



Operations and Maintenance Manual

AXONE-DUO Single-Axis Tracker

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[ENGLISH VERSION]

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ACRONYMS

DBOX: Drive Box

TBOX: Transmission Box

MBOX: Meteorological Sensor Box

SSR: Solid State Relay

PLC: Programable Logic Controller

UPS: Uninterruptible Power Supply

PoE: Power over Ethernet

SCADA: Supervisory Control and Data Acquisition

1. PRELIMINARIES

This manual is written as a practical guide for the safe and correct use of the machine, and also for its proper maintenance.

THE MACHINE WILL ONLY BE STARTED UP IF ALL INDICATIONS MENTIONED IN THIS MANUAL HAVE BEEN OBSERVED.



ATTENTION! NEVER USE THE MACHINE FOR USES OTHER THAN THE ONES AUTHORIZED BY THE MANUFACTURER.



ATTENTION! BEFORE ANY MAINTENANCE OPERATION IT IS COMPULSORY TO STOP THE MACHINE, ISOLATE IT FROM THE ELECTRICAL SUPPLY AND BLOCK IT.



ATTENTION! ALL ADJUSTMENT, REPAIR AND MAINTENANCE TRANSACTIONS SHALL BE MADE BY SPECIALIZED, COMPETENT, AND AUTHORIZED TECHNICAL STAFF.

2. WARNING

- This manual is an essential part of the machine and, as it is stated in the *Directive 2006/42/EC* of the European Parliament and of the Council on machinery (*R.D. 1644/2008 Annex I*), it must be kept.
- It must be read carefully as it contains important indications on safe operation and maintenance.
- This machine must be used only for the purpose for which it has been manufactured; any other use could be dangerous, for which reason the manufacturer will not be liable for damage caused.
- Any intervention or modification which alters the structure, or the working cycle must be made or authorized by the manufacturer.
- The substitution of pieces, elements or equipment, will be made considering the original pieces.
- If this is not so, the manufacturing company will not be liable for the possible consequences.

3. SAFETY NOTICE

4.1. SAFE FUNCTIONING

Safety notices contained in this section and throughout the manual are applicable to the works carried out on the machine. The text includes warnings concerning safety matters. It is important to observe the indicated safety notices. If not observed, personal or material damage to the machine or other equipment may occur.

Taking this into account, we provide basic recommendations concerning safety below.

- Review and observe the contents in this section before installing, starting up, maintaining or repairing the machine.
- Observe all warnings concerning specific areas indicated in the text.
- Keep this manual and show it to the staff operating the machine.
- Wear the right personal clothes and the necessary protective equipment.
- Study and take all safety measures prescribed by the company, general accident prevention regulations and safety legislation.

4.2. SAFETY SIGNS

The following signs are used throughout the manual to indicate hazards or their potential causes. **Read them carefully!** Failure to observe a warning could cause personal injury and/or damage to the machine or other equipment.



Key words

The following words are associated with the signs used in this manual as well as on labels placed on the machine indicate the potential risk level of hazardous situations that could cause damage or personal injury.

- **DANGER:** Indicates an imminent risk which, unless avoided, can cause loss of life or serious injury.
- **WARNING:** Indicates an imminent risk which, unless avoided, can cause serious injury.
- **CAUTION:** Indicates a potential risk which, unless avoided, could cause minor or moderate injuries. This word is also used to identify unsafe practices that could cause damage to property.

(See section 7.10. DESCRIPTION OF DANGER, PROHIBITED AND OBLIGATION SIGNALS).

4.3. SPECIALIZED STAFF

















“Specialized staff” refers to staff who know the machine in depth, its safe usage, maintenance and repair. Specialized staff must be physically capable of performing the corresponding tasks, knowledgeable of the rules and safety regulations, and must have been trained to install, work, maintain and repair the machine appropriately. It is the responsibility of the company using the machine to ensure that staff fulfils these requirements.







4.4. OPERATION

The machine must be operated by specialized staff in accordance with the instructions provided in this manual.



ATTENTION! FAILURE TO COMPLY WITH SAFETY WARNINGS MAY CAUSE PERSONAL INJURIES, DEATH OR MATERIAL DAMAGE.

-  Before using the machine carefully read the present operation and maintenance manual, especially those sections regarding safe working and safe use of the machine.
-  The machine must only be used by properly trained staff who have been informed of the hazards associated with the operation of the machine and the precautions required to be taken.
-  Never allow the machine to be operated by staff under the effect of substances that impair their reactions or who are unable to operate it for physical reasons.
-  **Before starting the machine ensure that there are no people or equipment in its danger areas.**
-  The greatest care has been taken in the design and manufacturing of the machine to ensure the safety of the operator. Therefore, every one of the **safety devices used are essential and may not be removed or eliminated under any circumstances**; any tampering can cause a hazard to you and those around you.
-  **Before starting up the machine, ensure that all its protective guards and safety devices are in place and fully serviceable, that moving parts are not blocked, that there are no damaged items and that all the machine components are correctly installed and in proper operating condition. Otherwise do not operate the machine.**
-  **Any safety devices removed for cleaning, maintenance or repair work must be reinstalled immediately upon completing the work.**
-  **Prior to performing any maintenance, repair or cleaning work the machine must be locked out and tagged out. In other words, turn the main power off, lock it out and signpost it appropriately.**
-  It is strictly forbidden to use the machine if any distortion or malfunction is detected. In such case the machine must be immediately locked out and tagged out (isolated from the power supply and signposted appropriately) and the technical support service called to correct the faults detected.
-  Certain practices or minor alterations by the user can cause damage and/or accidents. Users are advised against carrying out any alterations without prior approval by the manufacturer.
-  The use of non-original replacement parts can compromise the proper operation of the machine. The manufacturer declines any liability for the use of such parts.
-  Always keep the machine clean and in good operating condition.
-  Adjustments and repairs should always be performed by specialized, qualified and authorized staff.
-  Always check that the machine has not been tampered with by other persons.
-  Check that none of the safety elements have been tampered with.
-  **Do not use the machine in unfavorable weather conditions (strong wind, storms, etc.).**

-  Keep your limbs and/or clothes clear from rotating or moving parts. Do not wear loose clothes when maintaining units with rotating or moving parts. Remove wristwatches, rings, necklaces or similar jewelry items and tie up or cover long hair prior to performing any work on or with the machine.
-  **NEVER USE THE MACHINE FOR PURPOSES OTHER THAN THOSE AUTHORISED BY THE MANUFACTURER.**
If in doubt, contact the manufacturer.
-  **The fencing must remain closed throughout the operation of the machine. NEVER leave the perimeter fencing open while the machine is in operation.**
-  **NEVER open the cabinet of the DBox or MBox unless the power supply has been disconnected.**
-  **Never open the TBox unless the power supply breaker has been disconnected**
-  In case of fire disconnect the machine from the power supply and use extinguishers with foam resistant to alcohol, dust, water spray or CO2, depending on the nature of the fire.

4.5. MEASURES IN CASE OF ABNORMAL FUNCTIONING

If a failure takes place when working the machine, proceed as follows:

- Stop the machine.
- Turn the power supply off by setting the main power off and signpost it appropriately.
- Verify the absence of voltage.
- Have the unity repaired only by authorized, specialized, competent staff.



WARNING: DO NOT START UP THE MACHINE UNTIL THE DETECTED FUNCTIONING FAILURE HAS BEEN REPAIRED.

4.6. MAINTENANCE/REPAIR

For the execution of maintenance or repair procedures rely only on specialized, competent, authorized staff. When carrying out these tasks, please wear appropriate clothing and protection equipment.



TAKE THE FOLLOWING STEPS BEFORE TRYING TO MAINTAIN OR REPAIR THE MACHINE.

- Stop the machine.
- Turn the power supply off by setting the main power off and signpost it appropriately.
- Verify the absence of voltage.
- If the machine energizes itself, repeat the previous steps: unplug, mark and cover. Try to energize the machine again.
- If the machine does not energize itself, begin the maintenance /repair tasks.



ATTENTION! ALL ADJUSTMENT, REPAIR AND MAINTENANCE TASKS SHALL BE CARRIED OUT ONLY BY SPECIALIZED, COMPETENT, AUTHORIZED TECHNICAL STAFF.

For maintenance or repair tasks, the following personal protective equipment is required at all times:



REQUIRED: It is compulsory to use safety boots with insulation and reinforced toe. Failure to use may result in personal injury.



REQUIRED: It is compulsory to use safety gloves at all times. Failure to use may result in personal injury.



REQUIRED: It is compulsory to wear a safety helmet to protect against low machine parts and/or ejections, falling objects, tools or parts of the machine. Failure to use may result in personal injury or death.

(See section 8.5 *MAINTENANCE* in this manual)

4.7. CLEANING

As a consequence of the natural movement of the equipment it is not necessary to clean the solar panels as often as if they were stationary solar panels. To avoid damage to the equipment, it is advisable to clean the plaques, at least twice a year (depending on the weather conditions in every area), with pressurized water, mixed with degreasing cleaner and polish, using a rubber brush not to scratch the modules.

For the cleaning of the machine and working area, the procedure is as follows:

- Connect to SCADA and set the Clean Manual Movement to the desired blocks or to the entire plant.
- Activate the emergency stop button in the DBox.
- Proceed with the cleaning of all its elements.
- Lubricate the machine with the recommended greases and oils, or those with similar characteristics.
- Check and set the electrical and mechanical elements to the correct state.
- Once the machine is clean, check the state and operation of the installed safety devices.

For that purpose, it will be necessary to use the following personal protective equipment:



REQUIRED: It is compulsory to use safety boots with insulation and reinforced toe. Failure to use may result in personal injury.



REQUIRED: It is compulsory to use safety gloves at all times. Failure to use may result in personal injury.



REQUIRED: It is compulsory to wear a safety helmet to protect against low machine parts and/or ejections, falling objects, tools or parts of the machine. Failure to use may result in personal injury or death.



WARNING: avoid the accumulation of liquids, powders and solids on the machine as they could affect the performance and correct operation of the machine.



CAUTION: Eliminate any excess oils or grease which could accumulate after maintenance or performance works. Failure to do so may result in personal injury.



IMPORTANT: Before using any machine cleaning product, always check its safety instructions or the material safety data sheet provided by the manufacturer.



CAUTION: In case of accidentally dropping any product please check the safety details provided by the manufacturer.

4.8. WASTE DISPOSAL

Disposal of equipment and materials must be carried out according to local regulations.

In order to avoid pollution, pay special attention to correct waste disposal methods.

- Always collect the oil drained from your machine in suitable containers and deliver it to a specialized collection and management company. Never drain directly on the ground, or dump into drains, rivers, lakes or the sea.
- Respect laws and regulations concerning dangerous objects and products disposal such as oils, fuel, cooling gel, solvent, filters or batteries.



4. USER INSTRUCTION MANUAL

4.1. SECTORS OF USE

The machine will be used only for POSITIONING THE SOLAR PANELS SO THAT THEY STAY CLOSE AND AT THE CORRECT ANGLES TO THE SOLAR RAYS, FOLLOWING THE SUN PATH FROM SUNRISE IN THE EAST TO SUNSET IN THE WEST, as in the conditions indicated by the manufacturer.



ATTENTION! NEVER USE THE MACHINE FOR USES OR CONDITIONS OTHER THAN THOSE AUTHORIZED BY THE MANUFACTURER



ATTENTION! Never use the machine with an inappropriate type or greater number of photovoltaic panels than recommended by the manufacturer.



ATTENTION! Do not use the machine in adverse weather conditions (strong wind, storms, etc.).

- This machine will only be used for the purpose for which it was specifically designed. Any other use will be considered as inadequate and as such, non-reasonable.
- The manufacturer or provider will not be liable for the possible damage caused by inappropriate, wrong and/or non-reasonable use.
- Safe and correct use of the machine implies following the User Manual indications and particularly:
 - The machine must be operated only by staff who has been previously instructed of its correct use and safety hazards. If necessary, the manufacturer or distributor may be consulted. Correct safety measures must be taken during the works to minimize associated risks and avoid prohibited actions.
 - Work must always be carried out using the protection systems provided with the machine which must be reviewed and maintained as per the user manual. These must not be removed or discarded.
 - Established safe working methods must be employed at all times.
 - Maintenance of the machine will be carried out following the indicated guidelines, by staff having the basic knowledge on the machine's operation, the mechanical and electrical aspects to allow them to perform the work.
 - During maintenance work the safety measures provided with the machine will be employed or, as the case may be, other indicated complementary measures.



DANGER: The use of this machine in a way other than the described in this document may result in personal injury, death or material damage.

