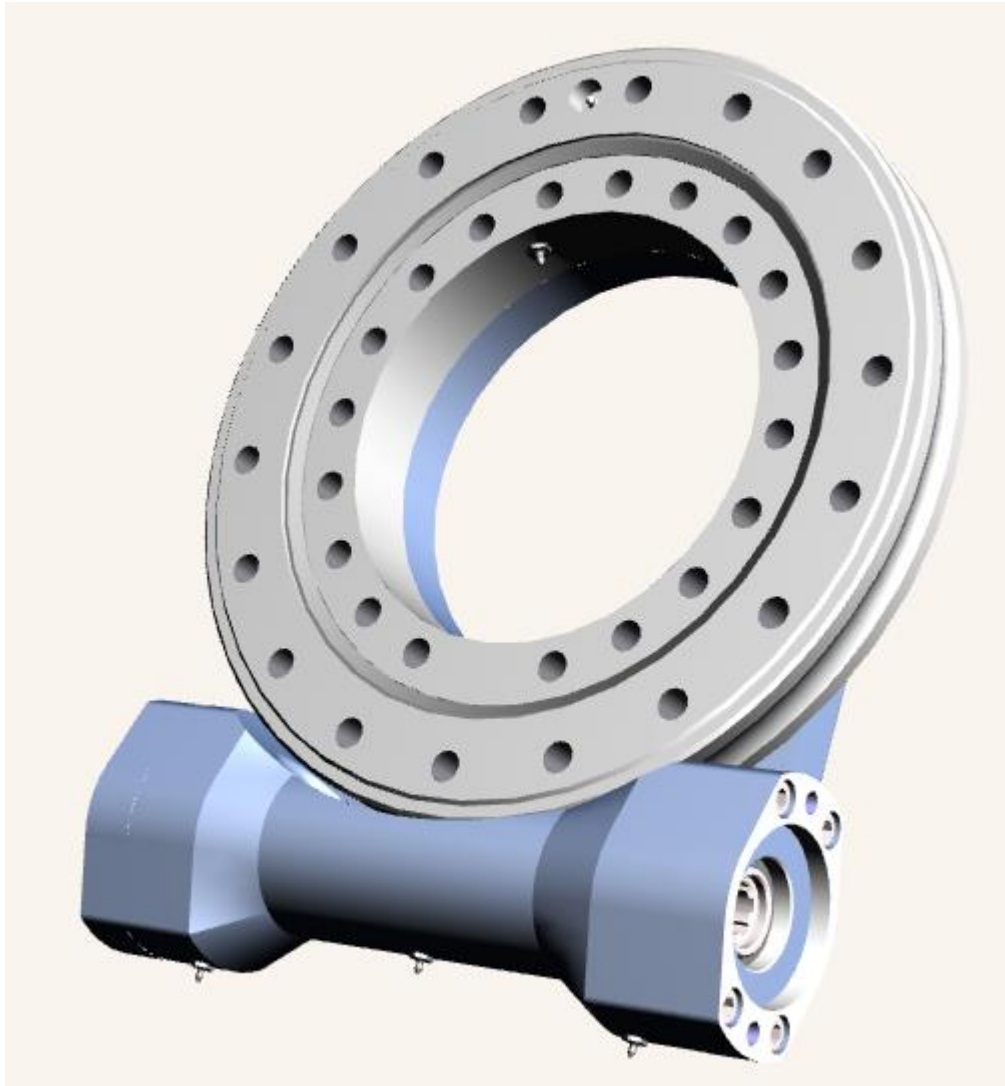


Slew Drive Installation and Maintenance Manual





The following information is for your protection. Please read carefully:

- The following instructions provide the information needed for correct installation and maintenance of slew drives. Do not attempt to install or operate the slew drive until all of the instructions are read and thoroughly understood. If you have any questions, please contact Cone Drive.
- Exceeding the product ratings, output speed, or duty cycle will void the warranty. Please contact Cone Drive with any questions regarding rating and service factors.
- This product is provided without protective covers. It is the responsibility of the purchaser or user to provide guards for all exposed gearing, shafting, couplings, sprockets, sheaves, belts chains or any other moving parts in accordance with local, state and federal requirements.
- The slew drive has moving mechanical components and is typically connected to electrical or hydraulic components which operate under high voltage or pressure. Operation and repair should only be done by qualified personnel.
- Do not alter the product without approval from Cone Drive.

