HNP Mikrosysteme

Operating manual for micro annular gear pump
mzr-7240

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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.

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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 Use

The micro annular gear pump mzr-7240 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 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.

Data concerning resistance of the pumps to the manipulated liquids have been elaborated according to the best of HNPM'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 manual please contact directly HNP Mikrosysteme.

1.2 Pump Model Designation

This manual is valid for the micro annular gear pumps mzr-7241, mzr-7242, mzr-7243 and mzr-7245 manufactured by HNP Mikrosysteme GmbH, Bleicherufer 25, D-19053 Schwerin, Germany.

The bottom line of this manual shows issue and date of issue of the manual.

1.3 Technical data of the micro annular gear pump mzr-7240

The following table shows the technical data of the micro annular gear pump heads mzr-7240.

			mzr-7240
Technical data			
Displacement volume [µl]			48
Measurements [mm]		L x W x H	150 x 100 x 42 *
Weight [g]			550 *
Internal volume [µl]			110
Materials pump head		see chapter 4.3	
Threaded fluid supply connections		see chapter 4.4	
Coupling		bellow coupling *	
Performance parameters			
Flow rate	Q [ml/min]	min.	0,048
	[ml/min]	max.	288
	[l/h]	max.	17,28
Smallest dosage volume [µl]			5
Differential pressure range [bar]			0 – 5 bar (290 psi)*
Max. inlet pressure [bar]			1 bar (14 psi)
viscosity range of pumpable liquids η [mPas]		min.	0,3
		max.	10.000*
Precision CV [%]			1
Pulsation [%]			6
Operating temperature [°C]		min.	-5
		max.	60
Ambient temperature [°C]		min.	-5
			50
Storage temperature [°C]		min.	-5
		max.	40

Legende: ● true / available CV Coefficient of Variation
* depending on the motor / axial bearing

table 1 Technical data of the micro annular gear pump heads mzr-7240

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.

1.4 Measurements and flow charts

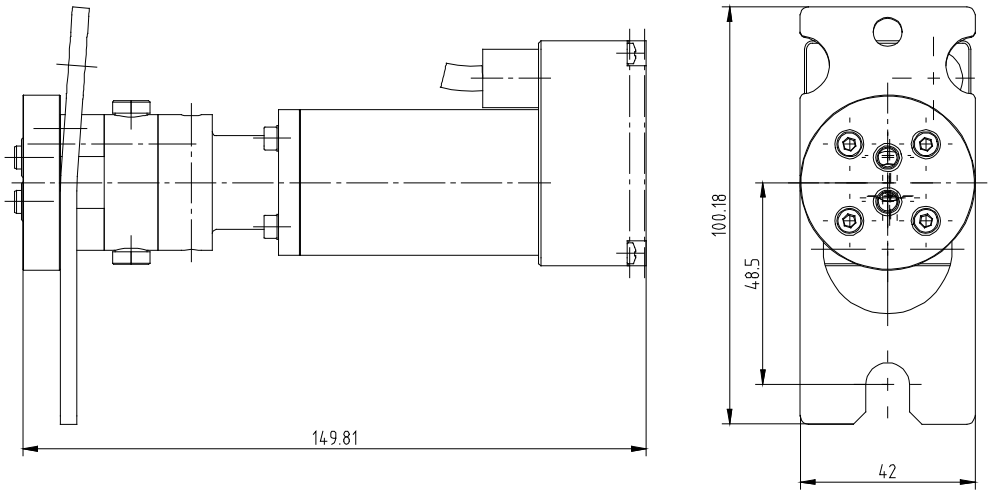


figure 1 Measures of the micro annular gear pump mzr-7245 (picture with a programmable servomotor)

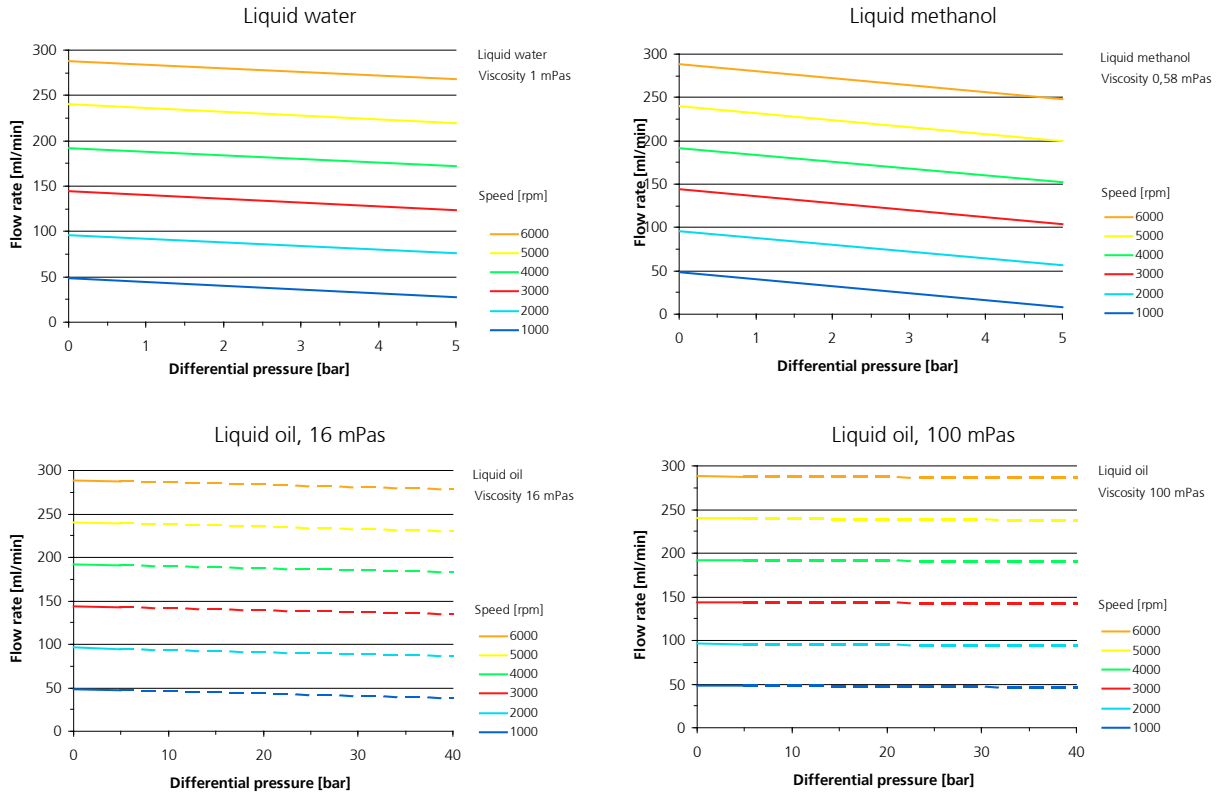


figure 2 Flow charts mzr-7240

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

Please comply not only with the general safety instructions listed below, but also with specific safety instructions mentioned in the following chapters.

Non respect of the safety instructions marked with the following signs represents danger to *people*:

Danger symbol

Safety symbol according to DIN 4844 – W9

High voltage symbol

Safety symbol according to DIN 4844 – W8

Non compliance with the safety instructions marked with the following sign:

Warning

represents a risk of damage to the *micro annular gear pump*.

Operating instructions machined directly on the pump such as the indication of liquid input and output should be followed and kept in a clearly readable condition.

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 surface temperature of the motor under full load may exceed 60°C. If needed, this surface should be protected on site against contact in order to avoid skin burns.

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.

The micro annular gear pumps mzr-7240 must not be used in areas exposed to explosion risks or in the proximity of inflammable gases and vapors.

Possible leaks of dangerous liquids (for example from the shaft sealing) 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 8.

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.

Under normal working conditions the shaft sealing rings integrated in the pump prevent the liquid from leaking out of the device. The micro annular gear pumps are "technically leak-proof" however not "hermetically sealed" which means it may occur that gases or liquids enter to or escape from the pump.

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 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.

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 8.5)
- 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

4.1 Principe of the micro annular gear pumps

Micro annular gear pumps are reciprocating and rotary pumps and are provided with external toothed internal rotor and annular toothed external rotor which are slightly eccentric bearing to each other (see figure 3). Both rotors with their cycloid indenting are at any time interlocked and form a system of several sealed pumping chamber during rotation. With rotation of the rotors around their offset axis, the pumping chambers increase on the induction side, while at the same time the delivery side of the pump decreases. Between the kidney-like in- and outlet a homogeneous flow rate is generated.

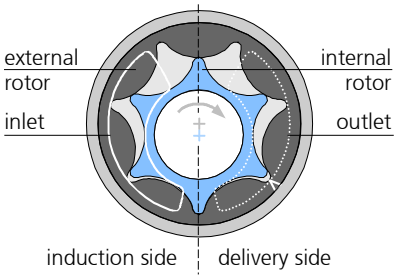


figure 3 Assemble of the micro annular gear pump

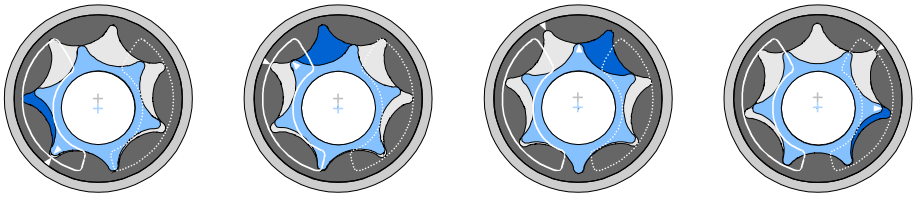


figure 4 Function principle of the micro annular gear pump

Reciprocating and rotary pumps have a direct allocation to the fed amount of the displacement volume V_g of the pump and its actuator's number of revolutions n. The displacement volume describes the volume, which is theoretically fed with each revolution. The coherence of the flow rate referring to the formula (= volumetric flow rate) Q of the pump is:

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

The volumetric efficiency η_{Vol} describes the coherence of the actual flow rate from the theoretical resulting value. Differences occur according to leaking, as the sealing on the inside of the pump is done over a gap. The volumetric efficiency is dependent on the media and the pressure against which it has to be fed.

Example: The pump mzr-7240 feeds with its displacement volume of 48 µl with 3000 RPM and a volumetric efficiency of 100 % referring to the above-mentioned formula the flow rate of 144 ml/min. The following table shows the volumetric displacement in dependence to the number of revolutions (η_{Vol} = 100 %).

Speed [rpm]	**Q** [ml/min]	**Q** [ml/h]
500	24	1440
1000	48	2880
2000	96	5760
3000	144	8640
4000	192	11520
5000	240	14400
6000	288	17280

table 2 Theoretical flow rate of the micro annular gear pump

The pressure, which the pump has to generate, is given by the construction of the fluidic system and the results of the hydrostatic pressure and the hydraulic resistants (given by tubes, contractions etc.).

The viscosity of the pumping medium has an important influence on the volumetric efficiency. The volumetric efficiency increases with higher viscosity according to the smaller disengagement through the gaps of the pump.

Cavitation is an effect, which can result in a specific ceiling speed. The reason for this is the static pressure reaching the steam pressure of the liquid in the inlet port of the pump. In this state an increase of speed does not result in an increased flow rate. The formation of gas prevents a sufficient feeding of the pump. With increasing viscosity of the liquid (e.g.> 10.000 mPas), the ceiling speed is lower.

The specific feature of the mzr-pumps is their highly precise design, as well as the guarantee of high accumulator pressure and high accuracy in flow rate and dosage. Therefore, space width and transverse space width of the rotors as well as the interspace to the adjacent case parts are in the range of just a few micrometers. This precision is at the same time the criterion to achieve a volumetric efficiency in the range of approx. 100 %.

4.2 Construction

The micro annular gear pump is composed of the pump head, the coupling unit, the drive and the angle support (see figure 5).

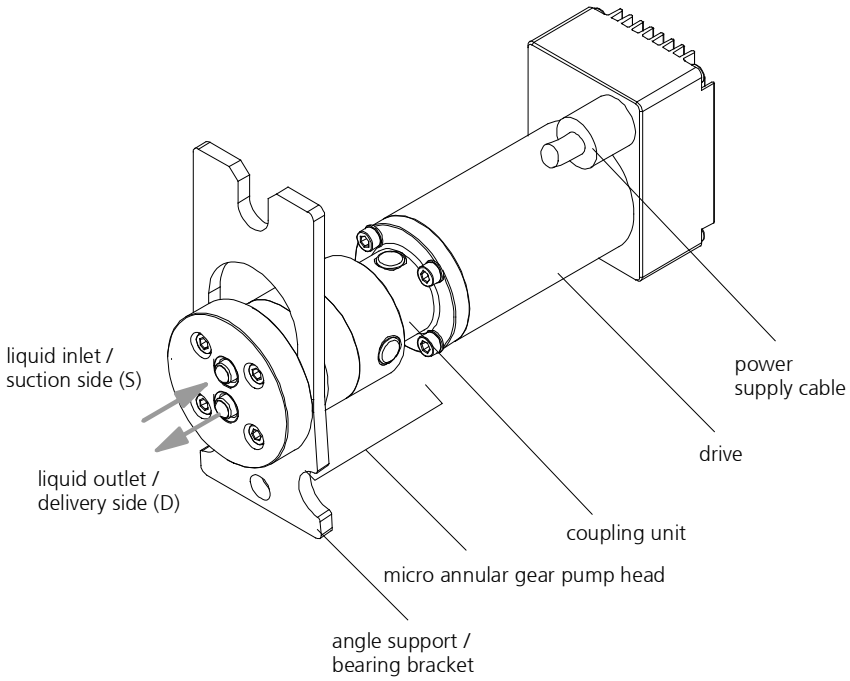


figure 5 Construction of the micro annular gear pump mzr-7245-ha-v M5 +A

4.3 Materials and media

Wetted parts	mzr-7240 pump head
Pump housing	see table 4
Rotors, shaft, bearing	see table 4
Shaft sealing	graphite-reinforced PTFE, 316L spring
Static sealing	see table 5

table 3 Construction materials of the wetted parts

Designation	Material Rotors, shaft, bearing	Material Pump housing
-hs	tungsten carbide Ni-based	stainless steel 316 L (1.4404, 1.4435)
-ha	tungsten carbide Ni-based	Aluminum

table 4 Construction materials

Designation	Material static sealing
-v	FPM (fluorelastomer)
-f	FFPM (perfluoroelastomer)
-e	EPDM

table 5 Construction materials

The resistance of the construction materials to the delivered liquids should be verified by the operator for each individual application. Pumps handling non-lubricating liquids have shorter service lives.

