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Operating and Installation Manual

DIRECT DRIVE LINEAR MOTORS

**SKA COMPACT and
SKA DDL LINEAR STAGE**

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1 Introduction

This manual contains instructions for using and installing **SKA COMPACT and SKA DDL Linear Stage** linear motors. They should be considered part of the equipment and as such must be kept in a safe place and handled with care.

All our products are manufactured and checked thoroughly at the factory so as to guarantee their performance and the specifications indicated on the label and in our marketing literature. Proper use and proper installation are essential in order to safeguard correct operation.

Motor Power Company Srl is not liable in case of negligence or failure to comply with the standards and requirements described in this manual. It is also not liable for any damage caused by improper use of the product.

Check the equipment supplied is complete at the time of purchase. All complaints must be submitted in writing within eight days after taking delivery of the motor.

1.1 Guarantee

Motor Power Company Srl guarantees its products for a period of 12 (twelve) months from the date of purchase. This guarantee consists exclusively of the repair or replacement without charge of any parts that our Service Department has examined and has deemed faulty.

Barring any liability for direct and/or indirect damages, this guarantee only covers material faults and will be null and void should parts have been removed, in case of tampering or of repairs that were not undertaken at our premises and/or by unauthorised personnel.

All equipment returned must be sent carriage paid, also during the guarantee period.

1.2 SKA COMPACT and SKA DDL Linear Stage linear motors

You have purchased a product from Motor Power Company's SKA Direct Drive range.

The SKA range is another step forward in the technological development of motion control thanks to linear technology, offering benefits both in terms of performance and energy savings.

An intrinsic feature of SKA Direct Drive products is their ability to couple the motor directly with the load: SKA Direct Drive linear motors have autonomous axes, capable of directly handling the mechanics associated with them without the need for other components for the transmission of motion. The result is genuine on board integration, allowing the elimination of complex kinematic chains.

This manual contains the instructions for using and installing **SKA COMPACT** products: linear axis designed as a "plug & play" solution thanks to the enclosed, weight-bearing structure made of extruded aluminium, and **SKA DDL Linear Stage** products: iron core linear motor fitted with a motor block, moving table, recirculating ball slides, linear guides, bellows, encoder, wiring and chain in addition to the power parts.

Thank you for choosing a SKA Direct Drive product.

For more details of the full range of our products and of the best in motion control, visit www.motorpowergroup.com.