Contact Information:

Cone Drive

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1. Mounting Orientations

It is important to consider the source of potential contamination when mounting the slew drive and provide appropriate protective measures.

When mounting a slew drive vertically, we recommend mounting it in the worm over position. This will provide contamination protection for the gearing and bearings (see Figure 1).

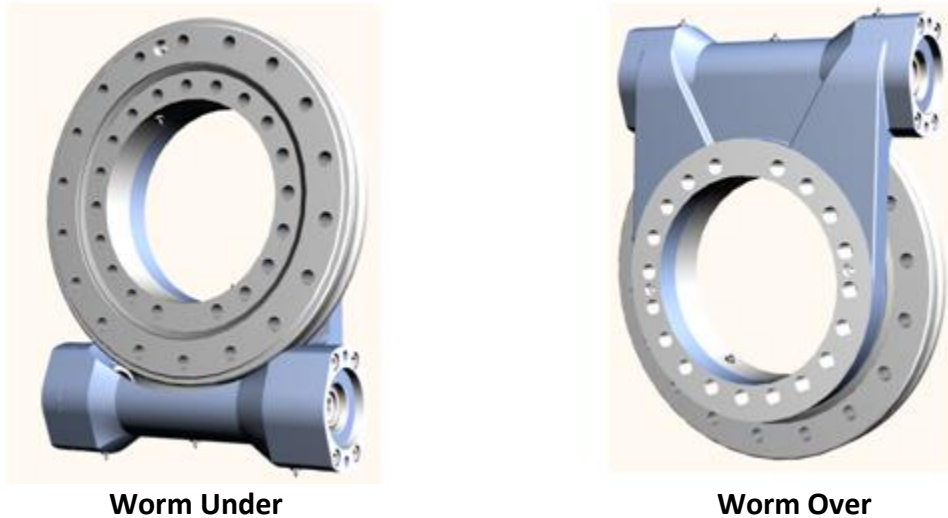


Figure 1. Vertical Mounting Orientations

When mounting a slew drive horizontally, we recommend mounting it with the housing up. This will provide contamination protection for the gearing and bearings (see Figure 2).

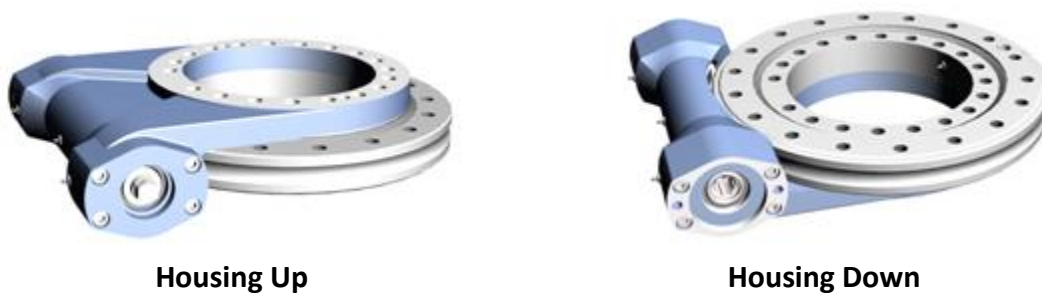


Figure 2. Horizontal Mounting Orientations

2. Transportation, Handling and Storage

2.1 Transportation

When transporting the slew drive take special care to avoid impacts with the unit. The exposed nature of the slew drive can result in damage. Slew drives come with the backlash preset. Impacts can alter this setting resulting in poor or excessive contact in the gearing.

2.2 Handling

When handling or moving the unit, install appropriately rated eyebolts or hoist rings into the mounting holes in the slew drive.

2.3 Storage

When storing the slew drive for more than 3 months, it is recommended that the grease in the slew drive be purged with new grease prior to start up. See Section 4.2 (Lubrication).

When storing the slew drive for a period of 5 months or less, store indoors in the as-shipped orientation. Keep the unit away from heat and moisture sources. The slew drive will come with surface corrosion protection that will prevent corrosion for a period of approximately 5 months (if enclosed in the shipping packaging); longer periods of storage require special protective measures.

3. Installation

3.1 Preparation

- Check the slew drive for physical damage.
- Lift the slew drive with eye bolts. Ensure the eye bolts are fully threaded into the bolt hole. Use a minimum thread engagement of 1.5 times the bolt diameter.
- The slew drive shall be mounted in an unloaded condition.

