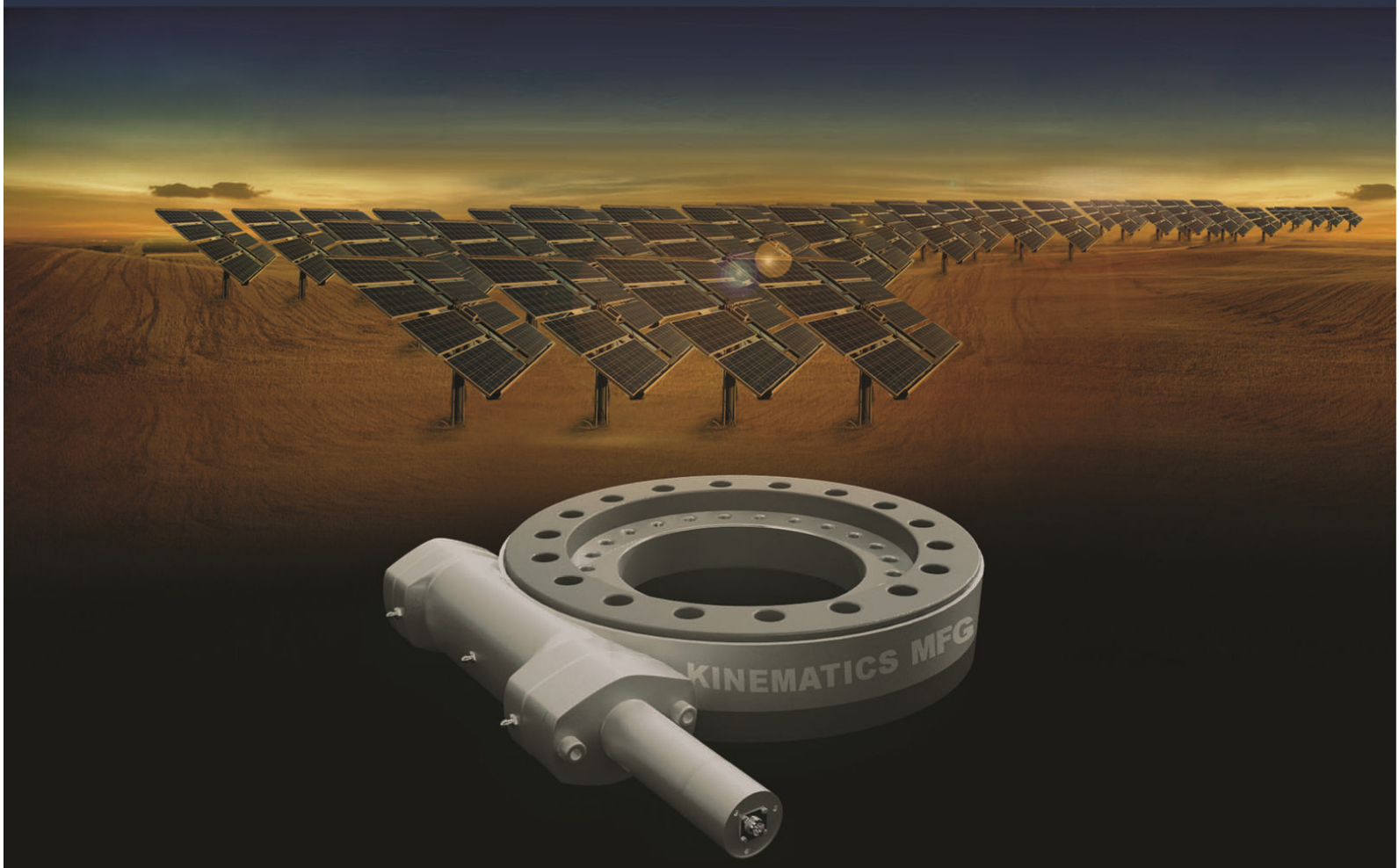
Kinematics Manufacturing

Patented Technology. Reliable Solutions.



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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.

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

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Contents

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Preface

The following instructions give you the information you need to be able to correctly install and maintain a KMI slew drive.

These instructions replace earlier versions.

All work steps listed here are to be executed by suitably qualified personnel.

Please do not hesitate to contact our Technical Department for any further assistance.

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Model Code

1	2	3	4	5	6	7	8	9	10
SE -	XX -	C -	XXX -	M -	HX -	R(L)X -	C -	2 -	XXXX

1-SE: Type for slewing drive.
S – Standard basic slewing drive.
SE - Enclosed housing slewing drive.
SDE – Dual axis, enclosed housing slewing drive.
Z – Zero backlash slewing drive.
FE – Friction brake, enclosed housing slewing drive.
VE - Vertical enclosed housing slewing drive.
KE - High International Protection (IP65 or IP66, enclosed housing slewing drive.
KVE - High International Protection (IP65 or IP66) vertical & enclosed housing slewing drive.