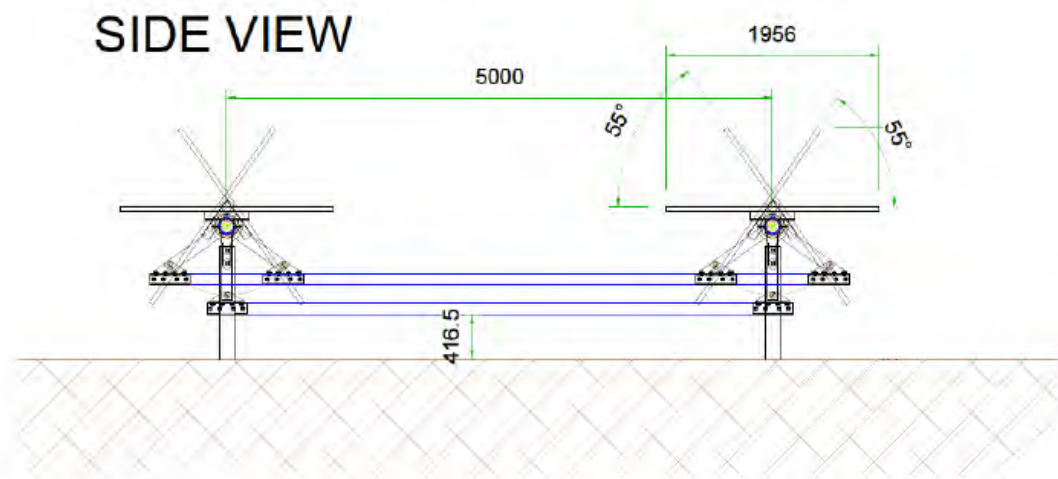
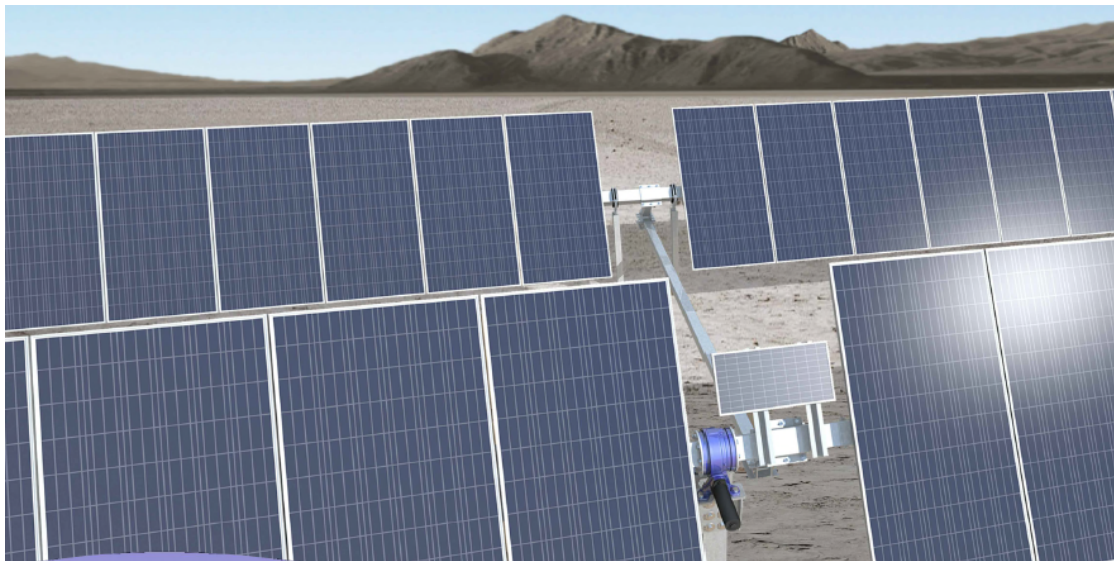
The following actions of the machine owner or worker are some of the many possible cases of inappropriate use of the machine. These actions will permit the manufacturer to declare himself non-liable in case of personal injuries or material damages which may occur:

- To use the machine with materials different from the ones authorized by the manufacturer.
- To modify or make changes in the unit without previous approval.
 - Modifications in the machine performance speed, by altering the pre-regulated and stated tracker by the manufacturer, or by modifying transmissions.
 - Any mechanical and/or electrical modification in the machine, its parts or its installations.
- Only use original replacement parts supplied by the manufacturer.
- To carry out a wrong assembly or installation.
- Wrong use, wrong storage or wrong maintenance.
- To ignore safety notices.
- To cancel or ignore the use of safety devices.
- To ignore instructions related to the installation, assembly, use, handling, storage, maintenance or repair, or to carry out these tasks by non-specialized staff.
- To use inappropriate auxiliary equipment or unsuited materials.
- To break the safety rules at work or the regulations issued by authorities or safety councils.
- **Damage of the machine as a result of natural catastrophe such as strong winds, ice, storms or other catastrophes.**
- **Installation in the equipment of more photovoltaic panels than recommended, or of panels different from those recommended.**
- Improper packaging of returned components.
- Damage of the machine as a result of personnel under the influence.
- Use in extreme temperature and climate conditions outside of the design specifications.

4.2. MACHINE DESCRIPTION

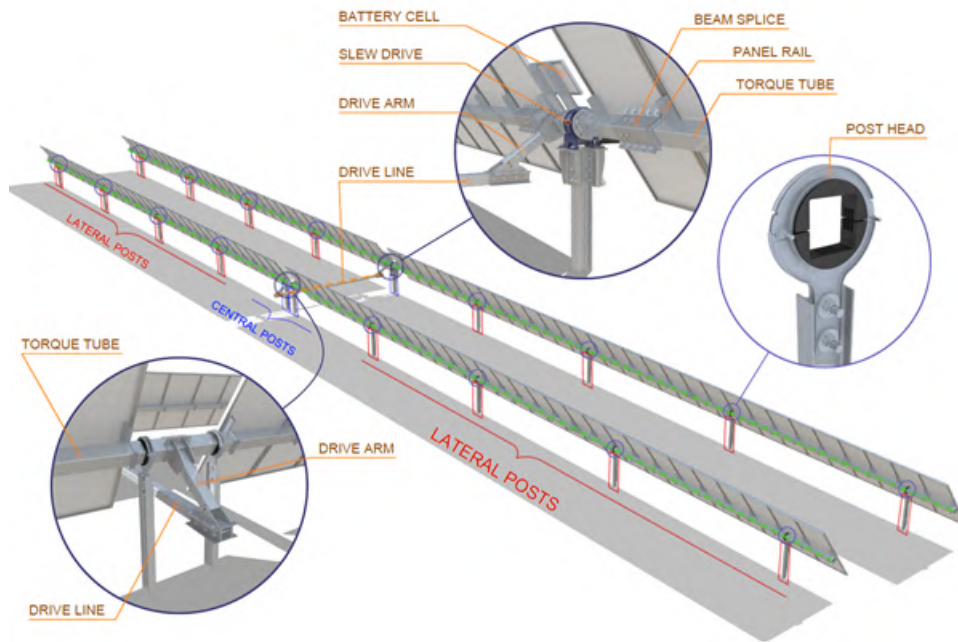
It is a machine whose function is positioning the solar panels so that they stay close and at correct angles to the solar rays, following the sun path from sunrise in the east to sunset in the west.

This machine is made up by a number of metal frames arranged along a North-South axis, onto which the photovoltaic modules are mounted. The rails or supports of said photovoltaic modules are joined by a metal section attached to a rotating driver, located in the centre of the assembly, which provides the East-West movement (zenithal axis) to enable solar tracking. The maximum reachable angle is $\pm 55^\circ$, resulting in a significant improvement in production compared with a fixed-structure system.



Solar tracker at maximum tilt position (55° to the horizontal) and in the stow position (0°)

The solar tracker is made, mainly, with the following elements or components:



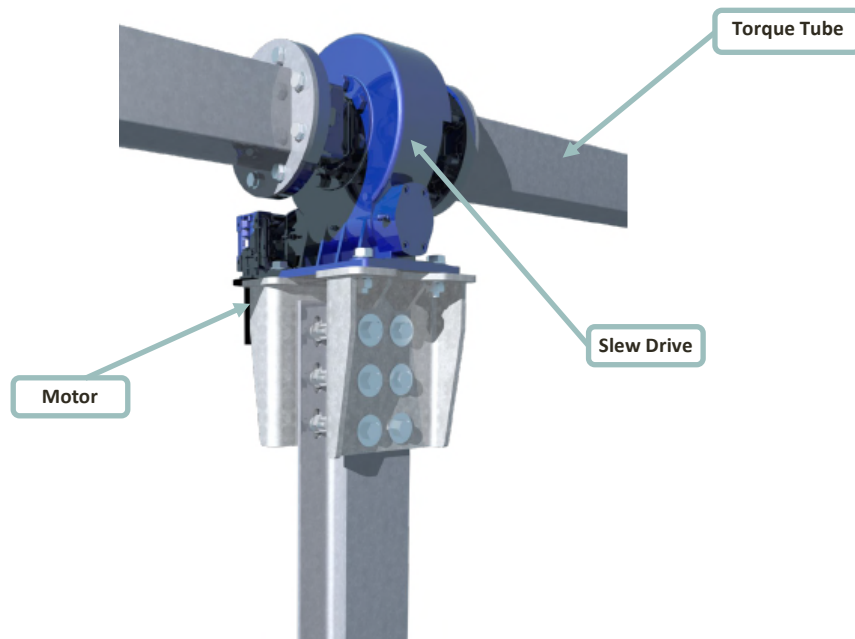
The installation support structure (support posts, torque tube and solar panel rails) has been made and designed with the necessary resistance and dimensions so that the set has the necessary stability to be used without the risk of overturning, collapse or being displaced untimely.

The support posts lie on a foundation defined for each project (see Assembly manual).

Attached to the post heads are the torque tubes on which the solar panels are mounted by means of their support brackets (rails), allowing the direct anchoring and fixing of several different panel types (bifacial, monocrystalline, polycrystalline or thin film photovoltaic solar panels).

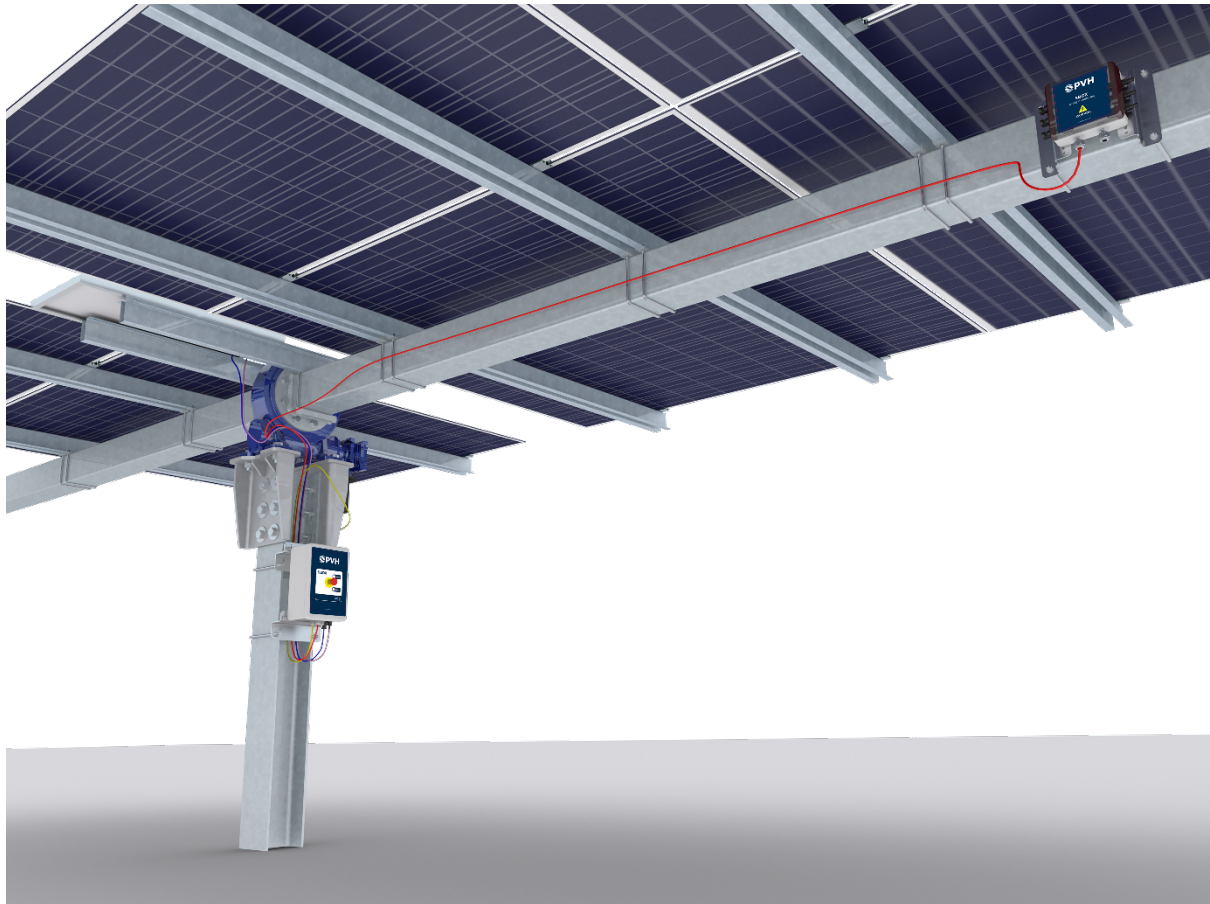
The entire assembly's support structure is made of steel with several coatings and/or Magnelis, assuring adequate corrosion resistance. It is designed and manufactured to withstand the maximum capacity of solar panels indicated on TECHNICAL CHARACTERISTICS OF THE MACHINE, accordingly.

