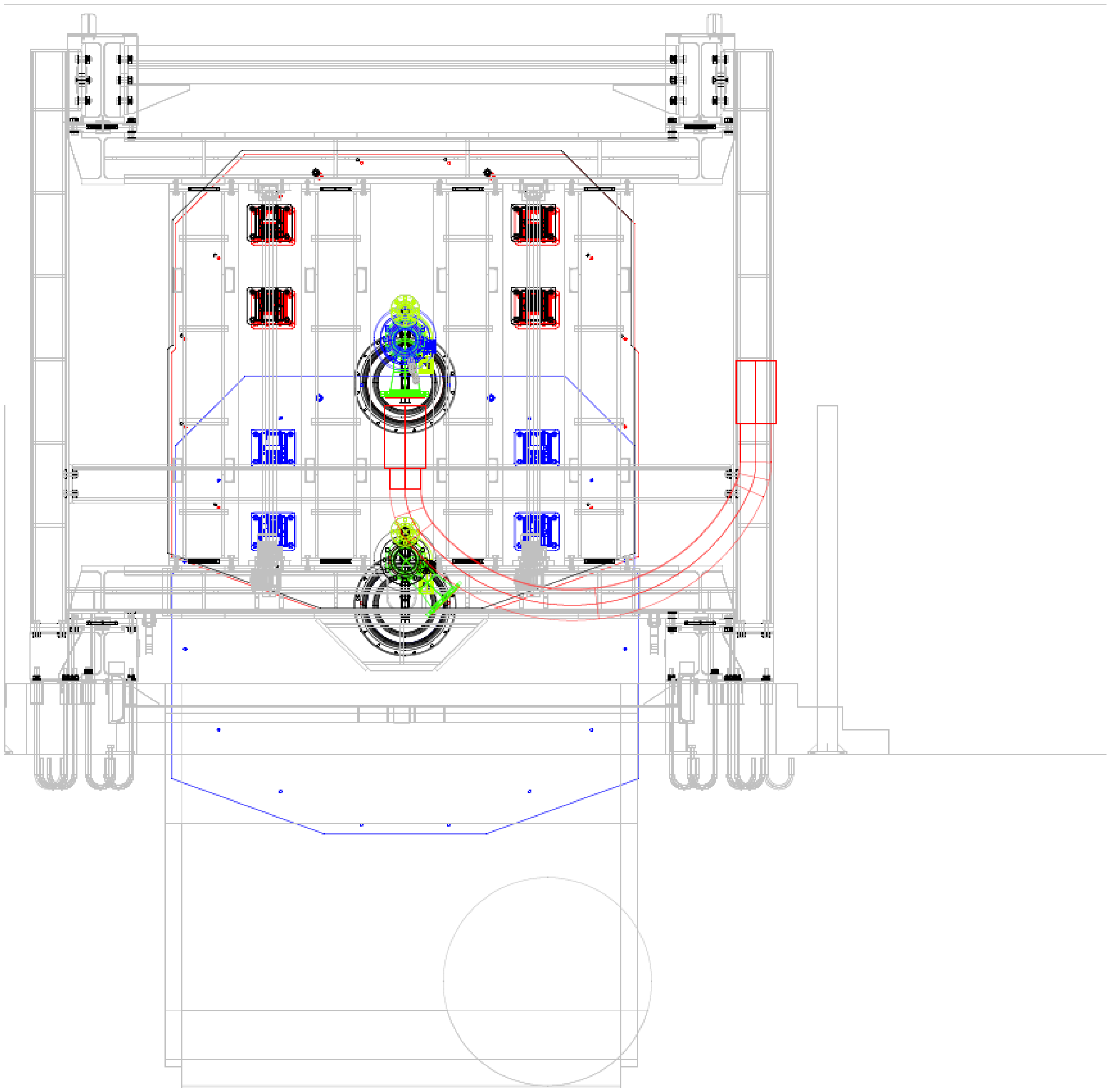
5. ATTACHMENTS

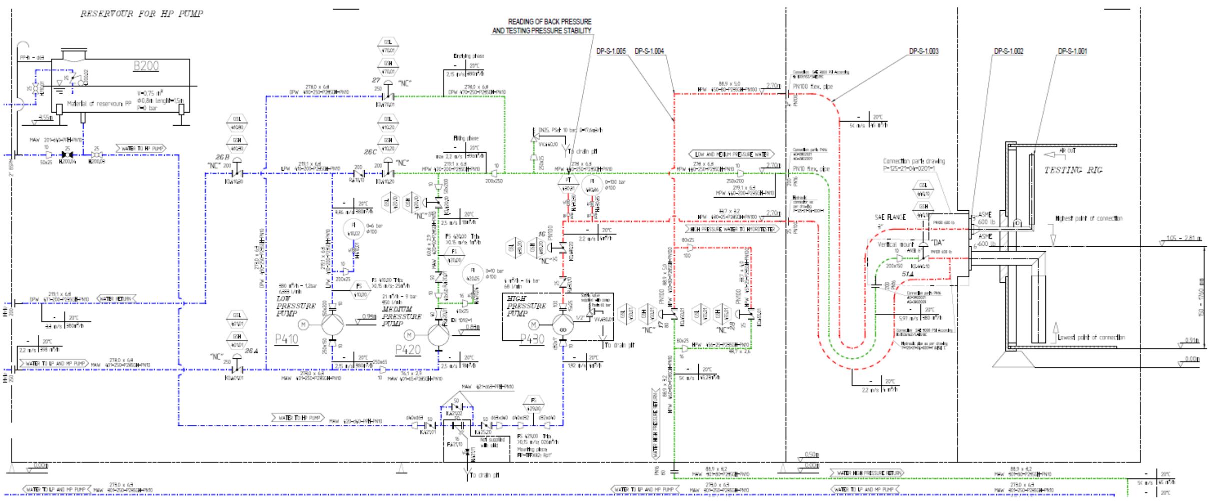


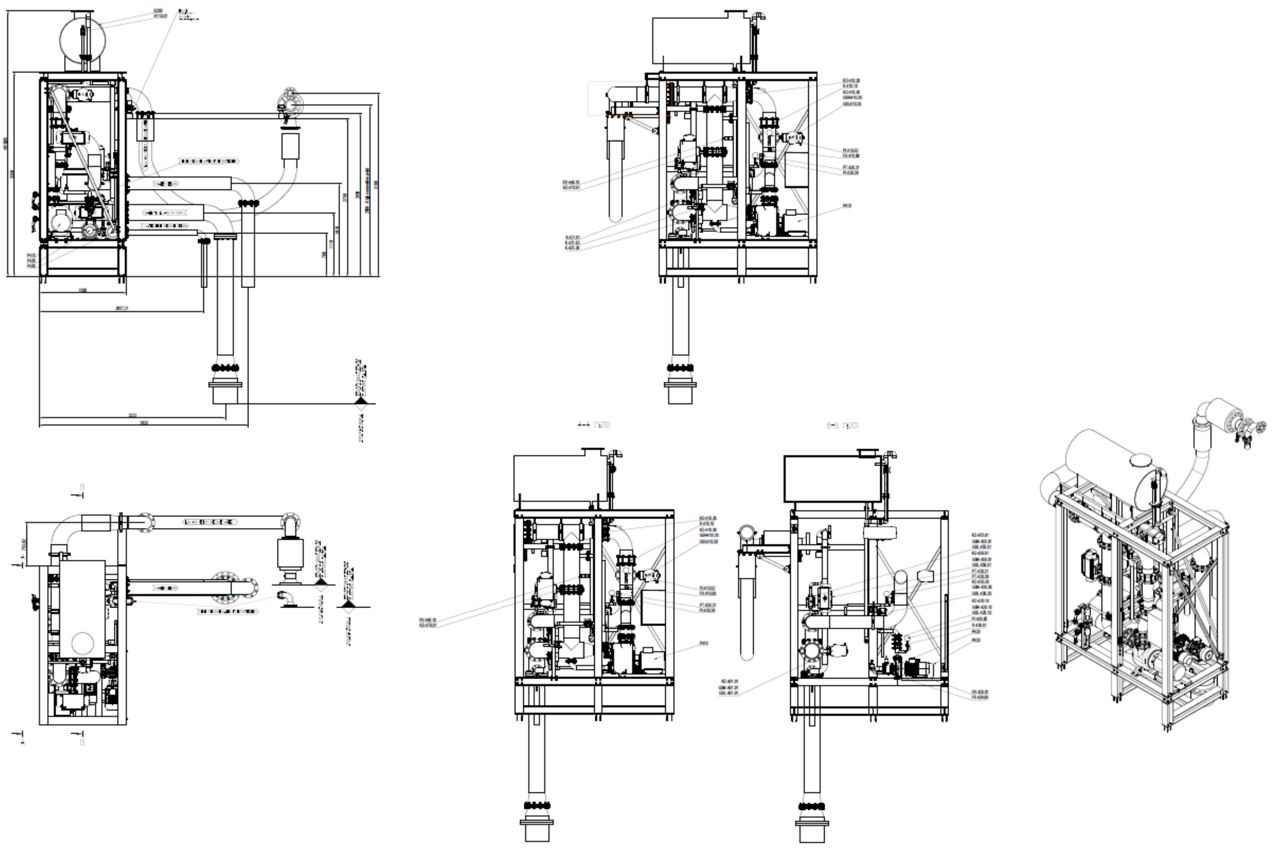
Slice B-B; 1:20

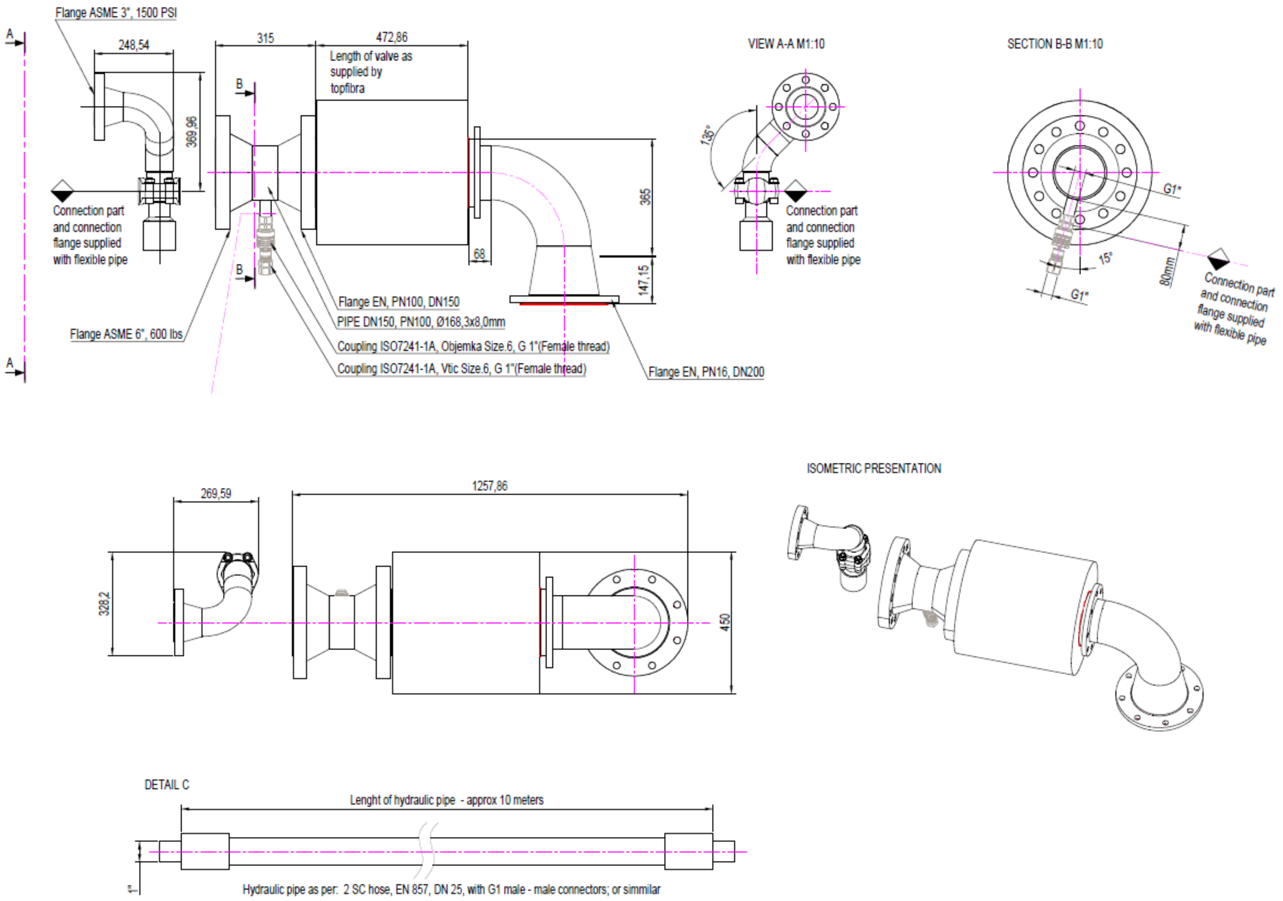
Slice B-B; 1:20






RESERVOUR FOR HP PUMP
B200
READING OF BACK PRESSURE AND TESTING PRESSURE STABILITY
DP-S-1.005
DP-S-1.004
DP-S-1.003
DP-S-1.002
DP-S-1.001
TESTING RIG
LOW PRESSURE PUMP
P410
MEDIUM PRESSURE PUMP
P420
HIGH PRESSURE PUMP
P430
SAE FLANGE
ASME 600 lb




Flange ASME 3", 1500 PSI
248,54
369,96
315
472,86
Length of valve as supplied by topfibra
365
68
147,15
Connection part and connection flange supplied with flexible pipe
Flange ASME 6", 600 lbs
Flange EN, PN100, DN150
PIPE DN150, PN100, Ø168,3x8,0mm
Coupling ISO7241-1A, Objemka Size.6, G 1"(Female thread)
Coupling ISO7241-1A, Vtic Size.6, G 1"(Female thread)
Flange EN, PN16, DN200
VIEW A-A M1:10
135°
Connection part and connection flange supplied with flexible pipe
SECTION B-B M1:10
G1"
15°
80mm
Connection part and connection flange supplied with flexible pipe
269,59
1257,86
328,2
450
ISOMETRIC PRESENTATION
DETAIL C
Lenght of hydraulic pipe - approx 10 meters
Hydraulic pipe as per: 2 SC hose, EN 857, DN 25, with G1 male - male connectors; or simmilar