4.4 Fluidic connectors of mzr-7240

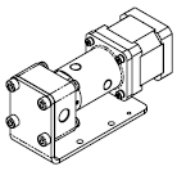
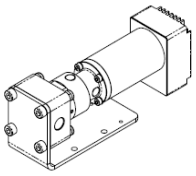
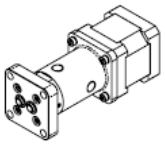
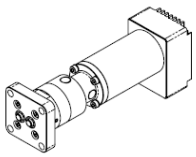
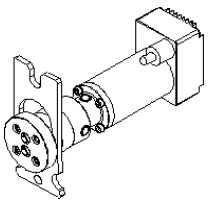
	Fluidic connectors	Construction mzr-7241	Construction mzr-7245
S	lateral 1/8" NPT internal thread		
M4	Tubes, square, screw		
M5	Tubes, round, bearing bracket	-	

table 6 Fluidic connectors

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.

In order to prevent foreign bodies from penetrating into the pump, the liquid inlet and outlet are protected with plastic plugs or screws. Please remove them before you assembly the pump.

5 Modular system

The spectrum of applications of the modular modular 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.

- *Fluidic seal module* prevents possible chemical reactions between the delivered liquid and the surrounding environment
- *Axial bearing module* enables the pump liquids with increased pressure
- *Gear box module* increases the torque of the drive allowing to deliver high viscosity liquids and provides for a constant operation of the motor at low speeds.

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 Fluidic seal module

The module can be employed for liquids which tend to crystallize, when air contact is given. The module prevents reactions by covering the outcoming shaft by a fluidic ambience.

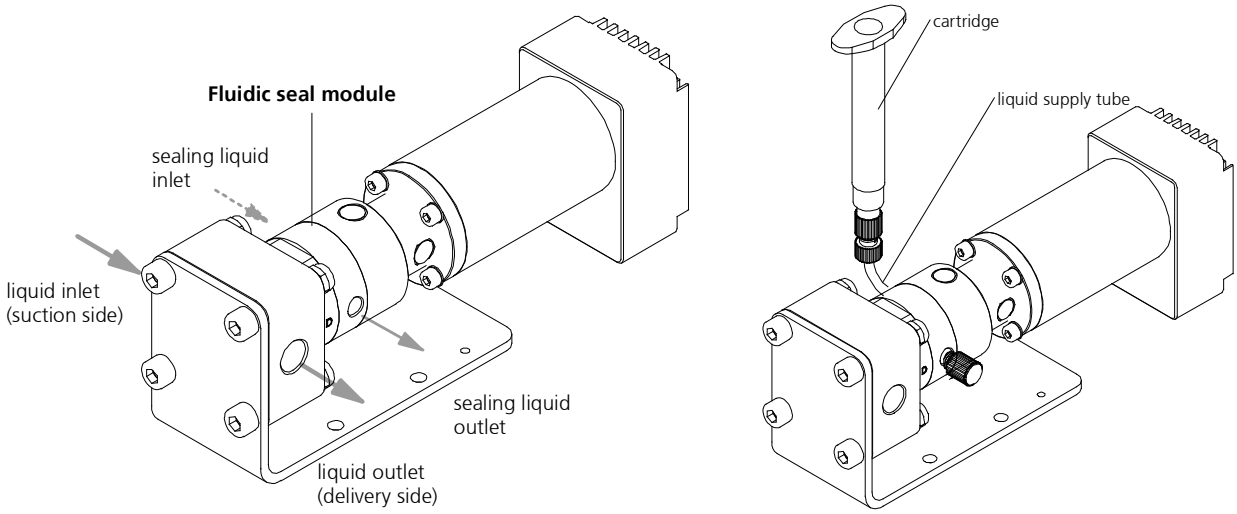


Figure 6 Design of the micro annular gear pump with fluidic seal module (figure with mzr-7245 S +S) (layout on the right: with the optional sealing liquid delivery set)

The module can be applied for liquids which tend to react or crystallize in contact with gases such as oxygen or water. The use of a fluidic seal module has to be confirmed with the pump manufacturer.

Functioning of fluidic seal module

Based on the pump design in the rotary shaft seal there is a liquid boundary film where the liquid is in contact with the ambient. Here small amounts of ambient humidity or oxygen can penetrate into the pump getting over the sealing lip. To prevent penetrating molecules from outside into the pump but also hazardous substances coming out of the pump the fluidic seal module was designed.

For this reason a second rotary seal is added to the pump which is located in the fluidic seal module. Between the two rotary seals a fluidic chamber (see figure 7) is formed which is filled with a sealing liquid compatible to the pumped liquid. The fluidic seal module has two ports opposite to each other for filling and degassing. A pressure head can be applied to the sealing liquid to assure a support of the sealing function. In certain cases the sealing can be flushed.

The sealing liquid will dilute the pumping liquid during operation with a dilution ratio of approx. 1:1,000,000. The sealing liquid has to be compatible with the delivered liquid and has to be determined in interdependence. A

cartridge can be used as a reservoir and is sufficient at maximum flow for one month in most cases.

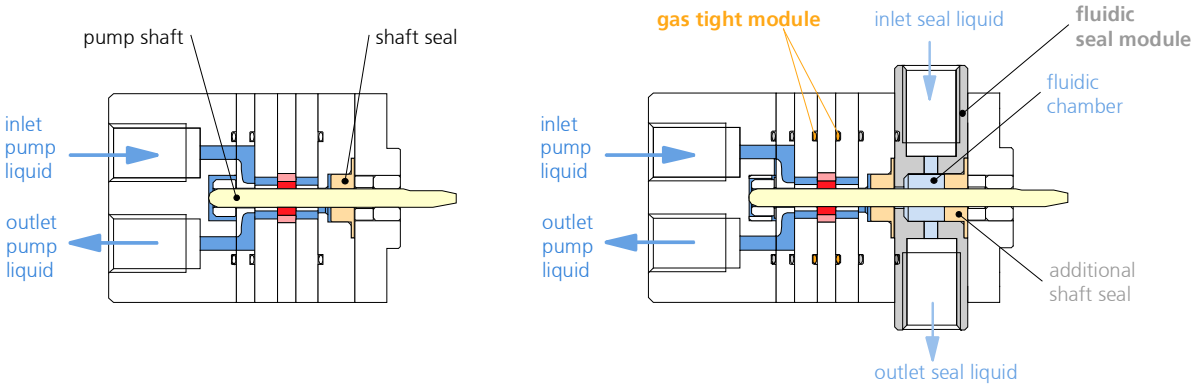


figure 7 Pump head without the fluidic seal module Pump head with the fluidic seal module

Operation with fluidic seal module

The selected *sealing liquid* has to be *compatible* with the *delivered liquid*. The customer is in charge of the correct selection.

The filling procedure through the port has to be realized carefully. The ports have a 1/4"-28 UNF thread. They are displaced to realize a better degassing of the seal chamber also in a horizontal direction. The filling of the sealing liquid starts with the lower level port. The filling of the fluidic seal module continues until no bubbles can be seen on the outlet port side. When the liquid is free of bubbles the outlet port has to be closed by vent screw. To fill the chamber a cartridge or syringe with an appropriate thread 1/4"-28 UNF can be used.

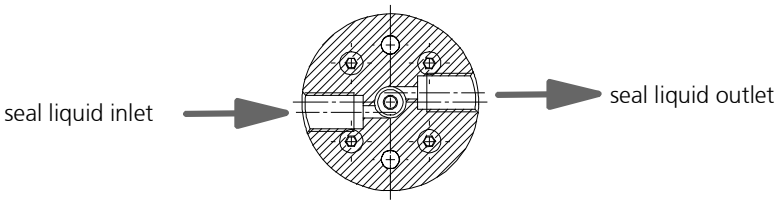


Figure 8 Sectional view of the fluidic seal module

Please note that the cartridge or syringe has to be filled up always with sufficient sealing liquid to avoid air or moisture contact.

If a different installation is selected than the standard installation (e.g. pump marking horizontal readable) it is possible to exchange the seal liquid inlet port and outlet port.

The cartridge always has to be assembled in a vertical way to guarantee that the liquid is gas free and can refill the sealing chamber.

5.2 Axial bearing module

The axial bearing module enables the pump liquids with increased pressure.

5.3 Gear box module

The gear box module enables to increase the torque of the drive in order to deliver high viscosity liquids or to handle liquids at high differential pressure. The gear box module is available with a 3.71 : 1 and 14 : 1 reductions for the pump type mzr-7245. The micro annular gear pump with the gear box module is longer of about 30 mm. The position of the controller housing to the pump head may be shifted at about ± 10° depending on the pump head.

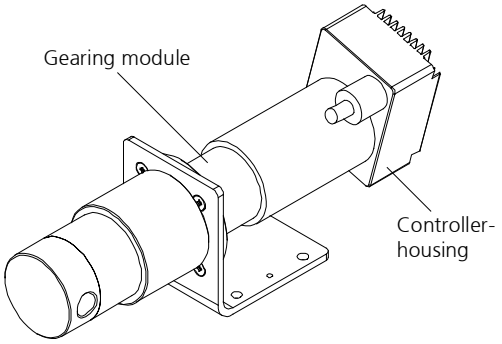


figure 9 mzr-7205 with the gear box module

Please take into notice that for the micro annular gear pump with the gear box module the power supply should be specifically set (see chapter **Fehler! Verweisquelle konnte nicht gefunden werden.**)

Please take into notice that the operating temperature range is changed from -20 °C (-4 °F) to a maximum of 120 °C (248 °F), if the gear box module and the heating module are combined.

6 Optional motor versions

The spectrum of applications of the modular pump series may be expanded by using different motors. The motors allow for special applications, which could otherwise not be accomplished with one pump motor version.

– Brushless DC motor as mzr-7241
– Brushed DC motor as the mzr-7242
– Stepping motor without encoder as mzr-7243
– Stepping motor with encoder as mzr-7243
– Programmable servo motor with integrated control as mzr-7245

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

6.1 Brushless DC-motor as mzr-7241

The micro annular gear pump mzr 7241 can be powered alternatively with a brushless DC-motor. This has a smaller design and a wide speed range, which include the entire speed range of micro annular gear pump covers and has an increased life span compared to a DC-motor with brushes.

Performance parameters	
Nominal voltage	17 V
Max. continuous torque	50 mNm
Power	40 W
No-load speed at 9 V	8000 rpm
Max. continuous current	3,57 mA
Terminal resistance, phase-phase	0,2 Ω
Terminal inductance, phase-phase	0,26 mH
Speed range	500 – 6.000 rpm
Number of pairs of poles	4 (= 8 Pole)
Ambient temperature	-10 … +50 °C (-14 … +122 °F)
Type of Hall effect sensor	digital

table 7 Technical data of the brushless DC-motor

Function motor cable	**Description**	**wire colour**
Phase	U	yellow
Phase	V	red
Phase	W	black
Function hall sensor cable	**Description**	**wire colour**
Hall sensor	H1	blue
Hall sensor	H2	white
Hall sensor	H3	green
Voltage	+5 V	red
Mass	GND	black

table 8 Pin configuration of the motor

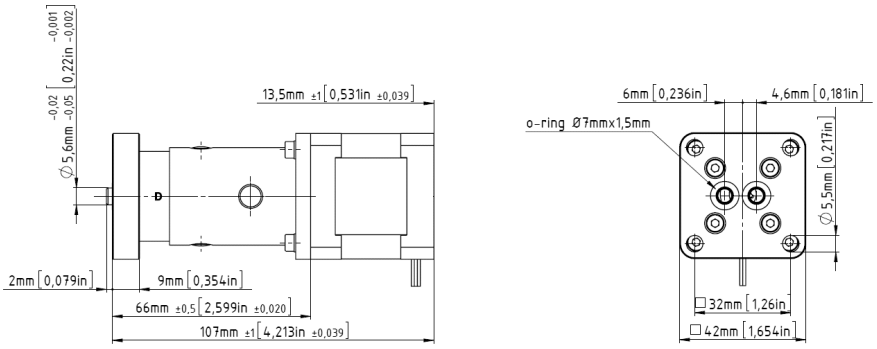


figure 10 Measurements of the micro annular gear pump mzr-7241 with fluid connection »M4« and brushless DC-motor

Note that is necessary to use for the operation of a brushless DC-motor a control modul for brushless DC-motors! The micro annular gear pump mzr-7241 can therefore be supplied with the optional controllers S-KB-4.

6.1.1 Operation with the S-KB-4 control unit

The S-KB-4 control unit is a compact 2-Q DC servoamplifier for speed set of brushless DC motors with a current consumption of up to 4 A. The operating parameters of this control unit are specially adapted to the micro annular gear pump mzr-7241 of the modular pump series manufactured by HNP Mikrosysteme. The S-KB-4 motor control unit based on a high capacity microcontroller, which may be precisely adjusted also at low motor speeds.

A set of inputs and outputs enable the user to adjust the motor control such as the nominal value input, the sense of rotation input and error output.

At the delivery the parameters of the control unit S-KB-4 are preset for operation with the micro annular gear pump mzr-7241. Also the analog nominal value input of the control unit is by default preset for the operation.

