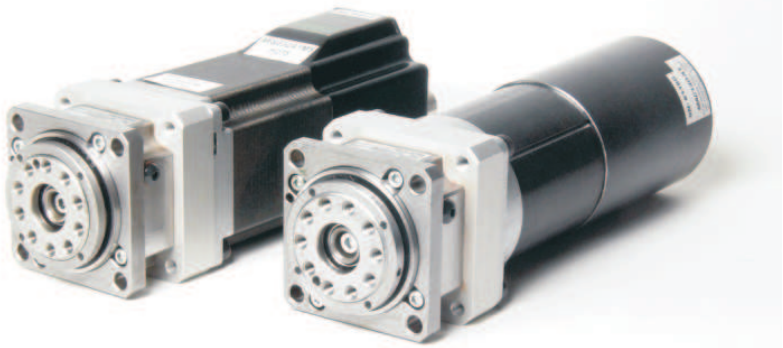
Backlash Free Geared-Motors with Integrated Controllers



JVL offers a unique combination of integrated servo motors-MAC motor® - or integrated stepper motors - QuickStep® - together with backlash free robot gear reducers.

Main advantages:

- Zero backlash
- Integration of high capacity radial-axial bearings into the reduction gear
- Almost 100% increase of the rated torque
- More than 90% transmision efficiency by rated torque
- Reduction ratios from 33:1 to 175:1 (see table below)
- High precision performance
- High linearity of the torsion characteristics
- Very low level of noise and vibration
- Decreased external dimensions
- High reliability
- Long service life

The table below shows the preferred types.

	Unit	HSPG 050	HSPG 070	HSPG 080	HSPG 110	HSPG 140	HSPG 170	HSPG 200
Version and Ratios		Nema 23 - 63:1	TB 75:1	E 37:1 TB 63:1	E 135:1 TB 89:1	E 69:1 TB 33:1 TB 115:1	E 125:1 TC 59:1 TC 105:1	E 125:1 TC 63:1 TC 125:1
Torque Nominal (Gear box)	Nm	18	50	78	122	268	495	890
Torque Acc./Dec. (Gear box)	Nm	36	100	156	244	670	1.237	2.225
Input Speed Rated (Gear)	RPM	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Input Speed Max (Gear)	RPM	5.000	5.000	E 37= 4.000 TB 63= 5.000	E 135= 5.500 TB 63= 4.500	E 69= 4.500 TB 33= 3.000 TB115= 4.500	E 125= 3.900 TC 59= 3.500 TC105= 4.000	E 125= 4.000 TC 63= 3.500 TC125= 4.000
Tilting Stiffness, E type	Nm/arcmin			70	155	380	1.100	1.300
Tilting Stiffness, T type	Nm/arcmin	14	35	62	150	340	705	1.070
Torsional Stiffness, E type	Nm/arcmin	-	-	10	24	62	110	200
Torsional Stiffness, T type	Nm/arcmin	4	7	9	22	54	102	178
No-load Starting Torque, E	Nm	-	0,10	0,22	0,07	0,28	0,48	0,81
No-load Starting Torque, T	Nm	0,05	0,10	0,12	0,13	0,44…0,22	0,68...0,56	0,98…0,81
Lost Motion Max	arcmin	1,5	1,5	1,5	1,0	1,0	1,0	1,0
Tilting Moment Max	Nm	40	142	280	740	1.160	2.430	3.300
Radial Force	kN	3,85	2,8	4,8	9,3	11,5	19,2	21,1
Axial Force	kN	3,85	4,1	6,9	13,1	17,0	27,9	31,7
Inertia	kgcm²	0,007	0,061	0,030	0,16	0,67	1,15	2,60
Diameter (see drawings)	mm	Square 55 x 55	70	E = 95 TB = 80	E = 123 TB = 110	E = 150 TB = 140	E = 190 TC = 170	E = 225 TC = 200
Height w/o flange	mm	41,0	50,5	E = 62 TB = 47	E = 77,0 TB = 69,5	E = 76 TB = 70,5	E = 93 TC = 83	E = 110 TC = 93
Height with Flange	mm	48,5	-	-	-	-	-	-
Weight w/o Flange or Housing	kg	0,5	1,1	1,6	3,8	E = 5,8 TB = 6,45	E = 10,8 TC = 11,7	17,2
Recommended Motors		MAC140, MAC141 & MIS23x	MAC140, MAC141 & MIS23x	MAC141, MAC400 & MIS23x	MAC 400 & MAC800	MAC 800 & MAC1500	MAC 1500 & MAC 3000	MAC 1500 & MAC 3000

