WITTENSTEIN | cyber motor

cyber® linear motor
L3S / L3SK / LNS

Operating Manual

Revision: 01

Info	Description
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		✉	✆
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1 Introduction

1.1 About This Document

This document gives instructions on safely operating our cyber® linear motors products, which include the L3S, L3SK and LNS series. It describes how to install, operate and maintain the linear motors listed.

All personnel working with WITTENSTEIN cyber® linear motors should have this user manual available during operating and should read relevant operating and safety information before starting operation.

1.2 Documents on cyber® linear motor L3S, L3SK and LNS

In addition to this user manual, the other documents that are available on listed linear motors:

- Installation drawing - provides information on motor mounting and wiring schematics for electrical installation.
- Data sheet - provides information on technical data for a specific motor size.
- Product catalogue – provides product description, linear motor selection and sizing.

If the information and notes provided in this documentation do not address your requirements, please contact WITTENSTEIN s.r.o..

1.3 Typographical Conventions

DANGER

DANGER indicates a hazardous situation which, if not avoided, may result in death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, may result in death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

NOTICE

NOTICE indicates possible property damage.

The following table shows the structure of a warning:

SIGNAL WORD

Type and source of hazard

Possible consequences of not avoiding the potential hazard

- ➢ How to avoid the hazardous situation

The following table shows other typographic elements:

Symbol	Explanation
	Notes about important operations and other useful information
➢	This is an action to be carried out
•	This is a bullet list
	This identifies important information

1.4 Structure of Warning Notices

The warning notices in this user manual have the following structure:

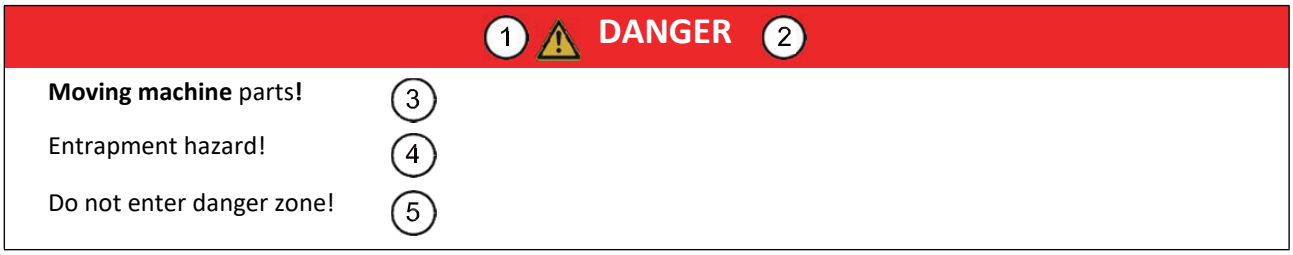


Figure 1: Structure of a warning notice

Legend

1 Warning symbol

2 Signal word

3 Type and source of hazard

4 Possible consequences of a potential hazard

5 Hazard prevention measures

1.5 Abbreviations

Abbreviation	**Explanation**
L3S	Iron core flat linear motor series with natural cooling
L3SK	Iron core liquid-cooled flat linear motor series
LNS	Ironless flat linear motor series with natural cooling
IATA	International Air Transport Association
ESD	Electrostatic discharge

Table 1: Abbreviations

2 Safety Instructions

Do not attempt to install, operate, maintain or inspect the linear motor until you have read through this user manual and appended document carefully and can use the equipment correctly. All cyber® linear motors L3S, L3SK and LNS may only be set up and operated in conjunction with this manual.

Human safety and equipment safety must be the first considerations when performing the installation procedures for the linear motor and drive system. When it comes to electronics in your factory or workplace, you want to make sure both your facility and the employees in it are safe. What follow are the safety instructions for working on the servo motor.

⚠ WARNING

Danger of high voltage and electrical shock hazard!

This creates the danger of death, severe injury, or extensive material damage.

- It is vital that you ensure the motor is safely earthed to the PE (Protective Earth). Electrical safety is impossible without a low-resistance earth connection.
- Do not unplug any connectors during operation.

NOTICE

- Observe and adhere to the technical data and in particular the information given on the motor nameplate.
- The installation must comply with the local regulations and use of equipment and installation practices that promote electromagnet compatibility and safety.
- Safety equipment - To protect yourself against personal injury by falling motor, always wear suitable safety equipment, such as work shoes, when handling the motor.

Use this document if you are responsible for installing or troubleshooting motors. As with any electro-mechanical device, safety should be considered during the installation and operation. Throughout this manual you will see safety messages marked with the CAUTION and WARNING signal words. Follow the prescribed actions to avoid any potentially hazardous situation.

2.1 Safety Oriented Systems

The use of control technology in safety-oriented systems calls for special measures. When planning to use control technology in a safety-oriented system, the user should seek detailed advice in addition to referring to all the potentially available standards or guidelines on safety-engineering installations.

2.2 Qualified Personnel

Only properly qualified personnel are permitted to perform such tasks as transport, assembly, setup and maintenance of the motors.

