ondrives *Precision Gears*

Gearbox Technical

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Spiral bevel teeth in this range have been case hardened and finsh ground to DIN 5 quality.

$\mathbf{T_{2n}}$ Torque figures are maximum torque at gearbox output based on S4/S5 Cyclic operation (IEC 60034-1) at ED <60% or EZ <20min at 20ºc ambient temperature at n_1 0-1000 min^{-1} (r/min) ≈10,000 hours life.

$\mathbf{T_{2b}}$ is 1.5 x T2n Max Acceleration Deceleration Torque (Max <1000 Load Cycles per 60min more than this would require using a factor to lower.)

$\mathbf{T_{2not}}$ is 2 x T2n Emergency Stop Torque (Max 1000 Cycles in lifetime of unit)

$\mathbf{n_{1nom}}$ Nominal input speed 1500 min^{-1} (r/min) S1 at 50% $\mathbf{T_{2n}}$ for ≈$1.2x10^6$ cycles

$\mathbf{P_{thermal}}$ Thermal power rating at S1 and $\mathbf{n_{1nom}}$ and need to keep lubrication temp within limits.

S1 Continous operation (IEC 60034-1) .

S4/S5 Cyclic operation (IEC 60034-1) at ED <60% or EZ <20min.

ED = Duty % out of total cycle. If ED60% would be 40% at zero speed 60% at speed.

TC = Time in min at speed in cycle.

Max operating temp of gearbox with Klubersynth GE 46-1200 grease approx 75°c .

Max operating temp of gearbox using Klubersynth GH 6-220 synthetic oil approx 95°c.

If temperature-speed is getting high a lower viscosity oil GH6-150 GH6-80 may be required and or cooling of gearbox-oil, otherwise reduced life or failure will occur.

If your design goes higher than the torque-temp for the unit, please contact Ondrives Ltd.

We can maufacture specials and to design using our KISSsoft® & Gleason GEMS® design suites.

Figures are to be used for guidance only and are to help with initial selection. You will need to assess duty, cycles and confirm gearbox suitability with your own calculations & trial in application.

$$i = \frac{n_2}{n_1}$$

$$P_1 = \frac{T_1 \, x \, n_1}{9550}$$

$$T_1 = \frac{T_{required}}{i} \, x \, \frac{100}{\eta z}$$

$$T_{2n} > T_{required} \, x \, K_a$$

Application factor K_a

i [u] = *Gear Ratio*
n_1 = *Input speed min^{-1} (r/min)*
n_2 = *Output speed min^{-1} (r/min)*
T_1 = *Input torque (Nm)*
T_{2n} = *Nominal Output torque (Nm)*
P_1 = *Input Power (kW)*
ηz = *Meshing Efficiency (%)*
$T_{required}$ = *Torque to drive application (Nm)*

DIN 3990 ISO 6336 Application factor K_a

Working characteristics of driving machine	Working characteristics of driven machine			
	Uniform	Light Shocks	Moderate Shocks	Heavy Shocks
Uniform	1.00	1.25	1.50	1.75
Light Shocks	1.10	1.35	1.60	1.85
Moderate Shocks	1.25	1.50	1.75	2.00
Heavy Shocks	1.50	1.75	2.00	2.25+

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Inertia

$$T_a = J \times \alpha$$

$$\alpha = \frac{\omega_2 - \omega_1}{t}$$

$$J_T = J_m + \frac{J_L}{i^2 \times \eta}$$

T_a = *Acceleration torque (Nm)*
J = *Inertia (kg.m^2)*
J_T = *Total reflected inertia at gearbox input (kg.m^2)*
J_m = *Reflected inertia of gearbox (kg.m^2)*
J_L = *Inertia of load (kg.m^2)*
t = *Acceleration time (sec)*
i = *Ratio*
α = *Angular acceleration (rads/sec^2)*
ω = *Angular/Rotational Velocity (rads/sec)*
η = *Efficiency (%)*

Example:
Assume a 3:1 ratio, 90% efficient gearbox with a reflected inertia of 0.00052kg•m^2.
Torque required at output to drive load is 1Nm

If we were to accelerate the gearbox from rest to 500 rpm in 1.5 seconds the acceleration would be as follows:
500 rpm = (360 ° x 500) min^{-1} = 180000° min^{-1}
180000° min^{-1} = (180000 ° / 60) s^{-1} = 3000° s^{-1}
3000 °•s^{-1} = (π/180) * 3000 = 52.36 rad•s^{-1}
So, acceleration = 52.36/1.5 = 34.91 rad•s^{-2}

