Technical Information

Symbols and units

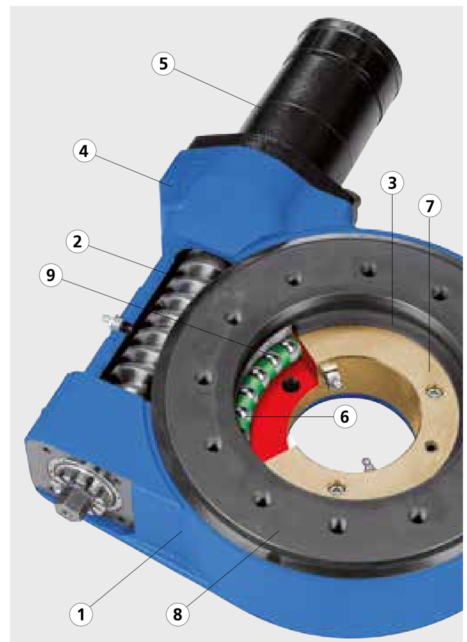
α_A	—	Bolt tightening factor
C_{ax}	kN	Dynamic load rating, axial
C_{rad}	kN	Dynamic load rating, radial
$C_{0\ ax}$	kN	Static load rating, axial
$C_{0\ rad}$	kN	Static load rating, radial
D_L	mm	Raceway diameter of the rolling elements (see product range overview, P. 6/7)
ED_B	%/min	Duty per minute
f_a	—	Application service factor
F_{ax}	kN	Equivalent axial load including all occurring impact loads and required safety factors, calculated from all axial forces
F_{axD}	kN	Equivalent axial load including application service factor for determining the load point in the limiting load diagram
F_{rad}	kN	Equivalent radial load including all occurring impact loads and required safety factors, calculated from all axial forces. The gearing circumferential force that occurs must be taken into account!
$F_{rad\ max}$	kN	Limit value for checking frictional capability
F_{sp}	kN	Bolt tightening force
i	mm	Gear ratio
m	mm	Module
$M_{d\ B}$	Nm	Operating torque
$M_{d\ nom}$	Nm	Nominal torque
$M_{d\ max}$	Nm	Maximum torque
$M_{h\ max}$	Nm	Maximum holding torque
M_k	kNm	Equivalent tilting moment including all occurring impact loads and required safety factors, calculated from all axial and radial forces causing tilting
M_{kD}	kNm	Equivalent tilting moment including equivalent radial load and application service factor for determining the load point in the limiting load diagram
M_w	Nm	Friction torque of the slew drive under operating load in the installed state
M_{wA}	Nm	Friction torque of the slew drive in the unloaded state
n	min^{-1}	Output speed
n_{perm}	min^{-1}	Permissible output speed
n_b	—	Number of mounting holes per bearing ring
Q	l/min	Oil flow
p	bar	Pressure differential
S_F	—	SP series: Safety factor against tooth base fatigue WD series: Safety factor against tooth fracture, dynamic
$S_{F\ S}$	—	WD series: Safety factor against tooth fracture, static
S_W	—	WD series: Safety factor against tooth wear, dynamic
z_1	—	Number of teeth, pinion
z_2	—	Number of teeth, wheel

Function

Function of the slew drive

Slew drives comprise a geared slew drive with high load carrying capacity (1), one or more geared drive elements (2), a functional seal (3), a housing (4) and a hydraulic or electric drive (5). Slew drives are designed for grease lubrication.

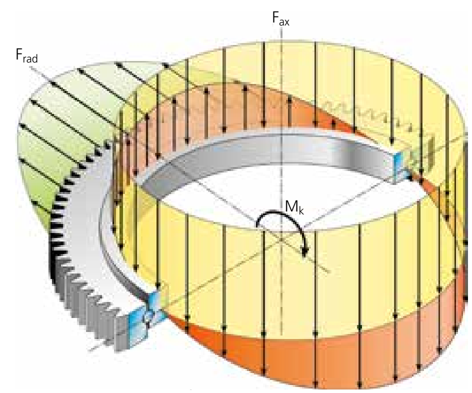
In the slew drive, rolling elements (6) transfer the loads between the inner (7) and outer ring (8). The load carrying capacity of the raceway system is determined by, amongst other parameters, the bearing design, the hardening depth, the rolling element size and quantity. Spacers (9) separate the rolling elements of the rolling element chain and minimize wear.