2-XX: Product size, ex. 3, 5, 7, 9, 12, 14, 17, 21, 25 is the Ball Path Diameter
3″- Size in inches of ball path diameter, reduction ratio: 62.
5″- Size in inches of ball path diameter, reduction ratio: 62.
7″- Size in inches of ball path diameter, reduction ratio: 73.
9″- Size in inches of ball path diameter, reduction ratio: 61.
12″- Size in inches of ball path diameter, reduction ratio: 78.
14″- Size in inches of ball path diameter, reduction ratio: 85.
17″- Size in inches of ball path diameter, reduction ratio: 102.
21″- Size in inches of ball path diameter, reduction ratio: 125.
25″- Size in inches of ball path diameter, reduction ratio: 150.

3-C: Engineering Level, A, B, C, etc…

4-XXX: The reduction ratio.

5-M: M-metric mounting threads, None-Screw hole by British measurement.

6-HX:
HA-Heavy load (Gear teeth hardness: HRC52-60).
HB-Intermediate load1 (Gear teeth hardness: HRC30-32 / >=2mm).
HC-Light load (Gear teeth hardness: HB220-260).
HQ- Intermediate load1 (QPQ- Gear teeth hardness: 550-700HV0.1, >=15um/0.45mm).

7-R (L) X: R-right side, motor position. L- Left side, motor position.
X:A - Away, hydraulic port position & direction.
I - In, hydraulic port position & direction.
U- Up, hydraulic port position & direction.
D - Down, hydraulic port position & direction.

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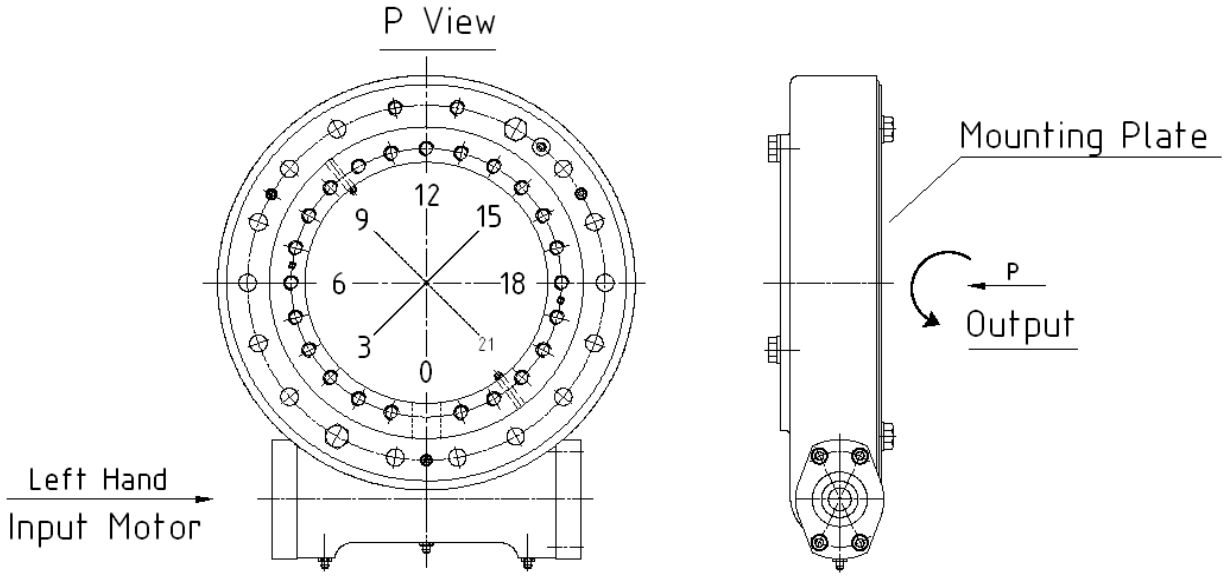
8-C: C-Capped end (no hex extrusion).
E- Encoder.
None- Worm hex extrusion.

9- 2: None-Worm number
Blank-Single worm drive
2-Dual worm drive

10-XXXX: Paint Code
Blank-RAL9017, Traffic black (standard paint code)
XXXX-RAL code (customer choice)

Example:
SE17C-102M-24RC-XXXX-REV.A
S - Slewing drive
E - Enclosed housing
17 - 17" ball path diameter
C - Engineering Level
102 - Reduction ratio
M-Metric threads
24 – 24VDC Electric Motor
R – Right hand mount
C-Capped end (no hex extrusion)
XXXXX – OEM Special Specifications Apply (if applicable)
Rev – Current Revision Release (not required)



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Transport, Handling & Storage

Transport only in horizontal position, impacts should be avoided.

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

Use the holes of the rings in the slewing drives to fix bolts for safe hoisting, handling and placement.

Store only in a horizontal position and in closed rooms, keep it away from getting wet, the surface corrosion protection of exposed mating surfaces lasts approximately 1 month in closed packaging. Longer period storage requires special protective measures.

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Installation

Preparation

Check the slewing drive for physical damage.

Clean the slewing drive and the mounting structure, see ***Cleaning***.

Remove extraneous materials 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 (e.g. diesel oil) that will not damage the rubber seals.

Applicable provisions for cleaning media are observed (e.g. manufacturer provisions, protection of workers, environment protection).