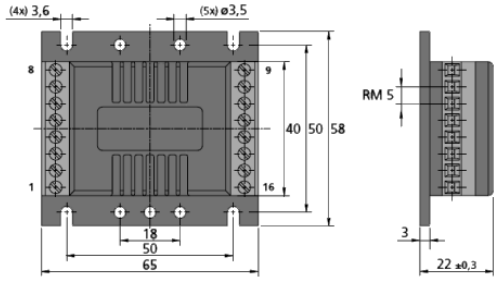
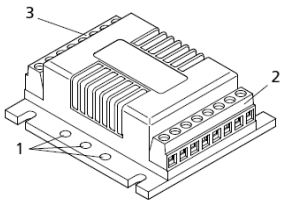


figure 11 Measurements and connection ports of the motion controller S-KB-4



1 Mounting threads
2 Screw-type terminal strip, motor end
3 Screw-type terminal strip, supply end

figure 12 Connection description of motion controller S-KB-4

Technical data

General technical data			
Type of control unit		2-Q servo amplifier	
Power supply for electronic	U_P	24 (5 - 28)	V DC
Power supply for motor	U_{mot}	24 (10 - 28)	V DC
Residual ripple		≤ 3 %	
Max. continuous output current	I_{dauer}	3,8 *	A
Max. peak output current	I_{max}	6 *	A
Total standby current		18	mA
Speed range		500 … 6000 *	rpm
Output voltage for external use	V_{cc}	5 max. 30 mA	V
Input direction of rotation	DIR	low 0 … 0,5 / high 3 … U_B (high for clockwise) $R_{in} \geq 10\ k\Omega$	V
Fault output optional frequency output	FG	Open collector, max. 15 mA, switched through GND, no error 1 lines per revolution	
Reserved connector	IO1, IO2	n.c.	
Operating temperature range		0 … +60 (32 … +140 °F)	°C
Storage temperature		-25 … +85 (-13 … +185 °F)	°C
Measurement		approx. 65 x 58 x 22	mm
Weight with housing		160	g

*) Values limited in the control unit

table 9 General technical data

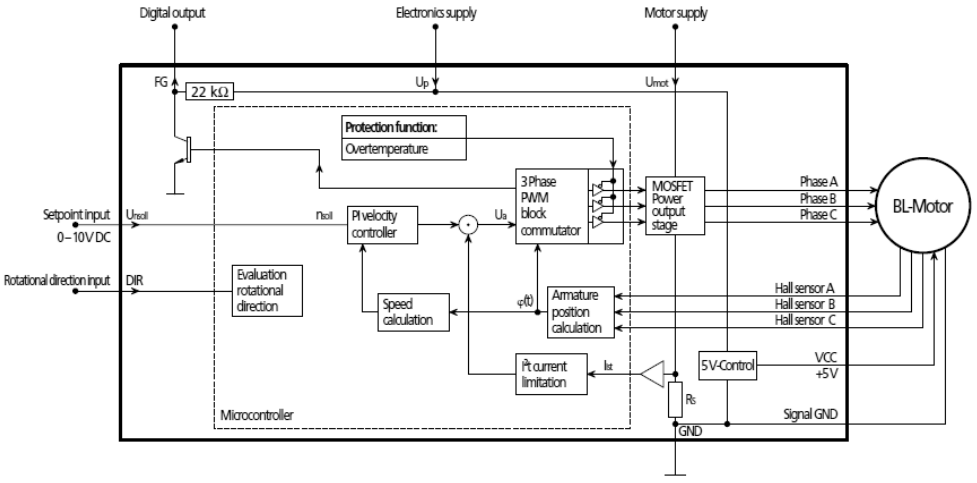


figure 13 Block diagram of control unit S-KB-4

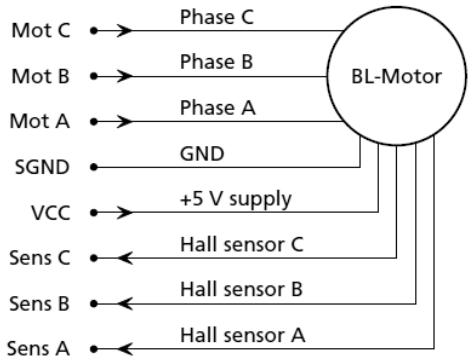


figure 14 Motor connection of control unit S-KB-4

Controller Pin	Connection motor	wire colour
Mot C	W	black
Mot B	V	red
Mot A	U	yellow
Controller Pin	**Connection sensor**	**wire colour**
SGND	GND	black
VCC	+5 V	red
Sens C	H3	green
Sens B	H2	white
Sens A	H1	blue

table 10 Motor connection of control unit S-KB-4

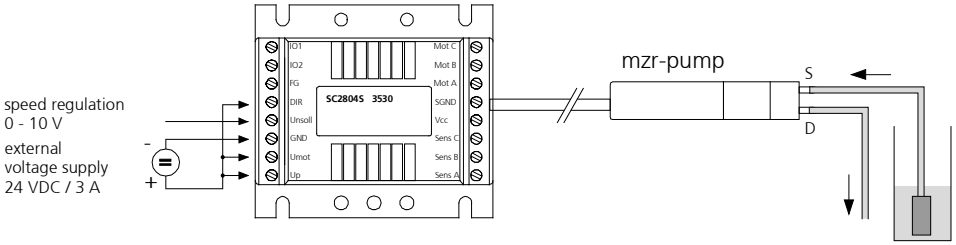


figure 15 Connection sheet of control unit S-KB-4

This manual contains general instructions that come with installing and operating the pump. For more detailed information see the attached motion controller instructions.

Incorrect assembly or assembly with the wrong fixing materials can cause damage to the controllers.

Assembly and installation instructions from the manual of the motion controller are adhere.

Electrostatic discharges at the controller connections can cause damage to or destruction of the electronics.

Note and follow the ESD protective measures from the manual of the motion controller are adhere.

Before starting up, check the parameters configured in the controller and if necessary adjust to the connected motor.

From HNP Mikrosysteme supplied are configured and labelled with programmed pump

6.2 Brushed DC-motor without encoder as mzr-7242

The micro annular gear pump mzr 7242 can be powered alternatively with a brushed DC-motor. This has a smaller design and a wide speed range, which include the entire speed range of micro annular gear pump covers and has an increased life span compared to a DC-motor with brushes.

Performance parameters	
Motortype	2642W024CXR275-5360
Nominal voltage	24 V
Max. continuous torque	26 mNm
Power	23 W
No-load speed at 24 V	5900 rpm
Max. continuous current	0.82 A
Terminal resistance, phase-phase	5.84 Ω
Terminal inductance, phase-phase	0,56 mH
Speed range	500 – 6.000 rpm
Ambient temperature	-30 … +100 °C (-14 … +122 °F)

table 11 Technical data of the brushless DC-motor

Function motor	**Description**
Motor +	+
Motor -	-

table 12 Pin configuration of the motor

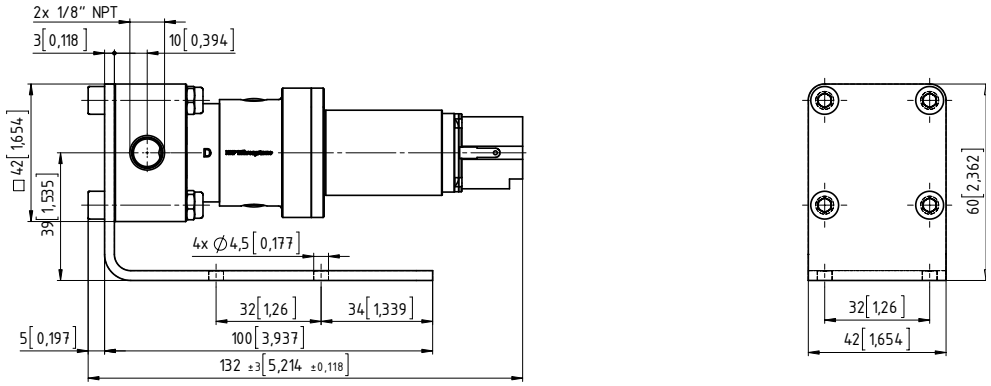


Figure 16 Design of the micro annular gear pump mzr-7242 with brushed DC-motor without encoder

6.3 Stepper motor without encoder as mzr-7243

The micro annular gear pump mzr-7240 may alternatively be a stepper motor drives. This has next to the smaller size for a limited speed range.

Stepper motor	
Motor type	M-1715-1,5S
Speed range	1 – 500 rpm
Phase resistance (at 20°C)	2,1 Ω (± 10%)
Inductance per phase (1 kHz)	5 mH (± 20%)
Nominal current per phase (2 current phases)	1,5 A
Holding torque (2 current phases)	420 mNm
Length cable	300 mm
Ambient temperature [°C]	-10 … + 50°C
Weight	230 g

table 13 Technical data for the stepper motor

Function Motor cable	**Cable**	**Colour**
Phase	A\	black
Phase	A	green
Phase	B\	red
Phase	B	blue

table 14 Wiring of the motor cable (alternative colour possible)

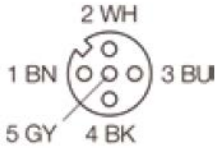
6.4 Stepper motor with encoder as mzr-7243

The micro annular gear pump mzr 7240 may alternatively be a stepper motor drives. This has next to the smaller size an extended speed range.

Stepper motor	
Motor type	AS4118L1804-E
Speed range	1 – 500 U/min
Phase resistance (at 20°C)	1,75 Ω (± 10%)
Inductance per phase (1 kHz)	3,3 mH (± 20%)
Nominal current per phase (2 current phases)	1,8 A
Holding torque (2 current phases)	6 mNm
Max. allowed winding temperature	80°C
Motor cable	ZK-M12-5-2M-2-PUR-S
Encoder cable	ZK-M12-8-2M-2-PUR-S
Length cable	2 m
Max. operating temperature range	85°C
Ambient temperature [°C]	-10 … + 50°C
Weight	340 g

table 15 Technical data for the stepper motor

Function Motor cable	**Connector**	**PIN**	**Colour**
Phase	A\	1	brown
Phase	A	2	white
Phase	B\	3	blue
Phase	B	4	black
Motor Ground	GND	5	shield



Function Encoder cable	**Connector**	**PIN**	**Colour**	**Assignment**
Encoder	A\	1	white	
Encoder	A	2	brown	
Encoder	B\	3	green	
Encoder	B	4	yellow	
Encoder	GND	5	grey	
Encoder	I\	6	pink	
Encoder	I	7	blue	
Encoder	Vcc (5 VDC)	8	red	
Ground	housing	GND	shield	

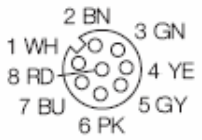


table 16 Technical data for the stepper motor

6.5 Brushless DC-motor with integrated controller

The micro annular gear pump mzr-7245 is driven by electronically commutated, brushless motors with integrated control. The control unit is composed of a 16-bit microcontroller and power electronics. It enables to adjust both speed and position of the motor. The motor is highly dynamic and suitable for dosing tasks performed by the micro annular gear pump. CDs or diskettes containing software running under Windows® which permits to set the parameters, as well as to program and control the pump are included in the package. The package contains also a user-friendly terminal box and a null-modem cable for an easy connection to the serial port of a PC.

6.5.1 Technical data of the drive 3564K024BCS

Performance characteristics of the motor	
Nominal voltage U_B	24 VDC
Supply voltage	12 – 30 V
Residual ripple	≤ 2 %
Max. continuous current	2.8 A
Max. peak current	8 A
Power	44 W
Max. continuous torque	50 mNm
Counts per turn	1000*
Speed range	1 – 6000 rpm
Max speed at 24 V	9000 rpm
Max speed at 30 V	12,000 rpm
Input No. 1 (speed input)	0 – 10 V
Resistance input No. 1	18 kΩ
Fault output (input No. 2)	Open collector max. U_B / 30 mA no error: switched to GND programmed as an input: low 0...0.5 V / high 4 V...U_B
Digital input No. 3	low 0...0.5 V / high 4...30 V
Serial port	RS-232
Protection class	IP 44
Connection cable length	1 m

table 17 Technical data for the drive of micro annular gear pumps mzr-7245

Wire	Description
blue	GND
pink	+24 V
brown	Analog input
white	Fault output
gray	Analog GND
yellow	RS-232 RXD
green	RS-232 TXD
red	Digital input

table 18 Pin configuration of the motor

Motor current parameters	mzr-7245
Peak current LPC [mA]	8000
Continuous current LCC [mA]	2800
Max. speed SP [rpm]	6000
Acceleration AC [rotation/s²]	500

table 19 Programmed current and acceleration parameters at the delivery of standard pumps

Parameter setting (at delivery)	mzr-7245
Peak current LPC [mA]	4000
Continuous current LCC [mA]	2800
Max. speed SP [rpm]	6000
Acceleration AC [rotation/s²]	500

table 20 Programmed parameters at the delivery with the gear box 3.71 : 1

Parameter setting (at delivery)	mzr-7245
Peak current LPC [mA]	1200
Continuous current LCC [mA]	1000
Max. speed SP [rpm]	6000
Acceleration AC [rotation/s²]	500

table 21 Programmed parameters at the delivery with gear box 14 : 1

pin plug / socket	Description
1	GND
2	analog input
3	+24 V
4	fault out
5	analog GND
6	RS-232 RxD
7	RS-232 TxD
8	digital Input 3

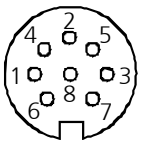


table 22 Pin configuration of the optional lengthening cable

6.5.2 Connection of the micro annular gear pump to the power supply

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 5 A for the micro annular pump mzr-7245.

The micro annular gear pump 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

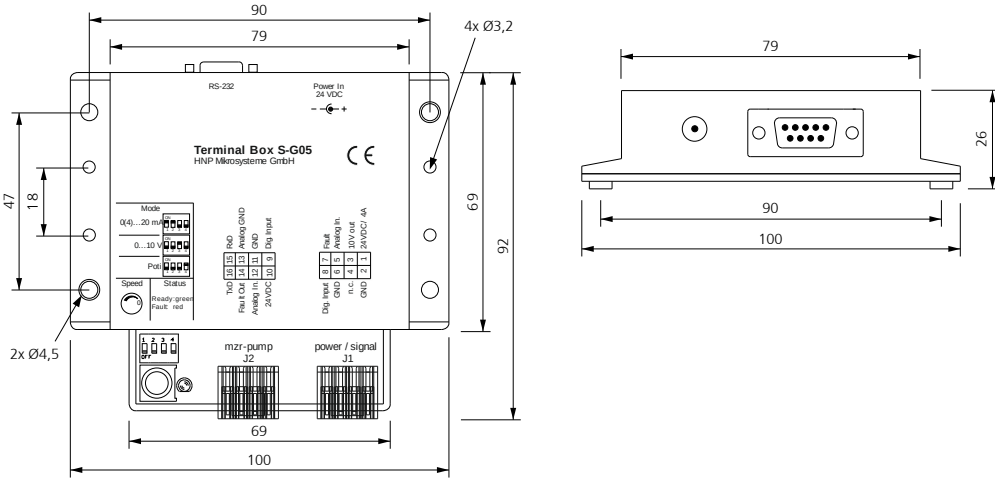


figure 17 Measurements of the Terminal Box S-G05

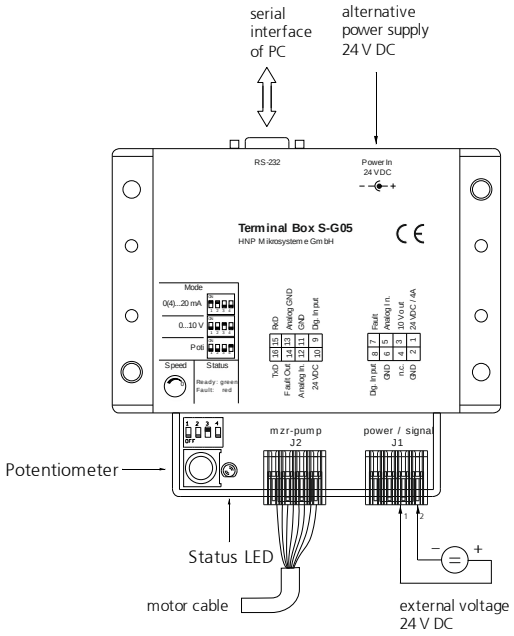


figure 18 Connection of the micro annular gear pump to the power supply

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

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

table 24 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 19 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 25 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
– an external potentiometer and
– the RS-232 interface

Individual start up procedures are described in the following points.

6.5.2.1 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 table 24.

2. Bring the potentiometer 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.

6.5.2.2 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 table 24.

