HNP Mikrosysteme

Operating manual for micro annular gear pump
mzr-6359 Ex, mzr-6359X2 Ex, mzr-7259 Ex, mzr-7259X2 Ex

HNP Mikrosysteme GmbH
Bleicherufer 25
D-19053 Schwerin
Phone: 0385/52190-301
Fax: 0385/52190-333
E-mail: info@hnp-mikrosysteme.de
http://www.hnp-mikrosysteme.de

Last update: October 2016

Impressum

Original instructions

HNP Mikrosysteme GmbH
Bleicherufer 25
D-19053 Schwerin

This manual has been prepared with care. HNP Mikrosysteme does assume no liability for any errors in this manual and resulting consequences. Likewise, no liability is assumed direct or subsequent damages arising from an incorrect use of the devices.

While using micro annular gear pumps, the relevant standards regarding the specifications of this manual have to be followed.

Subject to change without notice.

Contents

1	**General information**	**1**
1.1	Application scope of the pumps	1
1.2	Product information	2
1.3	Technical data of the micro annular gear pumps	3
1.4	Measurements	6
1.5	Flow charts	7
1.6	Technical data of the Ex-motor	9
1.7	Technical data of the altenativ brushless DC Ex-motor (X2 version)	12
2	**Safety instructions**	**15**
2.1	Safety symbols in this operating manual	15
2.2	Staff qualification and training	15
2.3	Safety-conscious work	16
2.4	Safety instructions for the operator	16
2.5	Safety instructions for maintenance, check and assembly of the pump	16
2.6	Unauthorized pump conversions and spare part manufacture	17
2.7	Improper modes of operation	17
2.8	General safety instructions	17
3	**Transport and intermediate storage**	**18**
3.1	Shipment of the pumps and protection measures	18
3.2	Transport	18
3.3	Intermediate storage	18
4	**Description of the micro annular gear pump**	**19**
4.1	Operating principle of the micro annular gear pump	19
4.2	Construction	21
4.3	Construction materials	22
4.4	Liquid supply	23
5	**Optional modules**	**24**
5.1	Heat insulation module	25
5.1.1	Operation of the micro annular gear pumps with heat insulation module in different temperature classes	26
5.1.2	Monitoring of operation in the temperature class T4 and T5	27
5.1.3	Liquid temperature range for operation in temperature class T4 and T5	28
5.1.4	Liquid temperature range for operation in temperature class T6	28
5.1.5	Thermal element	29

6	**System integration**	**30**
6.1	Check before the first assembly	30
6.2	Details place of operation	30
6.3	Mounting of the micro annular gear pump	30
6.4	General instructions for the assembly of the liquid supply network	31
6.5	Electrical Connections	32
6.6	Assembly instruction for tubing and accessories	32
6.7	Filter selection and use	34
6.8	Requirements for motor controller	35
6.9	Operation with external motion controller S-HD-KL	36
6.10	Connection of the micro annular gear pump with S-G05	39
6.10.1	Startup with potentiometer	41
6.10.2	Startup with external 0-10 V signal	42
6.10.3	Startup with an external 0(4)-20 mA current signal	43
6.10.4	Startup with external potentiometer	45
6.10.5	Startup with the RS-232 interface	46
6.11	Installation of the software »Motion Manager«	47
7	**Startup/shutdown of a mzr-pump**	**48**
7.1	Preparing for operation	48
7.2	Startup of the micro annular gear pump	48
7.3	Re-start after dry run	48
7.4	Operation of the micro annular gear pumps without heat insulation module in different temperature classes	49
7.5	Monitoring of operation in the temperature class T5, T6	50
7.6	Flushing procedure after use	50
7.7	Shutdown of the micro annular gear pump	53
7.7.1	Conservation	55
7.7.2	Dismantling of the system	56
7.8	Trouble shooting	57
7.9	Return of the micro annular gear pump to the manufacturer	57
8	**Software »Motion Manager«**	**58**
8.1	Command mode	58
8.2	Programming of motion controller	60
8.3	Transfer of mcl-files to motor controller	60
9	**Accessories for microfluidic systems**	**63**
10	**Non-liability clause**	**63**
11	**Problems and their removal**	**64**
12	**EC Directive**	**67**
12.1	Electromagnetic Compatibility (EMC)	68

12.1.1 EMC Directive and Standards 68
12.1.2 Information on use as intended 69

13 Declaration of conformity - manufacturer's declaration 70

14 Maintenance and service 84
14.1 Micro annular gear pumps 84
14.2 Magnetic coupling 84
14.3 Ex-Motor 84

15 Contact person 85

16 Legal information 86

17 Safety information for the return of already employed micro annular gear pumps and components 87
17.1 General information 87
17.2 Declaration of liquids in contact with the micro annular gear pump 87
17.3 Shipment 87

18 Declaration of media in contact with the micro annular gear pump and its components 88

19 Appendix 89

1 General information

This operating manual contains basic instructions to be followed during integration, operation and maintenance of a mzr® micro annular gear pump. For this reason it is necessary to read it carefully before any handling of the device. The present manual should always be kept at the operation site of the micro annular gear pump.

In case assistance is needed, please indicate the pump type visible on the housing.

1.1 Application scope of the pumps

The micro annular gear pumps described in this manual are suitable for continuous delivery and discrete dosage of water, watery solutions, solvents, methanol, oils, lubricating liquids, paints and varnishes as well as many other liquids.

If you intend to treat any aggressive, poisonous, or radioactive liquids, you must conform to safety measures as according to the regulations in force. Any project concerning handling of magnetic or corrosive liquids should be previously discussed with the pump manufacturer.

The micro annular gear pumps *must not* be used for invasive medical applications, in which the liquid having had contact with the pump is re-introduced to the body.

Micro annular gear pumps exclusively are provided for use in the industrial area. A private use is excluded.

The micro annular gear pumps *must not* be used in aircrafts and spacecrafts or other vehicles without prior consent of the manufacturer.

The data concerning resistance of the pumps to manipulated liquids is elaborated according to the best of HNP Mikrosysteme's knowledge. However, operating parameters varying from one application case to another, no warranty for this information can be given.

Information given in this manual does not release the customer from the personal obligation to check the integrity, correct choice and suitability of the pump for the intended use. The use of the micro annular gear pumps should be conform with technical norms and regulations in force.

If you wish to receive more information than comprised in this operating manual please contact directly HNP Mikrosysteme.

1.2 Product information

The present operating manual is valid for the micro annular gear pumps mzr-6359 Ex, mzr-7259 Ex and mzr-6359X2 Ex, mzr-7259X2 Ex manufactured after June 2016 by HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin, Germany.

The date of release of the present manual figures on the cover.

The micro annular gear pumps described in the operation manual are conform to the applicable EC standards and are permitted to bear the CE mark.

1.3 Technical data of the micro annular gear pumps

		mzr-6359 Ex, mzr-6359X2 Ex	mzr-7259 Ex, mzr-7259X2 Ex
Explosion-protection			
Ex-certification	CE Ex II 2G IIC c T4 X		
Temperature class	T4		
Ambient temperature	0 … +40 °C		
Installation place	Ex-area zone 1, 2		
Protection categories	c, d (Ex-motor)		
Technical data			
Displacement volume [µl]		24	48
Measurements [mm]	L x B x H	see appendix	see appendix
Weight [g]	approx.	4900	4900
Internal volume [ml]		3.55	3.57
Rotor material	partially stabilized ZrO_2, optional: tungsten carbide Ni-based	●	●
Pump case material	alloy C22 (2.4602), optional: stainless steel 316L	●	●
Bearing material	sintered silicon carbide (SSiC), Al_2O_3	●	●
Static sealing	FFPM, optional: FPM	●	●
Threaded fluid supply connections	1/8" NPT (lateral)	●	●
Coupling	bellow coupling	●	●
Performance parameters			
Flow rate Q [ml/min]		0.024 - 112	0.048 - 225
Flow rate Q [ml/min]	X2 version	0.024 - 96	0.048 - 192
Min. dosage volume [µl]		15	30
Max. system pressure [bar]	inlet pressure+differential pressure	80 (1160 psi) 60 (870 psi) for pump made of 316L	80 (1160 psi) 60 (870 psi) for pump made of 316L
Differential pressure range [bar]	viscosity 1 mPas	5 (-hx) (72 psi) 15 (-cx) (217 psi)	15 (-dcx) (217 psi), 20 (-cx) (290 psi) 30 (-hx) (435 psi)
	viscosity >16 mPas	40 (580 psi)	40 (580 psi)
Viscosity η [mPas]	min.	0.3	0.3
	max.	100*	100*
Dosage precision CV [%]		<1	<1
Pulsation [%]		6	6
$NPSH_R$-value [m]	min.	-	-
Liquid temperature [°C]	min.	-5	-5
	max.	60 (150 *)	60 (150 *)
Ambient temperature [°C]	min.	0	0
	max.	40	40
Storage temperature [°C]	min.	0	0
	max.	40	40

Legend:
- ● available
- ⊙ optional / on demand
- – not available
- * with supplementary modules

table 1 Technical data and performance parameters of the micro annular gear pumps mzr-6359 Ex and mzr-6359 Ex

		mzr-6359X2 Ex	mzr-7259X2 Ex
Explosion-protection			
Ex-certification	CE Ex II 2G IIC c T4 X		
Temperature class	T4		
Ambient temperature	0 … +40 °C		
Installation place	Ex-area zone 1, 2		
Protection categories	c, d (Ex-motor)		
Technical data			
Displacement volume [µl]		24	48
Measurements [mm]	L x B x H	279 x 80 x 75	279 x 80 x 75
Weight [g]		4900	4900
Internal volume [ml]		3.55	3.57
Rotor material	partially stabilized ZrO_2, optional: tungsten carbide Ni-based	●	●
Pump case material	alloy C22 (2.4602), optional: stainless steel 316L	●	●
Bearing material	sintered silicon carbide (SSiC), Al_2O_3	●	●
Static sealing	FFPM, optional: FPM	●	●
Threaded fluid supply connections	1/8"NPT (lateral)	●	●
Coupling	bellow coupling	●	●
Performance parameters			
Flow rate Q [ml/min]	min.	0.024	0.048
[ml/min]	max.	96	192
[l/h]	max.	5,76	11.52
Min. dosage volume [µl]		15	30
Max. system pressure [bar]	inlet pressure+differential pressure	80 (1160 psi) 60 (870 psi) for pump made of 316L	80 (1160 psi) 60 (870 psi) for pump made of 316L
Differential pressure range [bar]	viscosity 1 mPas	15 (218 psi)	20 (-cx) 290 psi 30 (-hx) 580 psi
	viscosity >16 mPas	40	40
Viscosity η [mPas]	min.	0.3	0.3
	max.	100*	100*
Dosage precision CV [%]		<1	<1
Pulsation [%]		6	6
$NPSH_R$-value [m]	min.	-	-
Liquid temperature [°C]	min.	-5	-5
	max.	60 (150 *)	60 (150 *)
Ambient temperature [°C]	min.	0	0
	max.	40	40
Storage temperature [°C]	min.	0	0
	max.	40	40

Legend:
- ● available
- ⊙ optional / on demand
- – not available
- * with supplementary modules

table 2 Technical data and performance parameters of the micro annular gear pumps mzr-6359X2 Ex and mzr-6359X2 Ex

Warning The material properties of a liquid (e.g. viscosity, lubricating property, particle content, corrosiveness) impacts the technical data and the lifetime of pumps. Under appropriate conditions the characteristic values may be increased or decreased.

Warning If you intend to operate the pump out of the range of the above given specification, please consult the manufacturer. Modifications may be necessary to ensure successful operation. Otherwise the pump or the system may be damaged seriously.

Warning The manufacturer of the pump cannot guarantee the fatigue strength of the pump case due to the unknown load impact defined by different specification parameters like type of liquid, concentration, temperature. The cause for this restriction is a non predictable corrosion at the pump case like pitting, micro cracking and surface erosion which causes a wall thickness reduction and an increase of the notch effect. This could reduce the fatigue strength limit considerably. Under a particularly aggressive environment only a time dependent stability can be assumed. Because of the mentioned above the manufacturer cannot give specifications concerning the number of possible load alternations.

1.4 Measurements

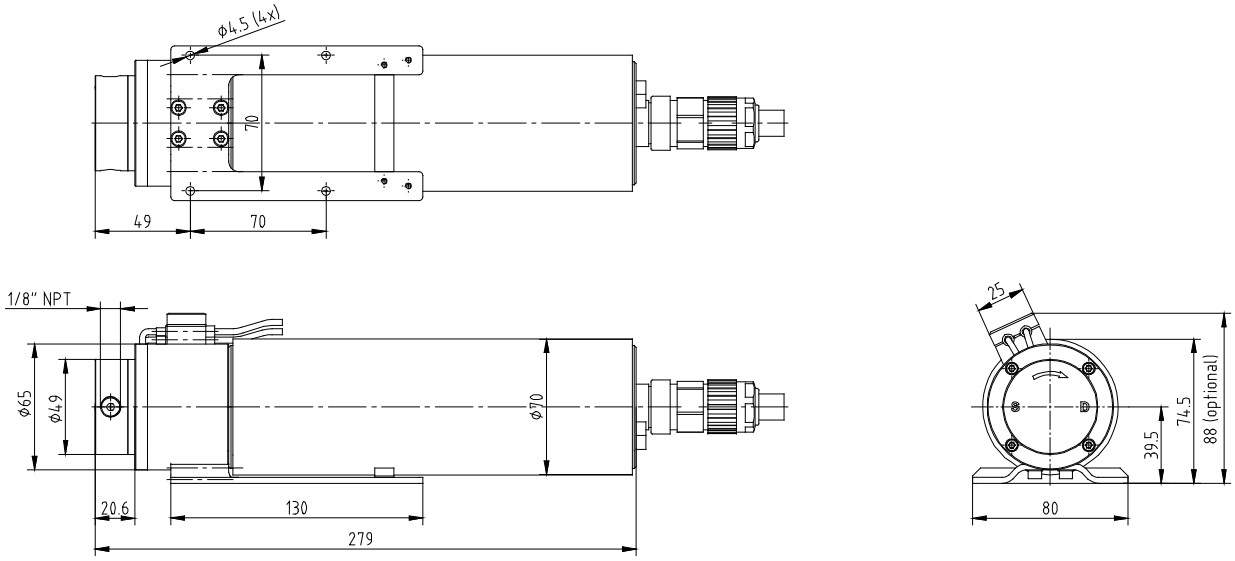


figure 1 Measurements of the micro annular gear pump mzr-6359 Ex and mzr-7259 Ex with lateral fluid connection 1/8" NPT