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Permissible Flatness Deviation

Table 1: permissible flatness including perpendicularity deviations for Slewing drives

Size of Slew Drive	Permissible perpendicularity deviation in length [in]	[mm]	Permissible perpendicularity deviation in angle dimension degree
3″	0.009	0.237	0.32
5″	0.031	0.335	0.32
7″	0.016	0.405	0.32
9″	0.022	0.569	0.32
12″	0.032	0.807	0.32
14″	0.036	0.907	0.32
17″	0.045	1.133	0.32
21″	0.057	1.489	0.32
25″	0.069	1.753	0.32

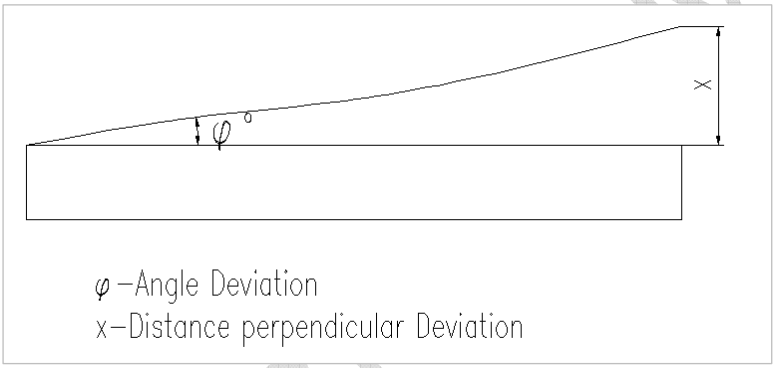

Figure 2.1

The form must resemble a sine curve that gradually rises and falls.

Mounting Bolts

As the gearbox manufacturer, we do not supply, warrant or recommend the mounting fasteners used. Please take great care in specifying this item which will attach our product to yours.

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.

Bolts with a fully threaded shaft are not permissible.

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.

Ensure mounting bolts are adequately secured by correct preloading.

Notice: Use of split rings, split washers, etc. not permissible.

Tightening Torque	Mounting Bolt Dimension					
Class	**M6** (1/4-20UNC)	**M8** (5/16-18UNC)	**M10** (3/8-16UNC)	**M12** (7/16-14UNC)	**M16** (5/8-11UNC)	**M20** (3/4-10UNC)
Class 8.8	11.5 N.M	28 N.M	55 N.M	97 N.M	240 N.M	470 N.M
Class 10.9	14 N.M	33 N.M	72 N.M	120 N.M	305 N.M	600 N.M
Class 12.9	17 N.M	42 N.M	83 N.M	145 N.M	360 N.M	705 N.M

Table 2: Tightening Torque and initial preloads for mounting bolts.
KMI does not warrant information of this table. Information is for guidance only.

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Installing the Slewing Drive

Clean the mounting structure, e.g. from welding, galvanizing, residues, dirt, etc.

Lift the slewing drive with eye bolts.

The slewing drive shall be mounted in unloaded condition.

Remove the shipping bolts before setting on the final mounting structure.

The following procedure (Figure 2.2) shall be followed in order to avoid deviations between bolt tightening forces.

Apply thread lock liquid to threads.

Brand: 

Type: TS242Threadlocking adhesive

Note: General purpose, chemotropic, viscosity. For locking and sealing M6-M20 threads

Parts can be separated using hand tools, controlled lubricity, can attain accurate clamp loads.

Color: Blue

Usage:

Shake thoroughly before use

Clean and dry parts with TS755 cleanser

Lay thread lock liquid on thread gap requesting fitting parts fully.

Preload the bolts crosswise. See the general pattern in sketch below of how bolts get torque in crosswise sequence. Start with either inner or outer ring. Do the crosswise torqueing of all bolts to 30% of tightening torque. Then repeat crosswise torque to 80% of tightening torque. Finally, crosswise torque to 100% of the tightening torque.

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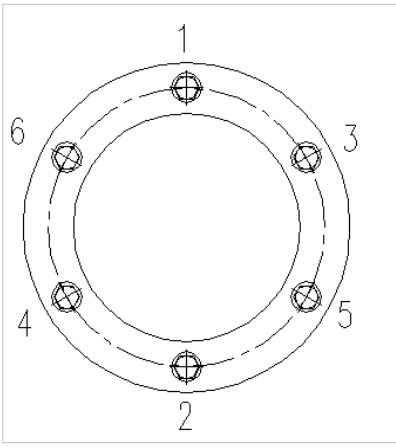

Figure 2.2

First completely torque inner or outer ring, then do the other ring.

Once the screw is tightened, please permanently mark the position of the screw head to that of the stationary structure. This will be used later during inspection to be sure the screw head has not unwound.