FS410.00

Input only on silver cells

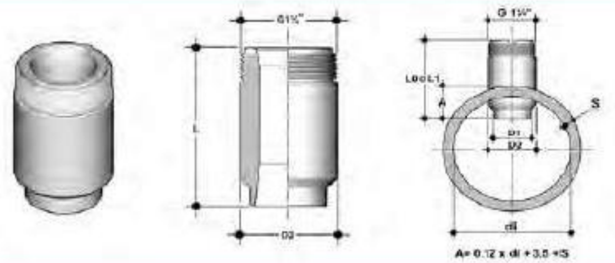
d	219,1
di	**209,1**
s	5
A	**33,592**

FS420.00

Input only on silver cells

d	60,3
di	**54,5**
s	2,9
A	**12,94**

INSTALLATION ON METAL PIPES

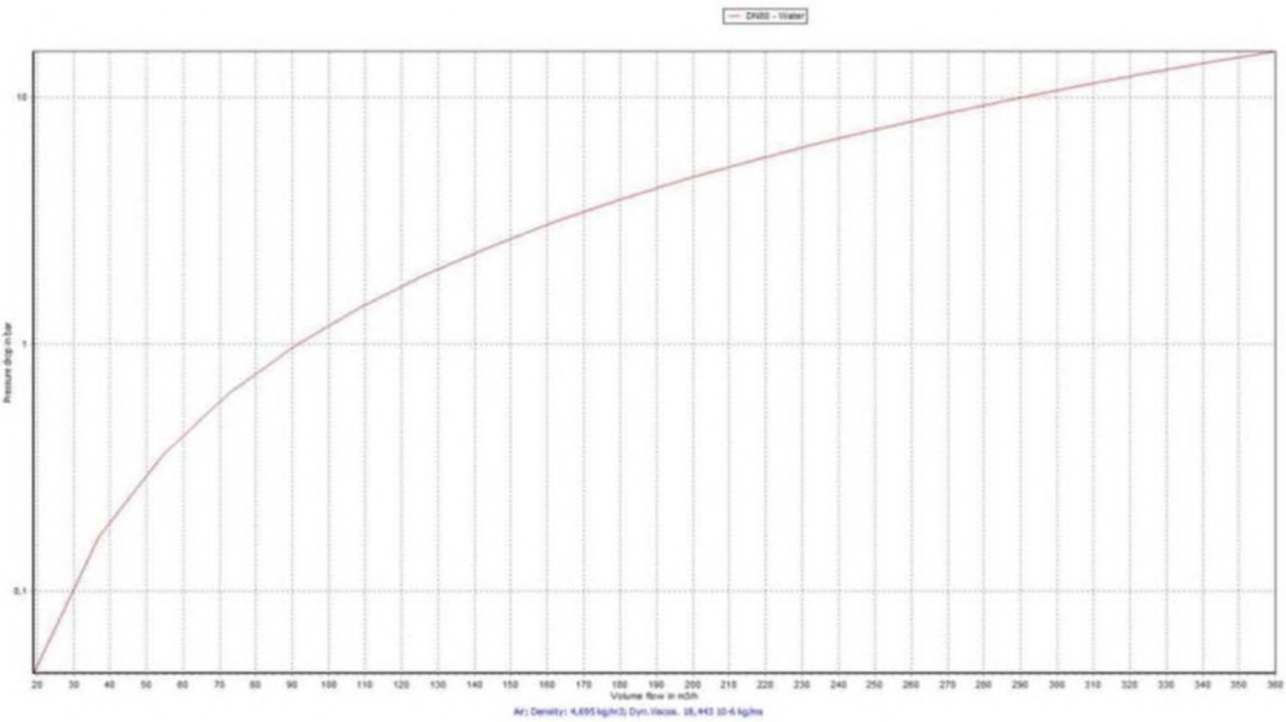


316L SS Weld on Adapters (PN25)

