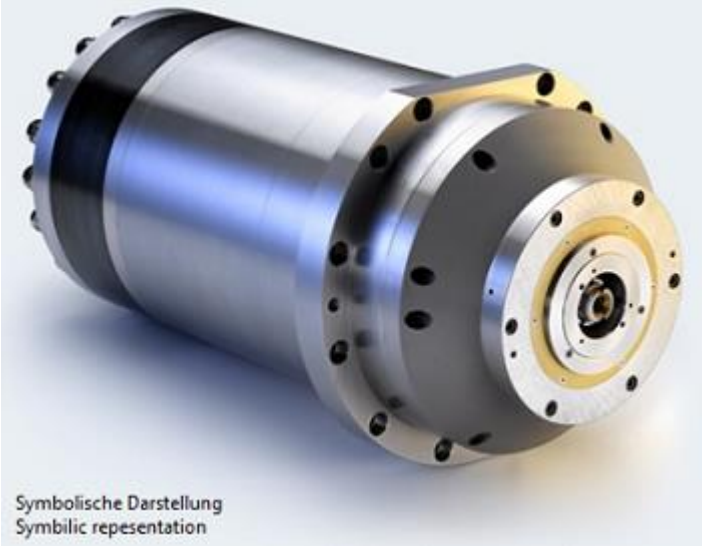
KESSLER

Manufacturer recommendation

Motor spindle

Art. no.: see type plate/data sheet
Serial no.: see type plate/data sheet



Symbolische Darstellung
Symbilic repesentation

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Manufacturer recommendation:
Motor spindle

Original instructions - German
All other languages are a translation of the original.

Contents

1 About these manufacturer's recommendation

At the time of publication the information provided in these instructions complied with technical standards. Subject to change without notice. We reserve the right to make alterations without notice.

The original instructions are provided in German. All other languages are a translation of the original.

1.1 Purpose

These instructions support you during the planning, project development and preparation of machine installations for motor spindles. They contain all important general technical specifications, and recommendations..

These instructions contain information about the various features and functions. If your spindle does not have these features or functions, ignore the sections which are not relevant.

1.2 Limitations

These instructions are not a stand-alone manual. They do not replace the original assembly instructions.

These instructions do not contain specific information about the motor spindle. Specific information can be found in the corresponding assembly instructions.

1.3 Application area

NOTICE	The processing of glass, ceramics and materials with similar properties is only permitted after consultation and approval by KESSLER.

1.4 Validity

These instructions are no longer valid after initial delivery.

Important notice

Once your product has been delivered and received, only the specifications in the corresponding assembly instructions apply.

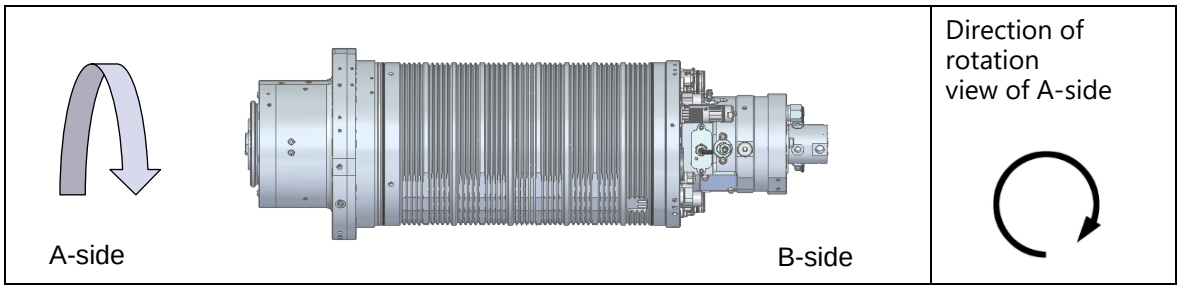
➔ Make sure that the assembly instructions are observed.

➔ Please note the data sheet.

2 Direction of rotation

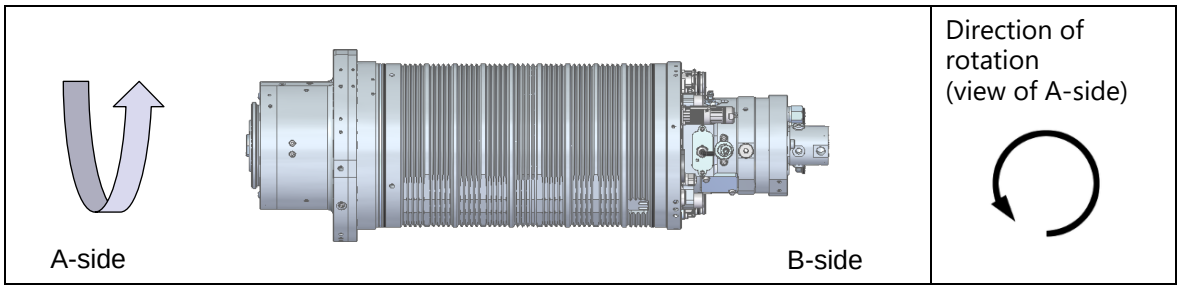
The direction of rotation of the spindle is determined when the power lines are connected to the inverter.

Clockwise direction of rotation (standard)



symbolic illustration

Counterclockwise direction of rotation (special)



symbolic illustration

Note

To change the direction of rotation, the parameters in the inverter must be changed. The contact details for detailed information on your product can be found in the "Service and Support" chapter.

3 Transport and storage

3.1 Transport

Transport may only be carried out by qualified technical staff or a specialised company.

3.1.1 Protection during transport

During transport protect the unit from the following:

- moisture
- impact
- contamination
- being dropped

3.1.2 Packaging upon delivery

The unit is supplied wrapped in anti-corrosion film in a box. Depending on the model, the unit may also be secured on a transport frame inside the box.

3.1.3 Unpacking

➔ Check the transport packaging immediately after receipt of goods for external signs of damage.

NOTICE	**Risk of damage from corrosion** If the unit is unpacked too quickly or exposed to fluctuating temperatures, this could lead to corrosion and, as a consequence, damage to the unit. ➔ Store the unit for at least 24 hours at a temperature of 23 ±2°C. After this, first remove the protective foil.

3.2 Storage

NOTICE	**Risk of damage from incorrect storage and return transport**
	Incorrect storage and return transport can result in corrosion of the unit or damage to the bearings.
	➔ Observe the following instructions for storage time, environmental conditions, protection against bearing damage and storage and return transport.

3.2.1 Storage time

The maximum storage time is 18 months.

Additional rust protection measures are required for storage times over 7 days.

➔ Make a note of the date put into storage and the unit's identification.

3.2.2 Environmental conditions

The environmental conditions influence functionality and service life of the unit.

➔ Observe the following conditions for the environment:

- The temperature of the unit may not exceed 40 °C during storage.
- The storage area must maintain as constant a temperature as possible, between 4 °C and 40 °C.
- The storage area must be dry and free of dust and dirt.
- To prevent condensation, the temperature must not fall below the dew point.
- Storage outdoors is not permitted.

3.2.3 Corrosion protection

Corrosion protection measures are necessary for storage of used units and for return transport to the manufacturer.

Corrosion protection measures for storage and return transport

➔ Ensure that the unit does not contain any fluids and that all openings are closed with sealing caps.

➔ Apply oil to the housing.

➔ Pack the unit in anti-corrosion film. We recommend the use of VCI-foil.

➔ Use the box and/or transport frame supplied for storing or returning the unit. In this way the unit is better protected against damage and corrosion.

➔ Make a note of the date of storage or date of packing and the designation of the unit. Label the packaging with this information.

➔ Observe the specifications on environmental conditions in this chapter.

Warranty for incorrect corrosion protection measures

There is no warranty for damage and consequential damage caused by incorrect corrosion protection measures.

3.2.4 Protection against bearing damage

Standstill marks

Exposure of the unit to shock or vibrations can result in bearing damage in the form of standstill marks.

- Vibrations of max. 0.1 mm/s are permitted for a storage time of up to 6 months.
- Vibrations of max. 0.08 mm/s are permitted for a storage time of up to a maximum of 18 months.
- If necessary, store the unit on a base which isolates against vibration.

Standstill corrosion

Long storage times can result in standstill corrosion in the bearings.

- The rotor must be spun once a month by technical staff. We recommend at least 10 revolutions.
- When installing bearing motors that have been in storage for more than 2 weeks, a start-up cycle must be carried out on commissioning. See chapter “Commissioning”.

4 Installation

The unit was designed and built to the specifications of the customer. The fitting surfaces must comply with the specified measurements and tolerances.

