GasMix

Here you will find technical documentation for Landia GasMix in the form of schematic drawing, service instructions and more.

Please click onthe links below"table of contents"to get the information needed.

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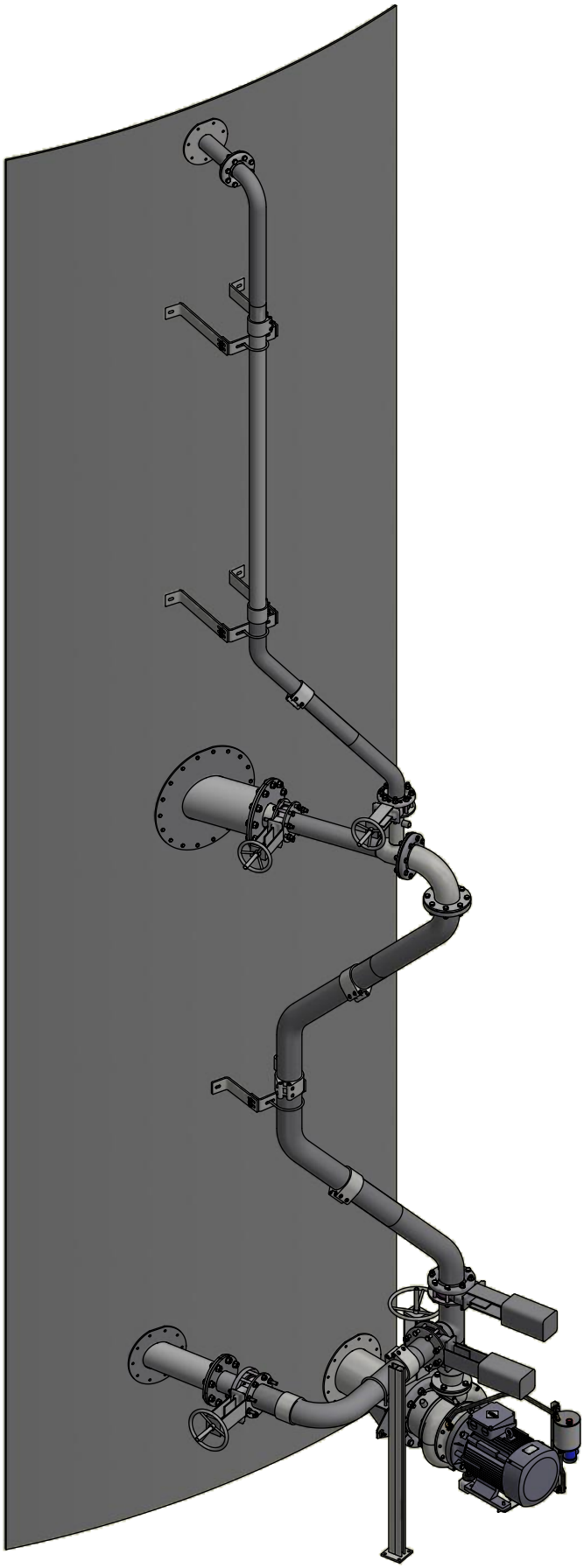
Content last updated on 25. February2021



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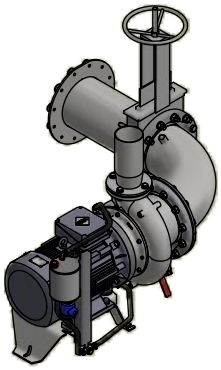

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Styret dokument

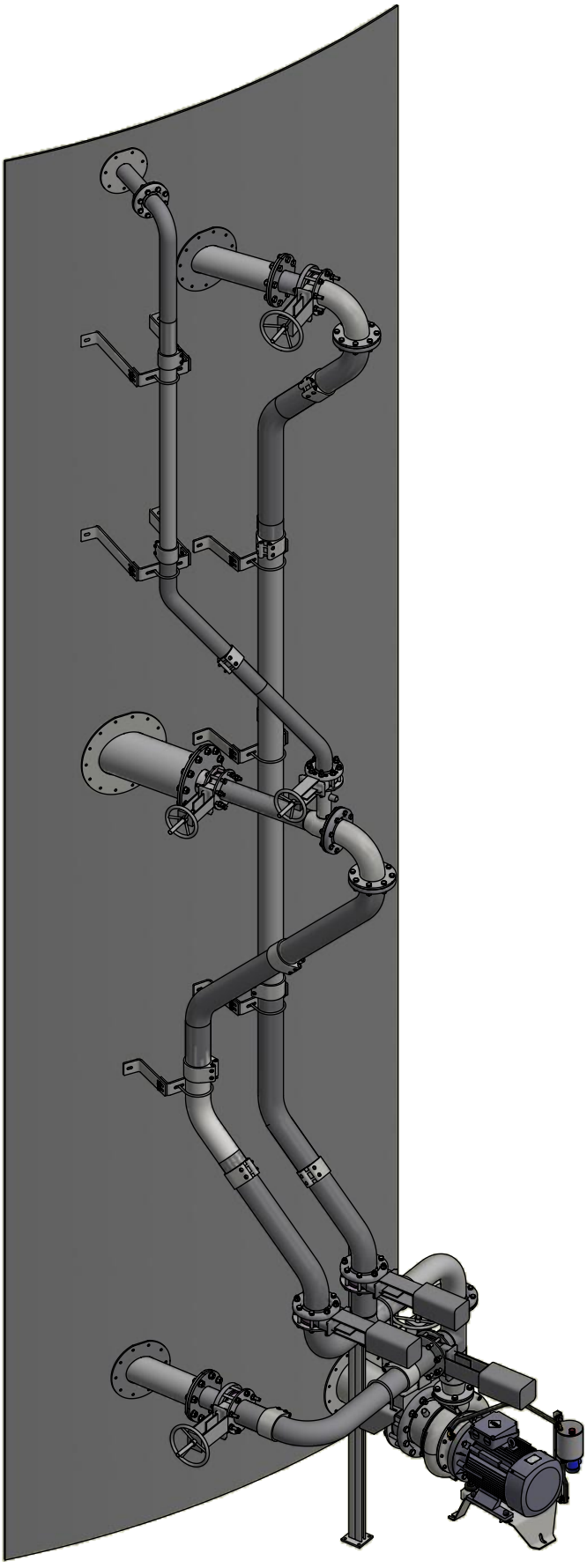
Landia

GasMix
Principtegning, schematic drawing
Dessin de principe, Prinzipskizze

Scale:	Sign.:		Date:
1 : 35	HL	KSK	23-04-2015

Dwg.no.: 3740920

Rev. date: 30-04-2020



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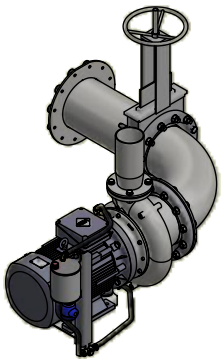

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		Dwg.no.: 3740921		
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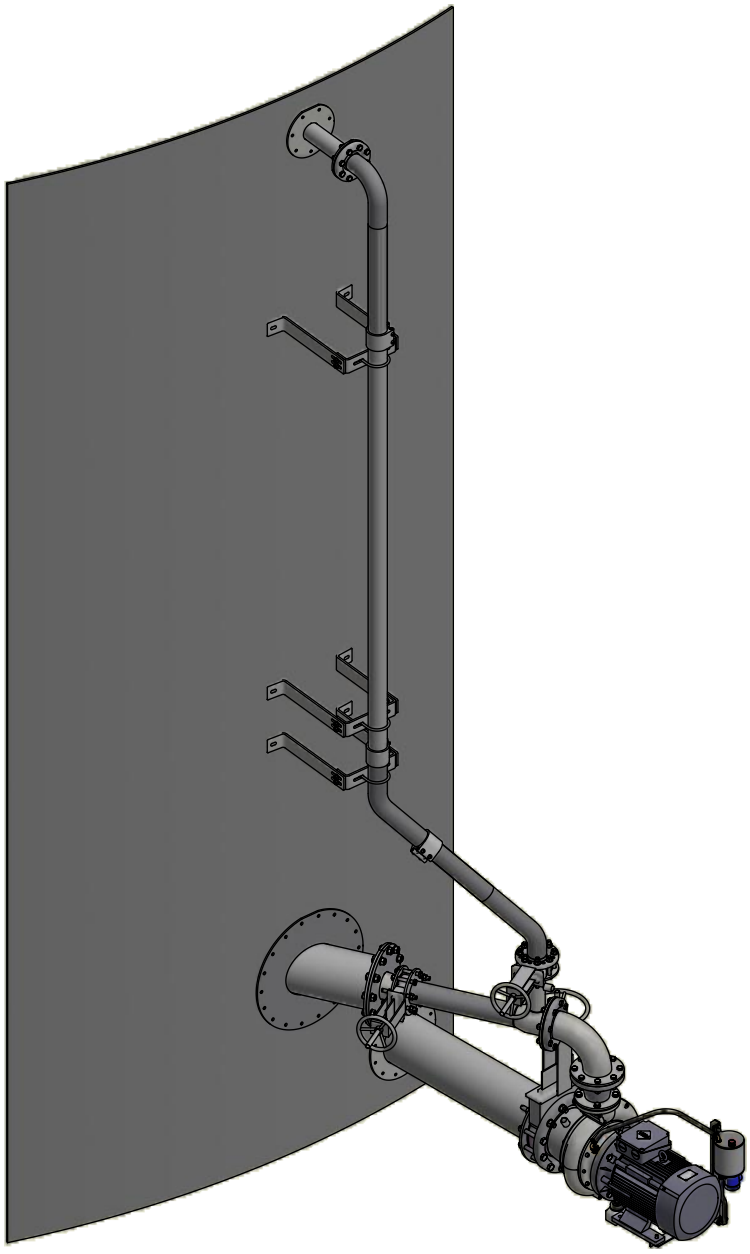

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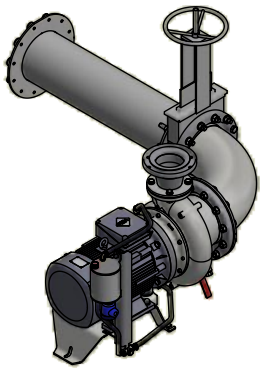

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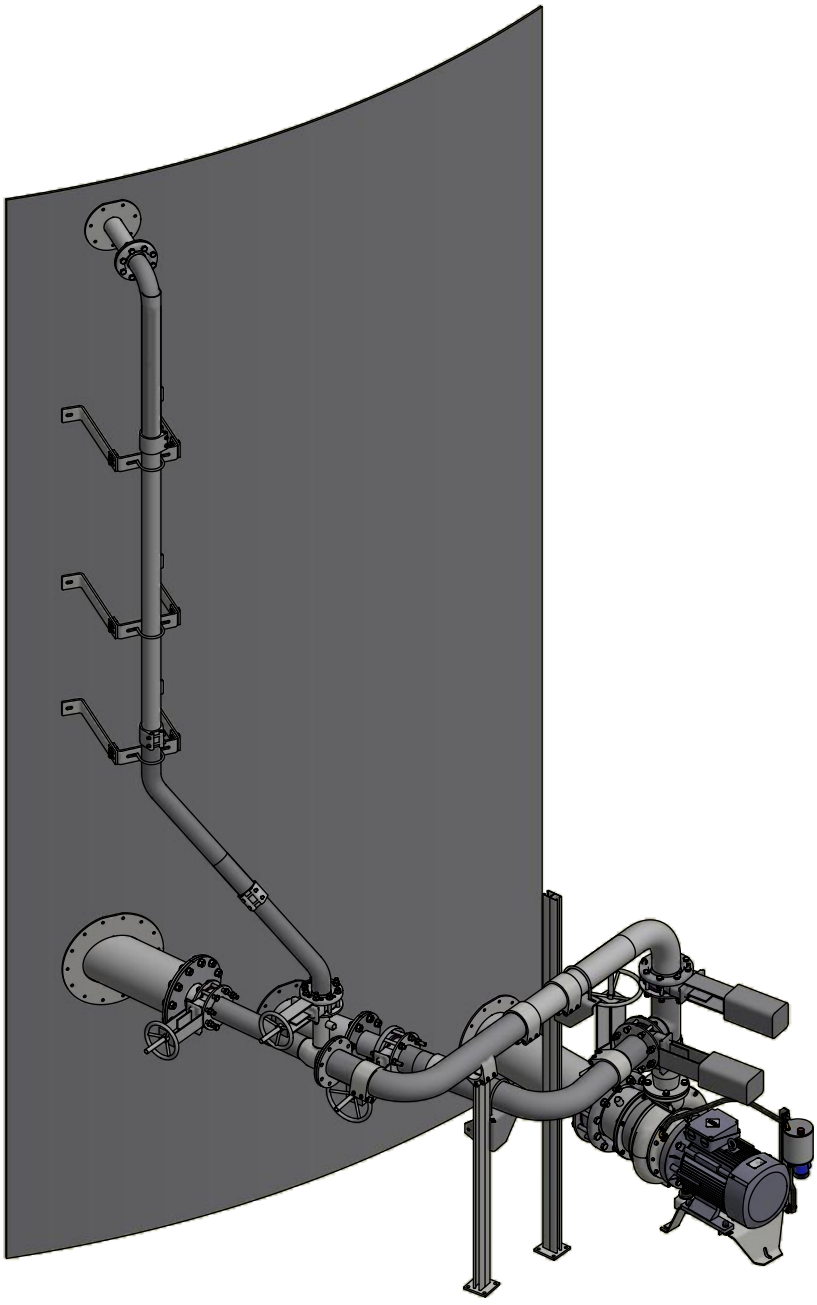
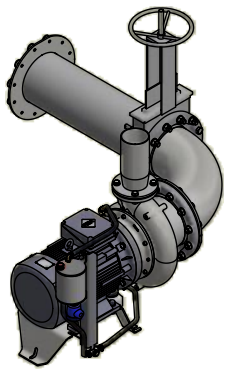
		Dwg.no.: 3740857		
		Rev. date: 18-09-2017		





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		Dwg.no.: 3740924		
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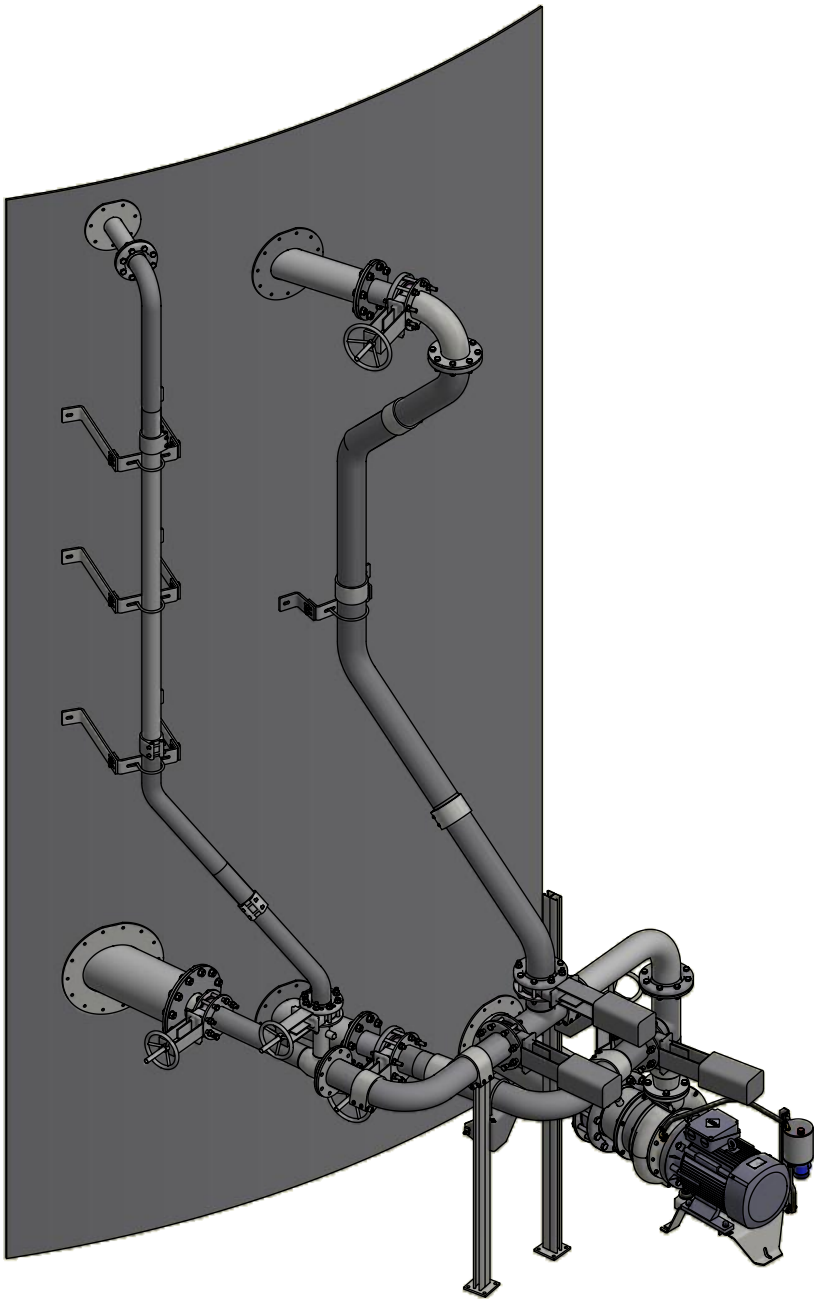

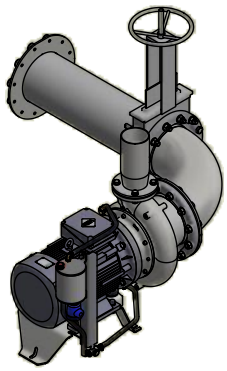

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Styret dokument

Landia	GasMix Principtegning, schematic drawing Dessin de principe, Prinzipskizze	Scale: 1 : 35	Sign.: CML KSK	Date: 07-04-2017
		Dwg.no.: 3740936		
		Rev. date: 18-09-2017		

MPTK-GI

The MPTK-GI chopper pump is an integrated part of the Landia GasMix System. The pump is ideal for pumping sludge with a high dry matter content. The knife system prevents clogging and ensures a steady chopping of organic material, leading to increased biogas production.

APPLICATION EXAMPLES

- Landia GasMix mixing system

PUMP RPM

1,500 rpm

MATERIAL OF CONSTRUCTION

Motor housing and oil chamber	Cast iron EN-GJL-250
Pump housing	Cast iron EN-GJL-250
Pump impeller	Cast iron EN-GJL-250 Cast iron EN-GJS-700-2 (optional) W1.4408/AISI316 (optional) not available for MPTK-I 105
Pump Shaft	W1.6582/AISI4340
Bolts	A4
Sealing system	Mechanical shaft seals: silicon carbide/silicon carbide
Knife system	Hardened steel W1.0038/S235JR W1.4404/AISI316 (optional) not available for MPTK-I 105
Extended knife system	Hardened steel W1.0038 (optional) W1.4404/AISI316 (optional) not available for MPTK-I 105
Oil type	15W-40 Vario HDX (with moisture detection)

SERVICE AND MAINTENANCE

Recommended service interval/oil change	Maximum 2,000 operating hours/minimum once a year
Motor	Lifetime lubricated bearings
Oil chamber	Periodic oil change

SURFACE TREATMENT

Machinery enamel: RAL 9005 (Jet Black)	Jet Black
2-component coating: RAL 7005 (Mouse Grey) (optional)	Mouse Grey

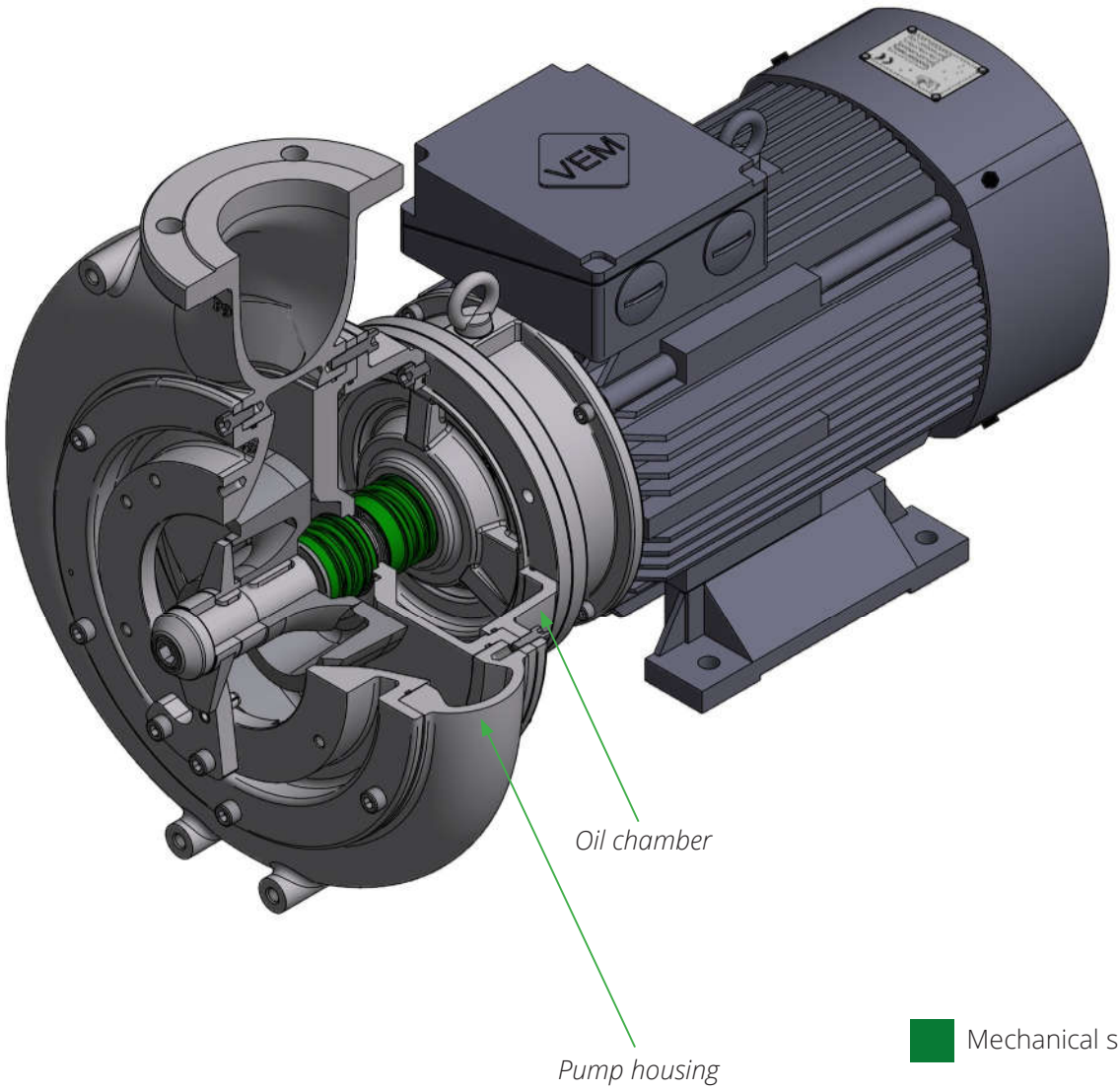
MONITORING FUNCTIONS

Thermistor 140 °C

Moisture detection system (optional)

DESIGN

The open pump impeller design enables the MPTK-GI pump to handle liquids with high viscosity. For liquids containing abrasive particles, such as sand, Landia has developed special materials so that the pump's life span is extended significantly in comparison to a standard pump.
MPTK-GI pumps are equipped with a knife system at the inlet of the pump, which ensures problem-free operation during the GasMix mixing process.



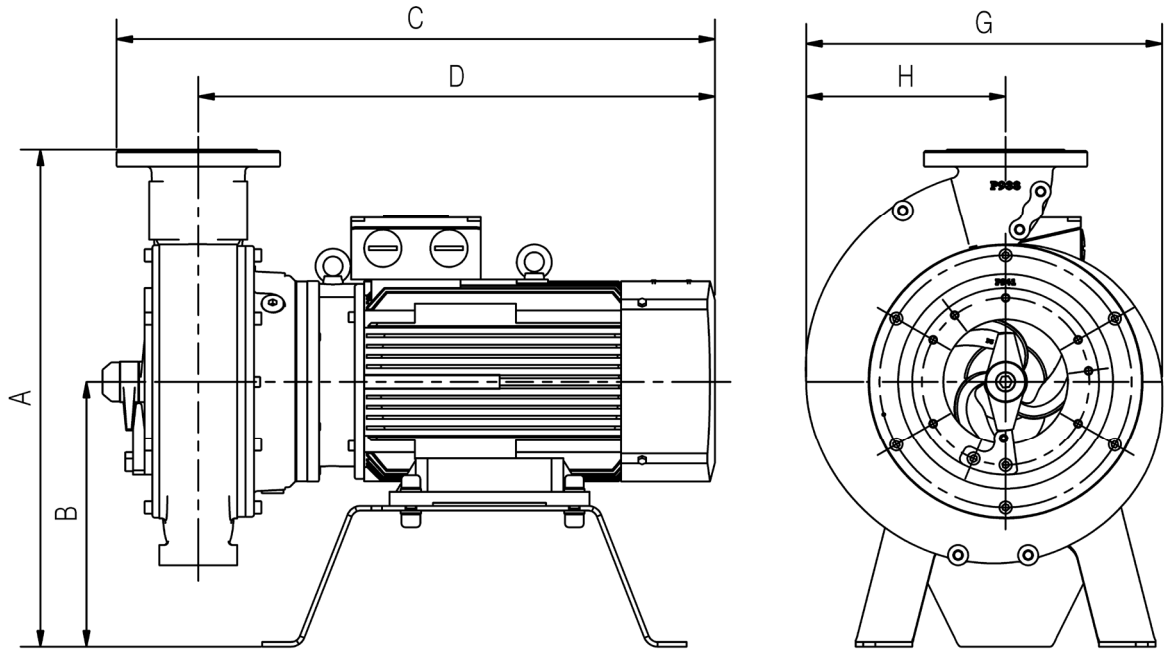
ELECTRICAL DATA

Motor type	3-phase AC motor
Nominal voltage	400 V
Minimum voltage allowed	360 V
Nominal frequency	50 Hz
Applicable for VFD operation	Yes
Ingress protection rating	IP 55
Insulation class	F

Model	Item number	Nominal power	Motor	Full load current (400 V)	Connection method	Start current (DOL)	cos phi	Efficiency
		[kW]	[rpm]	[A]	Y/Δ	[A]		[%]
MPTK-GI 105 15.0 kW-1,500 rpm	2514980	15.0	1,465	29.0	Δ	212	0.84	88.7
MPTK-GI 105 18.5 kW-1,500 rpm	2514981	18.5	1,460	35.0	Δ	238	0.85	89.3
MPTK-GI 105 22.0 kW-1,500 rpm	2514982	22.0	1,465	43.0	Δ	280	0.82	90.1
MPTK-GI 150 22.0 kW-1,500 rpm	2514680	22.0	1,465	43.0	Δ	280	0.82	90.1
MPTK-GI 150 30.0 kW-1,500 rpm	2514681	30.0	1,465	57.0	Δ	399	0.84	90.7
MPTK-GI 105 18.5/15.0 kW-1,500 rpm IE2	2534981	18.5	1,470	37.5	Δ	240	0.78	91.2
MPTK-GI 105 22.0 kW-1,500 rpm IE2	2534982	22.0	1,475	42	Δ	307	0.83	91.6
MPTK-GI 150 22.0 kW-1,500 rpm IE2	2534680	22.0	1,475	42	Δ	307	0.83	91.6
MPTK-GI 150 30.0 kW-1,500 rpm IE2	2534681	30.0	1,480	58.5	Δ	423	0.8	92.3

For voltages others than 400 V/50 Hz please refer to the attached Appendix.