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 table 23)

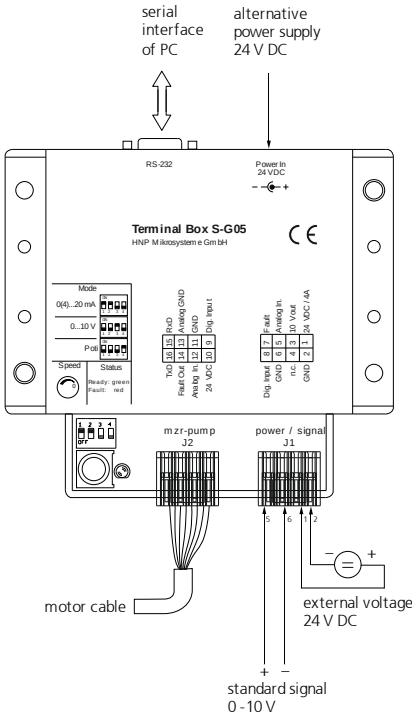


figure 20 Startup with an external 0-10 V voltage signal

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.

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.

6.5.2.3 Startup with an external 0(4)-20 mA current 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 table 24.

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 table 23)

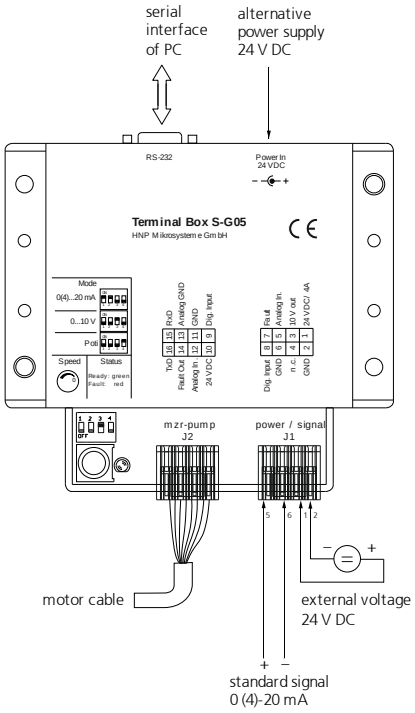


figure 21 Operation via an external 0 (4)-20 mA voltage

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.

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 10).
– 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.

6.5.2.4 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 table 24.

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 table 23)

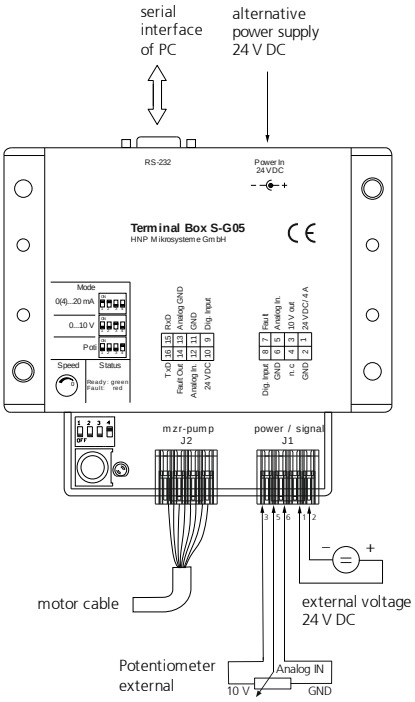


figure 22 Startup with an external potentiometer

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.

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.

6.5.2.5 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 table 24.

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 9 or Chapter 10.

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 10).

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.

6.5.2.6 Startup of the pump units with network mode (NET1 Command)

All standard units are delivered with node number 0. In order to prepare the units for network operation, they must first be individually connected to the PC and set to the desired node address using the FAULHABER Motion Manager.

A serial network can be constructed using the so-called daisy-chain technique, in which the transmit cable of the Master (PC, PLC) is connected to the receive cable of the first node, from where it is looped through to the receive cable of the second node, and so on. The same procedure is followed with the receive cable of the Master, which is looped through to all transmit cables of the drive node. The current generation of Motion Controllers do not require a multiplexer board for serial network operation. The multiplex mode is activated with a command NET1.

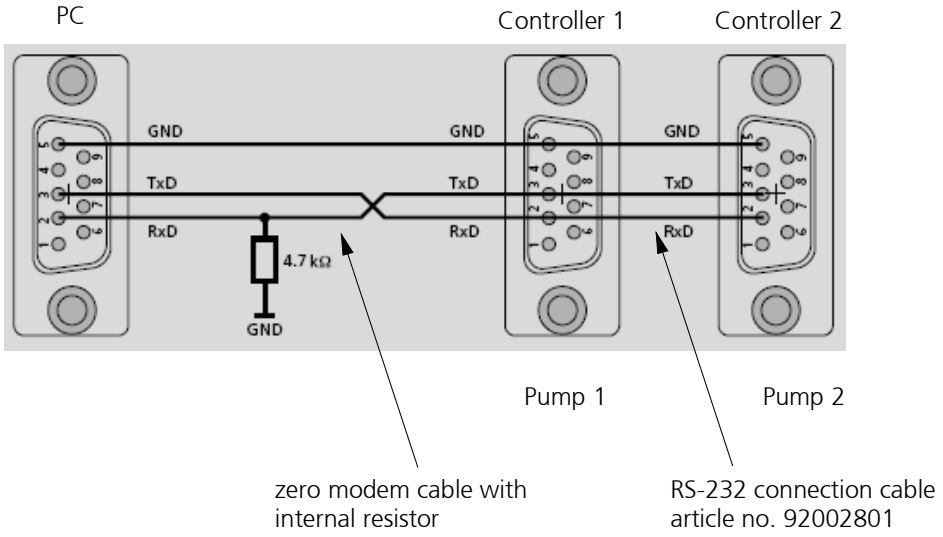


figure 23 Connection between PC, Controller Pump 1 and Controller Pump 2

1. Connect the RS-232 port of the controller Pump 2 with the RS-232 of the controller Pump 1. For this purpose use the delivered 9-pole RS-232 connection cable.

2. Connect the In Port of the RS-232 connection cable with a free serial interface of a PC. For this purpose use the delivered 9-pole null-modem cable with internal resistor.

3. Put the potentiometer of the control units 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.

5. You may now install the delivered software as described in the chapter 10.

While connecting the DC voltage pay attention to the correct polarity, otherwise electronics may be damaged.

Remarks:

- Controller which the manufacturer specifically shipped for the network modus were with the command NET1, SOR0, ANSW0 and DIPROG programmed.
- In order to address the individual drives in the network, the node number must be specified before each ASCII command to be sent (e.g. 2V500). Commands without a node number are adopted by all drive nodes in the network.
- No unaddressed query commands may be sent in network mode, as otherwise all units will answer simultaneously and the message frames will mix, resulting in communication errors. It must also be ensured that no asynchronous responses are sent by several units simultaneously, and that the command acknowledgement is switched off when using unaddressed transmit commands. Use the ANSW0 command to set the response behaviour.

6.5.3 Connection of the micro annular gear pump with terminal box S-G05 with screw clamp terminal

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 5 A for the micro annular pump mzr-7245.

The micro annular gear pump 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 screw clamp terminal
- an alternative voltage supply via a DIN connector conform with DIN 45323
- 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

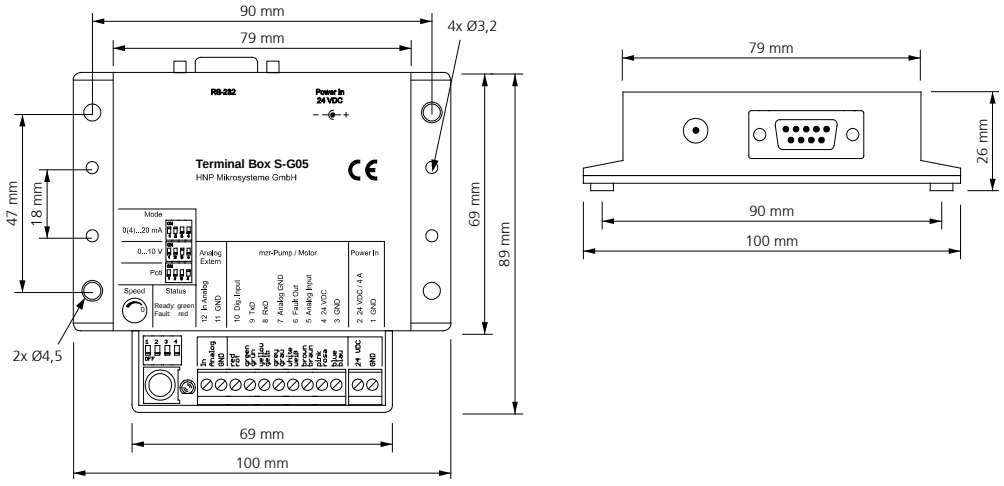


figure 24 Measurements of the Terminal Box S-G05

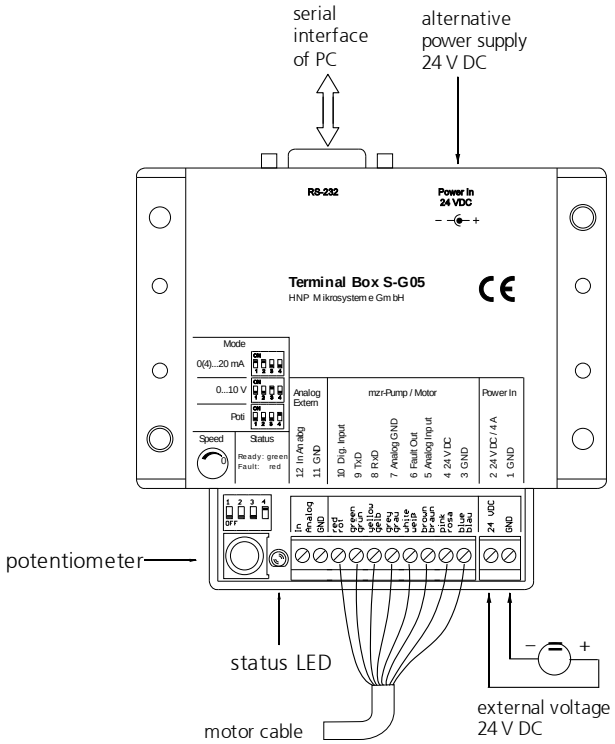


figure 25 Connection of the micro annular gear pump to the power supply

Wire	Function	Terminal Box
blue	Ground	GND
pink	Voltage supply	24VDC
brown	Analog input	Analog Input
white	Error output	Error Out
gray	Ground analog input	Analog GND
yellow	RS-232 interface signal reception	RxD
green	RS-232 interface signal transmission	TxD
red	Digital input	Dig.Input

table 26 Wire configuration between the drive and the Terminal Box S-G05

The speed setting in operation of the micro annular gear pump is to implement the functions from chapter 6.5.2. The connection of an external potentiometer can't be realized.

7 System integration

7.1 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.

7.2 Mounting of the micro annular gear pump

The micro annular gear pump is mounted on an angle support with M4 screws. The favored mounting position of the micro annular gear pump is horizontal. However, if the pump has to be operated vertically, the motor must be located above the pump head in order to prevent the liquid from entering into the motor.

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.

7.3 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.

7.4 Mounting of the micro annular gear pump

Mounting of the micro annular gear pump head to an different actuator

Mounting of the micro annular gear pump head is done by stainless steel M4 screws on the front side flange of the actuator. If you assemble a different actuator, please pay attention to the fact that axial forces may not be introduced. The misalignment of the pump and motor axis may not exceed 1/100 mm.

Mounting of the micro annular gear pump

The mounting angle of the micro annular gear pump can be fixed with four M4 screws. The preferential position of the pump is horizontal. If the pump has to be operated vertically, the position of the motor must be above the pump head in order to prevent liquid from entering into the motor.

Warning

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

Take precautions for the case of a leakage in order to prevent damage of nearby objects and the environment.

The motor have to be protected from damp and dust.

The preferred position to assemble the micro annular gear pump is horizontal. To avoid intruding fluids you may lay the pump under the actuator in vertical operation.

The mechanical assembly of the pump may not be done over the fluidic connectors or the motor.

The actuators used may be protected against dust, condensing moisture, humidity, splashing, aggressive gases and liquids. Ensure sufficient ventilation and therefore cooling of the motors.

7.5 Assembly instruction for tubing and accessories

Particles or soiling can block or impair the function of the micro annular gear pump.

Warning

Please check that all wetted parts of the fluidic system are clean. Clean these parts in case before mounting the pump.
Please check whether there are swarfs in the screw connections, pollution remaining in reservoirs or soiling in valves, pipe work or filters.

The micro annular gear pump mzr-7240 is available in two versions. The liquid supply openings may be lateral or front with a 1/8" NPT thread screw. Pump heads equipped with the heating module are available with front liquid ports only.

Lateral screw connection 1/8" NPT

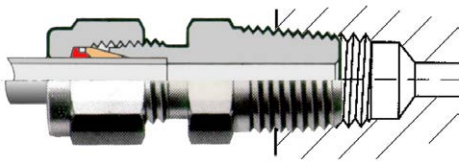


figure 26 Fluid connection fitting 1/8" NPT, stainless steel

9. The thread of the fitting should be wrapped with 2-3 layers of PTFE tape and screwed in the NPT thread (see table 27). First manually, then tightened with ½ to ¾ wrench turns.

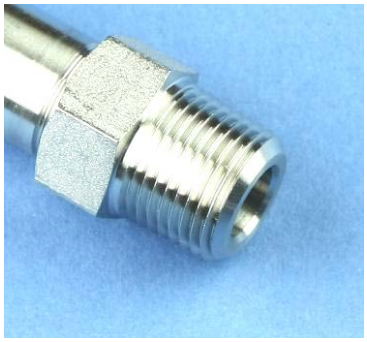
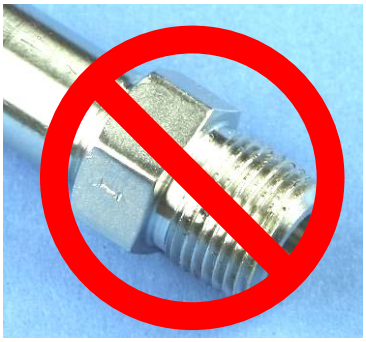
		
Clean the internal and external screw threads leaving no residues.	Make sure the internal and external screw threads are not dented or deformed.	Wrap the PTFE tape around the screw thread clockwise beginning with the second pitch of screw thread..
The PTFE tape should be wrapped tightly around the screw 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 27 Use of PTFE Tape

10. Cut the tube or hose to the right angle with an adapted hose cutter. Metal tubing, that produces swarf during cutting must be throughoutly cleansed and flushed. The smallest piece of swarf in the liquid delivery system may cause failure of the micro annular gear pump.

11. Screw the tube or hose (the latter always with a support tube) in the fluid inlet/outlet port of the pump first manually then tighten it with 1¼ wrench turns. During this operation use a second wrench to hold the hose against the bottom of the inlet/outlet port.

12. 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.

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

7.6 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.

8 Startup/shutdown of a mzr-pump

8.1 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 longer 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?

8.2 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).

Warning Avoid dry operation of the pump over a longer time. The pump should be filled in before it is put to operation.

8.3 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 28 and table 29). 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.