Fitting of the unit may only be carried out by qualified technical staff.

4.1 Preparing for installation

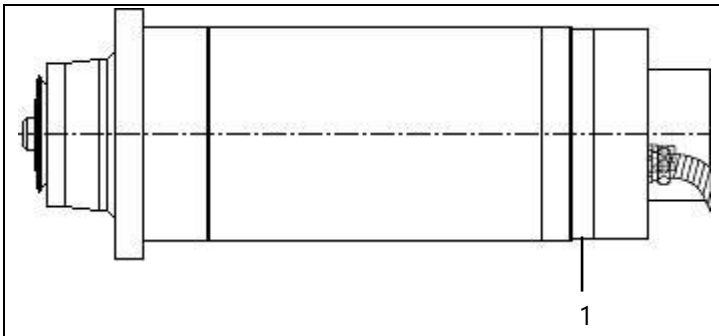
The fitting surface must be completely free of contamination.

➔ Before fitting, ensure that the fitting surface is free of swarf, dirt particles, oil, liquid, etc.

➔ Clean the fitting surface of the unit and remove any preserving agents.

Horizontal installation position

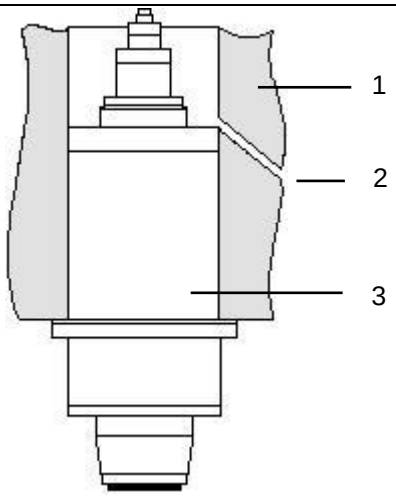
For the horizontal installation position the appropriate leakage bore holes must be located on the underside of the unit.



1 Leakage bore hole

Vertical installation position

For a vertical installation position a leakage bore-hole must be provided in the fitting at the level of the rear face.



1 Installation bushing
2 Leakage bore hole
3 Unit

4.2 Installation in axis head

⚠ WARNING!	**Damage to the machine and spindle due to high gyroscopic torques!**

Overlapping rotary movements, i.e. rotating A- or C-axis and simultaneously rotating motor spindle, gyro torques occur.

These gyro torques load drives of the axes and can lead to uncontrolled axis movements in the event of overload.

The machine tool manufacturer must ensure the following conditions:

- ➔ That a speed limitation of the A- and C-axes is programmed in the machine control above a certain speed of the motor spindle or is limited by non-critical values.
- ➔ That the maximum speed of the A- and C-axes is calculated when using specific tools (different from the data sheet).

➔ Persons must not be within the swivel range of the unit!

4.2.1 Calculation of the max. speed C-axis and A-axis

$M_{A-/C\ hold}$ Stand still S6 max: holding torque [Nm], C-axis or A-axis.
See data sheet of the different axes.

J_{Sp} Rotor moment of inertia spindle [kgm²] *See data sheet motor spindle.*

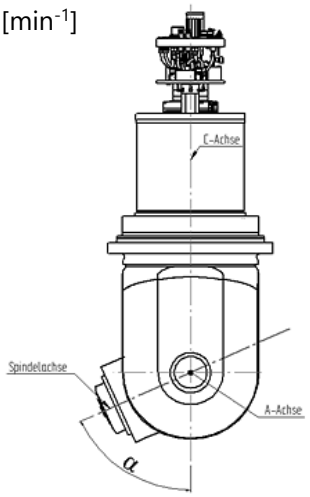
J_{tool} Mass moment of inertia tool [kgm²]
See reference tools in data sheet, other tools must be calculated separately.

n_{Sp} Speed spindle [min⁻¹]

$n_{C-/A\ max}$ Max. permissible speed of the C-axis or A-axis [min⁻¹]

$$n_{C\ max} = \frac{M_{A\ hold} \times 900}{(J_{Sp} + J_{tool}) \times \pi^2 \times n_{Sp}}$$

$$n_{A\ max} = \frac{M_{C\ hold} \times 900}{(J_{Sp} + J_{tool}) \times \pi^2 \times n_{Sp}}$$



Position A-axis α = ±90° worst case!

5 Electrical system

Work on the electrical system may only be carried out by an electrician.

➔ Ensure that a second qualified person is available to disconnect the power supply in the event of an emergency.

5.1 Electrical interface

The electrical interface is designed with wire or plug.The relevant specifications for the electrical connection can be found in the dimension sheet and/or circuit diagram.

For connection with cable

Starpoint (if applicable)

The starpoint is for diagnostic and measuring purposes.

➔ Ensure that the neutral point is electrically insulated.

➔ Ensure that the starpoint is not connected to the protective earth conductor.

Contact points

➔ Protect the contact points against corrosion.

➔ Protect the contact points and outlets from mechanical loads e.g. with strain reliefs or terminal boxes.

Connecting lines

➔ Ensure adequately dimensioned connection lines in accordance with specifications for current in the data sheet

For connection with plug

The interface consists of one or more plugs. The plug allocation can be found in the dimension sheet and/or circuit diagram.

➔ Ensure correct fit of plug connections.

➔ Ensure correct fitting of the O-rings in the connector. Leaking plug connections can result in a short-circuit. This could lead to damage to the unit, machine or surrounding area.

➔ Do not disconnect connectors under voltage/load.

5.1.1 Surge suppressor for synchronous motors

Overvoltage protection is required where a synchronous motor has a high emf (electromotive force). The surge suppressor prevents harmful charging of the DC link system by the motor when it operates as a generator.

If the theoretical terminal voltage generated at maximum speed lies above a certain threshold value, voltage protection is necessary.

- The value of the terminal voltage can be found in the data sheet (emf).
- The threshold value above which the installation of voltage protection is required depends on the inverter used.

NOTICE	**Functional faults and damage to the inverter are possible!** ➔If the inverter-dependent threshold value is exceeded at maximum speed, voltage protection is necessary.

6 Thermal motor protection

The electric motors are supplied with integrated temperature sensors. PTC thermistors and bimetal temperature sensors provide thermal motor protection. To guarantee protection, especially with load during standstill, each motor phase is provided with one of the three in-series connected temperature sensors.

Connection of the bimetal or PTC thermistor sensors is compulsory in order to avoid damage from thermal overload.

6.1.1 Circuit diagram thermal motor protection

The relevant specifications for thermal motor protection can be found in the circuit diagram.

A reserve set is provided for each temperature sensor.

6.1.2 Electrostatic discharge

Electrostatic discharge can cause damage to electronic components. Measures to protect from electrostatic charge are necessary.

Protective measures against electrostatic charge

➔ Ensure that electronic components do not come into contact with electrically insulating materials such as plastic parts or foil, or synthetic clothing.

➔ For this use:

- antistatic shoes and clothing
- wrist and/or ankle straps for earthing
- antistatic work surface
- conductive and antistatic floor coverings

6.2 Protective measures temperature sensor

➔ The wires for the KTY 84-130/PT1000 sensor must not be connected in-series to the wires of the PTC thermistor or bimetal temperature sensor.

Connect the temperature sensor in accordance with the circuit diagram.

6.2.1 Protective measures KTY 84-130/PT 1000 sensor

The maximum permissible current for identification of the rotor position by the frequency converter may not be exceeded.

➔ Limit the power for rotor position identification. See parameter list.

➔ Short-circuit the reserve set.