General information

TwinSpin General Information

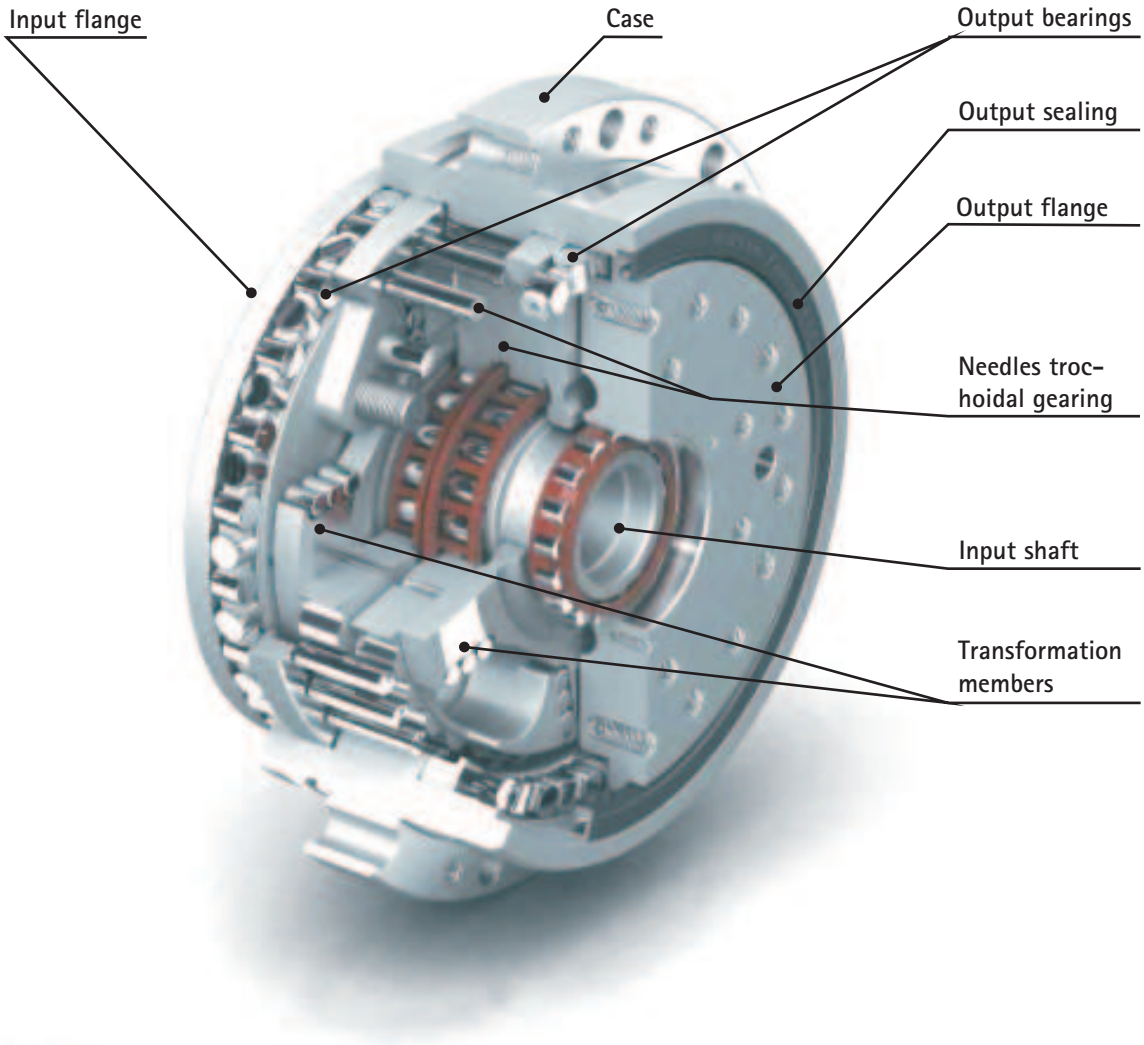
The TwinSpin (TS) bearing reducers are highprecision reducers based on a new reduction mechanism and a new design of a radial-axial output bearing. As a result, they represent a new generation of power transmission systems. The notion "bearing reducer" indicates the full integration of a highprecision trochoidal reduction gear and a radial-axial bearing in a single unit.

This new transmission concept allows the use of the TS reducers directly in robot joints, rotary tables, and wheel gears in various transport systems.

TS bearing reducers are designed for applications requiring a high reduction ratio, high kinematic accuracy, low cost motion, high moment capacity and high stiffness of a compact design with a limited installation zone, and low mass.

T Series

E Series



Performance characteristics

Nominal Life Calculation

The TwinSpin reducer's norminal life is determined by the service life of the roller bearings on the input shaft. This nominal life time is limited by the material fatigue of the rolling bearings. It does not take into account other factors which may be a limit to the practical lifetime, such as lack of lubrication contamination or overload.

Norminal life is a statistical value only. It denotes that the probability is that 10% out of large quantity of reducers will likely fail in 6000 hours under rated conditions due to material fatigue.

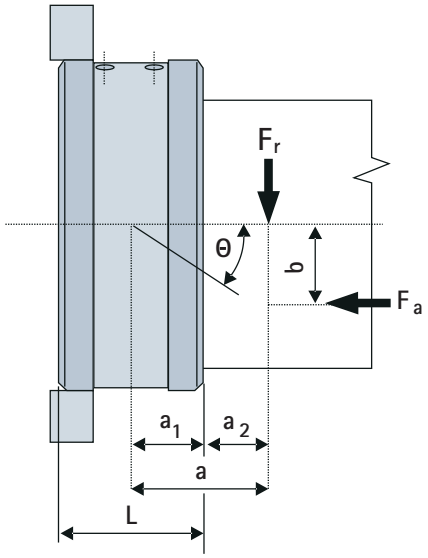
Norminal life for given speed and load values can be calculated as follows:

$$L_h = k \times \frac{n_R}{n_a} \times \left(\frac{T_R}{T_a}\right)^{\frac{10}{3}} \text{ [hrs]}$$

k -6000 nominal lifetime [hrs]
L_h -desired service life [hrs]
T_a -average output torque [Nm]
n_a -average input speed [rpm]
T_R -nominal torque [Nm]
n_R -nominal input speed [rpm]

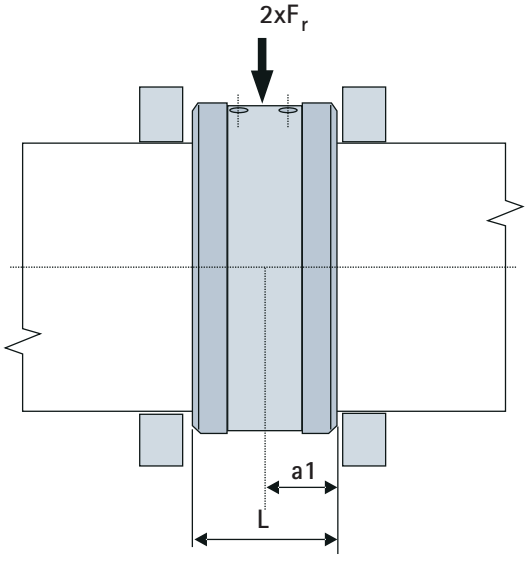
$$\Theta = \frac{F_r \times a + F_a \times b}{M_t}$$

Θ output flange tilting angle [arcmin]
M_t moment rigidity [Nm/arcmin]
F_r radial load [N]
F_a axial load [N]
a arm of action F_r [m]
a=a1+a2
a1=L/2
b arm of action F_a [m]



Maximum Torque During Acceleration and Breaking (T_{MAX})