1.5 Flow charts

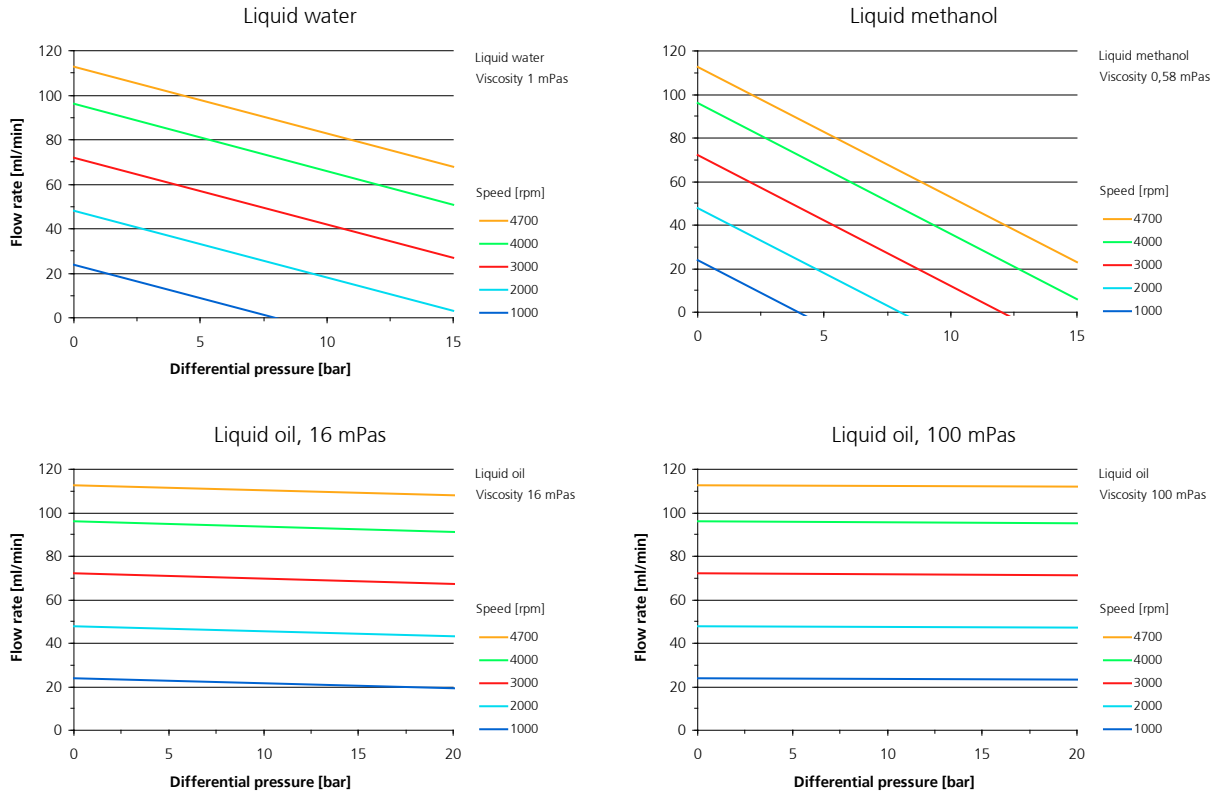


figure 2 Flow charts of the mzr-6359 Ex and mzr-6359X2 Ex

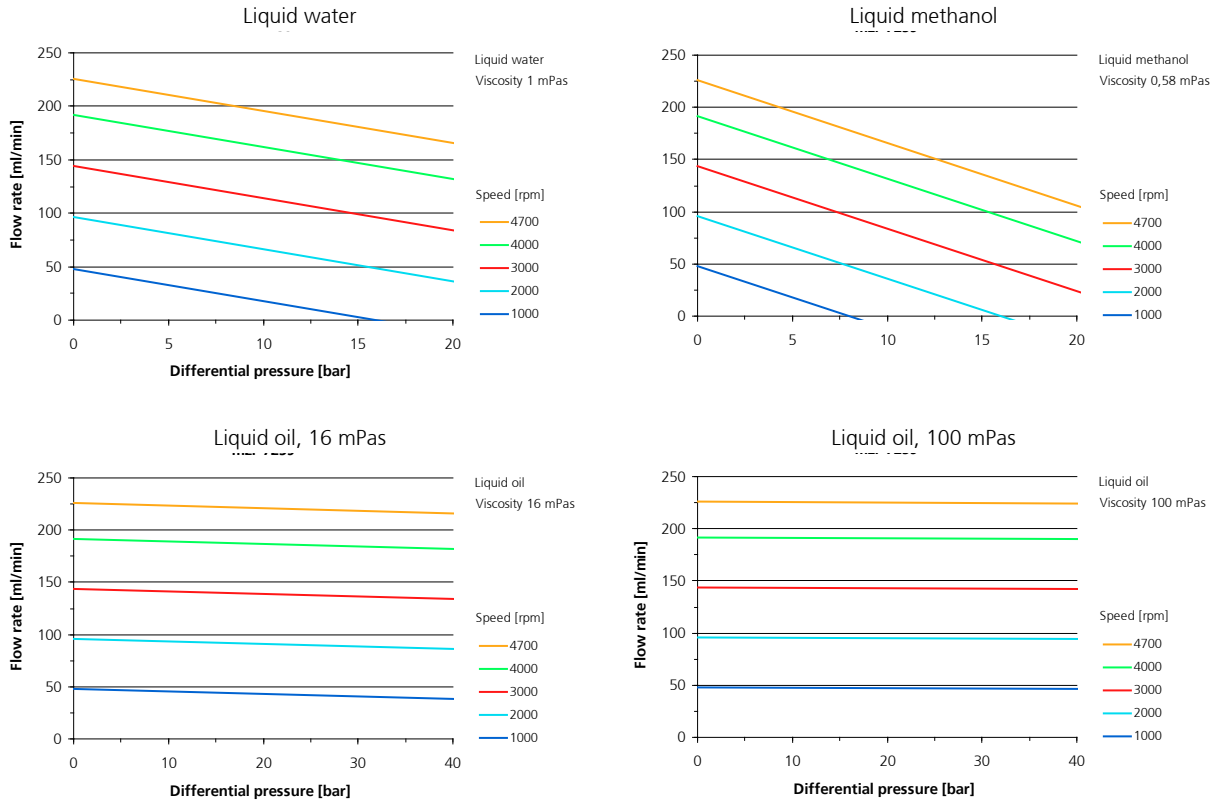


figure 3 Flow charts of the mzr-7259 Ex and mzr-7259X2 Ex

1.6 Technical data of the Ex-motor

The micro annular gear pumps mzr-6359 Ex and mzr-7259 Ex are equipped with an explosion-proof DC-motor. The parameters of the motor are described in table 3. The speed of the motor can be controlled with the optional motion controller S-HD-KL. One of the motor's features is a highly dynamic behavior. For operation it is recommended to use a power source of 24 V (with a power rating of 5 A).

The motor of the pumps is corresponding to the applicable EC standards. The confirmations according to EC 94/9/EG as well as of EC conformity are given.

Measurements	
Diameter of motor casing	70 mm
Length of motor casing	210 mm
Weight	approx. 1,8 kg
General data	
Type	EXR-1.24HEDL-L10
Manufacturer	Edelweiss Actuators Srl, Via Padergnone 21 I-24050 Zanika BG Italy
Distribution / Service	Mattke Antriebstechnik Leinenweberstraße 12 D-79108 Freiburg Germany
Test body	0948
Number of certificate	TÜV-A 11ATEX0006X
Certification	EN60079-0, EN60079-1, EU-Richtlinie 94/9/EG, Anhang III
Ex-certification	II 2G Ex d IIC T5 Gb
Installation place	Ex-area zone 1, 2
Specification	
Nominal voltage	24 V DC
Max. continuos current by Temperature range T6	2 A
Max. continuos torque	75 mNm
Max. power	53 W
Max. dissipation	11 W
No load speed by 24 V	4700 rpm
Speed range	1 – 4700 rpm
Length of the cable	10 m
External compensation of potential	wires: 4 mm² flexible 6 mm² single-wire
Protective class according EN60529	IP54
Operation temperature range	-20 … +45 °C

table 3 Technical data Ex-motor for mzr-6359 Ex and mzr-7259 Ex

Parameter	mzr-6359 Ex	mzr-7259 Ex
Max. Peak current	1800 mA	2000 mA
Max. Continuos current	1500 mA	1800 mA
max. Acceleration	550 U/s²	550 U/s²

table 4 Programming current parameters for mzr-6359 Ex and mzr-7259 Ex

Wire	Function
brown	motor +
blue	motor -
yellow/green	screening / PE
red	V_{cc} (5 VDC)
blue	SGND
pink	channel A neg.
grey	channel A
yellow	channel B neg.
green	channel B
brown	channel I neg. (index)
white	channel I (index)

table 5 Pin configuration motor cable (10 Lead of cable) valid as of September 2012

Wire	Function
white	motor +
brown	motor -
yellow/green	screening / PE
red	V_{cc} (5 VDC)
blue	SGND
pink	channel A neg.
grey	channel A
violet	channel B neg.
black	channel B
red/blue	channel I neg. (index)
pink/grey	channel I (index)

table 6 Pin configuration motor cable (10 Lead of cable) valid until September 2012

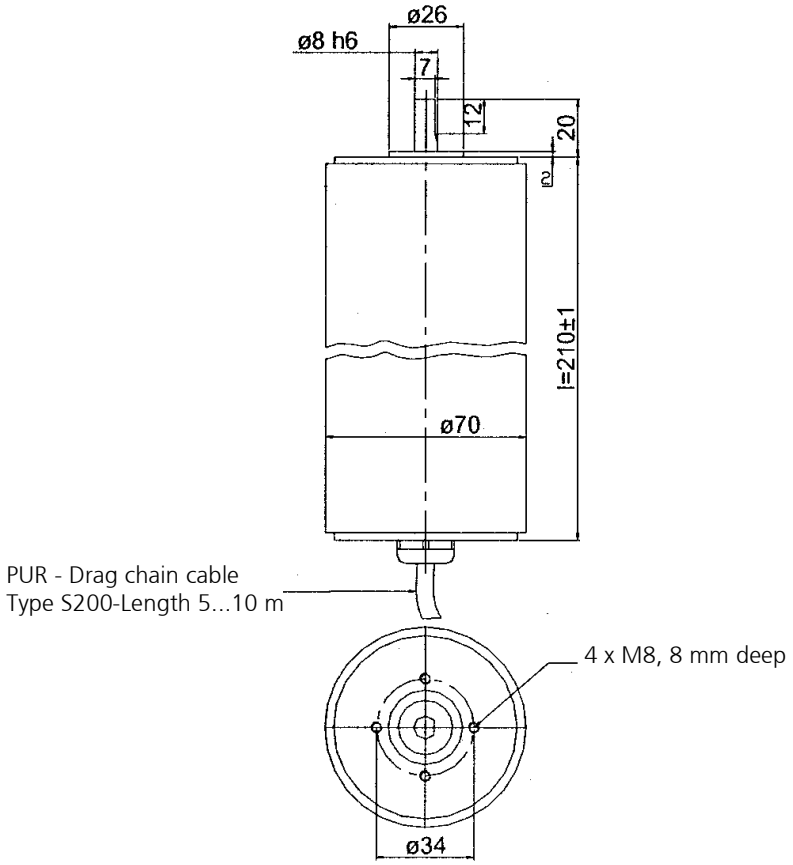


Figure 4 Measurements of the motor (standard cable length 10 m)

The motor is delivered with a digital encoder type HEDL5540 with line driver and 500 counts per revolution.

Encoder	
Max. voltage V_{cc}	5 VDC ± 10 %
Number of channels	3 (A, B, O)
Counts per revolution and channel	500
Output signal at V_{cc} = 5 VDC	EIA standard RS422 used driver: DS26LS31
Output current	max. 20 mA
Phase shift Φ (nominal)	90°
Operating temperature range	0 ... +40°C

table 7 Technical data encoder

1.7 Technical data of the altenativ brushless DC Ex-motor (X2 version)

The micro annular gear pumps mzr-6359X2 Ex and mzr-7259X2 Ex are equipped with a alternativ explosion-proof brushless DC-motor. The parameters of the motor are described in table 3. The speed of the motor can be controlled with the internal motion controller. One of the motor's features is a highly dynamic behavior. For operation it is recommended to use a power source of 24 V (with a power rating of 5 A).

The motor of the pumps is corresponding to the applicable EC standards. The confirmations according to EC 94/9/EG as well as of EC conformity are given.

Measurements	
Diameter of motor casing	70 mm
Length of motor casing	285 mm
Weight	approx. 2,3 kg (without cable)
General data	
Type	EXR-32.24-MC3-L10
Manufacturer	Edelweiss Actuators Srl, Via Padergnone 21 I-24050 Zanika BG Italy
Distribution / Service	Mattke Antriebstechnik Leinenweberstraße 12 D-79108 Freiburg Germany
Test body	0948
Number of certificate	TÜV-A 11ATEX0006X
Certification	EN60079-0, EN60079-1, EU-Richtlinie 94/9/EG, Anhang III
Ex-certification	II 2G Ex d IIC T5 Gb
Installation place	Ex-area zone 1, 2
Specification	
Nominal voltage	24 V DC
Max. continuos current by Temperature range T5	2 A
Max. continuos torque	85 mNm
Max. power	53 W
Max. dissipation	11 W
No load speed by 24 V	4200 rpm
Speed range	1 – 4000 rpm
Length of the cable	10 m
External compensation of potential	wires: 4 mm² flexible 6 mm² single-wire
Protective class according EN60529	IP54
Operation temperature range	-20 … +40 °C

table 8 Technical data Ex-motor for mzr-6359X2 Ex and mzr-7259X2 Ex

Parameter	mzr-6359 Ex	mzr-7259 Ex
Max. Peak current	1700 mA	1700 mA
Max. Continuos current	1500 mA	1500 mA
max. Acceleration	500 U/s²	500 U/s²

table 9 Programming current parameters for mzr-6359X2 Ex and mzr-7259X2 Ex

Wire	Function	Cable cross-section
brown	24 VDC	0,5 mm²
blue	GND	0,5 mm²
yellow/green	screening / PE	0,5 mm²
red	3 IN	0,14 mm²
blue	n.c.	0,14 mm²
white	Fault out	0,14 mm²
pink	n.c.	0,14 mm²
grey	AGND	0,14 mm²
yellow	RxD / IN CAN_L	0,14 mm²
green	TxD / IN CAN_H	0,14 mm²
brown	ANIN	0,14 mm²

table 10 Pin configuration motor cable (12 Lead of cable)

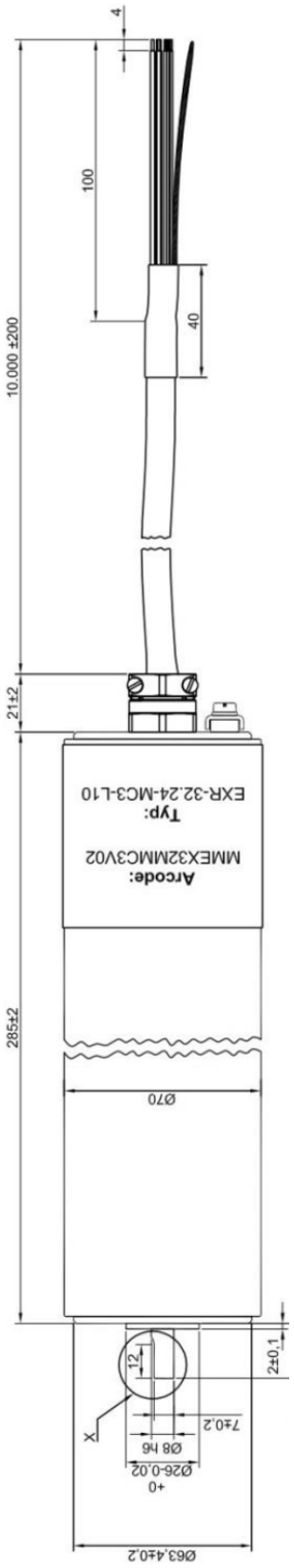


Figure 5 Measurements of the motor (standard cable length 10 m)

2 Safety instructions

Comply with the general safety instructions listed in the safety section as well as with the special safety instructions listed under the other main sections. All legal and corporate safety instructions have to be obeyed.

2.1 Safety symbols in this operating manual

The safety instructions listed in this operation manual are specially labeled. It can cause danger for persons, if they are not complied with.

Danger symbol		Non-compliance poses danger for persons.
High voltage symbol		Non-compliance poses danger of electrical shock.
Ex-symbol		These instructions must be complied with in full for explosion-protection.

The type plate mounted on the pump must be complied with and has to be maintained in a clearly readable condition.

Please pay attention to items marked with the following symbols. Pump or system damage is possible if these warnings are ignored.

Warning

Information plates attached directly to the pump head for example name of the fluid inlet/outlet, sign with the direction of rotation must be observed and preserved.

2.2 Staff qualification and training

The staff operating, servicing, inspecting and assembling the pumps must evidence the appropriate qualification for these works. Areas of responsibility and competence as well as monitoring of the staff must be precisely regulated by the decision maker. If the personnel do not have the necessary knowledge, they must be trained and instructed accordingly. If necessary, this can be implemented by the supplier or the manufacturer on behalf of the operator. Furthermore, the operator in charge must ensure that the content of the present manual has been fully understood by the personnel.

2.3 Safety-conscious work

The safety instructions listed in this operating manual, applicable national regulations concerning accident prevention as well as internal work, operation and safety regulations of the operator must be complied with.

2.4 Safety instructions for the operator

The drive should be protected against dust, water vapor condensation, humidity, splash water, aggressive gases and liquids. Please provide for adequate air ventilation and thus cooling of the motor.

Possible leaks of dangerous liquids should be guided away in a way not to represent any danger for the personnel and the environment. The pump should be regularly checked for possible leakage. All legal requirements in this matter should be followed.

The existing protections against contact for the moving parts of the pump (such as for example the coupling) must not be removed during operation.

Take care that all risks resulting from the electric energy are excluded. (For details please refer to the instructions provided by the authorities in charge or your power supplier.)

Warning Please insure, that the totality of the liquid supply accessories such as tubes, hoses, filters etc. are free from dust or dirt particles. Impurities such as metal, plastic or glass particles may impair or damage the pump leading to its failure.

Warning Please, operate the pump with a filter featuring 10 µm or smaller pores. It will protect the pump.

2.5 Safety instructions for maintenance, check and assembly of the pump

As a rule all maintenance work on the device should be performed when the device is at a standstill. The shutdown procedure described in this manual must be followed. Pumps delivering liquids hazardous to health must be decontaminated. Immediately after the work had been completed all safety equipment and protection measures should be applied.

Before starting the operation, please take into notice the instructions listed in the chapter 7.

Warning Should a malfunction of the pump occur, do not dismantle the pump on your own but contact one of HNP Mikrosysteme's service staff for professional assistance.

2.6 Unauthorized pump conversions and spare part manufacture

Conversions or modification to the device are only permitted with prior consent of the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other parts will annul the liability of the pump manufacturer for any resulting consequences.

2.7 Improper modes of operation

The safety of operation of the delivered device can only be insured by correct use, as described in chapter 1. The limit values given in this manual must not be exceeded in any case.

2.8 General safety instructions

Please observe the following safety instructions

The pump may operate at high pressures. For this reason please use only the delivered accessories and ensure that the employed fittings and tubing have been prescribed and approved for these pressures.

In order to decrease the pressure, provide the system with a *pressure control valve* directing the excess liquid to the storage tank or back to the suction side. In the case of blockage of the pressure side the operating pressure can multiply, this can lead to the damage of downstream components.

At a standstill, the liquid may flow through the pump in the direction of the falling pressure. In order to avoid this unwanted movement, please integrate *non-return valves* (see accessories).

Protect the micro annular gear pump and the electric drive against strokes and shocks.

The allowed operating parameters of the drive should not be exceeded. In particular an *incorrect polarity setting* of the supply voltage may lead to damage of the control unit.

Warning

Please operate the pump with a filter featuring 10 µm or smaller pores. It will protect the pump.

3 Transport and intermediate storage

3.1 Shipment of the pumps and protection measures

The pumps leaving the factory are secured against corrosion and shocks. The inlets and outlets of the pumps are protected with plastic plugs in order to prevent any foreign bodies from penetrating into the device.

3.2 Transport

In order to avoid any damage related to transport, the package must be protected against shocks. HNP Mikrosysteme guarantees, that all goods leave the factory in the best condition. Any noticed damage should be reported to the concerned forwarding agent, authorized dealer or to HNP Mikrosysteme, as manufacturer.

3.3 Intermediate storage

Following points concerning pump storage should be observed:

- Necessary conservation procedure (see also chapter 7)
- The protective plugs must be left screwed in
- The pump should not be stored in humid places
- For storage temperature - refer to chapter 1.3 of the present manual

4 Description of the micro annular gear pump

4.1 Operating principle of the micro annular gear pump

Micro annular gear pumps are positive displacement pumps. They contain two rotors, bearing slightly eccentrically to each other; an externally toothed internal rotor and an annular, internally toothed external rotor (see figure 6). Due to their cycloid indenting, the rotors remain interlocked at any time, forming during rotation a system of several sealed pumping chambers. As the rotors revolve around their offset axis, the pumping chambers increase on the induction (suction) side and simultaneously decrease on the delivery side of the pump (see figure 7). A homogenous flow is generated between the kidney-like inlet and outlet.