Load distribution

Depending on the external load, different load distributions and contact angles occur in the rolling element chain.

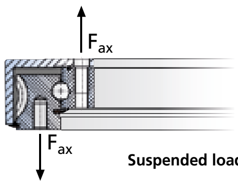
- In the case of an axial load F_{ax}, all the rolling elements are loaded in the same direction.
- In the case of a radial load F_{rad}, one segment of the rolling element chain carries the load.
- In the case of a tilting moment M_k, one segment carries the load on one side and one segment on the opposite side.
- Usually, combinations of axial, radial and tilting moments occur.



Technical Information

- Axial loads can be supported or suspended.
- Suspended axial loads and the load of the rising segment of the tilting moment must be held with the mounting bolts.

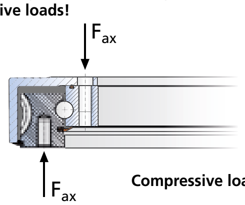
Caution: In this case, catalog information is <u>not</u> valid!



Suspended loads

- Radial loads must be transmitted through frictional capability between the slew drive and the mounting structure.
- Only a good bolted connection can ensure the function of the slew drive.
  The bolted connection and the tilting clearance of the slew drive must be checked regularly.

All bolt data given in the catalog is valid only for compressive loads!



Compressive loads

Gear
Slew drives of the WD series are designed with a worm gear. Slew drives of the SP series are designed with a spur bevel gear. Permissible torques are listed in the dimensioning tables.

Drive
The drive is provided by a flange mounted hydraulic or electric motor. Both the connection flange and the shaft/hub connection conform to the normal industrial standard. This means that standard hydraulic motors can be mounted without any trouble. Appropriate adapters are required for electric motors. At IMO, the drive motors are designed according to the specifications of the customer and can be very flexible with regard to rotational speed and torque.

Housing
The housings are made as a welded or cast components and are matched to the size of the slew drive. As standard, the housings are supplied with a primer.

Sealing
The polymer seals protect the slew drive against the ingress of normal quantities of dirt, dust and light spray water. In case of severe dirt contamination, water jets or mechanical load, the seals must be protected with upstream labyrinths on the mounting structure. The functionality and achievable service life of the slew drive are primarily dependent on avoiding the ingress of dirt particles into the slew drive.
High-pressure cleaners must not be used to clean slew drives.

Operating temperature
Standard versions of IMO slew drives can be used in ambient temperatures from –20°C to +70°C.

Selection criteria

The criteria listed below must be taken into account for the correct selection of a slew drive.

Position of the output shaft

Vertical: Slew drives of any series can be used.

Horizontal: Slew drives of any series can be used with the exception of the WD-H series as well as sizes 0478, 0625, 0620, and 0713 of the WD-L series. Here, it is essential that a slew drive with a double-threaded worm is used, because otherwise a jerk-free operation cannot be ensured during reverse load situations.

Alternating: Slew drives can be used as described under “Output shaft, vertical” up to an inclination angle of 5° to the vertical. In the case of inclination angles beyond this, slew drives must be used as described under “Output shaft, horizontal”, as otherwise jerk-free operation cannot be ensured.

Slew drives that are not self-locking can optionally be equipped with a holding brake, if safe holding of the load is required.

Loads
The operating load point of external loads, such as axial load, radial load and tilting moment, must lie below the static limiting load curve. For this, please refer to the sections “Static raceway load carrying capacity” and “Mounting bolts”.

Shocks, vibrations
To satisfy the special requirements of the various applications, shock coefficients for the gears must be taken into account. Slew drives of the WD series are not suitable for applications with continuous vibrations.

Reverse torques
Due to their high ratios WD-series slew drives can be severely damaged under reverse load conditions if the reverse torque exceeds the maximum permissible table values $M_{h\ max}$.

Torque
The operating torque must not exceed the maximum torques stated in the dimensioning tables, calculated with the application service factor 1. You can find explanations of the different torque specifications below:

SP series:

Maximum torque $M_{d\ max}$:
SP-H slew drive series:
The maximum torque is limited by the maximum radial load of the planetary gear used.
SP-I slew drive series:
The maximum torque is limited by the maximum input torque of the hydraulic motor used for a ø 25 mm key shaft.

Nominal torque $M_{d\ nom}$:
The nominal torque is calculated with a safety factor against tooth base fatigue $S_F = 1$, at the output speed stated in the dimensioning table and one-way varying load.