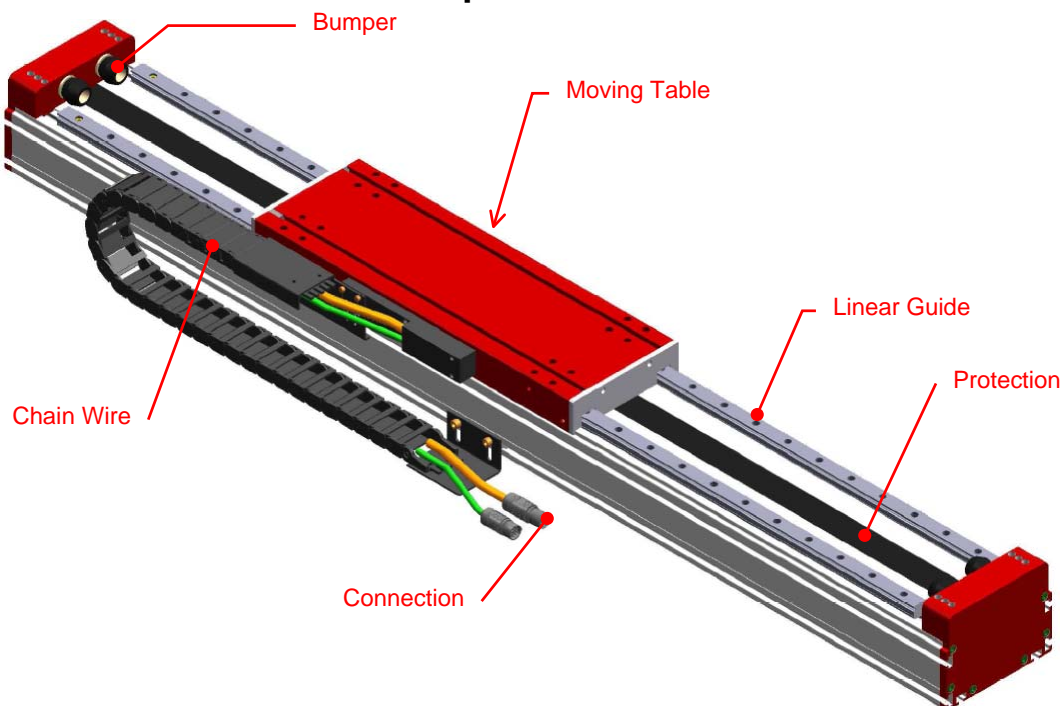
1.3 Specifications of SKA motors

All the motor's specifications are indicated on the label attached to its casing as well as in the technical and marketing documents. It is important to comply with the information provided in order to safeguard correct use and duration of the motor.

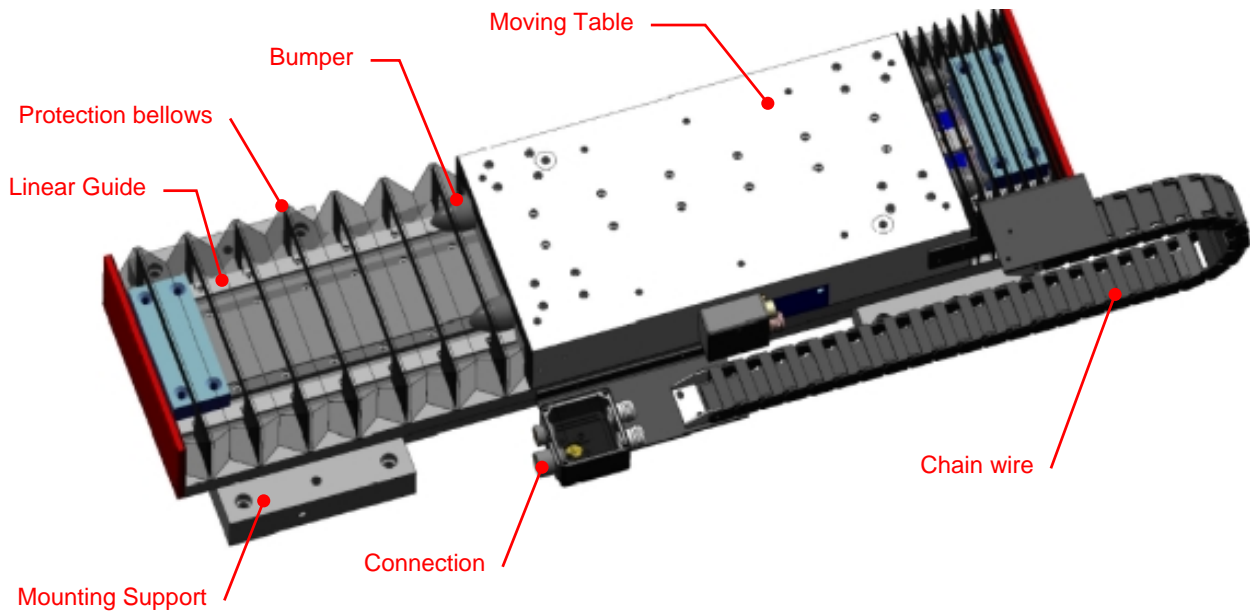
All specifications have a tolerance of $\pm 5\%$, unless specified otherwise.

1.4 Parts

1.4.1 SKA COMPACT motor parts



1.4.2 SKA DDL Linear Stage motor parts



1.5 Copyright

Motor Power Company Srl owns the copyright of this manual, which was designed for machine operators and maintenance personnel.

The instructions and specifications it contains may neither be completely nor partially copied, distributed or examined by unauthorised persons for the benefit of our competitors, or disclosed to third parties.

Motor Power Company Srl reserves the right to take legal action against anyone breaching this condition and to modify this manual without notice .

2 General safety instructions

SKA COMPACT and SKA DDL Linear Stage linear motors are designed and certified according to European Economic Community standards as set out in the 93/68/EEC Directive and in accordance with the 89/336 Directive and subsequent amendments. This means they are suitable for incorporation into a machine that must be declared compliant with the safety standards in the countries where this is to be used (European countries: 98/37/EC - 89/336/EC – 98/68/EC directives).

It may only be put into operation if national EMC requirements for the application are met. The supplier of the system/machine is responsible for ensuring the limits set by national standards are met.