6.2.2 Shut-down temperature motor

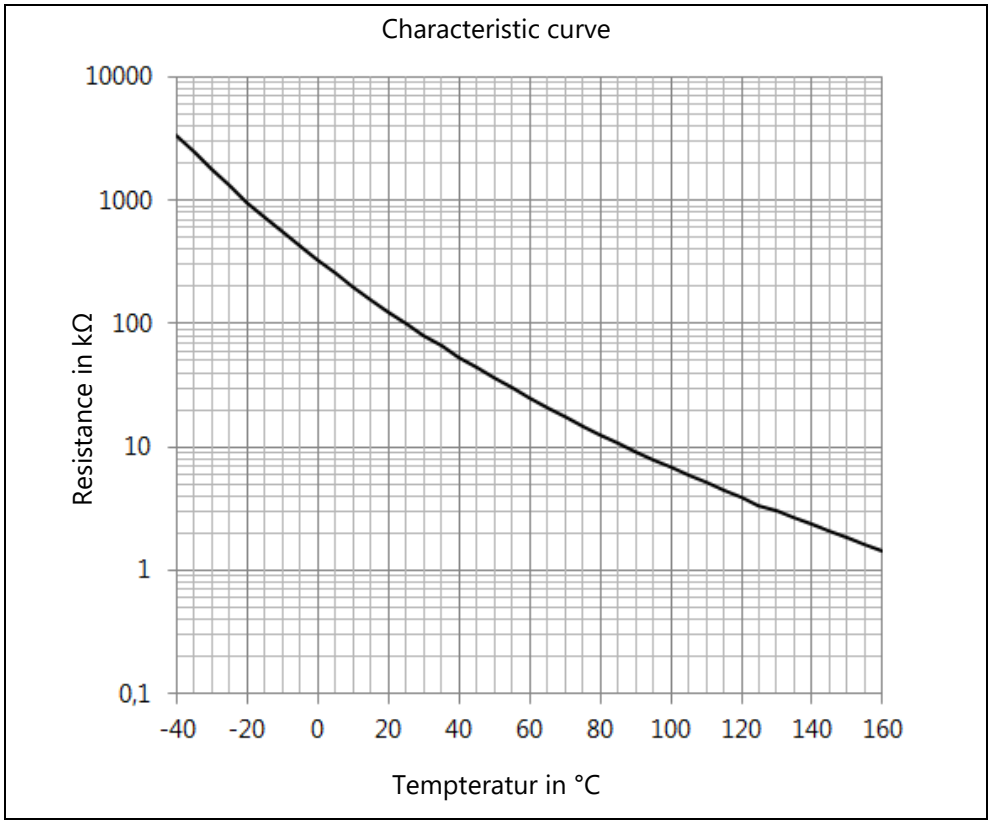
To protect the motor from overheating and damage, make sure that the control system is programmed according to the parameter list, as specified below:

- If the motor temperature reaches the threshold limit, a warning signal must be emitted.
- If the motor temperature reaches the shutdown limit, the motor must be switched off immediately.
- The parameter list is supplied with the operating instructions.

6.3 NTC thermistor temperature sensor

The NTC thermistor temperature sensor measures and monitors the temperature inside the motor coil. The NTC thermistor temperature sensor is a temperature-sensitive component.

When the temperature rises the resistance of the NTC thermistor temperature sensor drops. The characteristic curve is not linear.



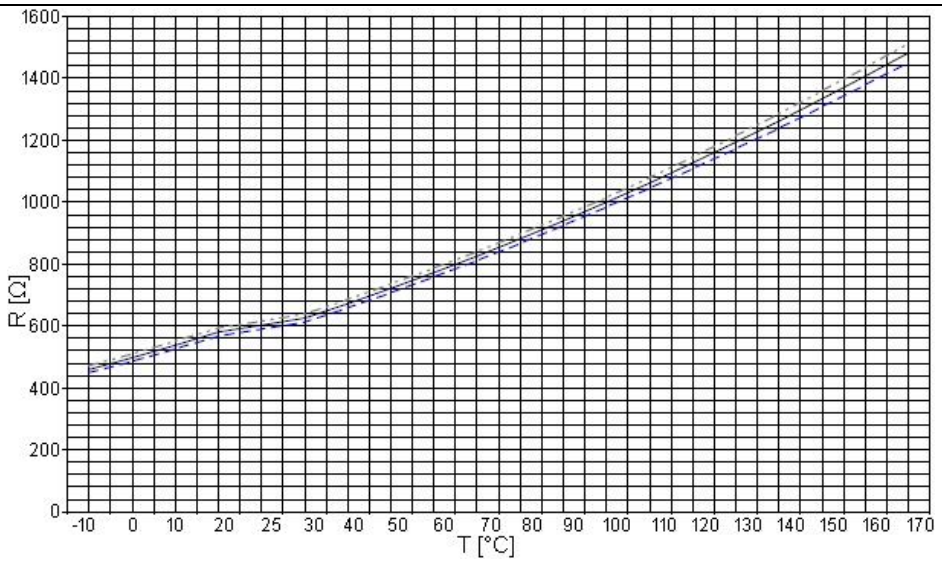
6.4 Bimetal temperature sensor

Bimetal temperature sensors are purely switching elements. The contact is interrupted in the area of the nominal response temperature (140 °C). This is a NC-contact (NC = normally closed):

- Up to the nominal response temperature the contact is closed.
- From the nominal response temperature the contact is open. After opening the contact, switch the motor off immediately.

6.5 KTY 84-130 sensor

The KTY 84-130 sensor measures the motor coil temperature. The sensor is a temperature-sensitive component. When the temperature rises, the electrical resistance increases. The characteristic curve is almost linear within the measuring range.



R resistance
T temperature

Three curves are shown:

maximum (max.)
typical (typ.)
minimum (min.)

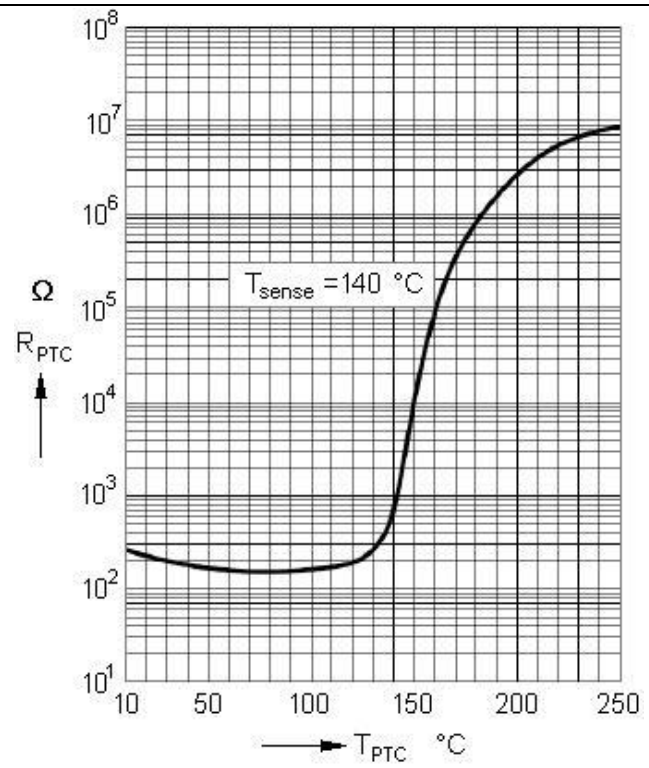
The spread in numbers:

Temperature [°C]	max. resistance [Ω]	typ. resistance [Ω]	min. resistance [Ω]
20	592	581	570

6.5.1 PTC thermistor temperature sensor

The PTC thermistor temperature sensors are elements which have an erratically changing characteristic curve.

The resistance rises steeply in the area of the nominal response temperature (140 °C).



R_{PTC} PTC thermistor resistance

T_{PTC} PTC thermistor temperature

PTC thermistor resistance R_{PTC} depending on the PTC thermistor temperature T_{PTC} (small-signal resistance value)

6.5.2 PT1000-sensor

To monitoring the coil temperature of the motor, the unit is equipped with a platinum termperature sensor.When the temperature rises, the electrical resistance increases. The characteristic curve is almost linear within the measuring range.

Technical specifications

Warning temperature	130°C
Shut-down temperature	140°C
Nominal resistance	1000 Ω by 0 °C gem. DIN EN 60751:2009
Tolerance	Class B ±0.3 °C bei 0°C
Disruptive strength	3.8 kV AC, 50Hz / 1 min.
Measuring current	0.1 - 0.3 mA

6.6 Operation of the motor

Considerable voltage peaks can occur due to system oscillations when operating the motor with a frequency converter with pulsed voltage output (e.g. PWM). Significant influencing factors, along with the motor size, include the length of the connection leads as well as the number and type of axes in the drive assembly.

Excessively high voltage peaks strain the motor's electrical insulation system and can result in failure. The following limit values may not be exceeded:

Amplitude	Max. 2000 V peak to peak
Build-up time	Max. 10kV / µs

In order to avoid voltage peaks, observe the frequency converter's manufacturer's instructions. If necessary, attenuators must be used in the drive assembly.

6.6.1 Torques

Torque standstill (S0)

During standstill increased thermal loads can occur in the individual motor phases.

➔ Ensure that the “standstill torque” does not exceed the S1-torque more than 0.7-fold for sustained periods.

Torque maximum (S1)

The S1 torque corresponds to the maximum permissible motor speed in continuous operation with a uniform load for all phases. It also describes the thermal limit value of the motor.

➔ Ensure that the cooling system dissipates the heat as specified..

➔ Ensure that the S1 torque is also not effectively exceeded for load cycles (e.g. S6).