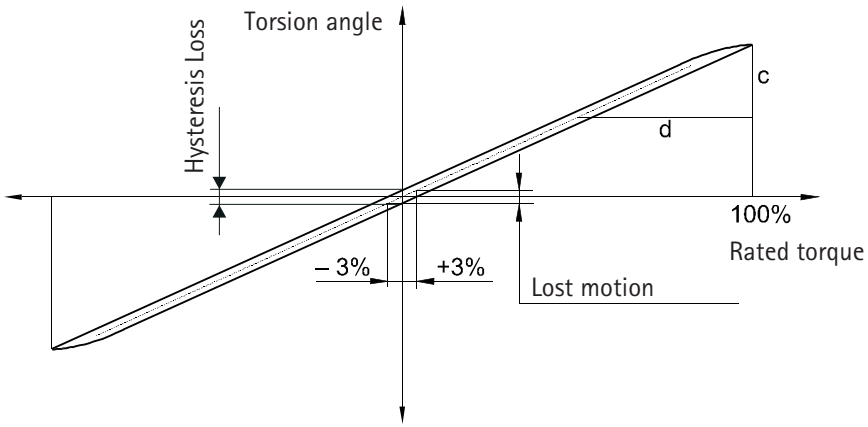
Due to inertial loads the torque applied during acceleration and breaking is higher than the rated value. The maximum allowable torque, when the reducer starts or stops is shown in the table on page 1.



Output flange is fixed from both side.
Radial load is 2xF

Load and the titing moment on the output flange

Performance characteristics



Hysteresis curve and the definition of stiffness

Torsional Stiffness, Lost Motion and Backlash

If the input shaft and the case are fixed and a torque is applied to the output flange, then the load diagram has a shape of a hysteresis curve.

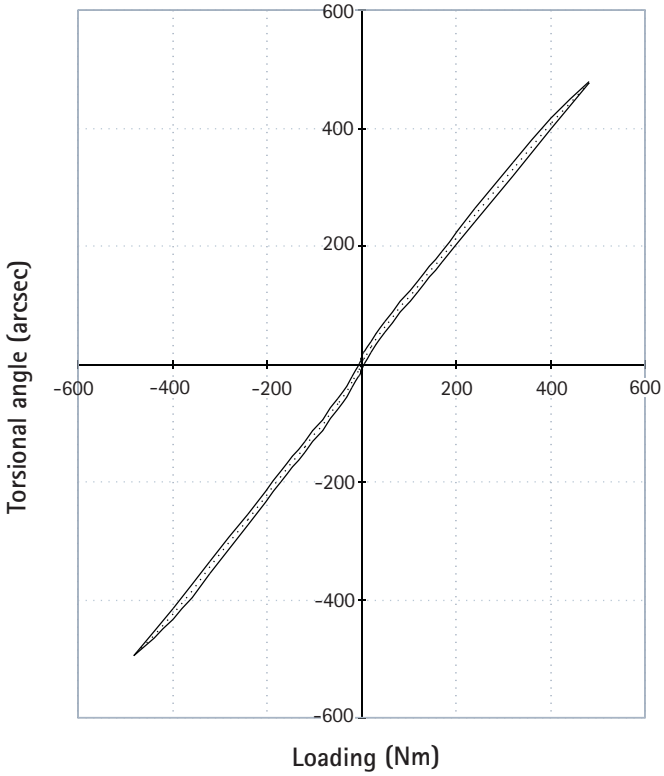
Lost motion (LM) is a pitch angle of the output flange at +/-3% norminal torque measured on the centerline of the hysteresis curve

Torsional stiffness (K^t) is defined as follow:

$$K_t = \frac{d}{c}$$

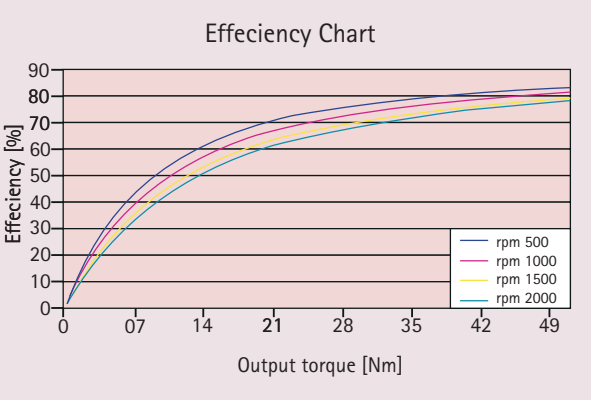
The torsional stiffness and lost motion values are provided in the Table on page 1. The torsional stiffness values are statistical values for the particular reduction ratio. Bearing reducers with hysteresis and lost motion of $\leq$ 0.6 [arcmin] can be supplied on request

The hysteresis characteristic of TS 140-139-TB with the lost motion under 0.5 [arcmin] is illustrated in the figur below.