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Determine Tilting Clearance

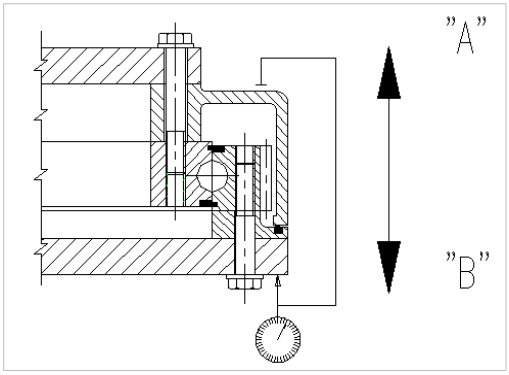
The tilting clearance increases with raceway wear. To determine the increase in tilting clearance, it is necessary to take basic periodic measurements.

Permanently designate the measuring point in the main load direction.

Record all measured values into Table 3.

Procedure

Determine and mark the measuring spot at the point of load, both on the housing as well as on the worm wheel or on the slewing ring.



Fix the dial gauge. The use of magnetic dial would be ideal in this case.

Apply a 20kg load in "A" direction.

Set the dial gauge on zero.

Apply a 20kg load in "B" direction.

The measured difference between "A" and "B" corresponds to the tilting clearance and serves as the basis for comparison for later inspections.

Figure 2.3

Table 3: User Written Tilting Measurements

Item	Load	Direction "A"	Direction "B"	Remark
1				
2				
3				
4				
5				
6				

General

All subsequent measurements are performed at the same measuring point, with the same loads, at the same position of the housing relative to the worm wheel or gear ring and in the same sequence.

All the measured values are recorded.

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Primary Movers
Electric Motor

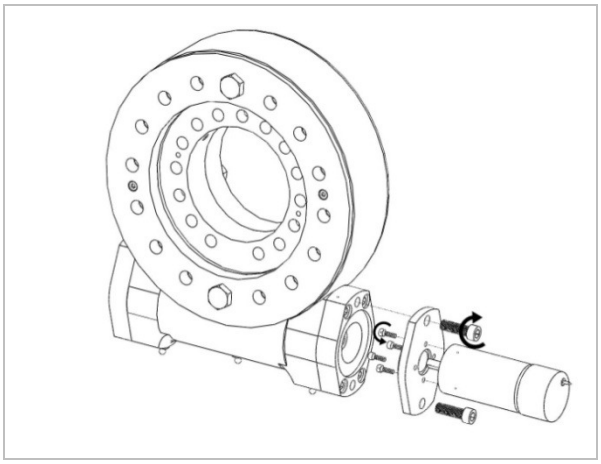

Figure 3.1

For standard 24VDC motor

Clean mounting surface see ***Cleaning***

Attach the adapting piece and tighten screws to the motor;

Put on the motor and tighten the screws to the base;

Connect the DC power to the motor, check its rotation. If not the desired direction of rotation, exchange the LINE (L) and NEUTRAL (N).

⚠ For other motor, such as 110VDC motor, brushless DC motor, AC motor etc. need to read the specification of the product!

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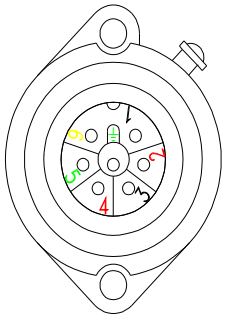
Hall Encoder

Standard Magnetic pulse generator

Output type		voltage output
Pull-up resistor		Yes
Output signal		2 square wave signals, phase quadrate: 90°
Impulses per revolution	ppr	2,channels A and B
Operating voltage	VDC	U_N=12 (5 … 24)
Operating current	mA	max. 12 (U=12V)
Deviation of pulse width		Max. 15°
Deviation of phase shift		Max. 15°
Output voltage(low level)	VDC	Max. 0.4 (20mA)
Operating temperature	℃	-40 … +85

Connection: Typical Brushed DC motor example. Check your motor specification for complete details!



Electric Connection:

Pin 1: Motor, 0V (MOTOR INPUT), (Black thick wire inside)
Pin 2: Motor, +24V (MOTOR INPUT), (Red thick wire inside)
Pin 3: Hall, 0V (HALL INPUT), (Black thin wire inside)
Pin 4: Hall, +12V(5-24) (HALL INPUT), (Red thin wire inside)
Pin 5: Hall, Signal A (HALL OUTPUT,square wave signal)(Green thin wire inside)
Pin 6: Hall, Signal B (HALL OUTPUT,square wave signal)(Yellow thin wire inside)
Pin 7: GROUND (G)

"Connection detail always as viewed from connector end of motor, not from shaft end"

⚠ For other encoder, such as incremental encoder, etc. need to read the specification of the product!

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Maintenance & Safety Checks

Mounting Bolts

To compensate for possible settling, it is necessary to retighten the bolts to the prescribed torque .This shall be done after no more than 100 hours of operation and without external load applied to the bolt connection. This inspection shall be repeated annually.

The inspection frequency may be reduced under special operating conditions. In case of loose bolts, replace all bolts and washers with new ones.

KMI does not supply or warrant any fasteners for attaching the slew drive to the customer's equipment. The few large diameter cap screws shipped in the new slewing drives are for shipping purposes only. These are very low grade fasteners and should never be reused in the final installation of the slew drive.