The safety of people is the main goal pursued by our designers. We strive to envisage all possible hazardous situations when we design our equipment and naturally incorporate appropriate safety devices. Nevertheless, the number of accidents caused by imprudent and inept use of the various machines and / or equipment remains very high.

The implementation of appropriate safety precautions is, therefore, essential in order to reduce the risk of fire, electric shocks and injury. The safety instructions provided below must be read with due care and attention and understood before the equipment is used. After reading this manual, keep it in a safe place. Motor Power Company Srl is not liable in case of failure to observe the safety and accident prevention instructions provided in this manual.

- Before starting installation, check the SKA motor is intact, without any damaged and / or broken parts. Any broken or damaged parts must be repaired or replaced exclusively by personnel authorised by Motor Power Company Srl. Any repairs undertaken by unauthorised personnel will render the guarantee null and void and increases the risk of operating unsafe and potentially hazardous equipment.
- Keep the area where you are working clean and tidy. Untidy areas and environments promote the possibility of accidents.
- Any form of inspection, control, cleaning, maintenance, exchange and replacement of parts must be done with the equipment turned off and the power disconnected.

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- Before starting work, take time to become familiar with the control devices and how they work.
 - It is advisable there be no children, other people or animals close to you during installation: make sure they are at a safe distance.
 - It is essential to employ the services of specialized personnel to carry out installation.
 - Do not subject the equipment to unreasonable strain.
 - Do not allow children, any inexperienced persons or anyone not in good health to touch or use the equipment. Always comply with the current legislation in your country relating to the minimum working age.
 - Always install the equipment in places that are adequately lit and in a safe and stable position.
 - Use suitable lifting equipment to move the equipment and wear safety gloves and footwear.

2.1 Explanations of symbols and references



This symbol is placed next to instructions which will result in injury, death or long-term health risks if they are not carried out properly.



This symbol is placed next to instructions, which may result in injury, death or long-term health risks if they are not carried out properly.



This symbol is placed next to instructions, which may result in injury or damage to the product if they are not carried out properly.



This symbol indicates operations that must be carried out by the machine operator or maintenance engineer.

DEFINITION OF MACHINE OPERATOR OR MAINTENANCE ENGINEER

The machine operator or maintenance engineer is a person with a sufficient degree of technical preparation in order to operate the equipment. He or she has perfect knowledge of the contents of this manual. He or she has been properly informed and trained and has clearly defined duties that are classified at company level. MOTOR POWER COMPANY Srl is not liable should persons work on our equipment who fail to meet the above requisites.

2.2 Designated use and applications



Motor Power Company's SKA COMPACT and SKA DDL Linear Stage synchronous linear motors are intended for use as linear servomotors.

Before switching on any equipment for the supply of the motors, it must be programmed with the correct specifications for the application and the type of motor.

The units are manufactured for installation in machines used in commercial applications or light industry.

Note: SKA linear motors are not designed for direct connection to mains electricity. "Inappropriate use" includes using the motor in any field of application that is not included in the above description or in circumstances other than those described in this document or with different specifications.

Special security applications are not allowed unless expressly specified in detail in the operating instructions. For example, the following types of application are not included: cranes, passenger lifts, passenger vehicles and equipment, medical equipment, refineries, transportation of hazardous items, nuclear areas, use in areas with fields of high frequency, mining, contact with food, control of safety devices and any other environment that is not commercial or light industrial.

2.3 Specific instructions for electrical safety



Note: This section concerns drive units and components with a voltage above 50 Volts. Touching parts with a voltage above 50 Volts may be dangerous and result in an electric shock. When using electrical devices, some parts will inevitably have a dangerous voltage.

High voltage! Risk of death or serious injury caused by electric shocks.

- Only personnel who are qualified and trained to work with electrical appliances are allowed to operate and / or repair the unit
- Observe the general rules and safety instructions during installation
- Before switching on the system, the earth connection must be connected on all electric units using the connection points provided. Failure to complete this connection could lead to dangerous voltages on the metal casings of electrical appliances.
- The leakage current is higher than 3.5 mA.
- Use copper wires with minimum 10 mm diameter for the entire length of the earth circuit

2.4 Hazardous movements



Hazardous malfunctions may be caused by failure to control a connected motor correctly. This may be the result of various causes:

- Improper or incorrect wiring
- Incorrect use of components
- Sensor and transducer faults
- Faulty components
- Software faults

Such malfunctions may occur immediately after switching on or during operation. Monitoring driven components excludes any predictable malfunction but is not sufficient in order to safeguard safety, especially as regards the prevention of damage or injury. It is, therefore, necessary to provide safety systems that are triggered should the motor fail to start and / or take possible uncontrolled movements of the motor into account.