3.2 Cleaning

- Clean the slew drive and bearing mounting surfaces and the mounting structure using a cold solvent. Use a solvent that will not damage the rubber seals of the drive/bearing.
- Take care not to get any solvent into the slew drive bearing or slew drive gear mesh.
- The mounting surface must be clean and smooth. Be sure to remove impurities from the mounting surface (such as rust, corrosion, flash, burrs, paint, welding slag, loose particles, etc.)
- Cleaning the slew drive with steam or pressure washer is not recommended.

3.3 Socket Head Cap Screws and Hex Head Bolts

- W Series Slew Drives come with socket head cap screws connecting the slew bearing to the housing. The socket head cap screws are recessed into the housing and shall not be removed. S Series Slew Drives come with hex head shipping bolts. Remove and discard these bolts prior to mounting the drive.

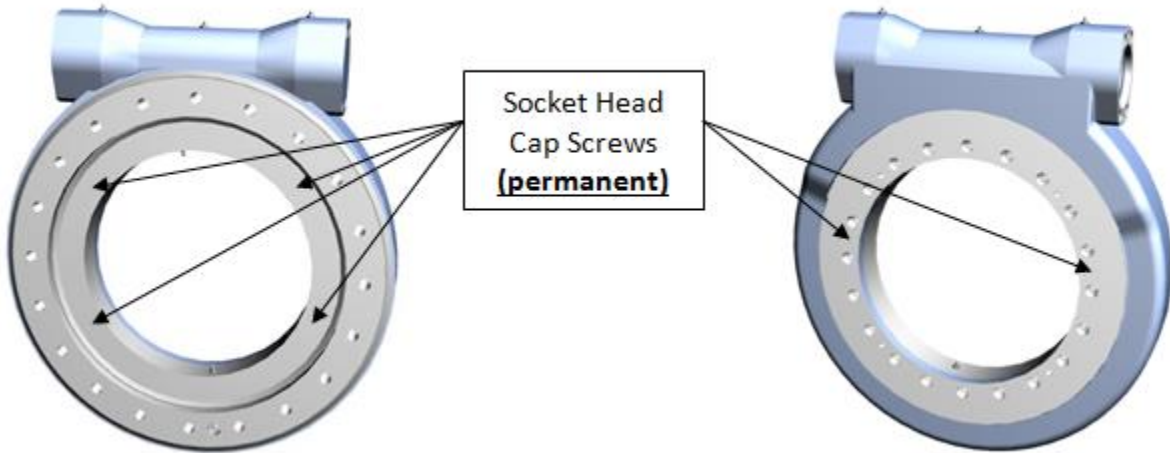


Figure 3. Shipping Bolts and Socket Head Cap Screws

3.4 Permissible Flatness Deviation of the Mounting Surface

To ensure sufficient stiffness to the load transmitted, the slew drive must be mounted on a machined surface/base. This will ensure uniform distribution of the stresses induced to allow minimal deformation in the slew drive bearing.

The allowable degree of flatness deviation of the slew drive mounting surface is shown in Table 1. Measurements are to be taken circumferentially around the mounting surface structure. Peak values should not be measured more than once in 180 degrees and should resemble a smooth sinusoidal curve.

Size of Slewing Drive		7"	9"	12"	14"	17"	19"	21"	25"
Permissible flatness deviation	[mm]	0.11	0.16	0.23	0.26	0.32	0.42	0.45	0.49
Permissible flatness deviation	degree	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

Table 1: Permissible Flatness Deviations of the Mounting Surface

3.5 Permissible Perpendicularity Deviation of the Mounting Surface

The allowable degree of perpendicularity deviation of the slew drive mounting surface is shown in Table 2. Measurements are to be taken from the inside diameter to the outside diameter of the slew drive/bearing mounting surface.

Size of Slewing Drive		7"	9"	12"	14"	17"	19"	21"	25"
Perpendicularity deviation	[mm]	0.1	0.12	0.15	0.15	0.15	0.15	0.2	0.2

Table 2: Permissible Perpendicularity Deviation of the Mounting Surface

3.6 Mounting Bolts

As the slew bearing manufacturer, we do not supply, warrant or recommend the mounting fasteners used.

3.6.1 Tightening Torques

Use of split rings, split washers, or polymeric washers of any kind is not permissible, however it is recommend that the end user use flat washers of appropriate size and strength to minimize the bolt contact pressure.