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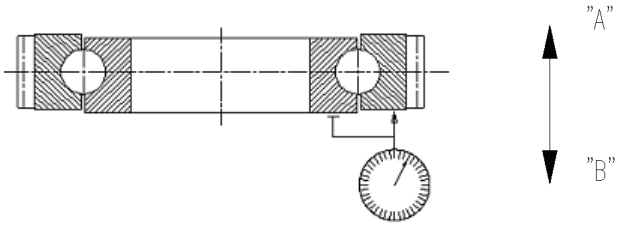

Tilting Clearance

Measuring tilting clearance on new product without rated load

Figure 4.1

- Fix the dial gauge. The use of magnetic dial would be ideal in this case. Apply a 20kg load in "A" direction.
- Set the dial gauge on zero.
- Apply a 20kg load in "B" direction.
- The measured difference between "A" and "B" corresponds to the tilting clearance and serves as the basis for comparison for later inspections.

"A-B"≤Table 1 Value

Table 1: Tilting clearance on new slew drives

Size of Slew Drive	Permissible perpendicularity deviation in length		Permissible perpendicularity deviation in angle dimension
	[in]	[mm]	degree
3"	0.002	0.06	0.09
5"	0.0035	0.09	0.09
7"	0.004	0.11	0.09
9"	0.006	0.16	0.09
12"	0.009	0.23	0.09
14"	0.010	0.26	0.09
17"	0.013	0.32	0.09
21"	0.017	0.42	0.09
25"	0.019	0.49	0.09

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Measuring tilting clearance on new product under rated load

- Install slew drive into customer specific equipment using customer's standard load, as long as the load falls within maximum guideline ratings of the KMI slewing drive.
- Take a measurement using the same instruction of 4.2.1 Record this value as the equipment's starting raceway tilting clearance value.
- Raceway wear leads to increased tilting clearance.
- Check the increase in tilting clearance δ_k directly on a slewing drive.
- The value (m1) determined after installation of the slewing drive is considered as the basic value and is deducted from the latest inspection value (mx). The difference between mx and m1 may not exceed 0.8 mm (0.0315in) during the life of the drive. If this value is exceeded then the drive is worn out.

$\delta_k = mx\text{-}m1 \quad \leq \delta_T perm$

$\delta_T perm = 0.8mm\ (0.0315in)$

- Increase in tilting clearance is to be converted proportionally for each measurement (after the installation measurement) and compared with δ_k permissible.
- Reduce the inspection interval to 200 operating hours if the measured increase in tilting clearance amounts to approx. 75% of the maximum permissible increase in tilting clearance.
- Reduce the inspection interval once again after further increase in tilting clearance (to 50-100 operating hours).
- Replace the slewing drive if the maximum permissible increase in tilting clearance is reached.

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Torsional Clearance

Gear wear leads to increased rotational backlash.

Procedure:

- Attach a dial gage between the stationary and rotating structure.
- Determine the rotational play by gently turning the upper structure against the stationary structure, reading the total difference in measurement from a clockwise to a counterclockwise turn.

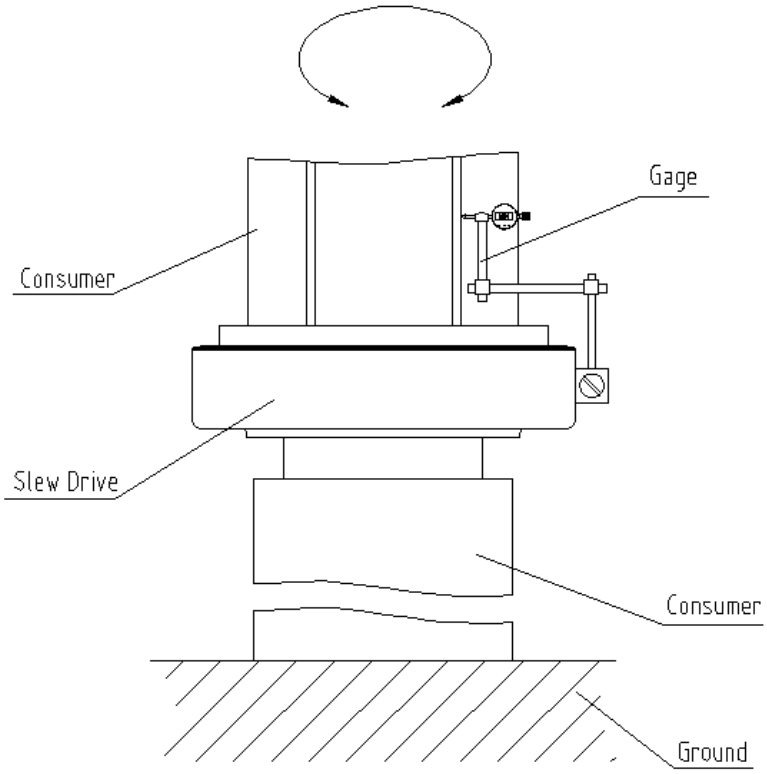

Figure 4.2

- Do not force the turning or the measurement will be inaccurate. The purpose of the measurement is to find the gap clearance.
- All measured values are to be recorded.

Lubrication Instruction

Provisions about handling the respective lubricants must be observed.