Qualified personnel are those who are specialized with required knowledge and experience, who have been trained to perform such work and authorized to commission systems and circuits, in accordance with established safety practices and standards. The qualified personnel must know and observe all relevant national and international standards and regulations.

2.3 Electrical Hazards

⚠ WARNING

Electrical Hazard!

Certain electrical systems have to be maintained and cleaned by staff. Before they can be accessed, the systems have to be disconnected from the mains to eliminate electrical hazards to operating staff.

- The motor must be demonstrably disconnected from the mains
- Secure the connector to avoid accidental reconnections
- Verify that the system is dead
- Carry out earthing and short circuiting
- Provide protection from adjacent live parts
- Safety regulations for work on the equipment in which the motor is applied must be observed.

2.4 Thermal Hazards

WARNING

Burn hazard!

The surface temperature of the motor may reach up to 130 °C (266 °F) and may become very hot in operation, according to each motor protection category.

- Do not touch hot surfaces, measure the temperature, and wait until the motor has cooled down below 40 °C (104 °F) before touching it.

2.5 Magnetic Hazards

WARNING

Magnetic hazard!

Due to the presence of permanent magnets on the surface of magnet tracks (secondary parts), special care must be taken when handling with those parts.

The presence of high-energy magnetic fields and associated large attraction forces can lead to life-threatening situations, both due to their effect on cardiac pacemakers (or similar implants) and due to injuries caused by the interaction between magnets and metal objects.

Because magnetic forces are invisible, they are often underestimated. The attraction magnetic forces act suddenly and, depending on the distance, can rise very quickly to high values. Injuries caused by the attraction magnetic forces are very painful.

- Clearly visible warning signs must be used ("WARNING:"STRONG MAGNETIC FIELD!", "LARGE MAGNETIC ATTRACTION FORCES!").
- Installation and maintenance must be carried out by trained personnel only.
- Persons with cardiac pacemakers (or similar implants) must not handle with linear motors or their parts.
- Do not place metal objects (e.g. work tools) near the magnet tracks (secondary parts).
- Keep electronic data carriers, watches or other devices sensitive to magnetic field away from secondary parts.

2.6 Mechanical Hazards

WARNING

Mechanical hazard!

Danger from moving parts with possible risk of death or very serious injuries.

- Make sure all precautions have been taken.
- Never go into the travel range of a linear drive on an unsecured machine.

3 Product Information

- WITTENSTEIN cyber® linear motors L3S, L3SK, LNS are supplied in form of active parts (built-in motors). The air-cooled L3S and liquid-cooled L3SK represents an ironcore linear motors, while LNS utilizing ironless design. In both cases those motors are consisting from primary parts with motor winding and secondary parts with permanent magnets (magnet tracks).