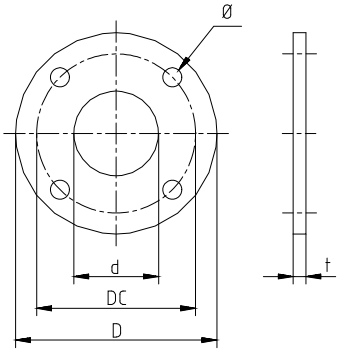
OVERALL DIMENSIONS



Model	Item number	A [mm]	B [mm]	C [mm]	D [mm]	G [mm]	H [mm]	Weight [kg]
MPTK-GI 105 15.0 kW-1,500 rpm	2514980	640	340	730	625	460	250	200
MPTK-GI 105 18.5 kW-1,500 rpm	2514981	640	340	730	625	460	250	210
MPTK-GI 105 22.0 kW-1,500 rpm	2514982	640	340	795	690	460	250	260
MPTK-GI 150 22.0 kW-1,500 rpm	2514680	822	380	870	725	580	320	330
MPTK-GI 150 30.0 kW-1,500 rpm	2514681	822	380	870	725	580	320	380
MPTK-GI 105 18.5/15.0 kW-1,500 rpm IE2	2534981	640	340	752	647	460	250	270
MPTK-GI 105 22.0 kW-1,500 rpm IE2	2534982	640	340	797	692	460	250	325
MPTK-GI 150 22.0 kW-1,500 rpm IE2	2534680	822	380	867	724	580	320	375
MPTK-GI 150 30.0 kW-1,500 rpm IE2	2534681	822	380	937	794	580	320	435

We reserve the right to make technical changes.

OVERALL DIMENSIONS WELDING FLANGE



Model/ Pump series	Article no.	Material	MPTK 50 - 65 – 80 - 105 DIN 2573 PN 6 Dim. [mm] MPTK 150 2576 PN 10 Dim. [mm]				
			D	DC	d	ø	t
MPTK-I 50	7713006	W1.0038/S235JR	ø110	90	ø52	4 x ø10	8
MPTK-I 65	7713052	W1.0038/S235JR	ø160	130	ø69	4 x ø14	8
MPTK-I 80	7713053	W1.0038/S235JR	ø192	150/160	ø82	4 x ø18	10
MPTK-I 105	7713054	W1.0038/S235JR	ø212	170/180	ø107	4 x ø18	10
MPTK-I 150	7713009	W1.0038/S235JR	ø285	240	ø152	8 x ø22	12

MPTKR-GI

The MPTKR-GI chopper pump is an integrated part of the Landia GasMix System. The pump is ideal for pumping sludge with a high dry matter content. The pump's knife system prevents clogging and ensures a steady chopping of organic material, leading to increased biogas production.

APPLICATION EXAMPLES

- Landia GasMix mixing system

PUMP RPM

1,500 rpm

MATERIAL OF CONSTRUCTION

Motor housing and oil chamber	Cast iron EN-GJL-250
Pump housing	W1.4408/AISI316
Pump impeller	W1.4408/AISI316
Pump Shaft	W1.4404/AISI316
Bolts	A4
Sealing system	Mechanical shaft seals: silicon carbide/silicon carbide
Knife system	W1.4404/AISI316
Extended knife system	W1.4404/AISI316 (optional)
Oil type	15W-40 Vario HDX (with moisture detection)

SERVICE AND MAINTENANCE

Recommended service interval/oil change	Maximum 2,000 operating hours/minimum once a year
Motor	Lifetime lubricated bearings
Oil chamber	Periodic oil change

SURFACE TREATMENT

Machinery enamel: RAL 9005 (Jet Black)	Jet Black
2-component coating: RAL 7005 (Mouse Grey) (optional)	Mouse Grey

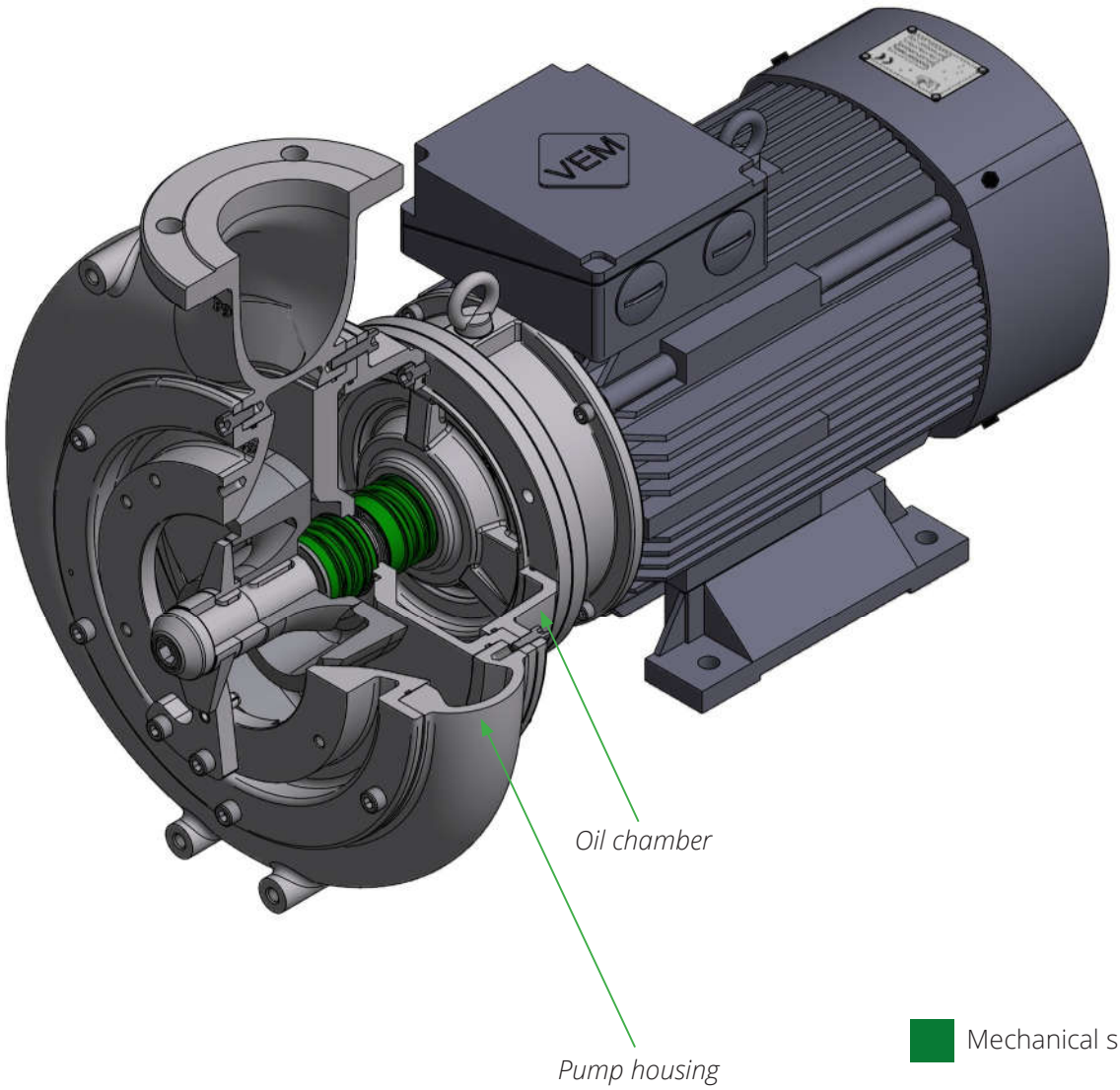
MONITORING FUNCTIONS

Thermistor 140 °C

Moisture detection system (optional)

DESIGN

The open pump impeller design means that the MPTKR-GI pump can pump liquids with a high viscosity. For liquids containing abrasive particles, such as sand, Landia has developed special materials so that the pump's life span is extended significantly in comparison to a standard pump.
MPTKR-GI pumps are equipped with a knife system by the inlet to the pump, which ensures problem-free operations during the GasMix mixing process.



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Nominal voltage	400 V
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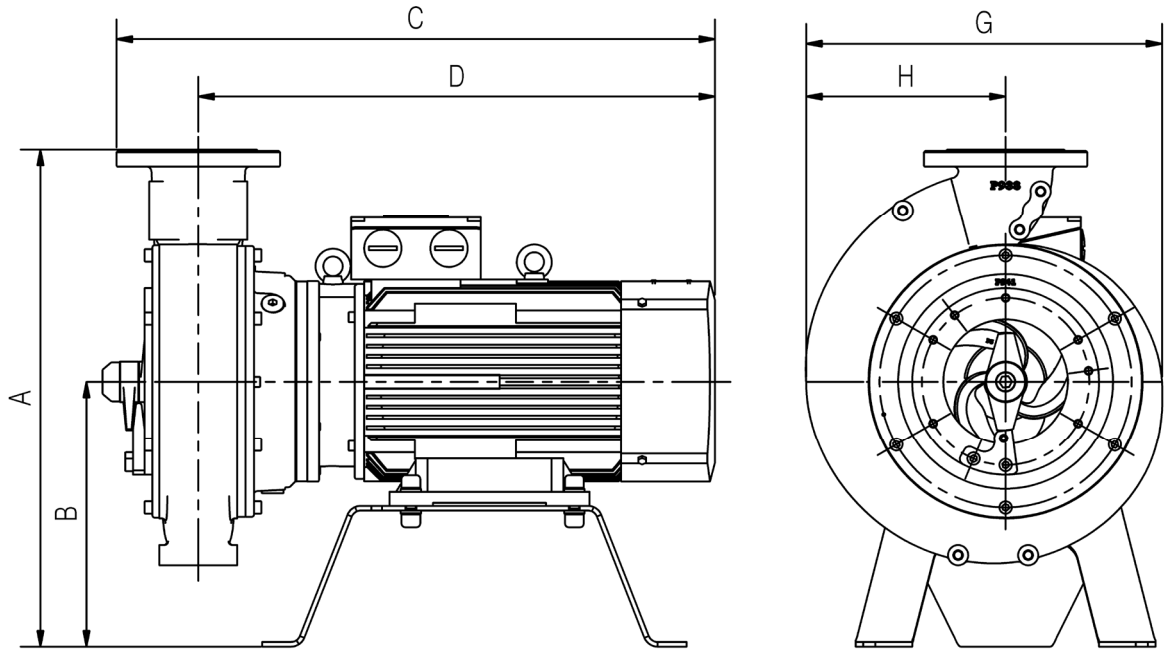
Nominal frequency	50 Hz
Applicable for VFD operation	Yes
Ingress protection rating	IP 55
Insulation class	F

Model	Item number	Nominal power	Motor	Full load current (400 V)	Connection method	Start current (DOL)	cos phi	Efficiency
		[kW]	[rpm]	[A]	Y/Δ	[A]		[%]
MPTKR-GI 105 15.0 kW-1,500 rpm	2514280	15.0	1,465	29.0	Δ	212	0.84	88.7
MPTKR-GI 105 18.5 kW-1,500 rpm	2514281	18.5	1,460	35.0	Δ	238	0.85	89.3
MPTKR-GI 105 22.0 kW-1,500 rpm	2514282	22.0	1465	43.0	Δ	280	0.82	90.1
MPTKR-GI 105 18.5/15.0 kW-1,500 rpm IE2	2534281	18.5	1,470	37.5	Δ	240	0.78	91.2
MPTKR-GI 105 22.0 kW-1,500 rpm IE2	2534282	22.0	1,475	42	Δ	307	0.83	91.6

For voltages others than 400 V/50 Hz please refer to the attached Appendix.

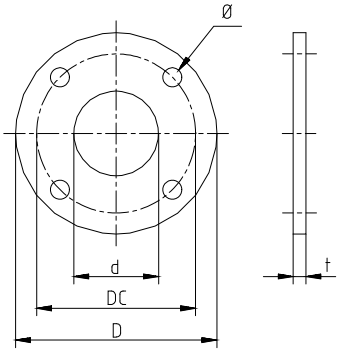
OVERALL DIMENSIONS



Model	Item number	A [mm]	B [mm]	C [mm]	D [mm]	G [mm]	H [mm]	Weight [kg]
MPTKR-GI 105 15.0 kW-1,500 rpm	2514280	640	340	730	625	460	250	218
MPTKR-GI 105 18.5 kW-1,500 rpm	2514281	640	340	730	625	460	250	228
MPTKR-GI 105 22.0 kW-1,500 rpm	2514282	640	340	795	690	460	250	270
MPTKR-GI 105 18.5/15.0 kW-1,500 rpm IE2	2534281	640	340	752	647	460	250	270
MPTKR-GI 105 22.0 kW-1,500 rpm IE2	2534282	640	340	797	692	460	250	325

We reserve the right to make technical changes.

OVERALL DIMENSIONS WELDING FLANGE



Model/ Pump series	Article no.	Material	MPTK 50 - 65 – 80 - 105 DIN 2573 PN 6 Dim. [mm] MPTK 150 2576 PN 10 Dim. [mm]				
			D	DC	d	ø	t
MPTK-I 50	7115021	W1.4404/AISI316	ø110	90	ø52	4 x ø10	8
MPTK-I 65	7715004	W1.4404/AISI316	ø160	130	ø69	4 x ø14	8
MPTK-I 80	7715005	W1.4404/AISI316	ø192	150/160	ø82	4 x ø18	10
MPTK-I 105	7715006	W1.4404/AISI316	ø212	170/180	ø107	4 x ø18	10
MPTK-I 150	7715025	W1.4404/AISI316	ø285	240	ø152	8 x ø22	12

LANDIA GASMIX

Anaerobic Digester Mixing System

1. **Landia GasMix Chopper Pump**
   A key component in the GasMix system is the chopper pump. In addition to providing the correct flow and pressure for the GasMix nozzles its integrated chopping device will chop solids into smaller particles, resulting in improved biogas process – and more biogas produced!

2. **GasMix Nozzle**
   The uniqueness of the Landia GasMix lies in the design of the GasMix nozzle. Years of development has gone into this to achieve the most efficient performance. When substrate is pumped through the GasMix nozzle biogas is sucked from the gas holding part of the digester, mixed with the substrate and injected under pressure back into the digester creating not only a horizontal mixing pattern but also a vertical pattern true 3D mixing.

3. **Mixing Nozzle – lower**
   The digester content is re-circulated through the lower mixing nozzle in order to create a rotational movement in the lower part of the tank and to avoid settlement at the tank floor.

4. **“Crust Breaker” Mixing Nozzle – upper**
   The digester content is re-circulated through the upper mixing nozzle in order to create a rotational movement in the upper part of the digester and to avoid, or even break down, crust on the liquid surface.

5. **Automated Valves**
   The Landia GasMix system is a flexible mixing system and the mixing process is controlled by means of a number of automated valves – pneumatic or electrical. This means the operation time of each nozzle is variable depending on the substrate characteristics and can be fine-tuned to provide effective mixing with the lowest possible parasitic load.

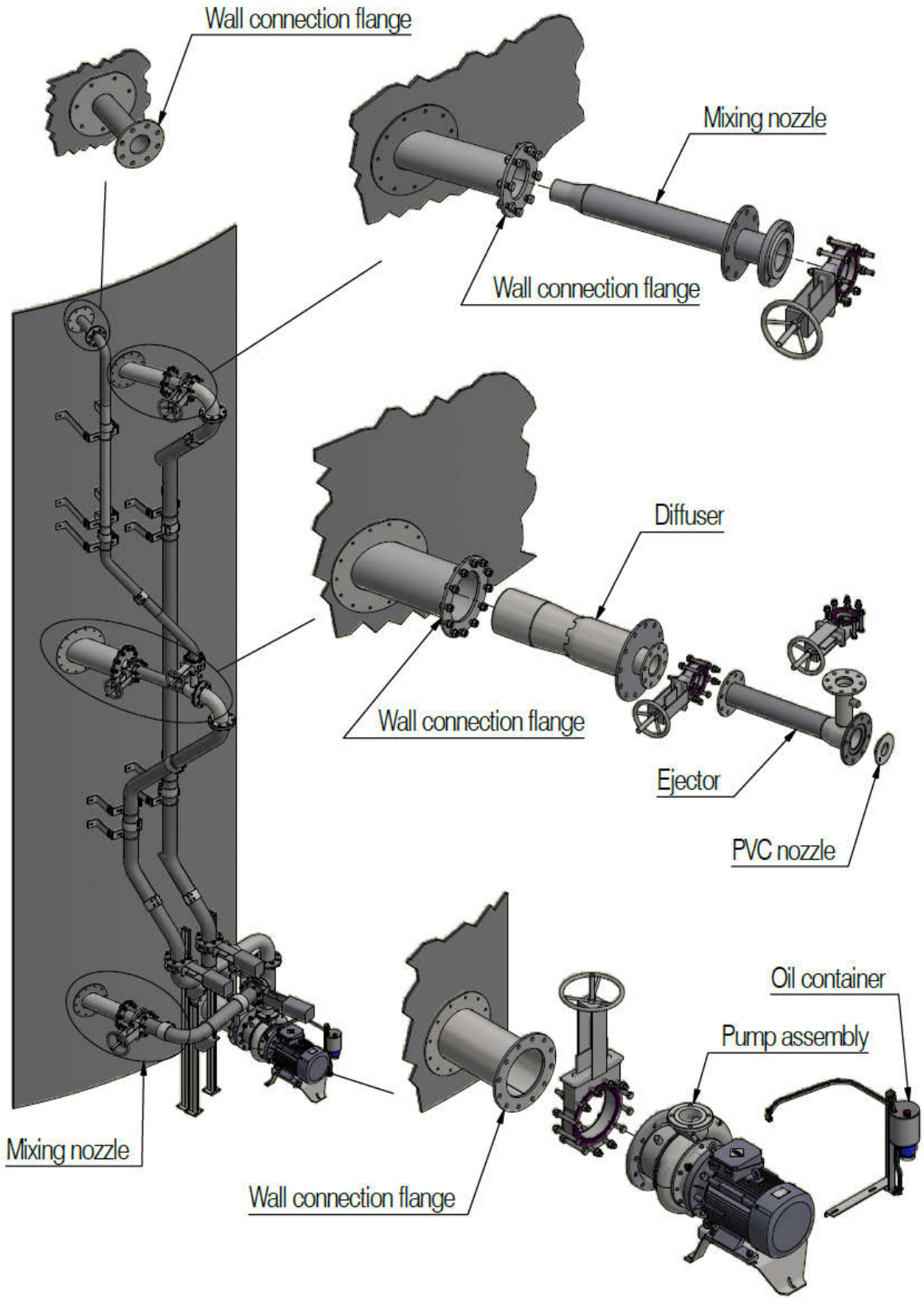
FIELD OF APPLICATIONS

- All types of digesters
- Pre-treatment tanks (e.g. hydrolysis tanks)
- Storage tanks (also with varying levels)

MATERIAL OF CONSTRUCTION

Pipework	Stainless steel (W1.4301) Mild steel (W1.0038) - *only used where the pipework is re-insulated* Pipe wall thickness min. 4.0 mm
Valves (casing / gate / gaskets)	Epoxy-treated W1.6025 / W1.4301 / NBR
Wall connection flanges Wall connection flange, gas connection	Stainless steel (W1.4301) Acidproof stainless steel (W1.4404)
Mixing nozzles	Stainless steel (W1.4301/Optional W1.4404) Nozzle wall thickness 6.0 mm
Ejector and diffuser	Stainless steel (W1.4301/Optional W1.4404) Diffuser wall thickness 6.0 mm
Ejector nozzle (PVC nozzle)	PE-HD 1000
Flex-couplings	Acidproof stainless steel (W1.4404) and EPDM-rubber
Bolts, washers and nuts	A4-80
Gaskets, flange- and valve	Steffca Universal 531320

SYSTEM COMPONENTS



TANK OPENINGS FOR NOZZLES AND WALL CONNECTION FLANGES

	Concrete tank (3730096)	Steel tank (3730097)
Gas connection	Ø 120 mm (DN80)	Ø 120 mm (DN80)
Mixing nozzles	Ø 186 mm, 25° (DN150) Ø 186 mm, 30° (DN150) Ø 276 mm, 0° (DN200)	Ø 200 mm, 25° (DN150) Ø 230 mm, 30° (DN150) Ø 250 mm, 0° (DN200)
GasMix diffuser	Ø 300 mm, 30° (DN250)	Ø 350 mm, 30° (DN250)
Inlet (pump suction)	Ø 300 mm, 0° (DN250) Ø 350 mm, 0° (DN300)	Ø 270 mm, 0° (DN250) Ø 350 mm, 0° (DN300)

The above table should only be considered indicative information. Landia always makes project specific installation drawings showing precise positions and dimensions of all supplied components.

TANK WALL LOADS

The tank supplier can use the below pressure stress as basis for dimensioning.

Axial pressure stress from mixing	< 800 N
Axial pressure stress from the diffuser	< 800 N
Vertical stress per nozzle*	< 1000 N

***All external pipework must be supported to relieve the tank and pump of weight loads from the piping system.**

GATE VALVES

Pneumatic, nominal supply pressure	6 bars (+/- 1 bar)
Required quantity of air, DN125 /	1.8 / 2.1 L air per stroke per valve
Voltage for pneumatic guide valve	24 VDC
Survaillance functions	2 pcs. inductive sensors for notification of positioning (optional) Control voltage 24 VDC

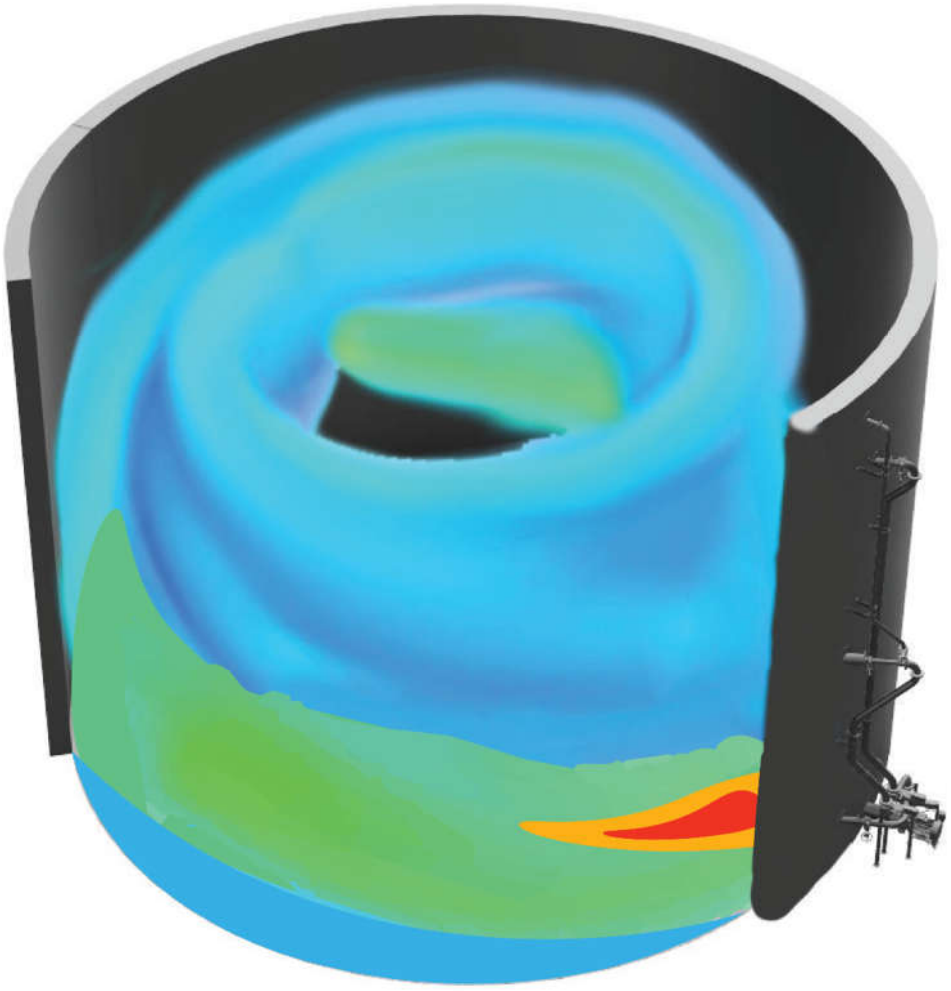
MIXING SYSTEM OUTPUT

Performance data for the specific installation isfacility and installation dependent. The composition of the sludge/biomass, the dry matter content and the temperature considerably affects the pump performance.

The Landia GasMix mixing pattern is unique due to both horizontal and vertical mixing. During operation the chopper pump continuously moves liquid from the bottom to nozzles positioned at different levels in the tank. This also contributes to effective heat distribution.