The zenithal movement of the solar panels is carried out by means of a rotating driver located on the central post of the structure. The rotating driver consists of a slew drive connected to a motor that applies the necessary torque to rotate the torque tube.

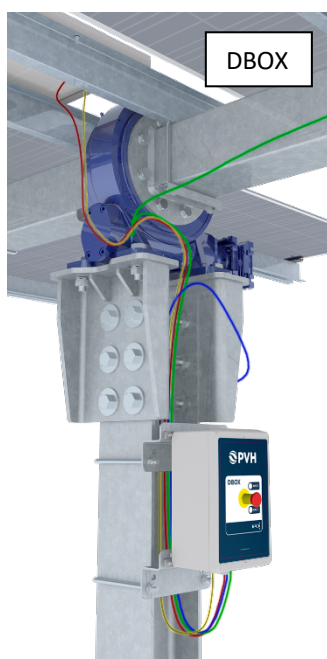


Thus, the rotating driver orients the solar panels following the sun's course from sunrise to sunset, keeping close to the perpendicular of the sun's rays.

Its movement and position is controlled by an automated device with an industrial PC (TBox, DBox and MBox), an inclinometer or SBox that detects the panel inclination angle, and two end stops preventing it from rotating beyond the permissible limits ($\pm 55^\circ$ on the zenithal axis).

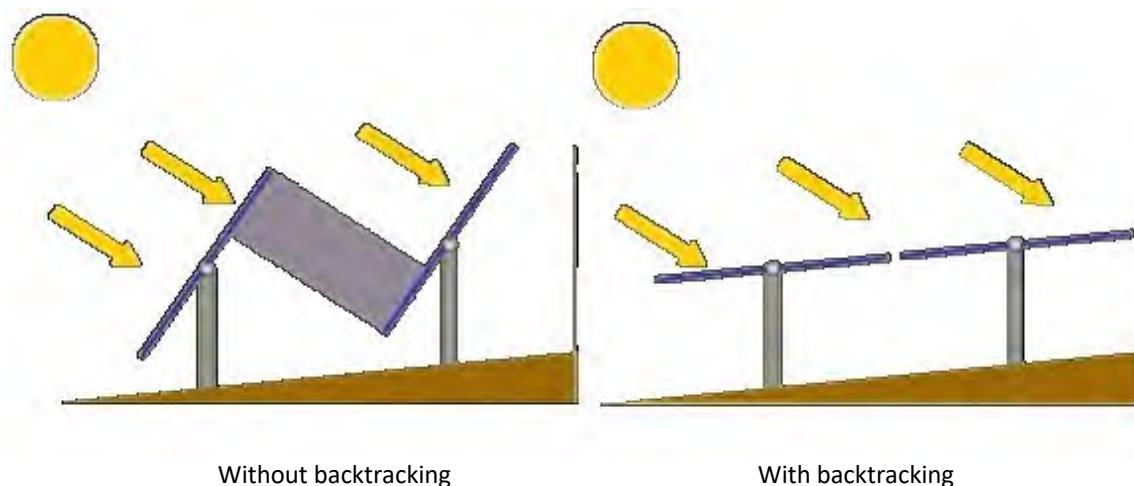


The solar tracker incorporates an electric control box (DBOX) including the cable that energize the motor. The installation assembly is complete with several solar trackers controlled by the main control box (TBox), which includes the PLC and the industrial PC, allowing the necessary start-up mode (manual or automatic) settings to be entered and displaying information on any error occurring during operation. The drive boxes (DBOX) and meteorological boxes (MBox) are connected with the TBox through LoRa, the wireless technology that PVH employs.



The single-axis solar tracking is carried out by means of the astronomical programming implemented in the TBox, which drives the trackers to position the solar panels at the optimal inclination relative to the sun throughout the day.

In addition, a backtracking algorithm is implemented to prevent self-shading of the solar trackers at certain times of day (early in the morning and late in the evening), leading to an enhancement in production. The backtracking algorithm detects when one row is casting a shadow on the row immediately behind it and the system corrects its inclination angle to avoid shading.



The machine is also equipped with a wind vane and anemometer or an ultrasonic anemometer to measure the wind speed and direction, so that in case of strong winds the panels are placed in the stow position, offering the least possible resistance to the wind and protecting the structure.

The electrical equipment² is composed of a series of control elements, power and safety controls which are located in the electrical boxes and the machine body.

Additionally, the machine has a number of safety measures, elements and devices, as described in TBox manual.

The (approximate) dimensions of the machine are measured in mm in the manual:

See PLANS OF GENERALS DIMENSIONS of the machine.

These dimensions are approximate, and they may vary without affecting the safety of the machine.

4.3. OPERATION DESCRIPTION

The manufacturer's technical staff will be responsible for setting the parameters required for commissioning of the machine. The user will only intervene in tasks of start-up/stop, process control and SURVEILLANCE of SAFETY conditions.

² See ELECTRICAL DIAGRAMS.

The operation description consists of the starting up, process controlling and stopping of the machine.

- ▲ **Prior to starting up the machine, check the full functionality of the safety devices and verify that no moving parts are blocked, that there are no damaged elements, and that all the machine components are correctly placed and fully operational.**
- ▲ **Never start up the machine if any of its safety devices have been removed or disabled.**
- ▲ **Prior to starting up the machine check for the absence of people in the machine's danger areas.**

For the START UP of the TBox the procedure is as follows:

1. Turn on the main power supply by means of the main power breaker.

For the START UP of the DBox the procedure is as follows:

1. Connect the PV panel cables or the AC power cable with the DBox module provided.
2. Connect the fuse.
3. Unlock the emergency stop button.

For the START UP of the MBox the procedure is as follows:

1. Connect the PV panel cables or the AC power cable with the DBox module provided.
2. Connect the fuse.

In both plants with few units and in those with a large number of solar trackers there is the possibility of adding a real-time tracker status and movement monitoring system (SCADA). This type of software monitors and records essential equipment information and allows detailed observation of each individual tracker, as well as changing their operating status, resetting the TBox and DBox or instructing it to move to a certain position.

Normal STOPPING of the solar trackers can be performed either individually, by pressing its own emergency stop button, or for the entire installation, by sending the status over the entire plant from the SCADA.

In case of EMERGENCY or malfunction:

- Press the red EMERGENCY STOP BUTTON on the DBox to stop the individual solar tracker involved.
- Alternatively, connect with SCADA to the TBox and select the desired tracker or group that you will stop.














The EMERGENCY STOP BUTTONS are easily accessible and provide a swift and easy means of stopping the machine in a safe manner in the event of a hazardous situation. Once such a situation passes, the machine must be reset by manually clearing the stop.











4.4. GENERAL SAFETY RULES





WARNING: NOT ADHERING TO SAFETY WARNINGS MAY CAUSE PERSONAL INJURY, DEATH OR MATERIAL DAMAGE.

-  Before using the machine carefully read the present operations and maintenance manual, especially those sections regarding safe working and safe use of the machine.
-  The machine must only be used by properly trained staff who have been informed of the hazards associated with the operation of the machine and the precautions required to be taken.
-  Never allow the machine to be operated by staff under the influence of substances that impair their reactions or who are unable to operate it for physical reasons.
-  **Before starting the machine ensure that there are no persons in its danger areas.**
-  The greatest care has been taken in the design and manufacture of the machine to ensure the safety of the operator. Therefore, every one of **the safety devices used are essential and may not be removed or eliminated under any circumstances**; any tampering can cause a hazard to you and those around you.
-  **Before starting up the machine, ensure that all its protective guards and safety devices are in place and fully serviceable. That moving parts are not blocked, that there are no damaged items and that all the machine components are correctly installed and in proper operating condition. Otherwise do not operate the machine.**
-  **Any safety devices removed for cleaning, maintenance or repair work must be reinstalled immediately upon completing the work.**
-  **Prior to performing any maintenance, repair or cleaning work the machine must be locked out and tagged out. In other words, turn the main power breaker to OFF, lock it out and signpost it appropriately.**
-  It is absolutely essential that the machine undergo thorough regular inspections to ensure the functionality of all its components. Follow the recommendations given in the maintenance section in this manual.
-  It is strictly forbidden to use the machine if any distortion or malfunction is detected. In such case the machine must be immediately locked out and tagged out (isolated from the power supply and signposted appropriately) and the technical support service called to correct the faults detected.
-  Certain practices or minor alterations by the user can cause damage and/or accidents. Users are advised against carrying out any alterations without prior approval by the manufacturer or construction company.
-  The use of non-original equipment manufacturer replacement parts can compromise the proper operation of the machine. The manufacturer declines any liability for the use of such parts.
-  The manufacturer or distributor will not accept liability for any damages arising from any work or alteration performed on the machine without the manufacturer's or distributor's prior consent.

-  The machine must be kept clean and in proper operating condition, especially as regards to its moving parts, controls, indicators, etc.
-  Do not perform any cleaning, adjustment or maintenance work while the machine is in operation.
-  Adjustments and repairs should always be performed by specialized, qualified and authorized staff.
-  Always check that the machine has not been tampered with by other persons.
-  Check that none of the safety elements have been tampered with.
-  **Do not use the machine in adverse weather conditions (strong wind, storms, etc.).**
-  Keep your limbs and/or clothes clear from rotating or moving parts. Do not wear loose clothes when maintaining units with rotating or moving parts. Remove wristwatches, rings, necklaces or similar jewelry items and tie up or cover long hair prior to performing any work on or with the machine.
-  **NEVER USE THE MACHINE FOR PURPOSES OTHER THAN THOSE AUTHORISED BY THE MANUFACTURER.** If in doubt contact the manufacturer.








ANY INTERVENTION WITH THE ELECTRICAL INSTALLATION, HOWEVER MINOR, REQUIRES THE INTERVENTION OF AUTHORIZED, SPECIALIZED, COMPETENT STAFF.

-  Any work on the machine must be carried out with clean, suitable tools in good condition.
-  Avoid using non-approved tools.



DANGER! DO NOT OPEN THE ELECTRICAL DASHBOARD WITHOUT PREVIOUSLY DISCONNECTING THE MACHINE ELECTRICAL SUPPLY.

-  Any transport, assembly or dismantling must be made by staff specifically trained for such work.
-  Never allow unauthorized staff to operate or repair the machine.
-  In case of fire disconnect the machine from the power supply and use extinguishers with foam resistant to alcohol, dust, water spray or CO₂, depending on the nature of the fire.
-  **The fencing must remain closed throughout the operation of the machine. NEVER leave the perimeter fencing open while the machine is in operation.**
-  **Do not install a number of photovoltaic panels exceeding the manufacturer's recommendation or an unsuitable type of photovoltaic panel.**

4.5. INDICATIONS ON NOISE

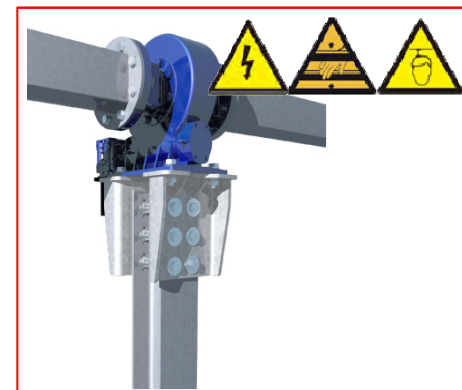
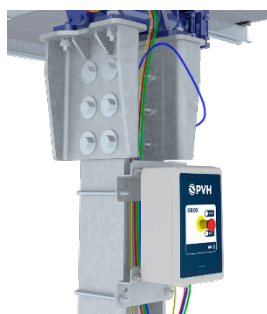
Operation of the machine does not generate, under normal conditions of use, a noise which surpasses the reasonable limits stated by the European rule, LEVEL OF CONTINUOUS EQUIVALENT PONDERED ACOUSTIC PRESSURE < 85 dBA, so it will **NOT be necessary to use auditory protection.**

4.6. DANGER AREAS

The following diagram indicates the different danger areas in the surroundings of the machine.