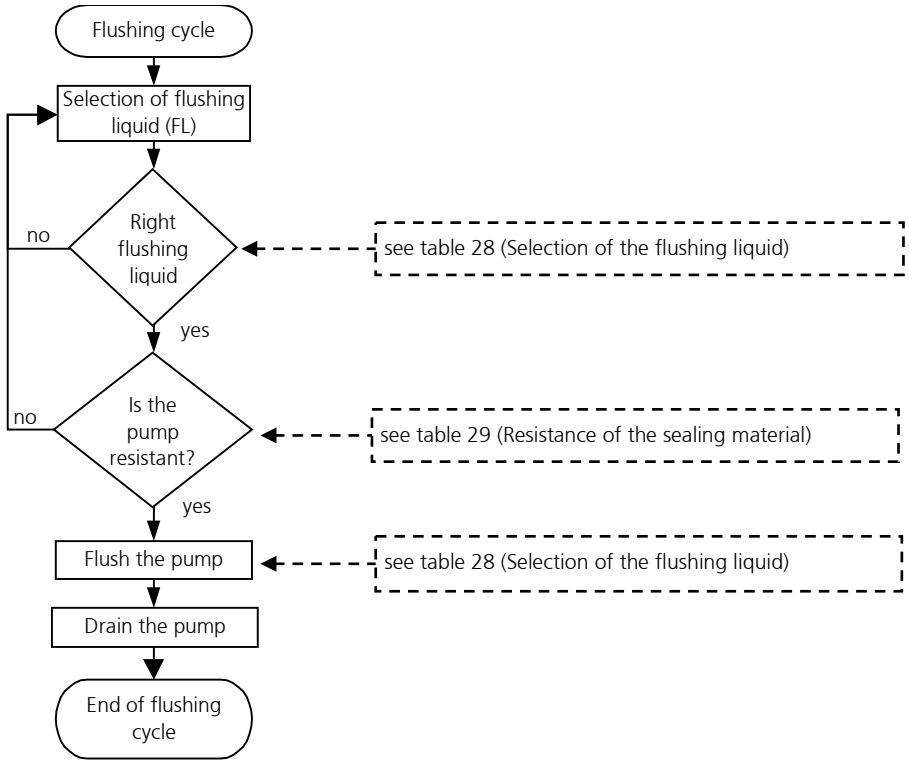


figure 27 Diagram of the flushing procedure

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 29).

Warning The flushing liquid (solvent) and the recommended duration of the flushing procedure depend on the delivered liquid (see table 29). 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 28 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 29).

	Shaft sealing		O-ring material		
Flushing liquid	PTFE (Teflon®), graphite-reinforced	UHMWPE	FKM (Viton®)	EPDM	FFKM
acetone	0	0	3	0	0
benzene	0	3	1	3	0
benzyl alcohol	0	-	0	2	0
butanol	0	-	1	0	0
dimethyl sulfoxide (DMSO)	0	0	3	0	0
ethanol	0	0	0	0	0
isopropanol	0	0	0	0	0
methanol	0	0	2	0	0
methylethylketone (MEK)	0	0	3	1	0
styrene	0	-	1	3	1
toluene	0	1	2	3	0
water	0	0	0	0	0
xylene	0	1	2	3	0
benzine/petroleum ether	0	0	0	3	0
oil / fine mechanics oil	0	0	0	3	0

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

table 29 Resistance of the sealing materials depending on the flushing liquid (solvent)

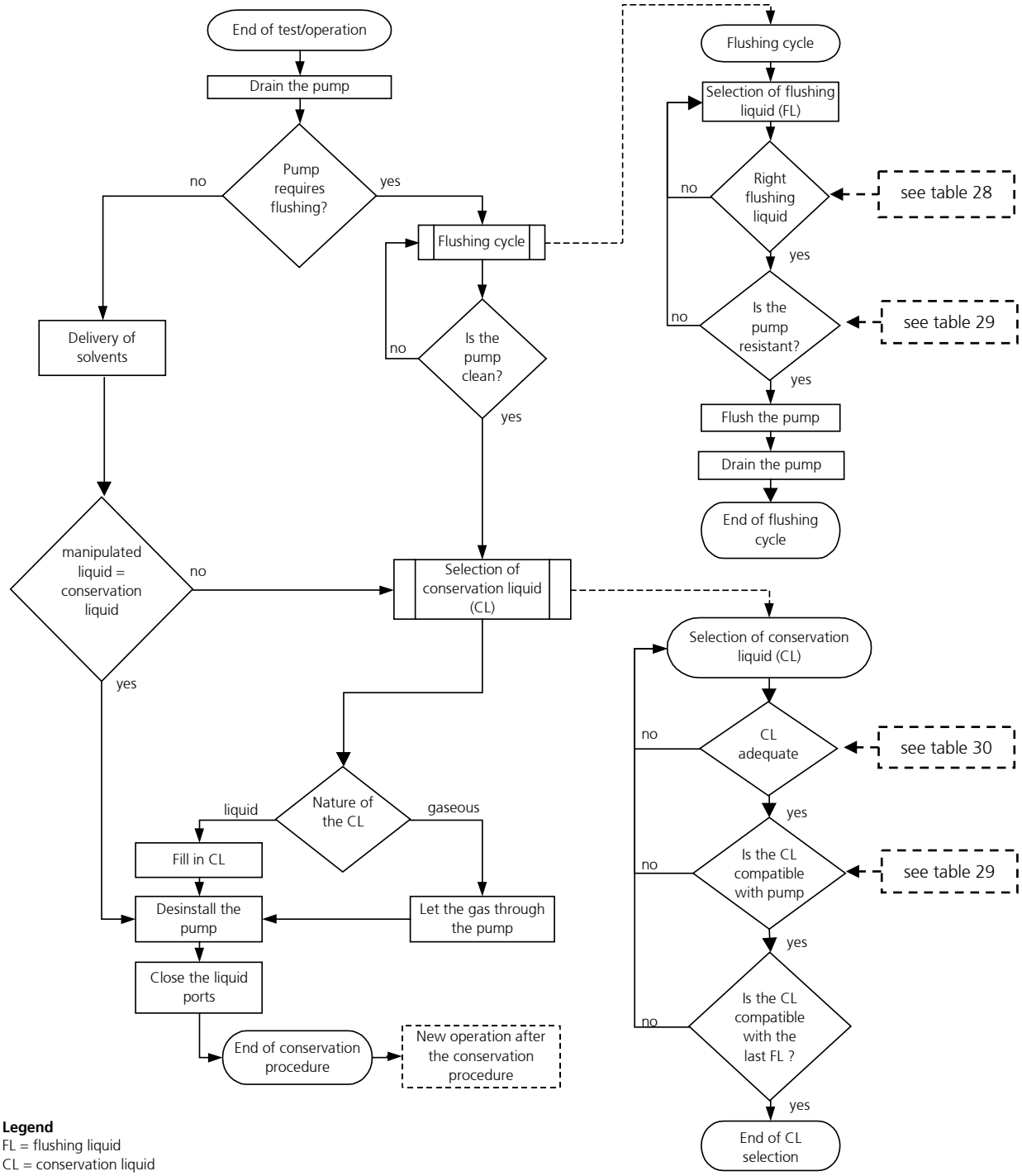
8.4 Shutdown of the micro annular gear pump

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 8.3.

– After the flushing procedure decrease speed of the pump to 0 rpm
– Fill the pump with a suitable conservation liquid (see chapter 8.5)
– Remove the pump from the system (see chapter 8.5.1)

By proceeding as shown in the diagram (see figure 29) you may prepare the pump for a longer standstill.



Legend
FL = flushing liquid
CL = conservation liquid

figure 28 Diagram of the shutdown procedure

8.5 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 8.3), be filled in with a suitable conservation liquid.

The conservation liquid may be selected from the table 30 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 29 presents a diagram of conservation agent selection.

Remark: This diagram is repeated as a part of the figure 28 (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 30.

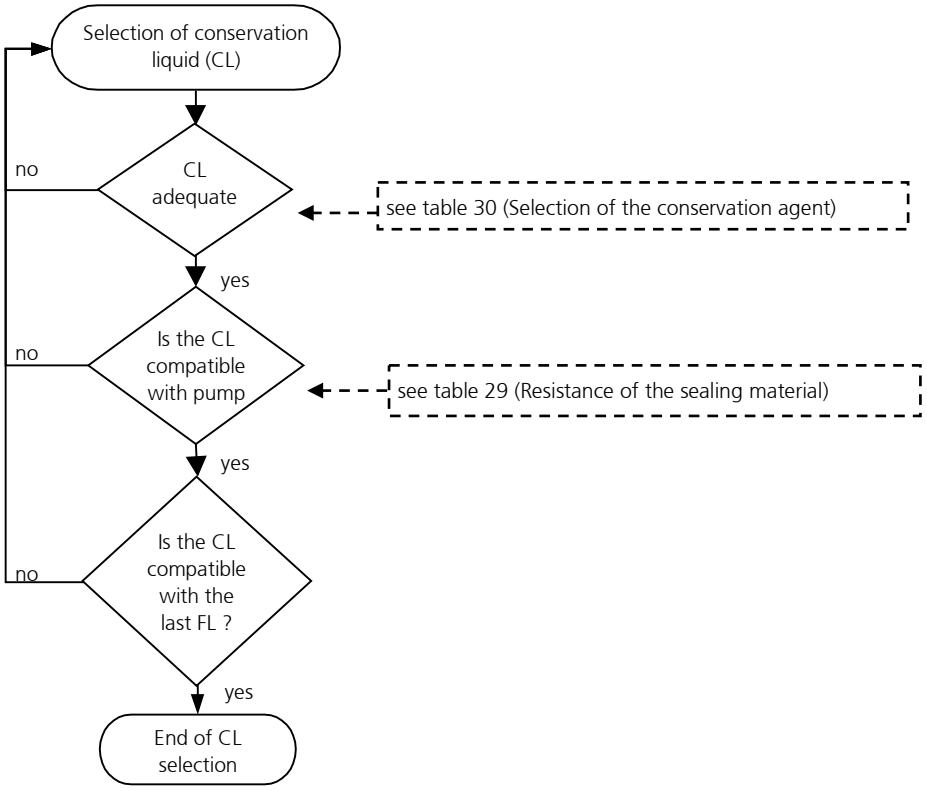


figure 29 Diagram - selection of conservation liquid (CL)

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 30 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.

8.5.1 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 8.3 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.

8.6 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 28 and table 29) 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 17) 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.

8.7 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 20). 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.

9 Software »mzr-Pump controller«

Install the delivered software »mzr-pump control« from both diskettes by starting the program »Setup« on the diskette »Disk 1«. The delivered software is compatible with Windows 95®, Windows 98®, Windows NT, Windows 2000® and Windows XP®.

The software »mzr-Pump controller« can you start after installation over the start menu under »programs - HNP Mikrosysteme«. You can choose after the start the pump type »mzr-7245«.

With the pump mode »Dosage« (see figure 30) you can set constant quantity in the physical units µl (ul), mg or rotations with break. You can set the number of repetitions or works endless. The separate dosage can define with an speed profile, with the flexible parameter »Max. velocity« and »acceleration«. The max. speed is programmed with 10-6.000 rpm and the acceleration is programmed with max.1-2.000 rpm/s².

The dosage can start over the button »Start« rather through press »Enter«. With the button »Stop« rather a new pressing of »Enter« you can break the numerous dosage.

With the pump mode »Continuos flow« (see figure 31) you can set continuos flow rates in the physical units ml/min, g/min and rpm. With the button »Start« rather through press »Enter« you can start the pump for programming time »Duration«. The button »Stop« rather a new pressing of »Enter« you can stop the pump. With the control field »Potentiometer« you can control the speed of the pump over the Potentiometer or the external standard signal 0 - 10 V.

With the »fluid density« you can calculate with weight units.
note: If you works with volume units you needn't the »fluid density«. Then you can works with the standard value »1«.

Over the »calibration factor« can you adjust the effective value with the nominal value.The formula for calculation of the calibration factor is:

$$\text{calibration factor} = \frac{\text{quantity nom. value}}{\text{quantity eff. value}}$$

In praxis you must programming against the high precision of the pump the calibration factor some over 1.

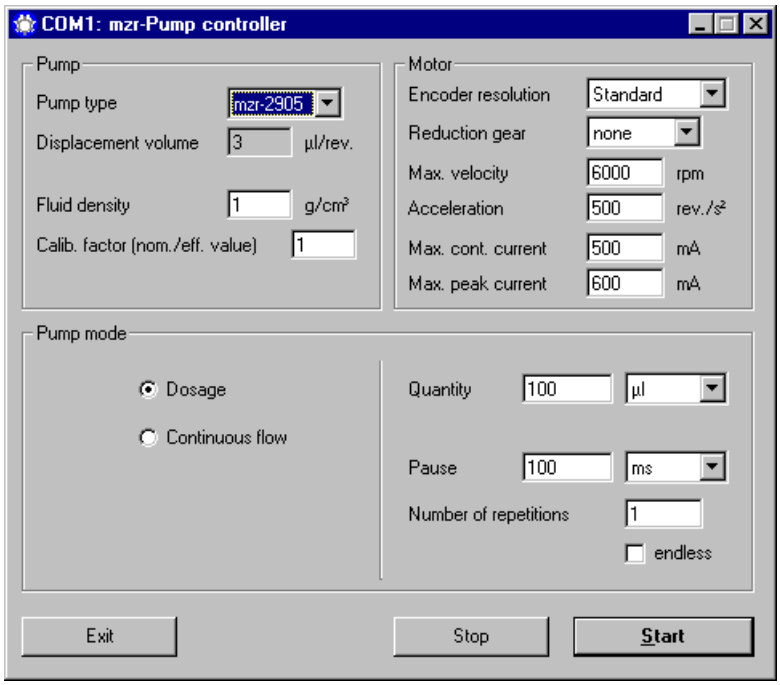


figure 30 windows for pump mode dosage

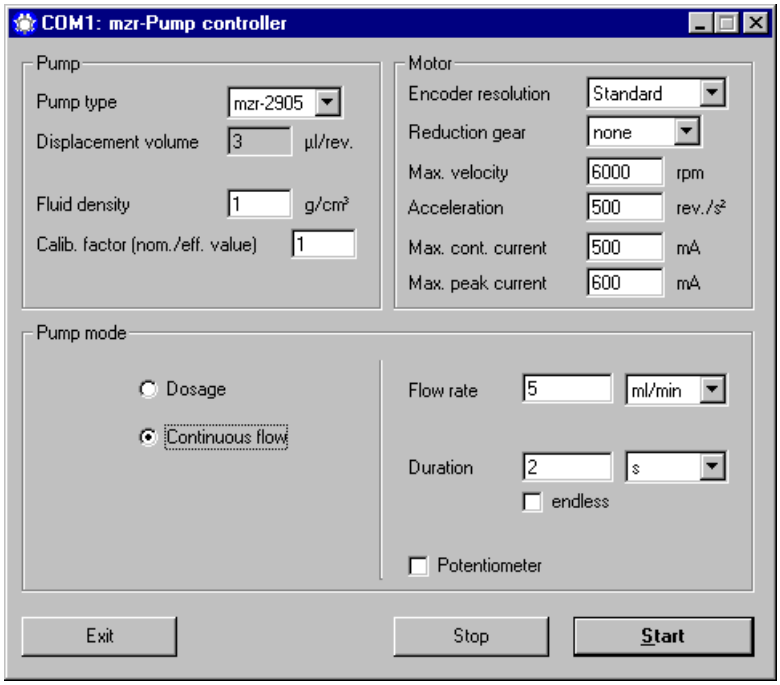


figure 31 windows for pump mode continuos flow

10 Software »Motion Manager« (Option)

The »Motion Manager« software enables operation and configuration of the drive and offers a possibility of an online graphic analysis of the operating data. The software is delivered on CD. The program may be installed on a PC running under Windows 7®, Windows 8 or Windows 8.1® operating systems.