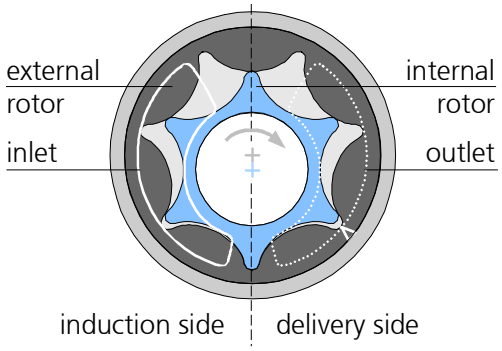


figure 6 Principle of the micro annular gear pump

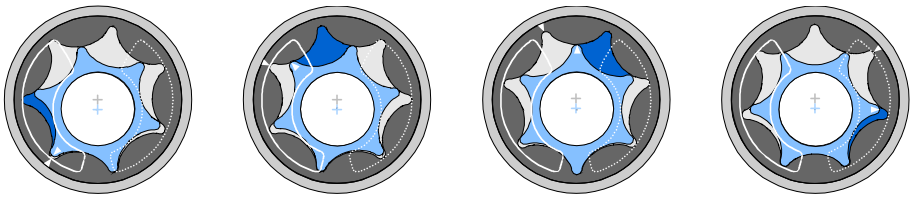


figure 7 Operating principle of the micro annular gear pump

In the case of rotary displacement pumps, the delivered amount of liquid may be easily calculated form the displacement volume V_g of the pump and the number of revolutions of the rotor n. Displacement volume stands for the volume of liquid that is moved within one revolution of the rotor. This relationship is illustrated by the following formula:

$$Q = \eta_{Vol} \cdot V_g \cdot n$$

The volumetric efficiency η_{Vol} shows the relationship between the actual and the theoretical flow rate. The existing differences result from internal movement of the liquid during the operation.

Example: According to the formula mentioned above the mzr-7259 Ex pump featuring a displacement volume of 48 µl delivers at 3000 rpm and with a volumetric efficiency of 100% 144 ml/min.

The table 11 shows theoretical flow rate values depending on speed expressed in ml/min and ml/h.

	mzr-6359		**mzr-7259**	
Speed [rpm]	**Q** [ml/min]	**Q** [ml/h]	**Q** [ml/min]	**Q** [ml/h]
500	12	720	24	1440
1000	24	1440	48	2880
2000	48	2880	96	5760
3000	72	4320	144	8640
4000	96	57601	192	11520

table 11 Theoretical flow rate of the micro annular gear pumps

Pressure generated by the pump is determined by the configuration of the fluid delivery system and results from both the hydraulic pressure and the hydraulic resistance (tubing, narrow passes etc.). The *volumetric efficiency* of a pump decreases when the differential pressure rises.

The *viscosity* of the manipulated liquid has an important impact on the volumetric efficiency. The volumetric efficiency increases for higher viscosity values because the *internal leakage* values go down.

Cavitation is an effect which, starting form a certain limit speed value, may reduce the volumetric efficiency of a pump. In the case of highly viscous liquids this limit speed value is lower. That happens because of the liquid-specific drop of vapor pressure in the suction tube which leads to gas formation inside the pump.

The particularity of the mzr-pumps is their highly precise construction, which provides for both high operating pressures and a high dosage precision. The gap between both rotors and between the rotors and the adjacent case parts lies in the range of a few micrometers. This precision is the key factor enabling to achieve volumetric efficiency close to 100%.

4.2 Construction

The micro annular gear pump is composed of the pump head, the coupling unit, the drive and the bracket (see figure 8).

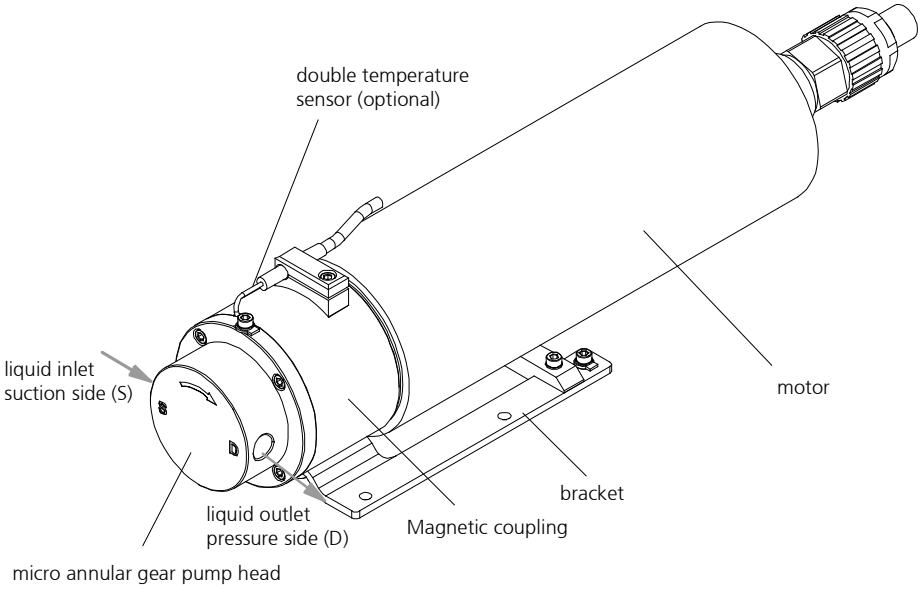


figure 8 Design of the micro annular gear pump mzr-7259 Ex

4.3 Construction materials

Wetted parts	mzr-xx59-cy Ex	mzr-xx59-cs Ex
Rotor materials	partially stabilized ZrO2	partially stabilized ZrO2
Control plates	Al_2O_3 ceramics	Al_2O_3 ceramics
Pump case material	alloy C22 (2.4602)	stainless steel 316 L
bearing material	sintered silicon carbide (SSiC), Al_2O_3 ceramics	sintered silicon carbide (SSiC), Al_2O_3 ceramics
shaft material	sintered silicon carbide (SSiC)	sintered silicon carbide (SSiC)
Static sealing material	FFPM (Kalrez® Spectrum™ 6375)	FFPM (Kalrez® Spectrum™ 6375)
Distance washer	PTFE	PTFE

table 12 Construction materials of the wetted parts, rotor material CVD-diamond coated tungsten carbide

Wetted parts	mzr-xx59-hy Ex	mzr-xx59-hs Ex
Rotor materials	tungsten carbide Ni-based	tungsten carbide Ni-based
Control plates	tungsten carbide Ni-based	tungsten carbide Ni-based
Pump case material	alloy C22 (2.4602)	stainless steel 316 L
bearing material	tungsten carbide Ni-based	tungsten carbide Ni-based
shaft material	tungsten carbide Ni-based	tungsten carbide Ni-based
Static sealing material	FFPM (Kalrez® Spectrum™ 6375)	FKM optional: FFPM (Kalrez® Spectrum™ 6375)
Distance washer	PTFE	PTFE

table 13 Construction materials of the wetted parts, rotor material tungsten carbide

The resistance of the construction materials to the delivered liquids should be verified by the operator for each individual application.

The material combinations and -cs and -cy can not be used for pumping water or DI water.

Pumps handling non-lubricating liquids have shorter service lives.

4.4 Liquid supply

	mzr-xx59 Ex
Liquid inlet/outlet	lateral 1/8" NPT internal thread front 1/8" NPT internal thread
Tubing	tube/hose OD 6 mm

table 14 Liquid supply

The micro annular gear pump head has an inscription on the front side. The liquid inlet connection is marked with the letter »S«, the liquid outlet connection with the letter »D«. An arrow indicates the inherent turning direction of the shaft.

Sealing plugs are inserted into the holes for the fluidic connections as protection against contamination during delivery. The sealing plugs have to be removed before assembly of the fluidic connectors. If the fluidic connectors are disassembled, please re-seal the threads with the cleaned sealing plugs as protection against particles.

5 Optional modules

The spectrum of applications of the high performance micro annular gear pump series may be expanded by using different additional modules. The modules allow for special applications, which could otherwise not be accomplished with a standard pump version. The modules may be combined with each other and with almost all available pump heads and motor versions.

– *Thermal insulation module* extends the operating temperature range of the pump by protecting the motor from overheating

The configuration of a given pump version should in each case be discussed with consideration to the specific requirements of the application. *Additional* customized modules may be designed on demand.

5.1 Heat insulation module

The heat insulation module enables to deliver liquids with a higher liquid temperature range (see table 15). It comprises thermally insulating coupling components made of plastic (PEEK) located between the pump and the drive. The drive should not be exposed to overheating. For this reason the heat transfer from the pump to the drive should be limited. An additional thermal barrier is provided by the plastic motor housing. If the surrounding temperature rises, the pump is working over a longer period or the manipulated liquid features a high temperature, convection cooling of the motor is recommended.

Pump type	Liquid temperature range
mzr-6359/7259--cs Ex	-20…+100 °C (-4…+212 °F)
mzr-6359/7259-cy Ex	-20…+100 °C (-4…+212 °F)
mzr-6359/7259-hs Ex	-20…+150 °C (-4…+302 °F)
mzr-6359/7259-hy Ex	-20…+150 °C (-4…+302 °F)

table 15 Liquid temperature range with heat insulation module for mzr-6359 Ex, mzr-7259 Ex, mzr-6359X2 Ex and mzr-7259X2 Ex

The switching-off temperature measured on the integrated thermocouple in the pump, must be set at a maximum liquid temperature of 150 °C to 155 °C (311 °F).

Earth the pump head additionally at the corresponding terminal clamp.

For operation of the micro annular gear pump with heat insulation module the optional temperature supervision of the magnetic coupling is necessary (see installation 4.2).

The pump fulfills the requirements for use in explosive areas in which endangering explosion by substances of the explosion group of IIB can be conditional (like e.g. hydrocarbons).

The pump carries the changed identification with the non insulating coupling components and the higher temperature:

CE II 2G c IIB T3 X

Description of the single symbols:

	Equipment meets the requirements of the RL 94/9/EG
II	Equipment of the group of equipment II („Non-mining industry“)
2G	Equipment of the category 2, intended for the employment in zone 1 (explosion endangerment by inflammable gases, steams or nebulas), can be used also in zone 2
C	As explosion prevention measure the ignition enclosure was converted „constructional security“(c) according to DIN EN 13463-5.

IIB The equipment fulfills the requirements for the employment within highly combustible ranges, within which the explosion endangerment can be due to materials of the explosion group IIB (like e.g. hydrocarbons).

T3 The equipment fulfils the requirements to that temperature class T3.

X For the safe employment of the equipment within highly combustible ranges special conditions are to be considered.

5.1.1 Operation of the micro annular gear pumps with heat insulation module in different temperature classes

The micro annular gear pump with heat insulation module is certified for the temperature class T3.

For the employment of the pump in environments with the Ex requirement temperature class T1 and T2 no additional external measures are necessary for the temperature monitoring.

For the employment of the pump in environments with the Ex requirement temperature class T4 and T5 additional external measures are necessary for the temperature monitoring.

The following general security requirements apply to the application:

Warning Micro annular gear pumps are highly precise manufactured devices. *No contamination* may reach the inside of the pump since this can damage the pump. Make sure therefore, that all of the wetted parts are kept absolutely free of dirt, dust or chips since this can affect the function of the pump.

Remove dust deposits regularly from the pump's surface, drive and connection pipes so as to prevent the formation of ignition sources. The cleaning interval must be determined by the level of dust precipitation by the operator.

The fluid connections mounted to the pump have to be checked immediately after putting into service and following to this in a six month cycle on tightness and leakage.

Monitor the operating sound of the pump. If grinding noise occurs, switch off the pump immediately. Check the pump for damage. Friction between metallic parts can lead to overheating or formation of sparks.

Flow monitoring is also required for operation in hazardous areas to securely prevent dry running. If the flow stops, the pump must be stopped immediately.

If the pump is used in hazardous areas, a flow sensor must be installed directly downstream of the pump. The flow sensor must not create a noticeable back pressure in case of damage. If the delivery rate of the pump falls to 20% of the theoretical flow rate, the pump must be stopped immediately.

5.1.2 Monitoring of operation in the temperature class T4 and T5

For operation of the micro annular gear pump with heat insulation module in environments with Ex-zone request of temperature class T4 and T5 additional external measures are necessary for the monitoring.

Monitoring surface temperature of pump head

Temperature class	T4	T5
Max. surface temperature	95°C (+203 °F)	60°C (+140 °F)

table 16 Maximum surface temperature

Monitoring liquid temperature on pressure side

Temperature class	T4	T5
Max. liquid temperature	105°C (+221 °F)	80°C (+176 °F)

table 17 Maximum liquid temperature

During operation in hazardous areas, particular attention must be paid to the heat input in the liquid as well as to the increase of the pump's surface temperature. To avoid temperatures above a critical surface temperature one of the following two measures has to be implemented. If the specified top temperature is exceeded, the pump must stop immediately. For the monitoring the compliance with standard DIN EN 13463-6 has to be respected.

5.1.3 Liquid temperature range for operation in temperature class T4 and T5

For operation of the micro annular gear pump in environments with Ex-zone request of temperature class T4 and T5 the following reduced liquid temperature ranges result.

Following medium temperature ranges apply with an ambient temperature of 0…+40 °C (32…+104 °F).

Pump type	Liquid temperature range
mzr-6359/7259-cs Ex	-20…+100 °C (-4…+212 °F)
mzr-6359/7259--cy Ex	-20…+100 °C (-4…+212 °F)
mzr-6359/7259-hs Ex	-20…+100 °C (-4…+212 °F)
mzr-6359/7259--hy Ex	-20…+100 °C (-4…+212 °F)

table 18 Reduced liquid temperature range with heat insulation module for operation in temperature class T4

Pump type	Liquid temperature range
mzr-6359/7259-cs Ex	-20…+75 °C (-4…+167 °F)
mzr-6359/7259--cy Ex	-20…+75 °C (-4…+167 °F)
mzr-6359/7259-hs Ex	-20…+75 °C (-4…+167 °F)
mzr-6359/7259--hy Ex	-20…+75 °C (-4…+167 °F)

table 19 Reduced liquid temperature range with heat insulation module for operation in temperature class T5

These limitations of the medium temperature range considered in compliance with the permissible ambient temperature (see section 1.3).

5.1.4 Liquid temperature range for operation in temperature class T6

The employment of the micro annular gear pump with heat insulation module in environments with the ex requirement temperature class T6 is not permitted, because this leads to a restriction of the medium temperature on 60°C (140°F), which makes the employment of the heat insulation module ineffective.

5.1.5 Thermal element

The thermal element, integrated in the heat insulation module, is a double thermal element with ex-protection according to ATEX approval EEx ia IIC T6.

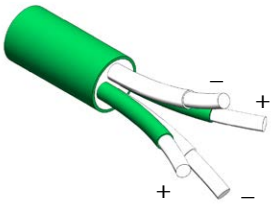
Thermal element		IEC 584.3 identification
Type	ABAo15/35mm/Ti/D50	
Thermal element	2 piec es Type K (NiCr/Ni)	
Temperature measuring range	0 to 400 °C (+32…+752 °F)	
Diameter of the sensing device	1,5 mm	
Material	V4A (1.4541)	
compensating circuit	12 m	
Diameter compensating circuit	4 mm	

table 20 Technical data of the thermal element for mzr-6359 Ex, mzr-7259 Ex, mzr-6359X2 Ex and mzr-7259X2 Ex

6 System integration

6.1 Check before the first assembly

Inspect the pumps for potential damage during the shipment (see chapter 3.2).

Please check, if the right pump type has been delivered, as according to the following points:

- Compatibility with the delivered liquid
- Viscosity range
- Pump performance (displacement volume, dosage volumes, operating pressures)
- Operating temperature range

If you notice any difference between the required and the delivered pump type, please contact HNP Mikrosysteme. Do not put the pump into operation without prior approval.

You must check not only the type of protection of the pump, but also the type of protection of all attached components. The nameplates of the individual components are important. The type of protection for the component with the lowest category always applies for the operation of all components in hazardous areas.

6.2 Details place of operation

Pay attention to the place of operation, that you need an installation location for service and enough room for maintenance. The pump should be installed and reinstalled without problems.

The place of operation mustn't be wet or damp. Don't install the pump in aggressive atmosphere!

6.3 Mounting of the micro annular gear pump

The micro annular gear pump is mounted on an angle support with M6 screws. The favored mounting position of the micro annular gear pump is horizontal. In vertical operation should drive under the pump head mounted to the pump head completely filled.

When mounting the motor, insulating elements must not be inserted between the pump head and the motor. The connecting screws between pump and motor must be made out of electrically conductive material (e.g. stainless steel).

Warning — Install the pump in such a way that in case of failure no liquid can enter the motor or controller.

Take precautions that in case of leakage no surrounding objects or environment will be damaged.

Install the micro annular gear pump only in places that fulfill the required conditions for safe pump operation.

The motor must be protected against humidity, dust or sweat.

Never install a pump in a small installation location without sufficient ventilation as the motor will be poorly cooled and can overheat.

6.4 General instructions for the assembly of the liquid supply network

Please always cut the tubing at a right angle with an adapted hose cutter. If metal tubes are used, an intensive cleansing procedure will be necessary. After machining the tubing has to be cleansed and flushed throughoutly. The smallest piece of swarf within the liquid delivery system may cause failure of the micro annular gear pump.

Please note that correct integration of the tubing with the pump head is a necessary condition to ensure the right direction of flow. If you wish to operate the pump in a reverse direction, please contact HNP Mikrosysteme, since it is not possible in every case.

In order to protect the interior of the pump from pollution, the pump heads are delivered with protective plugs. They should be put on when the pump is at a standstill.

For the best performance the suction tube should be as short as possible and have a large internal diameter.

Warning — In most cases the pump should be operated with a filter featuring pores that do not exceed 10 µm. The filter protects the pump from particles and dirt.

6.5 Electrical Connections

The electrical connection of the motors must be implemented according to VDE directives by skilled personnel. The operation manual supplied with the motors must also be complied with.

Carry out all work on the motor only in no power supply state! Ensure that there is no supply voltage to the motor!

Carry out the electrical connection only after the enclosed wiring diagram!

The sticker at the motor indicates the limiting values of the voltage for the motor!

Earth the motor using the terminal provided. Earth the pump head with heating module additionally at the corresponding terminal clamp.

6.6 Assembly instruction for tubing and accessories

1. Please cut the tubing rectangular with a hose cutter. If metal pipes are used an intensive cleaning procedure is necessary. After machining the pipes have to be cleaned and flushed very carefully. Smallest swarfs within the fluidic system can cause failure of the micro annular gear pump.