The mixing nozzles create powerful local mixing while the patented GasMix ejector draws biogas from the top of the tank and injects a liquid/gas mixture into the digester. The density of the biogas leads to it instantly going towards the top of the tank, which efficiently prevents the formation of crust.

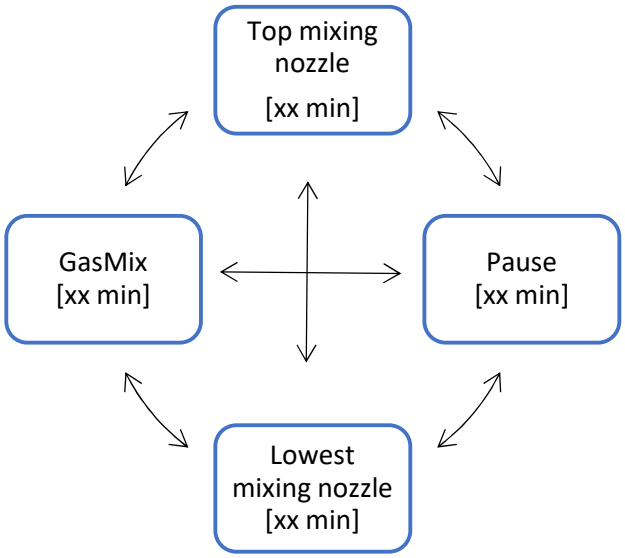
Liquid-flow for mixing nozzle	Up to 350 m^3/h
Liquid-flow for ejector and diffuser	Up to 350 m^3/h + 350 Nm^3/h
Nozzle pressure	Up to 2 bars



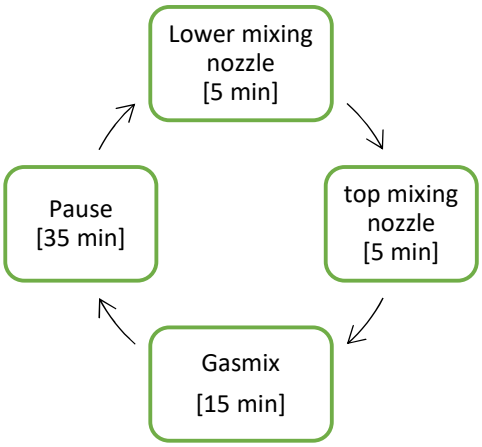
Visualisation of Landia GasMix with lowest mixing nozzle in operation (only depicted for illustrative purpose).

OPERATION CONTROL PHILOSOPHY

The GasMix mixing system is designed for sequence-controlled operation. This means that only one nozzle on each system is in operation at a time. If several GasMix systems are installed on one tank, the same nozzle on each system must be in operation at the same time. Hereby, powerful local mixing at all tank levels is achieved. Every nozzle is thereby in operation for a preset period, after which the system automatically switches to a new mixing- or pause sequence.
The pump always stops briefly when switching sequence. Please note that potentially explosive gas can never accumulate in the piping system, as valve "A" is always kept open during the pause sequence.



Landia GasMix PLC functions

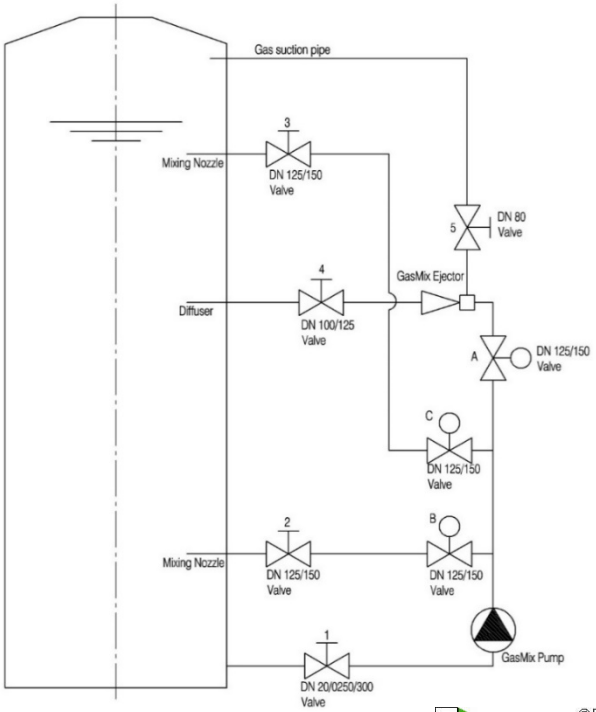


Example of regulated operational cycle

The local control panel itself and all associated software is not part of Landia's scope of delivery. The selected control system must as a minimum be able to handle the following functions:

- Individual programming of sequence timings
- Reorganisation of the sequences
- Start and stop of pump
- Control of pneumatic gate valves
- Feedback from the valves' inductive sensors
- Control of the pump's surveillance functions

Please note that Landia chopper pumps are well-suited for frequency regulated operation.

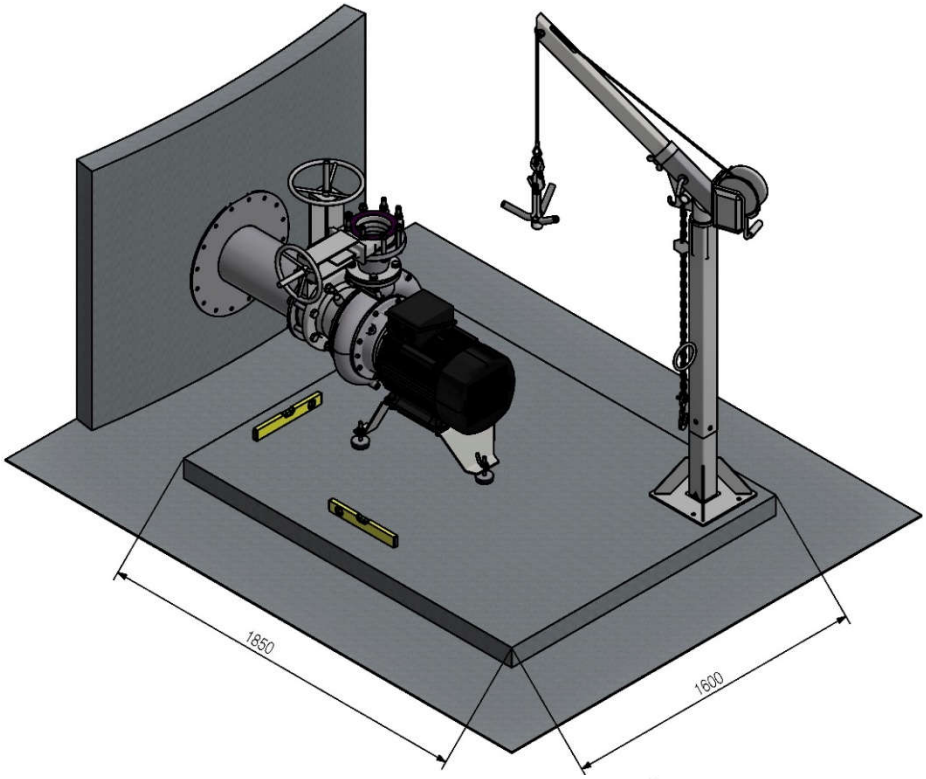


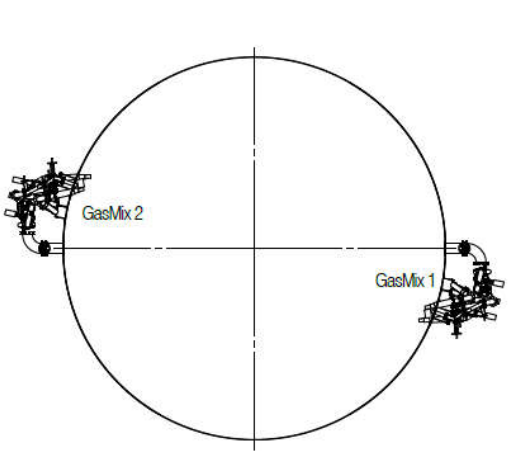
INSTALLATION CONDITIONS

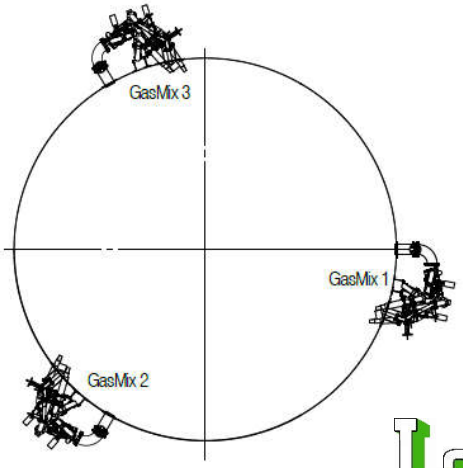
The mixing system must be located on a level and stable foundation. The pump must be in stable position during operation and not subject to weight effects on the inlet and outlet flanges. Thus, all weight effects from the piping system must be relieved on the foundation. Landia recommends installing a crane system with appropriate capacity for use during service- and repair tasks.

There should be at least one (1) meter around the pump to allow for proper maintenance and service. Likewise, the automatic gate valves should be accessible for maintenance and inspection.
The pump is equipped with a drain valve on the inlet side and it is recommended to establish a drain that can effectively divert the sludge/biomass at regular service.

Please also note that local environment and weather conditions may necessitate additional protection of the facility. Including e.g. establishing a canopy and/or frost protection of the pump and piping system.







The Landia GasMix system is a mixing system for digesters and biogas reactors. The system includes a dry installed 18.5–30.0 kW Landia chopper pump, as well as a range of manual and pneumatic gate valves. In this description, the starting point will be the associated PI diagram (drawing no. 3045269).

Please note that this description is thought of as a starting point for the operation of the Landia GasMix system. The final tune-in of the system must be performed by the operating staff at the facility.

The Landia GasMix system has five different operation sequences. The order of the sequences can be varied as needed. The change between these sequences occurs according to a clearly defined time period, which is set by the operating staff at the facility.

During the filling of the digesters, it is very important that the Landia GasMix operates enough, this is to prevent any buildup of crust on the surface and to make sure the digester content is homogenous.
At initialisation, Landia recommends that the pump operates 100% of the time, after which it is gradually adjusted towards the following operating times, as long as the tank remains well mixed.

Filling period

Liquid level below pump inlet + 1 m	stop pump
Liquid level under GasMix nozzle	only bottom nozzle operation
Liquid level over GasMix nozzle	15 min GasMix, 10 min bottom and zero pause.
Liquid level over top nozzle	according to the operations guide (always remember to make sure it is well mix before increasing pause time).

GasMix system operating sequence and time

Sequence 1: Mixing Phase Bottom	(approx. 5 min)
Sequence 2: Mixing Phase middle	(approx. 5 min)
Sequence 3: Mixing Phase Top	(approx. 10 min), or until movement on surface
Sequence 4: GasMix Phase	(approx. 15 min)
Sequence 5: Pause	(approx. 20 min)

However, it is important to emphasize that these values may only be considered as a recommendation that can be used at initialisation of the systems. Practical experiences and observations made by operating staff must therefore be the basis for the adjustment and optimisation of these times. Minimum operation time for each nozzle is 5 min.

Important

In all four operating sequences, all manual valves have to be fully opened.

Sequence 1, 2 and 3: Mixing Phase

In this phase, the mixing nozzle is operation to ensure sufficient mixing in the tank so that crust, or floating layer, is avoided. Only liquid is recirculated in this phase.

Parameter Overview					
Pump		On			
Valve No.		A	B	C	D
Mixing at the bottom (is used only if this nozzle is included)	nozzle B	Closed	Open	Closed	Closed
Mixing in the middle (is used only if this nozzle is included)	nozzle C	Closed	Closed	Open	Closed
Mixing at the top (is used only if this nozzle is included)	nozzle D	Closed	Closed	Closed	Open
GasMix treatment and mixing		Open	Closed	Closed	Closed

Note that in the mixing phase only one of the automatic valves for the mixing nozzles may be open at a time (B, C, or D) per GasMix pump.

Sequence 4: GasMix Phase

The mixing nozzle is stopped, and mixing is instead carried out by the gas ejector. The flow of liquid through the ejector nozzle causes biogas to be drawn through the gaspipe. The liquid is mixed with the biogas and recirculated back into the digester.

Parameter Overview				
Pump	On			
Valve no.	A	B	C	D
GasMix treatment and mixing	Open	Closed	Closed	Closed

Sequence 5: Pause

The pump is turned off (stopped) in this phase, with a purpose reducing the energy consumption.

In case of blocked biogas suction pipe

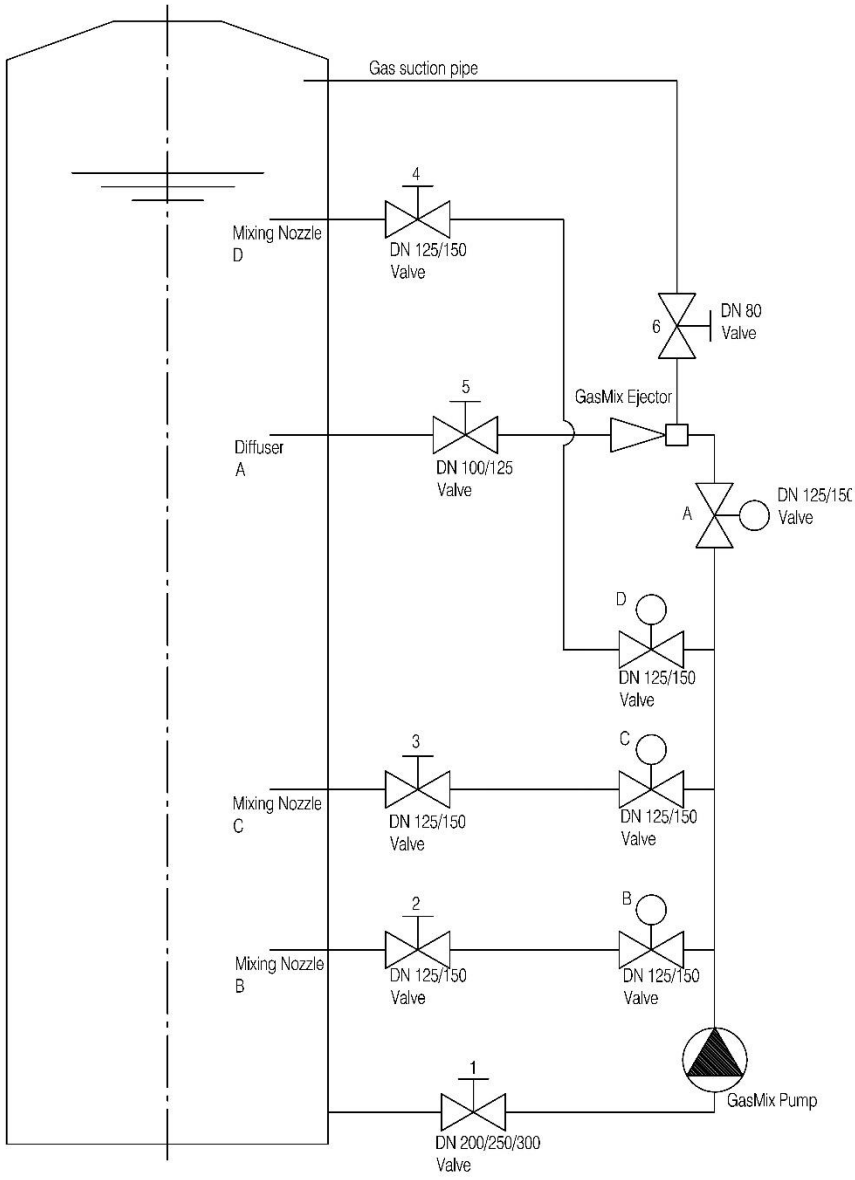
The pump is stopped. Valve 5 is closed manually and sequence 2 is run for 30 seconds. Afterwards, valve 5 is opened again and normal operation is resumed. If the gas pipe is still blocked, repeat the procedure.

Limit switch on pneumatic valves (Optional)

A limit switch is fitted (positioning indicators) on all pneumatic valves (A, B, C, and, possibly, D). Errors can be registered if the valve does not report as closed or open shortly after a signal has been sent.

Action

The pump is stopped, and the error is corrected. Emergency operation can optionally be continued by using manual valves (only in the case of closing errors).



Drawing 3045269

Service instruction

Gate valve

Pneumatic

ASSEMBLY AND STARTING INSTRUCTIONS:

All the valves, either handwheel or pnematic operated, can be fitted as desired (vertically, horizontally or even downward faced) according to its working.

The body of the valve should be correctly lined up with the flanges of the pipe to avoid stress. The fitting of the bolts into the blind holes will never touch the bottom of these holes, avoiding the filaments breakage.

The valve is suitable for the regulation of the fluid crossing, because the gate can be fitted in any intermediate position. For a better regulation it is recommended the use of special diaphragms in "V" or pentagonals.

In case of ***pneumatic operated valves*** before the starting operation it is very important to make sure that all air lines, electrovalves and cylinders have been checked and are completly cleaned by means of air. Filtered&clean air free of water is recommended, with a recommended pressure not higher than 7bar and not lower than 5bar. Cylinder are design to stand a maximum air supply pressure of 10 Bar.

*The watertightness proofs of the valves are in accordance with the pressures shown in the orders. In case this pressure has not been specified, the tests will be carried out at a mean closing pressure between 6 and 4Kgs, it depends on the diameter of the valve and 6Kgs. for compressed air.

*For the starting of large facilities, we have at your disposal the services of our trained staff, where standard working conditions will be applied for this type of operations.

VERY IMPORTANT

The pressure of the compressed air must be calculated according to the working pressure of the pipe. It is recommended to apply the minimum working pressure to guarantee the watertightness of the valve. A regulator of air inlet should be placed, if necessary.

MAINTENANCE OF VALVES

The ***handwheel operated valves*** are equipped with a lubricant which is in the maneouvering support. For a correct maintenance, it is recommended to lubricate at least, every 6 months.

For the correct performance of the valve, there are spare-parts to be replaced in case of damage of the valve, increasing the operational period of the valve. The spare-parts to be replaced are:
-The packing.
-The watertightness joints.
-The pneumatic cylinders.

Replacing of the packing:
Remove the system pressure and then the valve will be closed. Later on, release the gland and the packing will be replaced by a new one. Once the change is made, tighten the glan crosswise to avoid leakage.

Replacing of the watertightness joints:
The joint is placed in the body groove and it is fixed with a ring that is inserted under pressure. To replace the joint, remove the ring and place a new joint. Once the replacement is carried out, replace the ring under pressure.

Replacing of the pneumatic cylinders:
The pneumatic cylinders must be replaced when the two cylinder chambers are connected. This connection is due to the damage of the closing joints or sleeve.

VERY IMPORTANT

Suitable materials in contact with fluid (bodies, gates and joints) should be applied.

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VALVULAS ZUBI S.L.

INSTALLATION, OPERATION & MAINTENCE MANUAL

INDEX

DESCRIPTION

The 200 model knife gate is a uni-directional wafer valve designed for general industrial service applications. The design of the body and seat assures non-clogging shut-off with suspended solids.

HANDLING

When handling a ZUBI valve please pay attention to the following points:

- **Do NOT attach lifting gear to the valve actuators or gate guards**. They are not designed to bear the weight, and could easily be damaged.
- **Do NOT lift the valve by the valve bore**.
  This can cause damage to the seating surfaces and seals.

Ideally when using lifting gear to move a ZUBI valve, it should be supported by two or more eyebolts screwed into the tapped fixing holes in the valve body.

SAFETY WARNING:

- Check that the lifting gear is rated to carry the weight of the valve.
- Make sure the eyebolts have the same thread as the boltholes and that they are well secured.

During installation it is recommended to lift the valve via soft straps. These can be to the upper part of the valve body.

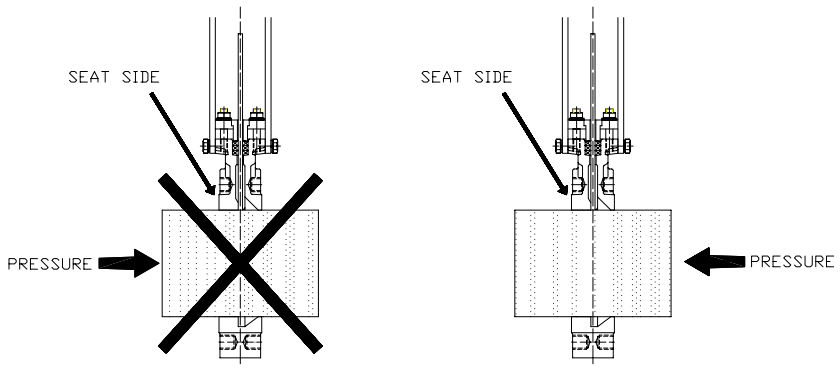
INSTALLATION

To avoid personal injury or damage to property from the release of process fluid:

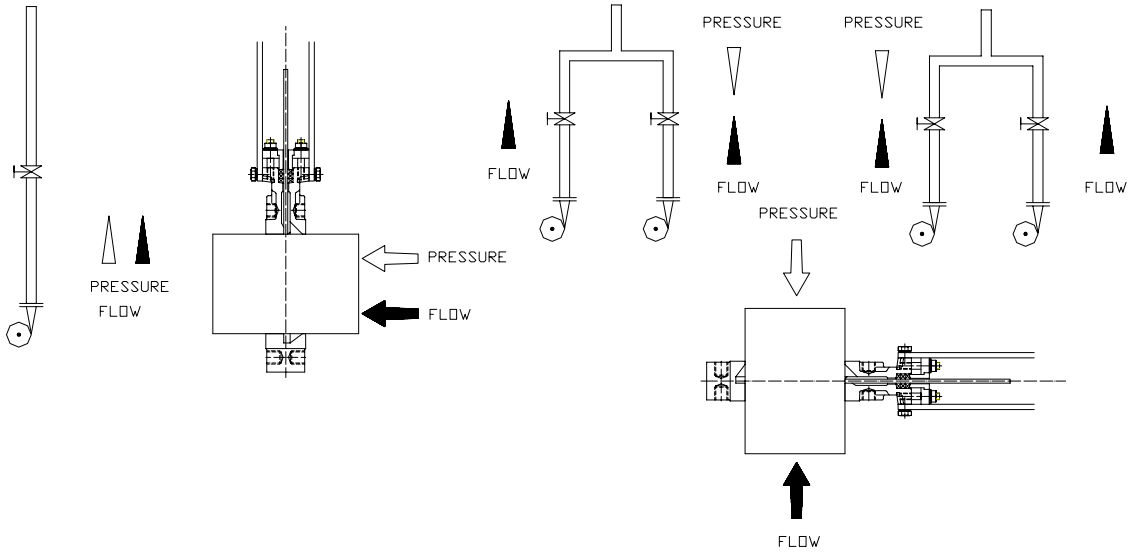
- Those in charge of handling and maintenance of the valve must be qualified and trained in valve operations.
- Use appropriate personal protection equipment (gloves, safety shoes, etc).
- Shut off all operating lines to the valve and place a warning sign.
- Isolate the valve completely from the process.
- Release process pressure.
- Drain the process fluid from the valve.

Before installation, inspect the valve body and components for any damage that may have occurred during shipping or storage. Make sure the internal cavities within the valve body are clean. Inspect the pipeline and mating flanges, making sure the pipe is free of foreign material and that the flanges are clean.

The valve is unidirectional. It should be installed with pressure exerted against the seat. The words “SEAT SIDE” are marked on the valve body to indicate the position of the valve seat. Installation and the correct orientation with respect to the direction of the flow is the responsibility of the user.



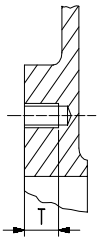
It should be noted that the direction of flow and differential pressure, do not always coincide.



Special care should be taken to maintain the correct distance between the flanges and to ensure that they are parallel to the valve body. Incorrect alignment of the valve can cause deformations, which can lead to difficulties in operation.

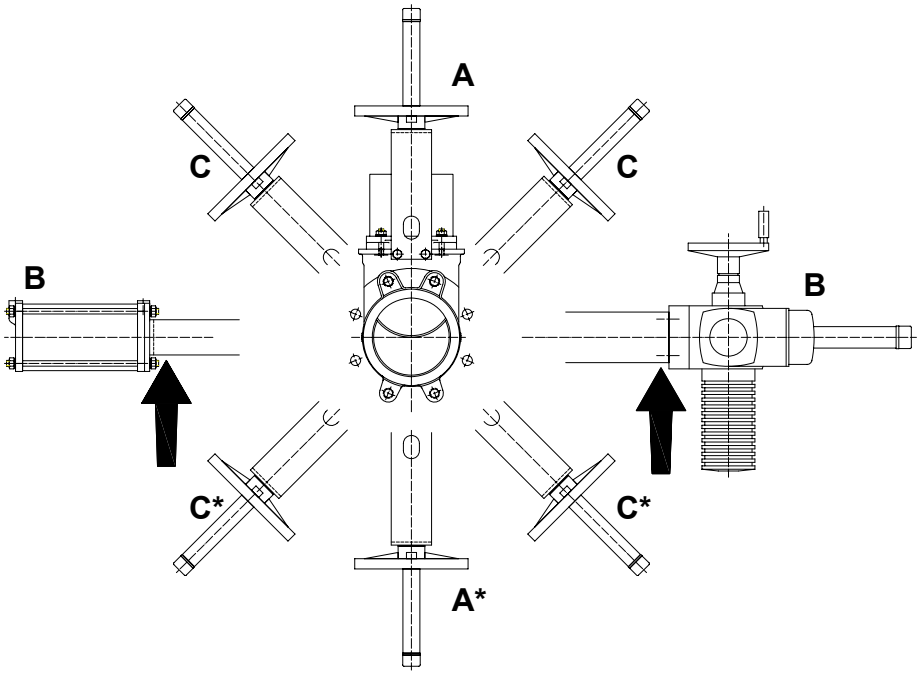
The following table gives the maximum torque values for the valve fixing bolts. Also shown is the maximum depth (T) allowed for the tapped blind boltholes drilled into the valve body.