Install the software »Motion Manager« by starting the program »Setup« from the CD. If the CD are not available you may still download this program from the web site http://www.hnp-mikrosysteme.de/download-center.html or the web site www.faulhaber.com (menu support - download). Here, the latest version is always available in English and German.

After the installation the »Motion Manager« program may be loaded from the »Faulhaber Motors« folder from the Windows start menu.

In order to program the drive, the micro annular gear pump should be put into operation. The drive should be connected to the PC with the delivered null-modem cable.

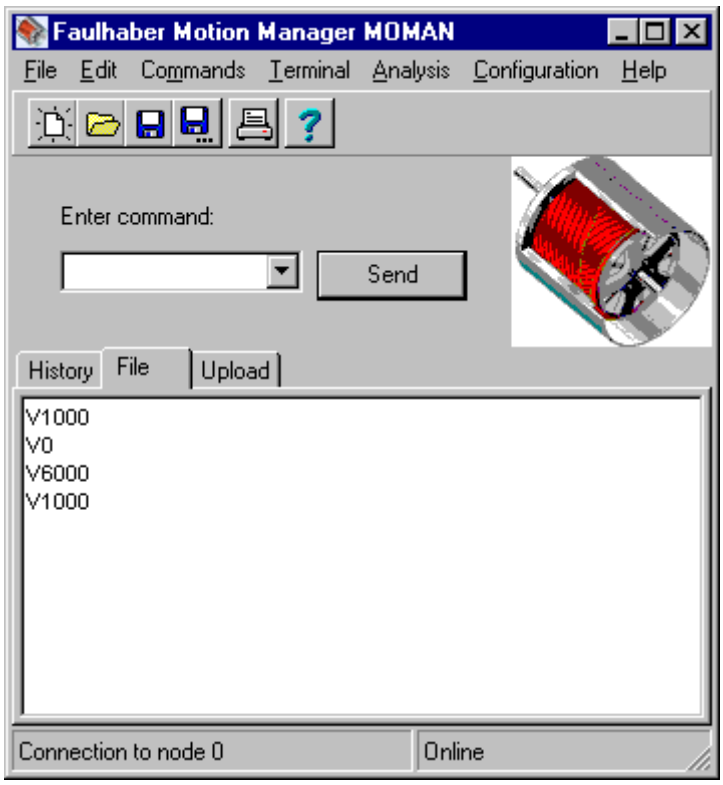


figure 32 Software Motion Manager for motor control

To use the Motion Manager-Software please read the Online-Help.
With the following commands feeding and dosage tasks could be done.

Example for feeding

Command	Description
SOR0	Set command velocity at the RS-232 port
V1000	Switch to velocity control mode and rotate with 1000 RPM (mzr-7240 = 48 ml/min)
V6000	Switch to velocity control mode and rotate with 6000 RPM (mzr-7240 = 288 ml/min)
V0	Stop the pump (rotate with 0 RPM)
SOR1	Set command velocity again with potentiometer on the connection panel

Example for dosage

Command	Description
SOR0	Set command velocity at the RS-232 port
LR1000	Load relative position at 1000 (1000 = 1 revolution, equivalent quantity mzr-7240 = 48 µl)
NP	Notify when target position is achieved (character "p" will be sent back to the PC)
M	Start positioning
LR10000	Load relative position at 10000 (10000 = 10 revolutions, equivalent quantity mzr-7240 = 480 µl)
NP	Notify position
M	Start positioning
SOR1	Set command velocity again with potentiometer on the connection panel

For stand-alone use without a PC the delivery volume contains a disk with mcl-files, which could be downloaded to the control unit and saved permanently to the EEPROM.

11 Accessories

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.

12 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.

13 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 (2006/95/EC)

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 (2004/108/EC)

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.

13.1 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.

13.1.1 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.

13.1.2 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!

Installation instructions:

The power supply and motor supply cable must be connected directly to the terminal box S-G05.

During the operation of micro annular gear pumps with a multiplexer board the connection of the terminal box S-G05 is not possible.

For the control unit S-KG no further conditions must be fulfilled in order to comply with the EMC-protection requirements.

14 Declarations of conformity

The delivered micro annular gear pump falls within scope of the following EC directives:

– Machinery Directive (2006/42/EC)
– EMC Directive (2004/108/EC)

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

HNP Mikrosysteme

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

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

mzr-7241, mzr-7242, mzr-7243, mzr-7245

are 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 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

– Machinery Directive (2006/42/EC)

Applied standards are particularly

DIN EN 809	DIN EN 60204-1	DIN EN 294
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: 30 December 2009

Signature manufacturer:

Dr. Thomas Weisener
CEO

HNP Mikrosysteme

EC-manufacturer's certificate (following EMC Directive 2004/108/EC)

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

mzr-7241, mzr-7245

are 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: 30 December 2009

Signature manufacturer:

Dr. Thomas Weisener
CEO

15 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 31 Problem 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.

16 Service, maintenance and warranty.

The maintenance of the micro annular gear pump should be carried out depending on the delivered liquid

– *for lubricating liquids* after 10,000 h working hours, but not later than 24 months after the initial operation

If during the first inspection the pump shows a particularly strong wearout, the maintenance intervals should be readapted to the operating parameters.

In order to prevent a strong wearout of the pump, the pump should be shut down properly after every application as described in the chapter 8.4. A supplementary flushing procedure with a neutral flushing liquid (see chapter 8.3) also slows down the wearout process of the pump.

It is not allowed to open the micro annular gear pumps. The warranty extincts with the expiry of the legal warranty period or with the opening of the pump. Furthermore HNP Mikrosysteme cannot give any warranty of exchange for parts whose damage result from incorrect use.

For service and maintenance please return your micro annular gear pump to HNP Mikrosysteme (You will find the address on the cover of the present operating manual).

The declaration of liquids having had contact with the micro annular gear pump and components must imperatively be completed. The nature of the liquids must be specified. In case of non-compliance the sender will be liable for any resulting injure to persons or any object damage.

Sealings, rotors and shaft are parts that undergo wear and will be replaced by HNP Mikrosysteme GmbH during maintenance depending on their degree of wear.

17 Contact persons

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
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18 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.

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

19.1 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.

19.2 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.

19.3 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

20 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: _____

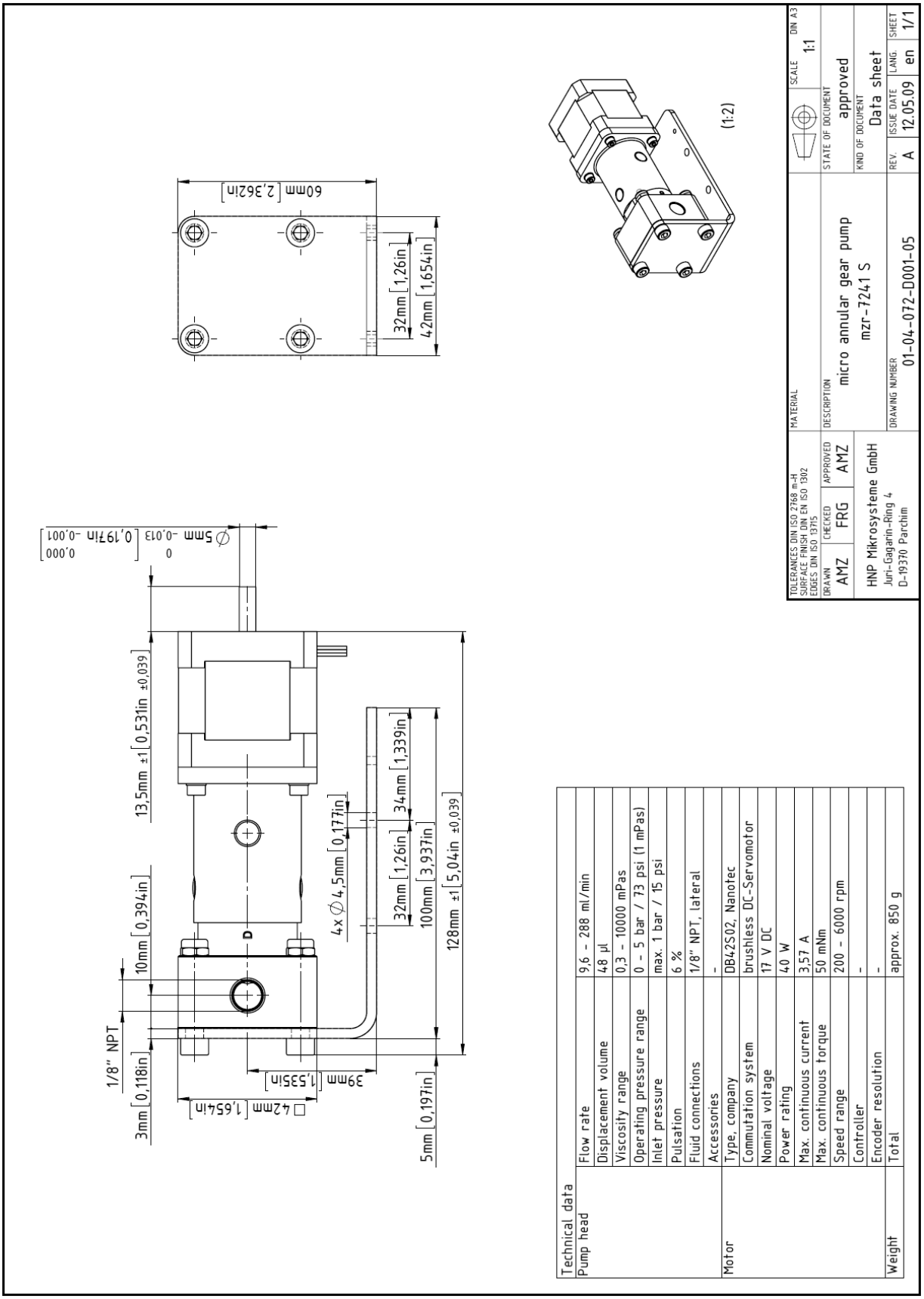
ZIP/city: _____ e-mail: _____

country: _____

city, date: _____ authorized signature / company stamp:

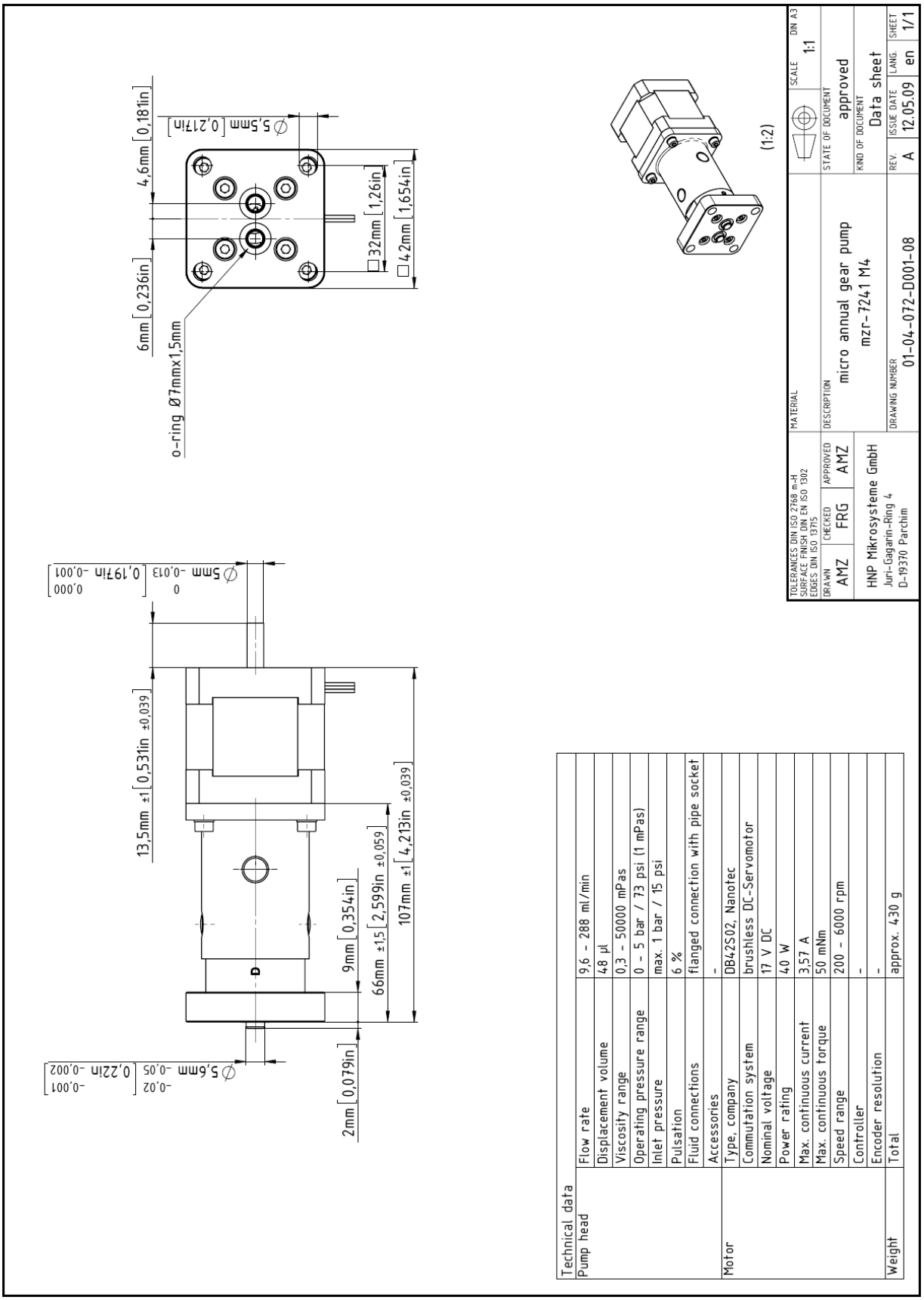
21 Supplement

- Layouts
- Operating manual for the S-KB-4 control unit (optional)
- Operating manual of the motor 3564K024BCS (optional)