2. Connect the 3/8" fittings with the tubing respectively the pipe work according to the attached installation instruction.

Please note that the correct assembly of tubes respectively pipes with the pump head is a necessary condition to secure the right direction of flow. When you want to operate the pump in reverse direction please contact HNP Mikrosysteme since this is not possible in any application.

3. The thread of the fitting should be wrapped with 2-3 layers of PTFE tape and screwed in the NPT thread (see table 21). First manually, then tightened with ½ to ¾ wrench turns.

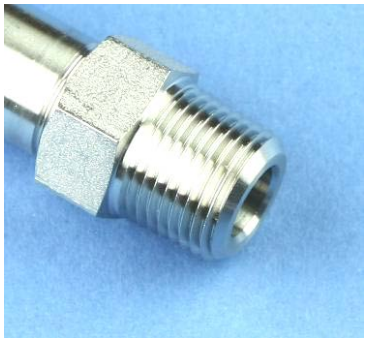
		
Clean the internal and external screw threads leaving no residues.	Make sure the internal and external screw threads are not dented or deformed.	Wrap the PTFE tape around the screw thread clockwise beginning with the second pitch of screw thread..
		
The PTFE tape should be wrapped tightly around the screw thread approx. two times (720°).	Cut the PTFE tape off and wind the end of the tape tightly around the screw thread.	The PTFE tape should not stick out over screw thread because pieces can be cut off and get into the system.

table 21 Use of PTFE Tape

4. The suction line should be installed ascending to the pump for better degassing. The suction line should be designed as short as possible. The inner diameter of the suction line should be large to guarantee good priming of the liquid. At the planning of the pipe system take care of possibilities for degassing.

5. Operate the micro annular gear pump always with a filter with a pore size of 10 µm or smaller. The filter prevents that particles or solids penetrate into the pump what can cause major damage.

6. Avoid dry running of the pump. Make sure that the liquid flow is not interrupted.

Warning

Dry running of a micro annular gear pump can *damage* bearings and dynamic seals especially. A short term dry running at the start-up of the pump does not cause problems.

Please check that all pipes, fittings and screw fittings are tight.

If there is leakage on the suction side it is possible that air penetrates into the pump. In this case priming will be difficult. At the discharge side the liquid comes out of the pump. Dry running causes the pump to heat up.

If the pump will be operated within an explosion proof area a check valve right must be integrated in the pressure line behind the liquid outlet port of the pump. The check valve has to prevent that the pump empties during shut-down time.

Behind the discharge port the discharge pipe should be installed ascending.

In case the pump operates against a closed system a safety valve has to be installed in the discharge pipe to release pressure. In this case the return flow pipe must go back to the reservoir and not directly to the suction line.

6.7 Filter selection and use

In majority of cases it is recommended to integrate a filter on the suction side of the micro annular gear pump to ensure its secure operation. The recommended filter pores or mesh size should not exceed 10 µm. The penetration of particles or swarf that could cause a blockage or damage to the pump can only be avoided by using an adapted filter.

HNP Mikrosysteme offers a choice of standard filters covering a broad spectrum of applications. You may count on our assistance for the selection of the most suitable one.

In order to select the best adapted filter, such operating parameters as flow rate, viscosity and degree of pollution of the liquid will be needed. An increase in at least one of the mentioned terms will require the use of a bigger filtering element or the pressurization of the delivered liquid. In case no suitable filter for high viscosity liquid can be found, it is possible to use a filter with slightly larger pore size. Prior discussion with HNP Mikrosysteme is here recommended. A filter with larger pores is still better than no filter at all. Alternatively an already filtered liquid may be used.

Warning Because filters have a large internal volume, it is recommended to fill in the filter and the suction tube with already filtered liquid in order to avoid a longer dry operation of the pump during the startup.

Warning Please control regularly the filtering elements for pollution. Cleanse regularly the filter or replace it with a new one. A polluted filter may considerably decrease the volumetric efficiency of a pump. Furthermore, because of the cavitation effects dosage imprecision and even pump damage may occur.

Warning A too small filter (too little filtering surface) may considerably decrease the volumetric efficiency of the micro annular gear pump. What is more, because of the cavitation effects dosage imprecision and even pump damage may occur.

6.8 Requirements for motor controller

To operate a micro annular gear pumps mzr-6359 Ex and mzr-7259 Ex a motion controller is necessary.

The alternative motor with integrated motor control requires no separate external motion controller. We recommend connecting a terminal box S-G05 (see chapter 6.10).

Motion controller			
Power supply	U_B	24	V
Max. continuous current	I_{dauer}	1800	mA
Max. peak current	I_{max}	2000	mA
Velocity range		1...4700	rpm
Operation modes		IxR, Encoder	
Encoder			
Max. voltage	V_{cc}	5 ± 10 %	VDC
Number of channels		2 (channel A, channel B)	
Counts per revolution and channel		500	counts/turn
Output signal at V_{cc} = 5 VDC		EIA Standard RS422 Driver: DS26LS31	
Output current		max. 20	mA
Phase shift Φ (nominal)		90°	

Table 22 Technical data motor controller mzr-6359 Ex and mzr-7259 Ex

The mounting place of the motor controller has to be outside of the Ex-area.

Check for correct polarity. False connection may cause severe malfunction or will even destroy the electronic of encoder or motion controller.

For operation of the motor controller current overload has to be avoided, because the motor or the internal encoder will be damaged otherwise.

Optionally the micro annular gear pumps can be delivered with the controller S-HD-KL together with connection board.

To operate a micro annular gear pump only an authorised control module of HNP Mikrosysteme may be used.

6.9 Operation with external motion controller S-HD-KL

The mounting place of the motor controller S-HD-KL has to be outside of the Ex-area.

The controller S-HD-KL controls the number of revolutions to achieve a constant flow rate or positions the motor for precise dosage volumes. Values can be set with the help of a potentiometer or with the external control signal 0-10 V. Second a serial interface allows the control of precise feeding and dosing tasks by an external PC. Included in the delivery volume are diskettes with a Windows® based software. The software enables the operator to manage dosing tasks by defining dosing data. A zero modem cable is included in the delivery volume to connect the pump controller S-HD-KL with a PC.

Controller S-HD-KL			
Type of control unit		4-Q servo amplifier	
Nominal voltage	U	24	V
Power supply	U_B	12 - 30	V
Residual ripple		≤ 2 %	
Max. continuous output current	$I_{continuous}$	1800*)	mA
Max. peak output current	I_{max}	2000*)	mA
Speed range		10...4700*)	rpm
Input No. 1	input resistance	5	kΩ
Nominal analog speed	voltage range	± 10	V
Nominal digital speed	PWM signal	low 0...0.5 / high 4...30	V
	frequency range	100...2000	Hz
Input No. 2	open collector	max. U_B / 30 mA	
	no error	switched to GND	
	programmed as input	low 0...0.5 / high 3.5... U_B	V
Input No. 3, 4, 5	TTL - logic level	low 0...0.5 / high 3.5...30	V
	PLC - logic level	low 0...7 / high 12.5...30	V
Program memory		6.6	kBytes

*) Values limited in the control unit with corresponding software

table 23 Technical data controller S-HD-KL

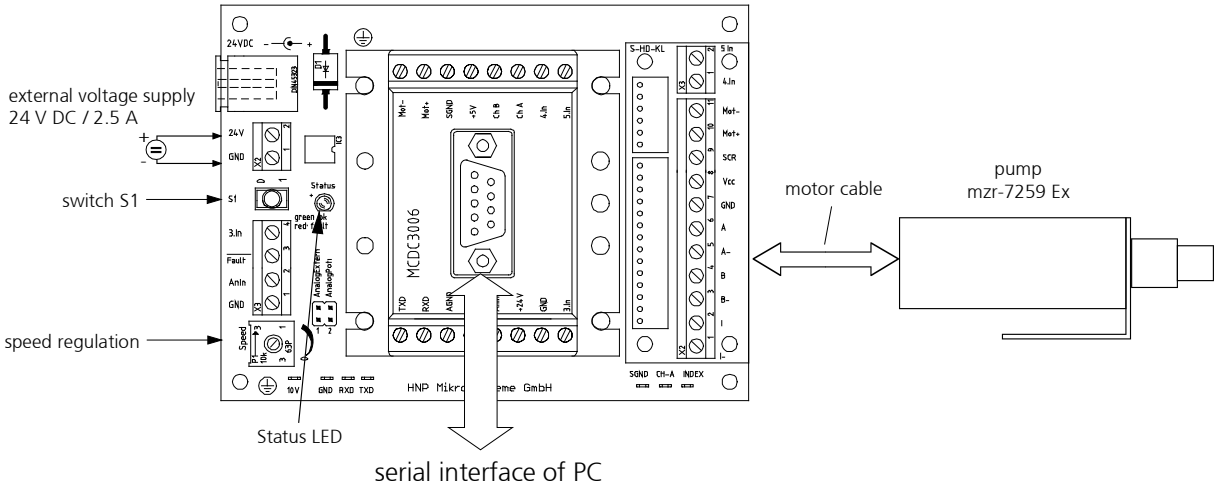


Figure 9 Connection schema controller S-HD-KL

The connection board is helpful for bringing into service of the micro annular gear pump easily. It comprises the following interfaces:

- the possibility to connect the voltage supply to the delivered DIN socket
- the possibility to connect the voltage supply with screw clamps
- a 10-pole connector assembly for the motor cable
- speed set with potentiometer
- analog voltage signal 0-10 V for speed control at the screw clamps
- 9-pole connection plug for the RS-232 interface
- error output with status LED, programmable also as trigger input with screw connections
- tumbler switch S1 for the connection of digital input No. 3 of the motor control unit
- screw clamps for the connection of digital inputs No. 3, 4, 5 of the motor control unit

Initial operation procedure

1. Connect the motor cable with the board S-HD-KL. Colour settings of wires see table 24.

Pin controller S-HD-KL	Function
white	motor +
brown	motor -
yellow/green	screening / PE
red	V_{cc} (5 VDC)
blue	SGND
pink	channel A neg.
grey	channel A
violet	channel B neg.
black	channel B
red/blue	channel I neg. (index) (not used)
pink/grey	channel I (index) (not used)

table 24 Pin configuration motor cable adapter (10 Lead of cable) from motor to controller S-HD-KL

2. Connect the RS-232 port of the MCDC3006 with a free serial interface of a PC. For this purpose use the delivered 9-pole null-modem cable.

3. Put the potentiometer of the S-HD-KL control unit to zero position by turning it clockwise to the limit stop.

4. Connect the voltage supply 24 VDC. This can be done with the integrated DIN connector or alternatively the 2-pole screw clamp (24 V = »+«; GND = »-«). Pay attention to the correct polarity.

Check for *correct polarity*. False connecting may cause severe malfunction or even destroy the electronic of the control unit.

The mounting place of the motion controller is intended for use outside of the hazardous areas only.

Explanation:

- It is possible to adjust speed of the micro annular gear pump with the potentiometer without the need to connect the serial interface.
- With the analog nominal value input (connection clamps »AnIN« and »GND«) it is possible to adjust speed of the pump with a standard signal 0-10°V. For this purpose it is necessary to plug the jumper on the S-HD-KL control unit from the »AnalogPoti« to the »AnalogExtern«. The serial interface does not need to be connected.
- In case of an overcurrent error the green status LED on the S-HD-KL control unit turns red
- The standard programs memorized in the motor control unit may be started with the tumbler switch S1.

5. Install the software »Motion Manager« described in the next chapter.

6.10 Connection of the micro annular gear pump with S-G05

In order to operate the pump a supplementary source of 24 VDC will be required. The ampacity of the voltage source should amount to around 4 A for the micro annular pumps mzr-6359X2 Ex and mzr-7259X2 Ex.

The mounting place of the motion controller is intended for use outside of the hazardous areas only.

The micro annular gear pump with alternativ brushless DC Ex-motor is connected via the Terminal Box S-G05. This enables an easy startup of the pump due to:

- the possibility to connect the voltage supply with the delivered plug connector J1
- alternative voltage supply via a DIN connector conform with DIN 45323
- separable pump connection "mzr-pump"
- speed set via potentiometer
- analog voltage input 0-10 V and 0 (4)-20 mA for speed control
- change of speed setting mode with a DIP-switch
- 9-pole connection plug for the RS-232 interface
- error output programmable also as trigger input or frequency output
- digital input with a screw connection
- possibility of installation on a 35 mm top hat rail

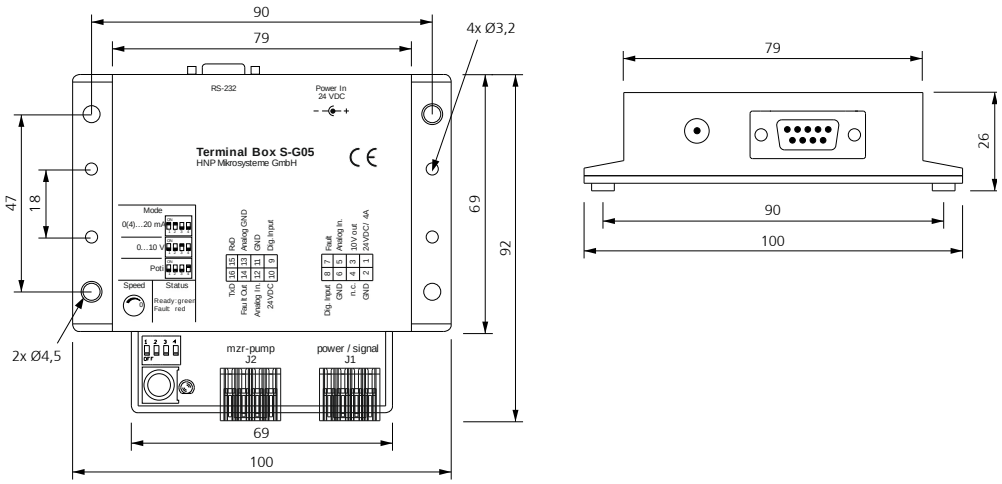


figure 10 Measurements of the Terminal Box S-G05

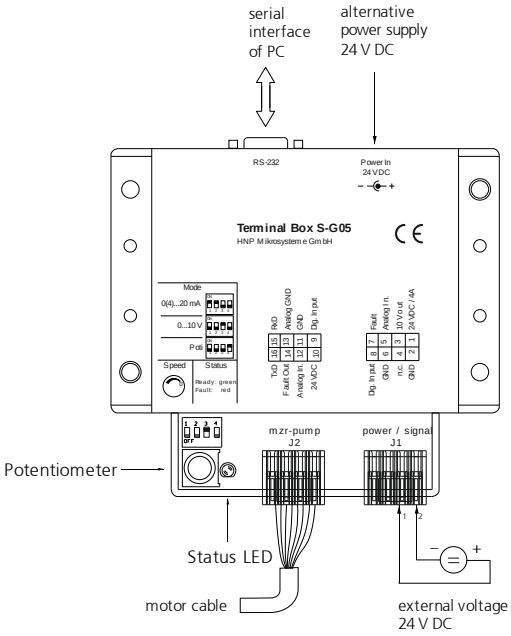


figure 11 Connection of the micro annular gear pump to the power supply

Connector J1 Pin	Function	Labeling Terminal Box
1	Voltage supply	24 VDC / 4 A
2	Ground	GND
3	10 V output voltage	10 V Out
4	not used	n.c.
5	Analog input	Analog In
6	Ground	GND
7	Fault output	Fault
8	Digital Input	Dig. Input

table 25 Connector J1 "power / signal" pin assignment of Terminal Box S-G05

Connnector J2 Pin	Function	Wire / Cable cross section	Labeling Terminal Box
9	Digital Input	red / 0,14 mm²	Dig. Input
10	Voltage supply	brown / 0,5 mm²	24VDC
11	Ground	blue / 0,5 mm²	GND
12	Analog input	brown / 0,14 mm²	Analog In
13	Ground analog input	grey / 0,14 mm²	Analog GND
14	Fault output	white / 0,14 mm²	Fault Out
15	RS-232 interface signal reception	yellow / 0,14 mm²	RxD
16	RS-232 interface signal transmission	green / 0,14 mm²	TxD

table 26 Connector J2 " mzr-pump" pin assignment configuration between the motor and terminal box S-G05

Installation of the cable wires
– tool: screwdriver blade 2.5 x 0.4 mm
– open the spring clamp with the screwdriver through the side slot
– cable in cable opening place (cable can be used with or without ferrule)
– remove the screwdriver

figure 12 Installation of cable wires in the connectors

LED Status	Definition
green	Power supply to the controller is active, no error
red	Motor error (current limitation or pump blocked)

table 27 LED for status indication

The operating speed of the micro annular gear pump may be set with:

– the potentiometer of the Terminal Box S-G05
– an external voltage signal 0-10 V
– an external, analog current signal 0 (4)-20 mA (without electrical isolation)
– an external potentiometer or
– the RS-232 interface

Individual start up procedures are described in the following points.

6.10.1 Startup with potentiometer

1. Connect the drive with the eight colored wires to the terminal box S-G05. The colors of the corresponding wire connections are described in the table 26.

2. Bring the potentiometer knob to null position by turning it clockwise to the limit stop.

3. Put the DIP-switch to the »Poti« position.

4. Connect the 24 VDC voltage supply to the terminal or to the DIN connector.

Make sure that the polarity of the supplied direct current is correct, otherwise electronics will be damaged.

5. Provide for a steady liquid supply to the pump in order to avoid dry operation.

6. The pump may now be put into operation by turning on the potentiometer knob.

Remarks:

– You may adjust speed of the micro annular gear pump without the need to connect it to the serial interface.
– In case error occurs for example due to motor overload - the green status LED on the Terminal Box S-G05 will turn red.

6.10.2 Startup with external 0-10 V signal

1. Connect the drive with the eight colored wires to the terminal box S-G05. The colors of the corresponding wire connections are described in the table 26.