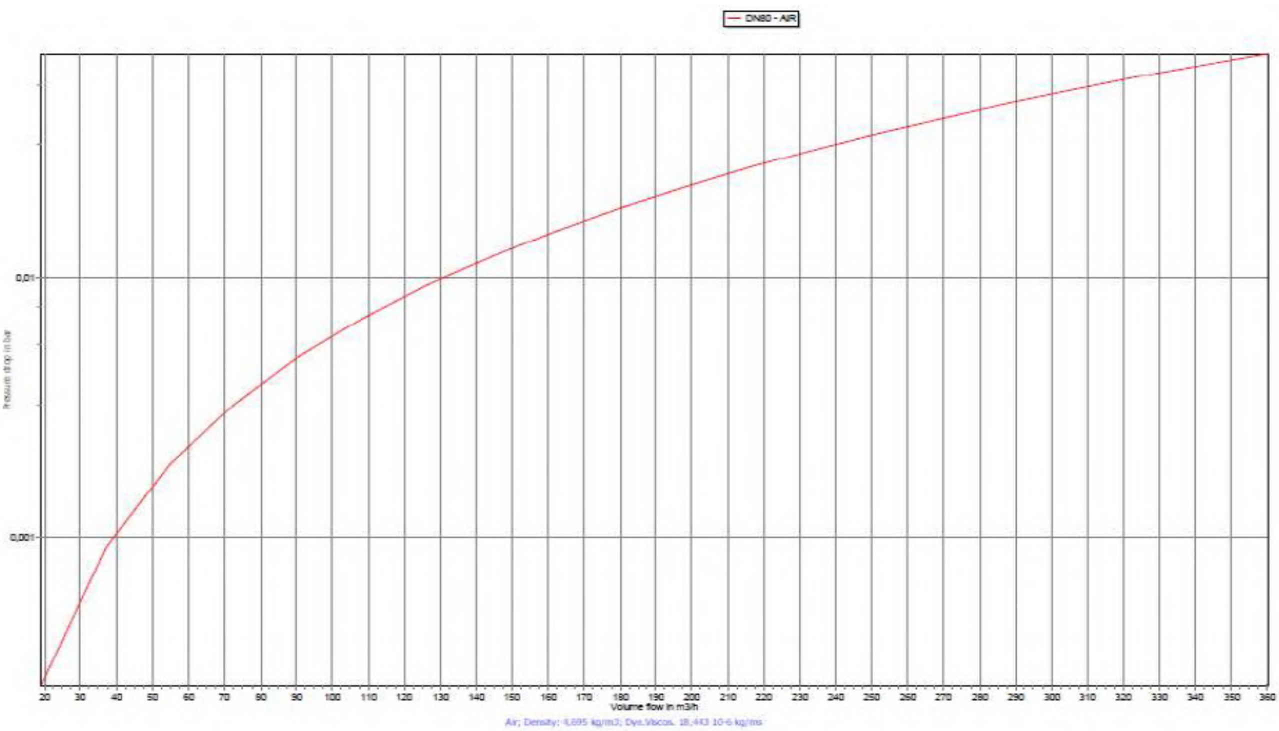
Part No.	DN/Size	d/R	Parallel Thread (GAS)	Body	L	D1	D2	Drilling Hole	Flow Sensor Lenght	Suitable for (*)
WAIXL0	40	-	1 1/4"	316L SS	68.5	33,9	34	34	L0	F & A
WAIXL0	50	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F & A
WAIXL0	60	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F & A
WAIXL0	65	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F & A
WAIXL0	80	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F & A
WAIXL0	100	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F & A
WAIXL0	110	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F & A
WAIXL0	125	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F
WAIXL0	150	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F
WAIXL0	175	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F
WAIXL0	200	-	1 1/4"	316L SS	68.5	33,9	44	44	L0	F
WAIXL1	225	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	250	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	300	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	350	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	400	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	450	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	500	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F
WAIXL1	600	-	1 1/4"	316L SS	98.5	33,9	44	44	L1	F

Calculation of Air vs. Water pressure drop for reading of back pressure of sensor PT430.31

		1	2	3	4	5	6
1. Flow medium							
Flow medium		Water (1,013 bar, 24 °C)	Water (1,013 bar, 24 °C)	Water (1,013 bar, 24 °C)	Water (1,013 bar, 24 °C)	Water (1,013 bar, 24 °C)	Water (1,013 bar, 24 °C)
Condition		liquid	liquid	liquid	liquid	liquid	liquid
Volume flow	m3/h	380,000	380,000	380,000	380,000	380,000	380,000