DN	50	65	80	100	125	150	200	250	300	350	400	450	500	600	700	800	900	1000
T (mm)	10	10	10	10	10	14	14	18	18	22	24	24	24	24	20	20	20	20
Kg.m	6	6	6	6	7	7	7	11	11	15	15	19	19	23	23	28	28	34



The valve can be mounted in any position with regard to the pipe. However, it is advisable to place it vertically in horizontal pipeline (A) if the installation allows it. (Please consult the technical department).

With larger diameters (> 300 mm), heavy actuators (pneumatic, electric, etc.), or with the valve installed horizontally (B) or at an angle (C) on a horizontal pipeline, the installation will require the construction of suitable supports. (See the following diagram and consult the technical department).



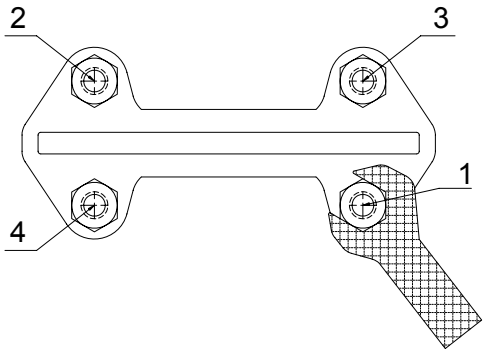
** For these positions please consult sales dept.*

In vertical pipelines, the construction of suitable supports is always required (for further information please consult the technical department).

Once the valve is installed, test that the flanges have been fastened correctly and that all electrical and/or pneumatic connections have been properly made.

Where electric accessories are mounted on the valve (i.e. solenoid valves, electro-pneumatic positioners, etc.), the valve must be earthed correctly before being put into operation.

First, operate the valve with no flow in the pipeline. Then test operation and valve seal with flow. It should be noted that the packing material might settle in shipping/storage, which can cause minor leakage. This can be remedied by tightening the gland follower (5) during installation. The nuts shall be tightened gradually and crosswise until the leakage stops (see the next figure). Check that there is no metal contact between the glandfollower (5) and the gate (2).



If the glandfollower nuts are pulled to hard, the force needed to operate the valve will increase, the valve function will be affected and the box packing lifetime will be shortened.
The table below shows the maximun torque value for tightening the glandfollower nuts.

ND	Torque (N.m)
50 - 100	20
125 - 200	30
250 - 1000	35

Once performance has been tested, the valve can be put into operation.

Approximate weight of the handwheel-operated valve (rising stem):

DN	50	65	80	100	125	150	200	250	300	350	400	450	500	600	700	750	800	900	1000	1200
Weight(Kg)	7	8	9	11	15	18	30	44	58	96	124	168	192	245	405	455	512	680	865	1055

ACTUATORS

Handwheel

To open the valve turn the handwheel (11) anticlockwise. To close turn the handwheel clockwise.

Lever

To operate the valve with this device, first loosen the locking clamp located on the top of the yoke (8). Then either open or close the valve by moving the lever in the desired direction. Finally, fix the position of the lever with the locking clamp.

Pneumatic

Valves are usually supplied with a double acting pneumatic actuator although, upon request, we can supply single-acting actuators. In both cases, the inlet air pressure should be, between 3,5 to 10 Kg/cm^2.

It is essential for a good maintenance of the cylinder that air should be well dried, filtered and lubricated.

It is recommended to actuate the cylinder 3-4 times before the start up, once it is installed in the pipeline.

Electric actuator

Depending on the type or make of the electric actuator, specific instructions (i.e. a manufacturer's manual) will be supplied.

MAINTENENCE

To avoid personal injury or damage to property from the release of process fluid:

- Those in charge of handling and maintenance of the valve must be qualified and trained in valve operations.
- Use appropriate personal protection equipment (gloves, safety shoes, etc).
- Shut off all operating lines to the valve and place a warning sign.
- Isolate the valve completely from the process.
- Release process pressure.
- Drain the process fluid from the valve.

The only maintenance required is to change the gland packing (4) or the seal (3) if the valve is a resilient seated type.

The life of these elements will depend on the working conditions of the valve such as: pressure, temperature, abrasion, chemical action, number of operations, etc.

- Replacement of the gland packing (4):

1) Depressurise the circuit and place the valve in close position.
2) Remove the gate guards (for automatically actuated valves only).
3) - Rising stem valves.Photo 1: Release the spindle or stem (6) from the gate (2).
   - Non rising stem.Photo 2: Release the stem nut from the gate (2).

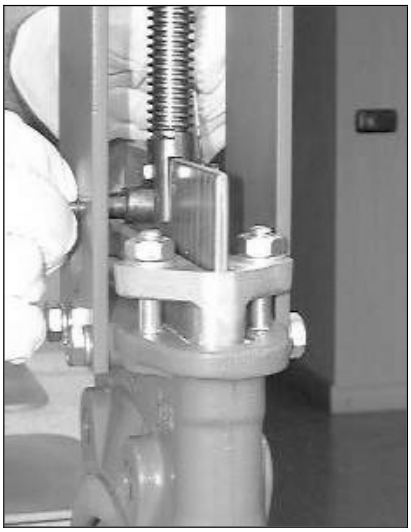


Photo 1

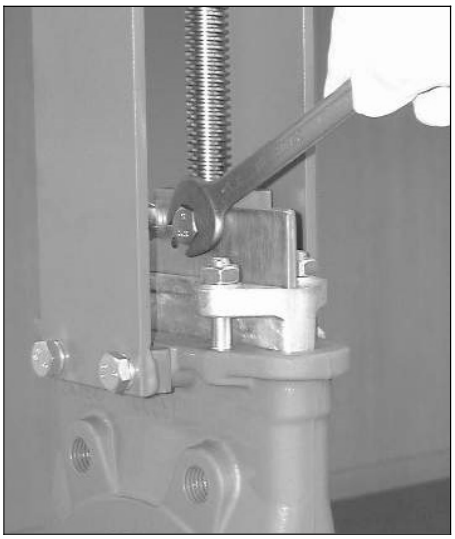


Photo 2

4) Loosen the screws of the yoke (8) and remove it (without loosing the actuator).
5) Loosen the nuts of the gland follower (5) and remove it. (Photo 3)
6) Remove the old packing rings (4) and clean the stuffing box.
7) Insert the new packing rings (4), making sure that the ring joints alternate (the first on one side of the gate, the next on the other and so on). (Photo 4)
8) Once the necessary packing rings (4) have been inserted, proceed with a steady initial tightening of the gland follower (5).(Photo 3)
9) Place the yoke (8) (with the actuator) and screw it.
10) Fix the stem (6) to the gate (2)(Rising stem valves.Photo 1) or fix the stem nut to the gate.(Non rising stem.Photo 2).
11) Remount the gate guards.

12) Carry out some operations with a loaded circuit and then re-tighten the gland follower (5) to prevent leakage.

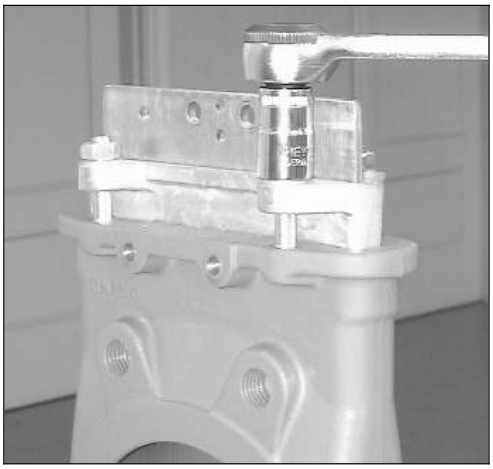


Photo 3

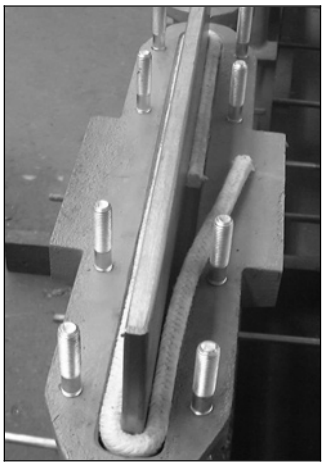


Photo 4

- Replacement of the seal (3) (only applicable to resilient seated valves):

1) Remove the valve from the pipeline.
2) Remove the gate guards (for automatically actuated valves only).
3) Release the spindle or stem (6) from the gate (2).(Rising stem valves.Photo 1) or release the stem nut from the gate.(Non rising stem.Photo 2).
4) Loosen the screws of the yoke (8) and remove it (without loosing the actuator).
5) Loosen the nuts of the gland follower (5) and remove it.(Photo 3)
6) Remove the old packing (4) and the gate (2) and clean the stuffing box.
7) Remove the seal retainer ring (10) which support the seals (3).
8) Remove the worn seal (3) and clean the seal housing.
9) Once the new seal (3) is cut according to size, insert it into the seat housing (making sure that the union of the seal is at the top). (Photos 5 and 6)

   If the valve has PTFE seal (3), follow next point.

   <u>Seal lengths</u>

ND	50	65	80	100	125	150	200	250	300	350	400	450	500	600
Lengths (mm)	205	255	295	365	440	510	680	860	1020	1190	1350	1510	1630	2010

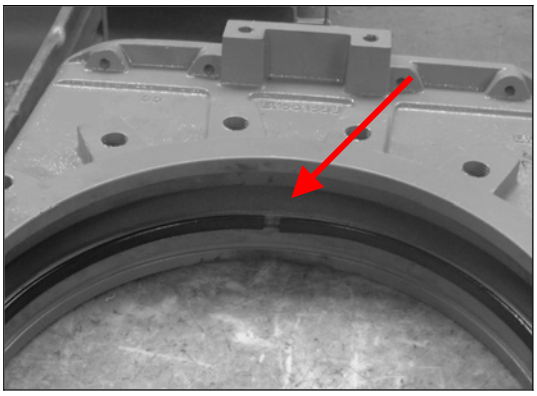


Photo 5

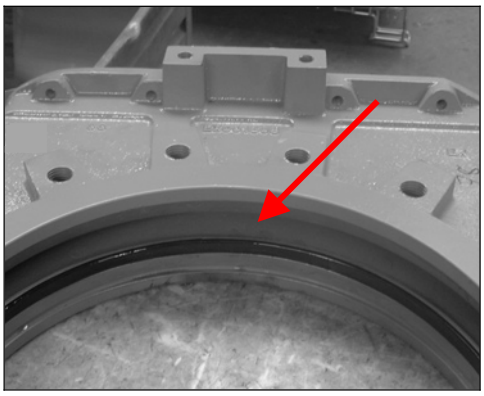


Photo 6

10) Insert the seal retainer ring (10) by hammering gently around the edge. (Photos 7 and 8)

Photo 7

Photo 8

11) Remount the gate (2).
12) Once the necessary packing rings (4) have been inserted, proceed with a steady initial tightening of the gland follower (5).(Photo 3) following the steps of point 4.1.

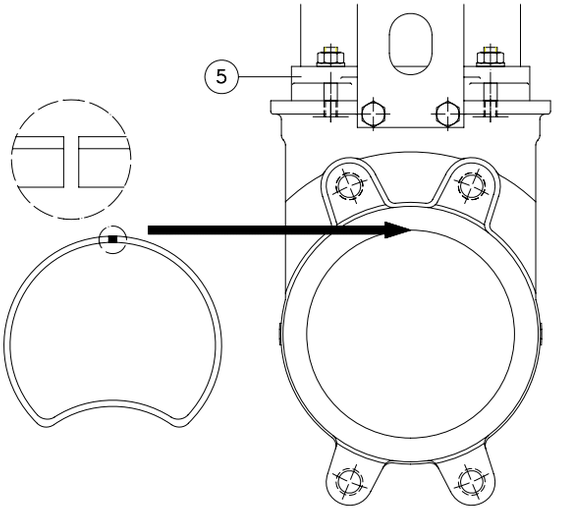
- Replacement of the PTFE seal (3):

Follow the same procedure as before but with following notes:

1. To obtain a tighter shut off in stainless steel valves (CF8M body), the machined housing of the seat is sealed with a plastic glue. This is not necessary in cast iron valves (GG25).
   With the seal in this position:

2. Make a circle, joining the ends and making a heart-shaped form (see the following diagram).

3. Insert both ends of the seal in the upper side of the machined housing of the seat (adjacent to the gland follower (5)), and pushing the arched part with a finger, insert the seal into the housing.
   If the diameter of the valve is small (up to DN150) a vice can be used.



- Lubrication:

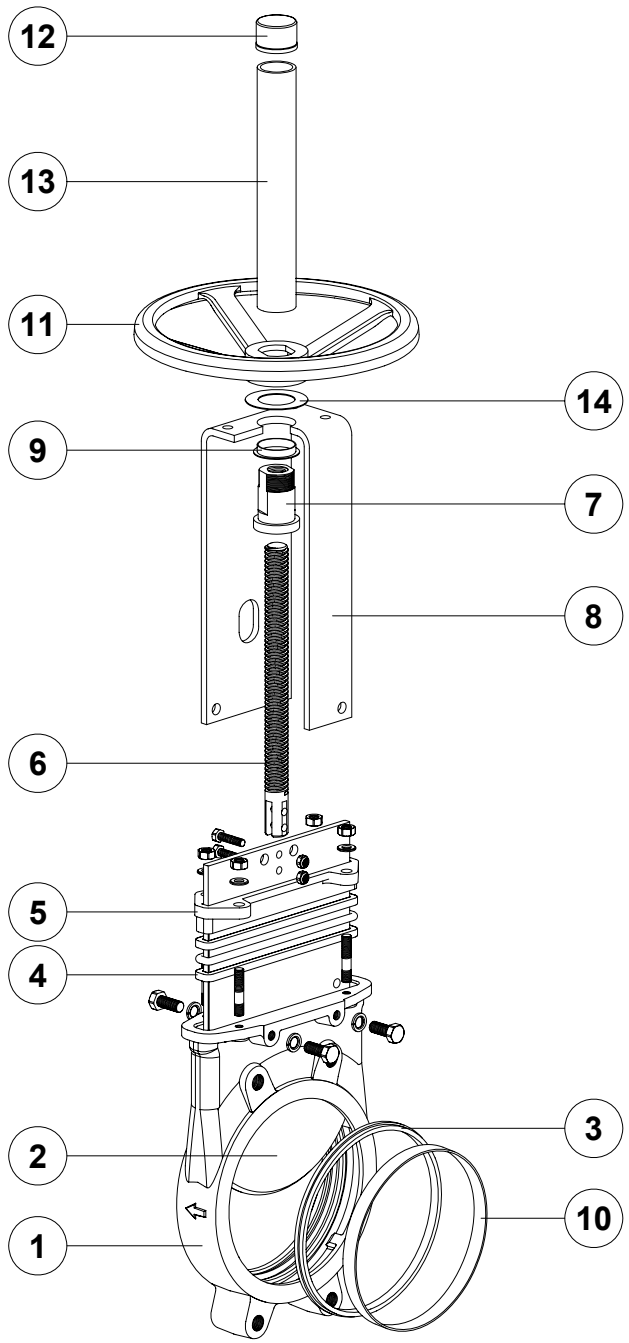
  Twice a year, it is recommended to remove the protection cap (12) and fill up the stem protector (13) halfway with a calcium-based grease with the following characteristics: highly water resistant, low ash content, and excellent adherence.

STORAGE

For long periods it is recommended to store the valves in a well-ventilated room. Valves should not be exposed to temperatures higher than 30ºC, as some soft seal materials can be damaged when exposed to higher temperatures.

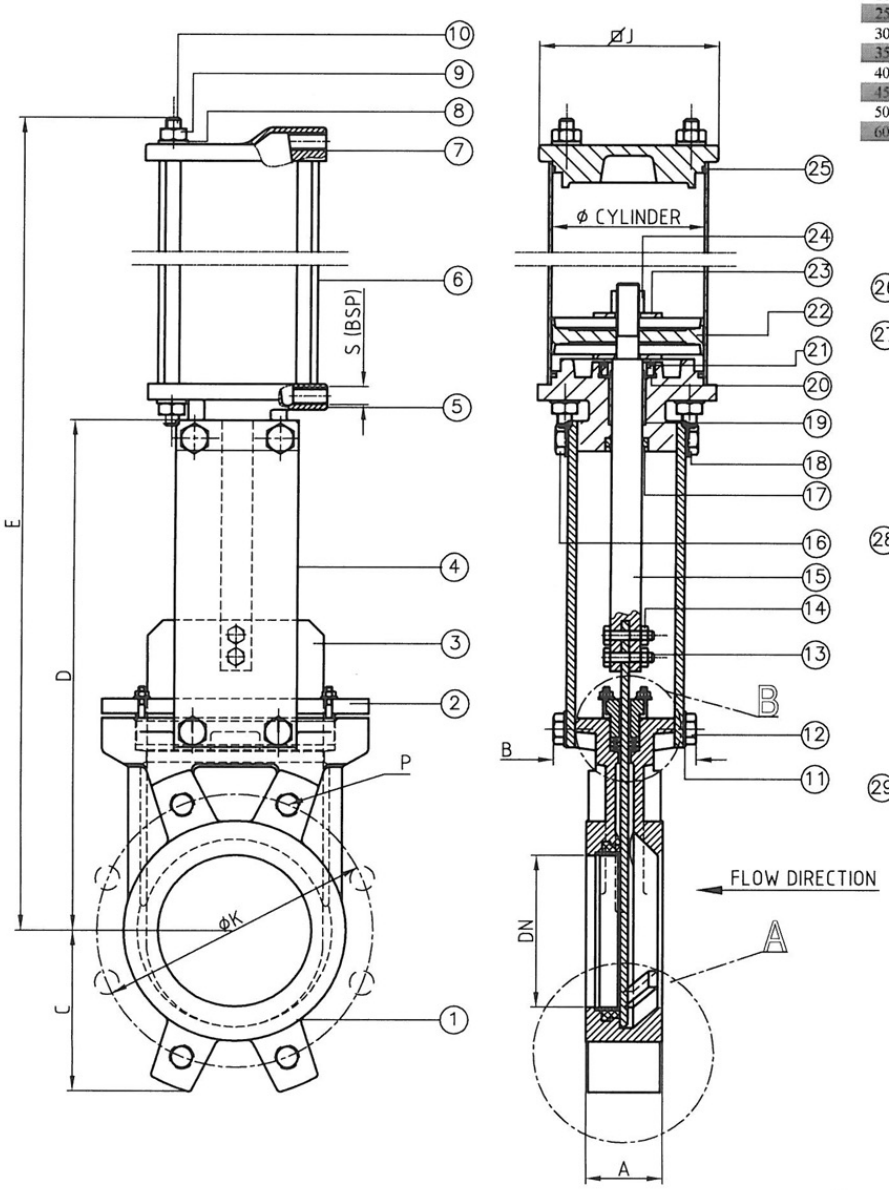
If outdoor storage cannot be avoided, cover the valve and protect it from sources of heat or direct sunlight. Provide good ventilation to avoid moisture.

PART LIST & DRAWING



1.- BODY
2.- GATE
3.- SEAL
4.- PACKING RING
5.- GLAND FOLLOWER
6.- STEM
7.- STEM NUT
8.- YOKE
9.- COLLAR
10.- SEAL RETAINER RING
11.- HANDWHEEL
12.- CAP
13.- STEM PROTECTOR
14.- FRICTION WASHER

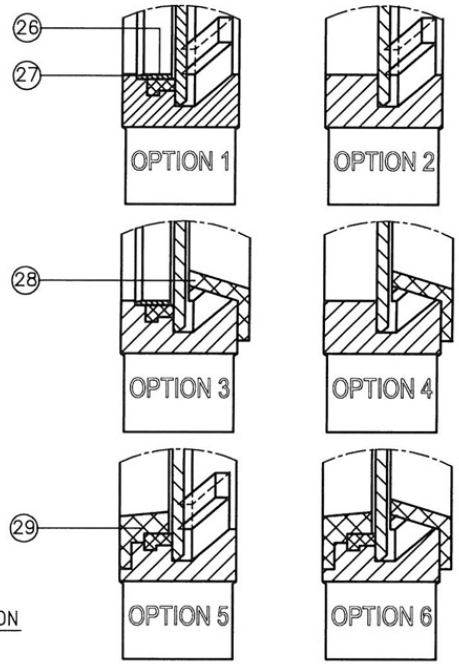
KNIFE GATE VALVE
200EA D/A(PNEUMATIC ACTUATOR)



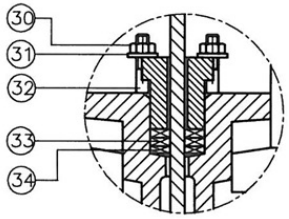
DN	INCHES	A	B	C	D	E	Ø CYLINDER	Ø J	S (B.S.P)
50	2"	40	90	60	240	410	80	102,5	1/4"
65	2 1/2"	40	90	68	270	456	80	102,5	1/4"
80	3"	50	90	90	295	500	80	102,5	1/4"
100	4"	50	90	105	335	560	100	122	1/4"
125	5"	50	100	118	370	640	125	147	1/4"
150	6"	60	100	135	418	716	125	147	1/4"
200	8"	60	120	170	522	880	160	182	1/4"
250	10"	70	120	202	625	1042	200	229	1/4"
300	12"	70	120	240	725	1182	200	229	1/4"
350	14"	96	192	255	845	1360	250	281	3/8"
400	16"	100	192	295	945	1540	250	281	3/8"
450	18"	106	192	318	1045	1675	300	343	3/8"
500	20"	110	192	345	1148	1840	300	343	3/8"
600	24"	110	290	405	1360	2145	300	343	3/8"

DN	INCHES	ØK		P		
		PN 10	ANSI 150	No.HOLES	PN 10	ANSI 150
50	2"	125	120,6	4	M16	W 5/8"
65	2 1/2"	145	139,7	4	M16	W 5/8"
80	3"	160	152,4	8	M16	W 5/8"
100	4"	180	190,5	8	M16	W 5/8"
125	5"	210	215,9	8	M16	W 3/4"
150	6"	240	241,3	8	M20	W 3/4"
200	8"	295	298,4	8	M20	W 3/4"
250	10"	350	361,9	12	M20	W 7/8"
300	12"	400	431,8	12	M20	W 7/8"
350	14"	460	476,2	16	M20	W 1"
400	16"	515	539,7	16	M24	W 1"
450	18"	565	577,8	20	M24	W 1 1/8"
500	20"	620	635	20	M24	W 1 1/8"
600	24"	725	749,3	20	M27	W 1 1/4"

SEAT OPTIONS



DETAIL B



REF.	DENOMINACION	MATERIAL	MATERIAL
1	Body	Cast iron GG25	SS316
2	Packing gland	Aluminium/GGG50	SS316
3	Gate	SS304L	SS316L
4	Support plate	Steel	Steel
5	Lower cup	Aluminium	Aluminium
6	Pneumatic tube	Aluminium	Aluminium
7	Upper cup	Aluminium	Aluminium
8	Washer	Steel	A2
9	Nut	Steel	A2
10	Tie rod	Steel	A2
11	Grower washer	Steel	A2
12	Bolts	Steel	A2
13	Union studs stem-gate	Steel	A2
14	Union nuts stem-gate	Steel	A2
15	Stem	SS303	SS303
16	Nut	Steel	Steel
17	Scraper	NBR	NBR
18	Actuator fixing nut	Steel	Steel
19	Gasket	Bronze	Bronze
20	Sealing ring	NBR	NBR
21	Sealing gland	SS316	SS316
22	Piston rod	NBR	NBR
23	Washer	Steel	A2
24	Nut	Steel	A2
25	Sealing o´ring	EPDM	EPDM
26	Sealing Ring	SS316	SS316
27	Seat	EPDM*	EPDM*
28	Deflecting cone 15º	SS316*	SS316*
29	Reinforced ring 8º	SS316*	SS316*
30	Nut	Steel	A2
31	Washer	Steel	A2
32	Studs	Steel	A2
33	Packing o´ring	EPDM*	EPDM*
34	Packing gland	SYNT+PTFE*	SYNT+PTFE*

*CONSULT MATERIAL

MAXIMUM WORKING PRESSURES RECOMMENDED:
DN50-DN250: 10Bar
DN300-DN400: 6Bar
DN450-DN600: 4Bar

STANDARD TEST PRESSURE:
DN50-DN400: 6Bar
DN450-DN600: 4Bar

Válvulas ZUBI S.L.
C/Auzolan 2B-bajo (20303) IRUN
Telf.943.635271 - Fax 943.635193
www.valvulaszubi.com - zubialvulaszubi.com

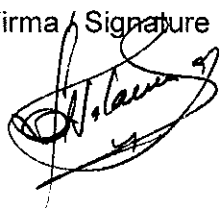
CERTIFICADO DE CONFORMIDAD ATEX 94/9/CE
DECLARATION OF CONFORMITY ATEX 94/9/CE

Valvulas Zubi S.L. declara que:

El alcance de la normativa ATEX es para aquellos "Aparatos" definidos en la letra a) del apartado 3 del artículo 1, caracterizados por tener una fuente potencial de ignición. Por tanto las VÁLVULAS DE GUILLOTINA, MEMBRANA, RETENCIÓN y COMPUERTA definidas en el CATÁLOGO DE VÁLVULAS (edición en vigor) de VALVULAS ZUBI S.L. que no lleven incorporado ningún dispositivo con una fuente potencial de ignición (por ejemplo un motor), no están sujetos a la normativa ATEX 94/9/CE al no estar dentro de su alcance. Por lo tanto, VALVULAS ZUBI declara que cumple con los requisitos de la Directiva relativa a los aparatos y sistemas de protección para uso en atmósferas potencialmente explosivas 94/9/CE (ATEX), Grupo II Categoría 3 (Zonas 2 y 22).

Valvulas Zubi S.L. declares that:

The target of ATEX directive is for those "Instruments" mentioned in letter a) of paragraph 3 of article 1, which may have a potential ignition source. Our KNIFE GATE VALVES, DIAPRAGHM VALVES, CHECK AND PENSTOCKS from VALVULAS ZUBI S.L. General Catalogue (edition in force) which do not incorporated any potential ignition equipment (by example electric actuator), are not under the ATEX 94/9/CE Directive. In conclusion, VALVULAS ZUBI declares that all our valves fulfill the requirements of the EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES DIRECTIVE 94/9/CE (ATEX), Group II Category 3 (Zones 2 & 22).