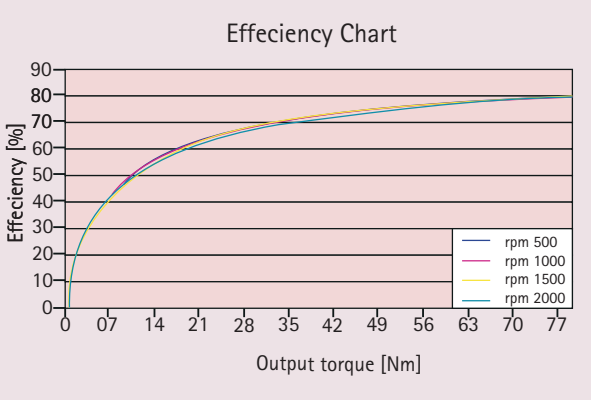


Lost motion
0.384 arcmin

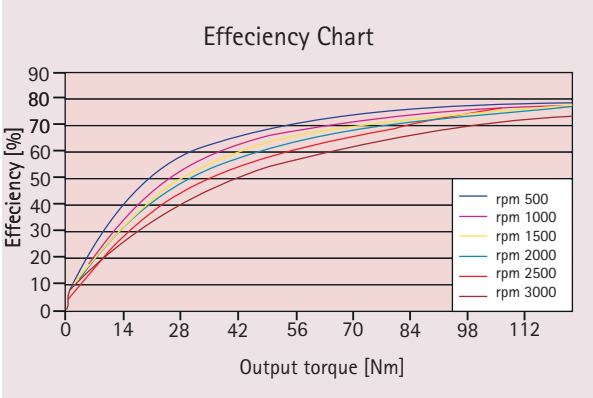
Performance characteristics



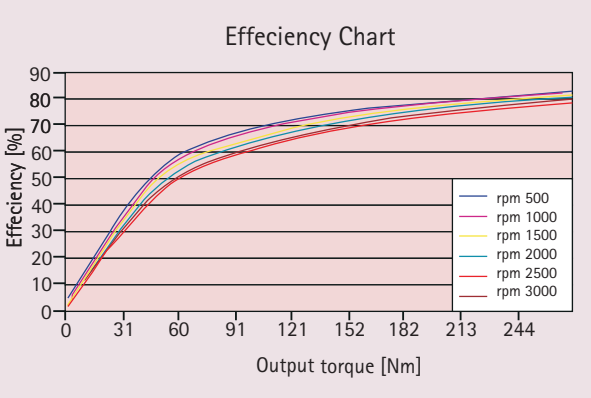
N_R= 50 Nm
H = 0.70 arcmin
LM = 0.38 arcmin
TS 70/87-TB
Temperature NT BR = 45°C



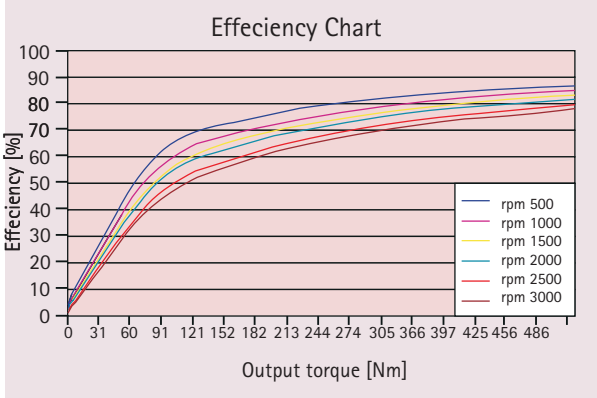
N_R= 78 Nm
H = 0.87 arcmin
LM = 1.0 arcmin
TS 80/97-TB
Temperature NT BR = 45°C



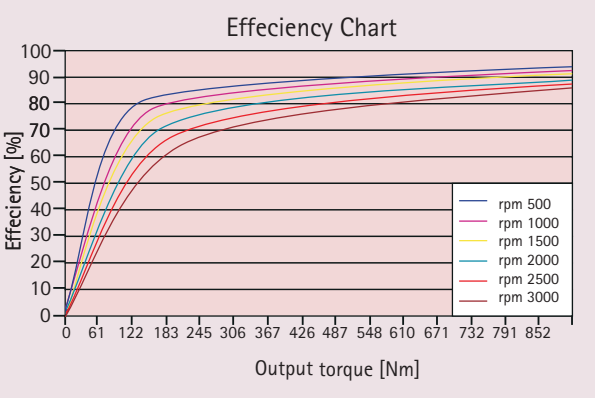
N_R= 122 Nm
H = 0.43 arcmin
LM = 0.34 arcmin
TS 110/89-Ta
Temperature NT BR = 45°C



N_R= 268 Nm
H = 0.50 arcmin
LM = 1.0 arcmin
TS 140/69-TA
Temperature NT BR = 45°C



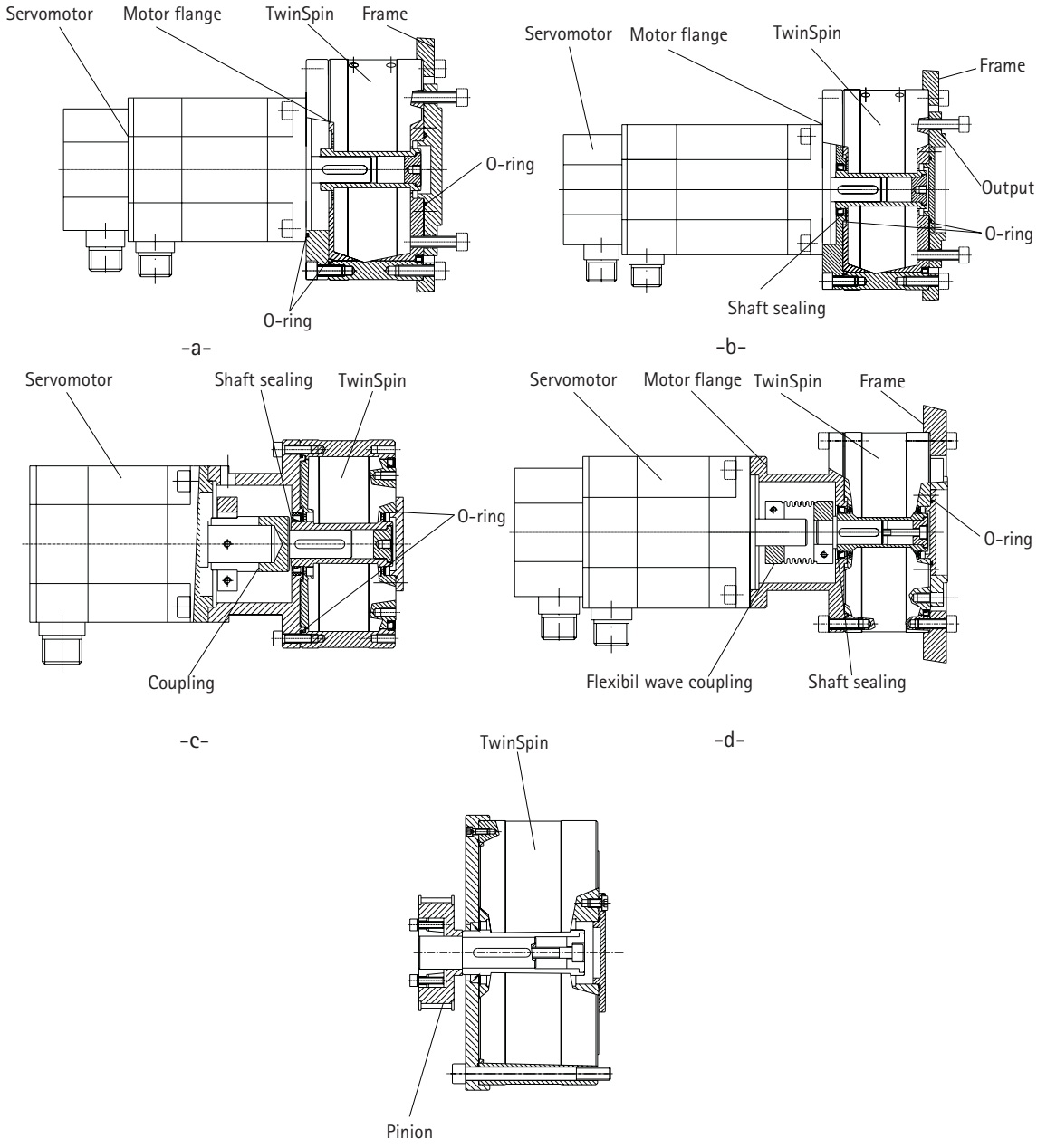
N_R= 495 Nm
H = 1.0 arcmin
LM = 0.85 arcmin
TS 170/125-TC
Temperature NT BR = 60°C