Mass flow	kg/h	378973,620	378973,620	378973,620	378973,620	378973,620	378973,620
Volume flow branch.pipe	m3/h						
Density	kg/m3	997,299	997,299	997,299	997,299	997,299	997,299
Dyn.Viscos.	10-6 kg/ms	910,730	910,730	910,730	910,730	910,730	910,730
Kin.Viskosität	10-6 m2/s	0,913	0,913	0,913	0,913	0,913	0,913
2. Additional data for gases							
Pressure (inlet, abs.)	bar						
Temperature (inlet)	K						
Temperature (outlet)	°C						
Norm volume flow	Nm3/min						
3. Element of pipe							
Pipe identification		**DP-S-1.001**	**DP-S-1.002**	**DP-S-1.003**	**DP-S-1.004**	**DP-S-1.005**	**DP-S-1.005**
Element of pipe		circular	circular	circular	Circular bend	circular	circular
Number		1	1	1	4	4	4
Dimensions of element	SI	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 150,000	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 80,000
		Length of pipe L in m: 1,000	Length of pipe L in m: 0,500	Length of pipe L in m: 10,000	Radius R in mm: 100,000	Length of pipe L in m: 2,500	Length of pipe L in m: 2,500
					Angle w in degree: 90,000		
4. Result of calculation							
Veloc.of flow	m/s	21,000	5,973	21,000	21,000	21,000	19,894
Reynolds number		1,840E+06	9,812E+05	1,840E+06	1,840E+06	1,840E+06	4,052E+05
Veloc.of flow2	m/s						
Reynolds number 2							
Flow		turbulent	turbulent	turbulent	turbulent	turbulent	turbulent
Absolute roughness	mm	0,150	0,150	0,150	0,150	0,150	0,150
Pipe friction number		0,023	0,020	0,023	0,023	0,023	0,023
Resistance coefficient		0,289	0,066	2,888	0,421	0,722	0,733
Resistance coefficient branch.pipe							
Press. drop branch.pipe	bar						
Pressure drop	bar	0,635	0,012	6,350	3,704	6,350	0,027
Pressure drop	bar	0,635	0,012	6,350	3,704	6,350	0,027
Sum Pressure drop	bar	**0,635**	**0,647**	**6,997**	**10,701**	**17,052**	**17,079**