To avoid accidents, injuries and / or damage:

- Do not allow personnel to approach the machinery or any moving parts.
Possible methods to prevent unauthorised access include:
 - safety rails
 - safety gate
 - safety cover
- Rails and barriers must be designed to counter the maximum potential kinetic energy

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- Ensure emergency switches are easily accessible and are in the immediate vicinity. Test the switches work properly before switching on the machine for the first time. Do not use the unit if the emergency switches do not work properly
 - Provide protection against sudden switch-on by isolating the drive power connection with an emergency switch or using a safety switch
 - Disable the drives before entering the dangerous area
 - Turn off electrical equipment before:
 - Repair work
 - Cleaning
 - Prolonged downtime of the driven application
 - Avoid using high-frequency equipment, control units and radios in the vicinity of electrical equipment and cables. If it is not possible to avoid using these devices, test the system in all modes to verify any possible malfunction before starting it up for the first time.

2.5 Magnetic or electromagnetic fields



Health hazard for wearers of pacemakers, metal implants or hearing aids in the immediate vicinity of electrical equipment.

- Wearers of pacemakers and/or metal implants must not access areas where motor parts with permanent magnets are stored, repaired or assembled
- A doctor's note is required before a person with a pacemaker is allowed to access such areas. The immunity to electromagnetic fields of pacemakers that have been or are to be implanted varies greatly: there are therefore no set rules.
- People with metal implants in their body or people with hearing aids should consult their doctor before entering these areas. Their health may be at risk.

2.7 Overheated parts



- Surfaces may be hot. Risk of injury! Risk of burns!
- Do not touch the surface of the moving part of SKA linear motors after it has been operating. Risk of burns!

3 Handling

**WARNING****ATTENTION**

SKA motors usually weigh over 30 kg. Therefore, they must be handled with caution and moved with the assistance of several people, preferably using lifting equipment.

Always use lifting equipment with an appropriate capacity to cater for the weight of the motor and use proper coupling systems (hooks, ropes, chains, etc. ..) for the weight to be lifted.

Avoid hooking directly up to motor parts when handling the motor: use the lifting eyebolts instead.

If you need to move the motor using other lifting points than those provided, proper lifting straps may be used, provided they can bear the weight and are long enough so they can be placed at the sides of the motor so that its total length is divided into equal sections.

The straps must wrap around the body of the motor without resting on the table, guides or cable support chain, as these could be damaged when the motor is lifted.

Always follow the instructions provided by the manufacturer of the lifting system.

If the motors are not installed immediately, they must be stored in their original crate in a dry, clean area that is not subject to vibration and is protected against sudden shifts in temperature that could cause condensation.

4 Assembly and commissioning of SKA motors

**WARNING****ATTENTION**

SKA linear motors may be placed in any position provided the identification label is visible and the motor is not directly in the flow of hot air coming from other parts of the machine and does not sit on top of hot surfaces.

The position chosen for the motor must respect the specifications given for the temperature and for protection against dust and humidity when the motor was ordered. In case of doubt, contact the technical department at Motor Power Company with the motor's reference code on its label. SKA motors are not suitable for use in environments where there is a danger of explosion, for underwater applications or for safety equipment.



Caution: you must consider the weight of moving parts if the motor is mounted with the longitudinal axis of motion not on the horizontal plane. It may be necessary to compensate for the weight to be lifted using various possible technical solutions or by oversizing the linear motor itself so that it is able to lift the load.

Always provide a locking system to prevent the load moving due to gravity when the motor is not powered.

Check these issues carefully before starting work and contact the technical department at Motor Power Company if necessary.

Electrical safety limit switches should be fitted at both ends of the SKA motor if they are not already fitted on the machine parts, in a position where they will intervene before the moving table arrivals at the end of its run.



Caution: electrical safety limit switches are essential for safeguarding the intrinsic safety of machinery whose movements must not be entrusted exclusively to the electronic control of the SKA motor.