2. Bring the potentiometer knob to the null position by turning it clockwise to the limit stop.

3. Put the DIP-switch to »0…10 V« position.

4. Connect an external 0-10 V voltage supply to the terminal clamps »AnalogIn« and »GND« to the S-G05. (see figure 13)

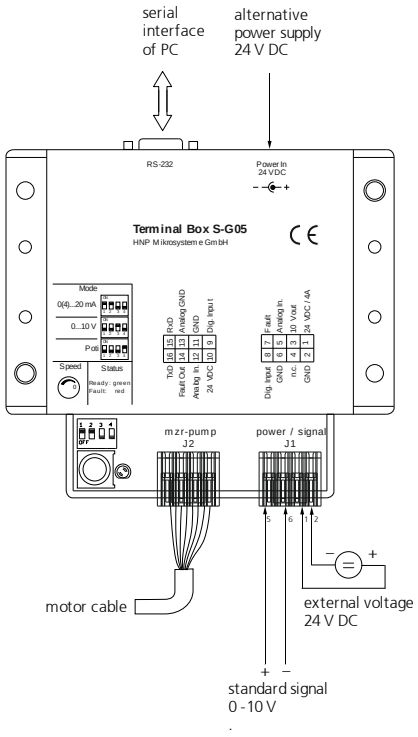


figure 13 Startup with an external 0-10 V voltage signal

5. Provide for a steady liquid supply to the pump in order to avoid dry operation of the device.

6. Connect the 24 VDC voltage supply to the terminal or to the DIN connector.

Make sure that the polarity of the supplied direct current is correct, otherwise electronics will be damaged.

The input circuit at the analog input is layed out as a differential amplifier. If the analog input is "open" there is already a voltage of 2 V. That means in this case that the motor would be turning at a speed of about 2000 rpm. In order to set 0 rpm the input must be connected over a low ohm resistor to the analog ground (AGND) or connected to the AGND-voltage level.

7. The micro annular gear pump may now be put into operation by increasing the external voltage signal. A voltage signal of 0 V corresponds to 0 rpm and 10 V to the maximal programmed speed (see chapter 1.7).

Remarks:

– You may adjust speed of the micro annular gear pump without the need to connect it to the serial interface.
– In case error occurs for example due to the motor overload - the green status LED on the terminal Box S-G05 will turn red.

6.10.3 Startup with an external 0(4)-20 mA current signal

The conversion is done internally without electrical isolation. A potential separation is possible only with a external transformer module.

1. Connect the drive with the eight colored wires to the terminal box S-G05. The colors of the corresponding wire connections are described in the table 26.

2. Bring the potentiometer knob to the zero position by turning it clockwise to the limit stop.

3. Put the DIP-switch to »0(4)…20 mA« position.

4. Connect the external current source to the screw clamps »AnalogIn« and »GND« to the S-G05. (see figure 14).

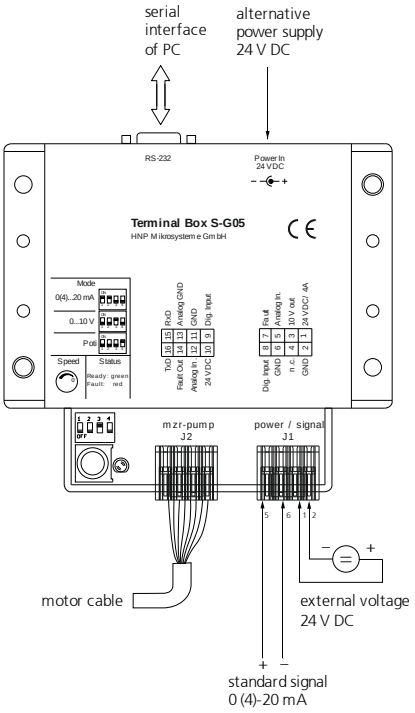


figure 14 Operation via an external 0 (4)-20 mA voltage

5. Provide for a sufficient liquid supply to the pump in order to avoid dry operation of the device.

6. Connect the 24 VDC voltage supply to the screw clamp terminal or to the DIN connector.

Make sure that the polarity of the supplied direct current is correct, otherwise electronics may be damaged.

7. The micro annular gear pump may now be put into operation by increasing the external current signal. 0 mA corresponds to 0 rpm and 20 mA to the maximal programmed speed (see chapter 1.7).

Remarks:

– For operation with the signal 4…20 mA an offset of about 2.1 V should be set by entering the command MAV2170. In order to set the nominal values the micro annular gear pump must be put into operation via the RS-232 interface and start with the » Motion Manager « software. Save the command in the EEPROM with the command EEPSAV (see chapter 8).
– Speed of the micro annular gear pump may be set by sending an external voltage signal without the need to connect the pump to the serial interface.
– In case error occurs for example due to a motor overload - the green status LED on the Terminal Box S-G05 will extinguish and a red one will light up.

6.10.4 Startup with external potentiometer

1. Connect the drive with the eight colored wires to the terminal box S-G05. The colors of the corresponding wire connections are described in the table 26.

2. Bring the internal potentiometer knob to the null position by turning it clockwise to the limit stop.

3. Put the DIP-switch to »0…10 V« position.

4. Connect an external 0-10 V voltage supply to the terminal clamps »AnalogIn«, »10 V« and »GND« to the S-G05.(see figure 13)

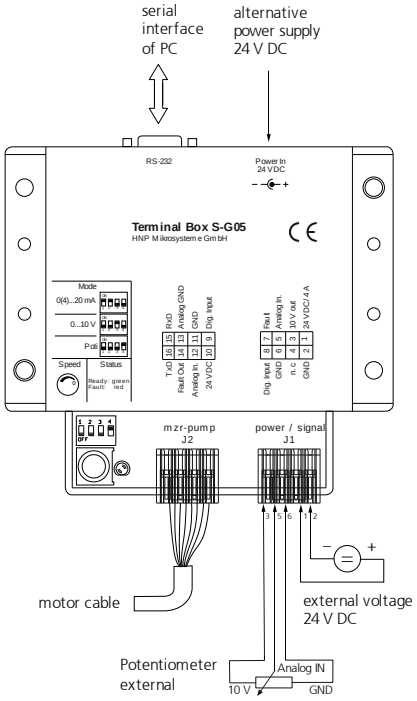


figure 15 Startup with an external potentiometer

5. Provide for a steady liquid supply to the pump in order to avoid dry operation of the device.

6. Connect the 24 VDC voltage supply to the terminal or to the DIN connector.

Make sure that the polarity of the supplied direct current is correct, otherwise electronics will be damaged.

The input circuit at the analog input is layed out as a differential amplifier. If the analog input is "open" there is already a voltage of 2 V. That means in this case that the motor would be turning at a speed of about 2000 rpm. In order to set 0 rpm the input must be connected over a low ohm resistor to the analog ground (AGND) or connected to the AGND-voltage level.

7. The micro annular gear pump may now be put into operation by increasing the external voltage signal. A voltage signal of 0 V corresponds to 0 rpm and 10 V to the maximal programmed speed (see chapter 1.7).

Remarks:

– You may adjust speed of the micro annular gear pump without the need to connect it to the serial interface.
– In case error occurs for example due to the motor overload - the green status LED on the terminal Box S-G05 will turn red.

6.10.5 Startup with the RS-232 interface

1. Connect the drive with the eight colored wires to the S-G05. The colors of the corresponding wire connections are in the table 26.

2. In order to prevent uncontrolled startup of the pump, bring the potentiometer knob to the null position by turning it clockwise to the limit stop.

3. Put the DIP-switch to »Poti« position.

4. Connect the RS-232 interface of the Terminal Box S-G05 with a free serial interface of a PC. Use for that the delivered 9-pole null-modem cable.

5. Now install the delivered software as described in the chapter 8.

6. Connect the 24 VDC voltage supply to the terminal or to the DIN connector.

7. Provide for a steady liquid supply to the pump in order to avoid dry operation of the device.

8. The micro annular gear pump may now be put into operation with the available software (operating mode RS-232 see chapter 8).

Remarks:

– In case error occurs for example due to the motor overload - the green error status LED on the Terminal Box S-G05 will turn red.

6.11 Installation of the software »Motion Manager«

The program »Motion Manager« provides easy operation and configuration of the motor together with an online graphic performance analysis tool. For installation a PC with Windows XP® or Windows 7® is required.

Install the software »Motion Manager« which is included in the delivery CD.

After successful installation start the program »Motion Manager« in the file »Faulhaber Motoren« via Windows® start menu.

If the CD of the »Motion Manager« are not delivered, because the software »mzr-pump controller« was included instead, you can download the software from the website http://www.hnp-mikrosysteme.de. The latest version can be downloaded in English or German under *Downloads*.

To program a micro annular gear pump motor and controller have to be put into operation. Both units have to be connected with the zero-modem cable.

7 Startup/shutdown of a mzr-pump

7.1 Preparing for operation

After the liquid supply system had been completed, please check once again the operating conditions of the micro annular gear pump as according to the following points:

- Are the inlet and outlet tubes correctly connected?
- Is the entire liquid supply system clean - that means free of particles, foreign bodies, pollution or swarf?
- Has a filter been installed on the suction side?
- Has a sufficient amount of the right liquid been supplied?
- The pump does not run the risk of a dry operation?
- The entire liquid supply system has been checked for leakage?
- Is it possible to stop the pump by an emergency switch if an unexpected malfunction occurs at the startup?

7.2 Startup of the micro annular gear pump

Switch on the voltage supply. The micro annular gear pump can now be put into operation by turning on the potentiometer knob or by sending a nominal external voltage signal.

Start the filling in of the pump at low or middle speed (1000 - 3000 rpm).

If the pump is used in hazardous areas, it must not run dry. The pump and all pipes must be primed and filled with liquid before starting.

7.3 Re-start after dry run

After a short dry run (it is assumed that the pump is not yet damaged), you must ensure that the pump has cooled down to a temperature below its maximally allowed surface temperature. The pump and the pipes must be completely primed and filled.

Re-starting is prohibited after a longer dry run. The pump must be dismounted to check for damage and any damaged parts replaced. The pump may only be operated again after complete priming and filling and the restoration of the earth.

7.4 Operation of the micro annular gear pumps without heat insulation module in different temperature classes

The micro annular gear pump without heat insulation module is certified for the temperature class T4.

For operation of the micro annular gear pumps in surroundings with Ex-zone request of temperature class T1-T3 and T4 no additional temperature measure is necessary for monitoring.

To the employment the following general safety requirements apply:

Warning

Micro annular gear pumps are highly precise manufactured devices. *No contamination* may reach the inside of the pump since this can damage the pump. Make sure therefore, that all of the wetted parts are kept absolutely free of dirt, dust or chips since this can affect the function of the pump.

Flow monitoring is also required for operation in hazardous areas to securely prevent dry running. If the flow stops, the pump must be stopped immediately.

Remove dust deposits regularly from the pump's surface, drive and connection pipes so as to prevent the formation of ignition sources. The cleaning interval must be determined by the level of dust precipitation by the operator.

The fluid connections mounted to the pump have to be checked immediately after putting into service and following to this in a six month cycle on tightness and leakage.

Monitor the operating sound of the pump. If grinding noise occurs, switch off the pump immediately. Check the pump for damage. Friction between metallic parts can lead to overheating or formation of sparks.

If the pump is used in hazardous areas, a flow sensor must be installed directly downstream of the pump. The flow sensor must not create a noticeable back pressure in case of damage. If the delivery rate of the pump falls to 20% of the theoretical flow rate, the pump must be stopped immediately.

7.5 Monitoring of operation in the temperature class T5, T6

For operation of the micro annular gear pump in environments with Ex-zone request of temperature class T5 and T6 additional external measures are necessary for the monitoring.

Monitoring surface temperature of pump head

Temperature class	T5	T6
Max. surface temperature	60°C	45°C

table 28 Maximum surface temperature

Monitoring liquid temperature on pressure side

Temperature class	T5	T6
Max. liquid temperature	80°C	70°C

table 29 Maximum liquid temperature

During operation in hazardous areas, particular attention must be paid to the heat input in the liquid as well as to the increase of the pump's surface temperature. To avoid temperatures above a critical surface temperature one of the following two measures has to be implemented. If the specified top temperature is exceeded, the pump must stop immediately. For the monitoring the compliance with standard DIN EN 13463-6 has to be respected.

7.6 Flushing procedure after use

After each service the micro annular gear pump should be carefully flushed with a non-corrosive, filtered and particle-free flushing liquid (see table 30 and table 31). During flushing procedure the pump should operate at a speed of about 3000 rpm and if possible against a low pressure (that can be obtained by using a restrictor, a capillary or similar). The flushing liquid must be compatible with the delivered liquid and suitable for solving the remaining liquid rests. Depending on the application for example water, or isopropanol may be used. If you have doubts whether a particular liquid is suitable for this function or not, please ask the manufacturer of the liquid or HNP Mikrosysteme GmbH.

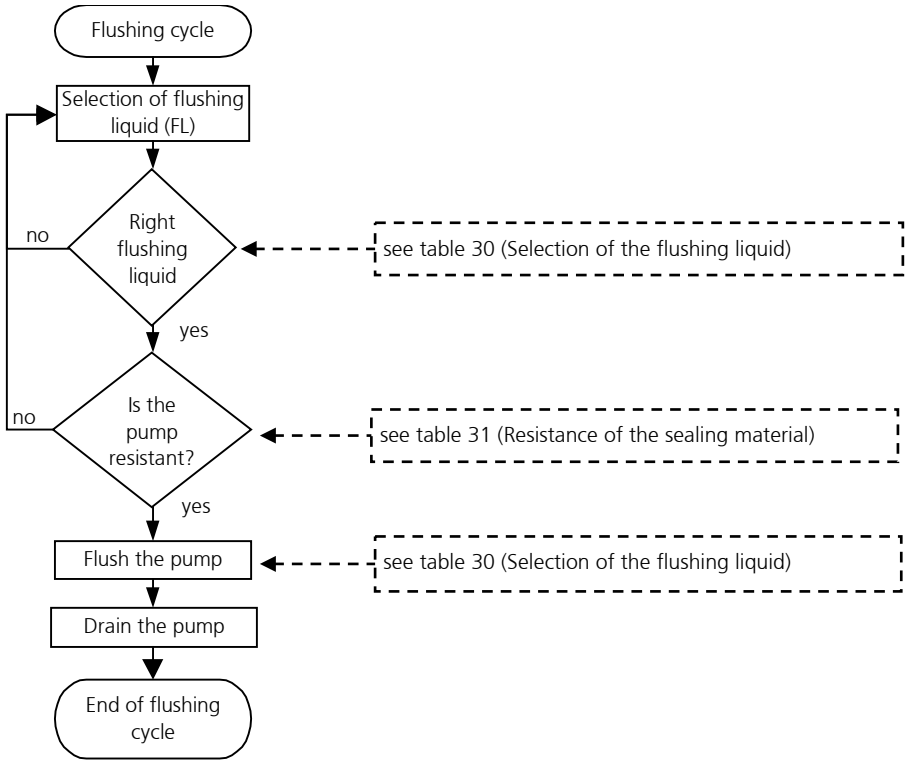


figure 16 Diagram of the flushing procedure

Warning Liquids that remain in the pump may crystallize, coagulate or lead to corrosion and as a consequence impair the work of the micro annular gear pump.

Warning Please make sure that the pump components and particularly O-rings and sealing are resistant to the employed flushing liquid. (see table 31).

Warning The flushing liquid (solvent) and the recommended duration of the flushing procedure depend on the delivered liquid (see table 30). The indicated flushing liquids are simple recommendations and should therefore be checked by the user as to their compatibility and suitability.

Regulations concerning use of substances dangerous to health should be followed!

	Nature of the delivered liquid	Flushing time [min]	Suitable flushing liquid
1	Oils, fats, plastifierss	15-20	isopropanol, ethanol, acetone, benzine/petroleum ether
2	Solvents (polar + nonpolar)	5-10	isopropanol, ethanol
3	Other organic liquids	10-15	isopropanol , ethanol
4	Refrigerating and cooling agents	15-20	isopropanol, ethanol
5	Neutral water/y solutions	20-25	isopropanol, ethanol
6	Basic solutions	25-30	DI-water (deionized water)
7	Organic acids	30-40	isopropanol, ethanol
8	Weak mineral acids	25-30	DI- water
9	Strong mineral acids	35-45	DI- water
10	Strong oxidizing liquids	35-45	DI- water
11	Paints, varnishes, adhesives	50-60	not specified - for further information please contact HNP Mikrosysteme.

table 30 Selection of the flushing liquid (solvent) and the duration of the flushing procedure depending on the delivered liquid.

Warning

Please make sure that the pump components and particularly O-rings and sealing are resistant to the employed flushing liquid (see table 31).

The material combinations and -cs and -cy can not be flushed with water or DI-water.