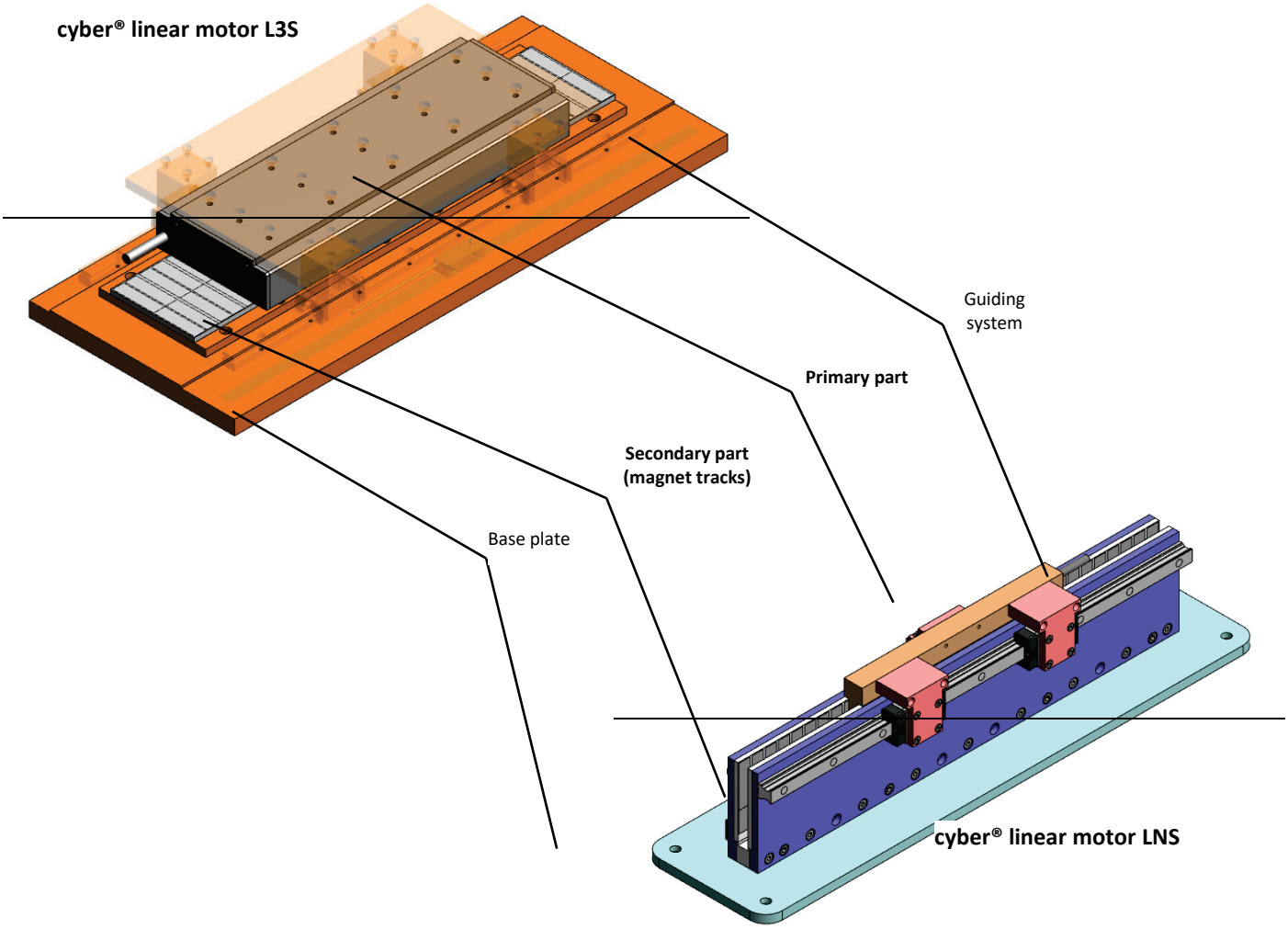


Figure 2: Basic parts of cyber® linear motors L3S and LNS

- All cyber® linear motors comply with 2014/30/EC (Low voltage directive), 2011/65/EU (RoHS) and related harmonized standards.
- WITTENSTEIN cyber® linear motors L3S, L3SK and LNS are designed and manufactured in accordance with strict CE standards, using rugged components with proven reliability in harsh thermal and shock load environments.
- CE certified

Intended Use

The motors in our product range are intended exclusively for commercial systems. They comply with the applicable standards and regulations. Serious personal injury and property damage can result from:

- Improper use
- Incorrect installation or operation

The technical data and information on the nameplates or in the product-specific data sheets for the motors form the basis for the proper commissioning of the motors. All instructions must be followed at all times.

Warranty and claims for defects: For related information, please check General Terms and Conditions of Sales and Delivery of WITTENSTEIN s.r.o.

3.1 Manufacturer Name and Address

The following table shows all the information regarding the manufacturer:

Info	**Description**
Company	WITTENSTEIN s.r.o.
Address	Trnkova 3129/119a, 628 00 Brno – Líšeň, Czech Republic
Phone	+420 517 078 300
E-Mail	info@wittenstein.cz
Web Site	www.wittenstein.cz ; www.cyber-motor.wittenstein.de

Table 2: Manufacturer name and address

4 Shipment and Storage

Please check the contents of each delivery are as ordered and that no damage has occurred during transit. Any problems should be immediately addressed to a WITTENSTEIN s.r.o. representative with a description of the fault or damage.

⚠ CAUTION

Danger of personal injury and damage to property!

Failure to observe these safety procedures could result in personnel injury or equipment damage.

- Do not forget to observe the safety signs on the motor.

4.1 Transport and Storage

⚠ WARNING

Heavy weight!

Danger during lifting and transporting procedures!

- Improper handling, unsuitable or defective devices, tools etc. can cause injuries and/ or property damage. Lifting devices, ground conveyors and lifting tackle must respond to all relevant regulations.

⚠ WARNING

Magnetic hazard!

- In storage areas, the secondary parts must be marked with a warning label ("CAUTION! STRONG MAGNETS!")
- Secondary parts must not be stored without a protective cover - it is always necessary to use special non-magnetic packaging from the manufacturer with prescribed electromagnetic gap.
- When transporting machines or machine parts with integrated primary and secondary parts, it must be ensured that these parts do not move freely relative to each other.

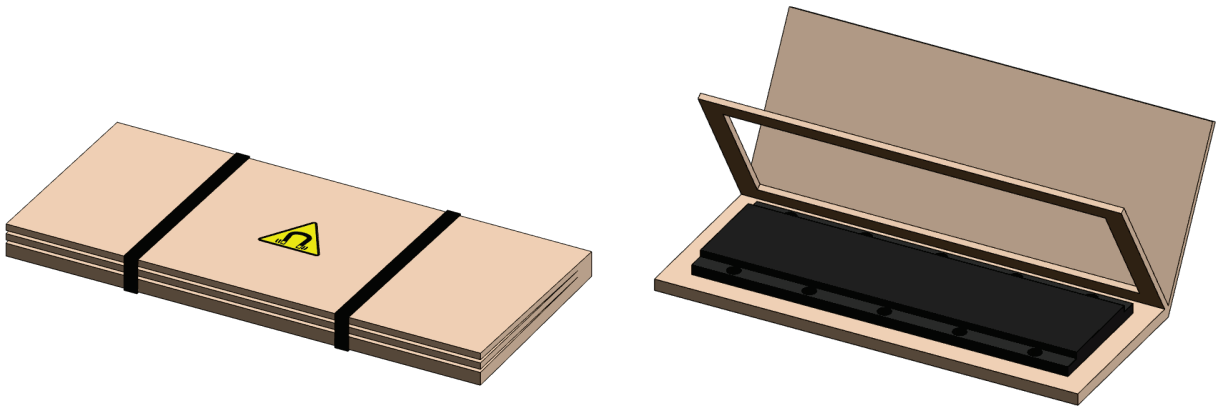


Figure 3: Special non-magnetic packaging of secondary parts

In case of intermediate storage, observe the following storage conditions:

- Recommended ambient temperature: +15 to +25°C (+60 to +78°F),
- Permissible temperature: 0 to +70°C (+32 to +158°F), temperature fluctuation: < 10°C (18°F) per day.
- Relative humidity: < 65 % non-condensing is recommended, 90 % is permissible.
- Ensure there are minimal vibration and shock where motors are stored.

NOTICE

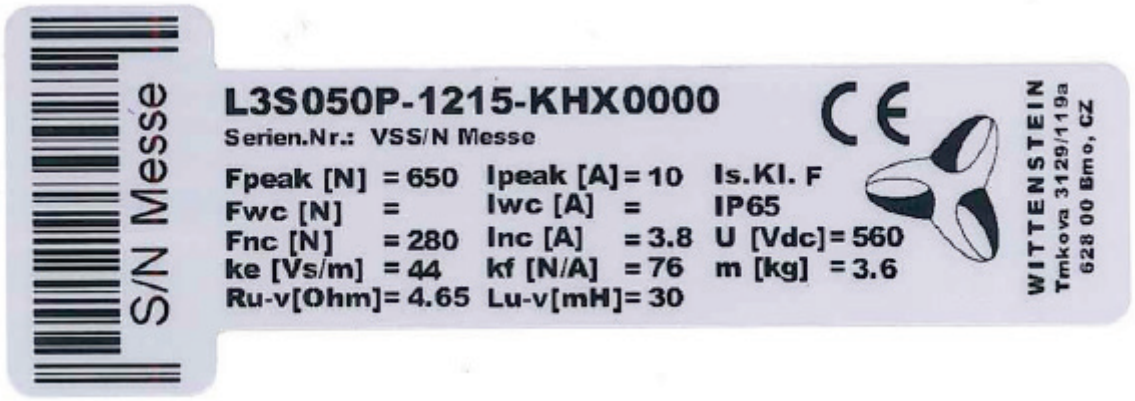
Damage due to dirt, moisture
Storage outside or under the wrong climatic conditions can cause corrosion and other damage to the servo motor. Condensation due to temperature fluctuations can result in electronic malfunctions.

⚠ CAUTION

Air transportation
Please note that air transportation of secondary parts must be in accordance with appropriate IATA Packing Instructions.
Corresponding certificate to ensure such a transportation will be issued by manufacturer upon customers request.

5 Motor Nameplate

The motor nameplate data are used for the setting of the servo drive. If you contact WITTENSTEIN s.r.o. concerning an issue, identification data of the motor must be supplied. **Please note that the specific design of the nameplate may vary.**



		Description
Identification data	**Typ**	Motor type and Motor model number (ordering number)
	S/N	Serial number
	Messe	Week and year of production + serial number
Motor technical data	**Fpeak [N]**	Peak force
	Fwc [N]	Nominal force with water cooling
	Fnc [N]	Nominal force
	Ke [Vs/m]	Voltage constant
	Ru-v [Ω]	Resistance of the motor winding at 20°C
	Ipeak [A]	Peak current
	Iwc [A]	Nominal current for water cooling
	Inc [A]	Nominal current
	Kf [N/A]	Force constant
	Lu-v [mH]	Inductance of the winding
	U [Vdc]	Voltage of the intermediate circuit
	m [kg]	Mass of the primary part
Standards	**Is. Kl.**	Insulation class
	IP	IP code
	CE	Conformity certificate will be issued upon request

Note: listed technical data are valid for ambient temperature range from 0 to 40 °C

Table 3: Motor nameplate

6 Installation

⚠ WARNING

Danger of personal injury!
Working with and on the linear motor without the required basic electrical knowledge may cause injuries or parts may be damaged.

- The motor is intended f or installation and use by qualified personnel, familiar with electrical machines and safety requirements.
- The safety equipment necessary to prevent accident s and electrical shocks must be provided by the installer.
- Ensure that the installation drawing and data sheet are available.

Following care must be taken while installing the motor:

- Read the name plate, warning and caution plates on the motor carefully.
- Refer to the installation drawing before installing.

⚠ CAUTION

Electrical hazard!
WITTENSTEIN s.r.o. motors may contain ESD sensitive parts.
For motors with such parts, additional care is required.