Firma / Signature	Nombre / Name	Cargo / Position
	Santiago Usabarrena	Director Gerente / Managing Director

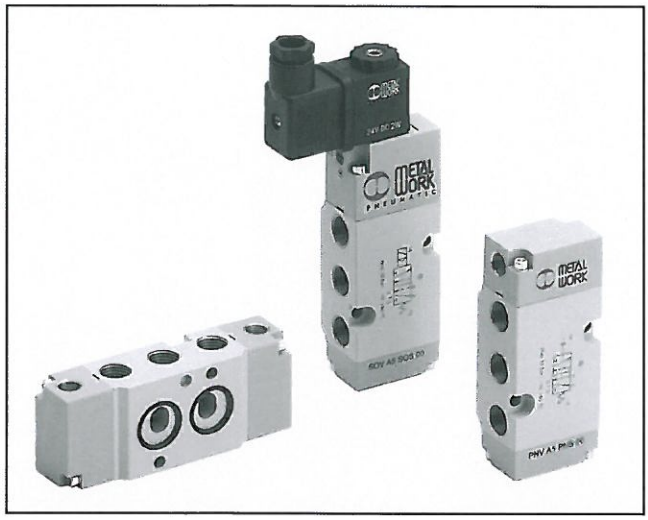
VALVULAS ZUBI, S. L.
N.I.F.: B-20/584033
C/ Auzolan, 2 B, bajo
20303 IRUN (Guipúzcoa)
Telf.: (943) 63.52.71 • Fax: (943) 63.51.93

Fecha / Date
IRUN, 06 de Abril de 2.008

NAMUR VALVES

TECHNICAL DATA

Operating pressure	
• Monostable, electric	2.5÷10 bar
• Bistable, electric	1÷10 bar
• pilot-assisted, electric	vacuum at 10 bar
Minimum pilot pressure	
• monostable, pneumatic	2.5 bar
• bistable, pneumatic	1 bar
Operating temperature range	–10° to 60°C
Nominal diameter	7.5 mm
Conductance C	264.26 Nl/min · bar
Critical ratio b	0.27 bar/bar
Flow rate at 6 bar ΔP 0.5 bar	750 Nl/min
Flow rate at 6 bar ΔP 1 bar (0.1 Mpa÷14.5 psi)	1100 Nl/min
Response time at 6 bar:	
• TRA/TRR monostable, pneum. at 6 bar	7 ms / 15 ms
• TRA /TRR bistable, pneum. at 6 bar	7 ms / 7 ms
• TRA/TRR monostable, electric, at 6 bar	19 ms/ 45 ms
• TRA /TRR bistable, electric, at 6 bar	21 ms / 21 ms
Compatibility with oils:	please refer to page 6.1/08

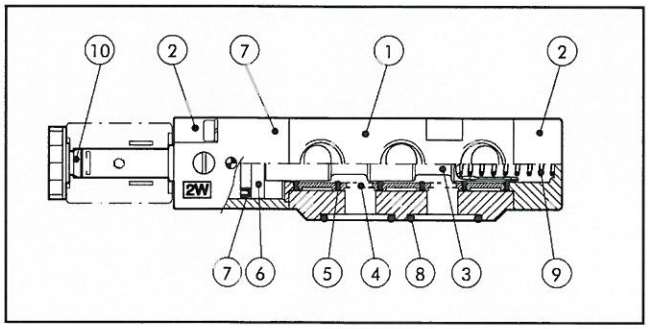


KEY TO CODES

P	N	V		A		5		P	N		S		O	O
FAMILY				PORT		FUNCTION		OPERATORS 14			RESETTING 12		FURTHER DETAILS	
PNV	pneum.		A	Namur	4	4/2	PN	pneum.	S	mechanical spring		OO		5/2
SOV	electro-pneum.				5	5/2	SO	solenoid	B	bistable		NC	normally closed	

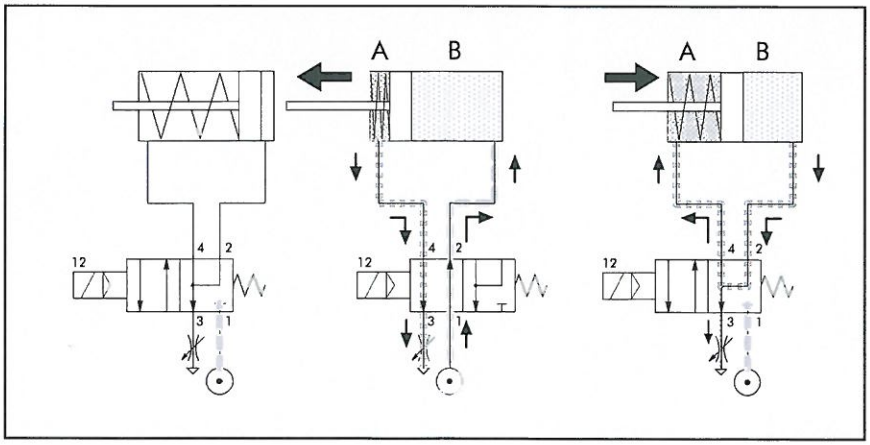
COMPONENTS

① VALVE BODY: Aluminium
② CONTROL/BASE: HOSTAFORM®
③ SPOOL: chemically nickel-plated aluminium
④ DISTANCE PLATES: plastic
⑤ GASKETS: NBR nitrile rubber
⑥ PISTONS: HOSTAFORM®
⑦ PISTON GASKET: NBR nitrile rubber
⑧ INTERFACE GASKETS: NBR nitrile rubber
⑨ SPRINGS: special steel
⑩ OPERATOR: Brass pipe – Stainless steel core

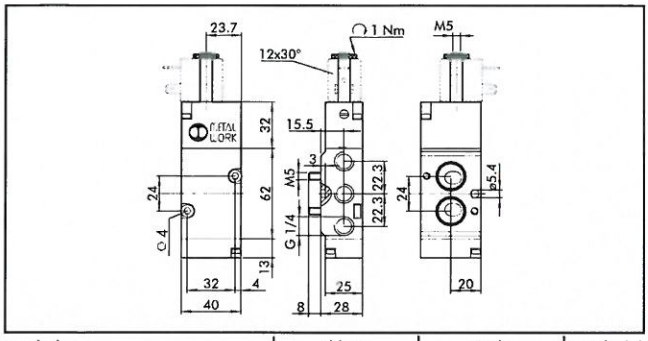


FUNCTIONING DIAGRAM 4/2 NAMUR VALVE

During the piston retraction stage, the air for chamber A is taken from the air leaving chamber B. This prevents the dirty air from getting in from the outside enviroment.

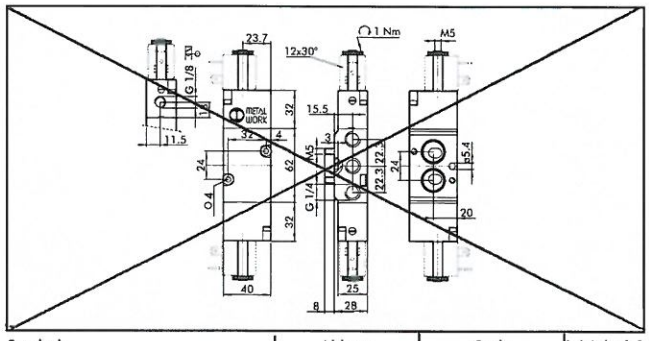


MONOSTABLE, SOLENOID/PNEUMATIC 5/2



Symbol	Abbrev.	Code	Weight [g]
	SOV A5 SOS OO	7021020100	234

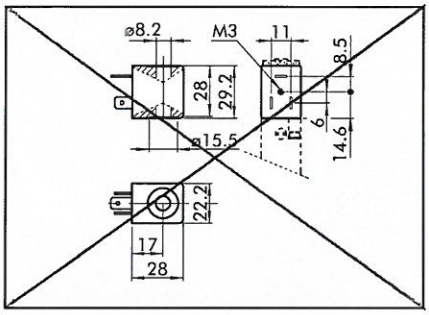
BISTABLE, SOLENOID/PNEUMATIC 5/2



Symbol	Abbrev.	Code	Weight [g]
	SOV A5 SOB OO	7021020200	270

ACCESSORIES: NAMUR VALVES

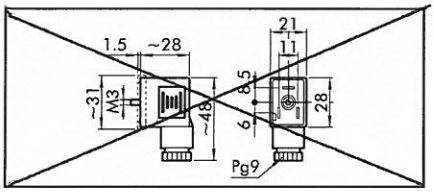
COILS



- Voltage tolerance: -10% + 15%
- Insulation class: F155
- Degree of protection: IP65 DIN 40050 with connector
- Avoid prolonged exposure to atmospheric agents
- Coil temperature 100% ED: from 70°C to 20°C – Ambient temperature
- According to Atex 94/9 CE rule, group 2, category 3 GD

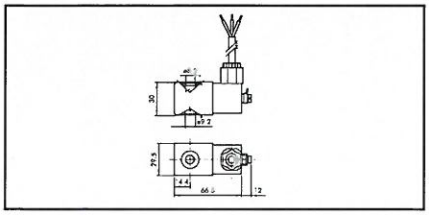
Nominal voltage	Absorption		Abbrev.	Code
	Inrush	Holding		
12Vcc	2W	2W	Coil 22 Ø8 BA 2W-12VDC	W0215000151
24Vcc	2W	2W	Coil 22 Ø8 BA 2W-24VDC	W0215000101
24V 50/60Hz	5.3VA	3.5VA	Coil 22 Ø8 BA 3.5VA-24VAC	W0215000111
110V 50/60Hz	5.3VA	3.5VA	Coil 22 Ø8 BA 3.5VA-110VAC	W0215000121
220V 50/60Hz	5.3VA	3.5VA	Coil 22 Ø8 BA 3.5VA-220VAC	W0215000131

COIL CONNECTORS



Colour	Ø Cable	Type	Code
Black	PG9	Standard	W 097051 0011
Transparent	PG9	LED 24V	W 097051 0012
Transparent	PG9	LED 110V	W 097051 0013
Transparent	PG9	LED 220V	W 097051 0014
Transparent	PG9	LED + VDR 24V	W 097051 0015
Transparent	PG9	LED + VDR 110V	W 097051 0016
Transparent	PG9	LED + VDR 220V	W 097051 0017

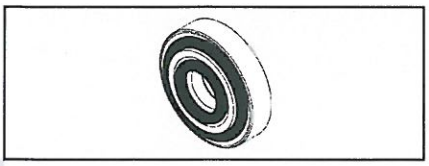
KIT COIL EEXM



Code	Description
0227606913	KIT FOR COIL 30 24 VDC EEXMT5 CABLE 3M
0227606915	KIT FOR COIL 30 24 VDC EEXMT5 CABLE 5M
0227608013	KIT FOR COIL 30 24 VAC EEXMT5 CABLE 3M
0227608015	KIT FOR COIL 30 24 VAC EEXMT5 CABLE 5M
0227608023	KIT FOR COIL 30 110 VAC EEXMT5 CABLE 3M
0227608025	KIT FOR COIL 30 110 VAC EEXMT5 CABLE 5M
0227608033	KIT FOR COIL 30 230 VAC EEXMT5 CABLE 3M
0227608035	KIT FOR COIL 30 230 VAC EEXMT5 CABLE 5M

according to Atex 94/9 CE rule, group 2, category 2 GD

KIT COILS SIDE 22 IP65



Code	Description
0222100100	KIT FOR COILS 22 - IP65

Improved IP65 protection, even after prolonged exposure to atmospheric agents.
Applicable to valves with a technopolymer control.

METAL WORK PNEUMATIC	**Declaration of conformity** Directive 94/9/CE "Potentially esplosive atmosphere"	CE TÜV CERTIFICATE N° EX9 04 04 49198 003

The Company
METAL WORK S.p.A.
Via Segni 5
25062 Concesio(BS)
ITALY

As the solely responsible party herewith declares that under the provision of EC directive

94/9/EC

COUNCIL DIRECTIVE.. IN POTENTIALLY EXPLOSIVE ATMOSPHERE
In its current form

The models supplied by METAL WORK of the following products types

- MINIVALVES, SERIES VME-1 MECHANICALLY /HAND OPERATED
- VALVES, SERIES PEV, PEDAL OPERATED
- VALVES, SERIES 70
- VALVES, SERIES NAMUR
- VALVES ISO 5599/1 SERIES IPV-ISV
- VALVES MACH 18
- VALVES MACH 11
- VALVES MACH 16

Exclusively in their NOT- ELECTRICAL part
As referred to in this declaration,
Complies with the following standards and normative documents
In they current form

EN 13463-1:2001	Non electrical equipment for use in explosion-hazard areas Part 1: Fundamentals and requirements
PrEN 13463-5:2000	Non electrical equipment for use in explosion-hazard areas Part 5: Protection through safe design

Products are marked additionally with the following characteristics:

II 2 GD c T5 T100°C -10°C<Ta<50°C

Awaiting for deposition of the technical folder at TÜV

Concesio, December 2003
Engineer's manager

Ing. Giorgio Guzzoni.

VALVOLE SECONDO DIRETTIVA 94/9/CE (ATEX)
AIR VALVES TO DIRECTIVE 94/9/CE (ATEX)

MINIVALVOLE AD AZIONAMENTO MECCANICO-MANUALE SERIE VME
VALVOLE CON COMANDO A PEDALE
VALVOLE SERIE 70
VALVOLE NAMUR
VALVOLE ISO 5599/1 SERIE IPV
VALVOLE MACH 18
VALVOLE MACH 11
VALVOLE MACH 16

Marcati secondo la direttiva 94/9/CE

II 2 GD c T5 T100°C -10°C<Ta<50°C

ATTENZIONE: le valvole marcate per essere utilizzate in zone potenzialmente esplosive devono essere utilizzate con solenoidi con la stessa categoria di protezione. Ad esempio, se una valvola marcata II 2 GD viene utilizzata con un solenoide II 3 GD, l'insieme valvola + solenoide può essere impiegato esclusivamente in una zona che prevede una protezione II 3 GD.

FUNZIONAMENTO
Le valvole alimentano alternativamente o contemporaneamente le linee pneumatiche poste a valle a seconda del comando impostato.
UTILIZZO
Per alimentare le valvole, l'aria compressa deve essere filtrata senza lubrificazione; se utilizzata, la lubrificazione deve essere continua.
ISTRUZIONI D'USO
Relativamente alla parte meccanica e pneumatica della valvola
(Attenzione: un assieme appartiene alla classe più bassa tra quelle dei particolari che lo compongono. Ad esempio, una valvola composta da una parte meccanica (corpo) e una parte elettrica (pilota), se quest'ultima è in classe II categoria 3 mentre il corpo è in classe II cat. 2, l'intera valvola assume la classe II cat.3).
Alimentare le valvole con aria compressa filtrata e non lubrificata (se l'aria è lubrificata, la lubrificazione deve essere continua)
Evitare che l'aria presente nell'atmosfera potenzialmente esplosiva possa entrare all'interno della valvola; eventuali passaggi che non vengono utilizzati devono essere protetti per evitare l'ingresso di gas o polveri esplosive.
La presenza di ossido di ferro (ruggine) e di leghe leggere (alluminio) può essere fonte di reazioni alluminotermiche qualora si verifichino scintille: evitare la presenza di ruggine (non utilizzando attrezzi corrosi) ed evitare il formarsi di scintille proteggendo la superficie del cilindro contro la caduta eventuale di attrezzi o altri oggetti.
MESSA IN SERVIZIO
La valvola deve essere impiegata in zone che corrispondano a quanto riportato sull'etichetta.
Il montaggio e la messa in funzione devono essere effettuati da personale qualificato e enel rispetto delle vigenti norme.
Per evitare lo scoccare di scintille dovute a cariche elettrostatiche, collegare a massa il sistema e limitare il ø esterno dei tubi a 20 mm.
N.B.: i dati tecnici funzionali e di impiego di ogni prodotto sono riportati nel "CATALOGO GENERALE" Metal Work e sul sito www.metalwork.it. Si raccomanda di consultarli sempre prima di installare e rendere operativi i componenti.

MINIVALVES, MECHANICALLY AND HAND-OPERATED, SERIES VME
VALVES, PEDAL-OPERATED
VALVES SERIES 70
VALVES NAMUR
VALVES ISO 5599/1 SERIES IPV
VALVES MACH 18
VALVES MACH 11
VALVES MACH 16

CE marking in compliance with Directive 94/9/CE

II 2 GD c T5 T100°C -10°C<aT<50°C

IMPORTANT: Valves designed for use in potentially explosive areas must be equipped with solenoids in the same class of protection. For example, if a valve marked II2GD is used with a 3 GD solenoid, the valve + solenoid assembly must only be used in an area for which a II 3GD protection class is required.

OPERATION
The valves supply the pneumatic downstream processing lines alternately or simultaneously, depending on the setting.
APPLICATION
The valves must be supplied with unlubricated filtered air. Lubrication, if used, must be continuous.

OPERATING INSTRUCTIONS
Those cover the mechanical and pneumatic components of the valve.
(Important: The class off an entire assembly is that of the lowest classified part. For example, in a valve comprised of a mechanical part (body) in class II cat. 2 and an electric part (solenoid) class II cat. 3, the valve as a whole is identified as class II cat. 3).
Supply the valves with unlubricated filtered air (lubrication, if used, must be continuous).
Take care to prevent air from potentially explosive areas from entering the valve. Any unused ports must be plugged to prevent explosive gas or dust from entering.
The presence of iron oxide (rust) and light alloys (aluminium) may cause aluminothermal reactions in the presence of sparks: avoid the formation for rust (do not use corrosive tools) and sparks. Protect the cylinder surface against damage from falling tools or other objects.

INSTALLATION
The valve must be used in the zones specified on the label.
Erection and setting to work must be performed by qualified personnel following the applicable rules and regulations. In order to prevent spark ignition due to electrostatic charge, earth the system properly and use pipes with a maximum external diameter of 20 mm.

N.B. Performance and specification data for each product are shown in Metal Work's GENERAL CATALOGUE and on the web site www.metalwork.it. It is advisable to consult them before installing or operating the units.

INCONVENIENTI	CAUSE	RIMEDI
La valvola non scambia	Manca il comando elettrico o pneumatico	Verificare il funzionamento con il comando manuale, ripristinare il collegamento elettrico o pneumatico
	Tensione di alimentazione non corrispondente alla tensione nominale della bobina	Sostituire la bobina o adeguare la tensione
	Tensione alimentazione fuori tolleranza	Verificare sul catalogo MW le tolleranze di tensione ammesse
	Le due bobine di una valvola bistabile sono comandate simultaneamente	Verificare il collegamento elettrico o pneumatico
	Il comando manuale bistabile è azionato	Verificare ed eventualmente disazionare
	La pressione di alimentazione è troppo bassa	Verificare sul catalogo MW la pressione minima di funzionamento della valvola. Nel caso si necessiti di una pressione di funzionamento più bassa, utilizzare valvole del tipo asservito
	Manca pressione di pilotaggio nelle valvole asservite	Alimentare pilotaggio con pressione adeguata
	Eccessivo consumo d'aria (es. valvole di soffio a scarico libero)	Utilizzare valvole del tipo asservito
	Collegamento errato dell'alimentazione	Verificare che l'alimentazione sia in bocca 1
	Scarichi tappati (bocca 3 e 5 o canotto elettrico)	Togliere tappi o se presenti regolare correttamente regolatori di flusso, se vi sono montati dei silenziatori verificare che non siano ostruiti
La valvola perde	Errato collegamento dell'alimentazione	Verificare che l'alimentazione sia collegata alla bocca 1
	Bocche 2 e/o 4 non collegate all'utilizzo	Verificare e collegare.
Il circuito non funziona correttamente.	La valvola non è del tipo previsto dall'impianto	Verificare lo schema pneumatico della valvola

PROBLEM	CAUSE	REMEDY
The valve fails to switch	There is no electric or pneumatic control	Operate the valve manually to check operation, and make the relevant electrical or pneumatic connections.
	Supply voltage different from the rated voltage for the coil.	Replace the coil or regulate the voltage.
	Supply voltage out of tolerance	Check the tolerance values in the MW catalogue
	Both coils of a bistable valve are controlled simultaneously	Check the electrical or pneumatic connection
	Bistable manual control activated	Check and deactivate if necessary.
	Air pressure too low	Check the minimum pressure for valve operation in MW catalogue. If low operating pressure is required, use pilot-assisted valves
	No pressure in pilot-assisted valves	Feed the pilot at the correct pressure
	Excessive air consumption (e.g. free-relieving blowoff valves)	Use pilot-assisted valves
	Wrong connection to the power supply	Check supply input to port 1
	Output ports plugged (ports 3 and 5 or electric sleeve)	Remove the plugs or adjust the flow regulators, if provided. If silencers are mounted, check they are not obstructed.
The valve leaks	Wrong connection	Check the air supply is properly connected to port 1
	Ports 2 and/or 4 not connected to the utilities	Check and make the connection as required
The circuit does not operate properly	The valve used is not suitable for the system	Check the pneumatic system diagram for the valve

ZERTIFIKAT • CERTIFICATE • 認証書 • СЕРТИФИКАТ • CERTIFICADO • CERTIFICAT

EC-Certificate

No. EX9 04 04 49198 003

Holder of Certificate: **Metal Work S.p.A.**
Pneumatic
Via Segni, 5-7-9
25062 Concesio (Brescia)
Italy

Name of Object: **Non-electric devices and components group II**

Valves

This EC-Certificate is issued according to Article 8(1) b) ii) of Council Directive 94/9/EC for equipment and protective systems intended for use in potentially explosive atmospheres (ATEX). It confirms the receipt and storage of the file for the listed product by TÜV PRODUCT SERVICE GMBH. See also notes overleaf.

Test report no.: 70071317.3

107588

Date, 2004-04-27

TÜV PRODUCT SERVICE GMBH is a Notified Body in accordance with Council Directive 94/9/EC EC for equipment and protective systems intended for use in potentially explosive atmospheres with the identification number 0123.

Page 1 of 2

TÜV PRODUCT SERVICE GMBH • Zertifizierstelle • Ridlerstrasse 65 • D-80339 München
Gruppe TÜV Süddeutschland

ZERTIFIKAT • CERTIFICATE • 認証書 • СЕРТИФИКАТ • CERTIFICADO • CERTIFICAT

EC-Certificate
No. EX9 04 04 49198 003

Model(s): Ex

Minivalves Series VME-1 mechanically / hand operated
Valves pedal operated
Valves Series 70
Valves NAMUR
Valves ISO 5599/ 1 Series IPV
Valves MACH 18
Valves MACH 11
Valves MACH 16

Description of Object: One set of technical documentation.

TÜV PRODUCT SERVICE GMBH • Zertifizierstelle • Ridlerstrasse 65 • D-80339 München
Gruppe TÜV Süddeutschland

Teekay Axilock-S
Pipe Coupling

Teekay

the pipe coupling

two pipes... two screws... two minutes

Introducing the Teekay Pipe Coupling System

Teekay Pipe Couplings allow pipes to be joined without the need for flanging, grooving, threading or welding. By simply butting two pipes together and connecting with a Teekay Pipe Coupling, space, weight, time and cost savings are achieved with every installation.

Teekay Couplings have been sold for over three decades to more than 85 countries worldwide for civil, water, oil & gas, marine, building service, process, automotive and countless other industrial projects for pipes between 21mm and 4200mm in diameter.

Mechanical & Sealing Concepts

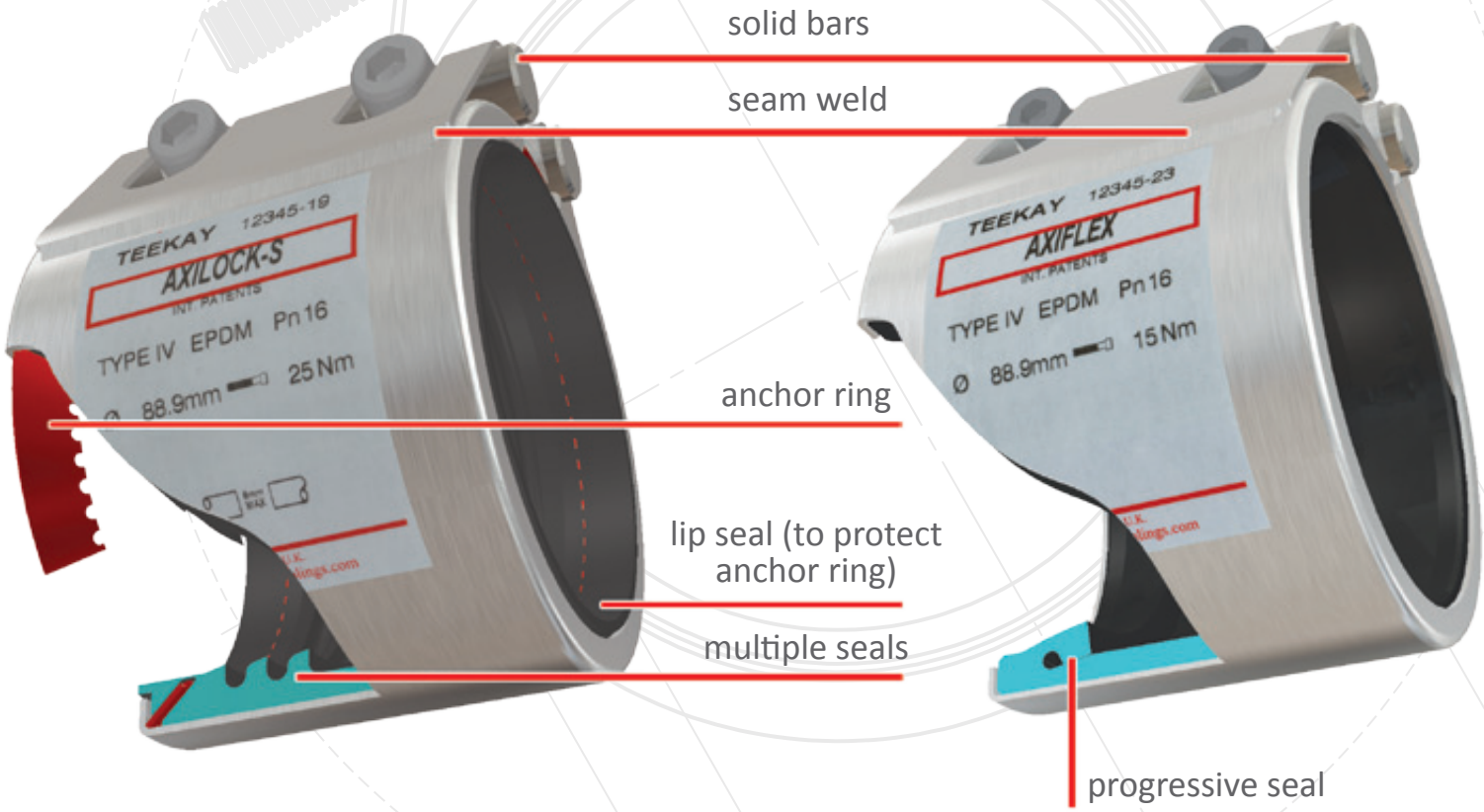
Teekay Couplings are available in two configurations, **Axilock** and **Axiflex**:

Teekay **Axilock**
(axially restrained)

The Teekay Axilock has two metallic anchor rings that dig into the pipe wall when the coupling is installed. This prevents the two pipes from pushing apart under pressure or pulling away under end-load.