		1	2	3	4	5	6
1. Flow medium							
Flow medium		Air	Air	Air	Air	Air	Air
Condition		gaseous	gaseous	gaseous	gaseous	gaseous	gaseous
Volume flow	m3/h	360,000	360,000	360,000	360,000	360,000	360,000
Mass flow	kg/h	1690,200	1690,200	1690,200	1690,200	1690,200	1690,200
Volume flow branch.pipe	m3/h						
Density	kg/m3	4,695	4,695	4,695	4,695	4,695	4,695
Dyn.Viscos.	10-6 kg/ms	18,443	18,443	18,443	18,443	18,443	18,443
Kin.Viskosität	10-6 m2/s	3,928	3,928	3,928	3,928	3,928	3,928
2. Additional data for gases							
Pressure (inlet, abs.)	bar	4,000	4,000	4,000	4,000	4,000	4,000
Temperature (inlet)	°C	24,000	24,000	24,000	24,000	24,000	24,000
Temperature (outlet)	°C	24,000	24,000	24,000	24,000	24,000	24,000
Norm volume flow	Nm3/min	21,773	21,773	21,773	21,773	21,773	21,773
3. Element of pipe							
Pipe identification		**DP-S-1.001**	**DP-S-1.002**	**DP-S-1.003**	**DP-S-1.004**	**DP-S-1.005**	**DP-S-1.005**
Element of pipe		circular	circular	circular	Circular bend	circular	circular
Number		1	1	1	4	4	4
Dimensions of element	SI	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 150,000	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 80,000	Diameter of pipe D in mm: 80,000
		Length of pipe L in m: 1,000	Length of pipe L in m: 0,500	Length of pipe L in m: 10,000	Radius R in mm: 100,000	Length of pipe L in m: 2,500	Length of pipe L in m: 2,500
					Angle w in degree: 90,000		
4. Result of calculation							
Veloc.of flow	m/s	19,894	5,659	19,894	19,894	19,894	19,894
Reynolds number		4,052E+05	2,161E+05	4,052E+05	4,052E+05	4,052E+05	4,052E+05
Veloc.of flow2	m/s						
Reynolds number 2							
Flow		turbulent	turbulent	turbulent	turbulent	turbulent	turbulent
Absolute roughness	mm	0,150	0,150	0,150	0,150	0,150	0,150
Pipe friction number		0,023	0,021	0,023	0,023	0,023	0,023
Resistance coefficient		0,293	0,070	2,934	0,422	0,733	0,733
Resistance coefficient branch.pipe							
Press. drop branch.pipe	bar						
Pressure drop	bar	0,003	0,000	0,027	0,016	0,027	0,027
Pressure drop	bar	0,003	0,000	0,027	0,016	0,027	0,027
Sum Pressure drop	**bar**	**0,003**	**0,003**	**0,030**	**0,046**	**0,073**	**0,100**



For more information contact us by writing at

support@topfibra.eu

or

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