N_R= 890 Nm
H = 0.71 arcmin
LM = 0.48 arcmin
TS 200/125-TC
Temperature NT BR = 60°C

Efficiency charts

T-series



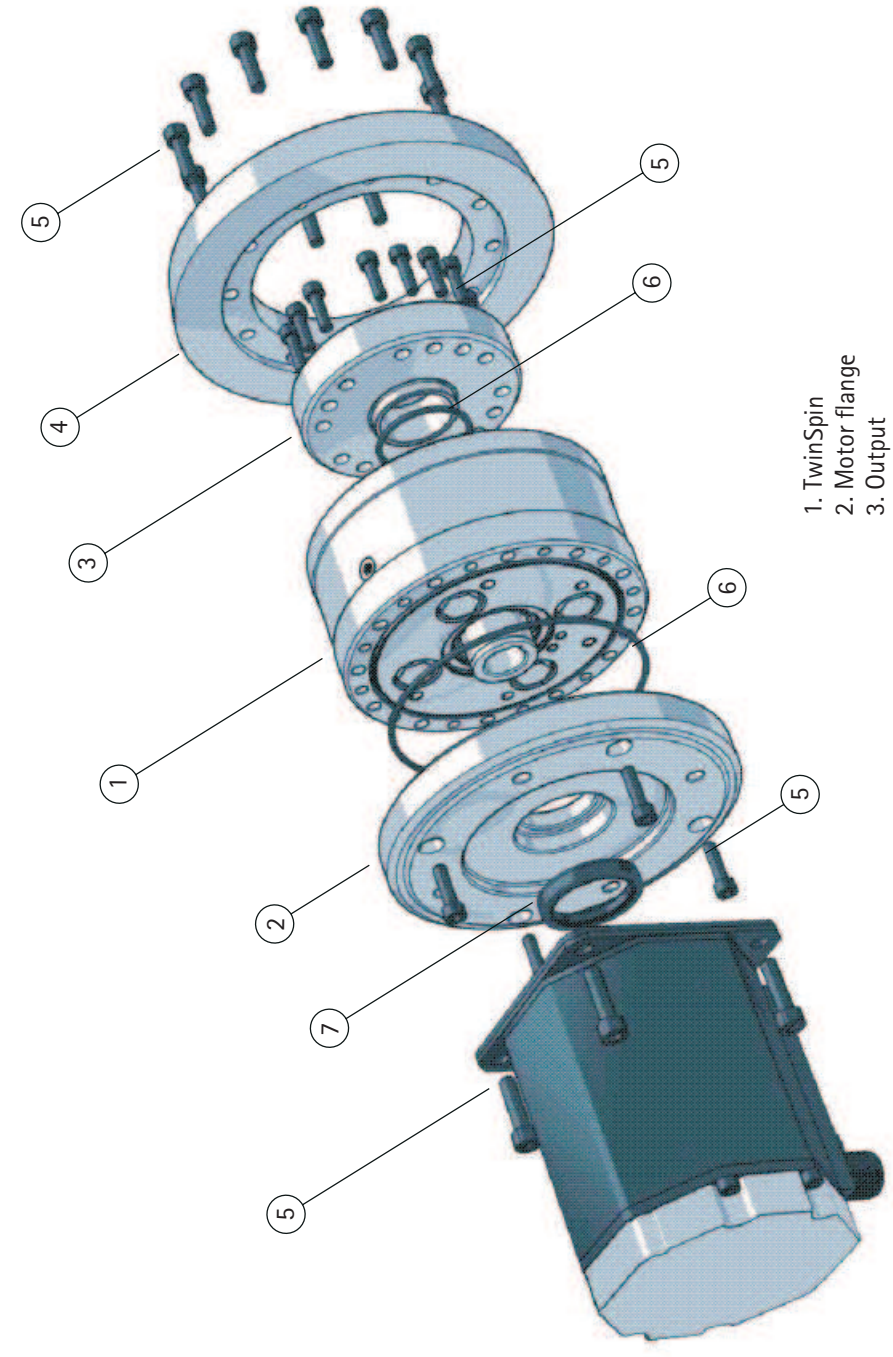
The most frequent connections

Installation Procedure

Prior to installation, wipe off the conservation oil layer from the reducer's surface with a clean and dry cloth. If the surface is dirty, use a cloth soaked in a suitable solvent (C6000 thinner, industrial petrol). It is important to prevent the thinner from penetrating into the reducer. Degrease the contact surfaces of frictiontype connections.

Most motor adaptor flanges are available on request, please contact the sales department or your local sales representative for futher assistance.

Assembly instructions



1. TwinSpin
2. Motor flange
3. Output
4. Frame
5. Screws
6. O-ring
7 Shaft sealing

Version T

Installation procedure

Lubrication, Cooling, Preheating

Lubrication

The TwinSpin bearing reducer is standardly lubricated with the Castrol LONGTIME PD 0 grease. Alternatively, the Castrol OPTIGEAR 150 oil may be used. Further information is available on www.castrol.com

The lubricant exchange interval is highly dependant on the individual operating conditions.