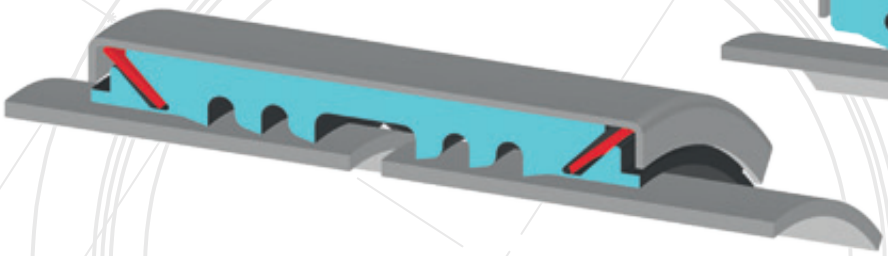
Teekay **Axiflex**
(non axially restrained)

The Teekay Axiflex joins pipes that are already anchored. In this instance the pipeline forces do not have to be contained by the couplings. Therefore diameters up to 4 metres are possible with this design. The coupling can be placed over the pipe ends or supplied in a wrap - around version.

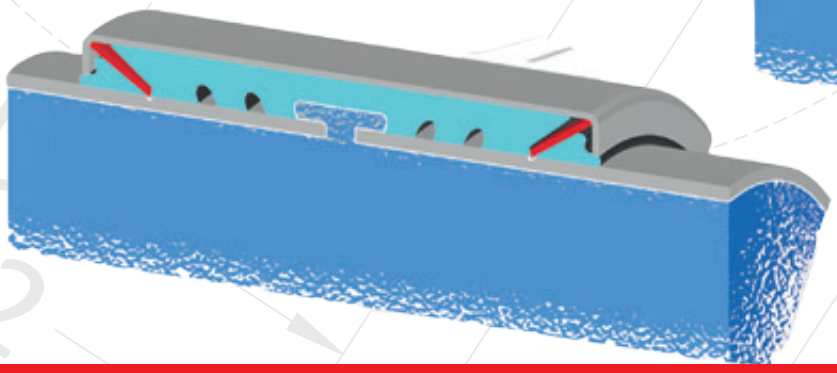


Each coupling (whether **Axilock** or **Axiflex**) consists of a casing, a gasket and a lockpart. The purpose of the casing is to house the gasket and to press it onto the pipe surface when the lockpart is closed. The lockpart is designed to pull the two ends of the casing together circumferentially around the pipe. In order to achieve this, the coupling is labelled clearly with a torque figure which ensures that the gasket is compressed sufficiently against the pipe surface.

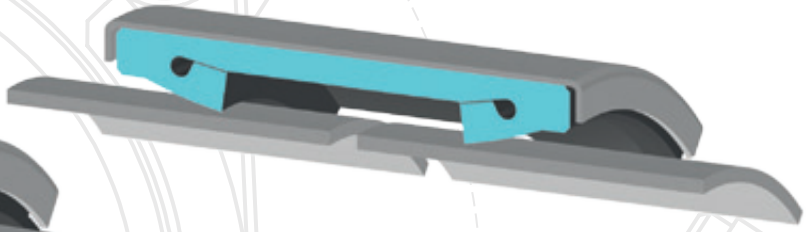
The **Axilock** has two anchor rings which are placed adjacent to, but separate from, the sealing mechanism.



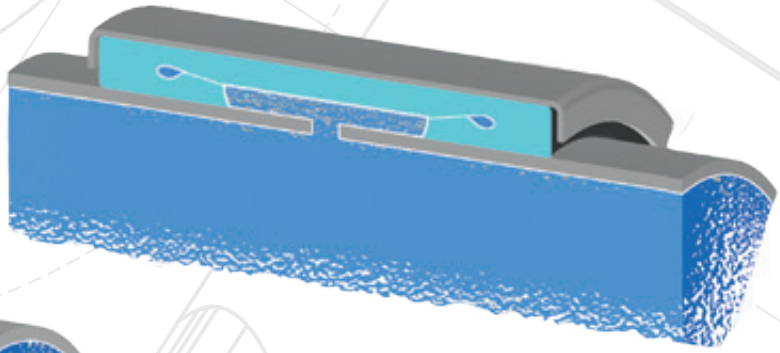
As the lockpart is tightened the sealing lips are pressed against the pipe surface to form a seal. At the same time the two anchor rings penetrate the rubber, bite into the two pipes and prevent them from pulling apart, whether by external loading or internal pressure. The end seal is also pressed against the pipe surface, which protects both the anchor ring and the section of the pipe where the anchor rings have bitten, from any possible external corrosion.



The **Axiflex** has two thick sealing lips which allow for pipe expansion and contraction.



The sealing lips press against the pipe surface and form lip seals. The lip seals are designed to resist the internal pressure in the pipes. As the pressure increases, the lip seals swell to seal more tightly against the pipe surface.



Axilock-S and Axilock

The Teekay Axilock range is designed to replace the need for flanging, welding, pipe grooving and pipe threading by providing a quick and easy solution to joining plain-end pipe. Incorporating grip rings at each end of the fitting, the Teekay Axilock offers high levels of security by locking the pipes together under pressure. Each coupling is 100% rubber-lined, ensuring that high levels of corrosion resistance are maintained throughout the life of the coupling.

Available in single (Axilock-S) and double (Axilock) casing versions depending on pressure and diameter.

Both models are suitable for new installations and retro-fit, whether on a ship, building or process plant. The Teekay Axilock range offers a versatile pipe coupling system that accommodates angulation, vibration and vacuum.

Material Selection

Type I

Casing: AISI 304/ DIN 1.4301
Fasteners: Alloy Steel, PTFE Coated
Gasket: EPDM/NBR/HNBR/Viton

Type II

Casing: AISI 304/ DIN 1.4301
Fasteners: AISI 316/ 316L
Gasket: EPDM/NBR/HNBR/Viton

Type IV

Casing: AISI 316L/ DIN 1.4404
Fasteners: AISI 316/ 316L
Gasket: EPDM/NBR/HNBR/Viton

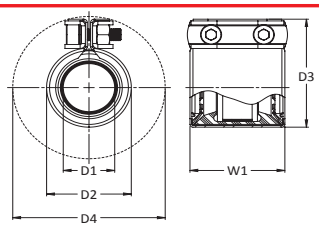
1.4462 Duplex casings and fasteners available on request.

Sizes: 21.3mm to 711.0mm

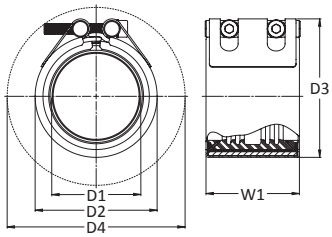
Temperature: EPDM -40°C to +100°C, NBR -20°C to +80°C, HNBR -20°C to +150°C, Viton -20°C to +250°C

Pipe Materials: Carbon steel, stainless steel, copper, cunifer, cast and ductile iron, GRP, most plastics & other materials (see page 36).

Axilock-S Dimensions



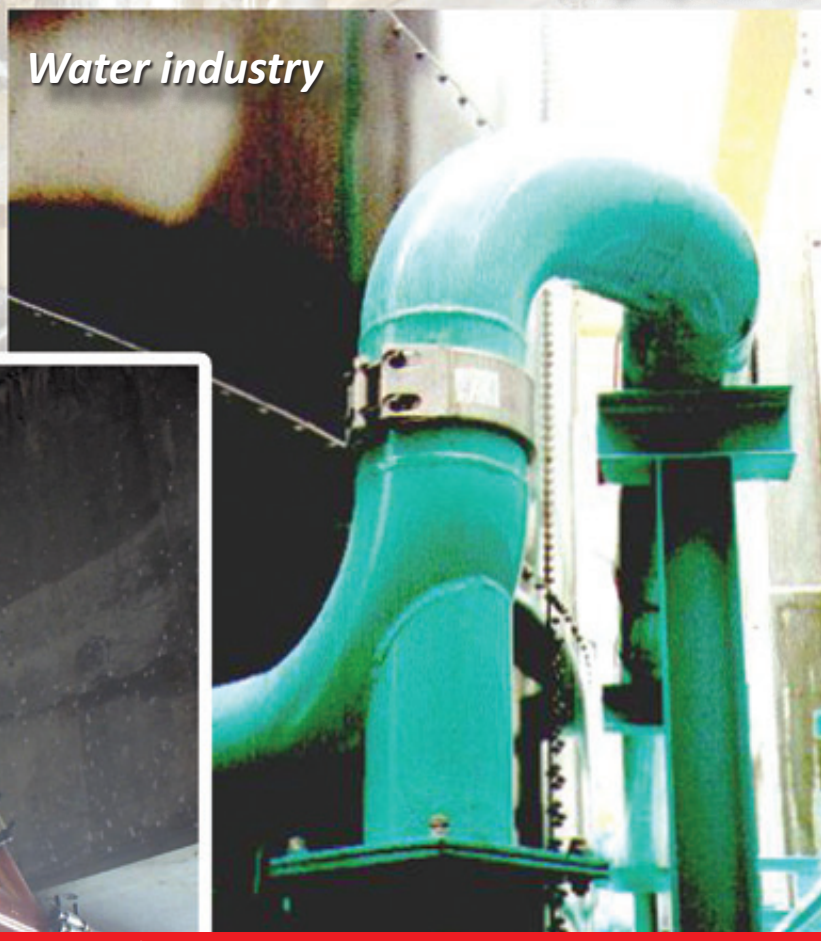
D1 Pipe O.D.	O.D. Tolerance	Working Pressure		Axial Pull	W1	D2	D3	D4	Screw Size	Hex Socket Adaptor	Weight	Box Qty
(mm)	(mm)	(bar)	(bar)	(N)	(mm)	(mm)	(mm)	(mm)		(mm)	KG	
21.3	21.0 / 21.6	16	42	5704	45	34	50	77	2 x M6	5	0.15	24
26.9	26.6 / 27.3	16	42	8528	45	39	56	83	2 x M6	5	0.16	24
28.0	27.7 / 28.4	16	42	8994	45	40	57	84	2 x M6	5	0.16	24
30.0	29.7 / 30.4	16	42	9900	45	42	59	86	2 x M6	5	0.17	24
33.7	33.3 / 34.1	16	42	11600	45	46	63	90	2 x M6	5	0.17	24
35.0	34.7 / 35.4	16	42	12031	45	47	64	91	2 x M6	5	0.18	24



D1 Pipe O.D.	O.D. Tolerance	Working Pressure		Axial Pull	W1	D2	D3	D4	Screw Size	Hex Socket Adaptor	Weight	Box Qty
(mm)	(mm)	(bar)	(bar)	(N)	(mm)	(mm)	(mm)	(mm)		(mm)	KG	
38.0	37.0/39.0	16	42	14069	65	55	67	130	2 x M8	6	0.42	12
42.4	41.4/43.4	16	42	16950	65	60	71	132	2 x M8	6	0.43	12
44.5	43.5/45.5	16	42	18360	65	62	73	134	2 x M8	6	0.45	12
48.3	47.3/49.3	16	42	21263	65	66	77	136	2 x M8	6	0.47	12
54.0	53.0/55.0	16	42	25463	88	71	87	138	2 x M8	6	0.72	12
57.0	56.0/58.0	16	42	27570	88	74	90	140	2 x M8	6	0.85	12
60.3	59.0/62.0	16	42	30855	88	78	93	143	2 x M8	6	0.87	12
63.0	62.0/65.0	16	42	32432	88	80	96	145	2 x M8	6	0.90	12
67.0	66.0/69.0	16	42	35271	88	84	100	147	2 x M8	6	0.90	12
70.0	69.0/72.0	16	42	36575	88	87	103	150	2 x M8	6	0.91	12
73.0	72.0/75.0	16	42	35590	88	90	106	152	2 x M8	6	0.93	12
76.1	75.0/78.0	16	42	37312	88	94	109	185	2 x M10	8	0.95	12
82.5	81.5/84.5	16	42	43317	88	101	116	189	2 x M10	8	1.00	12
84.0	83.0/86.0	16	42	43627	88	102	118	190	2 x M10	8	1.02	12
88.9	88.0/91.0	16	42	44352	88	107	123	193	2 x M10	8	1.05	12
98.0	97.0/100.0	16	42	59613	88	116	132	200	2 x M10	8	1.25	12
101.6	100.5/103.5	16	42	63263	88	120	136	202	2 x M10	8	1.28	12
104.0	103.0/106.0	16	42	65779	88	122	138	204	2 x M10	8	1.31	12
108.0	107.0/110.0	16	42	69651	88	126	142	207	2 x M10	8	1.35	12
110.0	109.0/112.0	16	42	72254	88	128	144	208	2 x M10	8	1.41	12
114.3	113.0/116.0	16	42	76987	89	133	149	211	2 x M10	8	1.50	12
118.0	117.0/120.0	16	42	79864	89	137	154	214	2 x M10	8	1.58	5
127.0	126.0/129.0	16	42	87442	89	146	163	221	2 x M10	8	1.75	5
129.0	128.0/131.0	16	42	89562	89	148	165	223	2 x M10	8	1.85	5
133.0	132.0/135.0	16	42	94510	114	152	177	236	2 x M12	10	2.46	5
139.7	139.0/142.0	16	42	101205	114	159	184	241	2 x M12	10	2.65	5
141.3	140.5/143.5	13	34	101968	115	162	187	243	2 x M12	10	2.80	5
144.0	143.0/146.0	13	34	104272	115	164	190	245	2 x M12	10	2.90	4
154.0	153.0/156.0	13	34	112025	115	174	200	253	2 x M12	10	3.05	4
159.0	158.0/161.0	13	34	117195	115	179	205	257	2 x M12	10	3.15	4
165.0	164.0/167.0	13	34	124068	115	185	211	262	2 x M12	10	3.25	4
168.3	167.0/170.0	13	34	126855	115	189	214	265	2 x M12	10	3.40	4
170.0	169.0/172.0	13	34	129431	115	190	216	266	2 x M12	10	3.41	4

Axilock-S & Axilock Applications

Teekay
the pipe coupling



Axilock-S or Axilock-FP
marine application guide

Marine applications guide to the use of Axilock-S / Axilock couplings and Axilock-FP / Axilock-FP Ultra

Ship System	Axilock-S & Axilock	Axilock-FP & Axilock-FP Ultra	Notes
Flammable Fluids (Flash Point ≤ 60°C)			
Cargo Oil Lines	✓	✓	Axilock-FP must be used in pump rooms and on open decks.
Crude Oil Washing Lines	✓	✓	Axilock-FP must be used in pump rooms and on open decks.
Vent Lines	x	✓	
Inert Gas			
Water Seal Effluent Lines	✓	✓	
Scrubber Effluent Lines	✓	✓	
Main Lines	✓	✓	Neither type permitted in Category A machinery spaces or accommodation spaces. Other machinery spaces may be acceptable providing couplings are in easily visible and accessible locations. Axilock-FP must be used in pump rooms and on open decks.
Distribution Lines	✓	✓	Axilock-FP must be used in pump rooms and on open decks.
Flammable Fluids (Flash Point > 60°C)			
Cargo Oil Lines	✓	✓	Axilock-FP must be used in pump rooms and on open decks.
Fuel Oil Lines	x	✓	Only Axilock-FP permitted but not in Category A machinery spaces or accommodation spaces. Other machinery spaces may be acceptable providing couplings are in easily visible and accessible locations.
Lubricating Oil Lines	x	✓	Only Axilock-FP permitted but not in Category A machinery spaces or accommodation spaces. Other machinery spaces may be acceptable providing couplings are in easily visible and accessible locations.
Hydraulic Oil	x	✓	Only Axilock-FP permitted but not in Category A machinery spaces or accommodation spaces. Other machinery spaces may be acceptable providing couplings are in easily visible and accessible locations.
Thermal Oil	x	✓	Only Axilock-FP permitted but not in Category A machinery spaces or accommodation spaces. Other machinery spaces may be acceptable providing couplings are in easily visible and accessible locations.
Sea Water			
Bilge Lines	✓	✓	Inside Category A machinery spaces only Axilock-FP is permitted.
Fire Main & Water Spray	x	✓	
Foam System	x	✓	
Sprinkler System	x	✓	
Ballast System	✓	✓	Inside Category A machinery spaces only Axilock-FP is permitted.
Cooling Water System	✓	✓	Inside Category A machinery spaces only Axilock-FP is permitted.
Tank Cleaning Services	✓	✓	
Non-Essential Systems	✓	✓	
Fresh Water			
Cooling Water System	✓	✓	Inside Category A machinery spaces only Axilock-FP is permitted.
Condensate Return	✓	✓	Inside Category A machinery spaces only Axilock-FP is permitted.
Non-Essential System	✓	✓	
Sanitary / Drains / Scuppers			
Deck Drains (Internal)	✓	✓	Use of couplings allowed only above freeboard deck.
Sanitary Drains	✓	✓	
Sounding / Vent			
Water Tanks / Dry Spaces	✓	✓	
Oil Tanks (flash point > 60°C)	x	✓	Only Axilock-FP permitted but not in Category A machinery spaces or accommodation spaces. Other machinery spaces may be acceptable providing couplings are in easily visible and accessible locations.
Miscellaneous			
Service Air (Non-Essential)	✓	✓	
Brine	✓	✓	
Steam	✓	✓	Couplings must be restrained on the pipes and may be used on deck with a design pressure of 10 bar or less.

The above table is for guidance only. For full details and more information on allowances and limitations on marine installations see IACS UR P2 Table 7, available as a download from **www.iacs.org.uk**

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Torque Tables

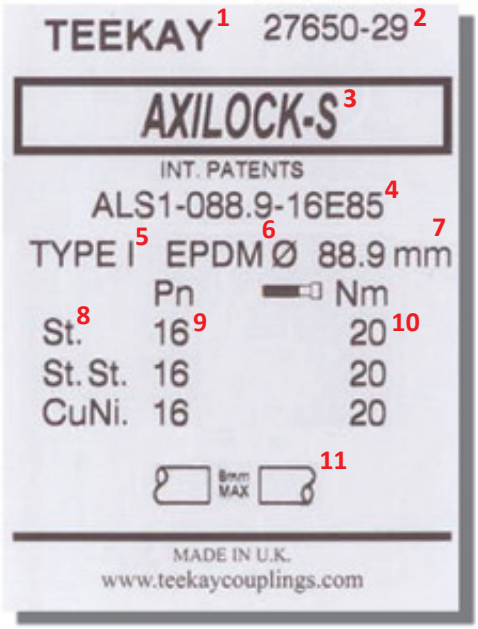
Please consult the table below for torque ratings on Axilock-S, Axilock and Axilock-FP couplings. All couplings have the torque rating printed on the label. Torques are based on standard pipe properties. Torques may be adjusted up or down according to wall thickness and/or material hardness.

D1 Pipe O.D.	Axilock S Torque (NM)			Axilock Torque (NM)			Axilock FP Torque (NM)			
(mm)	Steel	Stainless Steel	CuNi	Steel	Stainless Steel	CuNi	Steel	Stainless Steel	CuNi	VdS
21.3	8	8	8				8	8	8	
26.9	8	8	8				8	8	8	
28.0	8	8	8				8	8	8	
30.0	8	8	8				8	8	8	
33.7	8	8	8				8	8	8	
35.0	8	8	8				8	8	8	
38.0	15	15	10				15	15	10	30
42.4	15	15	10				15	15	10	
44.5	15	15	10				15	15	10	
48.3	15	15	10				15	15	10	30
54.0	15	15	10				15	15	10	
57.0	15	15	10				15	15	10	
60.3	15	15	15				20	20	20	30
63.0	15	15	15				20	20	20	
67.0	15	15	15				20	20	20	
70.0	15	15	15				20	20	20	
73.0	15	15	15				20	20	20	
76.1	20	20	20				30	30	25	30
82.5	20	20	20				30	30	25	
84.0	20	20	20				30	30	25	
88.9	20	20	20				30	30	25	45
98.0	25	25	25				30	30	25	
101.6	25	25	25				45	45	30	
104.0	25	25	25				45	45	30	
108.0	25	25	25				45	45	30	80
110.0	25	25	25				45	45	30	
114.3	30	30	30				45	45	30	80
118.0	30	30	30				45	45	30	
127.0	30	30	30				45	45	30	
129.0	30	30	30				65	65	30	
133.0	35	35	35				65	65	35	120
139.7	35	35	35				65	65	35	120
141.3	35	35	35	65	65	35	65	65	35	
144.0	35	35	35	65	65	35	65	65	35	
154.0	50	50	35	65	65	35	65	65	35	
159.0	50	50	35	85	85	35	85	85	35	150
165.0	50	50	35	85	85	35	85	85	35	
168.3	50	50	35	85	85	35	85	85	35	150
170.0	50	50	35	85	85	35	85	85	35	
193.7				90	90	50	90	90	50	
219.1				100	100	50	100	100	50	
222.0				100	100	65				
244.5				100	100	65				
267.0				100	100	65				
273.0				110	110	65				
323.9				110	110	65				
326.0				110	110	65				
355.6				120	120	65				
378.0				120	120	65				
406.4				140	140	65				

E&OE 02/08/10

Teekay
the pipe coupling

Whilst the Teekay Pipe Coupling range is easy and simple to install and use onsite, it is necessary to take external forces and environments into account when carrying out any installations. The following pages outline these elements and offer general installation guidelines and principles for good piping practice



Label Details

1 Trademark
2 Traceability number
3 Model
4 Part Number
5 Material specification
6 Gasket material
7 Pipe outside diameter
8 Pipe material:
St = steel
St St = stainless steel
CuNi = copper nickel
9 Working pressure
10 Torque rating for tightening screws
11 Recommended maximum pipe gap

Pipe Materials

Teekay Axilock Pipe Couplings are primarily designed to join metallic pipes. Other pipe materials, such as rigid plastics and GRP, can also be joined under certain circumstances. Soft plastic materials, such as PE, must be fitted with internal stiffeners (these should be specifically requested at time of order) but will not resist pull out forces generated by cold creep. Please contact us prior to joining non-metallic pipe materials.

Teekay Axiflex Pipe Couplings are suitable for use with the following piping materials:

- Carbon Steel (seamless, longitudinally or spirally welded)
- Stainless Steel (seamless or longitudinally welded), metric thin wall or standard schedule sizes
- Cast or Ductile Iron
- Concrete
- Asbestos Cement
- Glass Reinforced Plastic (GRP)
- Fibre Reinforced Polyester (FRP) centrifugally cast or spirally wound
- PVC and uPVC
- High Density Polyethylene (HDPE) and MDPE
- Polybutylene, Polypropylene and ABS

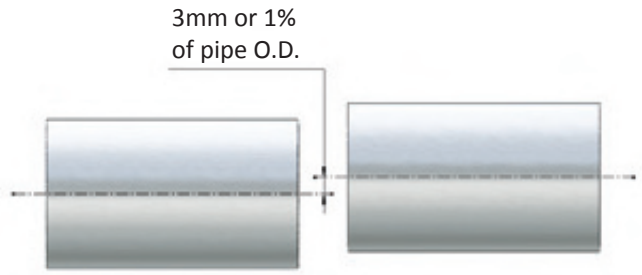
Ovality

Teekay Axiflex Pipe Couplings are sufficiently flexible to accept a misshape within the pipe cross section provided the out-of-roundness is fairly evenly distributed around the circumference (oval rather than D shaped). Depending on application and pipe material, up to 8% ovality may be accommodated.

Pipe Alignment

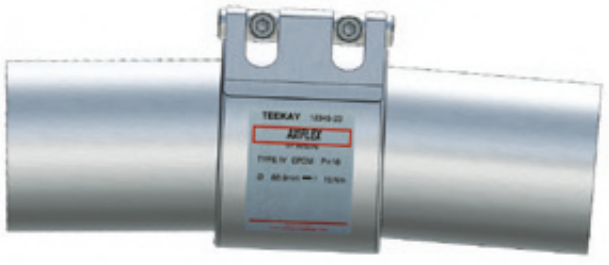
The distance between pipe ends is caused by several factors. These include axial distance between pipe ends, parallel misalignment, angular misalignment and tolerances on pipe diameters. There are individual limits for each of these parameters if they occur separately but there is also a maximum limit on the maximum distance between the pipe ends when a combination of these misalignments occurs.

Parallel Misalignment



Maximum permissible is 3mm or 1% of pipe O.D. (whichever is smaller).

Angular Misalignment



Maximum angle of deflection for Axilock Pipe Couplings:

Pipe Size O.D.	Maximum Angle of Deflection
(mm)	
21.3 – 60.3	5°
60.3 – 219.1	4°
219.1 – 406.4	2°
406.4 – 711.2	1°

Maximum angle of deflection for Axiflex Pipe Couplings:

Pipe Size ND	Coupling Width	Maximum Angle of Deflection
(mm)	(mm)	
40 – 100	85	5°
80 – 300	110	5°
150 – 500	140	5°
600 – 700	140	3.5°
800 – 1200	140	2°
200 – 700	210	5°
800 – 1200	210	3°
1300 – 1800	210	2°
1900 – 3000	210	1°
200 – 800	310 / 410	5°
900 – 1300	310 / 410	3°
1400 – 2300	310 / 410	2°
2400 - 3000	310 / 410	1°

Please note: Maximum angle of deflection assumes that the coupling spans the angle evenly.

