

Stepper motors and Gearheads

Introduction

FAULHABER offers stepper motors with 20, 24, 48, 100 or 200 steps per revolution which means many different step angles. The holding torque that it is possible to obtain with those motors is ranging from 0.2mNm to 22mNm.

If one wants to increase the holding torque, decrease the step angle or smoother the motion, a gearhead is a good option. Many different options are proposed for each motor type and the idea of this application note is to give you the tools to choose the right gearhead for the right application.

Gearheads options

Please find below some of the different gearheads possibilities:

Table 1 : Gearheads suitable with FAULHABER stepper motors. This list is non-exhaustive

Motor	Ratio	Gearheads	Type	Material
DM0620	4 – 4096	06/1	Planetary	Steel
AM0820	4 – 4096	08/1	Planetary	Metal/Steel
	4 – 1518	08/2	Spur	Metal
	120 – 1518	08/3	Spur with zero backlash	Metal
	4 – 4096	10/1	Planetary	Metal/Steel
AM1020	4 – 4096	10/1	Planetary	Metal/Steel
	9,17 – 6023	12/3	Spur	Metal
	69,2 – 2050	12/5	Spur with zero backlash	Metal
DM1220	4 – 4096	10/1	Planetary	Metal/Steel
	9,17 – 6023	12/3	Spur	Metal
	4 - 1024	12/4	Planetary	Metal
	69,2 - 2050	12/5	Spur with zero backlash	Metal
AM1524	5,33 – 23'014	15A	Planetary	Plastic
	6,3 – 3101	15/5	Spur	Metal/Plastic/Steel
	6,3 – 3101	15/5 S	Spur	Metal/Steel
	76 – 1670	15/8	Spur with zero backlash	Metal/Steel
	3.33 – 1367	15/10	Planetary	Steel
	3,71 – 5647	16/7	Planetary	Metal/Steel
	3,33 – 1367	17/1	Planetary	Steel
AM2224	3.71 – 1526	20/1R	Planetary	Metal
	19 – 23'014	22E	Planetary	Plastic
	19 – 23'014	22EKV	Planetary	Plastic/Steel/Ceramic
	3,1 – 30'969	22/2	Spur	Metal
	69,2 – 2050	22/5	Planetary	Metal
	3.71 – 1526	22/7	Spur with zero backlash	Metal
	3,71 – 1526	23/1	Planetary	Metal/Steel
	3-1294	22GPT	Planetary	Metal
AM2224R3	3.71 – 1526	26/1	Planetary	Plastic/Steel
	3.71 – 1526	26/1R	Planetary	Metal/Steel
AM3248	3-1294	32GPT	Planetary	Metal

For more details about the ratio available, please refer to the datasheets of the gearheads on the FAULHABER website. Note that the ratios are rounded and the exact values can be found on the website as well.

Zero backlash

Gearheads with zero backlash are mounted on the stepper motors with a preload in order to avoid any play between the pinion on the shaft of the motor and the gears within the gearhead. The assembly must be properly done as too much preload would lead to excessive friction.

Custom products

Today, approximately 3500 gearheads with custom options have been realized. This means that there is always the possibility to design a custom solution for a special application, it can be a special lubricant, a thread shaft or a special labeling, every solution can be discussed.

Ordering code

When ordering a motor with a gearhead, one must pay attention to the compatibility between the motor and the gearhead and then choose the right execution for the motor. Example:

DM12202R011009 124K256:1 K1417	Complete motor + gearhead designation
DM12202R011009 124K256:1 K1417	Motor execution, must suit to gearhead
DM12202R011009 124K256:1 K1417	Construction
DM12202R011009 124K256:1 K1417	Optional preloaded ball bearings
DM12202R011009 124K256:1 K1417	Ratio
DM12202R011009 124K256:1 K1417	Custom solution, special version

How to choose a gearhead?

There are some questions that you may ask yourself before choosing the proper gearhead. Those are summarized here under.