Do not open the cabinet unless it has been isolated from the power supply and the fuse has been removed.



Do not place hands in danger areas such as mechanisms of transmission while in motion

ENTANGLEMENT DANGER

Never start up the machine if the protection devices have been removed and/or discarded.



VERY IMPORTANT: IN CASE OF BLOCKAGE, BREAKING OF MECHANICAL ELEMENTS OR ANY OTHER INCIDENT, STOP THE MACHINE, CHECK ALL ENERGY SOURCES, AND CARRY OUT CORRESPONDING TASK.

4.7. LESS OBVIOUS DANGERS



WARNING: WHEN WORKING WITH THE MACHINE, THE WORKER OR SERVICE TECHNICIAN WILL NEED TO CONSIDER OTHER LESS OBVIOUS DANGERS WHICH ARE OFTEN IMPOSSIBLE TO REDUCE TO A MINIMUM IN THE PLACE WHERE THE MACHINE IS ASSEMBLED.

- Parts of the machine which hardly allow protection. They can be hot and after stopping the machine, take time in cooling down.
- There might be electrical voltages in the machine even after being disconnected.
- Mobile parts of transmission and work can remain in motion even after the machine has been disconnected.

4.8. MEASURES, ELEMENTS AND SAFETY DEVICES

Health and safety essential requirements related to the design and manufacturing of the machine which have been implemented are the following:

1. **Sharp and/or cutting edges** have been **rounded off** as much as possible to protect from the risk of cutting or puncturing.
2. The machine is provided with a **peripheral protection fence** with an access **gate locked** and accessible only for authorized staff. This fence has a strong constitution and is placed far enough from the dangerous area.
3. The machine is provided with an **inclinometer** in order to control the different positions of the solar tracker (zenithal movement) and to avoid major displacements which could cause the tracker to turn or bend more than allowed.
4. The machine is fitted with a wind vane with an anemometer or an ultrasonic anemometer to measure the wind speed and direction, so that if the wind speed exceeds the parameters specified, the TBox triggers the **storm alarm** and places the solar trackers in the idle position.
5. The machine is provided with a **protection device against over voltage** of atmospheric origin and operation.
6. In case of increase in the consumption of the engine, due to possible blocking by foreign objects, entanglement, or mobile elements friction, the corresponding **thermal protection** will activate itself (inverter), causing the machine to stop in safety conditions.
7. [Optional] The machine is provided with its corresponding **over voltage detection and cut automatic switches**, both in the power circuit and in the control and operation circuit. In this way it is ensured that intensity in the circuits do not surpass the value assigned to a component and does not surpass the admissible intensity in the conductors feeding it.
8. The operations and maintenance manual for the machine indicates that a **differential protection** device suitable for the machine's rated power must be installed in the power supply line.
9. **Operating components** are visible, their function is identified, they are placed outside the danger areas and their operation are only possible if intentional.

10. The operator interfaces and controls devices set up in the machine, and also the engines, micro detectors, envelopes and bypass boxes have a **minimum** protection degree **IP 55**, against penetration of solid or liquid objects which might be present in the work area under due conditions of use.
11. [AC powered Controller version] The **general controller of electrical supply (optional)** is in accordance with rule UNE EN 60204-1/A1:
 - It detaches the electrical equipment from the supply, cutting all active conductors from its supply.
 - It can be locked in position OFF by lock.
12. By means of design and manufacture **the active parts of the inner side of the dashboard are inaccessible**, accesable only by a key or specific tool for qualified or instructed people to gain access.
13. In general, the electrical equipment of the machine is designed and manufactured according to the harmonized rule UNE EN-60204-1/A1, and all **electrical elements and its conductions** will be made with the **appropriate** material for the function they must perform, as it is certified with their technical characteristics guaranteed by the **CE mark** present in all these materials.
14. The structural conduction parts of the electrical equipment and the machine will be connected with the equipment protection conductors of the machine. The main objective of **equipotential connection** is to minimize the consequences of an isolation failure.
15. The **stop** control has **priority** before the start up orders.
16. Interruption or later reestablishment, after an energy supply interruption, leaves the machine in a safe situation.
17. The TBox has an **UPS** (Uninterruptible Power Supply) to place the tracking panels in stow position, in case of electrical supply failure.
18. The DBox has an **emergency stop** device of the mushroom type with mechanical interlock.
19. All electrical elements and their conductions will be manufactured with appropriate materials for the function they are aimed to perform.
20. The machine and its elements do not present any **instability risks**. Its bearing structure has supporting pillars of sufficient strength and size to provide the required stability to the assembly in the intended operating conditions.
21. In the machine and its surroundings there will be warnings and notices, essential to guarantee the safety of the workers, such as the following:



26. The machine contains a **user's manual** which explains how to carry out in a safe way the usual and occasional transaction of the machine, and also the tasks associated to maintenance.

Nevertheless, even correcting the entanglement risks in mobile transmission elements, of an unconventional start up, etc, there would be a residual risk due to wrong use of the machine for ignoring how it works, dangers connected to its operation, or safety and protection measures against those dangers. Thus, in addition to the technical measures which have been indicated, the following measures will be adopted:

- Organization measures:
 - Danger notices.
 - Instructions, training.
 - Technical documents, instructions of use.
- Individual protection measurements:
 - Individual protection equipment.

4.9. DESCRIPTION OF DANGER, PROHIBITED AND OBLIGATION SIGNALS



DANGER: Electrical Risk. Lack of attention may cause personal injuries or material damage.



DANGER: Attention to hands, entanglement danger. Lack of attention may cause personal injuries.



DANGER: Attention to possible knocks on head with lower parts of the machine. Lack of attention may cause personal injuries or material damage.



PROHIBITED: Only authorized staff is allowed to come near the machine. Lack of attention may cause personal injuries or death.



REQUIRED: Before using the machine, it is compulsory to read and understand its right way of working, and also to identify risks inherent to its operation.

REQUIREMENT OF USE!

PERSONAL PROTECTIVE EQUIPMENT FOR INSTALLATION, ASSEMBLY, REPAIR AND/OR MAINTENANCE TASKS



REQUIRED: It is compulsory to use safety shoes insulated with reinforced toe. Failure to use may cause personal injuries.



REQUIRED: It is compulsory to use safety gloves. Failure to use them may result in personal injuries.



REQUIRED: It is compulsory to wear a safety helmet when there is risk of impact with low machine parts and/or ejections, or of falling objects, tools or parts of the machine. Use safety gloves. Failure to use them may result in personal injuries or death.



REQUIRED: It is compulsory to use a reflective vest while performing load lifting and moving work. Failure to use them may result in personal injuries or death.

THE MACHINE MUST BE ISOLATED FROM THE POWER SUPPLY AND LOCKED OUT PRIOR TO PERFORMING MAINTENANCE AND REPAIR WORK

Do not open the electrical box unless it has been isolated from the power supply

ELECTRIC CONTACT DANGER

4.10. SIGNAGE DISPOSITION

SIGNAGE is a part of the machine. They have been incorporated for safety reasons and they must not be removed or damaged under any circumstances. For reasons of space or visibility, signage may be found separated from the machine. In this case, they must be placed close to it, and be clearly visible for the worker operating the machine. In case of doubts when placing the signage please ask the manufacturer.



**PART B OF THE USER'S MANUAL IS RESERVED FOR
SPECIALIZED, COMPETENT, AUTHORIZED STAFF**



**ATTENTION! ALL MAINTENANCE TRANSACTIONS WILL BE CARRIED OUT WITH THE MACHINE
COMPLETELY DETACHED FROM THE ELECTRICAL SUPPLY.**

5. MAINTENANCE INSTRUCTIONS MANUAL (RESERVED FOR SPECIALIZED, COMPETENT, AUTHORIZED STAFF)













5.1. TRANSPORTATION AND PLACEMENT



ATTENTION! For handling and/or loading of parts or components of the machine more than 25 kg., as tools, removable drives or protections must be provided with safe means of handling.



CAUTION: DO NOT WANDER BENEATH LOADS SUSPENDED.

-  When the machine, or parts of the machine, is in process of being loaded, staff must be evacuated, and safety protections must be used.
-  Use a crane or forklift truck powerful enough to lift the machine.
(SEE PLANS OF INSTALLATION AND ASSEMBLY)
-  During lifting, make sure the load is stable.
-  It is strictly forbidden to walk around the load while it is suspended.
-  Check that the load is properly balanced during the lifting stage.
-  Raise the load to the minimum extent required to move it.
-  Avoid swinging of the load while moving it with a hydraulic boom or similar device.
-  Raise the load to the minimum extent required to move it.
-  While lifting and moving the load, the movements must be very slow and gentle to avoid dangerous swinging movements.
-  **ATTENTION!** All load lifting and handling operations must be performed by specialized, qualified and duly authorized staff.
-  **ATTENTION!** Do not cross or stand under suspended loads. All staff must be evacuated, and suitable safety protections must be used whenever raising and handling the machine.
-  **ATTENTION!** Use of the following personal protective equipment (PPE) is mandatory when lifting and moving the machine:



ES OBLIGATORIO
EL USO DE CALZADO
DE SEGURIDAD



ES OBLIGATORIO
EL USO
DE LOS GUANTES



ES OBLIGATORIO
EL USO DE CASCO



USO OBLIGATORIO
DE CHALECO
REFLECTANTE

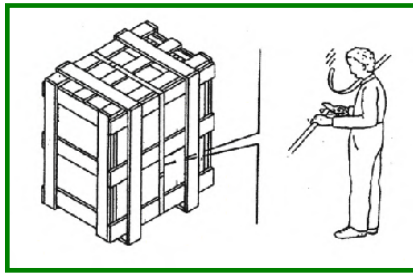
5.2. UNPACKING

Before unpacking the machine, the area where this will be placed needs to be conditioned.

Keep a space big enough to install the machine and to ensure it can operate in a proper and safe way.



**CUTTING THE METALIC HOOPS IS A DANGEROUS OPERATION (SEE FIGURE)
NEVER LEAVE CUT PIECES IN THE ENVIRONMENT.
DO NOT LEAVE CUT PIECES IN THE CONSTRUCTION AREA.**



Once the various machine components have been unloaded and unpacked, check them for integrity and conformity with the specifications provided in this manual.

Any lack of integrity or conformity of parts must be promptly reported to the manufacturer in writing.

To ensure proper operation it is recommended to always keep the contact surfaces and accessories clean.

5.3. INSTALLATION AND ASSEMBLY

During installation legal requirements of the country of destination related to work places and installations, which cover aspects such as passage areas, general illumination, electrical supply, etc, must be respected.

The installation of the machine must be carried out on a level with enough resistance to endure its weight, vibrations and efforts.

The installation of the machine must be made taking into consideration its working area. For that purpose, minimum safety distances between solar trackers or other obstacles must be respected (see plans), so that they can count on enough space to carry out its work (zenithal movement) in a safe way (without collision):

Minimum safety distance between trackers: 5 m

The machine is delivered completely assembled and installed and once its right performance has been checked.

(SEE MANUAL OF INSTALLATION AND ASSEMBLY)

(SEE PLANS OF INSTALLATION AND ASSEMBLY)

For installation and assembly works it is compulsory to use the following personal protection equipment (PPE):



5.3.1. ELECTRICAL INSTALLATION



FOR INTERVENTIONS WHICH REQUIRE HANDLING ELECTRICAL COMPONENTS INSIDE OR OUTSIDE THE BOARD, THE MACHINE MUST BE ISOLATED FROM THE ELECTRICAL.



ACCESS TO ELECTRICAL BOARD IS ALLOWED ONLY TO SPECIALIZED, COMPETENT, AUTHORIZED STAFF. BEFORE OPENING THE ELECTRICAL BOARD DOOR, BREAKER MUST BE SWITCHED OFF THE POWER SUPPLY. IT IS ESSENTIAL TO RESPECT RULES IN FORCE ON ELECTRICAL INSTALLATIONS FOR THE SAFETY OF USERS AND FOR THE MACHINE.



WARNING: IGNORE WARNINGS AND SAFETY MEASURES MAY CAUSE PERSONAL INJURIES, DEATH OR MATERIAL DAMAGE.

- Any electrical connection and equipment installation must be made by specialized, authorized, competent staff. Always respect instructions given for the installation of components and accessories.
- Check that the power supply voltage matches that indicated in the machine specifications plate.
- To connect to the main power supply or generator, connect the power supply cable to the connection box. Also connect the ground wire to the connection box.
- The machine has to be correctly grounded and protected by a fuse or automatic cut device, appropriate for its nominal current (see plaque in the machine).
- There will be no connection between the neutral conductor and the equipotential protection circuit inside the electrical equipment, and combined Terminal PEN must not be used.
- Check all the metal parts of the machine for proper equipotential bonding.
- The machine must be protected through its correspondent **automatic over voltage detection and cut switches (optionals)**.
- The machine must be protected with an **automatic differential circuit breaker**, appropriate for its nominal current.