Input torque to accelerate gearbox = 0.00052 x 34.91 = 0.01815Nm

If a load with inertia J_L was put on the gearbox output of 0.0062 kg.m^2 the total inertia at the gearbox input would become 0.00053kg.m^2

New input torque to accelerate gearbox	= 0.00053 x 34.91	= 0.01850Nm
Input torque to drive load	= (1/3 x 100/90)	= 0.37037Nm
Total input torque required at start up	= 0.37037 + 0.01850	= 0.38887Nm ≈ 0.39Nm

A margin needs to be added to account for inertia of connecting shafts/couplings, motor rotor inertia and friction from bearings and other elements.

1 radian (rad)	= 57.5928°	1.0 x 10^{-2} = 0.01
1 kg m^2	= 10,000 kg cm^2	1.0 x 10^{-3} = 0.001
1 kg m^2	= 1,000,000,000 g mm^2	1.0 x 10^{-4} = 0.0001
1 m^2	= 1,000,000 mm^2	1.0 x 10^{-5} = 0.00001
1 m^2	= 10,000 cm^2	1.0 x 10^{-6} = 0.000001
		1.0 x 10^{-7} = 0.0000001

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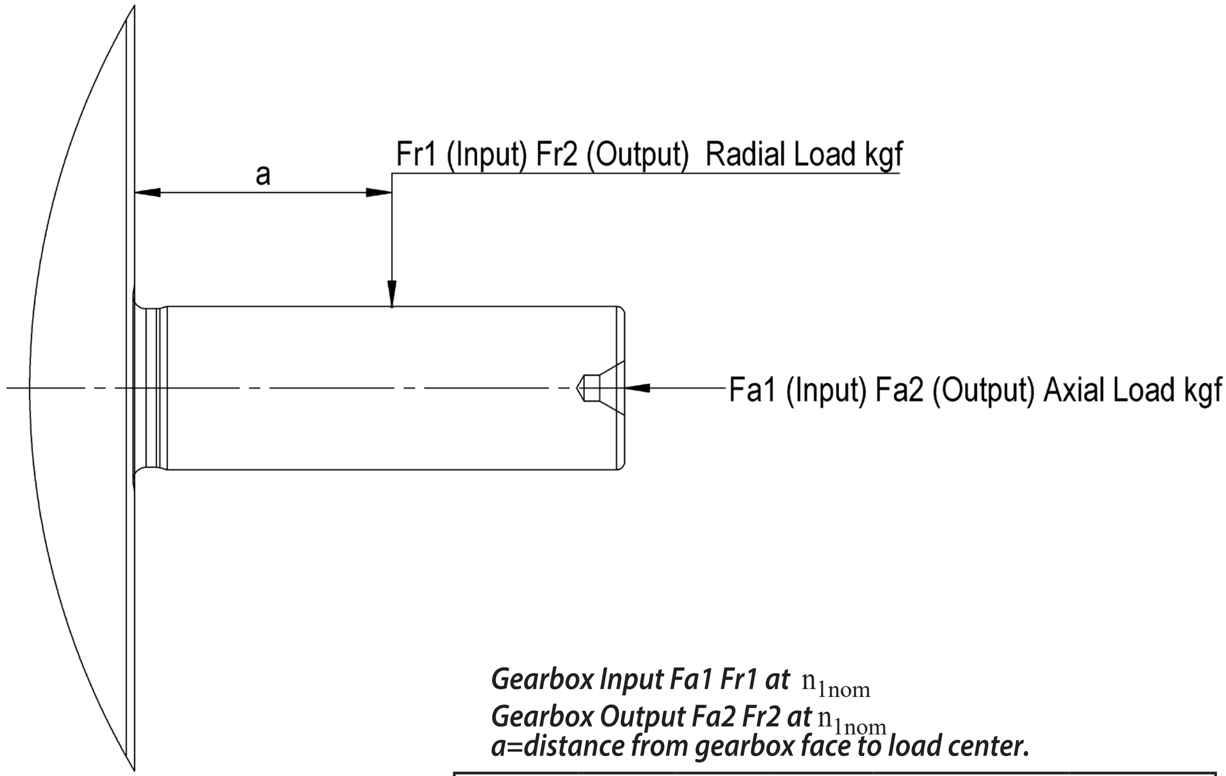
Radial Axial Loads Input & Output of Gearbox