	O-ring material		
Flushing liquid	**FKM**	**EPDM**	**FFPM**
acetone	3	0	0
benzene	1	3	0
benzyl alcohol	0	2	0
butanol	1	0	0
dimethyl sulfoxide (DMSO)	3	0	0
ethanol	0	0	0
isopropanol	0	0	0
methanol	2	0	0
methylethylketone (MEK)	3	1	0
styrene	1	3	1
toluene	2	3	0
water	0	0	0
xylene	2	3	0
benzine/petroleum ether	0	3	0
oil / fine mechanics oil	0	3	0

Legend: 0 ... good suitability 1 ... suitability 2 ... conditional suitability 3 ... labile - ... not specified

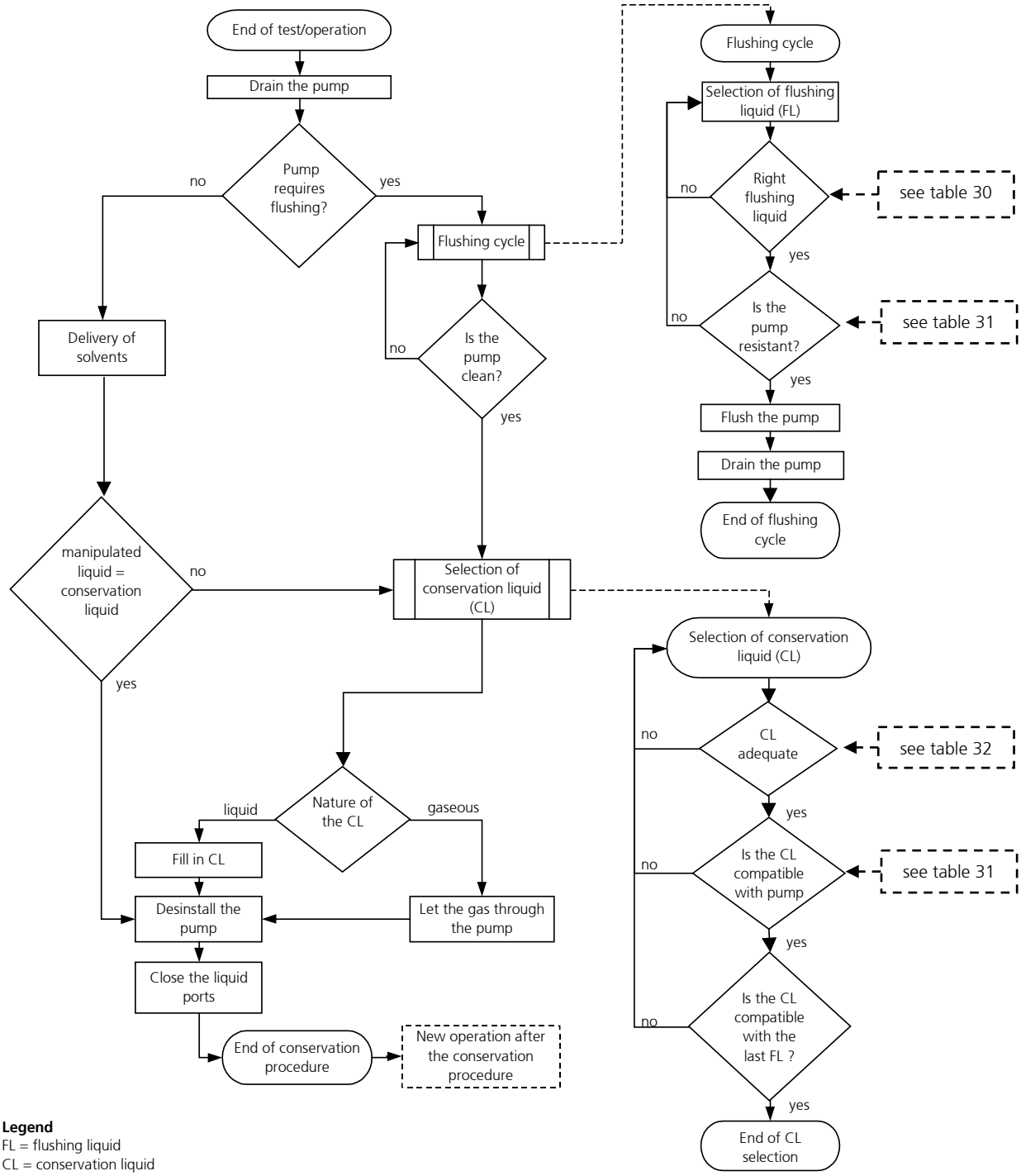
table 31 Resistance of the sealing materials depending on the flushing liquid (solvent)

7.7 Shutdown of the micro annular gear pump

In order to shut down a mzr-pump the following steps should be followed:

- Flush the pump with a filtered and particle-free flushing liquid (solvent) as described in the chapter 7.6.
- After the flushing procedure decrease speed of the pump to 0 rpm
- Fill the pump with a suitable conservation liquid (see chapter 7.7.1)
- Remove the pump from the system (see chapter 7.7.2)

By proceeding as shown in the diagram (see figure 17) you may prepare the pump for a longer standstill.



Legend
FL = flushing liquid
CL = conservation liquid

figure 17 Diagram of the shutdown procedure

7.7.1 Conservation

If the micro annular gear pump operates at irregular intervals or for other reasons should be put out of operation for a longer period, it should, after service and flushing procedure (see chapter 7.6), be filled in with a suitable conservation liquid.

The conservation liquid may be selected from the table 32 depending on the duration of the standstill and the resistance of the pump to the manipulated liquid. The indicated conservation liquids are simple recommendations and should therefore be checked by the user as to their compatibility and suitability. The figure 18 presents a diagram of conservation agent selection.

Remark: This diagram is repeated as a part of the figure 17 (shutdown procedure of the micro annular gear pump).

After the cleansing procedure the pump should be filled with a suitable conservation agent. You will find a choice of possible conservation agents in the table 32.

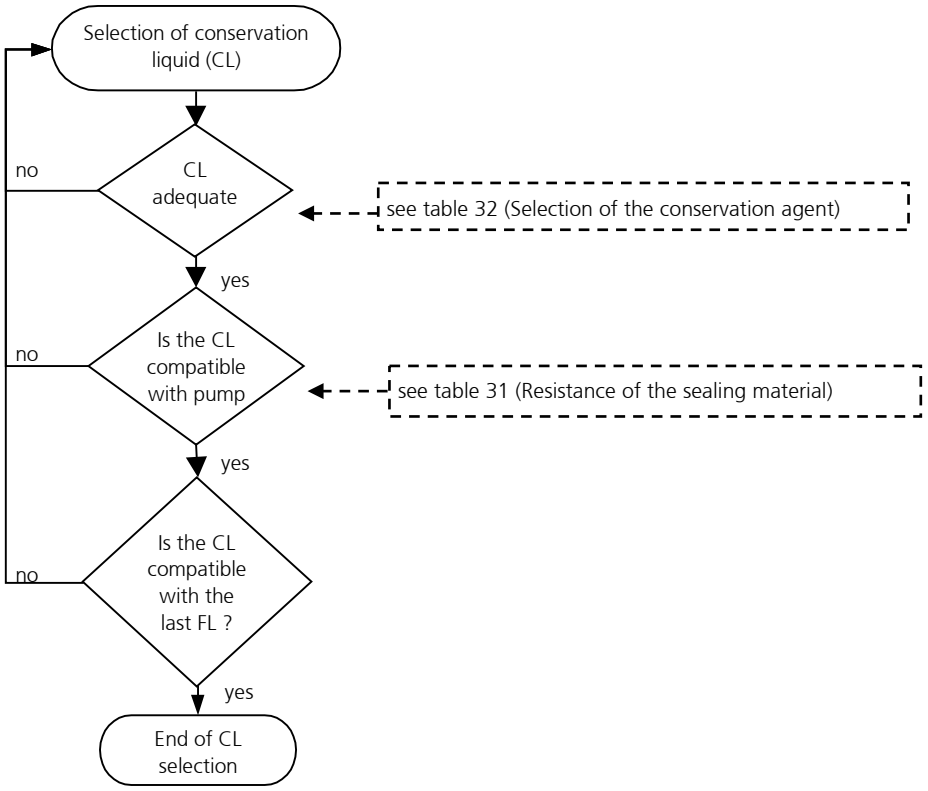


figure 18 Diagram - selection of conservation liquid (CL)

Liquids	Solubility in water	Compatibility with the delivered liquid	Duration of storage	Breakaway torque	Toxicology	Viscosity	Description
isopropanol	+	+	o	o	o	+	solvent for organic compounds, cosmetics, essential oils waxes, and esters, antifreezers, antiseptic agents
acetone	+	+	o	o	o	+	solvent for a number of organic compounds, unlimited solubility in water, dissolves natural and synthetic resins, fats, oils and commonly used plastifiers
ethanol	+	+	o	o	o	+	solvent for organic compounds, fats, oils and resins
DI-water	+	+	-	-	+	+	solvent for many organic and mineral liquids
fine mechanics oil	-	-	+	+	+	+	cleansing and protective action (dissolves fats, tar, rubber or adhesive substances, protects against corrosion).
hydraulic oil	-	-	+	+	+	-	lubricating and preserving properties (*Warning*: may resinate or deteriorate with time)
nitrogen	-	+	+	+	o	+	is not a solvent, may leave deposits after drying out
air / compressed air		+	+	+	+	+	is not a solvent, may leave deposits after drying out

Legend: + ... good/suitable o ... satisfactory; - ... bad/inadequate

table 32 Selection of the conservation agent

In order to prevent dust particles and foreign bodies from penetrating into the pump or the conservation agent from leaking out, please secure the liquid input and output openings with the delivered protective plugs or screws.

Warning

Water or DI-water should not be used as conservative liquids. They germinate already after a few days and build a biofilm which can later block the pump.

7.7.2 Dismantling of the system

- Put the drive out of operation by turning down speed to 0 rpm and by switching off the voltage supply. Make sure that the procedure described in the chapter 7.6 has been completed.
- Now that the pump has been stopped you may remove it from the system.
- Protect the inlet and outlet openings of the pump with adapted protective plugs or screws.

7.8 Trouble shooting

If the pump stops operating abruptly or has difficulties with starting operation, please undertake the following steps:

Try to liberate the micro annular gear pump:

- by turning the potentiometer knob back and forth or by connecting an analog voltage
- via the control software
- by pressing with a syringe a suitable flushing liquid (see table 30 and table 31) through the micro annular gear pump
- by changing the operating direction of the pump.

If these measures turn out to be ineffective, please contact the service staff of HNP Mikrosysteme (see chapter 18) and send the pump back to the manufacturer for inspection.

Warning *You should under no condition* try to disassemble the pump by yourself. This may cause damage to the pump components and consequently annul your warranty claims.

7.9 Return of the micro annular gear pump to the manufacturer

For the return of a micro annular gear pump and components that have already been employed, please follow the instructions:

- drain any remaining rests of the delivered liquid from the pump
- flush the pump with an adapted solvent
- remove the filter elements from integrated or loosely delivered filters
- protect all openings against dust with the delivered protective plugs or screws
- return the pump in its original packing

The service personnel which carries out the repair should be informed about the condition of the already used micro annular gear pump. This is done by means of the "Declaration of media in contact with the micro annular gear pump and its components" (see chapter 18). This form may also be downloaded from the web site *www.hnp-mikrosysteme.de/download*.

The "Declaration of liquids in contact with the micro annular gear pump and its components" must imperatively be filled in. The nature of liquid which entered into contact with the micro annular gear pump and its components must be specified.
In case of non-compliance, the sender will be liable for any resulting injure to persons or any object damage.

8 Software »Motion Manager«

For the programming of the micro annular gear pump the software » Motion Manager « must be installed (see section 6.8). The connection from controller to PC with the delivered zero modem cable has to be established and the micro annular gear pump have been taken into service.

8.1 Command mode

With software »Motion Manager« commands can be entered and sent directly to the motion controller to change the settings of the controller or execute movements.

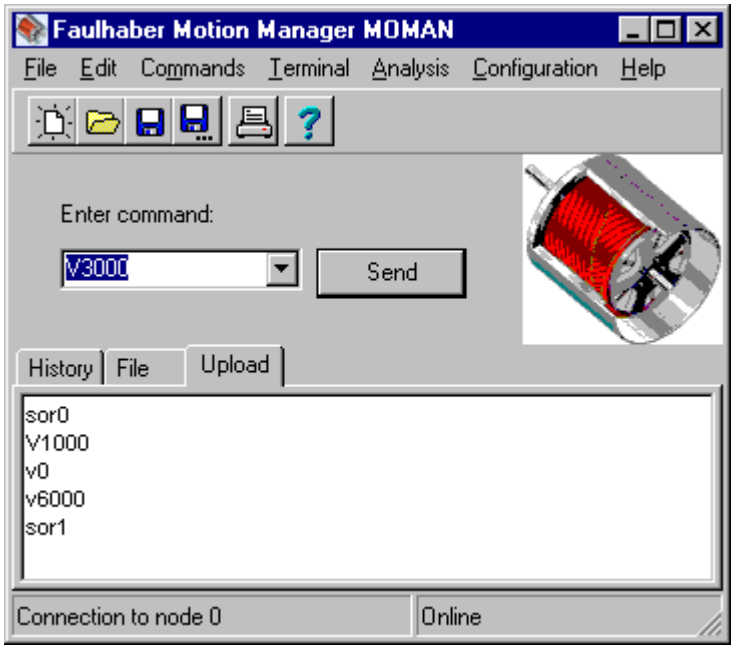


Figure 19 Program »Motion Manager« for direct control commands for the micro annular gear pump

The entry of command lines takes place in the field »Enter command:«. When the command entry is completed this must be confirmed by pressing the button »Send« to send. The commands can alternatively be written in capital or small letters. Surplus blanks are ignored by the motion controller.

Example for feeding

Command	Description
SOR0	Operation mode »RS-232«, *Source For Velocity* - set velocity with RS-232 command
V1000	Rotate with 1000 rpm (equivalent flow for mzr-6359 Ex = 24 ml/min, equivalent flow for mzr-7259 Ex = 48 ml/min)
V0	Stop pump rotation (speed 0 rpm)
V3000	Rotate with 3000 rpm (equivalent flow for mzr-6359 Ex = 72 ml/min) (equivalent flow for mzr-7259 Ex = 144 ml/min)
SOR1	Operation mode »analogue input«, *Source For Velocity* - set velocity with potentiometer setting on the connection panel

Example for dosage

Command	Description
SOR0	Operation mode »RS-232«, *Source For Velocity* - set velocity with RS-232 command
LR30000	Load relative position at 30000 to the pump 30000 = 10 revolution (equivalent quantity mzr-6359 Ex ≈ 120 µl, mzr-7259 Ex ≈ 240 µl) (explanation*: 3000 steps = 1* revolution*)*
M	Start positioning pump
LR60000	Load relative position at 60000 to the pump 60000 = 5 revolution, (equivalent quantity mzr-6359 Ex ≈ 240 µl mzr-7259 Ex ≈ 480 µl)
M	Start positioning pump
SOR1	Operation mode »analogue input«, *Source For Velocity* - set velocity with potentiometer setting on the connection panel

To use the »Motion Manager« software please also refer to the online help function of the program.

8.2 Programming of motion controller

For dedicated applications (e.g. communication with process control, or dosage parameters according to sensor input) the motion controller S-HD-KL can be programmed with a simple program language. The program files consist of ASCII-commands. The filenames can be saved with the extension »mcl« (*m*otion *c*ontroller *l*anguage). All motor settings can be set via the RS-232 port (e.g. maximum velocity, acceleration, relative position in position control mode, current parameter continuos and peak and the digital filter parameter for the dynamic performance). All settings and files can be stored to the onboard memory. Depending on the operation mode the motion controller therefore can run stand-alone.

The delivery volume comprises a disk with sample mcl-files which can be downloaded to the controller and stored permanently to the EEPROM.

8.3 Transfer of mcl-files to motor controller

mcl-files can be loaded over *File – Open* in the file-editor-screen.

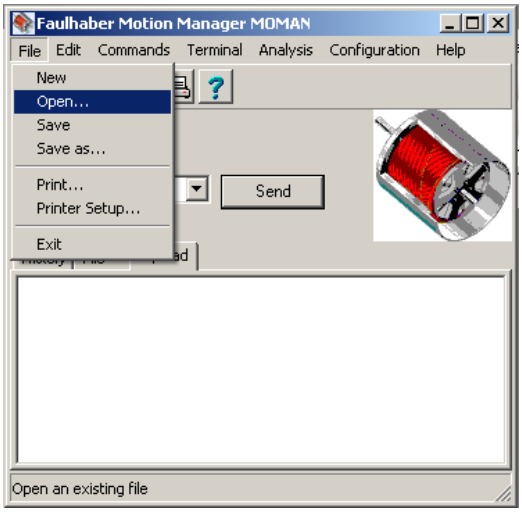


Figure 20 Menu *File – Open*

The required mcl file may be selected and loaded from the file selection window (see figure 21).

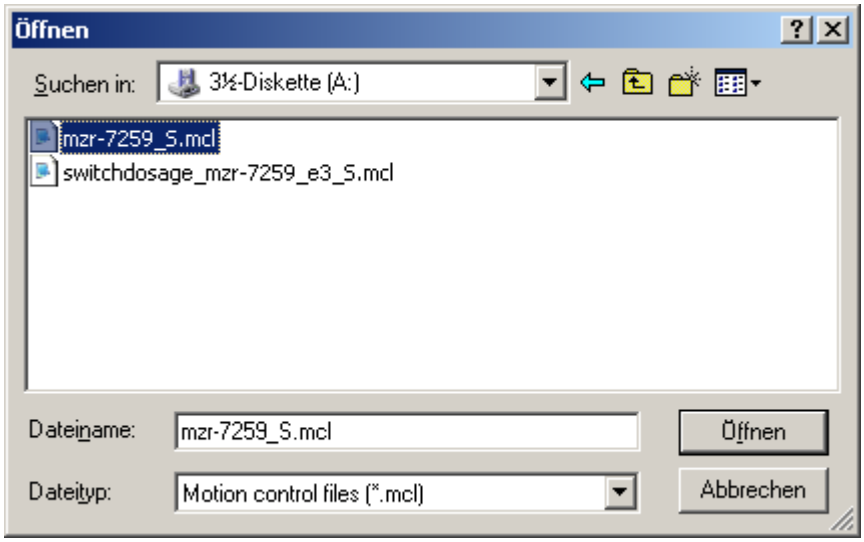


figure 21 File selection window

Open the window *Terminal – Transfer configuration files* for file transfer to the motion controller.

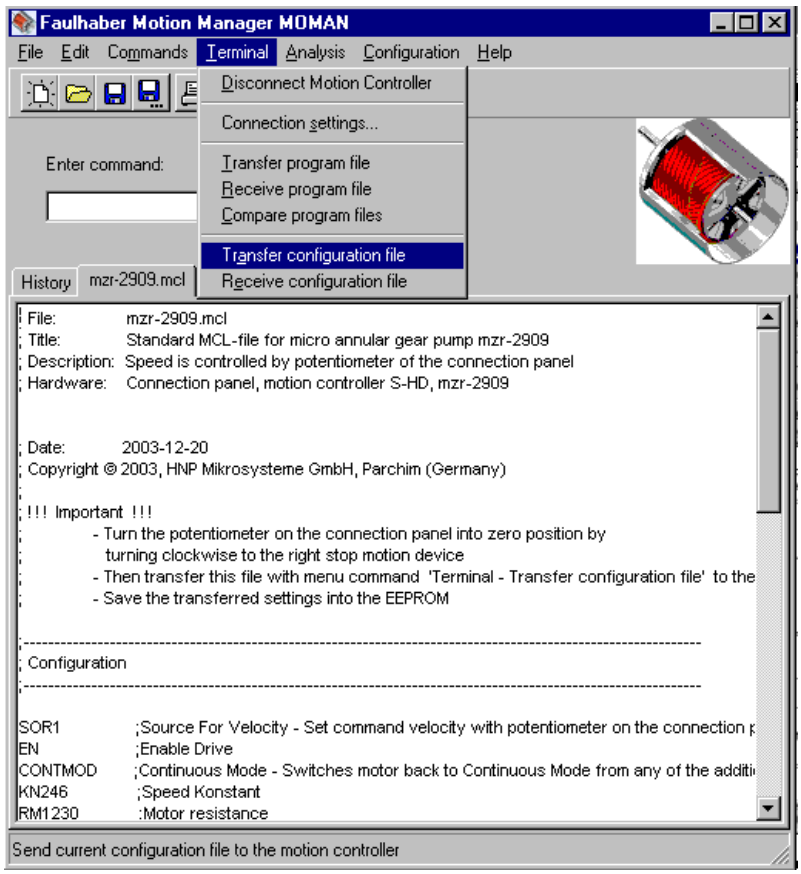


Figure 22 Transfer of mcl-file as Transfer configuration files

When a window appears with the enquiry if the mcl files should be transferred to the »Motion-Controller«, answer by clicking on the »Yes« button.