- The motor polarity is adjusted automatically. The system holds the axes when the measured speed is not expected. If the motor commissioning is active for the axis, the system will reverse the polarity of the motor in the next movement retry.
- Electrical wire must be periodically revised to determine if it is worn out or damaged.
- Section and isolation of connection wire to voltage supply must match the requirements of the unit current values and nominal voltages.
- Wires must never be crushed or pressed. Never place them in transit areas or where they might be damaged.
- Connect the machine wires as carefully as possible according to the rules in force.
- The tracker electric wiring is divided into the power part (engines), tracker control and communications, and the photovoltaic installation wiring.

(SEE ELECTRICAL DIAGRAMS)

(SEE MANUAL OF INSTALLATION AND ASSEMBLY)

5.4. COMMISSIONING

Before the commissioning of the machine:

- Check the correct levelling of the equipment.
- Verify the correct state of mechanical and electrical elements.
- Check that all elements and safety devices are duly located.
- Check that all warning, danger, duty and prohibited signage are duly located.
- Verify that the supply voltage is correct. (See plaque of characteristics of the machine).
- Connect the machine to the electrical supply.
- Check that the emergency stop button is unlocked.
- Adjust the necessary parameters² and Do the first START UP of the machine. (See section 4.4 OPERATIONS DESCRIPTION in this manual)
- Verify and check the right operation and that safety conditions for working with the machine are provided during the whole process. Check the right operation of control and protection devices.
- STOP the machine in safety conditions.

IF ALL INDICATIONS MENTIONED IN THIS MANUAL HAVE BEEN OBSERVED, IT IS POSSIBLE TO COMMISSION THE MACHINE.

² See the instructions manual of control software.

5.5. MAINTENANCE





BEFORE ANY MAINTENANCE SUPPORT, IT IS MANDATORY TO STOP THE MACHINE, ISOLATE IT FROM THE POWER SUPPLY, USE PERSONAL PROTECTIVE EQUIPMENT AND TAKE CARE AND APLY ALL THE SAFETY MEASURES NEEDED.



The user will make sure that all **maintenance, inspection and assembly works** are **made by competent, qualified, authorized staff who** have been widely informed through detailed study of the service instructions.

In

ATTENTION!

1. Place on the control and operation  electrical dashboard a  indicating that the machine has been consigned for maintenance and/or cleaning tasks.
2. Disconnect the power supply (PV panel or AC cable and fuse), press the emergency stop button and signpost it appropriately.
3. Once maintenance and/or cleaning tasks are over, make sure all staff is away from the machine's dangerous areas before starting it up again.

More complex maintenance transactions, which we indicate below, require the involvement of professionally qualified staff:

WORK REQUIRED	Frequency
Steel structure and modules	
Check torque of the bolts securing the posts to the foundation pad.	2Y
Retighten structural element fixing elements (post, torque tube and rails).	2Y
Retighten fixing of modules to their support brackets.	2Y
Check the condition of galvanized surfaces (treat rust with zinc spray as required).	2Y
Check all the bolts and nuts on the structure for proper condition and tightness (replace any corroded or broken items).	2Y
Check the condition of the welded joints on the structure (reweld or treat with zinc spray as required).	2Y
Moving Parts	
Check gear box for lubricating oil leaks.	Y
Check tightness of fixing bolts on the coupling bridle between the reduction gearbox-motor and the slew drive.	Y
Check tightness of the gearbox fixing screws.	Y
Check the motor fixing screws for proper condition (replace as required).	Y
Check and clean bearings on the structure.	2Y
Lubricate reduction screw drive with synthetic oil.	2Y

Frequency: W: Weekly, M= Monthly, Q=Quarterly, S= Six-Monthly, Y= Yearly



WASTE GENERATED DURING MAINTENANCE OF THE MACHINE WILL NEED TO BE TREATED ACCORDING TO LOCAL LEGAL REGULATION IN FORCE.



ANY ACCIDENTAL SPILLAGE OF LUBRICANTS DURING MAINTENANCE TASKS WILL NEED TO BE CLEANED IMMEDIATELY.

5.5.1. MAINTENANCE REPORTS

Preventive Maintenance

The aim of Preventive Maintenance is to ensure operation continuity of the machine, thus minimizing the probability of mistakes and maximizing reliability of the works carried out by the user.

Preventive maintenance has been made according to the protocols given by the different machine manufacturers, and using the wide experience achieved by maintenance staff.

Any deviation from the acceptance criteria of the machine parameters will be followed by the corresponding disciplinary action.

When finishing Maintenance, a Preventive Maintenance Report will be provided in which there will be full explanation, if necessary, of the corrections applied to the equipment, and parts or elements which have been repaired or replaced and indicated.



PV HARDWARE, S.L.U.

Avd de Barojas 32 Parque
Omega, Edificio. A Planta 3, 28108
ALCOBENDAS - (Madrid)

FECHA:

PREVENTIVE MAINTENANCE

☐

REPAIR

☐

PRIORITY:

URGENT

☐

USUAL

☐

WORKER DATA:

Surname and name:	
Position or function:	
Center/Department/Service:	

MACHINE AND SERVICE DATA:

Inventory Number:	
Machine Name:	
Location:	
SERVICE REQUIRED:	

OBSERVATIONS:

Signed:

5.6. FAILURES LOCATION



ANY INTERVENTION NEEDS TO BE CARRIED OUT BY COMPETENT, QUALIFIED AND AUTHORIZED TECHNICAL STAFF. IT IS COMPULSORY TO STOP THE MACHINE, ISOLATE IT FROM ELECTRICAL SUPPLY AND BLOCK IT.

PROBLEM	CAUSE	SOLUTION
UNUSUAL NOISE IN TURNING GROUP	Poor greasing	Lubricate engaging area.
	Bearings set increased and/or faulty bearings	Check bearings, substitute if needed. Adjust axis set of axial bearings.
	Foreign bodies in turning group	Stop the machine, clean the engagement and verify the state of sealing. Substitute if faulty. Lubricate again.
	Faulty gearwheel	Stop the machine. Verify the engagement and substitute if needed.
	Loose fixation bolts	Retighten fixation bolts
NOISE IN THE GEARBOX	Poor greasing	Check oil level in the gearbox. Verify there are no oil leaks in the gearbox.
	Bearings set increased and/or faulty bearings	Check bearings, substitute if needed.
	Loose fixation bolts	Retighten fixation bolts.
ZENITHAL AXIS NOT MOVING	Faulty turning group	Stop the machine and verify the turning group: i) Check slew drive ii) Check gearbox
	Electric engine not working	Check engine protections and state of DBox: i) Verify voltage gets to the DBox. ii) Note down kind of failure and follow the DBox manual.
		Verify the state of the electric engine: repair or substitute i) Connections. ii) State of the motor winding: continuity, short circuit, failure in one of the windings (it is working two phases). iii) State of bearing.
		The tracker will adopt the defensive position due to the anemometer signal, until wind conditions stop.
	Power Failure	Check that power and reestablish, if needed.

PROBLEM	CAUSE	SOLUTION
TRACKER STOPPED OR DISORIENTED	TBox or DBox out of service	Check that the TBox is triggered. Rearm.
	Error tracking parameters	Check the TBox application in SCADA if there are error parameters or fault alarm. Edit or solve error parameters according to the manufacturer instruction manual. Check correct installation and operation of the limit Switches (if provided) and placed in correct position or replace, if needed.
	Some damaged mechanical element (hydraulic jack, dampers, gear-motor, ...)	Check that all the mechanical parts are in good condition and replace, if necessary, damaged mechanical elements.
UNUSUAL NOISE IN SLEW DRIVE	Poor greasing	Lubricate engaging area.
	Bearings set increased and/or faulty bearings	Check bearings and substitute if needed.
	Foreign bodies in actuator	Stop the machine, clean the engagement and verify the state of sealing. Replace if faulty. Lubricate again.
	Faulty gearwheel	Stop the machine. Verify the engagement and substitute if needed.
	Loose fixation bolts	Retighten fixation bolts.
ONE OR MORE SOLAR TRACKERS IN ALERT OR FAULT CONDITION	Loss of connection between TBox and one or more DBox	Verify and call manufacturer's Technical Support Service.
	DBox has detected and inclinometer error.	Verify and call manufacturer's Technical Support Service.
	TBox failure	Verify and call manufacturer's Technical Support Service.

5.7. STORAGE

If the machine is going to be inactive for a long period:

- During the inactivity period the machine must be protected against weathering, dust and dampness which could damage the engine, the electrical installation and other metallic elements.
- For further starting up, check the manufacturer's or provider's technical assistance.

5.8. DISMANTLING

If the machine must be dismantled, it must be divided into homogeneous parts and its various component materials separated for subsequent treatment or disposal in accordance with the applicable regulations.

Any waste generated during dismantling of the machine must be treated in accordance with the applicable legislation to ensure the protection of the environment.

Make sure to adhere to the applicable legislation and regulations regarding the disposal of hazardous objects or products such as oils, fuels, solvents, filters and batteries.

Never drain oil directly on the soil; do not pour it into sewers, rivers, the sea or lakes.

Use suitable containers to collect lubricating oils held in the reduction gearboxes, variable frequency drives and in each tank of the machine, and hand over the oils to a specialized collection and management company.

Mechanical and electrical components must be removed for reuse if still serviceable. All plastic materials must be removed and stored separately.

All metal parts of the machine must be removed and classified by metal type for recycling.

* To obtain further details of installation, maintenance and technical information of the units, please read:

- DBox Installation and Maintenance Manual
- DBox Datasheet
- MBox Installation and Maintenance Manual
- MBox Datasheet
- TBox Installation and Maintenance Manual
- TBox Modbus or OPCUA Map
- TBox Datasheet
- Commissioning Process Documents
- Other Datasheets and Drawings by OEM
- Operation and maintenance manual of HE8C
- Operation and maintenance manual of HE9C
- Installation Manual



- Assembly Manual.
- Controller Manual



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Operation & Maintenance Manual for HE9C-61MHD-25MRC-65° -BC110-A1- REV.A



Operation & Maintenance manual of BC110



Kinematics Manufacturing

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KMI accepts no liability for;



Non-compliance with Installation and Maintenance Instructions.
Failure to pass on content to third party. Any omissions or errors in the document.

Note: The following text includes special notices and procedures that shall be observed.



Contents

1 .Preface	03
2 .Model code instruction	04
3 .Suggested spare parts list	05
4 .Packing, handing, storage and unpacking	08
5 .Installation.....	13
6 .Lubricating.....	17
7 .Failure criteria	20



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1. Preface

1. The following instructions give you the information you need to be able to correctly install and maintain a KMI slew drive.
2. These instructions are only for BC110 slewing drives. Installation and maintenance instructions with previous revision numbers are invalid.
3. All work steps listed here are to be executed by suitably qualified personnel.
4. Please do not hesitate to contact our Technical Department for any further assistance.



2.Model code instruction

HE9C-61MHD-25MRC-65° -BC110-A1-REV. A

H	Vertical type
E	Enclosed housing
9	Product size, 8"(Ball Path Diameter)
C	Engineering Level
61	Final reduction ratio
M	Metric mounting threads
HD	Standard Specification, Heat treatment code
25M	The input shaft diameter is $\Phi 25\text{mm}$.
R	Right Side
C	End Cap
65°	Rotation Angle
BC110-A1	Customer Code
REV.A	Revision Level. Subject to update any time.