- Do not touch the connect with bare hands.
- If the user carries out a HI pot test, then connects must be short circuited before the test is carried out. The polarity must be carefully observed. Avoid currents >4 mA in the KTY circuit

⚠ WARNING

Magnetic hazard!
Due to the presence of permanent magnets on the surface of magnet tracks (secondary parts), special care must be taken when handling with those parts.

- Do not remove the protective cover of secondary parts (see chapter 4.1.) until immediately prior to installation.
- Assembly work must always be performed by two workers.
- In case of an accident, respectively to release of body parts (fingers, hands, foot etc.) stuck between two magnetic components, always have at least two wedges made of solid non-magnetic material (e.g. stainless steel or hardwood) with an apex angle between 10 and 15 ° and a hammer (approx. 3 kg, made from solid non-magnetic material).
- Never place the secondary part with its magnetically active surface towards the ferromagnetic parts of the machine (or workbench, rack, etc.).
- Before mounting work on machines or devices where the secondary part is already installed, provide this part with a non-magnetic cover with an electromagnetic gap of approx. 25 mm thickness (e.g. a wooden board of the same thickness).
- Avoid spontaneous (uncontrolled) movement of primary and secondary parts due to magnetic forces before and after assembling the linear path.

Respect the technical data on the labeling plates on the motor enclosure.

6.1 Recommended Drives

The WITTENSTEIN s.r.o. motors are designed to be used together with any sinusoidal servo drive. There are no special requirements regarding the type or model of drive to use. Standard insulation system is designed for 560 Vdc. In case of need to use higher voltage of intermediate circuit (i.e 700 Vdc) or any other special requirements, please contact manufacturer.

6.2 Mounting

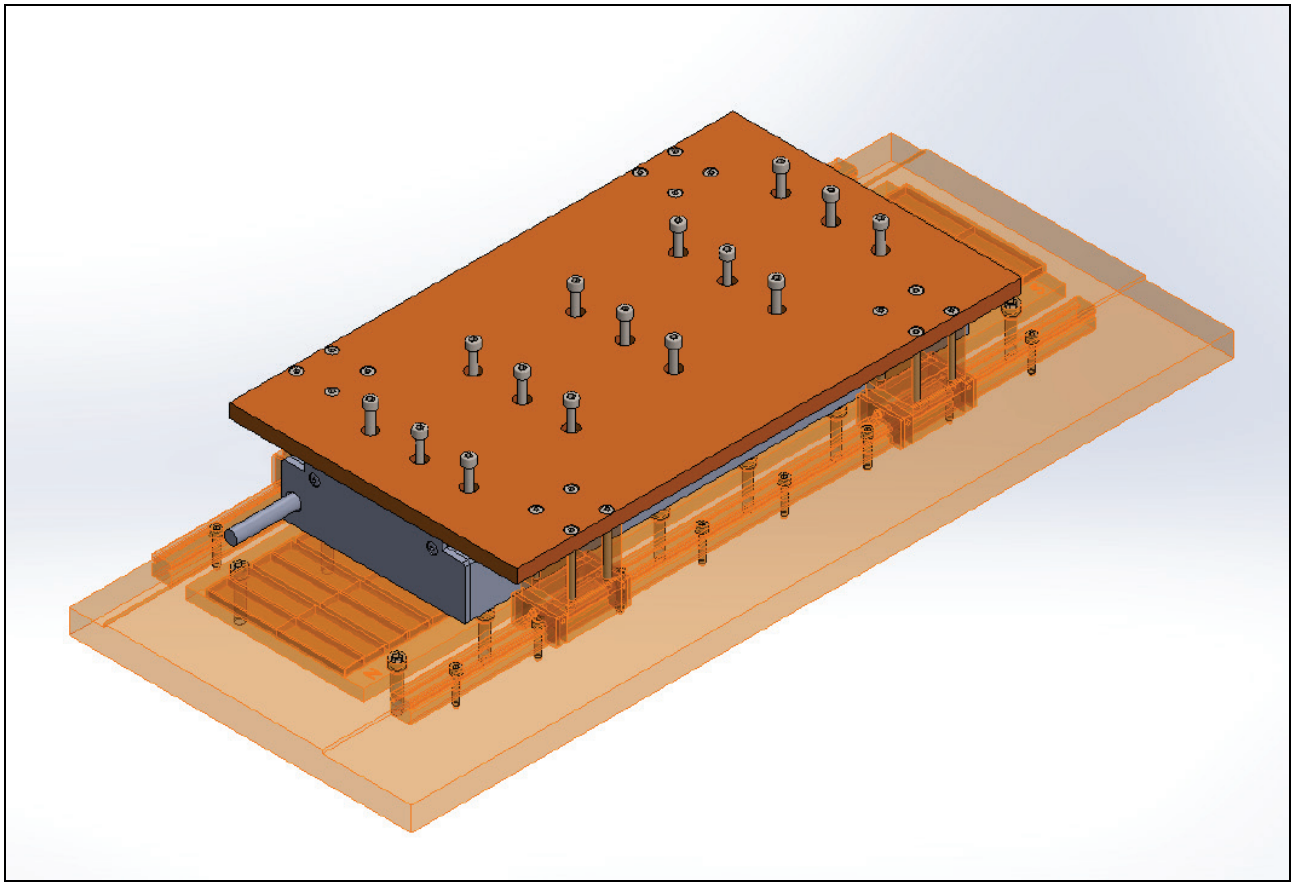


Figure 4: Example of connection points placement

The surface of connection flange of primary part must be properly cleaned from dust and impurities.