Max. torques by synchronous motors (S_{max})

The maximum torque has been reached, when the motor has drawn the maximum permissible current. The maximum permissible current is limited by the demagnetisation danger of the rotor's permanent magnets.

➔ Ensure that the temperature of the magnets does not exceed 80 °C.

Due to the danger of overheating, the maximum torque may not be applied for more than 1 second. The cycle time is in relation to the thermic conditions.

➔ Ensure that, on average, heat dissipation for S1 operation is not exceeded.

7 Oscillation speed

The maximum permitted oscillation speed of the spindle must not be exceeded during operation. If the maximum permitted oscillation speed is exceeded, this can result in damage to the spindle.

7.1 Permitted oscillation speed in continuous operation

• The permitted oscillation speed of the spindle during operation is divided into three ranges, which are valid for the overall speed range. The oscillation speed must be measured as close to the spindle tool interface as possible.

Range 1	< 8 mm/s	Permitted oscillation speed in continuous operation
Range 2	8 mm/s – 12 mm/s	Increased oscillation speed, which is only permitted for a short time (< 30 sec). Increased oscillation speeds drastically reduce the service life of tools and the spindle.
Range 3	> 12 mm/s	Non-permissible range

8 Sensory system

The unit has measuring sensors which influence the control. Only correct connection of these measuring sensors ensures fault-free operation.

The specific sensors and data are not yet available during the project development phase. The specifications in the connection diagram/circuit diagram and/or dimension sheet apply when the spindles are delivered.

9 Pneumatic system

Work on the pneumatic system must be carried out strictly by qualified technical staff.

9.1 Required line diameter

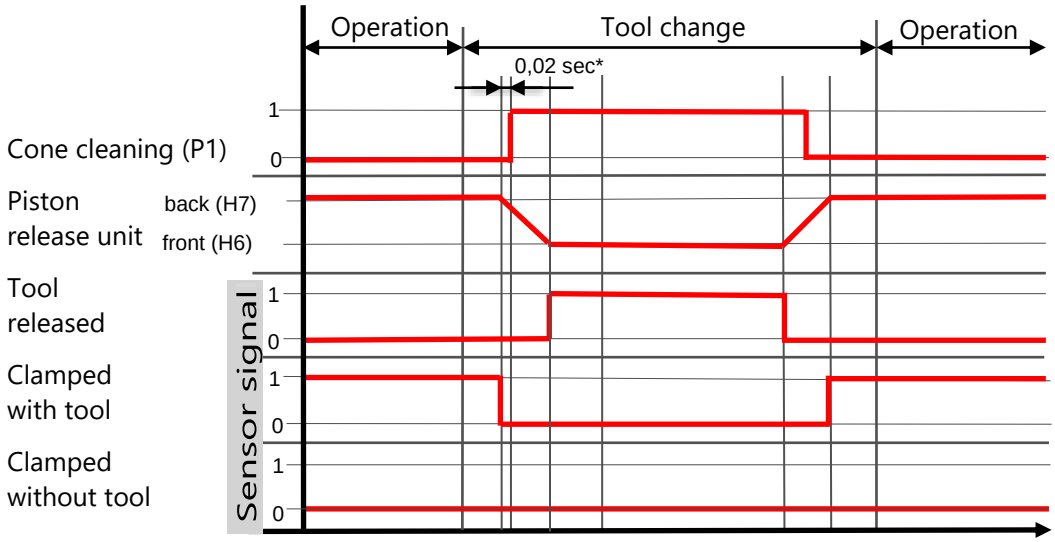
The outer diameter of the lines must comply with the specifications. In order to ensure sufficient volume flow, the minimum diameter of the lines must comply with the specifications in the following table.

Outer diameter (calibrated)	Inner diameter (minimum size)
16 mm	11.0 mm
14 mm	11.0 mm
12 mm	8.0 mm
10 mm	7.0 mm
8 mm	5.7 mm
6 mm	4.0 mm
4 mm	2.6 mm

9.2 General connections

Sealing air, scavenging air, air blast, cleaning air

Function diagram cleaning air



* Time delay between sensor signal "Clamped with tool" to "0" and the start of the cone cleaning

9.3 Important specifications for all lines

Due to the high requirements for functionality of the unit ensure that the following specifications are observed:

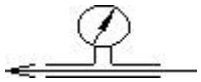
- ➔ Ensure absolute cleanliness for all work.
- ➔ Only cut the hose with hose cutters.
- ➔ Ensure that all lines are cleanly cut at a right angle to the axis.
- ➔ Ensure that all tubes are hydrolysis resistant and dimensioned for the stated pressures.
- ➔ Observe the manufacturer's installation specifications for your peripheral devices.
- ➔ Remove sealing caps at the unit only shortly before connecting the tubes.
- ➔ Blow through the hoses before use.
- ➔ Ensure that sufficient hose length is available. Folding and tension on the lines must not occur during operation.
- ➔ Ensure that the bending radius of the lines does not fall below that stated by the manufacturer.
- ➔ Ensure that hoses are not twisted during fitting or operation.
- ➔ Ensure that tubes are arranged and protected so that wear on the outer layer is prevented.
- ➔ Ensure that tubes are fitted so that the weight of the tubes does not lead to non-permissible loads.
- ➔ Do not use Teflon sealing tape to seal the screw connections. Particles can break off and cause deposits in the tubes and lead to damage of the rotary union.

9.4 Important conditions for compressed air

Pressure

The pressure quoted in the dimension sheet and/or data sheet must be applied directly to the unit. The air pressure on entry to the unit depends on line length.

➔ When connecting, use a suitable pressure gauge to measure the air pressure in the line on entry to the unit.



Air purity

Filters must be used to keep the compressed air clean. Otherwise dirt can build up in the lines and congest them.

➔ To trap water from the air supply use a suitable water trap with automatic emptying.

➔ Use dry and filtered compressed air in accordance with ISO 8573-1.

Air purity according to ISO 8573-1:2010				
Solid particles			**Water**	**Oil**
Maximum number of particles per m^3 Class 3			Pressure dew point Class 4	Total part oil Class 4
[0.1-0.5 µm]	[0.5-1 µm]	[1-5 µm]	[°C]	[mg/m^3]
-	≤ 90000	≤ 1000	+3	5

10 Hydraulic system

Work on the hydraulic system must be carried out strictly by qualified technical staff with special knowledge and experience with hydraulic systems.

10.1 Important specifications for hydraulic lines

Due to the high requirements for functionality of the unit ensure that the following specifications are observed:

- ➔ Ensure absolute cleanliness for all work.
- ➔ Ensure that all lines are hydrolysis resistant and dimensioned for the stated pressures.
- ➔ Ensure that all lines are cleanly cut at a right angle to the axis.
- ➔ Observe the manufacturer's installation specifications for your peripheral devices.
- ➔ Remove sealing caps only shortly before connecting the hydraulic lines.
- ➔ Ensure that sufficient hose length is available. Folding and tension on the lines must not occur during operation.
- ➔ Ensure that the bending radius of the lines does not fall below that stated by the manufacturer.
- ➔ Ensure that hoses are not twisted during fitting or operation.
- ➔ Ensure that lines are arranged and protected so that wear on the outer layer is prevented.
- ➔ Ensure that lines are fitted so that the weight of the lines does not lead to non-permissible loads.
- ➔ Do not use Teflon sealing tape to seal the screw connections. Particles can break off and cause deposits in the lines and lead to damage of the rotary union.

10.2 Media purity at the hydraulic system

The media purity depends on the components installed and the function.See the table in the relevant sections for details about the hydraulic clamping, motor cooling, rotary union, tool cooling etc..

10.3 Avoid wear of hydraulic components

Limit pressure peaks

Pressure peaks may not exceed 10 % of the maximum pressure. Excess pressure results in impairment of the service life and destroys the components.

➔ Use pressure control valves to limit pressure peaks. Pressure control valves are not included in the scope of delivery nor shown on the dimension sheet.

➔ Use a minimum pressure accumulator in the lines to absorb pressure peaks.

Maximum pressure increase/time

If the maximum pressure per time unit is exceeded, this will result in impairment of the service life and destroy the components.

➔ Ensure that the maximum pressure increase per time unit is not exceeded.

Maximum pressure increase/time	≤ 1 bar / ms

Bleeding

The hydraulic system must be completely depresurizzed.

Pressure for bleeding: ≤ 3 bar

If there is a connection “bleed clamp” then this connection should preferably be used to bleed the clamp.