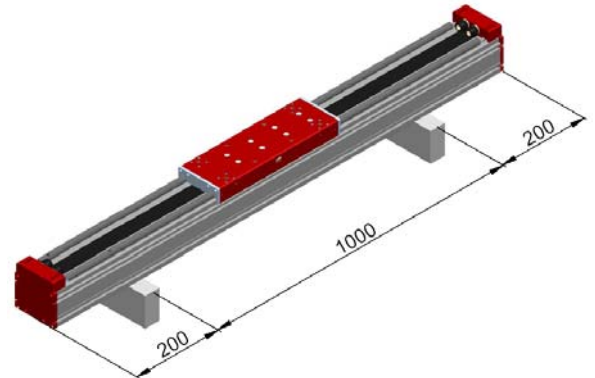
4.1 SKA COMPACT assembly surface

The motor must be supported by an adequately prepared surface to accommodate the SKA COMPACT motor. The size of this surface must be calculated to cater for the weight of the motor and the parts that will be mounted on it and precision machined to ensure the motor rests on it perfectly (maximum error of flatness 0.2 mm).

If the full length of the motor is not fitted on a flat surface but on a frame or other structure, the points supporting the motor must still have a flatness of 0.2 mm.

The recommended configuration for the structure supporting the motor is with areas for supporting and securing it that result in 200 mm maximum projection of the motor (maximum overhang) and 1 meter maximum distance between the support points (maximum span).

Other configurations are possible but they must be assessed and calculated by Motor Power Company's technical department. The above applies to any fixing position, also for motors blocked by side walls with respect to the table and any other installation.



4.2 Mechanical installation of the SKA COMPACT

After unpacking, the SKA COMPACT motor must be placed on the surface provided described in the paragraph above and secured to it using steel screws.

Use at least two screws at every fixing point to block the motor using appropriate plugs.

These screws must secure the motor firmly; tighten them by applying the torque setting listed in Table 1 and block using medium threadlock (such as Loctite 243).

Release the moving table by removing the appropriate lock and slide it by hand along the axis for its entire length, checking that the movement is smooth, that there are no parts knocking the table and that it trips the electrical safety limit switches before coming into contact with the end bumpers.

Now complete the electrical wiring of the motor using the connectors on the base and the performance tests: first with no load, then with no load mounted on the table, as described in Chapter 4.5 below "Electrical Installation of SKA motors".

4.3 Assembly surface for the SKA DDL Linear Stage

The motor must be supported by an adequately prepared surface to accommodate the SKA DDL Linear Stage motor. The size of this surface must be calculated to cater for the weight of the motor and the parts that will be mounted on it and precision machined to ensure the motor supports rest on it perfectly (maximum error of flatness 0.2 mm).

If the full length of the motor is not mounted on a flat surface but on a frame or other structure, the points supporting the motor must still have a flatness of 0.2 mm and all the support and fixing points required must be provided.

4.4 Mechanical Installation of the SKA DDL Linear Stage

After unpacking, the SKA motor must be placed on the surface provided as described in the paragraph above and secured to it using steel screws.

Use all the holes provided to secure the motor and appropriate steel screws at each point of attachment.

These screws must secure the motor firmly; tighten by applying the torque settings listed in Table 1 and block using medium threadlock (such as Loctite 243).

Release the moving table by removing the appropriate lock and slide it by hand along the axis for its entire length, checking that the movement is smooth, that there are no parts knocking the table and that it trips the electrical safety limit switches before coming into contact with the end bumpers.

Now complete the electrical wiring of the motor using the connectors on the base and the performance tests: first with no load, then with no load mounted on the table, as described in Chapter 4.5 below “Electrical Installation of SKA motors”.

4.5 Electrical installation of SKA motors

After the motor has been installed as described above, complete the wiring and connection to the power supply.

Refer to the documents provided with the motor for the wiring diagram and check you comply with the following points:

- All metal parts of the motor must be connected to earth
- The supply line must be sized so that current will not be supplied at any stage of operation that is above the maximum current stated in the catalogue or on the label
- Power supplies must be sized according to the rated current for the SKA motor as stated on its label; use suitable cables for the application that comply with current regulations
- Fit protection devices against overloads and short circuits, as the motor is not fitted with such protection
- Protect the power supply against possible voltage backfeed to the heads of the motor should it stop due to inertia
- If shielded cables are to be used, refer to the wiring diagram attached for the proper connections of the insulation / braid.