3.Suggested spare parts list

Item	Describe	Drawing No.	Material	Qty .
1	Hex head screw M10x35	GB/T 70.1-2000	12.9 class	8
2	End Cap	C03-80-AA-A1-45-REV.A	45#	1
3	O rings 82.5x2.65	GB/T 3452.1-2005	NBR+PVC	2
4	Taper roller bearing 33208	GB/T 297-1994	GCr15	2
5	Worm Shaft	W09B02-25H-C-HE-02-REV.A	42CrMo	1
6	Housing	BHE09C01-65° -01-REV.A	QT450-10	1
7	Top Plate	GM09HD-5-61-180° -PC210-01-REV.A	QTD1050-6	1
8	Seal 300X330X15	GB13871-1992	NBR+PVC	1
9	Grease Fitting 1/8"-27PIPE-TAP(longer)	JB/T 7940.1-1995	Stainless steel	3
10	Seal 250X280X15	GB13871-1992	NBR+PVC	1

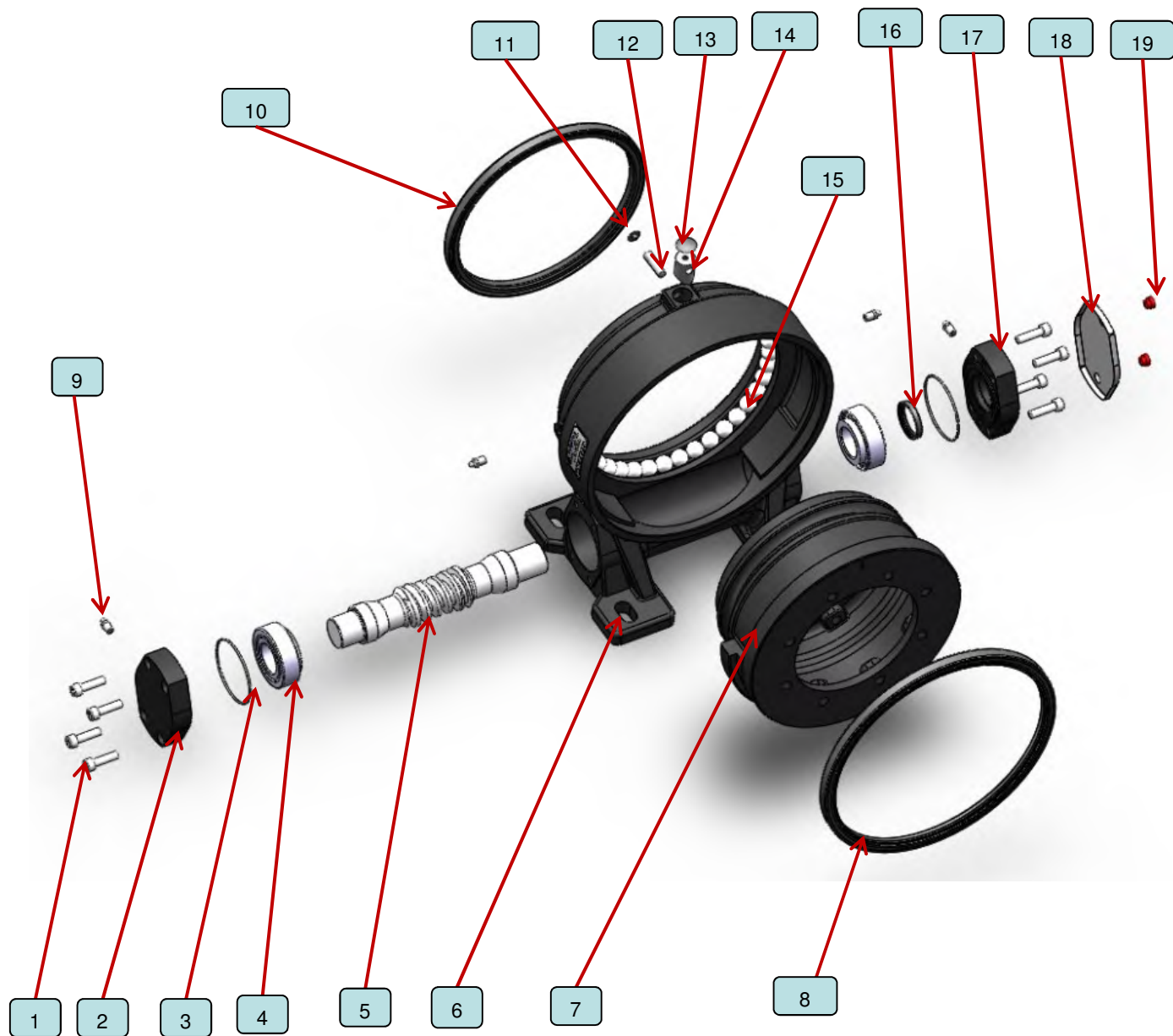


Item	Describe	Drawing No.	Material	Qty .
11	Small block	DS-01-REV.A	NBR+PVC	1
12	Taper pin 10x40	GB/T 118-2000	35	1
13	Big block	DS-02-REV.C	NBR+PVC	1
14	Ball Plug	GP50-25-REV.A	50Mn	1
15	Steel Ball $\Phi 22.225$	GB/T 308	GCr15	33
16	Seal 40X50X8	GB13871-1992	NBR+PVC	1
17	Motor Adapter	A04-80-82.5-106.4-A1-45-01-REV.A	45#	1
18	Dust cover	P007-106.4-01-REV.A	PVC	1
19	Screw M12x1.5		Plastic	2



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Spare Parts view



4. Packing, handing, storage and unpacking

4.1 Packing & unpacking Information



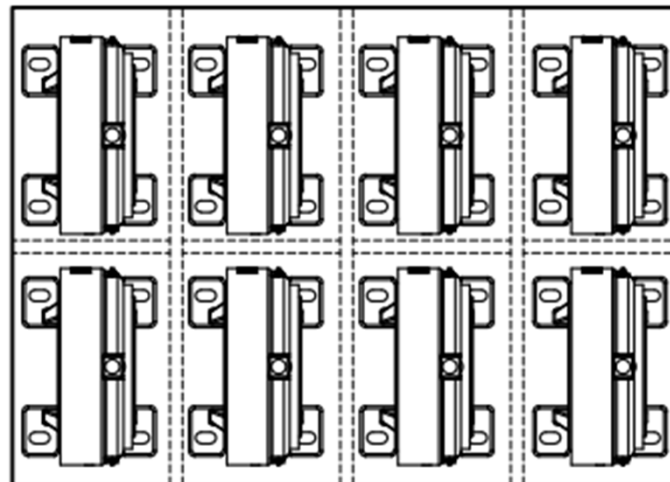
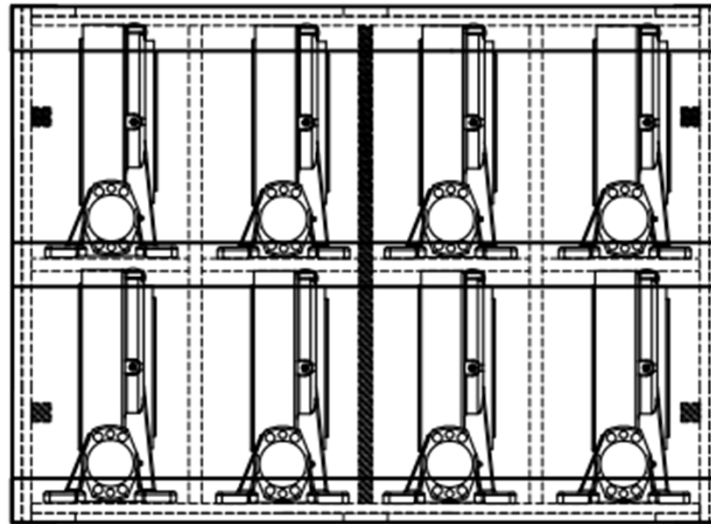
Final Packing

Contract Number	
Destination	
Production Type	
Production Name	
Series Number	
Crate Number	
Quantity	
Bar Code	
Origin	Made in China



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Packing inner view



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Several safety considerations must also be addressed before unpacking



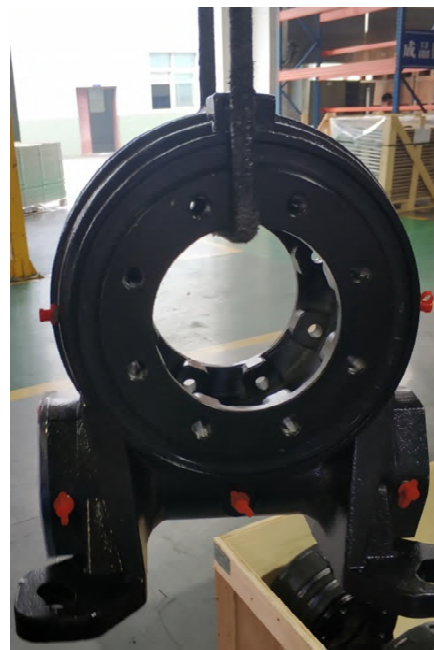
1, Cut off the steel banding with shears;

2, Use crowbar to open the crate's cover;

3, Be careful of all the nails\scrap banding and in general all sharp edges;



4.2 Handling process



The picture is for reference only.



4.3 Attention



1. Take great care in the position of the slew drive when transporting, handling & when in storage. Transport only in horizontal position, impacts must be avoided.

2. Wear work gloves and be careful when handling the slewing drives.

3. Store only in a horizontal position and enclosed prior to installation, keep away from moisture.

4. The drive, when stored, should be in a well ventilated, cool, dry, noncorrosive and safe environment indoor.

5. Preserving the spare parts in a well ventilated, cool, dry, noncorrosive and safe environment indoor.



5. Installation

5.1 Preparation & cleaning

Preparation

- Check the slewing drive for physical damage.
- Clean the slewing drive and the mounting structure, see [Cleaning](#).
- Remove extraneous material/debris from supporting surfaces.

Cleaning

- Clean corrosion protection coating from supporting surfaces of the slewing drive, follow the instructions below:
- Clean the exterior of the mounting surfaces using cold solvent or degreaser(such as IPAX) that will not damage the rubber seals.
- Applicable provisions for cleaning media are observed (e.g. manufacturer provisions, protection of workers.)





5.2 Choice of mounting bolts

- Prescribed sizes, number and quality grades shall be used.
- Grip ratio (grip length to diameter of bolt) shall be observed, from minimum ≥ 2 to maximum ≤ 10 .
- Slewing drive function, lifespan, and durability of the bolt connection are affected in case of non-compliance.
- Use flat washers of appropriate size and strength choice of tightening torques so that the permissible interfacial pressure is not exceeded.
- Mounting bolts are in normal cases adequately secured by correct preloading.
- Notice: Use of split rings, split washers, etc. is not allowed.



Table 1: Tightening Torque and initial preloads for mounting bolts.
KMI does not warrant information in this table.
Information is for guidance only.

Tightening Torque	Mounting Bolt Dimension					
	M8	M10	M12	M14	M16	M20
Class	(1/4-20UNC)	(5/16-18UNC)	(3/8-16UNC)	(7/16-14UNC)	(5/8-11UNC)	(3/4-10UNC)
Class 8.8	20 N.M	40 N.M	70N.M	113N.M	176N.M	344 N.M
Class 10.9	28 N.M	57N.M	100 N.M	159 N.M	248 N.M	485 N.M
Class 12.9	34 N.M	68N.M	120N.M	190 N.M	298 N.M	582 N.M



5.3 Installing the Slewing Drive

1. Clean the mounting structure, e.g. from welding, galvanizing, residues, dirt, debris, etc.
2. Lift the slewing drive with handle.
3. The slewing drive shall be mounted in unloaded condition.
4. The following procedure shall be followed in order to avoid deviations between bolt tightening forces.
5. Apply thread lock to threads.

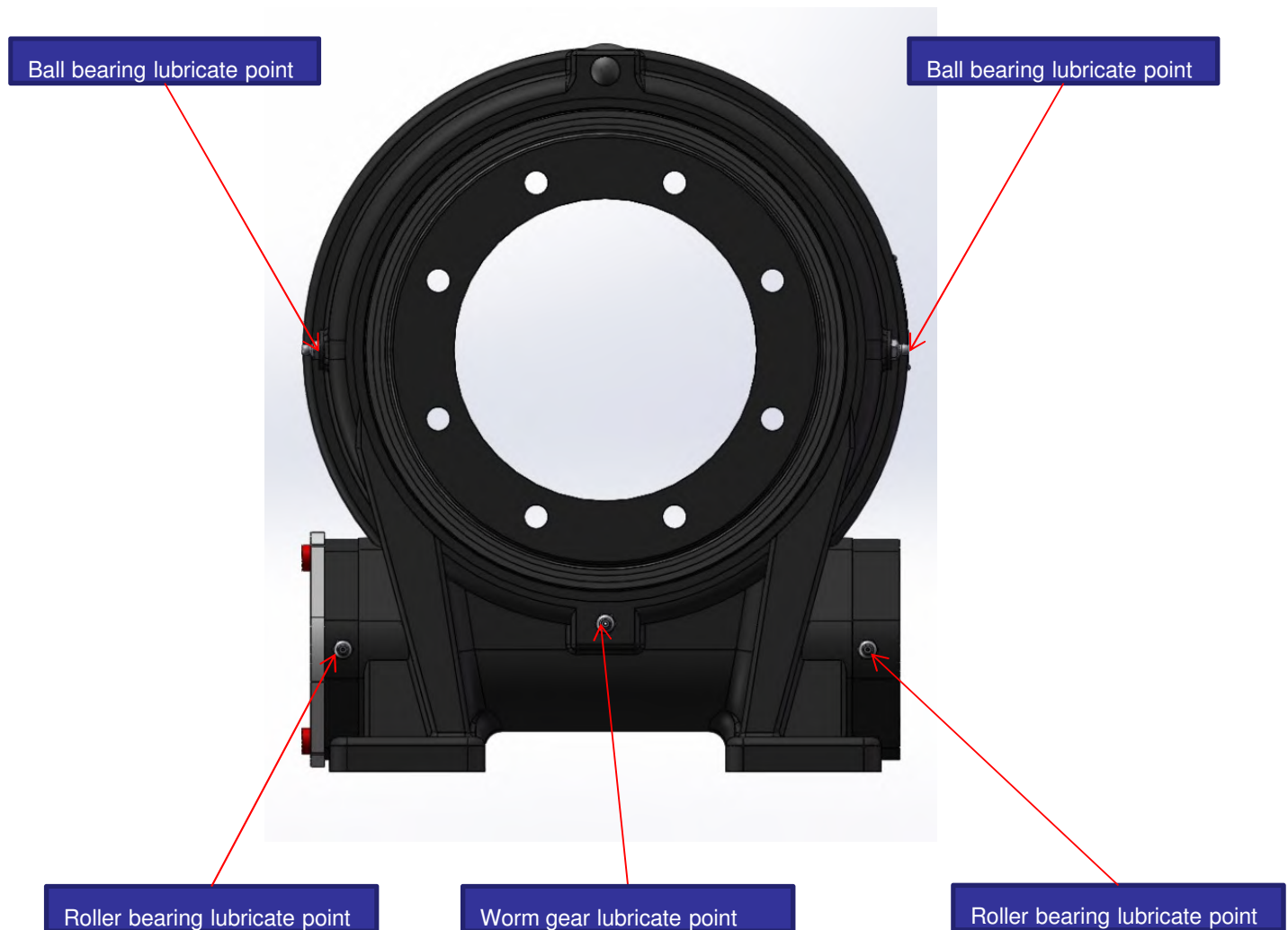
Recommended thread locking adhesive		
Brand		
Type	TS242	Loctite 243