If there is no special connection to bleed the clamp, then the clamp is to be bled via the screw connection “clamp the clamp” or “release clamp”. The location of the connections can be found on the dimension sheet.

The hydraulic clamp can be bled by using a portable bleeding device.

Hydraulik oil

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
19	260000-500000	17	64000-130000	14	8000-16000

11 Cooling system

Work on the cooling system must be carried out strictly by qualified technical staff with special knowledge and experience with hydraulic systems.

11.1 Required line diameter

The outer diameter of the lines must comply with the specifications. In order to ensure sufficient volume flow, the minimum diameter of the lines must comply with the specifications in the following table.

Outer diameter (calibrated)	Inner diameter (minimum size)
16 mm	11.0 mm
14 mm	11.0 mm
12 mm	8.0 mm
10 mm	7.0 mm
8 mm	5.7 mm
6 mm	4.0 mm
4 mm	2.6 mm

11.2 Important specifications for the cooling agent

Pure water severely lowers the pH-value and causes immediate corrosion to uncoated parts. The corrosion goes unnoticed for a time, but later can cause serious corrosion damage.

➔ Do not use pure water.

The quality of the cooling agent influences the functionality and service life of the unit to a high degree.

➔ Ensure that the freshly mixed cooling agent meets the stated specifications.

ph value	8,5 – 9,5
Conductivity	max. 700 µS/cm
Total hardness	5 – 30 °dH 0.89 – 5.35 mmol/l

11.3 Protective measures

Cooling agent filter

Filters must be used to keep the cooling agent clean. Otherwise dirt can build up in the lines and congest them. This can cause destruction of the motor.

➔ Use a solids filter for this.

Filter grade	< 100 µm

When choosing a cooling lubricant, make sure that the lubricant selected does not corrode, disintegrate or otherwise damage the materials listed.

The following materials are used in the motor cooling circuit:

-Steel (St52, C435E, 16MnCr5 and similar)

-EN-GJS-600

-AlMg4,5Mn

-Viton

-Zurcon®

-Nitrile butadiene rubber

-Polyurethane

-POM

Avoid damage from corrosion

➔ Avoid a combination of electro-chemically incompatible metals, such as copper and aluminium.

➔ Avoid an electrically conductible connection between electro-chemically incompatible metals.

➔ Avoid electrolytes which facilitate an exchange of metal ions.

➔ When installing a closed cooling circuit, add an anti-corrosion agent with a mixture ratio in line with the manufacturer's specifications.

Cooling agent properties

➔ When installing the cooling unit, ensure that the cooling agent is prepared to prevent the following under extreme conditions:

•Organic deposits (such as fungi and bacteria),

- Corrosion
- Freezing of the water.
- Wear of seals

11.3.1 Systemreiniger verwenden

Observe the manufacturer's specifications for the coolant and cleaning agents used. Incorrect use could otherwise cause irreparable damage to the seals and other severe damage.

If you use system cleaner, first make sure that the cooling system of the plant is rinsed through separately to remove any particles which are present. Only include the cooling system of the Kessler unit after you have done this.

11.4 Anti-corrosion agent

➔ If the unit is installed in a system, adhere to the specifications for the coolant in the assembly instructions of the system.

When installing a closed water cooling circuit, add an anti-corrosion agent. Observe the manufacturer's instructions on the mixing ratio.

Manufacturers of chemical additives for water

Manufacturer	Internet
Fuchs Europe Schmierstoffe GmbH	www.fuchs.com
Cimcool Europe B.V.	www.cimcool.net
Hebro Chemie GmbH	www.hebro-chemie.de

Unless otherwise specified in the data sheet, we recommend the following coolants.

Manufacturers of chemical additives for water

Motorex COOL CONCENTRATE ➔ Observe the manufacturer's instructions.	
Manufacturer	**Internet**
MOTOREX AG LANGENTHAL	www.motorex.com

Manufacturer of ready-for-use motor coolant

Motorex Cool-X ➔ Observe the manufacturer's instructions.	
Manufacturer	**Internet**
MOTOREX AG LANGENTHAL	www.motorex.com

12 Cooling lubricant

Work on cooling lubricant circuits must be carried out strictly by qualified technical staff with special knowledge and experience with cooling lubricant.

Unsuitable cooling lubricant

Kessler provides no guarantee for consequential damage when inappropriate cooling lubricants are used.

➔ Ensure that the cooling lubricant used meets the technical specifications provided.

12.1 Important specifications for the cooling lubricant

Pure water severely lowers the pH-value and causes immediate corrosion to uncoated parts. The corrosion goes unnoticed for a time, but later can cause serious corrosion damage.

➔ Do not use pure water.

The quality of the cooling lubricant influences the functionality and service life of the unit to a high degree.

➔ Ensure that the freshly mixed cooling lubricant meets the stated specifications.

ph value	8,5 – 9,5
Conductivity	max. 700 µS/cm
Total hardness	5 – 30 °dH 0.89 – 5.35 mmol/l
Corrosion protection (Test method in accordance with DIN 51360-2)	After 2 hours test time there should be no corrosion.
Elastomer compatibility	No changes to shore hardness or expansion permitted
Adhesive residue characteristics when slowly evaporating at 50 °C	There must be no development of sticky deposits. The coolant must remain easily soluble and emulsifiable.

12.2 Media purity (if rotary union is used)

Recommended media purity

Contamination such as foreign bodies, dirt, chips, etc., can considerably reduce the service life of the seals and hoses. Damage to seals and/or hoses can lead to failure of the rotary union and unit.

In order to ensure failure-free function of the rotary union and unit for as long as possible, we recommend that the specifications for media purity be adhered to.

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
17	64000-130000	15	16000-32000	12	2000-4000

Minimum requirements for media purity

In order to avoid increased wear and damage to the rotary union and unit, the minimum requirements for media purity must not be fallen short of.

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
-	- -	17	64000-130000	14	8000-16000

Solids filter minimum cooling lubrication

Filter grade:	< 12 µm

Solids filter for internal cooling lubricant

Filter grade:	< 50 µm

Solids filter for external cooling lubricant

Filter grade:	< 100 µm

13 Rotary union (if available)

See data sheet

13.1.1 Avoiding permanent leakage flow

Permanent leakage flow with unusually high amounts of leakage can cause damage to the rotary union. If the damaged rotary union is not replaced in time, consequential damage to the unit can occur.

Measures for avoiding permanent leakage flow

➔ Ensure that Teflon sealing tape is not used to seal the screw connections of the rotary union.

➔ Carry out all connections for the rotary union in a flexible manner. Strain relief must be included for line lengths over 50 cm.

➔ Ensure that no force is applied to the screw connections.

13.1.2 Media purity

Recommended media purity

Contamination such as foreign bodies, dirt, chips, etc., can considerably reduce the service life of the seals and hoses. Damage to seals and/or hoses can lead to failure of the rotary union and unit.

In order to ensure failure-free function of the rotary union and unit for as long as possible, we recommend that the specifications for media purity be adhered to.

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
17	64000-130000	15	16000-32000	12	2000-4000

Minimum requirements for media purity

In order to avoid increased wear and damage to the rotary union and unit, the minimum requirements for media purity must not be fallen short of.

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
-	- -	17	64000-130000	14	8000-16000

13.2 Air purity

Filters must be used to keep the compressed air clean. Otherwise dirt can build up in the lines and congest them.

➔ Use dry, filtered compressed air with the following air purity:

Air purity according to ISO 8573-1:2010				
Solid particles			**Water**	**Oil**
Maximum number of particles per m^3 Class 3			Pressure dew point Class 4	Total part oil Class 4
[0.1-0.5 µm]	[0.5-1 µm]	[1-5 µm]	[°C]	[mg/m^3]
-	≤ 90000	≤ 1000	+3	5

14 Oil-air lubrication system

Units run at high speeds are usually lubricated with an oil-air mixture.

14.1 Peripheral devices

The peripheral devices and their documentation are not included in the scope of delivery.

➔ Observe the manufacturer's installation specifications for your peripheral devices.

14.1.1 Important specifications for all connections

Due to the high requirements for functionality of the oil-air lubrication system ensure that the following specifications are observed. The connections are made by the customer.

The following specifications are applicable to all connections to peripheral devices, such as: dispensing unit, lubricating unit, oil separator.

Hose characteristics

➔ Ensure that all lines are hydrolysis resistant, oil resistant and dimensioned for the stated pressures.

➔ Ensure that sufficient hose length is available. Folding and tension on the lines must not occur during operation.

➔ Ensure that the bending radius of the lines does not fall below that stated by the manufacturer.

➔ Ensure that hoses are not twisted during fitting or operation.