TwinSpins' grease and oil quantities for the individual reducers are specified in the table below. These quantities, however, do not include the space between the reducer and the connected parts. If no shaft sealing is used here, the user must fill it with the lubricant (see figur on page 6)

High temperatures and high speeds and loading will reduce the service life of the lubricant.

In many cases a re-lubrication will not be necessary and the reducer can be declared as "lubricated for life". As a guideline, 20000 hrs. of operationtion can be considered as service life.

Recommended Lubricant Qty [cm³]

Size	Input Shaft axis position		
	Vertical	Horizontal w/Flanges fixed to the base	Horizontal w/Case fixed to the base
HSPG 070	13	13	10
HSPG 080	19	19	15
HSPG 110	38	38	30
HSPG 140	84	84	69
HSPG 170	142	142	117
HSPG 200	214	214	174

Note:
*The stated values represent 70-80% of reducer internal volume. In case the customer provides itself the reducer accessory is it necessary to increase these values by quantities which represent 70-80% of the volumen between the reducer and accessory.
**If there are used no shaft seal but another type of seal for reducer sealing or in case of wanted lubricant leakage of the reducer than is it necessary to define by the customer the re-lubrication interval on its responsibility or to consult the supplier because of the warranty confirmation.

During the operation the lubricant temperature shall not go beyond the temperature defined by the manufacturer because it is to count with a lost of lubricating capability of used lubricants

Limit temperature of the reducer surface

Lubricant	Reducer Limit Temperature	
	HSPG 060…140	HSPG 170…200
Castrol LONGTIME PD0	65°C	70°C
Castrol OPTITEMP TT1	65°C	70°C
Castrol OPTIGEAR RO 150	65°C	70°C
Castrol OPTIGEAR 150	65°C	70°C

When exceeding these limits it is necessary to provide cooling or pre-heating of the gears. In such cases, please, contact us.

(Attention. The temperatures stated in the table for Lubricants' Field of use and Life-time are the temperatures stated by the manufacturer for the determination of the lubricant life-time in certain extreme conditions of its use, for the determination of re-lubrication intervals or its change. These temperatures are not identical with temperatures in the reducer inside or on the surface. Because the conditions of temperature in the reducer inside and on the surface are less extreme in standard operation, the life-time of the reducer lubricant lifetime filling is higher as stated in the table.)

Cooling

The reducer cooling is not necessary in most of the cases. But there are some cases where the temperature on the reducer surface becomes a limiting factor at respective working cycle and relative ambient temperature.

The reducer warming-up in extreme working cycles shall not go beyond the increase of 40°C at the ambient temperature of 20°C -25°C, whereas the general rule $n_a < n_{eff}$ shall be kept for extreme working cycles.

The cooling is usually used in such cases:
a) special regulations valid for explosion environs where a very low temperature is requested.
b) ambient temperature is higher than 40°C.
c) heat transmission between electromotor and the reducer is too high

Because of the preservation of propre functionality reducer (lubricant, seal, pretention degree and material dilatation) during the quaranteed life-time temperature expresses a limit temperature of the reducer, measured on its surface

Limit temperature of the reducer surface

Lubricant	Reducer Limit Temperature	
	HSPG 060…140	HSPG 170…200
Castrol LONGTIME PD0	65°C	70°C
Castrol OPTITEMP TT1	65°C	70°C
Castrol OPTIGEAR RO 150	65°C	70°C
Castrol OPTIGEAR 150	65°C	70°C

The stated temperatures express a state when the reducer is not overloaded by speed with regard to the LM (lost motion). If the temperature is higher despite of static (increasing of the surface for the heat removal) or dynamic (ventilation) cooling than it is necessary to decrease the speed or to use a reducer with higher LM (lost motion).

Pre-heating

The pre-heating is only used in very rare cases when the reducer is run with very low duty factor at extreme ambient temperatures variations or at very low ambient temperatures

Usually, the reducer shall be pre-heated at temperatures lower than -10°C. This is not necessary if these temperatures are constant and not so low and speed values as well as values of the torque to be transmitted are low, but in any case a special, with noload running, pre-heating cycle is needed. At such temperatures is it necessary to count with higher noload running torque and futher with more bigler dimensioning of the drive motor.

FAQ'S

1. *Are reduction ratios between 20-30 possible with the TwinSpin bearing reducer?*

Transmission ratios less then 30:1 can be discussed if requested. The ratios are not offered as standard due to substantial increase in transmission error. Consult the technical and delivery conditions with the sales department.

2. *What is the noise of the TwinSpin during its operation?*

TwinSpin runs extremely smoothly. Reference noise measurements of the reducer mounted on a servomotor are available on request.

3. *Do you have information about the temperature increase, during the continuous running of the TwinSpin rated load?*

Bearing reducer are preferred assigned for the mode jobs S3-S8, i.e. the output speed in application is variable in both directions. The mode job S1 has to be consulted at manufacturer but it shall not exceed the temperature increase of 40°C measured at the ambient temperature of 25°C.

4. *Does the input shaft have an axial play for compensation of the heat growth from the connected servomotor?*

There is an axial clearance at the input shaft of the reducer that allows the heat dilatation. Please, handle properly the clearance when interfacing the reducer to a servomotor.

5. *Why do you have the possibility of grease or oil lubrication?*

Grease is used for the standard applications. Oil is only used for special application requests where there is demand for very low viscous friction, for high-speed applications, for special conditions and users preferences (e.g. extremly cold environment for radar applications).

6. *Is it possible to use the TwinSpin reducer independent of the installation position.*

Yes. Installation position can be vertical or horizontal. On request the manufacturer provides engineering support including assembly drawings.

7. What does it mean "nominal lifetime L10"?

The norminal lifetime L10 means the time in hours, when up to 10% of a batch fails due to the material fatgue.