All connection threaded holes for mounting screws must be used.

Used mounting screws, their tightening torque as well as material of the counterpart and length of thread must be designed with respect to the acting forces and dimensional drawing. In case of technical support is needed, consult the manufacturer.

Also, mechanical guiding must be designed to withstand:

- Static and dynamic load of the drive
- Attraction force between primary and secondary part

Please note that attraction force may vary from catalogue values depending on the quality of used magnets. In case of ambiguity, consult the manufacturer.

Ensure heat dissipation from the motor:

- For primary parts, thermal resistance must be ensured in accordance with the catalogue or datasheet.
- For secondary components, the maximum operating temperature must not exceed 40° C.

Note that insufficient heat dissipation has a negative effect on the motor parameters.

Follow the instructions and recommendations of the guiding system supplier.

The size of the air gap has a significant effect on the parameters of the machine. Unless otherwise stated, the catalogue parameters apply to the (mechanical) air gap of 0.5 mm. In case of using other than catalogue air gap, consult the manufacturer.

⚠ CAUTION

Ensure the correct setting of the air gap!

Note that incorrectly set air gap size or uneven air gap has a negative effect on motor parameters and lifespan of the guiding system.

For installation of liquid cooled motors please see chapter 6.3.

⚠ WARNING

Heavy weight!

Danger during mounting procedures!

- Improper handling, unsuitable or defective devices, tools etc. can cause injuries and/ or property damage. Lifting devices, ground conveyors and lifting tackle must respond to all relevant regulations.

Make sure that the secondary parts are correctly mounted regarding their magnetic polarity.

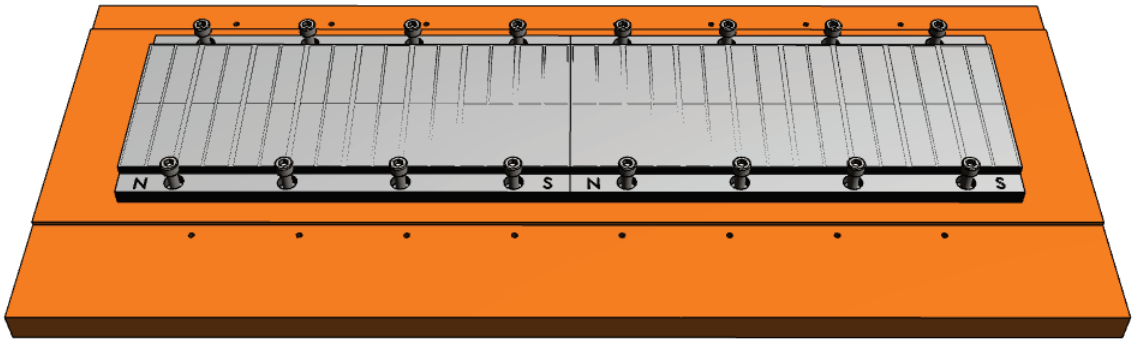


Figure 5: Correct sorting of secondary parts according to their polarity

6.3 Liquid Cooled cyber® linear motor L3SK

Liquid cooled motors must have a proper closed loop cooling circuit. The cooling medium has to be composed from desalted and demineralized water chemically neutral and with the addition of anti-corrosion agent. Such products must be compatible with the materials of the housings (aluminum and its alloys), with the materials of the gaskets (Viton) and with all the components of the circuit.

⚠ CAUTION

Do not connect the cooling system to a regular water line!

Using regular, untreated water can cause severe damage to the cooling system and it is to be avoided in any circumstance.

For additional conditions, refer to the following notes:

- Maximal water inlet pressure (< 1 min) Pmax = 1 MPa (10 Bar)
- Rated water inlet pressure Pn = 0,5 MPa (5 Bar) max.
- Minimal water flow and minimal pressure drop: listed in the catalogue or relevant datasheet (varies according to motor, size)
- PH-value: 6,5 to 7,5
- The recommended water hardness is 0,7 mmol/l. If cooling water does not meet this parameter, plasticizers should be used

The use of inhibitors to prevent corrosion in aluminum is strongly recommended. The ratio of anticorrosive agent (25%) to water (75%) should not be exceeded, otherwise a reduction in performance may occur.

Alternatively, other coolant can be used, such as water-glycol antifreeze, various coolant oils, etc. In this case, however, reduced performance is to be expected. The specific derating is determined by calculation after consultation with the manufacturer.

A constant monitoring of cooler flow is recommended.

Inlet cooling media temperature must be between 5° and 25°C to avoid condensation inside of the motor; in any case the inlet coolant temperature must be higher than the motor frame temperature of at least 2°C

Before activating the motor, make sure the cooling circuit is completely filled and leak free.