➔ Ensure that lines are arranged and protected so that wear on the outer layer is prevented.

➔ Ensure that lines are fitted so that the weight of the lines does not lead to non-permissible loads.

➔ Ensure all connections are flexible.

➔ Ensure that all lines are cleanly cut at a right angle to the axis.

Bearing lubrication connection

Each bearing lubrication connection must be connected to the dispensing unit with a separate lubrication line.

Bearing lubrication connections must not be joined together!

Do not use Teflon sealing tape

Particles can break off and cause deposits in the lines and lead to damage to the bearings.

➔ Do not use Teflon sealing tape to seal the screw connections.

Flush the system with compressed air

Contamination can lead to wear and reduce the service life of the bearings.

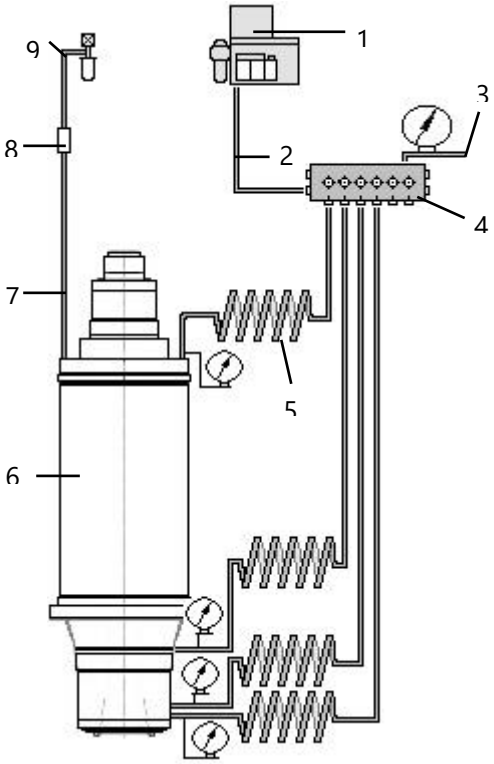
➔ Ensure absolute cleanliness for all work.

➔ Ensure that all hoses and screw connections on the peripheral devices and spindle/motor are clean.

➔ For flushing, use compressed air with the following air purity class:

Air purity according to ISO 8573-1:2010				
Solid particles			**Water**	**Oil**
Maximum number of particles per m^3 Class 3			Pressure dew point Class 4	Total part oil Class 4
[0.1-0.5 µm]	[0.5-1 µm]	[1-5 µm]	[°C]	[mg/m^3]
-	≤ 90000	≤ 1000	+3	5

14.1.2 Oil-air lubrication system components



1 Lubricating unit
2 Oil line to dispensing unit
3 Compressed air line to dispensing unit
4 Dispensing unit
5 Lubrication line coils
6 Spindle/motor
7 Oil-air extraction (if applicable)
8 Venturi tube
9 Collection container with silencer (connection only with extraction)

14.1.3 Requirements for lubricating oil

In order to ensure the functionality and longevity of the bearings, the lubricating oil for the oil-air lubrication system must meet the following quality requirements.

➔ Only fill the lubricating unit reservoir with filtered lubricating oil.

➔ Ensure absolute cleanliness when filling.

Recommendation for lubricating oil

➔ Unless otherwise stated in the technical data sheet, only use high-grade mineral oils or fully-synthetic lubricating oils in accordance with ISO class VG 68.

- Designation: CLP (circulating lubrication oil) or HLP (hydraulic oil)
- With EP-additives

For example:

Manufacturer	**Designation**
Mobil	SHC 626
Motorex	Hyperclean

The use of other lubricating oils must be tested by the customer.

Use of unsuitable oils can lead to increased wear in the bearings.

Non-permitted lubricating oils

- Molybdenum (IV)-sulphide additives, also known as MoS2/Molykote(R), are not permitted. There is a risk that the nozzles will become clogged and the bearings destroyed.
- Lubricating oils with the designation CGLP (mixed oils, bed track oil, slideway oil) are not permitted. The adhesive additives can cause deposits.

Specified lubricating oil purity for bearings

➔ Use lubricating oil with the following media purity:

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
15	16000-32000	13	4000-8000	10	500-1000

14.1.4 Requirements for compressed air

In order to ensure the functionality of the bearings, the compressed air for the oil-air lubrication system must meet the following quality requirements.

Air purity

➔ To trap water from the air-supply use a suitable water trap with automatic emptying.

➔ Use dry, filtered compressed air with the following air purity:

Air purity according to ISO 8573-1:2010				
Solid particles			**Water**	**Oil**
Maximum number of particles per m^3 Class 3			Pressure dew point Class 4	Total part oil Class 4
[0.1-0.5 µm]	[0.5-1 µm]	[1-5 µm]	[°C]	[mg/m^3]
-	≤ 90000	≤ 1000	+3	5

Air pressure on the inlet to dispensing unit

The air pressure on the inlet of the dispensing unit must be in accordance with the specifications of the device manufacturer and depends on the length of the pipeline.

Flow speed between dispensing unit and spindle/motor

The oil is transported by the air flow. For optimum lubrication we recommend a constant flow speed of the oil-air mixture. Optimum transport of the oil is achieved at a flow rate of approx. 100 mm/min.

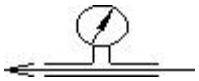
➔ Check the flow speed approx. 1 minute after a pump stroke by observing the oil film in the transparent synthetic hoses.

Air pressure on the inlet to spindle/motor

The air pressure on entry to the spindle/motor depends on the flow rate and line lengths.

- Recommended air pressure on spindle/motor entry: $p_{max} = 4.0_{-0.5}$ bar.

➔ When connecting, use a suitable pressure gauge to measure the air pressure in the line on spindle/motor entry.



14.1.5 Setting parameters for oil-air lubrication

➔ Ensure the functionality of the lubricating unit. Observe the manufacturer's instructions for the lubricating unit.

The stated cycle time and oil quantity are based on Kessler experience.

The oil-quantity per cycle is determined by the piston size of the dispensing unit. For the oil quantity per cycle, see the manufacturer's documentation for the dispensing unit.

Unless otherwise stated in the technical data sheet or dimension sheet, observe the following specifications for oil quantity, flow volume and cycle time.

Oil quantity

Minimum oil quantity per bearing:	160 mm^3/h (equivalent to 0.16 cm^3/h)
Recommended oil quantity per bearing:	180 mm^3/h (equivalent to 0.18 cm^3/h)
Maximum oil quantity per bearing:	200 mm^3/h (equivalent to 0.20 cm^3/h)

Oil quantities which are too high cause increased bearing temperatures over time.

Oil quantities which are too low lead to mixed friction in the bearing and therefore increased bearing wear and early failure.

Flow volume

We recommend a dispensing unit with a flow rate/piston size of 20 mm^3 (= 0.02 cm^3) per cycle and lubrication line.

Cycle time

In order to guarantee a continuous lubricant flow, the maximum cycle time must not be exceeded. Otherwise the bearings can be damaged due to insufficient lubrication.

Shorter cycle times with smaller oil quantities per cycle are beneficial for optimum lubrication of the bearings.

Maximum cycle time:	10 min

If the maximum calculated cycle time exceeds 10 minutes, then a dispensing unit with a smaller piston volume must be selected.

Calculation example:

$$\frac{\text{Piston size in } cm^3}{\text{Oil quantity in } cm^3/h} * 60 \text{ min} = \text{cycle time in min}$$

14.1.6 Preparing the dispensing unit connection

➔ Ensure that the oil lines between the lubricating unit and the dispensing unit are completely free of air. Observe the information in the manufacturer's documentation for the lubricating unit and the dispensing unit.

14.1.7 Synthetic lubrication lines

➔ Use transparent synthetic hoses with helical coils for the lubricating lines between the spindle/motor and the dispensing unit. Transparent synthetic hoses make it possible to visually observe the oil flow.

The synthetic hoses must meet the following requirements:

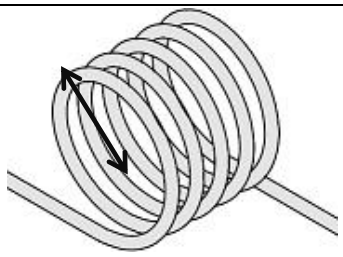
Material: Properties: according to DIN 73378	Polyamide PA12 oil-resistant, heat and light stabilised
Number of coils:	5
Diameter of the coils:	approx. 30-50 mm
Minimum hose length:	Spindle/motor – dispensing unit: 1 meter

The minimum length ensures that the oil supplied can develop into a constant oil film.