8. *What type of working (duty) cycle determine the rated torque and the corresponding nominal life?*

Rated torque is calculated value of loaded constant torque at calculated nominal constant input speed of the input shaft for the working (duty) cycle when calculated nominal lifetime is. L10=6000 hours and the duty factor ED=1 (100%).

9. *Do you provide interface flanges and motor shaft connections for the different servomotors?*

Yes. We are able to provide you with the necesssary technical support. Regarding the flange interfacing, we have a database of typical drawings of connecting couplings and interface flanges. We are able to prepare the assembly and detail drawings for customers if they exactly specify the type and size of motor. On request we are also able to manufacture the motor flange and coupling.

10. *The pair of flanges rotate with respect to the case with reduced speed. Is there any radialaxial clearance on the output bearing with respect to the reducer case?*

There are two options. The first one is without any clearance and preloaded in both directions as much as necessary. The second one, there is an axial and radial clearance up to 0.010 mm.

11. *Why is the TwinSpin reducer designated as a zero backlash reducer?*

TwinSpin is a zero backlash reducer beacause there is no reversal clearance between the trochoid tooths of the gearwheel and the cylindrical rollers of the hollow gearwheels in the reducer case. This is being reached by high-precision manufacturing of components and careful pairing during its assembling.

12. *Is TwinSpin self-locking?*

No. Even because of very good efficiency there is no self-locking effect.

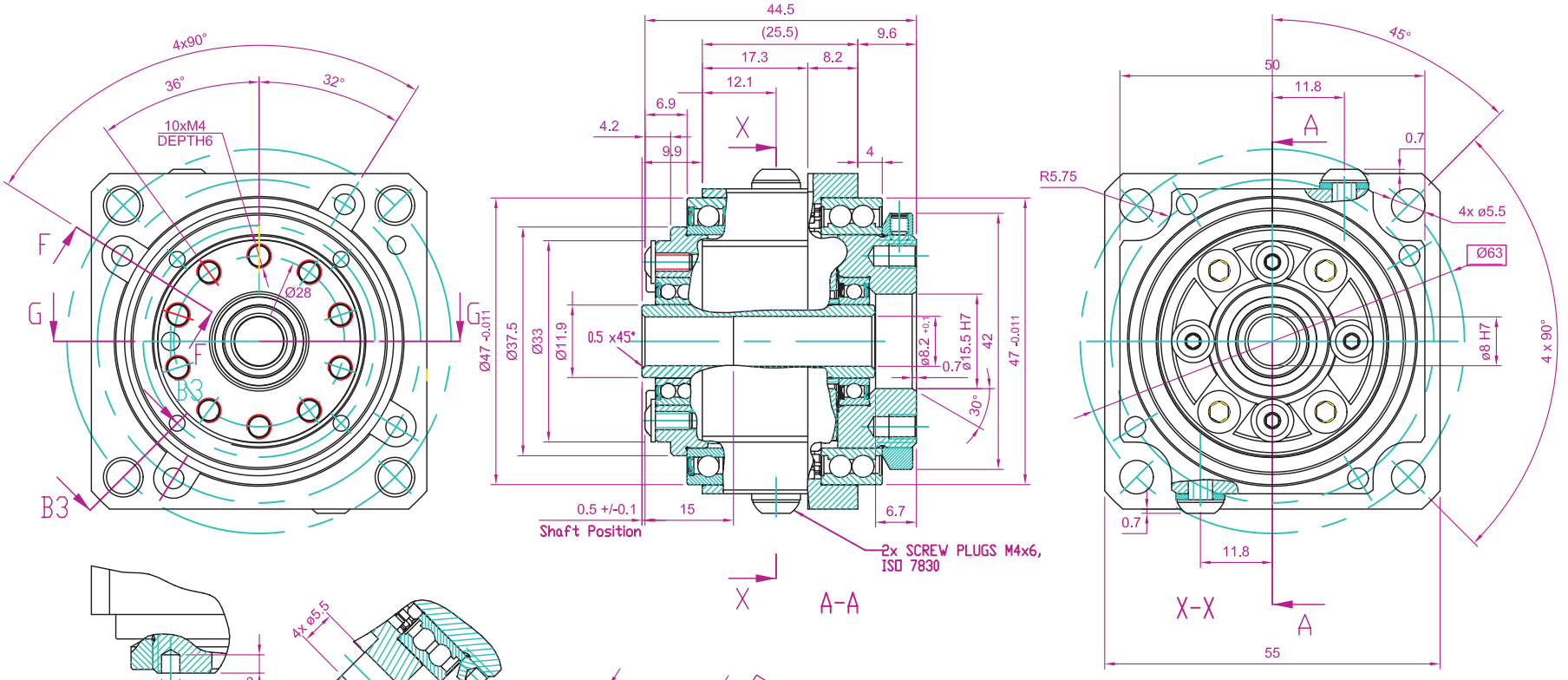
13. *Which part of the TwinSpin do you use to calculate the lifetime i.e. which part of the reducer fails first?*

The nominal lifetime is limited by the roller bearing between eccentric shaft and gearwheels.

14. *Why is TwinSpin called a bearing reducer?*

Because of integrated radial-axial roller bearings and high-precision speed reducer in one unit by which a excepionally powerful bearing application for output flange is reached.