While rotating the slewing drive, inject grease into all the cleaned grease nipples consecutively until a continuous collar of fresh grease forms at least on one sealing lip.

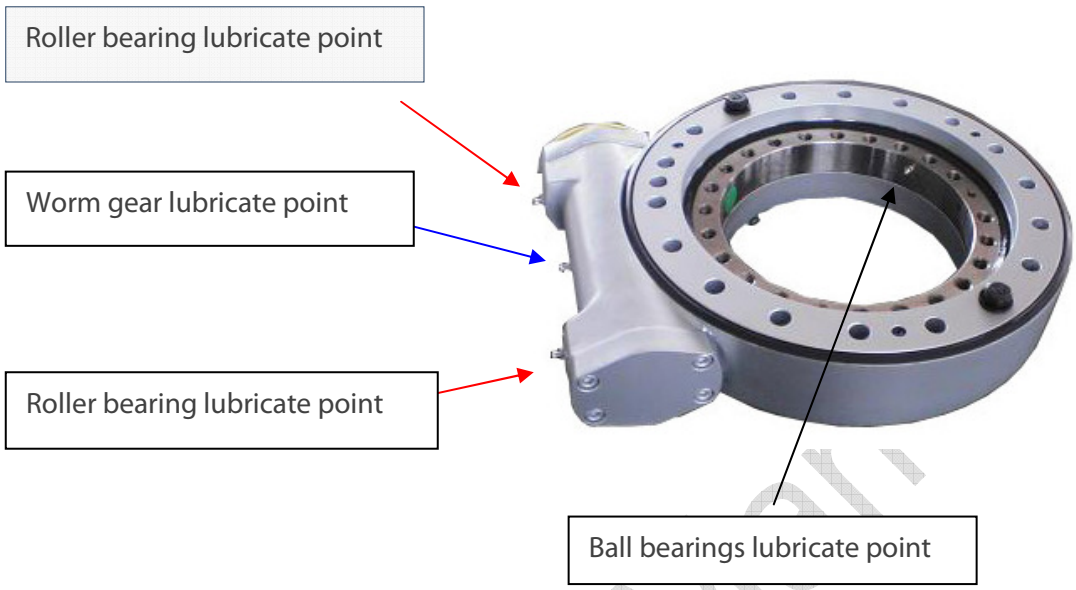

Figure 4.3 lubricate point

- 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 be sure each is hit directly. The ball bearing is enclosed separately.
- While rotating the slewing drive, inject grease into all the cleaned grease nipples consecutively as follows:

Lubrication point	Grease maintenance amount and cycle(unit: g)									
	3"	5"	7"	9"	12"	14"	17"	21"	25"	Frequency
Ball Bearings	7	7	8	13	15	16	18	40	50	Solar Trackers: every 1-2 years
Worm Gear	80	100	150	225	275	280	325	1250	1500	Mobile and Industrial Equipment every 6 months or 20000 output rotations.
Roller Bearings	25	25	40	40	40	40	40	50	50	
All applications are different and should be greased per their specific requirements. The directions listed here are only a guide.										

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Weather Protection

Paint spec

Epoxy Epicon Zinc HB-2

KMI drives are coated with a special two part epoxy coating in KMI's automated painting line to give the drive excellent heat and weather protection.

Epoxy

Brand: CMP

EPICON ZINC HB-2

EPICON ZINC HB-2 is a high-build type epoxy zinc rich paint based on a combination of epoxy resin and polyamide resin pigmented with metallic zinc power.

It has the following advantages:

- Long term rust-preventing property;
- Excellent physical properties such as toughness, impact and abrasion resistance;
- Extreme resistance to seawater, rain, heat, oil, oxidation and sunlight.

Recommended Use:

- As a primer for protection of blast-cleaned steel plates (ISO 8501-1 1988 Sa 2.5)
- Volume Solid: 52±2%
- Dry Film Thickness: 2.0-3.0 mils; 80-100 μm;
- Method of Application: Airless spray
- Thinner: EPOXY THINNER A
- Temperature Rating: 80C

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Grease Spec

Four places need to be lubricated, (1)slewing ring ball bearings, (2)worm gear, (3)taper roller bearings and (4)planetary gears. Slewing drives are supplied lightly lubricated.

Table 5: Eco Friendly Grease Specifications

Parts needing to be lubricated	Taper Bearing Ring raceway Worm Gear Thread		
KMI Recommended Greases	**Mobilux EP 2** for light duty applications with low torque and low speed.	**Castrol 936 SF Heavy A** for heavy duty applications with high torque, high speed or with horizontal axes of rotations.	**Mobil XHP 462 Moly** for medium to heavy duty applications. Low to high speed.
Applicable temp. range in ºC	-20 to +130 ºC	-20 to +130 ºC	-20 to +130 ºC
Color	Brown	Black	Gray
Four-ball test	250 kg ASTM D 2596	120 kg ASTM D 2596	315 kg ASTM D 2509
Viscosity	(-40 ℃, 10 s-1) Pas 160	@40℃ / 104℉ (mm2/s) ASTM D445 1890	ASTM D 445 cSt @ 40℃ 460
Dropping Point ℃	190	--	280
Penetration, Worked 0.1 mm	280	ASTM D217 330-360	ASTM D 1831, -5

Mobilux EP 2 is a lithium hydroxystearate based grease. It's formulated to provide extra protection against wear, rust and water. It is applied in heavy-duty application where high unit pressures are present. It provides excellent protection against rust and corrosion.

