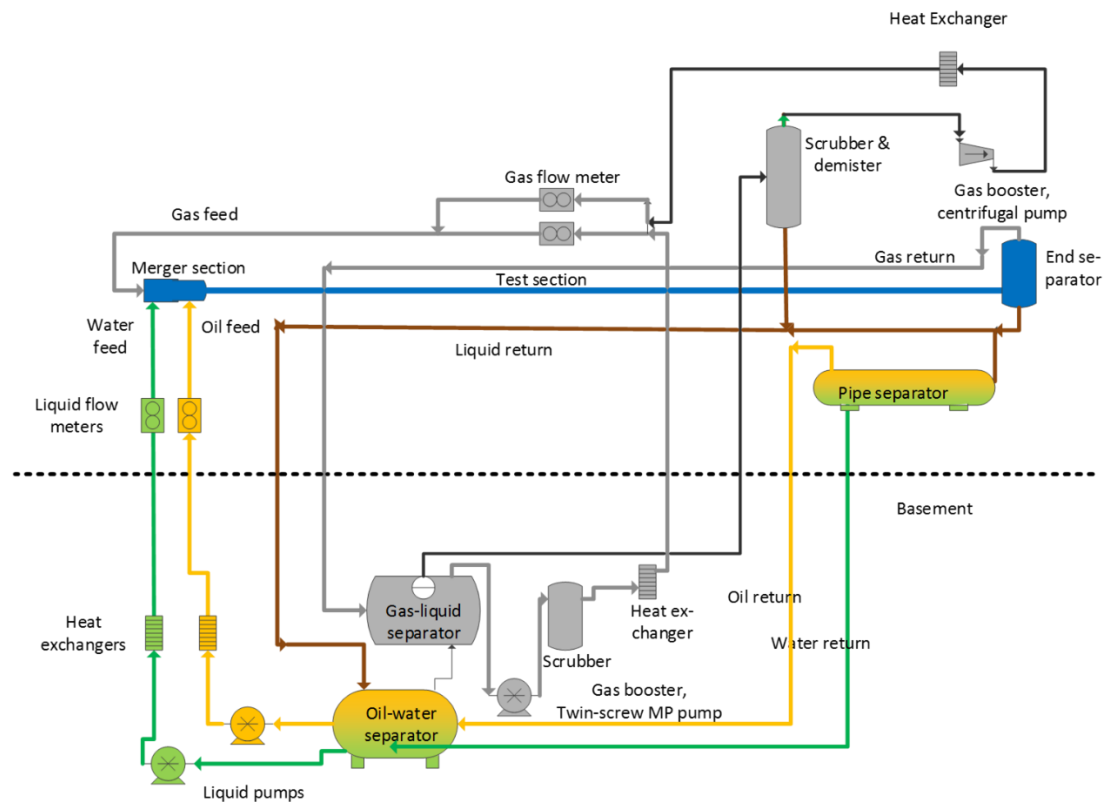


Technical specifications

Overall key data

- Loop material: AISI 316
- Fluids: Water, oil and gas
- Pressure: Max. 10 bara
- Temperature range: 10-30 °C
- Test section dimension: ID 100 mm, length 45 m at near-horizontal inclinations, 15 m long for vertical flow
- Test section material: PVC, carbon steel or stainless steel depending on the
- Variable inclination: 0-90o
- Gas phase: The dense gas SF6
- Superficial gas velocity range: 0.5 - 20 m/s
- Superficial oil velocity range: 0 – 1.5 m/s
- Superficial water velocity range: 0 – 1.5 m/s

Loop schematic



WFL in tabular form – Capacities and uncertainties

Overall

<i>Maximum pressure</i>	8 bar	<i>Superficial gas velocity</i>	0.3 – 11 m/s
<i>Test section diameter</i>	0.1m (other diameters on request)	<i>Superficial oil velocity</i>	0.0001 -2.5 m/s
<i>Test section length (straight pipe)</i>	45 m for incl. 0-5 deg. 25 m for incl. 0-7 deg. 15 m for incl. 0-90 deg	<i>Superficial water velocity</i>	0.0001 -2.5 m/s
<i>Test section material</i>	PVC (steel on request)		

Table 1. General specifications of the Well Flow Loop (superficial velocities relate to $D=0.1$ m test section)

Pump capacities

Liquid pumps

Manufacturer	Type	Model	Capacity [m ³ /h]/[m/s]	Motor effect [kW]
2 x Siemen&Hinsch	Centrifugal pump	ZLKC50200/180	45/1.5	12.6
Bornemann	Eccentric helical rotor	E2H 2650	30/1.0	11
Grundfos	Centrifugal pump	NBE100-160	120/3	40
Wanner Engineering Inc. Dosage pump	Membrane Plunger Pump	Hydra-Cell G10XDSGSNEMB	1.14/0.04	1.5
OBL dosage pump	Positive displ.	Type XRN6.38 A85	0.3/0.01	0.1