After completing the above steps for installation, an unloaded test cycle may be carried out by supplying power to the SKA motor by means of an appropriate electronic drive; calibrate to 15% of the nominal operating current for the nominal cycle of operation and perform a test cycle. The moving table

must move readily in both directions, respecting the positions set by the axis control.

If the outcome of the test cycle is successful, gradually increase the current of the driven application to both the nominal and peak values as envisaged for the cycle of operation.

4.6 Installing the load on the moving table

After completing the wiring and testing of the motor functions, you complete the final commissioning stage and mount the device that is to be controlled on the moving table. This must be done using the threaded holes on the table or using plugs and securing the screws with medium threadlock (such as Loctite 243).

Table 1

Screw Type	Torque
M4	3.04 Nm
M5	6.00 Nm
M6	10.33 Nm
M8	24.94 Nm
M10	50.31 Nm

5 Brake motors



All safety brakes (optional) fitted on the motors may only be used to block the motor after it has stopped running and not for dynamic braking.

The brakes are pneumatic, intrinsically safe brakes: they will close and block the table when there is no pressure at the supply pipe inlet.

During the movement of the motor it is essential that the brake disengages perfectly by supplying it with compressed air that is clean, filtered and dehumidified at a pressure between 5 and 7 bar. If these conditions are not met, the brake may only partially disengage or even fail to disengage.

The supply system for motors with a brake must also be fitted with special air pressure sensors that cut the electric supply to the motor if the pressure of the pneumatic circuit is not within the set limits.

6 Maintenance of SKA motors



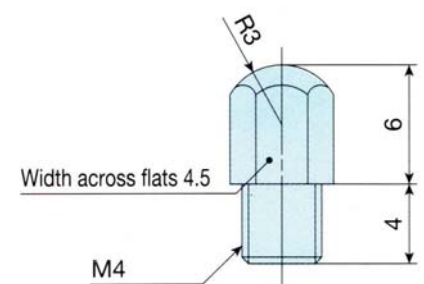
SKA Direct Drive motors were designed to be used for long periods and with extremely low maintenance demands. Nevertheless, they are still precision equipment requiring routine work in order to maintain their specifications. The work required depends on the demands of the type of application where they are used and the operating cycle.

Every 15,000 km of operation, lubricate the bearing slides adding new grease through the grease cups fitted on them so that the old grease is forced out completely.

Insert approximately 1 cm³ of grease for each slide, paying attention to any waste grease not used between the greasing cup, couplings and pump.

MATERIALS REQUIRED:

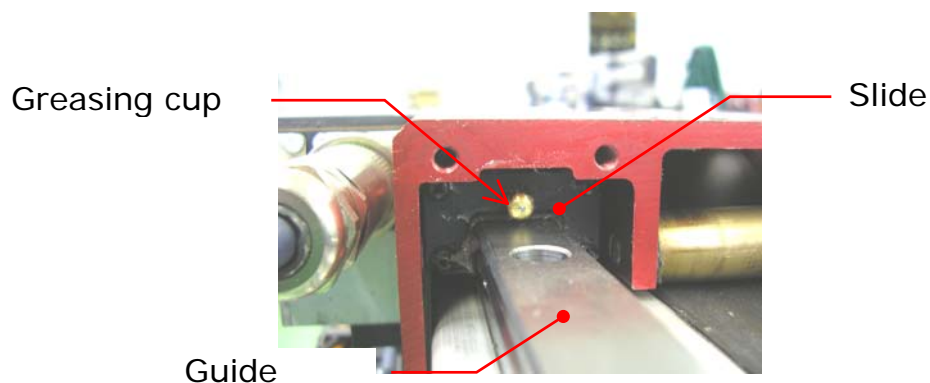
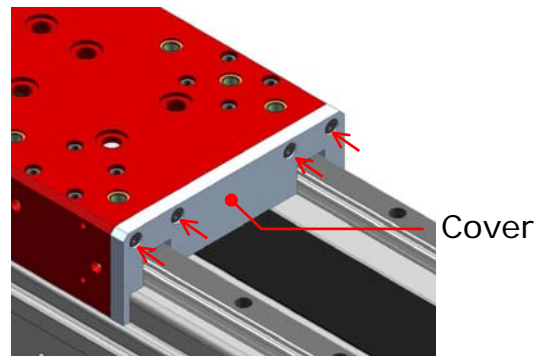
- Hexagonal spanners
- Straight ended lubricating pump suitable for the illustration opposite (see any subsequent notes)
- KP2K grease according to DIN 51825 for high loads with EP2 additives (Kluber Isoflex NBU 15 is recommended)



Notes on the greasing cup: if you do not have a suitable terminal to centre the greasing cup shown in the illustration, you can unscrew the greasing cup itself and inject the grease through a terminal for M4 threaded hole or with a terminal with straight hole and tapered tip.