Gearbox Input Fa1 Fr1 at n_{1nom}
Gearbox Output Fa2 Fr2 at n_{1nom}
a=distance from gearbox face to load center.

		a	Fr2 N	Fa2 N	Fr1 N	Fa1 N
SBC-55-L-	-	11	500	200	500	200
SBC-65-K-	-	13.5	500	200	500	200
SBC-90-L-	-	17.5	1500	750	1500	750
SBC-90-K-	-	17.5	1500	750	1500	750
SBC-110-K	-	21	2000	750	2000	750
SBC-140-K	-	26	3000	1750	3000	1750
SBC-170-K	-	30	4500	2000	4500	2000

For closer calculation,direction of rotation of drive - speed - torque have an impact on the bearing loads and the usable capacity to allow for better testing limits in the test trial stage.

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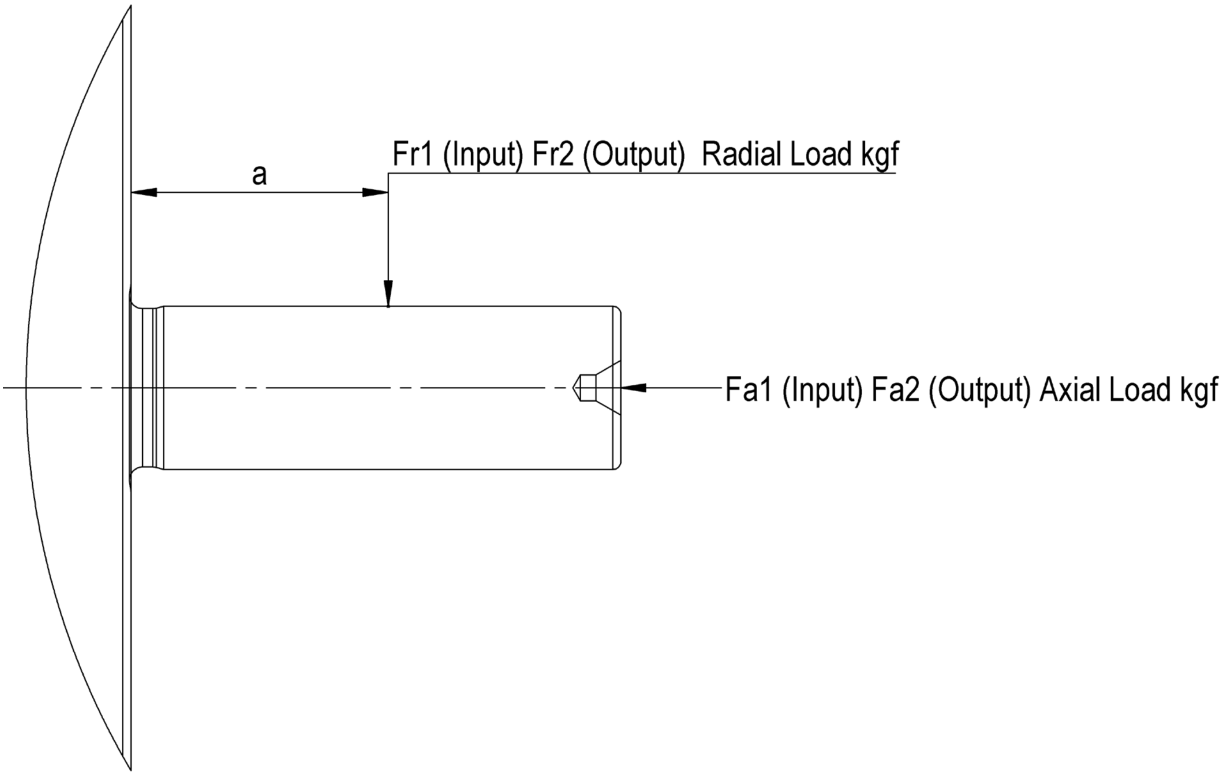
Bearing Loads



Gearbox Input Fa1 Fr1 at 1000 n^{-1}
Gearbox Output Fa2 Fr2 at 100 n^{-1}
a=distance from gearbox face to load center.
** = see product page for where a is from.*

		a	Fr2 kgf	Fa2 kgf	Fr1 kgf	Fa1 kgf
—		-	-	-	-	-

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