Table 2. Overview of liquid pumps (superficial velocities refer to $D=0.1$ m pipe)

Gas booster capacity

Manufacturer	Type	Model	Capacity [m ³ /h]	Motor effect [kW]
Bornemann	Two-spindle screw pump	MW7T.3ZK-85	400@2.5 bar (12 m/s)	65
Spencer Turbine	Centrifugal pump	GS24103C	1000@2.5 bara (25 m/s)	149

Table 3. Overview of gas boosters (superficial velocities refer to $D=0.1$ m pipe)

Flow rate meters

Measurand	Manufacturer	Type	Model	Range [m ³ /h]/[m/s]	Accuracy
Oil flow rate	Danfoss	Coriolis	MASSFLO 1000	[0.25-25]/ [0.01-0.8]	± 0.15% of range
Oil flow rate	Danfoss	Coriolis	MASSFLO 1000	[0.25-50]/ [0.01-1.6]	± 0.15% of range
Water flow rate	Fischer & Porter	El. Mag.	Type 10 Dx 3311A	[0.25-100]/ [0.1-3.3]	± 0.2% of range
Liquid flow rate	Bronkhorst	Coriolis	Cori-Tech M55-AGD-22-K	[0-1.2]/ [0-0.04]	± 0.4% of rate + 100 g/h
Gas flow rate	Instromet	Turbine	Type Q-75-F (DN80)	[12-400] / [0.5-13]	± 1% of rate
Gas flow rate	Instromet	Turbine	Type Q-G-100 (DN150)	[80-1600]/ [3-50]	± 1% of rate
Gas flow rate	Fischer & Porter	Vortex	Type 10V -1	[3-30]/ [0.1-1.0]	± 1% of rate
Gas Flow rate	Sick	Ultrasound	FlowSic600	0.5-30 m/s	± 0.7 % of rate

Table 4. Overview of the flow rate meters

Pressure and temperature

Measurand	Manufacturer	Type	Model	Range [m ³ /h]/[m/s]	Accuracy
Pressure	Druck	Piezo-electric	-	0-16 bar	± 0.3% FSO
Pressure	Tecsis	Piezo-electric	MASSFLO 1000	0-10 bar	± 0.3% FSO
Pressure	BD Sensors	Piezo-electric	DMP457 600-1002-1-3-G10-300-1-000 R1/4"	0-10 bar	± 0.35% FSO
Temperature	Hypateck	Pt-100	-	5-65 °C	± 0.3 °C reading
Temperature	Danelko Elektronik AB	Pt.100	-	5-65 °C	± 0.3 °C reading

Table 5. Overview of the flow rate meters

Diff pressure and holdup

Measurand	Manufacturer	Type	Model	Range	Accuracy
Diff.pressure	Fuji	Piezo-electric	FCX	0-6000 Pa (max, re-rangeable)	0.065% of FSO
Holdup 2-phase	IFE	Gamma attenuation	FVWM Broad Beam	0-100%	1.5% absolute
Holdup 3-phase	IFE	Gamma attenuation	FVWM Broad Beam	0-100%	2-4% absolute
Holdup 2-phase	InnospeXion/ IFE	X-ray attenuation	2x1 cameras 3x2 cameras Mono camera	0-100%	1.5% absolute

Table 6. Overview of the flow rate meters

Fluid properties

Measurand	Manufacturer	Type/ principle	Model	Conditions	Accuracy
Interfacial tension	White Elec. Instr. Co.	Du Noüy ring	Torsion Balance	Atmospheric	+/- 2 mN/m
Interfacial tension	KSV	Pendant drop	Cam 200	Atmospheric	-
Interfacial tension	Krüss	Pendant drop	DSA100B	High pressure	-
Viscosity, liquid	Anyton Paar	Rheometer	MCR 301	Atmospheric and high pressure	-
Density, liquid	Danfoss	Coriolis	MASSFLO 1000	Pressurised	0.15% FSO
Density liquid	EXAC	Coriolis	120A	Pressurised	0.15% FSO
Density, liquid	Bronkhorst	Coriolis	Cori-Tech M55-AGD-22-K	Pressurised	+/- 1.5 g/dm ³
Density, liquid	Anton Paar		DMA 48	Atmospheric	+/- 0.2 g/dm ³
Density, gas	IFE	Pycnometer	-	Pressurised	+/- 2.9 g/dm ³ (max)
pH	Jenway	-	Model 3510	Atmospheric	+/- 0.003Ph
Water-in-oil	Methrom	Karl-Fischer titration	Model 836	Atmospheric	-

Table 7. Overview of instruments for fluid characterisation