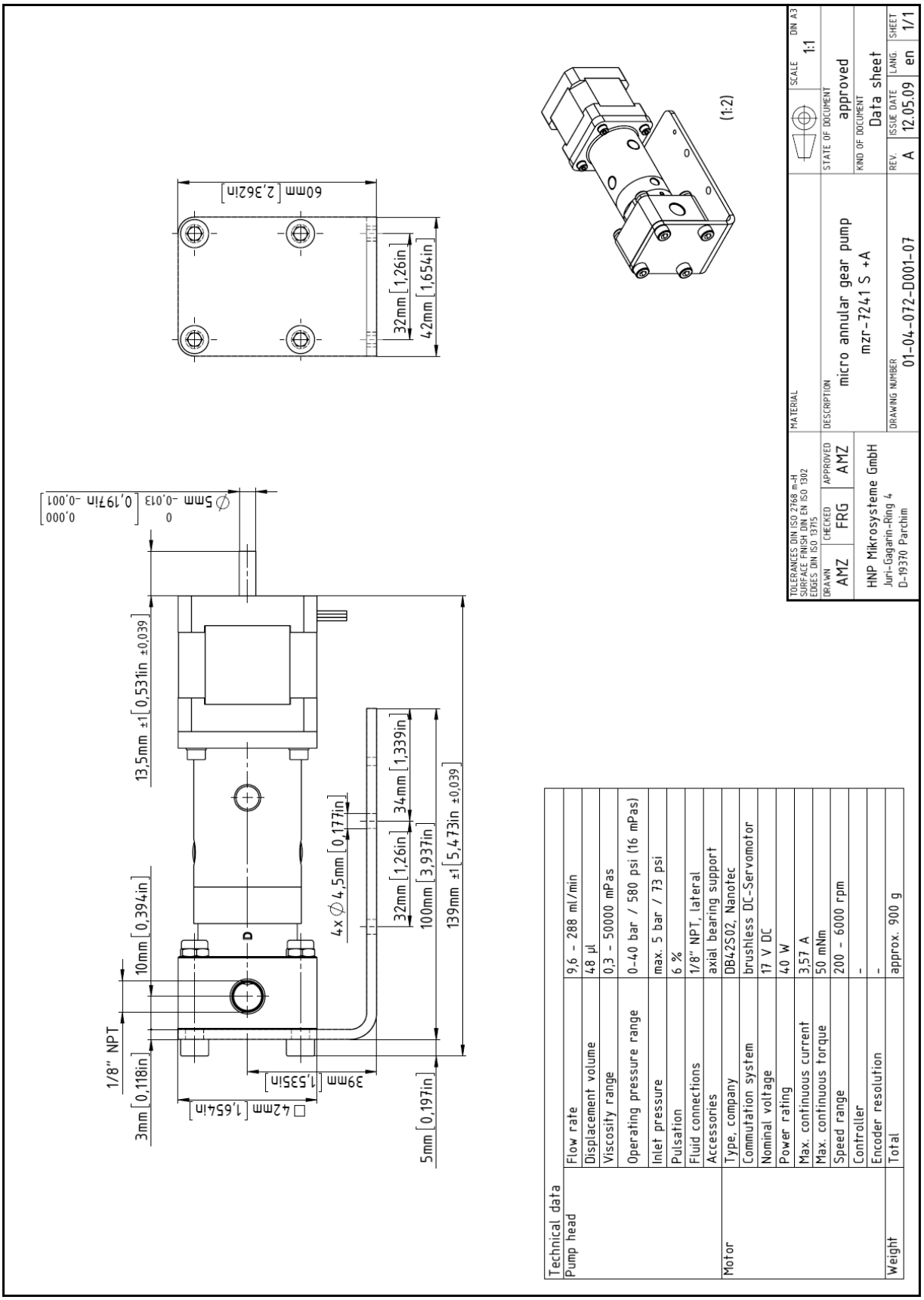
Technical data		
Pump head	Flow rate	9,6 - 288 ml/min
	Displacement volume	48 µl
	Viscosity range	0,3 - 10000 mPas
	Operating pressure range	0 - 5 bar / 73 psi (1 mPas)
	Inlet pressure	max. 1 bar / 15 psi
	Pulsation	6 %
	Fluid connections	1/8" NPT, lateral
	Accessories	-
Motor	Type, company	DB42S02, Nanotec
	Commutation system	brushless DC-Servomotor
	Nominal voltage	17 V DC
	Power rating	40 W
	Max. continuous current	3,57 A
	Max. continuous torque	50 mNm
	Speed range	200 - 6000 rpm
	Controller	-
	Encoder resolution	-
Weight	Total	approx. 850 g

figure 33 Data sheet micro annular gear pump mzr-7241 S



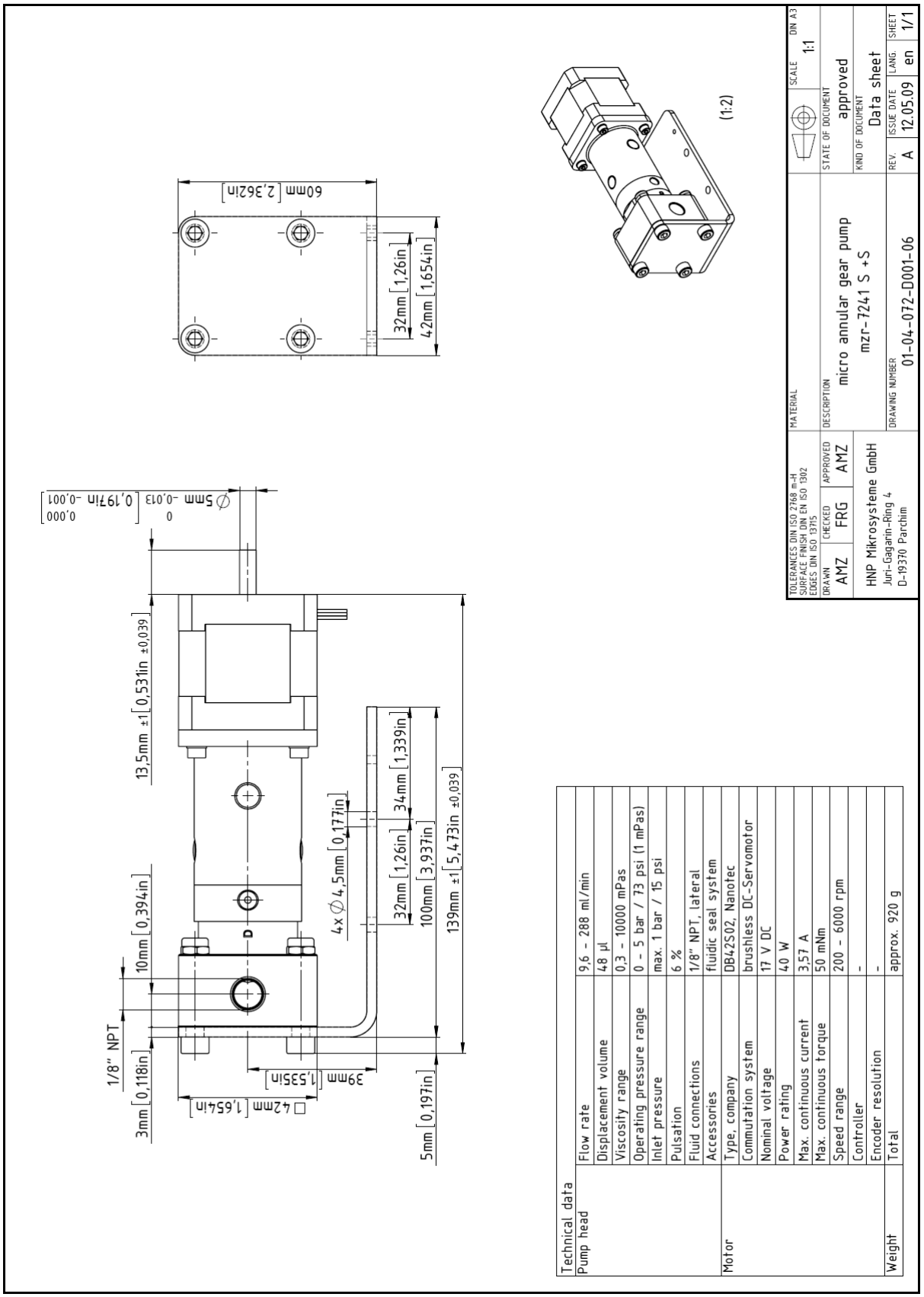
Technical data		
Pump head	Flow rate	9,6 - 288 ml/min
	Displacement volume	48 µl
	Viscosity range	0,3 - 50000 mPas
	Operating pressure range	0 - 5 bar / 73 psi (1 mPas)
	Inlet pressure	max. 1 bar / 15 psi
	Pulsation	6 %
	Fluid connections	flanged connection with pipe socket
	Accessories	-
Motor	Type, company	DB42S02, Nanotec
	Commutation system	brushless DC-Servomotor
	Nominal voltage	17 V DC
	Power rating	40 W
	Max. continuous current	3,57 A
	Max. continuous torque	50 mNm
	Speed range	200 - 6000 rpm
	Controller	-
	Encoder resolution	-
Weight	Total	approx. 430 g

figure 34 Data sheet micro annular gear pump mzr-7241 M4



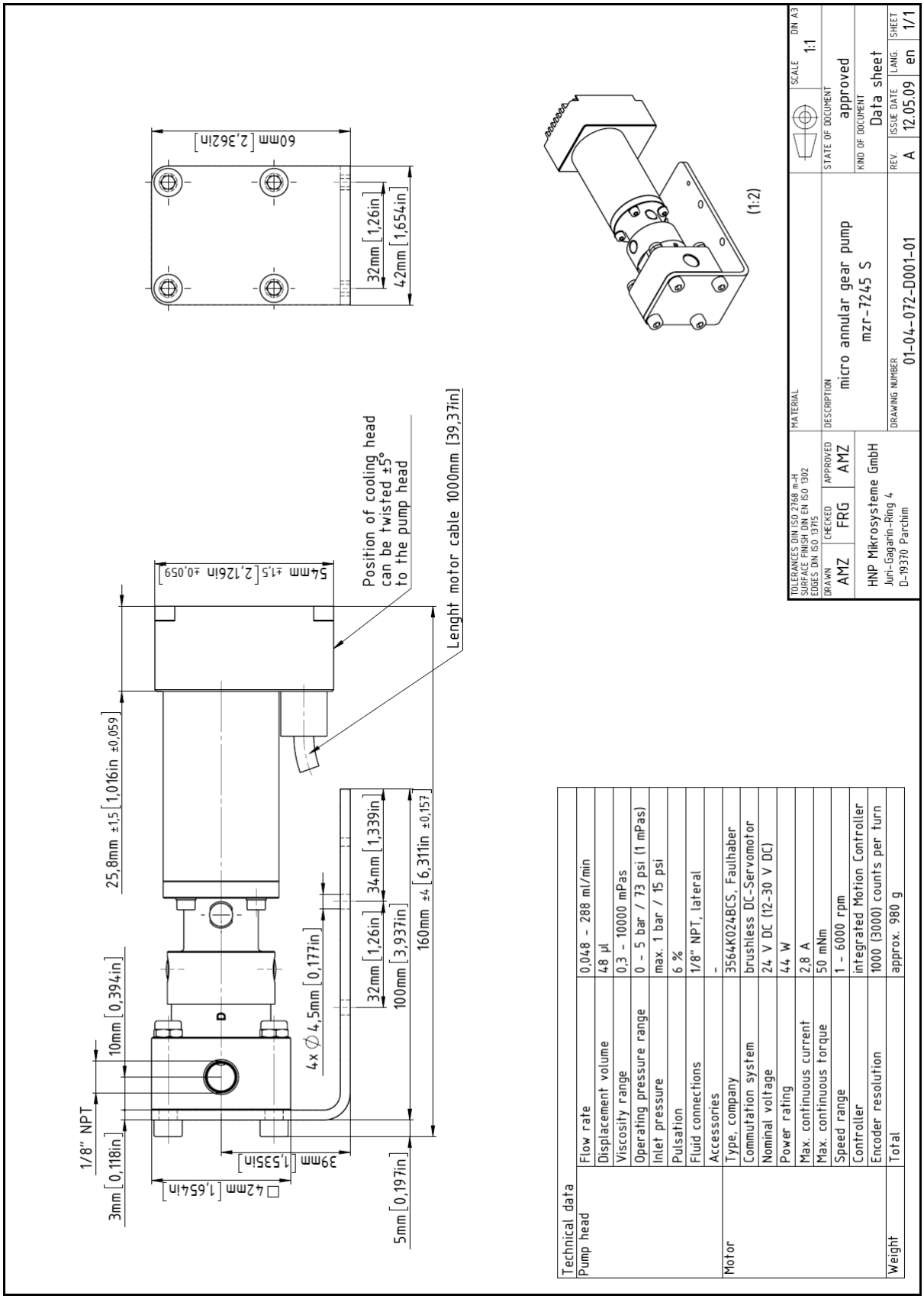
Technical data		
Pump head	Flow rate	9,6 - 288 ml/min
	Displacement volume	4,8 µl
	Viscosity range	0,3 - 50000 mPas
	Operating pressure range	0-40 bar / 580 psi (16 mPas)
	Inlet pressure	max. 5 bar / 73 psi
	Pulsation	6 %
	Fluid connections	1/8" NPT, lateral
	Accessories	axial bearing support
Motor	Type, company	DB42S02, Nanotec
	Commutation system	brushless DC-Servomotor
	Nominal voltage	17 V DC
	Power rating	40 W
	Max. continuous current	3,57 A
	Max. continuous torque	50 mNm
	Speed range	200 - 6000 rpm
	Controller	-
	Encoder resolution	-
Weight	Total	approx. 900 g