Maximum hose length Spindle/motor – dispensing unit:	5 meter

The maximum hose length serves to limit the lead time.

Ø approx. 30-50 mm



5 coils per lubrication line

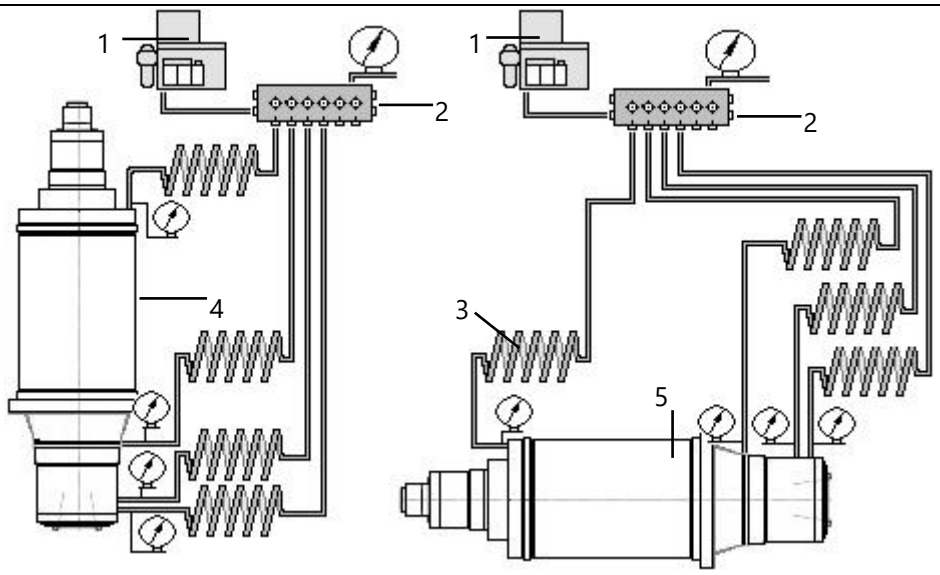
14.1.8 Required lubrication line diameter

Make sure you always use the line diameter specified in the dimension sheet for any connections.Do not change the line inner diameter between the dispensing unit and the spindle inlet. In order to ensure sufficient volume flow, the minimum diameter of the lines must comply with the specifications in the following table:

Outer diameter (calibrated)	**Inner diameter (minimum size)**
6 mm	3.5 mm
4 mm	2.3 mm

14.1.9 Helical coil axis alignment

➔ Ensure that the helical coil axis is always horizontally aligned (see figure). The helical coils serve as an oil-reservoir and ensure that the bearings are quickly supplied with oil when restarting.



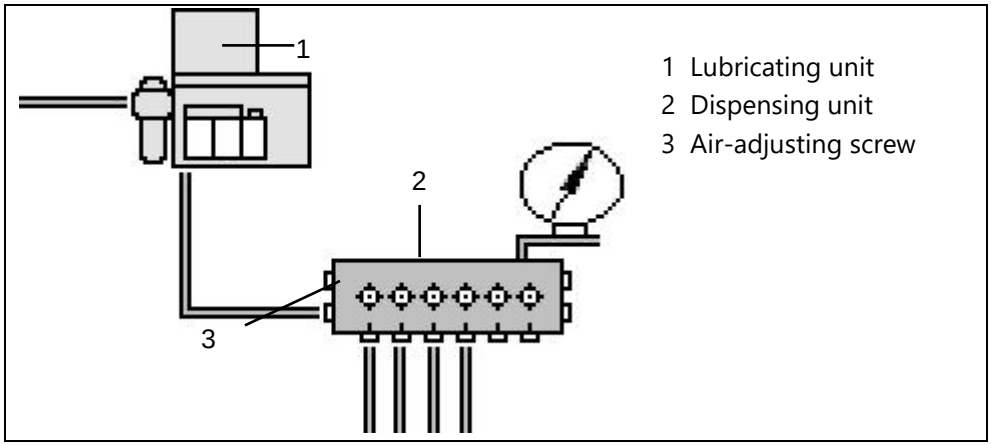
1 Oil-air lubricating unit
2 Dispensing unit
3 Horizontal helical coil axis (applies to all coils)
4 Vertical spindle/motor
5 Horizontal spindle/motor

14.1.10 Dispensing unit air-adjusting screws

For lubricating units with air-adjusting screws on the dispensing unit observe the following:

➔ Ensure that the air-adjusting screws and connections used are open.

➔ Ensure that the sealing on tamper-proof screws is not damaged.



14.1.11 Cleaning oil-air lubrication system

Before initial commissioning or after replacement of parts

Before initial commissioning or restart after replacement of parts it is necessary to completely clean the oil-air lubrication system before reconnecting to the spindle/motor.

➔ Flush the oil-air lubrication system with the oil-air mixture. Observe the manufacturer's specifications for the oil-air unit.

The duration is calculated from the line length between the dispensing unit and spindle/motor. Flushing must be carried out for at least one minute per 10 cm line length.

For sudden bearing failure

In case of repair, only the oil supply bore holes are cleaned. Debris and residue from bearing failure can still be in the lines and cause damage to new bearings.

➔ Replace the lubrication lines after sudden bearing failure.

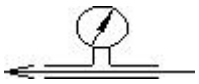
14.1.12 Connection of oil-air extraction

The connections for oil-air extraction are labelled "OS" in the dimension sheet.

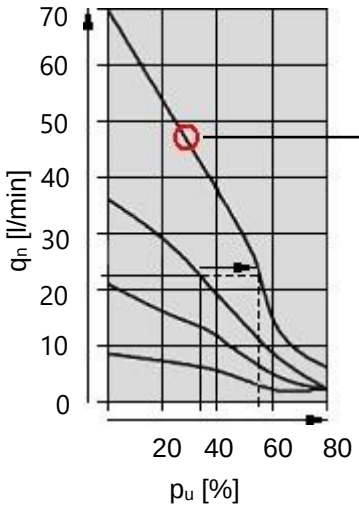
➔ If there are several oil-air extraction openings with the same designations, the oil-air extraction lines must be of the same length up to the point where they are joined.

➔ Connect the oil-air extraction lines to the oil-air extraction openings with negative pressure.

➔ When connecting, use a suitable pressure gauge and air-flow meter in the line on spindle entry to measure the air flow characteristics.



Negative pressure can be achieved by using a Venturi tube.



Example of a characteristic curve for a Venturi tube.

Operating point to be selected for the Venturi tube

Graphical illustration of volume flow rate q_n in relation to vacuum/operating pressure p_u

The maximum extraction volume of a Venturi tube is achieved with atmospheric air pressure (0 % vacuum).

Measurement of extraction volume

NOTICE

Air-flow meters are sensitive to oil.

➔ Observe the manufacturer's instructions for the air-flow meter.

➔ Always attach new tubes to the meter for every measurement.

When measuring the air flow, lubrication and extraction must be switched on.

Recommended extraction volume per bearing position

Unless otherwise stated in the technical data sheet, observe the following specifications.

The recommended extraction volume per bearing position must be at least 50 % but no more than 70 % of the air volume supplied to each bearing position.

It is essential to ensure that the specified extraction volume remains constant.

Return flow of the extracted oil back to the spindle must be prevented.

Oil separator

The extracted oil-air mixture must be disposed of by means of a collection device.

➔ We recommend an oil separator.

14.1.13 Leakage bore holes

➔ Depending on the installation position, whether vertical or horizontal, ensure that the relevant leakage bore holes on the underside are open.

➔ Ensure that leakage which may occur can flow congestion-free through the bore holes.

15 Grease-lubricated bearings

The design of the bearings and lubrication is adapted to the operating requirements. The ex-factory mounted bearings are lubricated and ready for operation.

15.1 Service life greased bearings

Bearings which are lubricated for their service life do not require maintenance or regreasing.

The service life is up to 20,000 operating hours or a maximum of three years, whichever occurs first.

The service life is heavily dependent on load, speed, vibrations and operating time. High loads, speeds and operating times result in a reduced service life.

15.2 Protect grease-lubricated bearings from increased wear

Units with grease-lubricated bearings, which operate constantly at top speed, can show signs of increased wear.

Top speed corresponds to the upper third of the speed range.

➔ Increase the service life by running the unit at a lower speed for short intervals during longer periods of continuous operation.

Continuous operation:	3-4 hours
Duration for lower speed:	3-5 minutes
Recommended lower speed:	< 1000 min^{-1}

15.3 Bearings with regreasing unit

If there is a regreasing unit, the bearings can be regreased as required.

Specifications for lubricating interval, lubricant quantity, lubricant recommendation and lubrication process can be found in the assembly instructions for the unit.