WD series:

Maximum torque $M_{d\ max}$:
The calculation of the maximum torque with a safety factor against tooth fracture $S_{F\ S} = 1$ is done according to G. Niemann / H. Winter, Maschinenelemente (machine elelments) Band III, 1986, for worm gears and is influenced by the
- Limit value of the tooth base stress
- Module
- Gear width

Nominal torque $M_{d\ nom}$:
The nominal torque is calculated with a safety factor against tooth wear $S_W = 1$,
- At the output speed given in the table
- For a calculated service life of 10000 h
- At a duty of 5%

For slew drives with two motors, the specified values are valid for a slew angle ≤ 170°.

SP and WD series:

Maximum holding torque M_h:
The maximum holding torque determines which reverse torque can be transmitted or held, without damage being caused to the gear. If the holding torque is unknown, the value of the maximum torque is assumed as the holding torque in the design process.

Rotational speed
Slew drives of SP series:
The max. permissible rotational speed is $\mathbf{n_{perm} = \frac{40000}{D_L}}$

WD slew drive series:
The maximum permissible rotational speed is given in the dimensioning tables. For higher speeds, please contact our Sales department.

Duty
Slew drives of the WD series are designed for intermittent duty. Applications with continuous running or with a high rate of duty and, simultaneously, a high output torque are not permissible. This would lead to unacceptable temperature increases in the gear and thus to premature failure of the slew drive.
The transmission of the maximum torque must be limited to 10% of each minute.

Static raceway load carrying capacity

The static load carrying capacity of the slew drive is determined by:

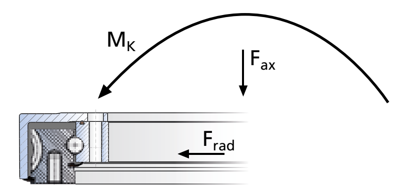
- Hardening depth of the raceway
- Number and size of the rolling elements
- Bearing design
- Raceway geometry

The limiting load diagram shows the permissible axial and tilting moments for the respective size of unit.

Each load case, including the required and recommended safety, must lie under the limiting load curve.

The limiting load diagrams are valid under the following condition:

- Static loading
- Limiting load curve with safety 1
- Grip length of the bolt at least 5x and maximum 10x the bolt diameter
- Continuous thread up to the bolt head is not permissible
- Bolt grade 10.9
- All mounting holes used
- Compressive load
- Sufficiently stiff and flat mounting structure
- Minimum strength of the mounting structure 500 N/mm²
- Radial loading taken into account as specified
- Compliance with all items of the Installation and Operating Manual



To address the peculiarities of the different applications, the following application service factors must be taken into account in the prevailing loads:

Application	Application service factor f_a	Remark
Construction machines	1.25	Normal operation
Forestry machinery	1.50	Rough operation
Foundry works	1.75	Rough operation
Manlift platforms	1.30	Normal operation
Mech. engineering, general	1.25	Normal operation
Mech. engineering, general	1.50	Heavy-duty operation
Measurement technology	2.00	Accuracy
Robot / handling systems	1.50	Accuracy
Rail vehicles	1.50	Rough operation
Special vehicles	1.50	Rough operation
Deep mining companies	1.75	Rough operation
Machine tools	1.50	Accuracy

The application service factors should be taken into account in the following equations for the prevailing loads:

$$\mathbf{F_{axD} = F_{ax} \bullet f_a}$$

$$\mathbf{M_{kD} = (M_k + 1.73 \bullet F_{rad} \bullet \frac{D_L}{1000}) \bullet f_a}$$

The tilting moment is increased accordingly to take the prevailing radial load into account.

This equation only applies when:

$$\mathbf{F_{rad} \leq 220 \bullet \frac{M_k}{1000} + 0.5 \bullet F_{ax}}$$

Should the value be exceeded, then the limiting load diagram is no longer valid.
Please contact our Sales department.