The grease helps to provide reduced wear under heavy load and vibration, protection against rust in the presence of water, extended bearing life in wet environments.

It meets or exceeds DIN 51825 (2004-06)

Castrol Molub-Alloy 936® SF Heavy is a uniquely compounded open gear lubricant developed specifically for use on heavy-duty equipment in mining and industrial service. It forms a tough lubricating film on the friction surfaces which is resistant to pressure and shock loads as well as unfavorable ambient conditions.

It meets or exceeds DIN 51502.

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Liquid Sealant

Product Description

LOCTITE® 510™ provides the following product characteristics:

Technology	Acrylic
Chemical Type	Dimethacrylate ester
Appearance (uncured)	Opaque pink paste LMS
Components	One component - requires no mixing
Viscosity	High
Cure	Anaerobic
Application	Gaskets and Sealing
Strength	Medium

LOCTITE® 510™ cures when confined in the absence of air between close fitting metal surfaces. This product is a general gasket product suitable for hand dispensing or screen printing.

Thread Lock Liquid

Tighten thread locking adhesives

Tighten thread locking adhesives are widely used for sealing, locking and corrosion resistance of threaded fasteners in various environments, can replace spring washers, pins and other traditional mechanical locking methods.

TS242 Thread locking adhesive TS242

Medium strength

- General purpose, chemotropic viscosity, For locking and sealing M6-M20 threads.
- Parts can be separated with hand tools, controlled lubricity, can attain accurate clamp loads.
- **Technical Specification**
  Color：Blue
  Viscosity：1200/6000 mPa.s
  Prevail Torque：4.8 Nm
  Break Torque：12 Nm
  Gap Fill：0.13 mm

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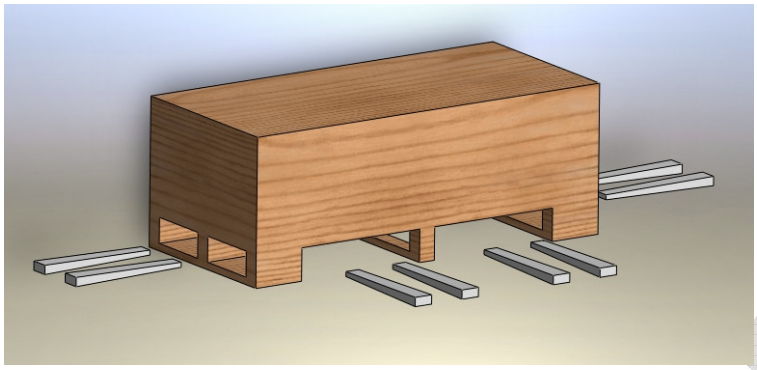
Temperature Rating of Overall Drive

Overall Slew Drive Temperature Rating: -20° C to +80° C

Transport, packaging, and storage

Transporting pallets/ crates with the forklift



Packages that are attached to pallets or packed in crates can be transported with a forklift under the following conditions:

- The forklift must be configured appropriately for the unit transport load.
- The operator must be authorized to operate the forklift.

Attachment:

1. Drive the forklift with the forks between or under the spars of the pallet/ crate.
2. Drive in the forks until they protrude on the opposite side.
3. If there is an eccentric center of gravity, ensure that the pallet/ crate cannot tip.
4. Lift the package and start the transport.

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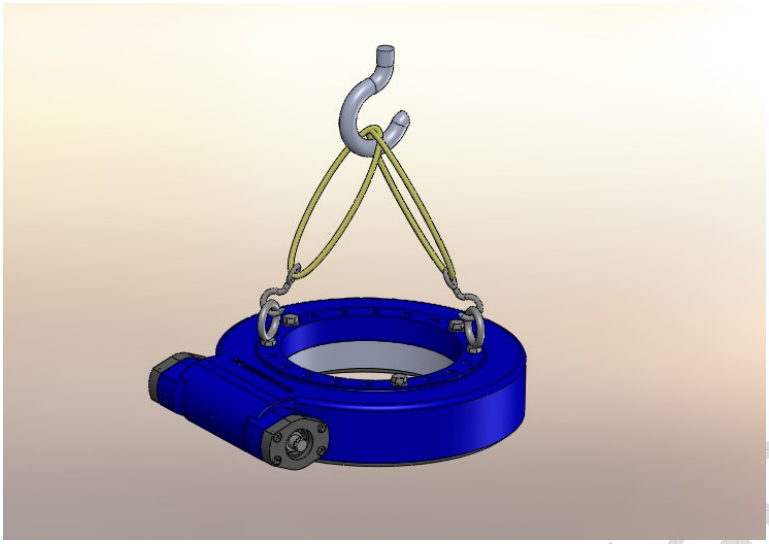
Transporting unpacked slewing rings

Use suitable lifting gear/ never transport product vertically

Unpacked slewing drives can be transported with lifting gear under the following conditions:



- The lifting equipment must be configured appropriately prior to transportation.
- The ring bolts must be configured appropriately for the weight of the transport unit.
- The slewing drive shall only be transported by itself.
- Transport within the company shall only be executed horizontally.