16 Hydraulic clamping

Work on the hydraulic system must be carried out strictly by qualified technical staff with special knowledge and experience with hydraulic systems.

Delay time

Delay time	0.3 s

Recommendation for oil

Hydraulic oil recommendation according to DIN 51524-2	e.g. HLPD 46

Filter grade

Filter grade maximum	40 µm
Filter grade standard	5 µm

Seals

Seals are required for the connection. Fitting of the seals belongs to the customer's scope of services.

➔ Ensure that the seals are not crushed or damaged.

Leak-tightness of the lines

After connection and before commissioning, the leak-tightness of the whole system must be checked by the customer.

Avoiding wear and failure

The clamp must:

- Not be used to slow the unit down.
- Only be used to secure the unit when it is at a standstill.
- The clamp must be released before commissioning the unit.

16.1 Media purity

Recommended media purity

Contamination such as foreign bodies, dirt, chips, etc., can considerably reduce the service life of the seals and hoses. Damage to seals and/or hoses can lead to failure of the unit.

In order to ensure failure-free function of the unit for as long as possible, we recommend that the specifications for media purity be adhered to.

Hydraulik oil

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
19	260000-500000	17	64000-130000	14	8000-16000

17 Bearing preload

The variable bearing preload enables adjustment of the bearing stiffness for different operating processes.

Setting bearing preload

The preload is designed for the bearings and appropriate speed.

The pressure for preload must be set and adjusted for increasing speed in accordance with the bearing preload diagram.

➔ Make sure that the maximum pressure specified in the bearing preload diagram is adhered to. The factory-set pressure could rise during operation, due to an increase in temperature. Excessive pressure could lead to a significant reduction in the service life of the bearings.

17.1 Hydraulic bearing preload

17.1.1 Recommendation for oil

We recommend using hydraulic oil according to DIN 51524-2:

- HLP 32 – ISO VG 32
- HLP 46 – ISO VG 46

Filter grade maximum	40 µm
Filter grade standard	5 µm

18 Release unit

Work on the release unit must be carried out strictly by qualified technical staff.

➔ Before you begin work on the release unit, read the safety instructions. See chapter “For your safety”.

NOTICE

Failure of unit!

The release unit may only be operated with hydraulic oil.

➔ Do not connect any compressed air to the hydraulic release unit.

Required line diameter

The outer diameter of the lines must comply with the specifications in the dimension sheet. In order to ensure sufficient volume flow, the inner diameter of the lines must be as large as possible.

Recommendation for hydraulic oil

For the hydraulic connection we recommend using hydraulic oil according to DIN 51524-2:

- HLP 32 – ISO VG 32
- HLP 46 – ISO VG 46

➔ Ensure that the oil used has lubricating qualities.

So that the lines do not become clogged with dirt, the hydraulic oil must be filtered by a maintenance unit.

Filter grade maximum	40 µm
Filter grade standard	5 µm

18.1 Media purity

Recommended media purity

Contamination such as foreign bodies, dirt, chips, etc., can considerably reduce the service life of the seals and hoses. Damage to seals and/or hoses can lead to failure of the unit.

In order to ensure failure-free function of the unit for as long as possible, we recommend that the specifications for media purity be adhered to.

Hydraulik oil

Media purity according to ISO 4406					
No. particles/100 ml > 4 µm		**No. particles/100 ml > 6 µm**		**No. particles/100 ml > 14 µm**	
Code	from-to	Code	from-to	Code	from-to
19	260000-500000	17	64000-130000	14	8000-16000

Recommendation for compressed air

To prevent wear of the seals, the compressed air must be oiled by a maintenance unit.

So that the lines do not become clogged with dirt, the compressed air must be filtered by a maintenance unit.

➔ Observe the specifications in the section “Important conditions for compressed air” in the chapter “Pneumatic system”.

19 Tool clamping system

Work on the tool clamping system may only be carried out by qualified technical staff.

The tool clamping system may only be fitted, set-up, operated, maintained and repaired by qualified technical staff. The staff must be specially trained or have many years of experience with clamping systems.

Important notice

➔ Tools may only be changed when at a standstill.

➔ Only operate the unit with a correctly clamped tool.

➔ Observe the specifications in the manufacturer's documentation in the appendix.

➔ Without the manufacturer's approval, no changes or modifications may be made, or fixtures added to the unit.

19.1 Product description

The tool clamping system is a system for draw-in and clamping of tools in motor spindles. The operating force is applied by a spring assembly. The spring assembly together with the respective clamping set constitutes a compact clamping device. The release of clamping force and ejection of the tool is performed by a release unit.

Technical specifications

Information the tool clamping system's technical design can be found in the manufacturer's documentation in the appendix.

Operating sequence

(1) The spindle is at a standstill.

(2) The tool clamping system is put in the release position.

(3) The tool is inserted automatically or manually where applicable.

(4) The tool is clamped by the clamping set.

(5) Depending on the tool position, the sensors for monitoring clamping send signals to the machine control system.

(6) Operation is enabled when the tool is correctly clamped.

(7) After a time delay the spindle commences operation.

(8) Machining.

(9) The spindle is at a standstill.

19.2 Important specifications for correct functioning

Due to the high requirements for functionality and safety of the unit, ensure that the following specifications are observed:

In General

➔ Ensure absolute cleanliness for all work.

Manufacturer's documentation

➔ Observe the manufacturer's documentation in the appendix.

Clamping force/drawing-in force

Depending on the manufacturer, the designations “clamping force” and “drawing-in force” are used interchangeably. Note: clamping force = drawing-in force.

Unless otherwise stated in the technical data sheet, when new, the clamping force must not deviate from the nominal value by more than 15%.

Speed

Increased speeds can lead to damaged parts and cause damage to or failure of the unit.

➔ Make sure that the maximum permissible speed is not exceeded.

Tool

➔ Observe the tool manufacturer's specifications.

➔ Ensure that only tools are used which are permitted for this tool clamping fixture. The tool must be matched to the clamping force of the spindle's clamping system.

➔ Ensure that the tools are approved for the operating speed.

➔ Ensure that only technically perfect and balanced tools are used.

➔ Observe the specifications for quality, maximum clamping force, speed, maximum residual imbalance or permissible oscillation speed. These specifications can be found in the technical data sheet.

19.2.1 Media

➔ Ensure that all connections are carried out in accordance with specifications.

➔ Ensure that all media pressures are set correctly according to specifications.

➔ Ensure that only the stated media are used.

Cooling lubricant properties

➔ Observe the specifications for cooling lubricant. See section “Cooling lubricant circuits”.

Operation with inner cooling lubricant

When operating with inner cooling lubricant it is absolutely necessary to fit a cooling lubricant supply set in the tool. A tool with an inner cooling-lubricant bore hole must be used.

Exceptions must be tested by the customer and approved by Kessler.

A tool with a fitted cooling lubricant supply set must be used.

Only tools with an inner cooling-lubricant bore hole may be used werden.

The warranty becomes null and void when damage due to flooding with inner cooling lubricant occurs because operation was carried out without using a cooling lubricant supply set for cooling lubricant.

20 Repairs

Due to the high requirements for functionality of the unit, repair work such as replacing parts must be carried out strictly by technical staff or their representatives who have been authorized and trained by Franz Kessler GmbH.

- Contact details for the Kessler Service can be found in the chapter “Service and Support”.

The Kessler Academy offers practical seminars for qualification of personnel.

- Contact details for the Kessler Academy can be found in the chapter “Service and Support”.

➔ Before you begin work on the unit, read the safety instructions. See chapter “For your safety”.

20.1 Wear and replacement parts list

➔ For all questions regarding the unit or replacement parts, always state the type, article number and, if available, the serial number.

20.1.1 Wear parts

Wear parts are parts which are subject to wear when use as intended.

Depending on the intensity of the use of the unit, wear parts can be result in failure within the statutory warranty period.

KESSLER does not accept any warranty claims for wear parts.

Typical wear parts could be for example: rotary union, clamp, toothed wheels, seals, springs.

20.1.2 Replacement parts

Replacement parts are parts which wear out during normal operation. Replacement parts may also include parts that are damaged or destroyed in case of not intended use or improper use.

Damaged or destroyed parts must always be replaced by original replacement parts from KESSLER.

Typical replacement parts could be for example: sensors, monitoring systems, bearing housing, torque motor, diverse rings, tubing.

Replacement parts should be exchanged as standard in case of an overhaul or repair.

A list of replacement parts for the unit can be found in the chapter “Wear and replacement parts list” in the assembly instructions.

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