Calculation example:

Application: Slew equipment for a construction machine in normal operation

Load: Axial load 55 kN
Radial load 6 kN
Tilting moment 86 kNm

Slew drive: pre-selected SP-H 0455/2 - 05910

Checking the radial load:

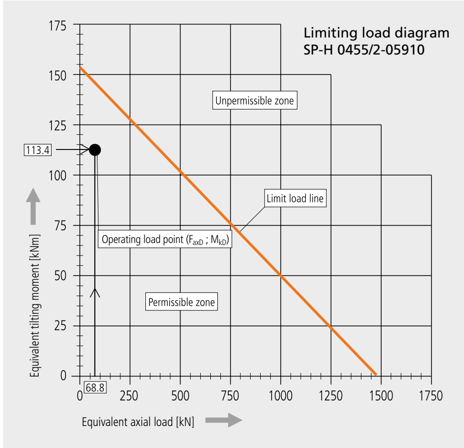
$$\mathbf{F_{rad} = 6\ kN \leq 46{,}4\ kN = 220 \bullet \frac{86}{1000} + 0.5 \bullet 55}$$

An application service factor of 1.25 results in the following values:

$$\mathbf{F_{axD} = 55 \bullet 1.25 = 68.8\ kN}$$

$$\mathbf{M_{kD} = (86 + 1.73 \bullet 6 \bullet \frac{455}{1000}) \bullet 1.25 = 113.4\ kNm}$$

At this point, it is possible to check in the limiting load diagram, whether or not the preselected slew drive is statically adequate:



If the operating load point is below the limiting load curve, then the slew drive is statically adequately dimensioned. If the loads occur frequently during slewing, then the selected types should be reevaluated, dynamically, for service life. Please contact our Sales department about this.

Mounting bolts

Prevailing loads must be transmitted safely. To ensure this, besides checking the raceway loads, the mounting bolts must be sized accordingly.
The bolt curve is shown in the static limiting load diagram with the following conditions:

- Fulfillment of the conditions as specified for considering the static load carrying capacity of the raceway.
- Bolts are duly tightened with a torque wrench (bolt tightening factor $\alpha_A = 1.6$).
- For slew drives with through holes, use the largest possible metric bolts with coarse-pitched threads.

Caution: In the case of suspended loads, the bolts are additionally subjected to tensional forces. Please contact our Sales department.

Static load carrying capacity of the mounting bolts
The determination of the operating load point, both with and without a radial load, takes place analog to the checking of the static load carrying capacity of the raceway.
If the relevant load case lies below the limiting load curve in the static limiting load diagram, then the bolted connection is statically adequately dimensioned.

Dynamic load carrying capacity of the mounting bolts
Usually, a static dimensioning of the bolted connection is sufficient. Dynamic checking is required in cases in which high numbers of load reversals act on the slew drive.
Please contact our Sales department about this.

Frictional capability of the bolted connection
If radial loads act on the slew drive, then it must be ensured that these loads can be transmitted to the bolts without shearing forces. Therefore it must be determined whether the radial load can be transmitted through frictional capability between the mounting structure and the slew drive.

$$\mathbf{F_{rad\ max} = \frac{n_b \bullet F_{sp}}{18.8}}$$

n_b = Number of mounting holes per ring

F_{sp} = Bolt tightening force of the mounting bolts

If the prevailing radial load exceeds the limit value, then we request you to contact our Sales department.

For slew drives with a different number of bolts or size of bolts in the inner and outer ring, the permissible radial load must be determined for both rings.
The smaller value is the limiting value.

Frictional capability prevails if $F_{rad\ max}$ is greater than the prevailing radial load.

Slew drives of the WD-H series must always be centered.

Securing the bolts

If the customer requires the bolts to be secured, we recommend the following products (the manufacturer's specifications apply):

Loctite
Application of Loctite 270 is suitable for high strength connections. This counteracts loosening and seals the thread.

Nord-Lock
Nord-Lock – self-locking bolt washers – are recommended for vibration and dynamic loads.
Due to a pair of wedge-locking washers, with tapered surface gradients between the two Nord-Lock washers greater than the gradient of the bolt thread, any bolt loosening tendencies are counteracted immediately.

We do not recommend using other bolt securing systems.

Friction torque

The friction torque of slew drives is dependent on many influence factors, such as:

- Stiffness and flatness of the mounting structure
- Load and loading combination
- Rotational speed and operating temperature
- Slew drive design
- Number and frictional torque of the seals
- Lubrication grease and filling level
- Production tolerances
- and other factors

The following equations can be used to approximately determine the friction torque of an unloaded slew drive:

Slew drives, SP series, with a minimum bearing clearance greater than zero

$$\mathbf{M_{wA} = 0.2 \bullet \frac{D_L^2}{2000}}$$

WD-L slew drive series, with bearing preload

$$\mathbf{M_{wA} = 2.0 \bullet \frac{D_L^2}{2000}}$$

WD-H slew drive series, with bearing preload

$$\mathbf{M_{wA} = 4.0 \bullet \frac{D_L^2}{2000}}$$

The friction torque for a slew drive under load can approximately be determined using the following equation:

$$\mathbf{M_w = 0.005 \bullet (4400 \bullet M_k + 4 \bullet D_L \bullet F_{rad} + D_L \bullet F_{ax}) + M_{wA}}$$

Gear

Shock coefficients
For applications, in which shocks can be expected, appropriate shock coefficients must be included to determine the max. torque.