Metric Mounting Bolts		Imperial Mounting Bolts	
Mounting bolt	Tightening Torque (N.m)	Mounting bolt	Tightening Torque (ft.lb)
	Class 10.9		Grade 8
M8	28	5/16-18UNC	18
M10	55	3/8-16UNC	35
M12	98	1/2-13UNC	80
M16	246	5/8-11UNC	159
M20	481	3/4-10UNC	285
M24	558	7/8-9UNC	455

Table 3: Tightening Torques (for reference only)

3.6.2 Bolt Torque Sequence

- Apply threadlocker to threads (such as Loctite 242 or 271) according to manufacturer's instructions.
- Thread the bolts and washers, if required, into the slew drive, hand tightening each bolt. Tighten one ring at a time. You can start with the inner ring or outer ring but you must follow the tightening procedure until the full tightening torque has been reached before moving to the next ring. The bolts should be tightened in a crosswise pattern as shown in Figure 4. Follow the crosswise pattern tightening each bolt to 30% of the tightening torque. Then repeat crosswise torque pattern tightening each bolt to 50% of tightening torque. Finally repeat the crosswise pattern tightening each bolt to 100% of the tightening torque. Proceed to the other ring and repeat the bolt torque sequence.

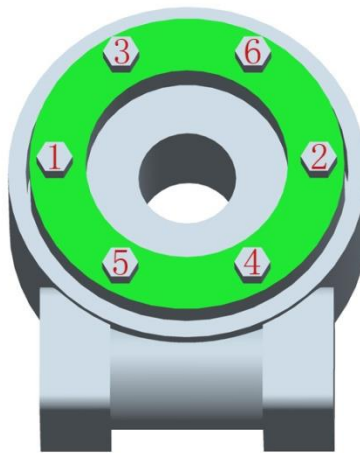


Figure 4. Bolt Torque Sequence

- Once a bolt is fully tightened, make a permanent mark on the bolt head and mounting structure. This mark will act as a visual indicator during inspection to confirm the bolt has not loosened.

3.7 Paint Repair

- During installation of the slew drive, any paint that is damaged shall be repaired. Failure to do so could result in corrosion issues and may affect the life of the slew drive.

4. Maintenance Checks & Lubrication

4.1 Mounting Bolts and Checks

- To compensate for settling in the system, it is necessary to retighten the bolts to the prescribed torque. This shall be done after approximately 100 hours of operation without external loads applied to the bolt. This inspection shall be repeated annually at a minimum.
- If a loose bolt is discovered, replace the bolt and mating washer with new ones.

- The running condition of the slew drive equipment should be evaluated during use. If excessive noise and vibration are observed, the equipment should be shut down for inspection and troubleshooting.

4.2 Lubrication

- On slew drives there are three components that require lubrication. These are the slew bearing raceway, the worm gearing, and the worm shaft tapered roller bearings. Slew drives come pre-filled with the grease listed in Table 4. Table 5 has the recommended grease quantities required to fill the units.

Parts Required to be Lubricated	Slew Bearing, Worm Gearing, Tapered Roller Bearings
Factory grease	Sinopec 7420-1
Applicable temp. range in °C	-30 ~+120
Color	Black smooth and buttery
Four-ball test	6082 N welding load
Viscosity (40 °C) cSt	1500
Dropping Point °C	180
Penetration, Worked 25°C	315
Recommended Replacement Grease	Mobil, XHP 462-Moly

Table 4: Factory Filled Grease

Parts Required to be Lubricated	Quantity of grease-fill (g)						
	7 "	9 "	12 "	14 "	17 "	21 "	25 "
Slew bearing raceway	15-20	30-35	45-50	55-60	70-75	120-130	140-150
Worm gearing	55-65	90-100	100-110	100-110	110-120	130-140	130-140
Worm tapered roller bearing	7±0.5	10±0.5	10±0.5	10±0.5	10±0.5	10±0.5	10±0.5

Table 5: Grease Quantity

- Manufacturer provisions for handling the respective lubricants must be observed.
- While rotating the slewing drive, inject grease into the cleaned grease fittings, according to Figure 5.
- Inject grease into grease fittings one shot/pump at a time. Each time the grease is injected, the raceway must be filled until grease weeps from the seal surface. When filling the bearing with grease, slowly rotate the bearing to ensure even distribution of the grease.
- Extra care must be taken when greasing the slew bearing to avoid over-pressurizing the bearing casing. Doing so may allow the seal to pop out of the seating surface. If this occurs, the seal must be re-seated prior to operation.