⚠ CAUTION
Risk of damage! Note that connection to the cooling circuit must be provided with use of flexible hosing. Otherwise there is a risk of motor damage. Take extra care when handling with liquid cooled motors. Careless handling can easily cause damage of the connection fitting. It is recommended to use second wrench while tightening or loosening the connection fitting.

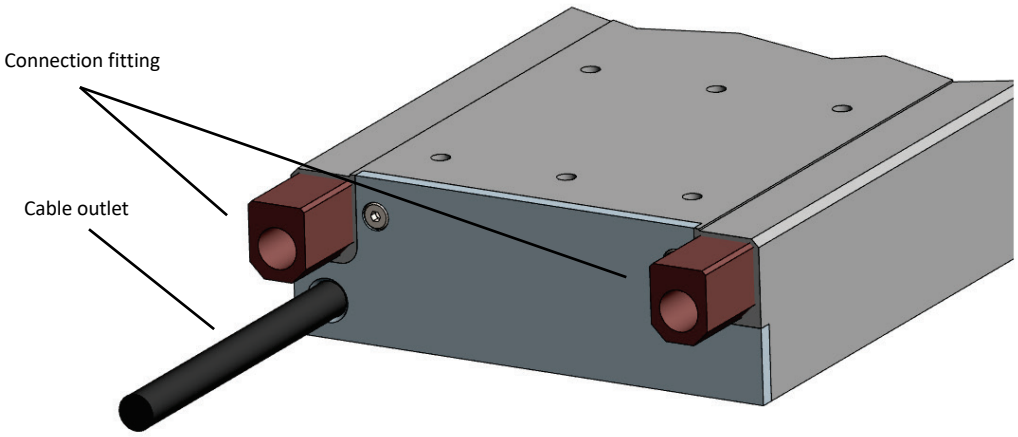


Figure 6: Position of liquid cooling connection points

7 Electrical Interfaces

For the correct connection, it is best to use the cable characteristics indicated by WITTENSTEIN s.r.o.. When using non-WITTENSTEIN s.r.o. components, the cable specifications must be fulfilled in every way.

⚠ WARNING

Hazardous voltage!

- Always make sure that there are no exposed cables.
- Only use appropriate power cables - electrical connection of linear motors must be provided with use of special cables intended to be used for dynamic applications.
- Corresponding support for those cables (e.g. with use of energy chains) must be ensured.

Connection and disconnection of the motors must be made with the controller switched off. Simply disabling the controller is not sufficient. During installation, special attention should be paid to the diameter of the protective earth (PE) conductor, which must be sized according to legal safety rules.

We recommend shielding cables. The shielding should be connected to earth at both ends.

7.1 Cables

The electrical connection of linear motors is performed with using of free cable ends. For specific wiring schematic, please check the relevant documentation or contact the manufacturer.

The cable outlet is configurable. In the standard version, the cable outlet is placed parallel to x-axis, but other variants (y and z-axis) are also possible.

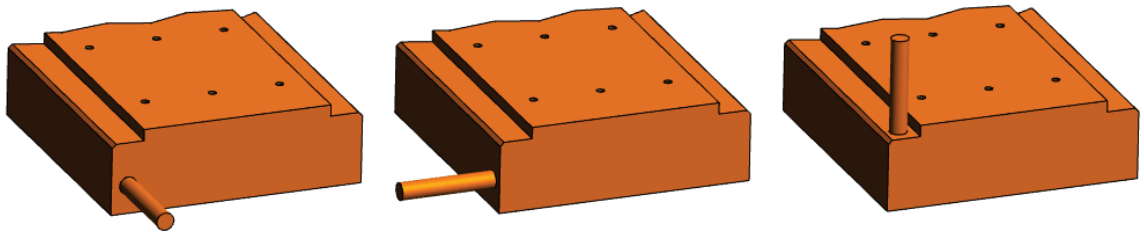


Figure 7: Cable outlet variants in x, y and z-axis

EMC

For compliance with Directive 2014/30/EC (EMC), and for correct system operation, used cables must be shielded (minimum cover 85%). Cable shielding must be connected to ground on both ends using a radio frequency connection (i.e. 360°). The cables and cable shields must be connected in accordance with the EMC requirements of the used drive.

NOTICE

Small wire diameters can lead to an unacceptable heating of the cable. This might result in a power loss to the motor, proportionally more severe as the cable length increases.

8 Maintenance

WARNING

Electrical hazard!

In case of motor disassembly, make sure that all electrically powered parts of the motor, windings and any accessory device which otherwise may lead to fatal injury is safely disassembled.

WARNING

Mechanical hazard!

Danger from moving parts with possible risk of death or very serious injuries.

- Make sure all precautions have been taken.
- Never go into the travel range of a linear drive on an unsecured machine.

WARNING

Magnetic hazard!

Due to the presence of permanent magnets on the surface of magnet tracks (secondary parts), special care must be taken when maintenance of those parts and related machine parts.