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Limited Warranty

1. PURPOSE.
This limited warranty to Buyer, is to provide for repair or replacement of equipment that Seller does not correctly manufacture. The equipment must be operated within the design specifications. The limited warranty does not cover normal wear and tear, nor does it cover any normal deterioration.

2. LIMITED WARRANTY.
Seller guarantees that the equipment when in good repair properly adjusted and in the hands of a competent operator is capable of performing as specified. Seller further provides the equipment to be free from defective material and workmanship defects and agrees to furnish free of charge any part or parts necessary to make good any defect directly traceable to a fault in material or workmanship of Seller provided that the claim for any such defect is made within one (1) year after Seller's original invoice and provided the defective part or parts are promptly returned to Seller's factory freight prepaid by Buyer. The charge will be prorated and will be a linear proportion of the original charge to the amount of time remaining on the warranty. Personnel will be provided to do the repairs at an additional charge. The decision as to replacement or repair of the equipment shall be solely that of Seller.

The Seller provides precision mechanical equipment that deteriorates every time it is used and this limited warranty does not cover the wear and tear on products' or electric motors/components supplied by third pay vendors. Any deterioration in performance resulting from the wear and tear on the equipment is not covered by this warranty. Likewise any misuse or use of the equipment outside the design scope of the equipment resulting in damage or failed performance is not a warranty issue

3. DAMAGES LIMITATION.
Seller's liability on any claim for loss or damage arising out of this Warranty or from the performance or breach connected with the supplying of any equipment, or the sale, resale, operation or use of such equipment, whether based on contract, warranty, tort(including negligence) or other grounds, shall not exceed the original purchase price of the equipment. Seller shall not in any event be liable for any claim, whether breach of contract, warranty, tort (including negligence) or other grounds for incidental, special or consequential damages including, but not limited to loss of profits or revenue, loss of use of the equipment or any associated product, cost of capital, cost of substitute products, facilities or services downtime, cost or claims of customers of Buyer for such damage.

4. SYSTEMS AND OTHER EQUIPMENT.
If Seller is furnishing equipment to Buyer that is part of a larger or interconnected system no guarantee is made as to the interaction of the components. Should Seller offer Buyer advice or other assistance which concerns the interconnection of any equipment, or any system or equipment in which Sellers equipment may be installed, and other equipment outside the scope of the equipment supplied by Seller, such advice or assistance will not subject Seller to any liability of any kind.

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5. DISCLAIMER.
Components and accessories in Seller's final assembly but not of Seller's manufacture are warranted only to the extent that they are warranted by the original Manufacturer. There are no other warranties, express or implied, either for merchantability or of fitness for a particular purpose. Buyer agrees that there have been no representations upon which Buyer rely other than those set forth in this Warranty. Unless specifically agreed in writing by an authorized representative of Seller, equipment sold is not intended fro use where failure of a single component could cause substantial harm to persons or property. If so used, Seller disclaims all liability. To the extent allowed by law, Seller specifically excludes and disclaims any and all implied warranties, including, without limitation, any implied warranties of merchantability and any implied warranties of fitness for a particular purpose. This Warranty does not cover damage caused during shipment, from accident, misuse, abuse, neglect, unauthorized equipment modification, failure to follow the operation instructions outlined in the owner's manual, failure to perform routine maintenance, and operation in excess of tolerances.

6. CHANGES TO EQUIPMENT.
It is further understood that any change to the equipment is done at the Buyers risk and Seller only provides a guarantee on equipment as it has been delivered and used in the proper manner. Any change to the construction, machining or any other aspect of the equipment will void any guarantee by the Seller and any not approved use or misuse of the equipment will void the Warranty.

7. SELLER'S OPTION.
Buyer agrees that the sole liability of Seller by virtue of any limited warranty made by Seller is to make the equipment fulfill the limited warranty. No limited warranty made by Seller shall be binding upon Seller after one (1) year from the date of the original invoice of the equipment and no liability for any special indirect or consequential damages of any nature is assumed by or shall be imposed by Seller based upon its undertakings herein.

8. INSTALLATION.
The equipment is a precision device and proper installation is a must. Should the equipment not be properly installed, this Warranty is void. If the equipment is not installed by Buyer, it should be done by properly trained installers. The equipment must be maintained as required in the installation instructions. The equipment must be maintained as stated in the manuals. Damage caused by disasters such as fire, flood, lightening, or improper electric current or power surges are not covered by this Warranty.

9. EXTRAORDINARY EVENTS.
Seller shall not be liable for the delay, non-delivery or default in shipment due to labor disputes, transportation shortage, delays in receipt of material, priorities, fires, accidents and all other causes because of Force Majeure, affecting Seller and/or its suppliers.

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