6.1 Greasing sequence for the SKA COMPACT:

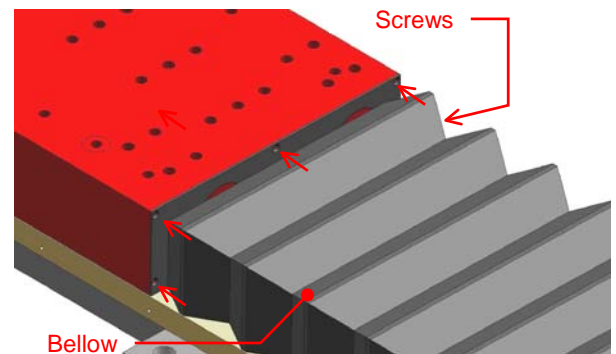
1. Disconnect the motor from the power supply
2. Move the moving table on one side towards the relative limit switch so as to have free access to the opposite side
3. Unscrew the 4 screws closing the motor's moving table and open the relative cover
4. The 2 motor slides can now be seen under the moving table with the 2 relative greasing cups at the end, where the grease is injected



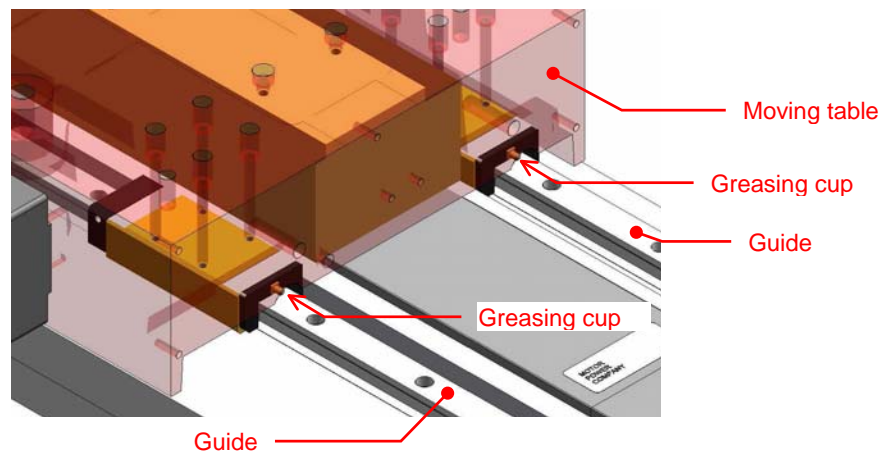
5. Load the hand pump with the correct grease and couple with the straight terminal to centre the greasing cups
6. Centre up the greasing cup and the terminal and exercise a light pressure, injecting the necessary amount of grease. Repeat for both slides on the open side
7. Close the cover and tighten the 4 screws
8. Repeat these steps for the other side of the motor, sliding the moving table toward the opposite limit switch.

6.2 Greasing sequence for the SKA DDL Linear Stage

1. Disconnect the motor from the power supply
2. Slide the moving table on one side towards the relative limit switch so as to have free access to the opposite side
3. Unscrew the 5 screws securing the bellows to the moving table of the motor and move it in order to gain access to the side of the table



4. The 2 motor slides can now be seen under the moving table with the 2 relative greasing cups at the end, where the grease is injected.



5. Load the hand pump with the correct grease and couple with the straight terminal to centre the greasing cups
6. Centre up the greasing cup and the terminal and exercise a light pressure, injecting the necessary amount of grease. Repeat for both slides on the open side
7. Close the bellows and tighten the 5 screws
8. Repeat these steps for the other side of the motor, sliding the moving table toward the opposite limit switch.

7 Decommissioning and disposal

It is essential you comply with the current legislation for decommissioning and disposal in the country where the SKA COMPACT and SKA DDL linear motors are used.



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