In order to save the configuration and the programmed operation files in the EEPROM, please confirm the dialogue window with »OK« (see figure 23). With this confirmation the program will be saved in the memory with a resident status and will be available for future operation.

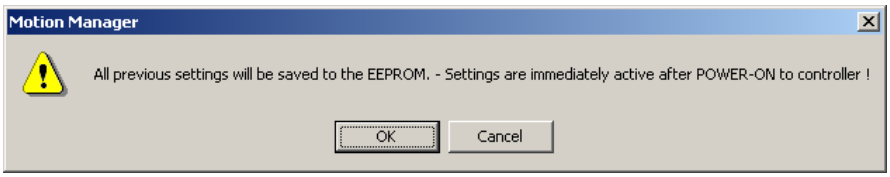


figure 23 Storage confirmation

9 Accessories for microfluidic systems

The accessory range for the liquid delivery systems of HNP Mikrosysteme comprises complementary equipment such as hoses, tubes, fluid fittings, filters and non-return valves that are best adapted to your micro annular gear pump. We will eagerly share our long date experience as far as component selection is concerned.

10 Non-liability clause

HNP Mikrosysteme GmbH shall not be liable any damage resulting form the non-respect of instructions comprised in this operating manual.

It belongs to the user to check the integrity, the correct choice and the suitability of the product for the intended use.

It remains at the responsibility of the user to conform to all laws, rules and regulations in force. This applies above all to the treatment of aggressive, poisonous, corrosive and other dangerous liquids.

11 Problems and their removal

Disturbance	Cause	Solution
1 The pump does not work.	No power supply	Check the power supply.
2 The pump does not pump the liquid.	No liquid in the primary tank	Fill the recipient/tank with liquid.
	Presence of air or gas in the pump	The pump cannot run dry against the system pressure. Fill in the pump at no pressure or at reduced system pressure.
	Malfunction of the liquid supply components (such as in the delivery tube, the needle or external non-return valve)	Check the components for possible disturbances to be eliminated. Cleanse the accessories where needed.
	Failure of the electric installation	Check the electric installation for the correct cable configuration, loose contacts, etc.
	The pump did not receive the start signal or start conditions are not fulfilled.	Check if the start condition have been fulfilled start signals (software control, PLC, start signal) and the programs.
	Motor disturbance: the red error LED is on.	Check the failure condition of the motor control with the Motion Manager software.
3 The pump does not start to operate.	The pump does not take in the liquid.	The tubing on the induction side is too long or has a too small internal diameter (a too low NPSHA value).
		The tubing or the fluid connection on the induction (suction) side are not tight. Please check the intake connection and the tubing.
		Air bubbles in the fluid system (tubes, valves, ...)
		If the viscosity of the liquid is too high, apply pressure on the suction side.
		Check the pressure exerted on the primary liquid tank.
		An external non-return valve does not open. Check the non-return valves.
		Submit the non-return valve to a higher pressure, so that the pump may fill in.
4 The motor turns, but the pump does not operate.	No liquid in the pump	Fill the pump with liquid.
	Air bubbles in the liquid supply system (tubing, valves, ...)	Fill the pump and the liquid supply system with liquid.
	The non-return valve does not open.	Rinse the non-return valve.
	Blocked delivery tubing or needle	Cleansing, flushing or exchange of the delivery tubing or dosage needle
	The coupling between the motor and the pump is out of position.	Return the pump to the manufacturer.
	The pump shaft is broken.	Return the pump to the manufacturer.
5 The pump is filled with liquid, but does not pump it.	Error indicator (the red status LED on the terminal box is on and the motor control has set the error output).	Check the motor error status with the Motion Manager software (command GFS). Try to liberate the pump by making it operate for 1 s in a reverse direction with -1000 rpm.
		Adapt the motor current to the control. Contact the manufacturer of the pump.
	Presence of particles in the delivered liquid or blockage of the pump.	Check the motor error status with the Motion Manager software. Try to liberate the pump by making it operate for 1 s in a reverse direction with -1000 rpm.
		Return the pump to the manufacturer for cleansing. Use a filter, flush the liquid delivery

Disturbance	Cause	Solution
		system.
		Flush the pump with a syringe.
	The non-return valve does not open.	Rinse the non-return valve.
	Blockage of the delivery tubing or the needle.	Cleanse, flush or exchange the delivery tubing or the needle.
	Air bubbles in the liquid delivery system, (tubing, valves)	Fill in the pump and the delivery system with liquid.
6 Dosage volume does not correspond to the set values.	Air bubbles in the liquid delivery system, (tubing, valves ,...) and the pump	Vent the liquid delivery system and check for untight fluid connections.
	Pump shows cavitation.	Too long or too narrow intake tubing. Shorten the intake tubing or change the position of the pump.
	Polluted or too small filter	Change the filter to a new or bigger one.
	The non-return valve does not open.	Rinse the non-return valve.
7 Speed of the pump cannot be adjusted.	Defective electric installation	Check the electric installation for correct cable configuration and loose contacts.
	Defective drive control	Return the drive control to the manufacturer.
8 Liquid drops from the dosing needle.	The non-return valve does not close.	Rinse the non-return valve.
	Too high pressure on the primary liquid tank	Stop the delivery of compressed air on the primary liquid tank.
	The liquid tank is placed at a higher level than the dosing needle.	Place the liquid tank at the same or slightly lower level than the pump.
9 Liquid leaks from the fluidic seal.	The connection kit of the fluidic seal module is untight.	Check the assembly, tighten the threaded connections.
	Pressure on the induction tank of the fluidic seal liquid	Stop the delivery of compressed air on the sealing liquid tank Defective sealing - if necessary return the pump to the manufacturer.
10 The dosage volume decreases with time.	Polluted filter.	Exchange the filter.
	Deposits in the pump.	Flush the pump or return it to the manufacturer for dismantling and cleaning.
	The pump is worn after a long operating period or after use with abrasive liquids.	New definition of the calibration factor of the pump, by modifying the pump characteristics graph necessary.
11 Leakage from the pump	The sealing does not function correctly.	Return the pump to the manufacturer.
12 Leakage from the coupling assembly	Defective shaft seal	Return the pump to the manufacturer to change the shaft sealing.
13 Leakage from the fluid connections	Untight lock rings	Exchange or tighten the fluid connections, exchange the fluid connection fittings.
14 Air bubbles on the delivery side	Loose fluid connections (particularly on the induction side)	Check and tighten the fluid connections.
	The shaft seal is untight or worn.	Return the pump to the manufacturer.
15 Minimal leakage during standstill	No error, cause relative to the operating principle	Employ a non-return valve. Place the liquid tank at the same or slightly lower level than the pump
16 Excess temperature	The surface of the pump is hot.	Clean the surface of the pump, rinse the pump
	The pump operates with difficulty.	The pump should be flushed.
	Particles in the delivered liquid or deposits in the pump	The operation of the pump should immediately be stopped! Return the pump to the manufacturer for cleansing.
	Noise of beveling	The operation of the pump should immediately be stopped! Return the pump to the manufacturer for cleansing and repair.
	The motor surface or the motor interior are too hot.	High temperature indicator in the drive is on. The motor has been shut down by the thermistor. Return the pump to the

Disturbance	Cause	Solution
		manufacturer.
17 The pump is noisy	Wearout of the pump or defective components	Do not continue to operate the pump, return it to the manufacturer for maintenance.
18 Lack of connection with the RS-232 interface	The pump is not connected.	Check the power supply 24 VDC.
		Check the connection of the interface and the null-modem cable. Change the cable if necessary.
	The drive control does not respond.	Interrupt the voltage supply for about 10 s, connect the voltage supply again. Automatic start of the integrated drive control
19 Overcurrent	Particles in the delivered liquid	Rinse the pump.
	The pump operates with difficulty.	Dosing needle is damaged. Needle should be cleansed, flushed or exchanged.
		Tubing on the delivery side, dosing needle or non-return valve are blocked. Cleanse, flush or exchange the components.
	Deposits inside the pump.	Flush the pump. If necessary return the pump to the manufacturer.
20 Undervoltage	Voltage supply < 12 VDC	Check the power supply 24 VDC.
21 Overvoltage	Voltage supply > 28 VDC	Check the power supply 24 VDC. The drive control may be damaged. Return the pump to the manufacturer.

table 33 Trouble shooting - causes and solutions.

If a disturbance that has not been mentioned in the above list, or that makes the use of the micro annular gear pump unsafe appears, please stop the operation of the pump without delay and contact the manufacturer.

12 EC Directive

A Directive or EC Directive is a legal instrument of the European Community addressing at the member states and forcing them to implement specific regulations or targets. Leastwise, micro annular gear pumps are covered, by the scope of application of the following Directives: The following directives are of importance for the user of the described micro annular gear pumps:

Low-Voltage Directive (2014/35/EU)

The Low-Voltage Directive is not relevant for micro annular gear pumps described in this manual, because the supply voltage is limited to a maximum of 30 VDC.

Machinery Directive (2006/42/EC)

A micro annular gear pump is a machine and is consequently covered by this Directive. However, it may be a part of a machine or installation.

EMC Directive (2014/30/EU)

The Directive on Electromagnetic Compatibility (EMC) applies to all electronic and electrical devices, installations and systems. Consequently, the Motion Controller of the micro annular gear pump is covered by the EMC Directive.

RoHS Directive (2011/65/EC)

To our knowledge our products delivered to you do not contain substances or applications in concentrations that are forbidden by this directive. No substances contain our products delivered to you after our current knowledge in concentrations or application, the placing on the market in products according to the valid requirements forbade to the Directive.

WEEE Directive (2002/96/EC)

Disposal of micro annular gear pumps has to be environmentally sound.

All materials and liquids haveto be recycled in accordance with the relevant regulations. Electrical parts can not be disposed of as household waste. They have to be delivered to designated collection points.

REACH regulation (EC) No. 1907/2006

HNP Mikrosysteme is not a manufacturer or importer of chemical substances subjected to registration, but in terms of regulation, a downstream user. As downstream user, we conduct the necessary communication with our suppliers to ensure future deliveries of all components necessary to us. We will notify you of all relevant, changes in our products, their availability and the quality of parts/products delivered by us within our business and coordinate the appropriate action in individual cases with you. Previous inspection did not show any limitation in the supply of material from our upstream suppliers.

12.1 Electromagnetic Compatibility (EMC)

Electromagnetic compatibility is defined as the ability of a electric or electronic device to function satisfactorily as intended in its electromagnetic environment without introducing intolerable electromagnetic disturbances in that environment.

12.1.1 EMC Directive and Standards

Comformity was proven by proof of compliance with the following harmonized standards by the company Dr. Fritz Faulhaber:

EN 61000-6-4 (10/01): Generic standards – Emission standard for industrial environments
EN 61000-6-2 (10/01): Generic standards – Immunity for industrial environments

These standards prescribe certain standardised tests for the emitted-interference and interference-immunity tests. The following tests are required due to the connections on the controller:

Generic Standard on Emitted Interference:	**Description**
EN 55011 (05/98)+A1(08/99)+A2(09/02):	Radio disturbance characteristics
Generic Standard on Interference Immunity	
EN 61000-4-2 (05/95)+A1(4/98)+A2(02/01):	Electrostatic discharge immunity test
EN 61000-4-3 (04/02)+A1(10/02):	Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4 (09/04):	Electrical fast transient/burst immunity test
EN 61000-4-5 (03/95)+A1(02/01	Surge immunity test
EN 61000-4-6 (07/96)+A1(02/01):	Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8 (09/93)+A1(02/01):	Power frequency magnetic field immunity test

Table 1 Standards Summary

All tests were conducted successfully.

12.1.2 Information on use as intended

For micro annular gear pumps, note the following:
Requirement for the intended operation is the operation according to the technical data and the manual.

Restrictions

If the micro annular gear pumps are used at home, in business or in commerce or in small businesses, appropriate measures must be taken to ensure that emitted interferences are below the permitted limit a values!

13 Declaration of conformity - manufacturer's declaration

Pump :	EC declaration / attestation of conformity (after Directive 2006/42/EC)
	EC declaration / attestation of conformity (following EMC Directive 2014/30/EU) for micro annular gear pump mzr-6359 Ex
	EC declaration / attestation of conformity (following EMC Directive 2014/30/EU) for micro annular gear pump mzr-7259 Ex
	EC declaration / attestation of conformity (following directive 2014/34/EU) for micro annular gear pump mzr-6359 Ex
	EC declaration / attestation of conformity (following directive 2014/34/EU) for micro annular gear pump mzr-7259 Ex
	EC declaration / attestation of conformity (following directive 2014/34/EU) for micro annular gear pump mzr-6359X2 Ex
	EC declaration / attestation of conformity (following directive 2014/34/EU) for micro annular gear pump mzr-7259X2 Ex
Coupling :	EC declaration / attestation of conformity (following directive 94/9/EC)
Ex-motor:	EC declaration / attestation of conformity
Thermal element :	EC declaration / attestation of conformity (following directive 94/9/EC)

table 34 Overview declarations of conformity and manufacturer's declaration

You may request the declarations of conformity for the micro annular gear pumps from us separately.

EC-manufacturer's certificate
(following Machinery Directive 2006/42/EC)

We hereby declare that the following micro annular gear pumps of the hermetic inert pump series:

mzr-6359 Ex, mzr-7259 Ex, mzr-6359X2 Ex, mzr-7259X2 Ex

is intended for installation into another machinery/plant and that start of operation is forbidden until it is identified that the machinery/plant into which these micro annular gear pump shall be installed corresponds to the regulations of the EC guidelines regarding safety and health requirements.

We confirm the conformity of the product described above to the following standards in terms of applied directives

– Machinery Directive (2006/42/EC)

Applied standards are particularly

DIN EN 809	DIN EN 60204-1	DIN EN ISO 13857
DIN EN ISO 12100 part 1		DIN EN 953
DIN EN ISO 12100 part 2		UVV

This statement does not warrant any characteristics in terms of product liability. Please note the safety instructions in the manual.

Mr. Lutz Nowotka, HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin is authorised to compile the technical file according to Annex VII A.

Date: 12. August 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

HNP Mikrosysteme

EC-manufacturer's certificate (following EMC Directive 2014/30/EU)

We hereby declare that the following micro annular gear pump of the hermetic inert pump series:

mzr-6359 Ex, mzr-6359X2 Ex

is intended for installation into another machinery/plant and that start of operation is forbidden till it is identified that the machinery/plant into which these micro annular gear pumps shall be installed corresponds to the regulations of the EC guidelines regarding safety and health requirements.

We confirm the conformity of the product described above to the following standards in terms of applied directives

– EMC Directive (2004/108/EC)

Applied standards are particularly

EN 61000-6-4 (10/01):	Generic standards – Emission standard for industrial environments
EN 61000-6-2 (10/01):	Generic standards – Immunity for industrial environments

This statement does not warrant any characteristics in terms of product liability. Please note the safety instructions in the manual.

Date: 12. August 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

HNP Mikrosysteme

EC-manufacturer's certificate (following EMC Directive 2014/30/EU)

We hereby declare that the following micro annular gear pump of the hermetic inert pump series:

mzr-7259 Ex, mzr-7259X2 Ex

is intended for installation into another machinery/plant and that start of operation is forbidden till it is identified that the machinery/plant into which these micro annular gear pumps shall be installed corresponds to the regulations of the EC guidelines regarding safety and health requirements.

We confirm the conformity of the product described above to the following standards in terms of applied directives

– EMC Directive (2004/108/EC)

Applied standards are particularly

EN 61000-6-4 (10/01):	Generic standards – Emission standard for industrial environments
EN 61000-6-2 (10/01):	Generic standards – Immunity for industrial environments

This statement does not warrant any characteristics in terms of product liability. Please note the safety instructions in the manual.

Date: 12. August 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

EC declaration / attestation of conformity (following directive 2014/34/EU)

As per the EC directive 2014/34/EU, dated 26 February 2014 and the legislation arising from its implementation, we declares that the explosion protected product, described in the operation and safety instructions of the micro annular gear pump

mzr-6359 Ex, mzr-6359X2 Ex

is a device in the sense of Article 1, (3) a) of Directive 2014/34/EU, and complies with the essential safety and health requirements as per Appendix II of Directive 94/9/EEC and the following harmonized directives:

– DIN EN 13463-1
– DIN EN 13463-5

The specified pump type falls into the explosion protection design classification „c ".An ignition hazard assessment is available. The pump carries the identification:

CE Ex II 2G c IIC T4 X

The technical documentation, in compliance with Article 13, (1) b) ii) of the directive 2014/34/EU,in combination with Appendix VIII Number 2, has been deposited with the following named body

DEKRA EXAM GmbH
Dinnendahlstraße 9
D - 44809 Bochum, Germany

Date: 12. August 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

EC declaration / attestation of conformity (following directive 2014/34/EU)

As per the EC directive 2014/34/EU, dated 26 February 2014 and the legislation arising from its implementation, we declares that the explosion protected product, described in the operation and safety instructions of the micro annular gear pump

mzr-7259 Ex, mzr-7259X2 Ex

is a device in the sense of Article 1, (3) a) of Directive 2014/34/EU, and complies with the essential safety and health requirements as per Appendix II of Directive 94/9/EEC and the following harmonized directives:

– DIN EN 13463-1
– DIN EN 13463-5

The specified pump type falls into the explosion protection design classification „c ".An ignition hazard assessment is available. The pump carries the identification:

CE Ex II 2G c IIC T4 X

The technical documentation, in compliance with Article 13, (1) b) ii) of the directive 2014/34/EU,in combination with Appendix VIII Number 2, has been deposited with the following named body

DEKRA EXAM GmbH
Dinnendahlstraße 9
D - 44809 Bochum, Germany

Date: 12. August 2016

Signature manufacturer:

Dr. Thomas Weisener
CEO

IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[1] **BAUMUSTERPRÜFBESCHEINIGUNG**

[2] **für nicht-elektrische Geräte und Komponenten der Gerätegruppen I und II, Gerätekategorien M2 und 2 sowie 3**

[3] Nr. der Baumusterprüfbescheinigung: **IBExU04ATEXB023 X**

[4] Komponente: **Magnetkupplungen MINEX® - S**
Baugrößen 22 bis 165

[5] Hersteller: KTR Kupplungstechnik GmbH

[6] Anschrift: Rodder Damm 170
D-48432 Rheine

[7] Die Bauart der unter [4] genannten Komponente sowie die verschiedenen zulässigen Ausführungen sind in der Anlage zu dieser Baumusterprüfbescheinigung festgelegt.