Spur, planetary or zero backlash?

A spur gearhead contains only one gear at the first stage, a zero backlash two gears and a planetary three gears. That is why a planetary gearhead needs more torque to be activated, meaning that it will use more torque from the motor.

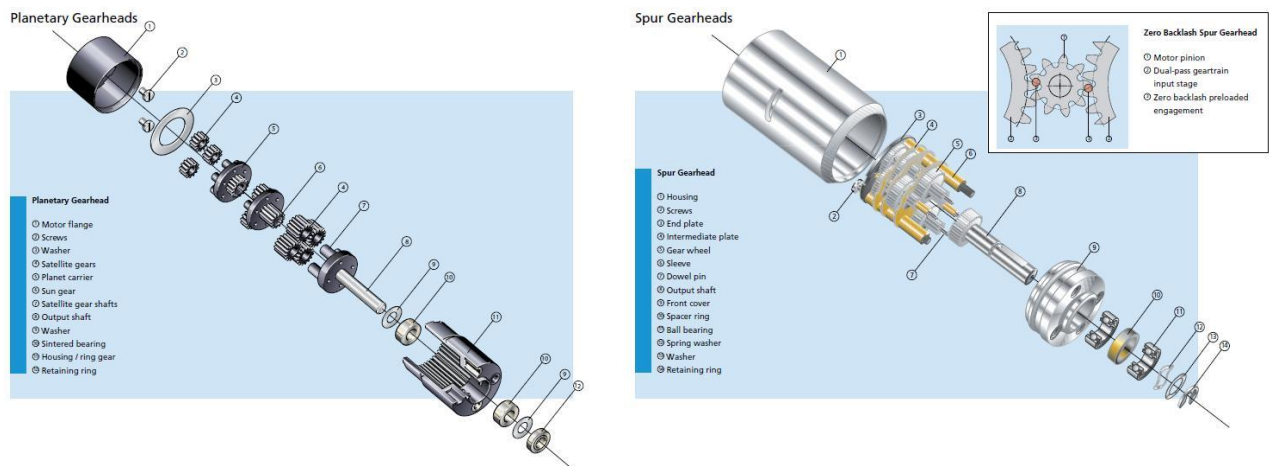


Figure 1 : Planetary (left) and spur (right) gearheads technologies with an inlet on zero backlash principle.

Spur gearheads are ideal for application requiring low torque, low power consumption (through increased gearhead efficiency) or high gear ratio.

The **zero backlash spur gearhead** is ideal for precise positioning and medium torque.

Finally, the **planetary gearhead** is the best solution for high torque, low noise, harsh environment as high temperature or vacuum and custom solutions.

Which ratio?

The ratio will directly influence respectively the torque, the resolution and the output speed of your system:

$$T_{out} = T_{motor} \cdot efficiency \cdot ratio$$

$$n_{out} = n_{motor} \cdot ratio$$

$$\omega_{out} = \frac{\omega_{motor}}{ratio}$$

The torque of the motor is then increased but the speed is reduced by the ratio factor. Also keep in mind that the torque is also reduced by the efficiency which can be down to 50% for zero backlash gearheads. The resolution of the movement is ameliorated by the ratio factor, which means that smaller displacement can be achieved.

Keep in mind that most of the time the ratio is a compromise between torque optimization, resolution requirements and speed limitation of the gearhead and the stepper motor.

Which lubricant?

When dealing with low pressure and out-gassing conditions, the lubricant has to be selected properly. Please inquire with your point of sales to discuss the available lubricant on the gearheads.

Plastic or metal?

Some of the gearheads, planetary or spur excepting zero backlash, are made of plastic. Such gearheads are slightly lighter, not subject to any electrical conductivity and cheaper.

On the other hand, metal gearheads are more robust, usually offer higher ratios, propose a wider temperature range (especially at high temperatures) and are more suitable for vacuum applications.

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