6. Lubricating

6.1 Inject and changing grease

6.1.1 Lubricate position





6.1.2 Lubricate

The Roller bearings and worm gear are open to the same cavity, but it's suggested to fill them using the separate grease points to ensure each point is adequately penetrated with lubricant directly. The ball bearing is enclosed separately.

While rotating the slewing drive, inject grease into all the cleaned grease nipples as follows:

a) Initial greasing

The Slewing Drives are supplied pre-lubricated.

- Roller Bearings – 0.05kg of grease/per grease fitting.
- Worm Gear – 0.1kg of grease/per grease fitting.
- Ball Bearing – 0.015kg of grease/per grease fitting.

b) Re-lubrication

Re-greasing must be done at regular intervals, this is a recommendation of inject grease quantity.

- Roller Bearings – 0.03kg of grease/per grease fitting.
- Worm Gear – 0.07kg of grease/per grease fitting.
- Ball Bearing – 0.008kg of grease/per grease fitting.

6.1.3 Recommend lubricants

- Grease Brand: Mobil EP-2
- Grease Alternative Brands: Shell Gadus S2 V220 2
BP Energrease LS-EP 2



Re-lubrication intervals depend on the prevailing work and environmental conditions. Re-lubricate once every 2 years at minimum.

Legal and manufacturer provisions about handling the respective lubricants must be observed.



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Grease MSDS

ExxonMobil

Product Name: MOBILUX EP 2
Revision Date: 24 Mar 2010
Page 1 of 10

SAFETY DATA SHEET

SECTION 1	PRODUCT AND COMPANY IDENTIFICATION
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PRODUCT

Product Name: MOBILUX EP 2
Product Description: Base Oil and Additives
Product Code: 2015A0208050, 641274
Recommended Use: Grease

COMPANY IDENTIFICATION

Supplier: ExxonMobil (China) Investment Co., Ltd.
17/F., Metro Tower
30 Tian Yao Qiao Road
Shanghai 200030 China

24 Hour Environmental / Health Emergency Telephone: (+86) 0532-83889090 (NRCC)
Supplier General Contact: (+86) 021-24076000

SECTION 2	HAZARDS IDENTIFICATION
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This material is not hazardous according to regulatory guidelines (see (M) SDS Section 15).

Other hazard information:

PHYSICAL / CHEMICAL HAZARDS

No significant hazards.

HEALTH HAZARDS

High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

ENVIRONMENTAL HAZARDS

No significant hazards.

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary



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7. Failure criteria—JB/T 5664-1991

J 17

JB

中华人民共和国机械行业标准

JB/T 5664—1991

重载齿轮 失效判据

1991-08-14 发布

1992-07-01 实施

中华人民共和国机械电子工业部 发布



Kinematics Manufacturing
Kinematics Delivers Innovation

Operation & Maintenance Manual for HE8C-61MHD-25MRC-65° -BC110-A1- REV.K02



Operation & Maintenance manual of BC110



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KMI accepts no liability for;



Non-compliance with Installation and Maintenance Instructions.
Failure to pass on content to third party. Any omissions or errors in the document.

Note: The following text includes special notices and procedures that shall be observed.



Contents

1 .Preface	03
2 .Model code instruction	04
3 .Suggested spare parts list	05
4 .Packing, handing, storage and unpacking	08
5 .Installation.....	13
6 .Lubricating.....	17
7 .Failure criteria	20



1. Preface

1. The following instructions give you the information you need to be able to correctly install and maintain a KMI slew drive.
2. These instructions are only for BC110 slewing drives. Installation and maintenance instructions with previous revision numbers are invalid.
3. All work steps listed here are to be executed by suitably qualified personnel.
4. Please do not hesitate to contact our Technical Department for any further assistance.



2.Model code instruction

HE8C-61MHD-25MRC-65° -BC110-A1-REV. K02

H	Vertical type
E	Enclosed housing
8	Product size, 8"(Ball Path Diameter)
C	Engineering Level
61	Final reduction ratio
M	Metric mounting threads
HD	Standard Specification, Heat treatment code
25M	The input shaft diameter is $\Phi 25\text{mm}$.
R	Right Side
C	End Cap
65°	Rotation Angle
BC110-A1	Customer Code
REV.K02	Revision Level. Subject to update any time.



3.Suggested spare parts list

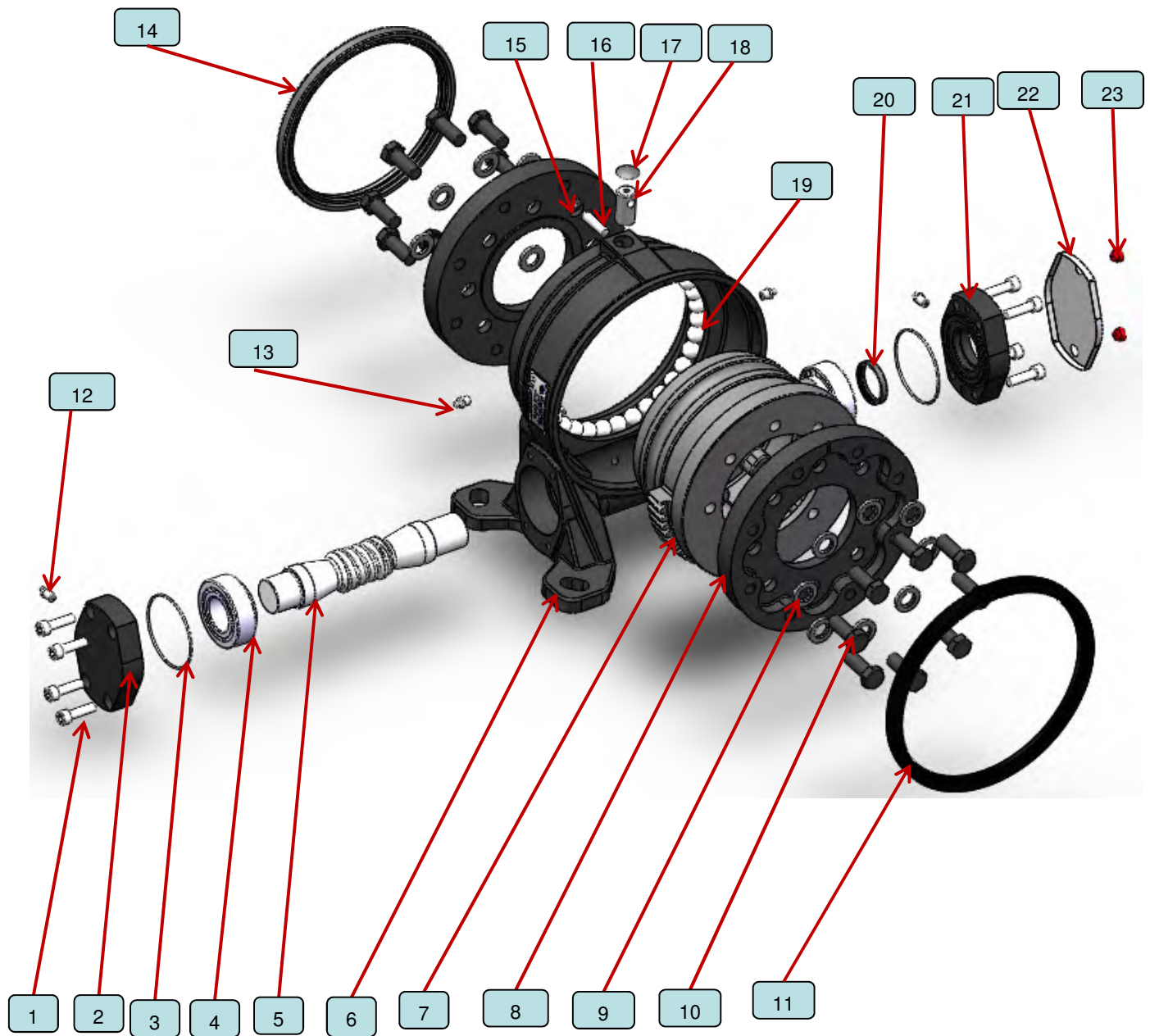
Item	Describe	Drawing No.	Material	Qty .
1	Hex head screw M10x35	GB/T 70.1-2000	12.9 class	8
2	End Cap	C03-80-AA-A1-45-REV.A	45#	1
3	O rings 82.5x2.65	GB/T 3452.1-2005	NBR+PVC	2
4	Taper roller bearing 33208	GB/T 297-1994	GCr15	2
5	Worm Shaft	W08B02-25H-C-HE-61G-TR-01-REV.A	42CrMo	1
6	Housing	BHE08B01-65° -01-REV.D	QT450-10	1
7	Top Plate	GM08HD-4-61-180° -PC165-02-REV.B	QTD1050-6	1
8	Flange	F05-130-X-210-BC110-01-REV.B	QT450-10	2
9	Flat washer 16	GB/T 1230-2006	45#	16
10	Hex bolt M16x40	GB/T 5783-2000	10.9 class	16
11	Seal 240X270X15	GB13871-1992	NBR+PVC	1
12	Grease Fitting 1/8"-27PIPE-TAP(longer)	JB/T 7940.1-1995	Stainless steel	3
13	Grease Fitting 1/8"-27PIPE-TAP	JB/T 7940.1-1995	Stainless steel	2
14	Seal 200X230X15	GB13871-1992	NBR+PVC	1



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Item	Describe	Drawing No.	Material	Qty .
15	Small block	DS-01-REV.A	NBR+PVC	1
16	Taper pin 10x40	GB/T 118-2000	35	1
17	Big block	DS-02-REV.C	NBR+PVC	1
18	Ball Plug	GP-22-50-40-01-REV.A	50Mn	1
19	Steel Ball $\Phi 19.844$	GB/T 308	GCr15	33
20	Seal 40X50X8	GB13871-1992	NBR+PVC	1
21	Motor Adapter	A04-80-82.5-111-A1-45-01-REV.A	45#	1
22	Dust cover	P007-111-01-REV.A	PVC	1
23	Screw M10x1		Plastic	2



Spare Parts view



4. Packing, handing, storage and unpacking

4.1 Packing & unpacking Information



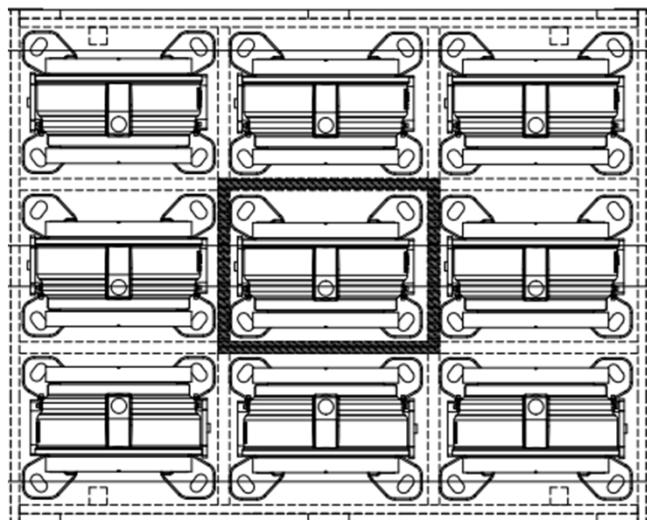
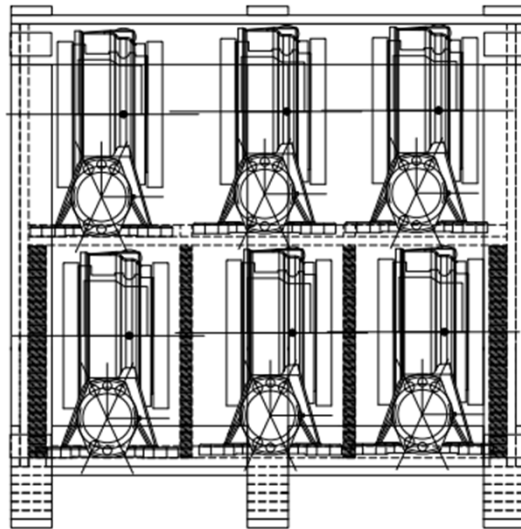
Final Packing