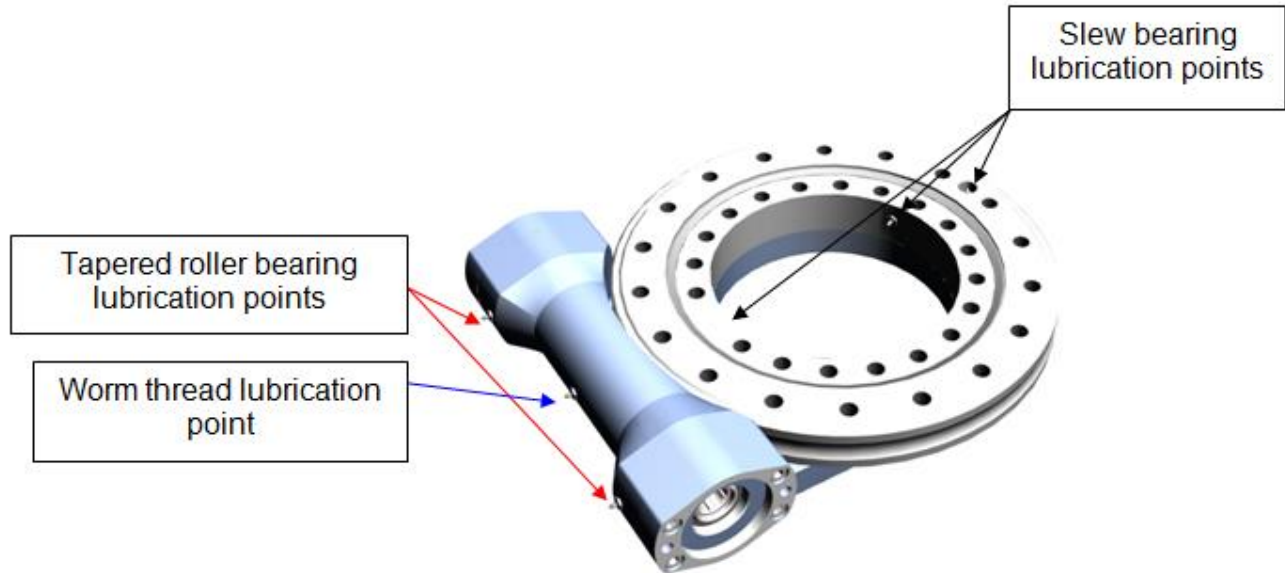


Figure 5. Slew Drive Maintenance Points

- Lubrication intervals for the slew drives are specified in Table 7 and are valid for the following operating conditions:
 - Environmental operating temperatures of -30 °C to +60 °C.
 - Drive rotational output speed < 2 rpm
 - Low to medium drive output torques as shown in Table 6

Size	7"	9"	12"	14"	17"	21"	25"
Output torque (kN·m)	.75	3.25	3.75	4	5	7.5	9
Output torque (ft.lb)	553	2,397	2766	2950	3700	5500	6650

Table 6: Low to Medium Output Torques

- Note that it is recommended to completely replace all the grease a minimum of every 3 years by filling each cavity with new grease.

Grease-Filled Slewing Drive Lubrication Intervals			
Environment	Product Type		
	W/S	WE/SE	WEA/SEA
Dry and clean workshop, industrial positioners with shielding (turntables/robots, etc.)	Every 500 hours of operation or once a year.	Every 500 hours of operation or once a year.	Once a year.
Difficult conditions in open grounds (crane/ bulldozer, etc.) wind turbine, solar, man-lift	Every 30 hours of operation or once every 3 months	Every 50 hours of operation or once every 6 months	300 hours of operation or once every 6 months
Aggressive climatic conditions sea/desert/arctic climate/very dirty surrounding/more than 70 continuous operating hours per week	Every 25 hours of operation or once every 2.5 months	Every 40 hours of operation or once every 3 months	Every 150 hours of operation or once every 4 months
Extreme conditions (tunneling machines, steel mills, oil field)	Every 20 hours of operation, or once every 2 months	Every 30 hours of operation, or once every 3 months	Every 50 hours of operation, or once every 3 months

Table 7: Recommended Lubrication Intervals

4.3 Slew Bearing Wear

As a slew drive bearing wears the amount of tilting clearance will increase. To determine the increase in clearance you must measure the initial clearance of the bearing and record it for future comparisons.