Service life
The expected service life of the gear depends primarily on the operating conditions. These include:

- Torque
- Output speed
- Duty
- Ambient temperature
- etc.

Technical Information

SP series slew drives

Gear design
Slew drives of the SP series are designed with a spur bevel gear according to DIN 3960, DIN 3962 and DIN 3967.
If higher torques are necessary or if a longer service life is required, the gear can be manufactured as a tempered or hardened version.

Permissible torques
Please refer to the dimensioning tables for relevant information.

Drive pinion
The pinions used in the different sizes have hardened gears.
You can find information on the transmission ratios and numbers of teeth in the dimensioning tables.
In a direct drive (SP-I), the drive pinion is supported by two radial bearings, which are integrated into the housing and the motor mount.
In the case of slew drives equipped with a planetary gear, the drive pinion is supported by the planetary gear.

WD series slew drives

Gear design
Slew drives of the WD series are designed with a hardened worm gear according to DIN 3975.

Permissible torques
Please refer to the dimensioning tables for relevant information.

Worm shaft
The worm shafts are made of hardened steel, with ground tooth flanks.

Angular accuracy

The angular accuracy of the slew drives is dependent on various factors:

- Tooth flank backlash
- Tolerances of the individual parts
- Elastic deformation under loads
- Gear wear
- Attachments

Should a slew drive with increased positioning accuracy be required, please contact our Sales department.

Tooth flank backlash
The tooth flank backlash is required to ensure smooth rotation of the slew drives. It relates to the highest point of the gear in the unloaded condition. A greater tooth flank backlash can be assumed at other positions of the slewing ring circumference. Adjustment or modification of the tooth flank backlash by the customer is not intended and also not permitted!

Tolerances of the individual parts
As with every machined part, the individual parts of the slew drives are subject to tolerances, the combination of which influence the angular accuracy.

Elastic deformation under loads
Under the influence of external loads, elastic deformations inevitably occur at the slew drives, any installed extension parts and the customer mounting structure, irrespective of any rotation of the slew drives.

Gear wear
Wear leads to increasing play in the gear as the period of use increases. We recommend regular checking of the wear state by determining the tooth flank backlash. Please refer to the Installation and Operating Manual for more detailed information.

Attachments
Optional attachments, such as motors, gearboxes and brakes, have an additional influence on the angular accuracy of the overall system. For more detailed information, please consult the appropriate manufacturer's information.

SP series slew drives

The tooth flank backlash is factory set to the highest point of the gear in the unloaded state to a value of ≥ 0.04 * module.

WD series slew drives

The tooth flank backlash is ≥ 0.3 mm at the highest point of the gear and in the unloaded state.

Caution: Slew drives of the WD-H series and some slew drives of the WD-L series are equipped with disk springs in the bearing of the drive train as standard. Depending on the size, these can lead to an additional axial shift of the worm shaft of ±0.5 mm to ± 2.5 mm!

Self-locking

SP series slew drives

Slew drives of the SP series are not self-locking.
We recommend using a brake to transmit the required holding torque, to hold a desired position safely or achieve a safe stop.

WD series slew drives

Self-locking on slew drives of the WD series exists only if the slew drive cannot be driven from the output side. Self-locking is directly related to the efficiency of the slew drive, which depends on many factors, such as

- Lead angle
- Friction angle
- Rotational speed
- Lubrication
- Material matching
- Surface finish
- etc.

Theoretically the slew drives are self-locking when the efficiency of the gear is < 50%.
The information in the dimensioning table corresponds to this statement.However, it is essential that the actual availability of self-locking in the supplied slew drive is determined individually under the given operating conditions.

We take no responsibility for the agreement between the theoretical information in the dimensioning tables and the practically available self-locking or non-self-locking characteristics.
We recommend using a brake to transmit the required holding torque, to hold a desired position safely or achieve a safe stop.