Contract Number	
Destination	
Production Type	
Production Name	
Series Number	
Crate Number	
Quantity	
Bar Code	
Origin	Made in China



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Packing inner view



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Several safety considerations must also be addressed before unpacking



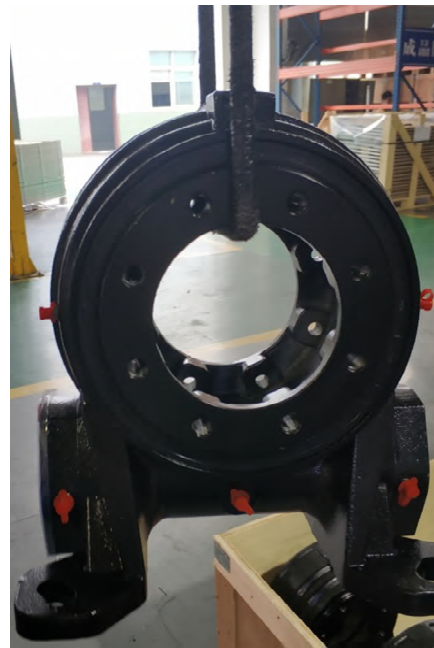
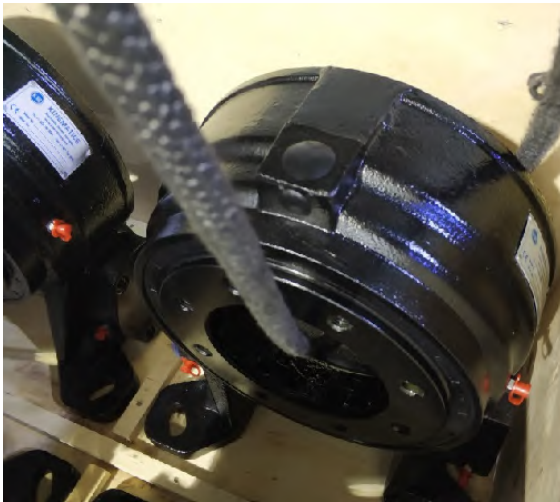
1, Cut off the steel banding with shears;

2, Use crowbar to open the crate's cover;

3, Be careful of all the nails\scrap banding and in general all sharp edges;



4.2 Handling process



The picture is for reference only



4.3 Attention



1. Take great care in the position of the slew drive when transporting, handling & when in storage. Transport only in horizontal position, impacts must be avoided.

2. Wear work gloves and be careful when handling the slewing drives.

3. Store only in a horizontal position and enclosed prior to installation, keep away from moisture.

4. The drive, when stored, should be in a well ventilated, cool, dry, noncorrosive and safe environment indoor.

5. Preserving the spare parts in a well ventilated, cool, dry, noncorrosive and safe environment indoor.



5. Installation

5.1 Preparation & cleaning

Preparation

- Check the slewing drive for physical damage.
- Clean the slewing drive and the mounting structure, see [Cleaning](#).
- Remove extraneous material/debris from supporting surfaces.

Cleaning

- Clean corrosion protection coating from supporting surfaces of the slewing drive, follow the instructions below:
- Clean the exterior of the mounting surfaces using cold solvent or degreaser(such as IPAX) that will not damage the rubber seals.
- Applicable provisions for cleaning media are observed (e.g. manufacturer provisions, protection of workers.)





5.2 Choice of mounting bolts

- Prescribed sizes, number and quality grades shall be used.
- Grip ratio (grip length to diameter of bolt) shall be observed, from minimum ≥ 2 to maximum ≤ 10 .
- Slewing drive function, lifespan, and durability of the bolt connection are affected in case of non-compliance.
- Use flat washers of appropriate size and strength choice of tightening torques so that the permissible interfacial pressure is not exceeded.
- Mounting bolts are in normal cases adequately secured by correct preloading.
- Notice: Use of split rings, split washers, etc. is not allowed.



Table 1: Tightening Torque and initial preloads for mounting bolts.
KMI does not warrant information in this table.
Information is for guidance only.

Tightening Torque	Mounting Bolt Dimension					
	M8	M10	M12	M14	M16	M20
Class	(1/4-20UNC)	(5/16-18UNC)	(3/8-16UNC)	(7/16-14UNC)	(5/8-11UNC)	(3/4-10UNC)
Class 8.8	20 N.M	40 N.M	70N.M	113N.M	176N.M	344 N.M
Class 10.9	28 N.M	57N.M	100 N.M	159 N.M	248 N.M	485 N.M
Class 12.9	34 N.M	68N.M	120N.M	190 N.M	298 N.M	582 N.M



5.3 Installing the Slewing Drive

1. Clean the mounting structure, e.g. from welding, galvanizing, residues, dirt, debris, etc.
2. Lift the slewing drive with handle.
3. The slewing drive shall be mounted in unloaded condition.
4. The following procedure shall be followed in order to avoid deviations between bolt tightening forces.
5. Apply thread lock to threads.

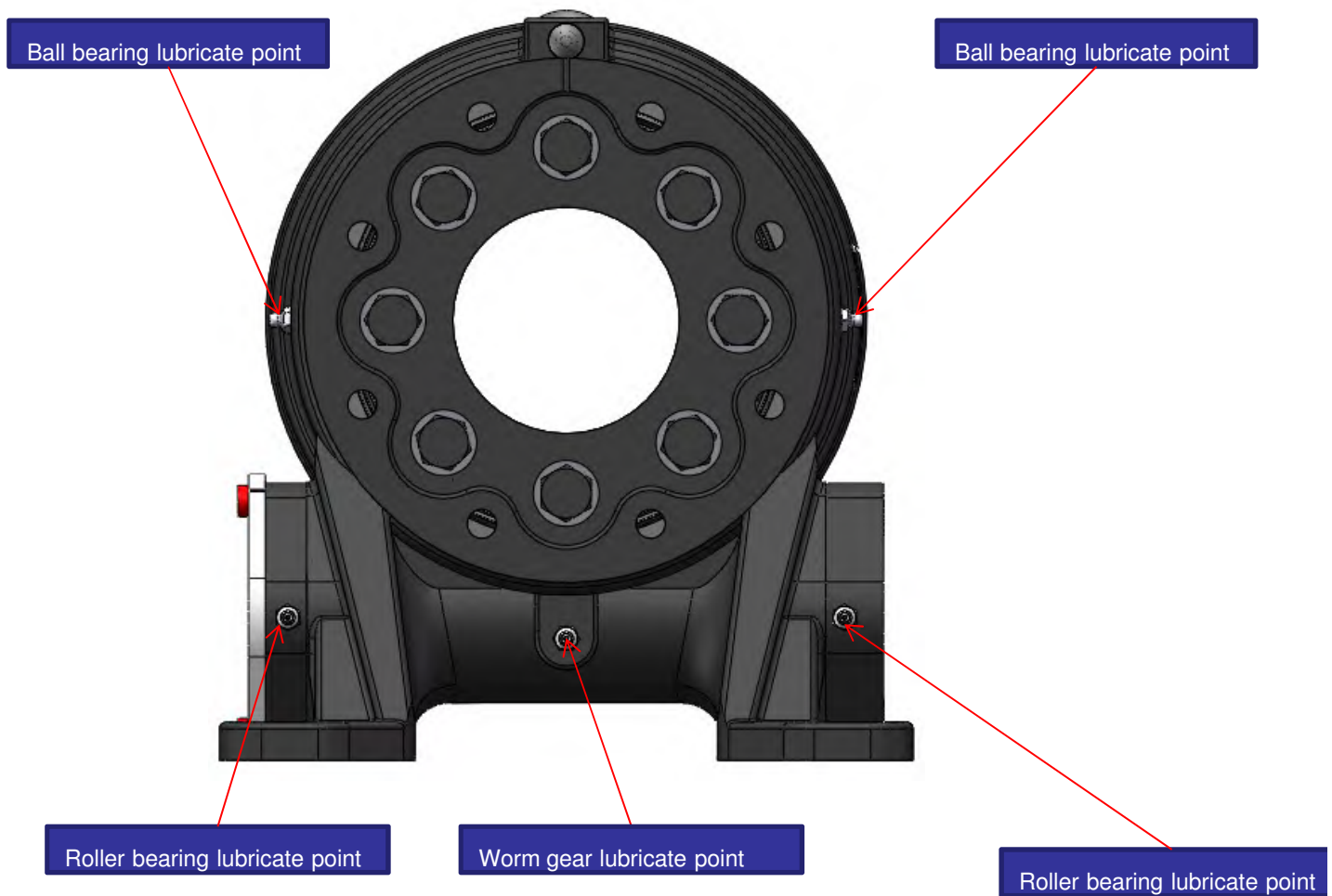
Recommended thread locking adhesive		
Brand		
Type	TS242	Loctite 243



6. Lubricating

6.1 Inject and changing grease

6.1.1 Lubricate position





6.1.2 Lubricate

The Roller bearings and worm gear are open to the same cavity, but it's suggested to fill them using the separate grease points to ensure each point is adequately penetrated with lubricant directly. The ball bearing is enclosed separately.

While rotating the slewing drive, inject grease into all the cleaned grease nipples as follows:

a) Initial greasing

The Slewing Drives are supplied pre-lubricated.

- Roller Bearings – 0.05kg of grease/per grease fitting.
- Worm Gear – 0.1kg of grease/per grease fitting.
- Ball Bearing – 0.015kg of grease/per grease fitting.

b) Re-lubrication

Re-greasing must be done at regular intervals, this is a recommendation of inject grease quantity.

- Roller Bearings – 0.025kg of grease/per grease fitting.
- Worm Gear – 0.05kg of grease/per grease fitting.
- Ball Bearing – 0.0075kg of grease/per grease fitting

6.1.3 Recommend lubricants

- Grease Brand: Mobil EP-2
- Grease Alternative Brands: Shell Gadus S2 V220 2
BP Energrease LS-EP 2



Re-lubrication intervals depend on the prevailing work and environmental conditions. Re-lubricate once every 2 years at minimum.

Legal and manufacturer provisions about handling the respective lubricants must be observed.



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Grease MSDS

ExxonMobil

Product Name: MOBILUX EP 2
Revision Date: 24 Mar 2010
Page 1 of 10

SAFETY DATA SHEET

SECTION 1	PRODUCT AND COMPANY IDENTIFICATION
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PRODUCT

Product Name: MOBILUX EP 2
Product Description: Base Oil and Additives
Product Code: 2015A0208050, 641274
Recommended Use: Grease

COMPANY IDENTIFICATION

Supplier: ExxonMobil (China) Investment Co., Ltd.
17/F., Metro Tower
30 Tian Yao Qiao Road
Shanghai 200030 China

24 Hour Environmental / Health Emergency Telephone: (+86) 0532-83889090 (NRCC)
Supplier General Contact: (+86) 021-24076000

SECTION 2	HAZARDS IDENTIFICATION
------------------	-------------------------------

This material is not hazardous according to regulatory guidelines (see (M) SDS Section 15).

Other hazard information:

PHYSICAL / CHEMICAL HAZARDS

No significant hazards.

HEALTH HAZARDS

High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

ENVIRONMENTAL HAZARDS

No significant hazards.

NOTE: This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary



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7. Failure criteria—JB/T 5664-1991

J 17

JB

中华人民共和国机械行业标准

JB/T 5664—1991

重载齿轮 失效判据

1991-08-14 发布

1992-07-01 实施

中华人民共和国机械电子工业部 发布

This foregoing document was electronically filed with the Public Utilities

Commission of Ohio Docketing Information System on

10/29/2020 4:14:18 PM

in

Case No(s). 20-1084-EL-BGN

Summary: Text Powell Creek Solar, LLC Supplement to Application - Safety Manuals Part 3 of 3 electronically filed by Teresa Orahod on behalf of Kara Herrnstein