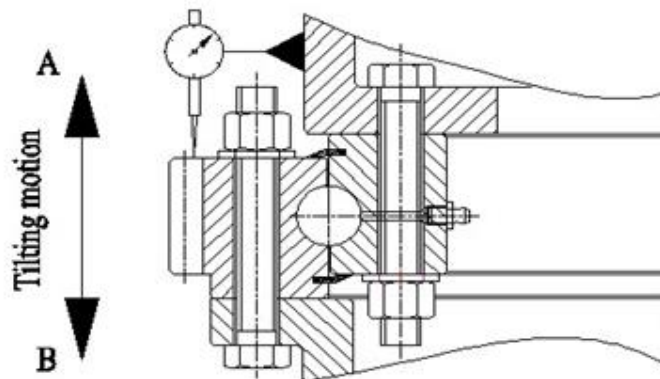


Figure 6. Tilting Clearance Measurements

- Determine the maximum tilting moment A-B and mark the measuring point. The measuring point should be as close as possible to the bearing pitch diameter.
- Attach the dial gauge as shown in Figure 6.
- Apply the defined tilting moment, minimum 50% of the max operational load in direction “A”. Set the dial gauge to zero.
- Apply the defined tilting moment, minimum 50% of the maximum operational load in “B” direction.
- The measured value displayed corresponds to the tilting clearance and serves as a basis for comparison for later inspections.

- If the recorded increase or delta is larger than the value shown in Table 8, replace the slew drive.
- All subsequent measurements are performed at the same measuring point, with the same position of the bearing rings relative to one another and in the same sequence.
- Record all measured values.

Bearing Tilt Clearance			
Raceway Diameter (mm)	Rolling Element Diameter (mm)	Allowable Tilt Increase (mm)	Allowable Tilt Increase (in)
< 200	14.00	0.64	0.025
< 300	19.84	0.89	0.035
< 430	22.23	1.02	0.040
< 640	25.40	1.14	0.045
< 830	31.75	1.40	0.055
< 1370	39.69	1.65	0.065
< 4300	60.00	2.29	0.090

Table 8: Maximum Increase in Bearing Tilt Clearance

- If the slew drive bearing has less wear than what is shown in Table 8 but starts to make noise, experiences rough rotation, requires more power to rotate, or has metal shavings in the grease, the slew drive should be replaced.

5. Drive & Control

5.1 Mounting a Hydraulic Motor

- Clean mounting surface faces of motor and slew drive (see Section 3.2 Cleaning).
- Check motor hydraulic port mounting position (see Figure 7).
- Tighten motor attachment bolts to appropriate torque level.
- Connect hydraulic supply to motor.
- Rotate the motor and slew drive under no load to confirm smooth rotation.
- Retest after loading is applied.

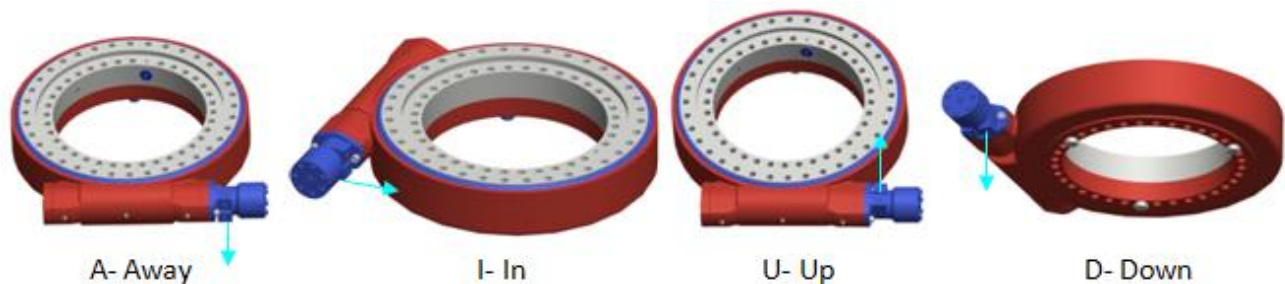


Figure 7: Hydraulic Motor Oil Port Position