Lubrication

Sufficient, regular lubrication is required to ensure reliable functioning and a long service life. In this regard, the lubrication grease fulfills the following functions:

For the raceway:

- Reduction of friction and wear in the roller contact
- Corrosion protection
- Lubrication of the seals
- Additional sealing effect of the grease collar

For the gear:

- Smoother running
- Less wear
- Reduced running noise
- Long service life
- Less heat development

Initial greasing
IMO slew drives are supplied pre-lubricated.
High-quality lithium grease based on mineral oil, with EP additives according to DIN 51502, KP 2 K-30, is the standard lubrication.

Regreasing intervals
Depending on the frequency of use and prevailing operating conditions, regreasing must be done at regular intervals. In general, care should be taken to ensure that the grease used is compatible with the initial greasing and the sealing material. In particular, care should be taken to ensure that the lubricating grease types specified in the order drawing are always used.
Should you wish to use another type of grease, you must check that this grease type is compatible with the one used for initial greasing. In this case, please contact your grease manufacturer. In addition, please always comply with the information in our Installation and Operating Manual.

Besides regular regreasing during operation, it is also necessary to lubricate the slew drive before and after longer down times. In addition, the equipment in which the slew drive is integrated must be regreased after cleaning.

CAUTION:
Slew drives must not be cleaned with high-pressure cleaners. Otherwise, larger pressurized volumes of water may ingress through the sealing gap and into the slew drive.
This cannot be removed, even through considerable amounts of regreasing. This greatly reduces the service life of a slew drive.

Miscibility
Greases with different saponification and base oils cannot be mixed. The grease manufacturers should always confirm the miscibility of different grease types.

Storage of lubricants
Even when unused, lubricants are subject to aging. After about 3 years, the grease used should be used up or replaced.

Design of the mounting structure

The safe transmission of prevailing loads and the reliable operation of the slew drive is achieved, among other things, through using an adequately dimensioned mounting structure. In this regard, the mounting structure must comply with certain minimum requirements for the slew drive to function reliably:

- Sufficient stiffness (see Installation and Operating Manual)
- The flatness requirements in the Installation and Operating Manual must be observed
- No hard points (e.g. from cross beams)
- Surfaces for bolts must at least be machined
- A cup-shaped structure is preferable
- Use all mounting bolts
- Use recommended bolt grade
- Minimum strength of the mounting structure 500 N/mm^2

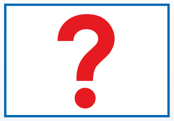
Depending on the maximum load and the application, the solutions for the design of the mounting structure may be very different. If the mounting structure is designed as a cup-shaped structure, the flange thickness should be at least 50% of the slew drive's overall height. The wall thickness of the cup should be about 30% of the flange thickness.
For weight-critical applications, the flange thicknesses can only be reduced if appropriate stiffening is provided and the specifications for the permissible deviation from flatness and angular misalignment as well as deformation under load are complied with. Please refer to the Installation and Operating Manual for values.

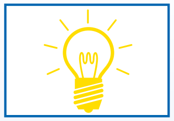
Please comply with our Installation and Operating Manual.

This compliance is of essential functional and safety relevance for our product and has a decisive influence on the intended service life. You can find the current version of the Installation and Operating Manual on the Internet at www.imo.de.

On request, we can also send you the manual in paper form.

Selection of a slew drive in just a few steps





You will find a detailed procedure on the following pages!

SP series Spur gear driven type

START

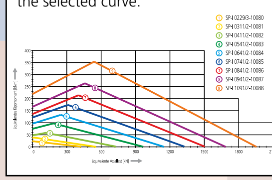
WD series Worm gear driven type

Without restrictions	n = 40000/D_L [min-1]	Without restrictions
Application without continuous vibrations and without high impact loading	Output speed 1)	Duty per minute ED_B 1)
Condition fulfilled	n ≤ 1 min-1 (WD-L/WD-H 0490,0645)	ED_B ≤ 80 %/min
	n ≤ 2 min-1 (WD-H 0300,0373)	
	n ≤ 3 min-1 (WD-H 0220)	

Position of the output shaft 1)			
Vertical	Horizontal	Alternating	
		Angle of inclination to the vertical	
		≤ 5 degrees	> 5 degrees
WD-L or WD-H	WD-L or WD-L 0478, WD-L 0625, WD-L 0620, WD-L 0713, WD-H with double-threaded gearing	WD-L or WD-H with single-threaded gearing	WD-L or WD-L 0478, WD-L 0625, WD-L 0620, WD-L 0713, WD-H with double-threaded gearing

Selecting a slew drive with greater max. torque $M_{d\,max}$

Selecting a slew drive using the limiting load diagram 1)2)
Operating point incl. application service factor f_a must lie below the selected curve.