Allowable pipe diameter tolerances

Type of Teekay Coupling	Pipe Outside Diameter	Coupling Width	Outside Diameter Tolerance
	(mm)	(mm)	(mm)
Axilock-S Axilock Axilock-FP Axilock-FP Ultra	21.3 – 35.0	45	+0.3 / -0.3
	38.0 – 57.0	65 / 85	+ 1 /-1
	60.3 – 429.0	85 / 110	+ 2 /-1
	429.0 – 711.0	110	+ 2 /-1
Axiflex Stepped Repair Coupling	21.3 – 35.0	45	+0.3 / -0.3
	38.0 – 44.5	65	+ / - 1
	48.3 – 76.1	85	+ / - 1.5
	82.5 – 125.0	85	+ / - 2
	88.9 – 149.9	110	+ / - 2
	153.0 – 193.7	110	+ / - 2.5
	200.0 – 326.0	110	+ / - 3
	153.0 – 193.7	140L	+ / - 2.5
	200.0 – 635.0	140L	+ / - 3
	168.3 – 170.0	140	+ / - 2.5
	291.1 – 345.4	140	+ / - 4
	355.0 – 1255.0	140	+ / - 4
	219.1 – 345.4	210	+ / - 4
	355.0 – 1255.0	210	+ / - 4
	1256.0 – 2350.0	210	+ / - 8
	2351.0 – 3050.0	210	+ / - 16
	315.0 – 326.0	310 / 410	+ / - 4
	333.8 – 1255.0	310 / 410	+ / - 4
	1256.0 – 1631.0	310 / 410	+ / - 8
	1632.0 – 2350.0	310 / 410	+ / - 16
	2351.0 – 3050.0	310 / 410	+ / - 16

Distance between Pipe Ends

For Axilock-S, Axilock, Axilock-FP and Axilock-FP Ultra couplings the optimum distance between pipe ends is 0 - 5mm. This allows for expansion and contraction, suction and vacuum, pipe deflection and a reasonable cutting tolerance.

For Axiflex, Stepped and Repair couplings the recommended gap between pipe ends depends on the width of the coupling and whether or not a vacuum ring is fitted. When the gap is exceeded (or in all vacuum applications) a vacuum insert must be fitted. The table below gives the maximum pipe gaps for these couplings:

Coupling Width	Maximum Pipe Gap (without vacuum ring)	Maximum Pipe Gap (with vacuum ring)
(mm)	(mm)	(mm)
85	5	20
110	5	30
140	10	40
210	20	50
310	30	110
410	30	150

- maximum pipe gap without vacuum ring can be doubled on applications where intrusion of the rubber gasket into the pipe gap is not a problem.

- maximum pipe gap with a vacuum ring is limited by the maximum angle of deflection. If the angle of deflection is less than the maximum allowable angle of deflection, the maximum pipe gap (with vacuum ring) can be increased accordingly.

Expansion & Contraction

Teekay Axilock pipe couplings can accommodate up to 6mm expansion/contraction in a straight line. At changes in direction make sure that any resultant angular deflection is restricted to a maximum of 2°.

Teekay Axiflex couplings can accept thermal expansion or contraction of the pipeline by axial movement through the coupling or by the angulation of two couplings. In either case the pipeline should be adequately restrained. If it is not possible to place the intermediate anchors between the couplings, the Teekay Axiflex coupling can be supplied with an integral central register to locate the coupling.

The recommended maximum pipe axial expansion or contraction which can be accepted by one coupling is as follows:

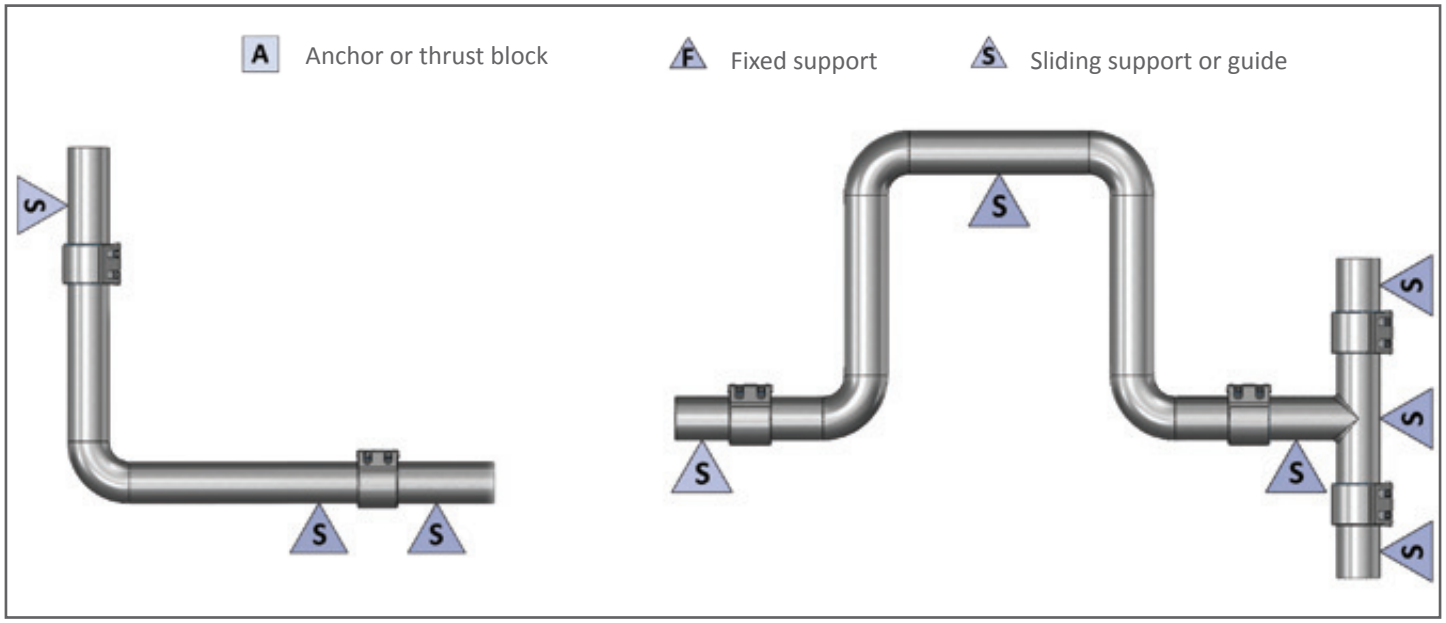
Coupling Width	Pipe Expansion/ Contraction
(mm)	(mm)
85	2.5
110	7.5
140	14.5
210	25
310	35
410	35

Lateral Displacement

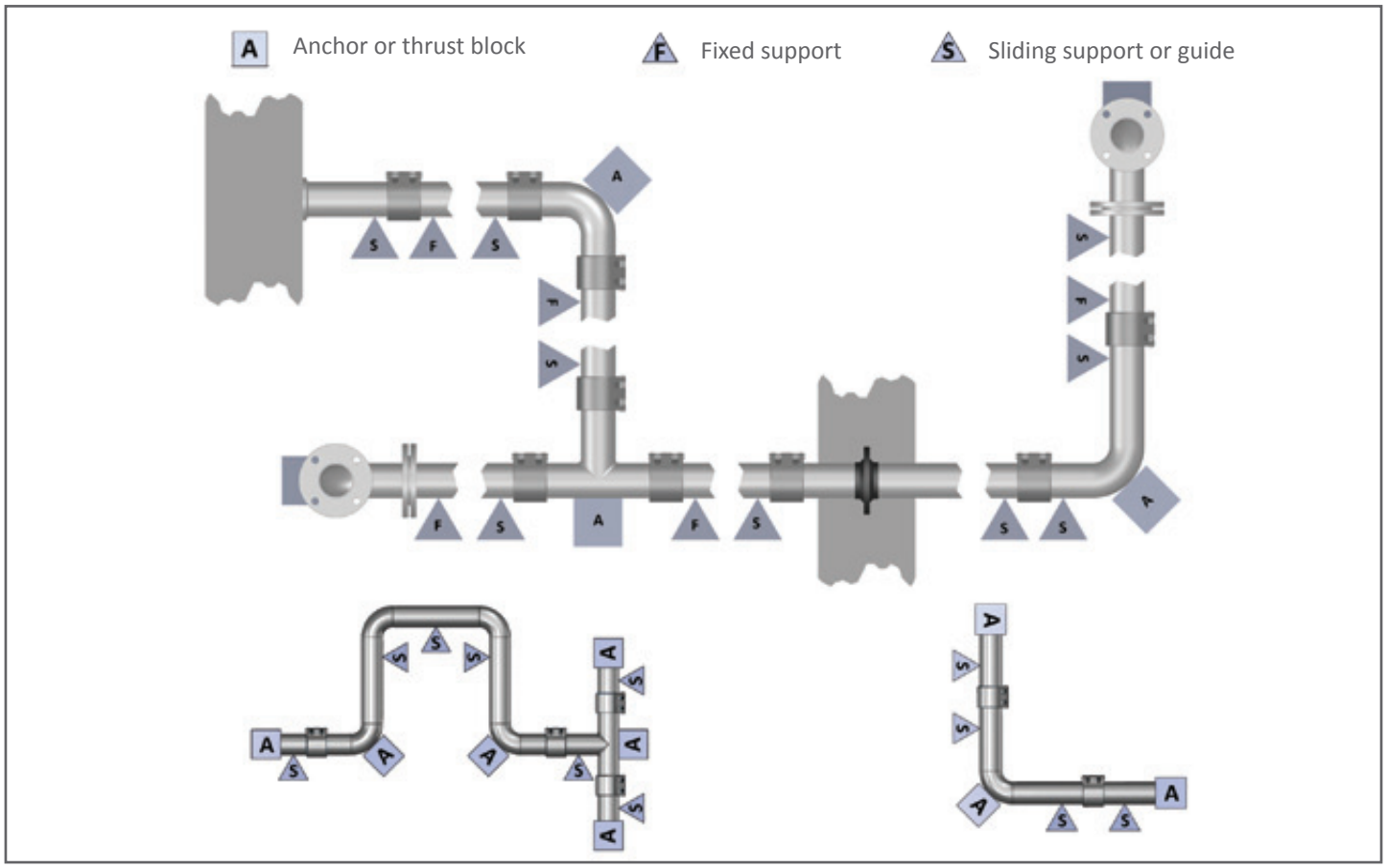
Lateral displacement may be accommodated by the use of two Teekay couplings with an intermediate length of pipe. Lateral displacement between two pipes then becomes simple angular deflection at each coupling. Hence, the amount of displacement which can be accommodated in a given configuration is related to the permissible angular deflection.

Installation Guide

Teekay Axilock pipe couplings should always be installed in accordance with good piping practice, conforming to relevant industry standards. For example:

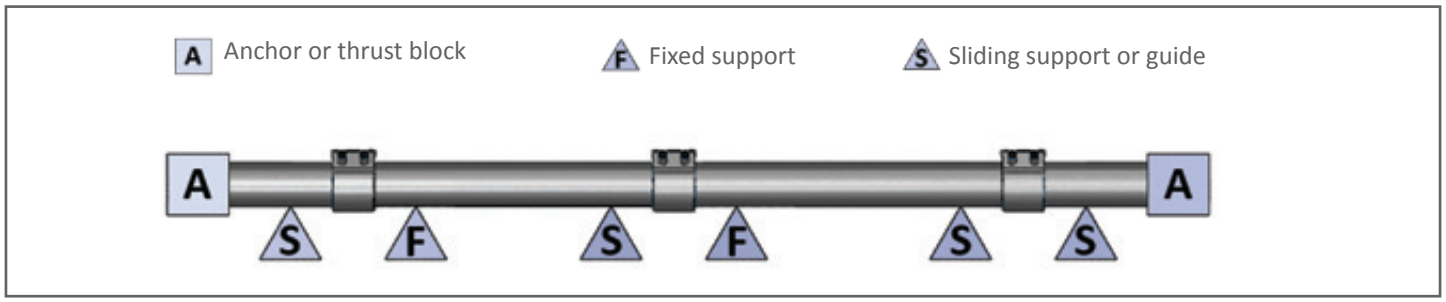


Standard Teekay Axiflex pipe couplings are not designed to accept end load pressures. As a result, pipes must generally be anchored against internal pressure at changes in direction, branches, valves and at pipe ends. For example:



Buried pipelines can generally be restrained by means of thrust blocks at major changes in direction. Straight runs and minor curves are usually restrained by soil friction. The same is largely true of gravity or very low pressure pipelines running along the ground, although with certain thermoplastic piping materials special attention should be given to restraining the forces generated by excessive expansion, contraction and creep.

For above ground applications it is recommended that pipelines should be anchored as shown in the following diagram:



Intermediate anchors should be designed to withstand the forces and movements transferred and imposed upon them by each of the pipe sections to which they are attached, taking into account such forces as friction, wind load, self weight, and changes in fluid momentum.

Above ground pipelines subject to side thrusts, or required to be used to absorb angular deflections or lateral displacements, must be adequately restrained and supported.

Supporting of the pipeline for shear deadweight must be carried out to ensure that no excessive sagging occurs beyond the limits of angular deflection of the coupling. Support pitching will depend on pipe material, diameter, wall thickness and operating temperature.

A simple method of harnessing pipelines is by welding lugs to the pipe and connecting them with tie rods.

Shock, vibration, water hammers

Due to the design of the gasket, Teekay couplings dampen sound, vibration and water hammer. Shock levels to military requirements can also be accommodated. In the case of Teekay Axiflex couplings for applications where excessive vibration might occur, it is recommended that the couplings are supplied with central registers to locate the pipe coupling in position.

Electrical Conductivity

In Teekay Axilock pipe couplings electrical conductivity is conveyed through the coupling casing by the anchor rings. In Teekay Axiflex pipe couplings stainless steel continuity strips are fitted to prevent the build up of static electricity. These should be specifically requested at time of order.

Support & Restraint

Teekay Axilock pipe couplings are designed to restrain the pipes axially. However, they are also flexible, allowing some axial and angular movement. Therefore the pipes should be guided to ensure that they remain within 2° angular deflection, especially where a long run of pipes suddenly changes direction.

Installation

The pipe ends should be cut square and all sharp edges and burrs must be removed.

The pipe surface must be clean and smooth with no loose material in the region of the sealing lips.

There must be no dents in the pipe in the region of the sealing lips.

The alignment of the pipe ends must be within the limits specified for the coupling.

Mark half the width of the pipe coupling on both pipe ends as a fitting guide. This will enable the coupling to be centred over the pipe ends when fitted.

Check that the coupling is of the right type and that a vacuum insert is fitted if required.

Remove the plastic packaging from the coupling.

Check that anchor rings are present in both ends of the coupling (Axilock only).

Do not dismantle the pipe coupling.

Do not drop the pipe coupling.

Move one pipe end out of the way and slide the coupling over one pipe end. Reposition the other pipe and slide the coupling over the joint into the correct position as shown by the fitting marks already drawn on the pipes.

Tighten clamping bolts partially until the coupling is “nipped up” against the pipe. Do not rotate the coupling on the pipe once the coupling is engaged.

Tighten the locking bolts evenly with a torque wrench to the final prescribed torque on the coupling label. Ensure that both bolts have reached torque by moving from one to the other until both click off without further rotation.

Over-tightening is not recommended and there is no need to re-tighten the bolts once set as this will impede the “seating” of the gasket.

If in doubt always loosen the coupling, re-align and start again!

Removal

Ensure that there is no pressure in the pipes at the joint to be removed.

Drain the pipes at the joint as far as is practicable.

Protect yourself against spilling liquid.

Protect any surrounding equipment from spilled liquid.

Make sure the pipe coupling is not supporting the pipe ends.

Loosen locking bolts alternately but do not remove completely.

Do not rotate pipe coupling on pipe as long as anchoring teeth are engaged (Axilock only).

Loosen anchoring teeth engagement, if necessary, by gently rocking or tapping the loosened coupling up and down the pipe (Axilock only).

Slide the coupling off the pipe.

Clean coupling and pipes ends and check the condition of the gasket before re-use.

Build Quality

There are many different types of pipe couplings and pipe connections on the market; stainless steel couplings, cast iron couplings, push-fit couplings, grooved couplings.....

At Teekay we consider build quality to be one of the most important aspects of manufacturing a well-engineered and user-friendly product. We know that good build quality hugely improves the life and performance of the product. Listed below are some features which make the Teekay product range stand out from the rest:

TIG welded seam

When fastening the coupling, the section of the casing that has to withstand the most stress is the area where the “ear” is welded to the outer casing. We TIG weld this section with a strong seam weld and then passivate it so there is no chance of corrosion when exposed to the elements. The seam weld provides uniform strength across the whole width of the casing, ensuring the strongest possible connection. We never spot weld this area of the coupling.

Solid bars and 2 screws on each coupling

Teekay couplings come with solid bars which are spot-faced in order to reduce stress points on the screw head. The solid bar prevents corrosion of the screw thread and provides extra strength in the lockpart. All Teekay couplings are supplied with a minimum 2 screws. This design feature is crucial to the secure fastening of the coupling across its entire width. The coating on each screw is a dry lubricant which negates the need for greasing the lockpart.

Unique Axilock multi-seal gasket

All Teekay Axilock-S, Axilock, Axilock-FP and Axilock-FP Ultra couplings come with a unique multi-seal gasket design which provides greater sealing security when compared with a single seal design. There is a high volume of material-to-space ratio which ensures long term sealing efficiencies.

Encapsulated anchor rings

All Teekay Axilock-S, Axilock, Axilock-FP and Axilock-FP Ultra couplings come with patented encapsulated anchor rings. This small section of rubber massively increases the life of the coupling by preventing any possible corrosion of the anchor rings. The teeth in the rings bite through the rubber and lock the pipes in place, leaving none of the teeth exposed when the coupling is installed. The rubber seal over the anchor ring also protects users when handling the coupling.

1 - multi-seal gasket

2 - encapsulated anchor ring

Table of contents

Introduction

MPTK-I is a dry installed pump.
By means of different equipment a great number of different pumping requirements can be met. The pumping takes place by means of an electric motor; a pump casing with an impeller is installed on the motor. The oil filled oil chamber between motor and impeller provides cooling and lubrication of the mechanical seals. The sealing system consists of two mechanical seals. The exterior seal separates the medium from the oil chamber, the interior seal separates the oil from the motor casing.

Application

This dry installed pump is to be applied for pumping of liquids with a high or a low dry matter content, like e.g. thick manure and highly polluted wastewater. The pump is only to be applied dry installed in connection with application at e.g. effluent treatment plants, in industry and in agriculture. If the pump is to be applied for other purposes, contact Landia A/S for advice.

Important

Please note the following points:

- Only a certified electrician is allowed to connect the unit.
- Prior to installation and start-up ensure that the equipment, such as hoses, pipes and pipe branches, is installed correctly and fixed to the pump.
- Prior to the first start of the pump, the pump shaft must be rotated manually. This also applies if the pump has not been in operation for a longer period.
- The pump must be dry installed but can be placed outside without protection as the motor is splash proof. The motor is not to be wrapped in plastic film etc.
- Prior to service/repair of the pump it is always to be ensured that the electrical connection of the pump is switched off or locked.
- Prior to disassembling the pump, the sluice valve on the pressure and on the suction side must be completely closed.

Service/repair

To maintain a high operating safety and a long service life without unnecessary and expensive repair, it is important from the beginning to execute regular and preventive service. Maintenance should be executed according to the intervals stated in the manual. Always follow the instruction carefully and only apply the parts described by Landia A/S in the spare parts list.
If you do not want to execute the service yourself, we can offer you a service agreement - please call for further information.

Please note

If spare parts not identical to the recommended are applied at service/repair, the guarantee from Landia A/S will be annulled. Spare parts can be ordered at Landia A/S or your local distributor.
For major repairs at a special workshop please contact:

Head Office:
LANDIA A/S
Industrivej 2
DK-6940 Lem St.
Tel.: +45 97 341244
info@landia.dk
www.landia.dk

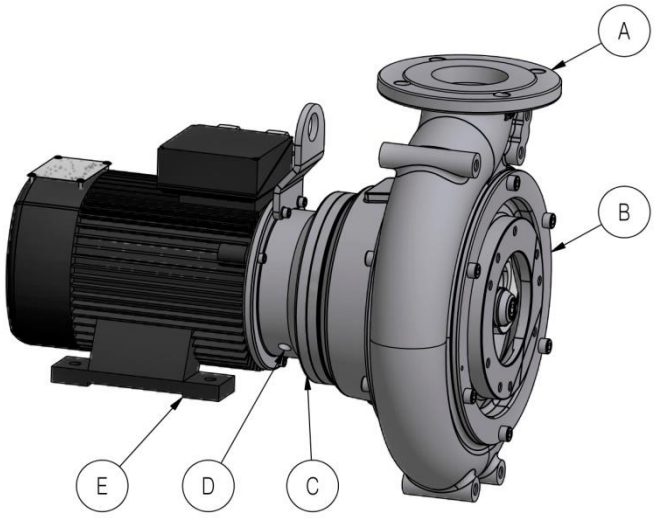
UK subsidiary:
Landia (UK) Ltd.
Waymills Industrial Estate,
Whitchurch,
Shropshire SY13 1TT
Tel: + 44 01948 661 200
info@landia.co.uk
www.landia.co.uk

Landia A/S is represented by local distributors worldwide, please call for further information.

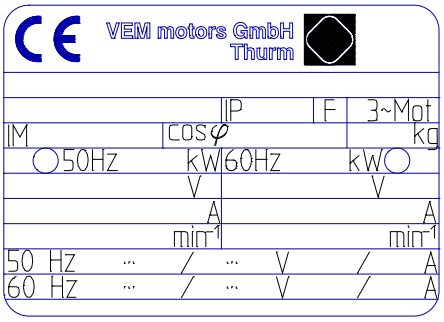
Installation

At installation, it must be ensured that the pump can be removed from the pipe system in case of breakdown, service etc. Therefore, block valves must be installed on the pressure and on the inlet side of the pump, unless the pipe system can be emptied in another way. Besides, it must be ensured at fixing to the concrete foundation that the pump can be lifted in service situations. By means of a motor support foot, the console of the pump is relieved, pos. E. At pump installations in piping systems compensators must be applied since vibrations and temperature fluctuations will influence the piping system.
At installation the drainage hole, pos. C, in the receiver and the condensation hole, pos. D, in the motor must turn downwards.

A. Pressure side
B. Suction side
C. Draining hole
D. Condensate hole
E. Motor base



Rating plate



IP:	Cage class
F:	Insulation class F
3~mot.nr.:	3 phased motor
IM:	Building form
cos φ:	Power factor
Kg:	Weight of motor without pump
kW:	Max. shaft power
V:	Mains voltage
A:	Nominal power consumption
min:	Motor revolutions per minute

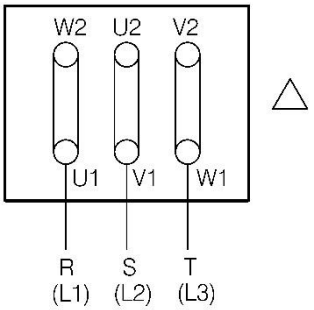
kW,V,A and min^{-1} for 50 Hz and 60 Hz respectively.
The final two lines state the allowed voltage intervals with power consumption at 50 Hz and 60 Hz resp.

Power connection

Every pump is equipped with the above mentioned rating plate with technical motor data. The motor is connected according to Fig. 1 or 2. It must be ensured that the other electrical parts correspond to the motor data. For each pump there is an electrical diagram. A protective motor switch must be applied at connection of the pump to the mains.

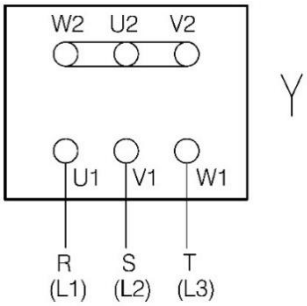
Only a certified electrician is allowed to connect the unit.

Fig. 1



Delta connection.

Fig. 2



Star connection.

Capacity

The capacity of the pump will always depend on the consistency of the medium.

To obtain the highest capacity possible with as low motor power as possible it is important that the diameters of the pump pipes are large enough and that sharp bends are avoided as far as possible. Large pipe dimensions are especially important in connection with long pumping distances. When installing in a pipe system where vibrations and temperature fluctuations affect the pipe system, compensators must be used.

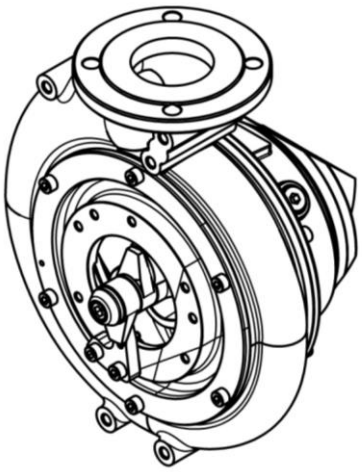
The pumps are equipped with open impellers especially suited for liquids with large particles, like e.g. raw wastewater, manure and industry applications.

For difficult mediums with e.g. a high dry matter content or large impurities which make up a risk for blocking, the pumps can be supplied with a knife system. The knife system which is placed in the inlet port consists of one (or three) fixed and two rotating knives. The knives comminute large impurities in the medium in order to ease the pumping. They are ideal for comminuting e.g. straw, shreds, paper, fish etc.

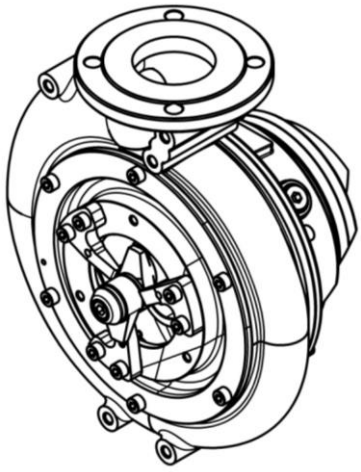
To minimize downtime on the pump due to metal objects in the medium, it may be recommended that a magnet be fitted to the feed system to the tank to which the pump is connected.

The pump capacity will be reduced if the edge of the guide traces on the front and back plates is worn round or if there are deep traces on the surface. You can minimize the wear on the front and rear plate by changing the impeller before the edges on the back of the impeller become too round. If the edges of the impeller become too round, it can be easier to settle stones in the clamp between the impeller and the back plate, which will turn the impeller round and the wear will increase. If you have any doubts or questions, please contact Landia for advice.