Ref. No.	Revision	Date	Sign.
-	-	-	-



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Checked	
Approved	

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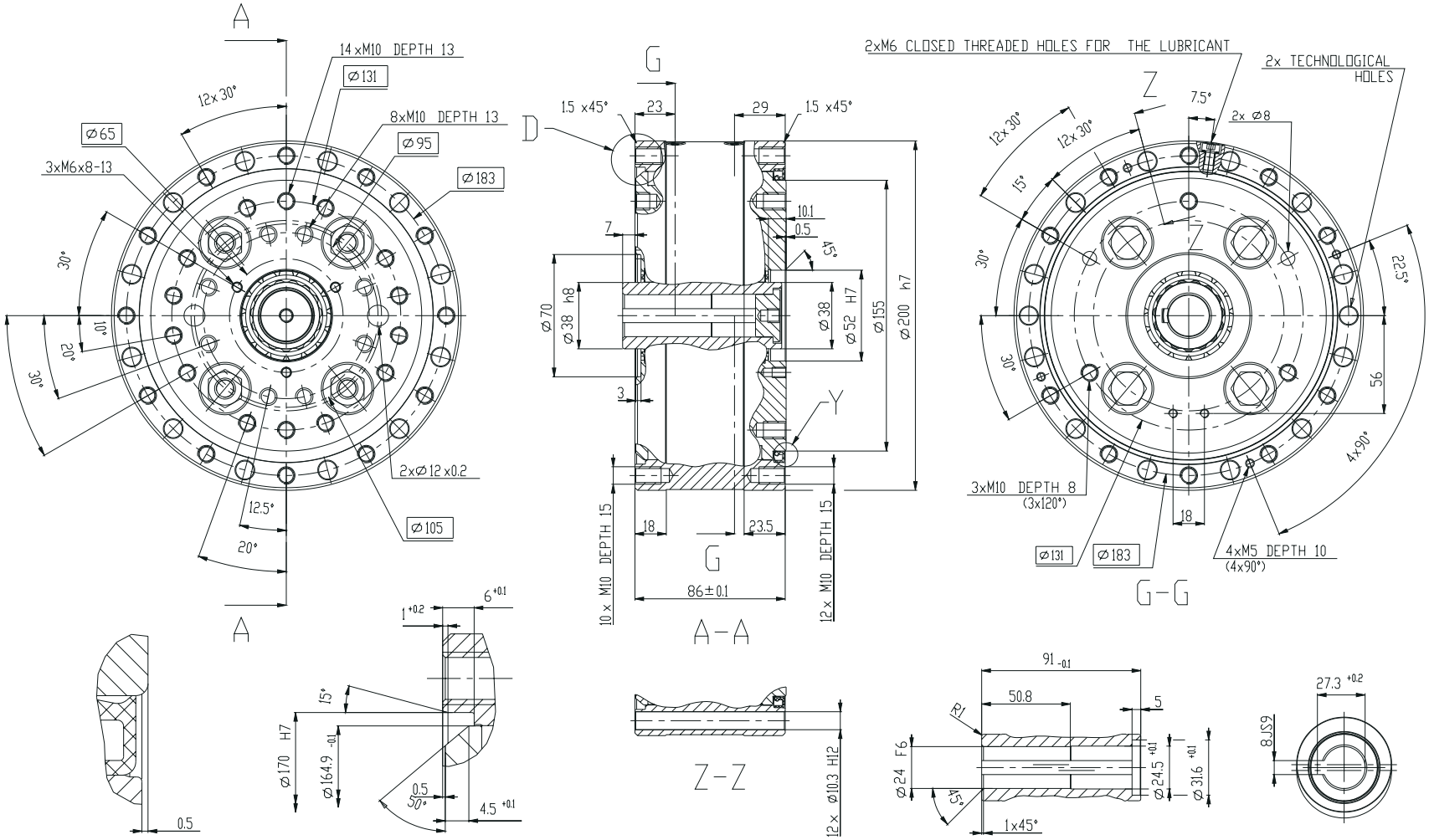
TS 50-I-F8-0701

Draw No. XXXXXX

Draw No. XXXXXX

TwinSpin TS200-i-TC



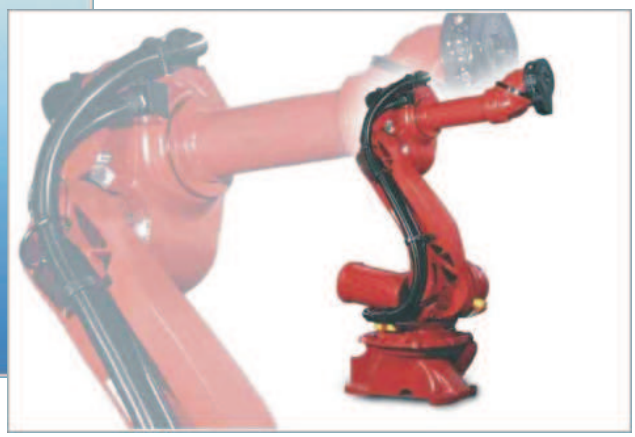
Note :
1) Use only standartized components such as O-ring seal, bolts, washers,etc.
2) Right to change without prior notice reserved.

Applications for Backlash Free Geared MAC motor®s and QuickStep®s

Typical applications:

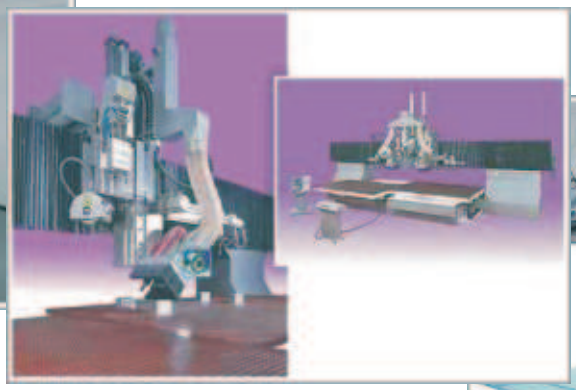
- Turntables
- Radar and Camera applications
- Moulding machinery, turning the form plate
- Automation and Robotics
- 2...6 axis Arm Robots
- SCARA Robots
- Machining centers
- Machine tools
- Substituting high ratio planetary reducers for saving space
- Measuring systems
- Medical equipment

Robotic and Automation

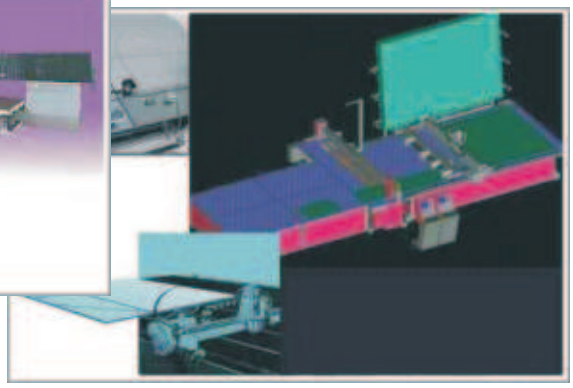


Medical equipment

Woodworking machines



Glassworking machines



Aircraft systems and equipment

Radar, Navigation and Camera systems

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