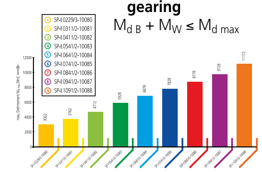


Selecting a slew drive with greater max. torque $M_{d\,max}$

Condition fulfilled

Condition not fulfilled

Static checking of the gearing
$M_{d\,B} + M_W \leq M_{d\,max}$



Condition not fulfilled

Condition fulfilled

Checking the selected slew drive at IMO for service life and static suitability
Please provide the "Application Data Sheet" (see end of the catalog) and sketch of the application for inspection.

SOLUTION

1) Selection criteria can only be used as rough guide values; if the limit value is exceeded, please contact IMO.
2) Please take the validity conditions into account as accurately as possible.

Procedure for selecting a slew drive in just 3 steps:

Using an example, the following section describes the pre-selection of a suitable slew drive:

Example
Application: Steering gear for an in-house transport vehicle; rough operation; limited installation space; output axis installed vertically, compressive loads

Load data:
Axial load: F_{ax} = 100 kN
Radial load: F_{rad} = 40 kN
Tilting moment: M_k = 80 kNm
Operating torque: $M_{d\,B}$ = 13200 Nm
Output speed: n = 1.0 min^{-1}

Description of the slew cycle under operating torque:
Slew 60° in 10 seconds in clockwise direction
Slew 60° in 10 seconds in counter-clockwise direction, slewing pause for 40 seconds
In terms of one minute: 20 seconds slewing - 40 seconds slew pause

→ 0.333 minutes slewing per minute
→ Duty per minute of operation:

$$ED_{B'} = \frac{0.333}{min.} \bullet 100\,\% = \frac{33.3\,\%}{min.}$$

Step 1:
Selecting a suitable design (WD or SP)
Comparing product characteristics

WD design:

- Features high torques at low output speeds and transfers high tilting moments, axial and radial loads
- Achieves the highest power density with the smallest diameter configuration
- Flat design thanks to tangentially arranged drives
- Provides high torque transmission, however the duty must always be taken into account.
- Slew drives without self-locking can be equipped with holding brakes
- Always take the position of the output shaft into account when selecting the slew drive
- Not recommended in cases of continuous vibrations or heavy impact loading

Typical applications:
Manlift platforms, steering gears for undercarriages of crane and heavy-duty vehicles, loading cranes, turntables, forklift rotators, mining equipment, and much more.

SP design:

- Enables higher output speeds
- Extremely narrow around the slewing ring but the drive protudes in the axial direction
- Offers a large, open internal diameter
- Very suitable for structures with a large radial diameters
- Fundamentally not self-locking in design

- Can be equipped with holding brakes
- The position of the output shaft is insignificant
- Preferred design for vibrations and impact loading applications

Typical applications:
Handling and automation units, packaging machines, tool changers, picker arms, construction machines, agricultural and forest harvesters, and much more.

Example step 1:
Worm gear driven types have proved their worth as steering gears. A high torque level and low output speed with a small installation height and diameter clearly speak for the use of a WD design. A single-threaded worm gear can be selected on account of the vertical output shaft installation position. The WD-L series offers the smallest assembly height of the worm gear driven slew drives.

Step 2:
Selecting a suitable construction size in the limiting load diagram for compressive loads:

A suitable slew drive is selected iteratively. For a pre-selected slew drive (e.g. WD-L 0478/3-04904), an operating load point is calculated depending on the external load, the application service factor and the raceway diameter D_L. Loading is permissible for the raceway and bolt connection, if the operating load point lies below the limiting load curve of the pre-selected slew drive.
If the operating load point lies above the corresponding limiting load curve, a slew drive with a higher load capacity must be selected, whose limiting load curve lies above the current operating load point. The operating load point must be recalculated for the newly selected size and the permissibility of the new operating load point checked in the limiting load diagram.
If, on the other hand, the operating load point lies even below the limiting load curve of a smaller size, then the permissibility of the newly calculated operating load point for this size can be checked in the limiting load diagram.
This iterative procedure is continued until an optimally suitable size has been determined, by which the operating load point lies below the corresponding limiting load curve.