Pump casing w. knife system

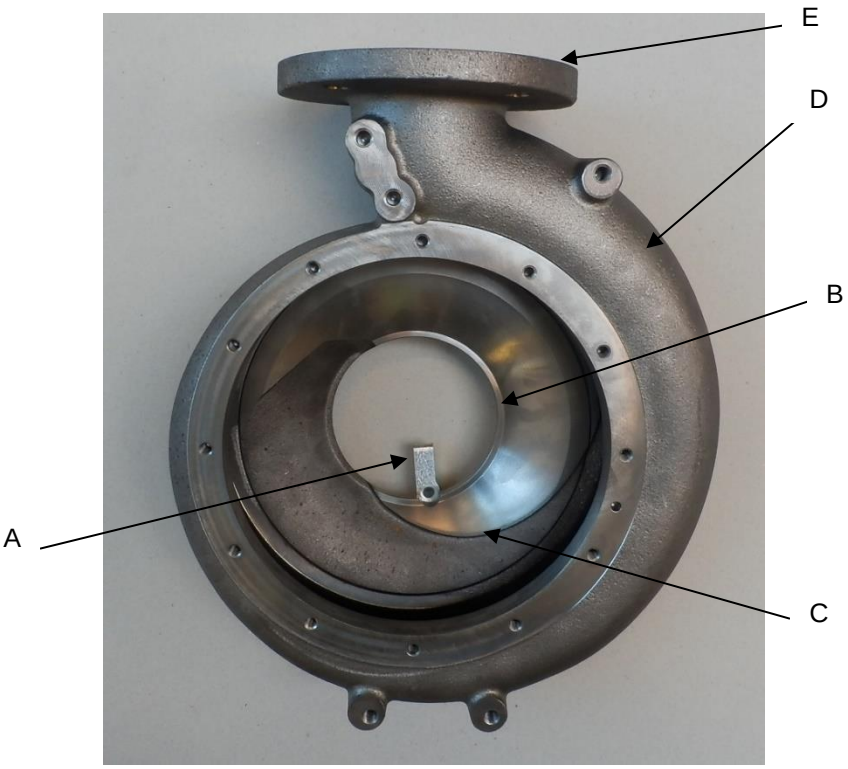


Pump casing w. extended knife system



Fitting the front plate

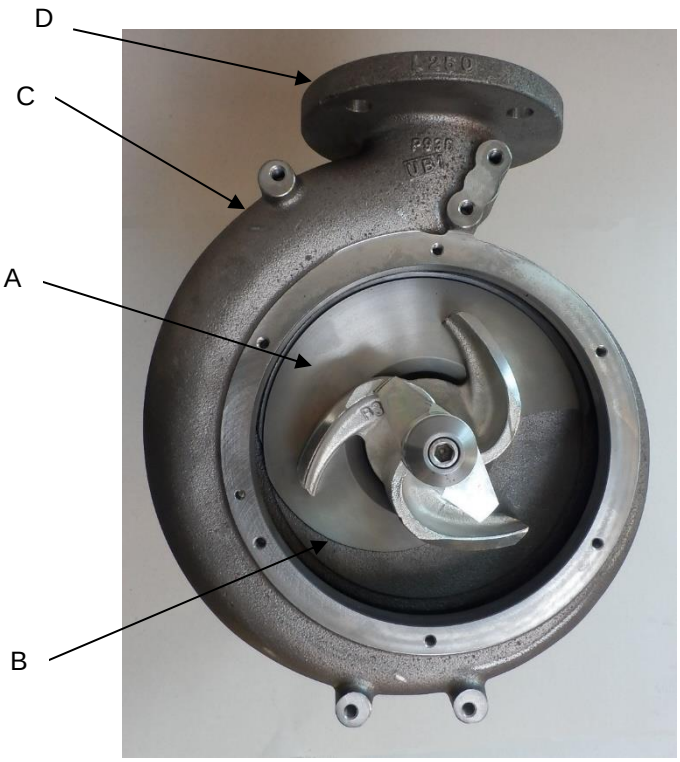
A. Knife with tightening pin
B. Front plate
C. Guide trace
D. Pump casing
E. Outlet



The front plate of the pump casing is designed with a guide trace. The guide trace has to be placed like shown on the above photo, regardless of how the outlet of the pump is turned.

Fitting the back plate

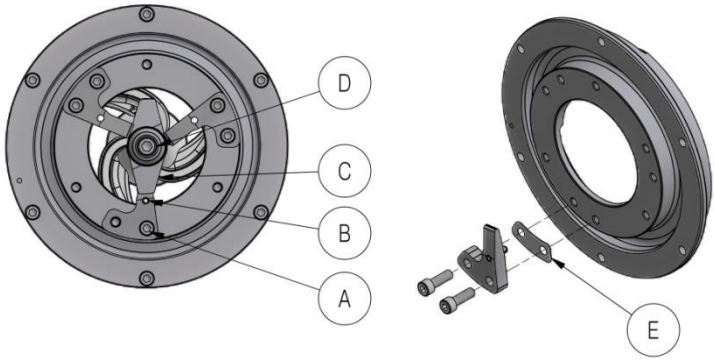
A. Back plate
B. Guide trace
C. Pump casing
D. Outlet



The front plate of the pump casing is designed with a guide trace. The guide trace has to be placed like shown on the above photo, regardless of how the outlet of the pump is turned.

Installation of knives

A. Fixed knife
B. Tightening pin
C. Rotating knife
D. Bolt
E. Shim



If the tightening pin in the fixed knife is missing, the pin/knife must be replaced.

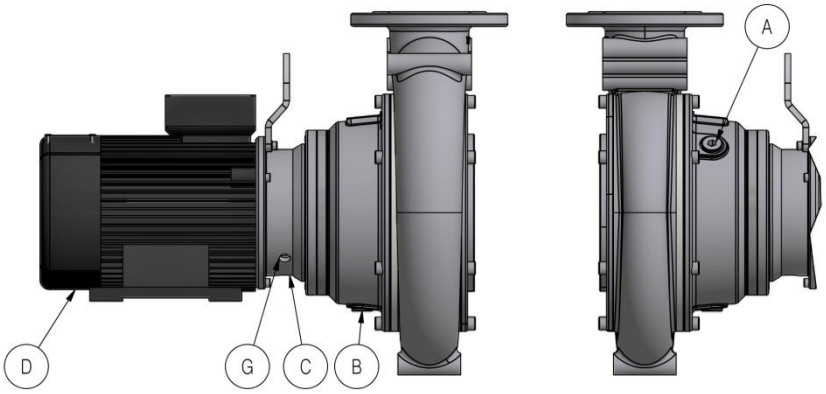
When the fixed and rotating knives are replaced, make sure that the shaft can rotate without the rotating knives touching the fixed knife/knives. If this is not the case, the fixed knife/knives must be adjusted with shims.

Inspection

Periodic inspections can ensure that the pump has a long life for modest costs. For every 6 months, possibly more often, depending on the operating conditions, the pump's impeller, oil supply, motor housing and any blade system should be checked. The oil must be changed at least once a year, or as described on the front of this manual for the recommended service interval for this particular unit.

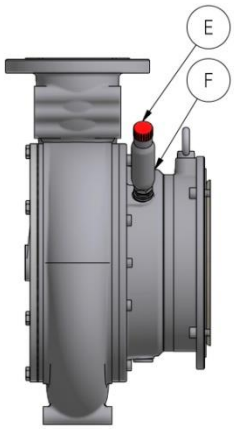
If large amounts of oil / liquid leak out of the drain hole in the intermediate chamber, the mechanical shaft seals of the pump should be checked. When replacing the knife system, tighten the bolts with a torque wrench according to the diagram below.

A. Top oil plug
B. Lower oil plug
C. Drainage hole
D. Condensate hole
E. Filter
F. Pressure equalization
G. Inspection hole



Oil control

The oil is checked by uninstalling the upper oil plug pos. A. For pumps with pressure equalization, pos. F is uninstalled.
The oil has to be clean and the level must reach the level of the upper plug pos. A when the pump is in a horizontal position, standing on its feet. If the oil is dirty, it must be changed and the two mechanical seals must be checked and changed, if necessary. Oil type see part list.



The oil is drained off at oil plug pos. B and is filled at oil plug pos. A. For pumps with pressure equalization, oil is filled at pos. F.

If the pump is equipped with an oil collector, a plug is placed in drainage hole C. The oil in the collector is drained by removing the plug in drainage hole C. If the oil collector is full, the oil comes out of inspection hole G.

For pumps equipped with pressure equalization, the filter pos. F must be cleaned or replaced in connection with maintenance to avoid plugging.

Disassembling/assembling

A major repair should take place at a special workshop.
Below please find some general conditions regarding disassembling/ assembling of the pump. The drawing attached to the spare parts list shows the construction of the unit. Not all parts can/should be dismantled, e.g. do not press the rotor off the shaft. When disassembling the unit, handle the mechanical seals with care as they are not shock resistant.
Prior to re-assembly, all sealing surfaces must be cleaned; all O-rings must be checked and changed, if necessary. Adhesive substance (e.g. Loctite) must be applied on all bolt joints. All bolts must be tightened with a tightening torque according to the diagram below:

Bolt sizes	Quality 10.9 - 12.9 Steel	Quality A4 kl. 80 St.steel
M5	-	4,5 Nm
M6	14 Nm	10 Nm
M8	34 Nm	24 Nm
M10	67 Nm	48 Nm
M12	115 Nm	82 Nm
M16	160 Nm	137 Nm

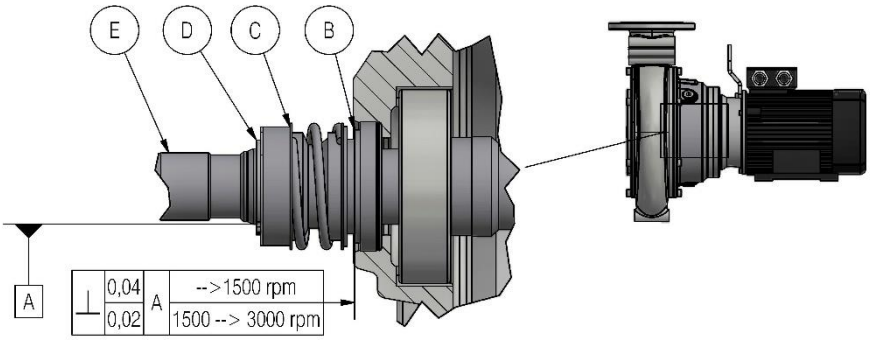
After mounting the bearing flange, the axial clearance must be checked as indicated in the table below.

Pump size 1500 rpm	Acceptable clearance	Pump size 3000 rpm	Acceptable clearance
50	0.25 ± 0.05 mm	50	0.50 ± 0.05 mm
65	0.50 ± 0.05 mm	65	0.80 ± 0.05 mm
80	0.50 ± 0.05 mm	80	1.30 ± 0.05 mm
105	0.80 ± 0.05 mm		
150 and 105 22/30 kW	1.30 ± 0.05 mm		

Installation of mechanical seals

When installing the mechanical shaft seals, it is important to note that these are precision products and that they should be treated as such. The slide faces must be protected during the installation.

B. Stationary sealing part
C. Rotary sealing part
D. Locking ring
E. Shaft



Push the stationary sealing part, pos. B, into place. Be careful not to damage the slide face during the installation.

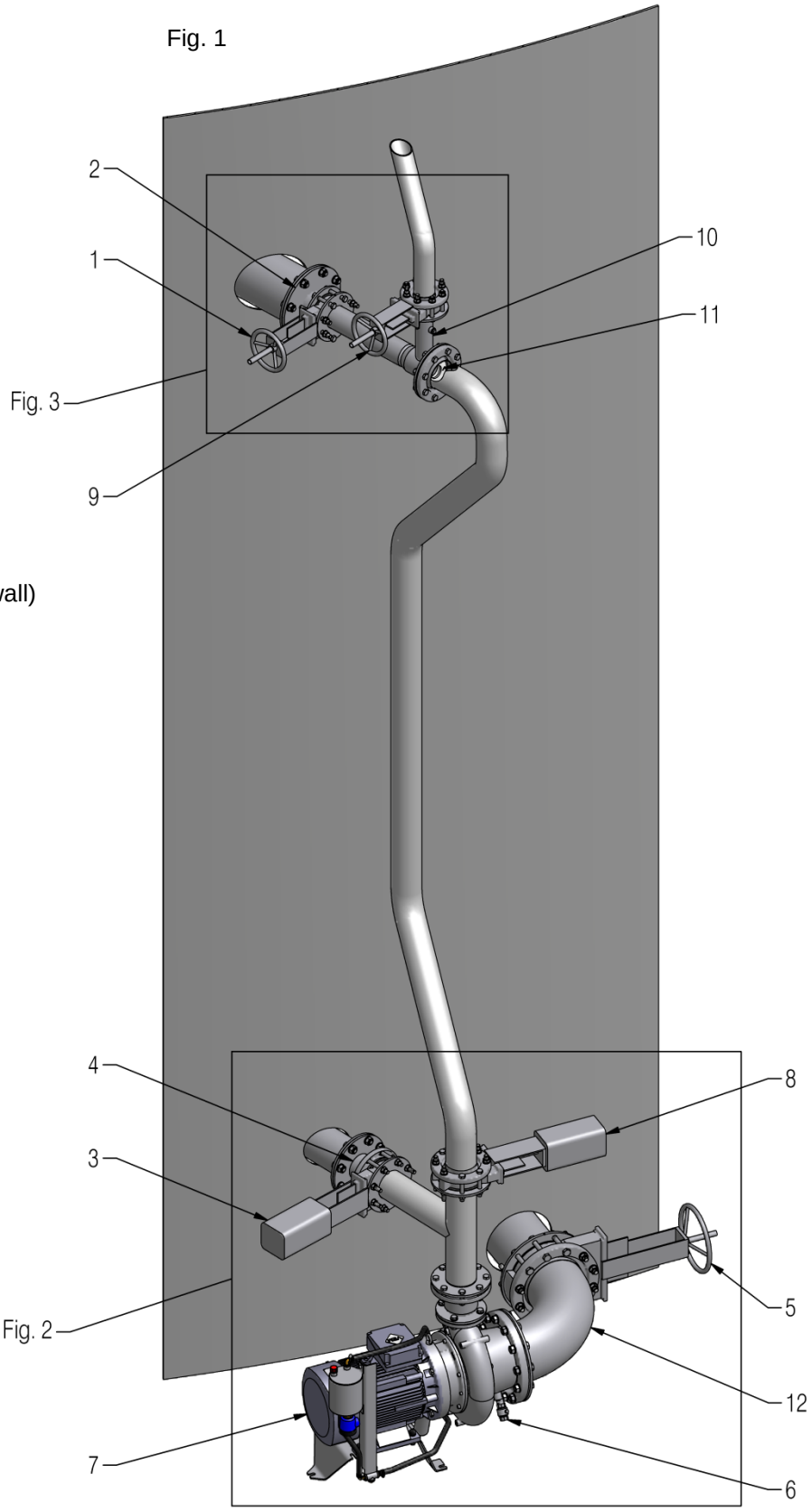
The rotating sealing part, pos. C, is put over the shaft. To ease the installation put soap water on the interior side of the rubber bellows as well as on the shaft. Do not apply silicone, PTFE lubricants or oil as they will prevent the rubber bellows from sticking to the shaft. Installation arbor should be used.
Locking ring, pos. D, is placed on the shaft and the seal is pressed until the locking ring is mounted in the locking ring groove. Check the seal by turning the motor shaft.

Oil is filled in the oil chamber. During the filling, the pump must be in a horizontal position.
Oil quantity: see spare parts list, otherwise the oil must reach the level of the upper oil plug.

Repair of the surface coating is necessary before the pump is put back into operation. See instruction for maintenance of surface coating.

We reserve the right to technical alterations. Translated from Danish.

Fig. 1



1. Gate valve
2. Diffuser (through tank wall)
3. Gate valve
4. Mixing nozzle (through tank wall)
5. Gate valve
6. Ball valve
7. Pump
8. Gate valve
9. Ball valve
10. Ejector
11. Ejector nozzle
12. Inlet pipe

Important

Before servicing / repairing the GasMix system, always ensure that the pump's electrical connection is disconnected and that the pump cannot be started unintentionally while servicing.

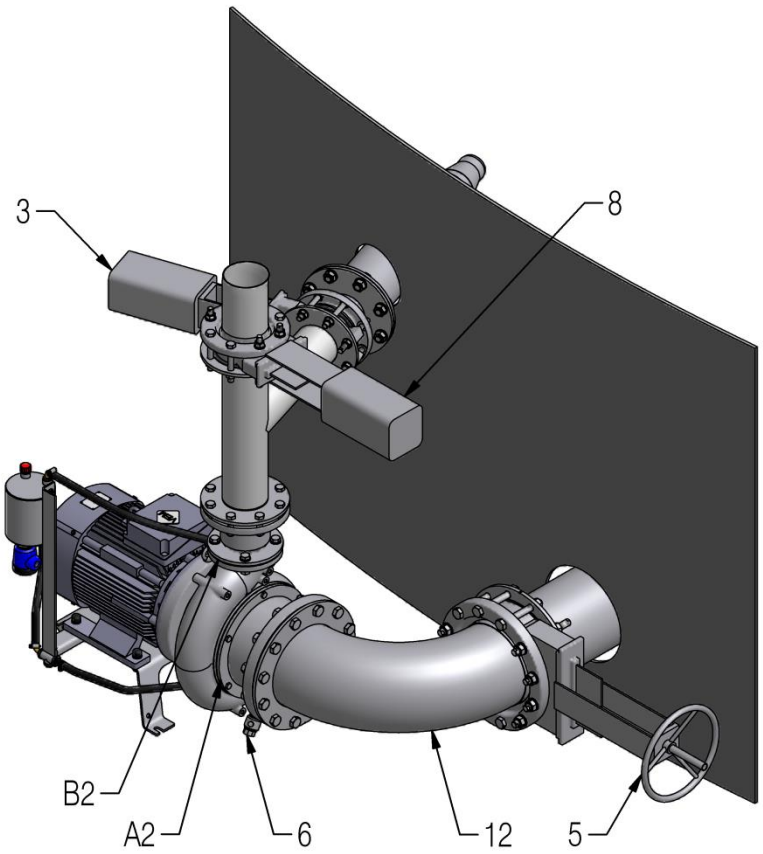
Accumulation of gas in the pipework

In case the GasMix system has prolonged stops, there is a risk of gas pockets forming in the pipework.

Dismantling the pump for service – see fig. 2

Prior to removing of the pump for service, please see the following instructions.
Close valves pos. 3, 5 and 8. If valve pos. 8 is not installed, valves 1 and 9 must be closed. See fig. 1. Drain liquids from the pump and the inlet pipe through valve pos. 6. Afterwards, the pump can be removed at the flanges pos. A2 and B2. The knife system, impeller and sealing system of the pump can also be serviced by removing the inlet pipe. If the inlet pipe is removed, please note that the gate valve pos. 5 must not be exposed to a water pressure higher than 6 m of water column without counter flange. The gate valve pos. 5 must under no circumstances be exposed to any external blows or impacts when the inlet pipe pos. 12 is removed.
For service of the pump see separate service instructions.

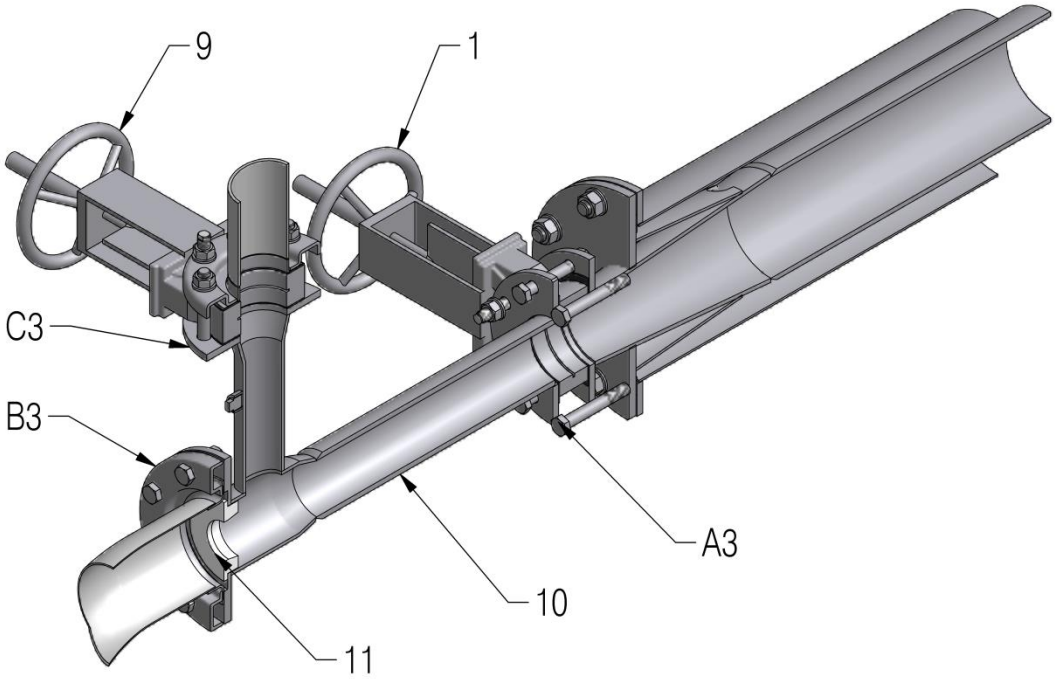
Fig. 2.



Replacement of ejector nozzle – see fig. 3

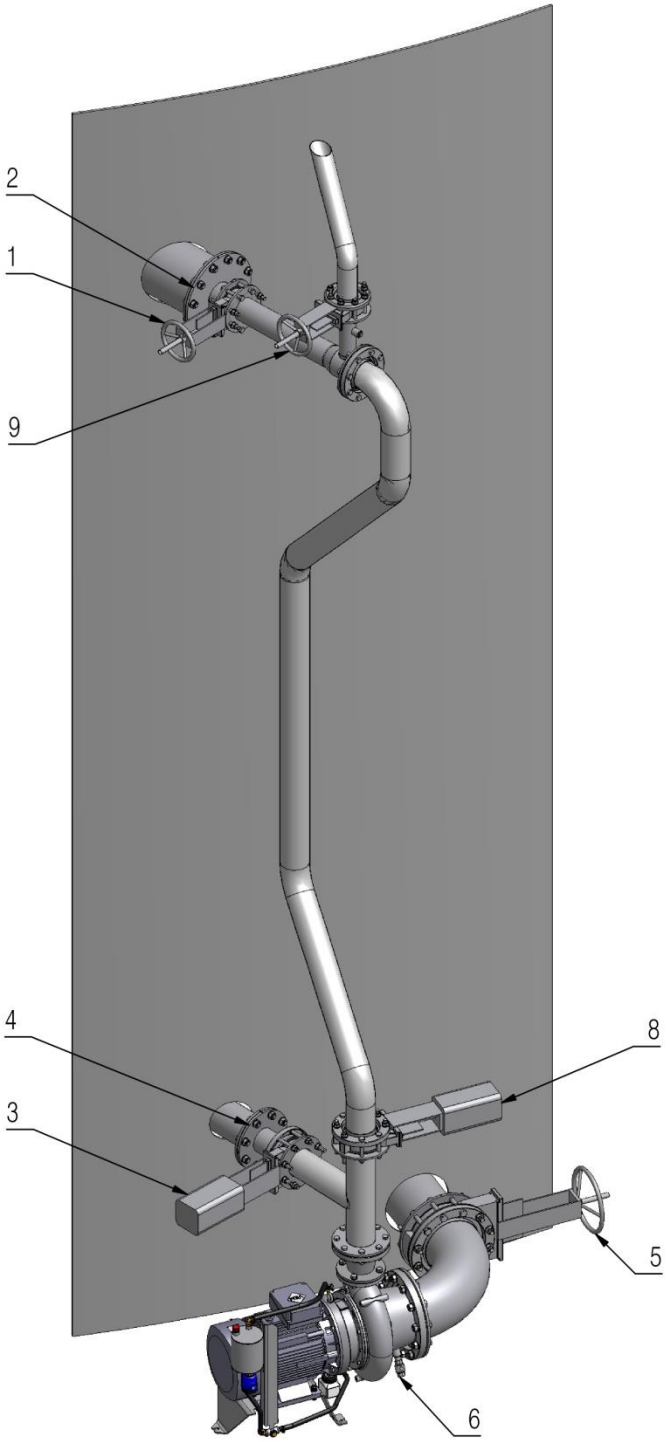
To ensure optimum efficiency in the GasMix system, it is recommended that the GasMix nozzle is replaced after 4-5 years of operation or as needed - depending on the abrasiveness of the liquid.
Close valve fig. 1 pos. 1, 3, 5 and 9. Drain liquids from the system through valve fig. 1 pos. 6 and remove the ejector fig. 3 pos. 10 at the flanges pos. A3, B3 and C3.
Check the ejector for wear before inserting a new ejector nozzle and reinstalling the system.
Gate valve pos. 1 and 9 must not be exposed to a pressure higher than 6 m of water column without counter flange and they must under no circumstances be exposed to any external blows or impacts when the ejector pos. 10 is removed.

Fig. 3



Dismantling valves, diffuser and mixing nozzle – see fig. 4

Fig. 4



- Service of valves pos. 1, 3 and 5. Diffuser pos. 2 and mixing nozzle pos. 4.
  Prior to removing, the liquid level in the tank must be lowered until it is under the level where service is performed.

- Service of valve pos. 8.
  Close valves pos. 1, 3, 5 and 9. Afterwards, liquids can be drained from the system through valve pos. 6 and valve pos. 8 can be removed.

- Service of valve pos. 9.
  It is very important that the gas above valve pos. 9 is turned off and that the gas pipe above valve pos. 9 is aired out thoroughly prior to service.
  Close valves pos. 1, 3 and 5. Afterwards, liquids can be drained from the system through ball valve pos. 6 and valve pos. 9 can be removed.
  When the valves are opened after service, it is important that valve pos. 5 is opened first. This is due to the fact that the system will be filled with liquid from the bottom up and the air in the system will be pressed out.

Translated from Danish.