- In case of an accident, respectively to release of body parts (fingers, hands, foot etc.) stuck between two magnetic components, always have at least two wedges made of solid non-magnetic material (e.g. stainless steel or hardwood) with an apex angle between 10 and 15 ° and a hammer (approx. 3 kg, made from solid non-magnetic material).
- Do not place metal objects (e.g. work tools) near the secondary parts.
- Avoid spontaneous (uncontrolled) movement of primary and secondary parts due to the magnetic forces.

NOTICE

Because of product liability issues any motor damage should be repaired by WITTENSTEIN s.r.o.. Non-WITTENSTEIN staff may be unable to comply with safety rules (e.g. VDE guidelines) and WITTENSTEIN s.r.o. quality standards.

NOTICE

Each time the motor is disassembled, the phasing of the encoder system must be done properly by, or with assistance from, authorized WITTENSTEIN s.r.o. personnel.

Observe the following prescriptions:

- Follow the instructions of the guiding system supplier.
- Make sure that the guide surfaces are clean.
- Check for bearing noise and vibrations during normal operation at regular intervals.
- Keep the motor clean in order to ensure free ventilation flow for cooling.
- Check that the motor is not noisy during operation and vibration does not exceed standard levels.
- To detect and correct any irregularities at early stages it is recommended to carry out an inspection after the first 50/75 operation hours.
- For liquid cooled cyber® linear motor L3SK it is recommended to periodically clean and check the cooling circuit. The use of cleaning products and/or deposit removers has to be subjected to preventive verification of compatibility with the used materials of the primary and secondary parts (polyurethane), and with all the components of the circuit.

NOTICE

Risk of damage!

Keep the air gap clean. If dirt occurs in this area, there is a risk of damage of the machine.

If there is a risk of ferromagnetic particles (metal chips and sawdust), it is necessary to provide the machine path with protective covers along the entire stroke length.

Linear motor must be operated in accordance with its technical specification. Otherwise, it may be damaged.

9 Troubleshooting

Problem	Cause	Action
Motor does not start	Wrong connections	Check the connections of the motor.
	Mechanical failure	Check that the mechanics coupled to the linear motor allow free movement.
	Parameters	Check the parameter settings of the drive system.
	Overload	Reduce the load or contact application engineer for more details.
	Parameters	Check the parameter settings of the drive system.
Motor does not reach the rated speed	Overload	Reduce the load or contact application engineer for more details.
	Connections	Check connections on the motor and drive side.
Motor runs in wrong direction	Overload	Reduce the load or contact application engineer for more details.
Motor overheats	Wrong connections	Check that no phase is incidentally open or grounded.
	Harmonic distortion	High harmonic distortion in the frequency converter output is not allowed.
Vibrations or loud noise	Misalignment	Check the correct alignment of the motor and load. Ignoring misalignment can cause serious damage.

10 Motor Disposal

In accordance with directive 2012/19/EC electronic devices are "special waste" (WEEE) and must be subjected to treatment and professional elimination.

WITTENSTEIN s.r.o. motors may contain environmentally regulated materials, such as lead solder and circuit boards. It is the user's sole responsibility to dispose of the motors in accordance with specific local and national regulations. Be sure to send the material to authorized disposal facilities under controlled conditions. If it is possible to recycle the component materials, always do so with the support of authorized professionals.

10.1 What to Do if Repairs Are Required?

The linear motor can be repaired only by WITTENSTEIN s.r.o.; opening or re-work of the motor will void the warranty.

For warranty as well as post-warranty repairs please follow the procedure described below:

- In case of post-warranty repair, first consult with manufacturer possibility to repair from feasibility and commercial standpoint.
- Perform all required procedures for safely placing out of service your motor and re-send it safely packed to the address of the manufacturer (with the original packing material if available) together with serial number of affected motor and PO for warranty or post-warranty repair.
- All parts such as carriages, feedback sensors, components of guiding system etc. not fitted by WITTENSTEIN s.r.o. must be removed because WITTENSTEIN s.r.o. cannot guarantee a correct disassembly.
- WITTENSTEIN s.r.o. would appreciate a detailed failure or breakdown report attached to the delivery paperwork. **"For Repair"** should be clearly stated on the delivery note.
- After the motor has been received a complete analysis will be performed by our technicians. During this process, WITTENSTEIN s.r.o. may request details about the operating conditions (duty cycle, loading forces, etc.) from the customer. For post-warranty repair, analysis may be charged.
- Based on the performed analysis, a repair proposal is issued, together with a price calculation based on labor and material, (if the motor is not repairable, a commercial proposal for its replacement can be issued).
- If the repair proposal is approved, the motor is repaired and sent back to the customer.
- The General Repair Conditions of WITTENSTEIN s.r.o. apply to warranty and post-warranty process.

⚠ WARNING

Magnetic hazard!

- For transportation of secondary parts back to the manufacturer please use original protective cover if available. If it is not available use the similar way of packaging like the one described in chapter 4.1. to prevent any risk related to presence of magnetic field.
- Transported secondary parts must be marked with a warning label ("CAUTION! STRONG MAGNETS!")

WITTENSTEIN | cyber motor

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