The following conditions must be fulfilled:

- Preconditions for the limiting load diagram apply (see section "Static raceway load carrying capacity")
- Equation $F_{rad} \leq 220 \bullet \frac{M_k}{1000} + 0.5 \bullet F_{ax}$ fulfilled

Step 3:
Static checking of the permissibility of the operating torque $M_{d\,B}$:

The following condition must be fulfilled:
- Operating torque $M_{d\,B}$ + friction torque $M_w \leq$ maximum torque $M_{d\,max}$

Please note:

We recommend having IMO check the service life of the selected slew drive. For this, please send our "Application Data Sheet" (see end of the catalog) to our Sales department together with sketches of the application.

Example step 2:

- Preconditions for the limiting load diagram apply
- Checking the condition:

$$F_{rad} \leq 220 \bullet \frac{M_k}{1000} + 0.5 \bullet F_{ax}$$

$$40 \leq 220 \bullet \frac{80}{1000} + 0.5 \bullet 100 = 67.6 \quad \text{(condition fulfilled)}$$

Calculation of the operating load point:
Application service factor: f_a = 1.5 (special vehicles)
Raceway diameter for WD-L 0478/3-04904: D_L = 478 mm
(see product range overview / compare P. 6 and P. 7)

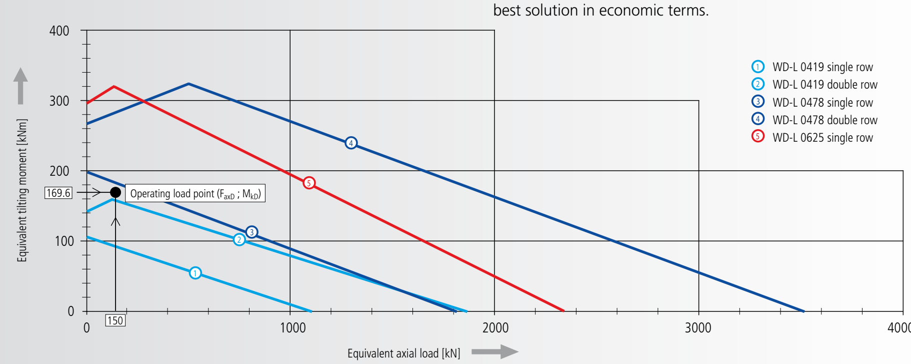
$$F_{axD} \leq F_{ax} \bullet f_a$$

$$F_{axD} = 100\text{ kN} \bullet 1.5 = 150\text{ kN}$$

$$M_{kD} = (M_k + 1.73 \bullet F_{rad} \bullet \frac{D_L}{1000}) \bullet f_a$$

$$M_{kD} = (80 + 1.73 \bullet 40 \bullet \frac{478}{1000}) \bullet 1.5 = 169.6\text{ kNm}$$

The operating load point lies below the limiting load curve of the selected slew drive WD-L 0478/3-04904 and is permissible. The operating load point of the selected slew drive lies above the limiting load curves of the smaller sizes, which are then not permissible. A slew drive that is larger than the selected slew drive WD-L 0478/3-04904 would not be the best solution in economic terms.



Example step 3:

- Checking the condition $M_{d\,B} + M_w \leq M_{d\,max}$

$$M_W = 0.005 \bullet (4400 \bullet M_k + 4 \bullet D_L \bullet F_{rad} + D_L \bullet F_{ax}) + M_{wA}$$

$$M_W = 0.005 \bullet (4400 \bullet 80 + 4 \bullet 478 \bullet 40 + 478 \bullet 100) + 2.0 \bullet 478^2/2000 = 2610\text{ Nm}$$

13200 Nm + 2610 Nm = 15810 Nm ≤ 24288 Nm
(condition fulfilled)

The slew drives of the sizes WD-L 0223, WD-L 0343 and WD-L 0419, each with two drives, and WD-L 0478 and WD-L 0625, with one and two drives, can statically transfer the operating torque $M_{d\,B} + M_w$.
As the operating load points of the WD-L 0419 sizes and smaller are inadmissibly above their limiting load curves (cf. step 2), the smallest selectable sizes are WD-L 0478/3-04904. If torques $M_{d\,B} + M_w$ of greater than 24288 Nm are required, then slew drives of the sizes WD-L 0478 with two drives or WD-L 0625 with one or two drives must be selected. However, in this example, they do not represent an economic solution.

Maximum torque $M_{d\,max}$ of the individual sizes