[8] IBExU Institut für Sicherheitstechnik GmbH bescheinigt, dass die unter [4] genannte Komponente die in Anhang II der Richtlinie festgelegten grundlegenden Sicherheits- und Gesundheitsanforderungen für die Konzeption und den Bau der Komponente zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen erfüllt.
Die Prüfergebnisse sind in dem Prüfbericht IB-04-4-027 vom 28.10.2004 festgehalten.

[9] Die grundlegenden Sicherheits- und Gesundheitsanforderungen werden erfüllt durch Übereinstimmung mit EN 13463-1:2001 und EN 13463-5:2003.

[10] Falls das Zeichen „X" hinter der Bescheinigungsnummer und/oder der Kennzeichnung unter [12] steht, wird auf besondere Bedingungen für die sichere Anwendung der Komponente in der Anlage zu dieser Baumusterprüfbescheinigung unter [17] und in der Betriebsanleitung hingewiesen.

[11] Diese Baumusterprüfbescheinigung bezieht sich nur auf die Konzeption und den Bau der festgelegten Komponente. Weitere Anforderungen dieser Richtlinie gelten für die Herstellung und das Inverkehrbringen dieser Komponente (siehe z. B. unter [19]).

[12] Die Kennzeichnung der unter [4] genannten Magnetkupplungen muss die folgenden Angaben enthalten:

II 2G c IIC T X

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7 - D-09599 Freiberg
Tel.: 03731 3805.0 - Fax: 03731 23650

Freiberg, 28.10.2004

Bescheinigungen ohne Unterschrift und ohne Stempel haben keine Gültigkeit. Bescheinigungen dürfen nur unverändert weiterverbreitet werden.

(Prof. Dr. Redeker)

- Stempel -

Anlage

Figure 24 EC declaration / attestation of conformity for the magnetic coupling after directive 89/392/EEC

Erklärung der EG-Konformität
Declaration of EC-Conformity
Attestation de conformité CE

Wir erklären in alleiniger Verantwortung, dass der	We declare that it is our sole responsibility that	Nous attestons sous notre seule responsabilité
	EX MOTOR EXR...	
auf den sich diese Erklärung bezieht, den Bestimmungen der folgenden Richtlinie entspricht	to which this declaration relates is in accordance with the provision of the following directives	se referant á cette attestation correspondent aux dispositions des directives suivantes
	94/9/EC 2004/108 EG 2006/42 EG	
und mit folgenden Normen übereinstimmt.	and is in conformity with the following standards.	et sont conformes aux normes.
EN60079-0: 2009 EN 50081-1 EN60079-1: 2007	EN 61000-6-2: 2005 EN 61000-4-2(12.09)	EN 50204 (02.96) EN 55022, KL.B(08.08)
Kennzeichnung:	Marking:	Marquage:
Ⓔx II 2 G Exd II C T5 Gb		EXR...
2006/42/EG Das bezeichnete Produkt ist zum Einbau in eine andere Maschine bestimmt. Die Inbetriebnahme ist solange untersagt, bis die Konformität des Endproduktes mit der Richtlinie 89/392/EWG festgestellt ist.	2006/42/EG The indicated product is intended for installation into a machine. Operation is prohibited until the final product is inaccordance with the 89/392/EWG regulation.	2006/42/EG Le próduit indiqué est prévu pour être intégré dans une machine. La mise en service n´est autorisée que lorsqua la directive 89/392/EWG a été venifiée.
Diese Erklärung ist keine Zusicherung von Eigenschaften im Sinne der Produkthaftung.	This statement does not ensure any characteristics regarding Product liability.	Cetto déclaration ne constitue pas une assurance des proprietes au sens de la responsabilité produit.
Die Sicherheitshinweise der Produktdokumentation sind zu beachten.	Saferty instructions stated in the product description have to be respected.	Les consignes de sécurité rappelées dans la documentation du produit doivent être respectées.

ZANICA, 09.02.12

EDELWEISS ACTUATORS S.R.L.
Via Padergnone 21
24050 Zanica
Italia

Figure 25 EC declaration / attestation of conformity for the Ex-motor directive 94/9/EC

THERMOCOAX

from vision to reality

Item	Indicative content based on Annex X of Directive 94/09/EC
Title	**EC STATEMENT OF CONFORMITY**
Reference	**SE900R018 rev. 2** **2004-09-30**
Manufacturer address	**THERMOCOAX** – **Planquivon- Athis de l'ORNE** – **- BP 26 – F61438 FLERS CEDEX – France**
Authorized representative in EU	THERMOCOAX SAS
Manufacturer declaration	We, THERMOCOAX SAS declares that the following equipment :
	Temperature sensor Type 1 : THERMOCOUPLE Model TCD EEx ia Bearing the following markings : **THERMOCOAX** CE 0081 Ex II 1 GD EEx ia II C T6-IP6X T80°C LCIE 03 ATEX 6102X
Declaration of compliance	Is designed and manufactured in compliance with the following applicable Directives.
to Applicable Directives	
First applicable Directive	- ATEX Directive 94/09/EC.
Individual declaration of compliance	Compliance has been obtained by application of the following standards :
Obtained through	EN 50014 (1997 + amendments 1 and 2) EN 50020 (2002) EN 50284 (1999) EN 50281-1-1 (1998) + amendement 1
Proof of compliance	For which an EC-Type Certificate LCIE 03 ATEX 6102 X and a Notification LCIE 03 ATEX Q 8061 according to Annexe IV have been obtained.
Under first Directive because included in the ATEX directive But not checked by the Notified Body	This product complies to electrical safety requirements, as they are expressed in the Low Voltage Directive 73/23/EEC (modified by Directive 93/68/EEC) and has been constructed in accordance to the following standards: EN 61515
Notified Bodies involved	The Notified Body responsible for monitoring the ATEX Directive is LCIE - B.P 8.- F92266 - Fontenay-aux Roses. Its Identification number is : 0081
Manufacturer's own warning	Subject to use for the purpose for which it was designed and/or installed in accordance with relevant standards and with the manufacturer's recommendations
Final declaration	We, the undersigned, hereby declare that the product(s) specified above conforms to the listed Directive(s) and standard(s)
Signatory : shall be legally responsible	Mr Capron General Manager

figure 26 Manufacturer declaration thermocouple sensor

14 Maintenance and service

14.1 Micro annular gear pumps

The first maintenance of the micro annular gear pumps has to take place after 4000 hours or after 6 month latest. If wear is low at the first inspection further maintenance intervals at the same operation conditions can be extended to 6000 hours or to a service interval of 12 month latest.

If there is increased wear at the first inspection the maintenance intervals have to be adapted according to the wear situation.

In case of maintenance and service please send the micro annular gear pump to your distributor or HNP Mikrosysteme directly. The address you may find on the front page of the manual or in section 1.

The micro annular gear pumps is sealed. It is prohibited to open or disassemble the pump. The warranty will expire immediately in such a case.
HNP Mikrosysteme cannot give any warranty for replacing in case of damages to the pump which are related to faulty operation.

14.2 Magnetic coupling

Maintenance of the magnetic coupling is not necessary according to the enclosed manufacturer's data when assembled by HNP Mikrosysteme.

Within the maintenance intervals of the pump must be checked. If at the first inspection damage at the metal bellow-type coupling is found the maintenance intervals have to be adapted according to the operational data. This check must be part of the maintenance intervals of the micro annular gear pump.

14.3 Ex-Motor

The explosion proof motor itself is maintenance free. According to the manufacturer's instruction the explosion proof motor has to be checked 1-2 times per year regarding cracks and damages. This check must be part of the maintenance intervals of the micro annular gear pump.

15 Contact person

Development and application assistance , service and accessories

Mr. Sven Reimann
Phone +49| (0) 385|52190-349

Service and maintenance

Mr. Steffen Edler
Phone +49| (0) 385|52190-307

Drive and control technology

Mr. Lutz Nowotka
Phone +49| (0) 385|52190-346

16 Legal information

Marks

mzr® is a registered German trademark of HNP Mikrosysteme GmbH.

MoDoS® is a registered German trademark of HNP Mikrosysteme GmbH.

µ-Clamp® is a registered German trademark of HNP Mikrosysteme GmbH.

HNPM® is a registered German trademark of HNP Mikrosysteme GmbH.

Teflon® is a registered trademark of DuPont.

Viton® is a registered trademark of DuPont Dow Elastomers.

Kalrez® Spectrum™ is a registered trademark of DuPont.

PEEK™ is a registered trademark of Victrex plc.

HASTELLOY® is a registered trademark of Haynes International, Inc.

Aflas® is a registered trademark of ASAHI Glass Ltd.

Microsoft®, Windows® are registered trademarks of Microsoft Corporation in the USA and in the other countries.

Cavro® is a registered trademark of Tecan Systems, Inc.

Other product names or descriptions not mentioned above are possibly registered trademarks of related companies.

Patents

Micro annular gear pumps (and housings) are protected by assigned patents: EP 1115979 B1, US 6,520,757 B1, EP 852674 B1, US 6,179,596 B1, EP 1354135, US 7,698,818 B2. Patents pending DE 10 2011 001 041.6, PCT/IB2011/055108, EP 11 81 3388.3, US 13/884,088, CN 2011 8006 5051.7, HK 13 11 2934.9, DE 10 2011 051 486.4, PCT/EP2012/061514, EP 12 728264.8, US 9,404,492 B2, CN 2012 8003 8326.2. In the US, Europe and China additional patents are pending.

17 Safety information for the return of already employed micro annular gear pumps and components

17.1 General information

The operator carries the responsibility for health and safety of his/her employees. The responsibility extends also to employees not belonging to the company that have a direct contact with the micro annular gear pump and its components during repair or maintenance works. The nature of media (liquids) coming into contact with the micro annular gear pump and its components must be specified in the corresponding declaration form.

17.2 Declaration of liquids in contact with the micro annular gear pump

The staff performing the repair or maintenance works must be informed about the condition of the micro annular gear pump before starting any work on the device. The »Declaration of media in contact with the micro annular gear pump« should be filled in for this purpose.

The declaration should be sent directly to the supplier or to the company designated by the supplier. A second copy of the declaration must be attached to the shipment documents.

17.3 Shipment

The following instructions should be observed for the shipment of the micro annular gear pump.

- drain any remaining liquid from the pump
- flush the pump with an adapted flushing liquid
- remove the filter elements from the integrated or loosely delivered filters
- all the openings should be air-tight plugged
- return the pump in the original packing

18 Declaration of media in contact with the micro annular gear pump and its components

Type of the device

Pump type/serial number/article no.: _____

Operating hours/running time: _____

Number of delivery note or delivery date: _____

Reason of return: _____

_____

_____

Contact with media (liquids)

The micro annular gear pump was in contact with:

_____

and has been rinsed with:

_____

Product info sheet / Material Safety Data Sheet: ☐ yes* ☐ no

* Please attach file

or is available on the following web site: www. _____

If a pump which had contact with dangerous substances could not be properly cleansed prior to shipment, we reserve the right to entrust a specialized company with cleansing of the device. The return of the pump in original packing is advisable. It is necessary in order to protect the employees and delivery staff.

Nature of media contact:

☐ explosive	☐ oxidizing	☐ sensitive to moisture
☐ toxic (toxic byproducts)	☐ radioactive	pH-value: approx. ____ to ____
☐ carcinogenic	☐ microbiological	other: _____
☐ irritant	☐ corrosive	_____

R-statements: _____ S-statements: _____

Declaration

Hereby I/we affirm that the stated information is complete and correct. Micro annular gear pump and accessories are shipped in conformity with the applicable regulations.

company: _____ ☐ Mrs ☐ Mr title: _____

division: _____ name: _____

street, no.: _____ phone: _____

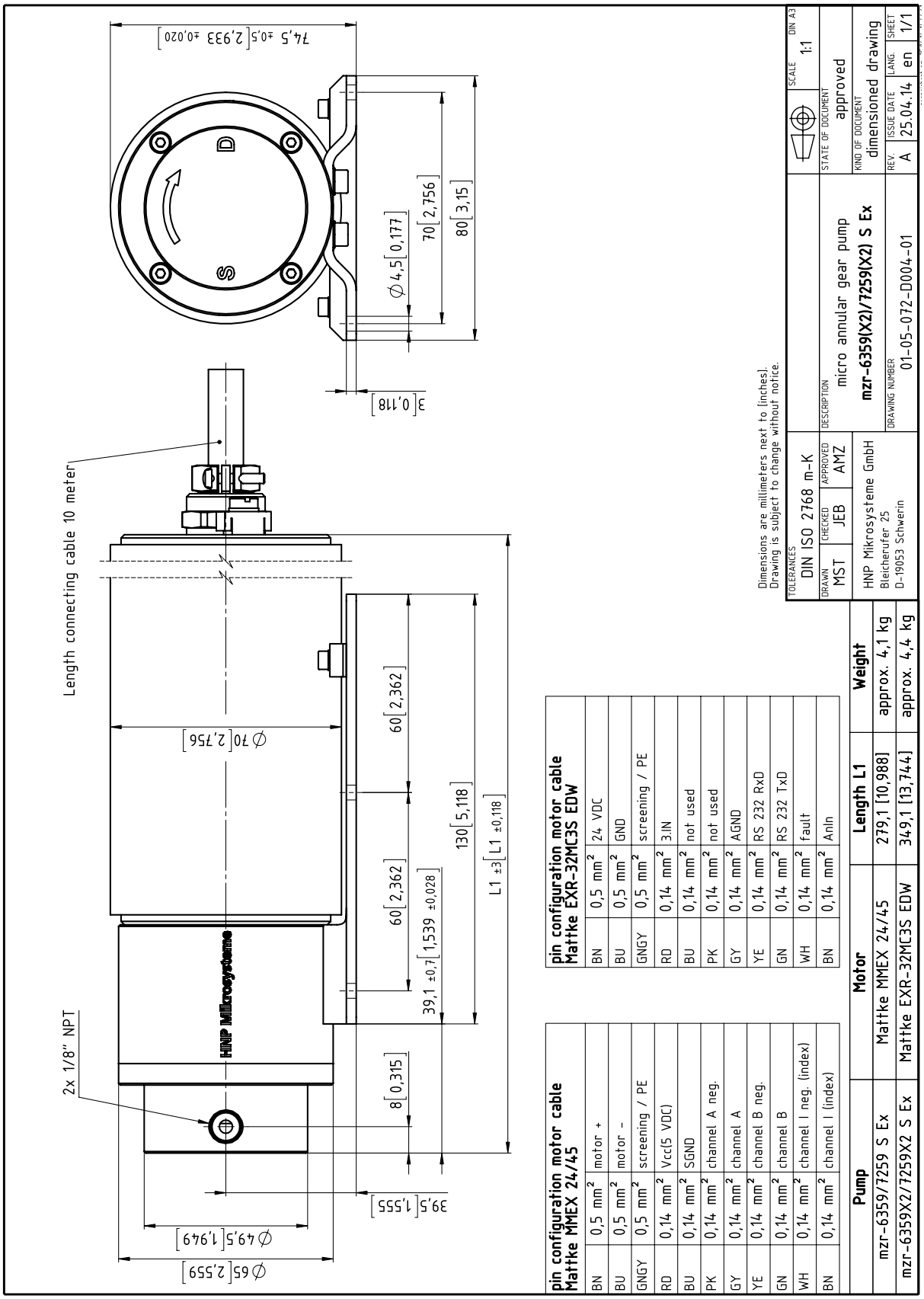
ZIP/city: _____ e-mail: _____

country: _____

city, date: _____ authorized signature / company stamp:

19 Appendix

Layout



pin configuration motor cable Mattke MMEX 24/45

BN	0,5 mm²	motor +
BU	0,5 mm²	motor -
GNGY	0,5 mm²	screening / PE
RD	0,14 mm²	Vcc(5 VDC)
BU	0,14 mm²	SGND
PK	0,14 mm²	channel A neg.
GY	0,14 mm²	channel A
YE	0,14 mm²	channel B neg.
GN	0,14 mm²	channel B
WH	0,14 mm²	channel I neg. (index)
BN	0,14 mm²	channel I (index)

pin configuration motor cable Mattke EXR-32MC3S EDW

BN	0,5 mm²	24 VDC
BU	0,5 mm²	GND
GNGY	0,5 mm²	screening / PE
RD	0,14 mm²	3.IN
BU	0,14 mm²	not used
PK	0,14 mm²	not used
GY	0,14 mm²	AGND
YE	0,14 mm²	RS 232 RxD
GN	0,14 mm²	RS 232 TxD
WH	0,14 mm²	fault
BN	0,14 mm²	Anln

Pump	Motor	Length L1	Weight
mzr-6359/7259 S Ex	Mattke MMEX 24/45	279,1 [10,988]	approx. 4,1 kg
mzr-6359X2/7259X2 S Ex	Mattke EXR-32MC3S EDW	349,1 [13,744]	approx. 4,4 kg

Figure 27 Data sheet mzr-6359 Ex, mzr-7259 Ex, mzr-6359X2 Ex and mzr-7259X2 Ex