figure 35 Data sheet micro annular gear pump mzr-7241 S + A



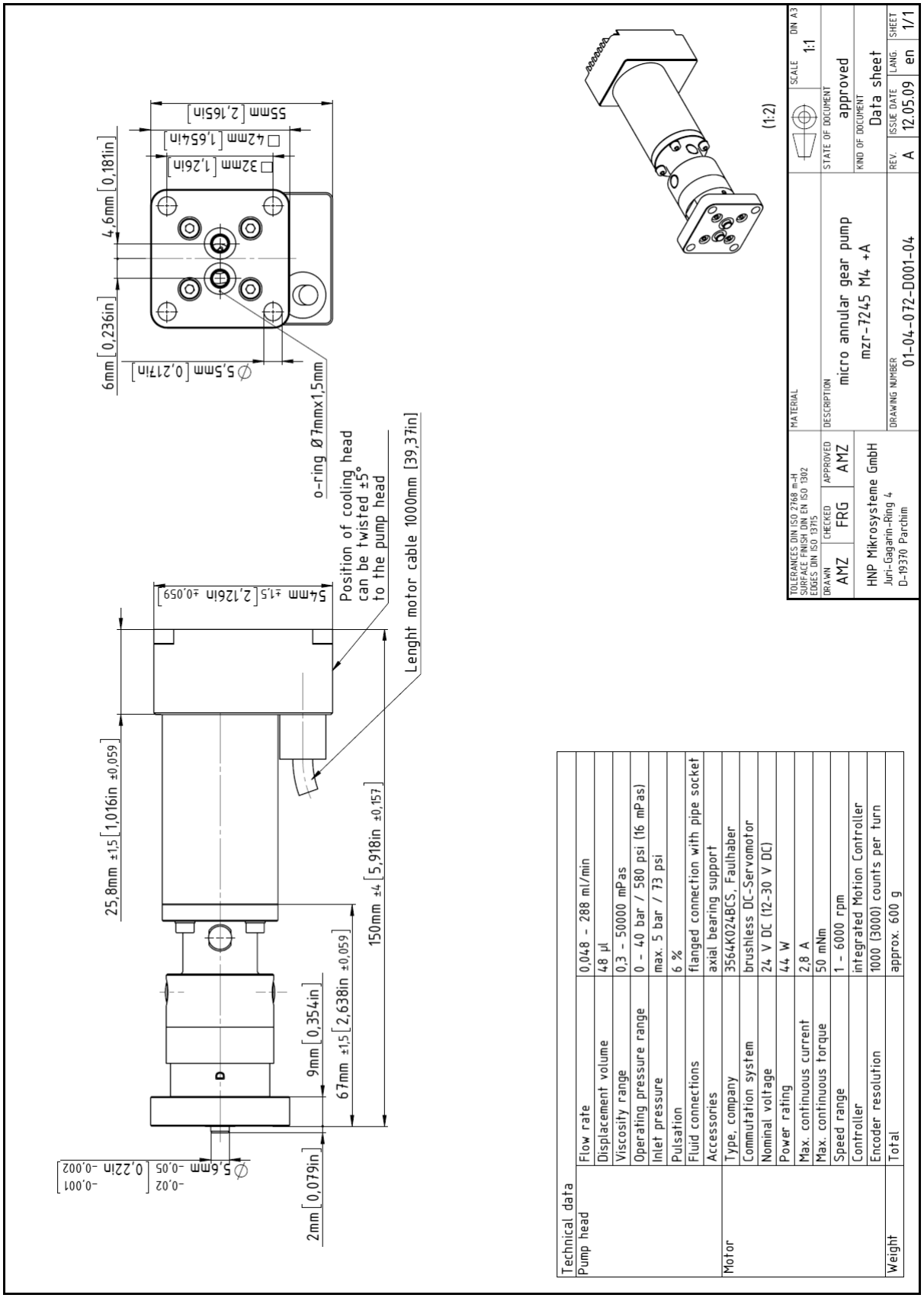
Technical data		
Pump head	Flow rate	9,6 - 288 ml/min
	Displacement volume	4,8 µl
	Viscosity range	0,3 - 10000 mPas
	Operating pressure range	0 - 5 bar / 73 psi (1 mPas)
	Inlet pressure	max. 1 bar / 15 psi
	Pulsation	6 %
	Fluid connections	1/8" NPT, lateral
	Accessories	fluidic seal system
Motor	Type, company	DB42S02, Nanotec
	Commutation system	brushless DC-Servomotor
	Nominal voltage	17 V DC
	Power rating	40 W
	Max. continuous current	3,57 A
	Max. continuous torque	50 mNm
	Speed range	200 - 6000 rpm
	Controller	-
	Encoder resolution	-
Weight	Total	approx. 920 g

figure 36 Data sheet micro annular gear pump mzr-7241 S + S



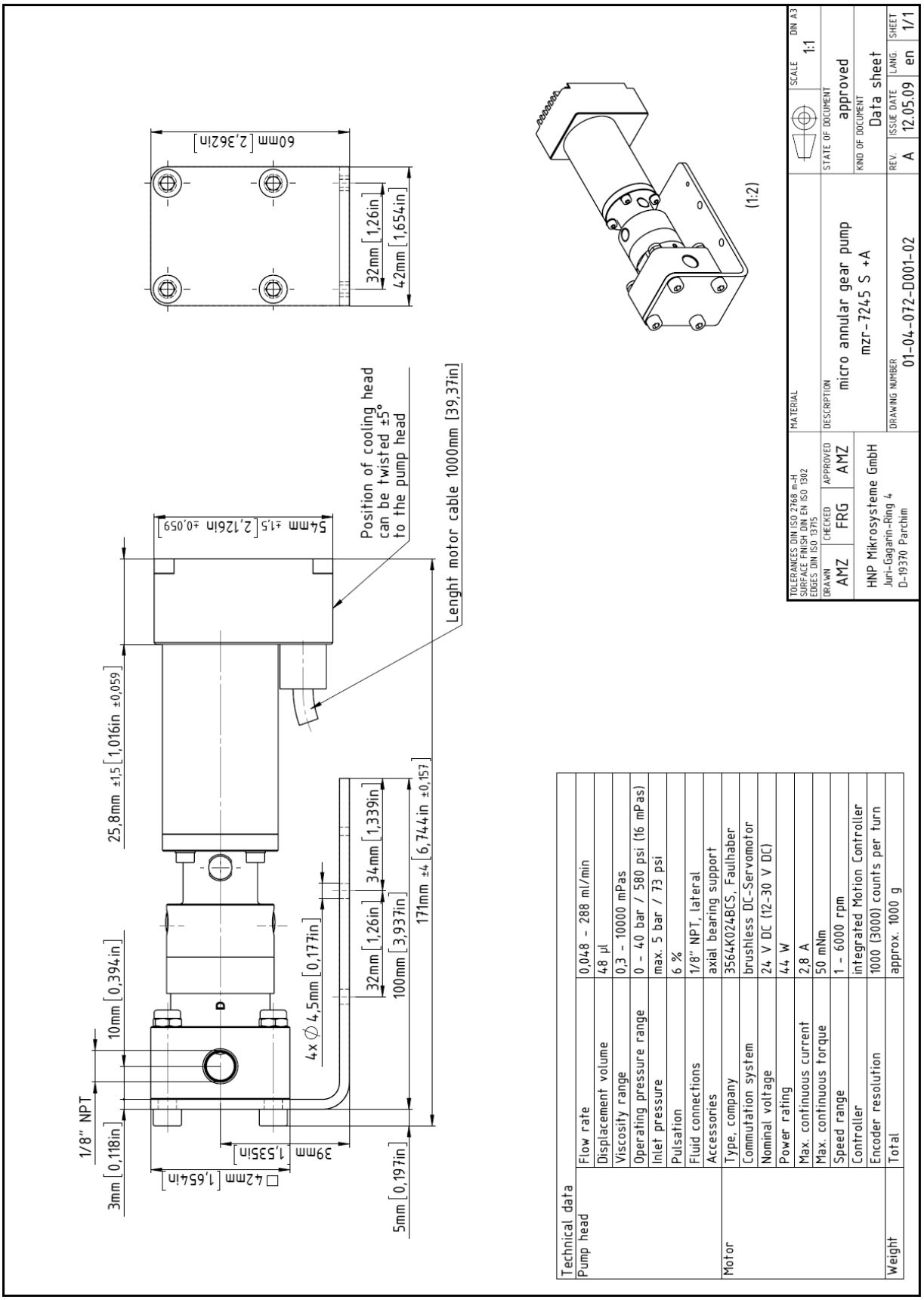
Technical data		
Pump head	Flow rate	0,048 - 288 ml/min
	Displacement volume	48 µl
	Viscosity range	0,3 - 10000 mPas
	Operating pressure range	0 - 5 bar / 73 psi (1 mPas)
	Inlet pressure	max. 1 bar / 15 psi
	Pulsation	6 %
	Fluid connections	1/8" NPT, lateral
	Accessories	-
Motor	Type, company	3564K024BCS, Faulhaber
	Commutation system	brushless DC-Servomotor
	Nominal voltage	24 V DC (12-30 V DC)
	Power rating	44 W
	Max. continuous current	2,8 A
	Max. continuous torque	50 mNm
	Speed range	1 - 6000 rpm
	Controller	integrated Motion Controller
	Encoder resolution	1000 (3000) counts per turn
Weight	Total	approx. 980 g

figure 37 Data sheet micro annular gear pump mzr-7245 S



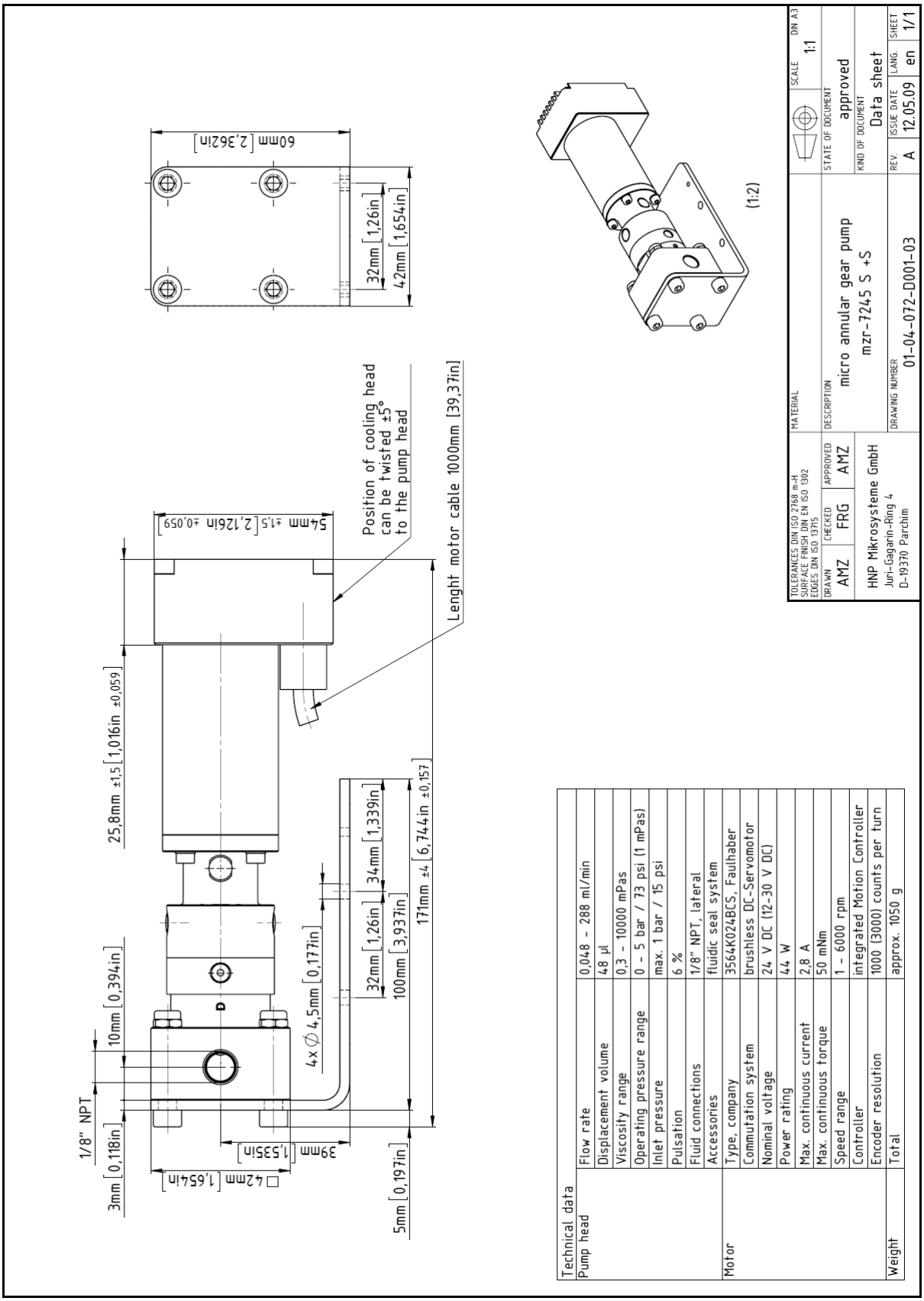
Technical data		
Pump head	Flow rate	0,048 - 288 ml/min
	Displacement volume	4,8 µl
	Viscosity range	0,3 - 50000 mPas
	Operating pressure range	0 - 40 bar / 580 psi (16 mPas)
	Inlet pressure	max. 5 bar / 73 psi
	Pulsation	6 %
	Fluid connections	flanged connection with pipe socket
	Accessories	axial bearing support
Motor	Type, company	3564K024BCS, Faulhaber
	Commutation system	brushless DC-Servomotor
	Nominal voltage	24 V DC (12-30 V DC)
	Power rating	44 W
	Max. continuous current	2,8 A
	Max. continuous torque	50 mNm
	Speed range	1 - 6000 rpm
	Controller	integrated Motion Controller
	Encoder resolution	1000 (3000) counts per turn
Weight	Total	approx. 600 g

figure 38 Data sheet micro annular gear pump mzr-7245 M4 + A



Technical data		
Pump head	Flow rate	0,048 - 288 ml/min
	Displacement volume	4,8 µl
	Viscosity range	0,3 - 10000 mPas
	Operating pressure range	0 - 40 bar / 580 psi (16 mPas)
	Inlet pressure	max. 5 bar / 73 psi
	Pulsation	6 %
	Fluid connections	1/8" NPT, lateral
	Accessories	axial bearing support
Motor	Type, company	3564K024BCS, Faulhaber
	Commutation system	brushless DC-Servomotor
	Nominal voltage	24 V DC (12-30 V DC)
	Power rating	44 W
	Max. continuous current	2,8 A
	Max. continuous torque	50 mNm
	Speed range	1 - 6000 rpm
	Controller	integrated Motion Controller
	Encoder resolution	1000 (3000) counts per turn
Weight	Total	approx. 1000 g

figure 39 Data sheet micro annular gear pump mzr-7245 S + A



Technical data		
Pump head	Flow rate	0,048 - 288 ml/min
	Displacement volume	4,8 µl
	Viscosity range	0,3 - 10000 mPas
	Operating pressure range	0 - 5 bar / 73 psi (1 mPas)
	Inlet pressure	max. 1 bar / 15 psi
	Pulsation	6 %
	Fluid connections	1/8" NPT, lateral
	Accessories	fluidic seal system
Motor	Type, company	3564K024BCS, Faulhaber
	Commutation system	brushless DC-Servomotor
	Nominal voltage	24 V DC (12-30 V DC)
	Power rating	44 W
	Max. continuous current	2,8 A
	Max. continuous torque	50 mNm
	Speed range	1 - 6000 rpm
	Controller	integrated Motion Controller
	Encoder resolution	1000 (3000) counts per turn
Weight	Total	approx. 1050 g

figure 40 Data sheet micro annular gear pump mzr-7245 S + S