APPLICATION CONSIDERATIONS

The primary reason to use a gearhead is that it makes it possible to control a large load inertia with a comparatively small motor inertia. Without the gearhead, acceleration or velocity control of the load would require that the motor torque, and thus current, would have to be as many times greater as the reduction ratio which is used. There are extensive motor and gearhead combinations that will meet the performance requirements of a specific application. We offer a selection of windings in each frame size, that combined with a selection of reduction ratios, offer an assortment of solutions to output requirements. Each combination of motor and gearhead offers unique advantages. Primary consideration in selection of the best combination of motor and gearhead is the output torque and speed required by the application. The no-load speed or peak torque may also be the driving consideration for certain applications.

The long and short-term capabilities of a gearmotor vary widely. Furthermore, the nature of the load being driven is a factor to consider when selecting the right gearmotor for the application. Shock loads shorten unit life, though the average torque may not exceed the specified rating. If there is doubt about the compatibility of a gearmotor selection for your application, consult the factory.

Duty cycle will limit the gearmotor's capability. Mechanisms that contribute to gearmotor failure often are related to heat and its effect on lubrication. Therefore, duty cycles long enough to experience significant temperature increases over ambient conditions should be avoided. The permitted output power for each motor is listed in the catalog. Compare these values to the RMS power output anticipated by the duty cycle for your design. The actual RMS power required by the load should not exceed the power rating for the gearbox.

Orientation, whether vertical, or horizontal, will effect lubrication distribution. Though the gearheads may be oriented in any position, horizontal mounting is recommended whenever possible.

Narrowing the selection process:
There are (3) basic steps presented here in matching the gearhead and motor. They are:
1. Determine the correct gear ratio and appropriate output torque rating.
2. Determine the required input torque (motor torque).
3. Insure the maximum power rating of the motor is not exceeded.

EXAMPLE

For example, n< 3000 rpm. Actual gearhead speed < 5000 rpm.
A gearmotor application has the following requirements: What motor and gearhead combination will meet these requirements?

Supply Voltage = 12.0 vdc
Output Speed = 50 to 60 rpm
Output Torque (@ gearhead) = 225.0 oz-in
Brush-Type Motor

Step 1 – Determine the correct gearbox size and reduction ratio

$\omega_o = \omega_i / n$ **Where:** ω_o = output speed, ω_i = input speed, and *n* = reduction ratio

The required output speed is between 50 and 60 rpm, therefore:
50 = ω_i **/ *n***, and since the **input speed** to the gearhead must be limited to no more than **3000 rpm**, the equation becomes:

50 = 3000 / *n*, and solving for *n* yields a 60:1 ratio. Since the torque requirement is 400.0 oz-in and a ratio of around 60:1 is needed, the **32mm gearhead** will meet the requirements, as a 59:1 (58:85:1) ratio with a continuous torque rating of **637.3** oz-in is available. The 59:1 ratio will yeild an output speed of **50.97 rpm**.

Step 2 - Find the appropriate motor (determine the required input torque)

According t the gearhead literature, the **32mm** will work with either a **BN12** (brushless) or a **C13** (brush-type) motor. As the requirement was for a brush-type motor, we will look at the **C13** series.

$T_i = T_o / (\eta * n)$ **Where:** T_i = input torque, T_o = output torque, n = gearbox efficiency, and η = the gearbox ratio. The ratio we have selected is 59:1 (58:85:1). This is a 3-stage gearhead with an efficiency of 70%; therefore:

T_i = 225 oz-in / (58.85 x .7)
T_i = 5.46 oz-in

According to the motor literature, the C13-L19 has a continuous torque rating of 7.5 oz-in. The required input torque is only 5.46 oz-in, so a C13-L19 is selected. The other consideration is to deteremine what winding (W10, W20, W30, W40 or W50) to use. Since the supply voltage is 12.0 vdc, and the input speed must be limited to 3000 rpm, we need a winding that will yeild a no-load speed of $\geq$ 3000 rpm. No-load speed may be calculated by:

$N_{nl} = V_s / K_e$ **Where:** N_{nl} = no-load speed, V_s = supply voltage, and K_e = the motor's back-emf constant (in krpm); therefore:

3000 = 12.0 volts / K_e By rearranging terms and solving for K_e, we find we need a K_e of 4.0 v / krpm. The C13-L19W30 has a back-emf constant of 4.03 v / krpm. We will select this motor and perform some new calculations.

$N_{nl} = V_s / K_e$ **-** N_{nl} **= 12.0 volts / 4.03 v / krpm = 2.97 krpm or 2970 rpm**

$\omega_o = \omega_i / n = \omega_o = 2970 / 58.85 = \omega_o =$ **50.46 rpm**

Step 3- Insure maximum power rating of motor is not exceeded

Output power is calculated by P = Tω, where T = torque in Nm and ω = speed in rad / sec, or if the units are in oz-in and rpm, and alternate equation is P = T x S / 1352. For our example, the output power is: **P = 5.46 oz-in x 2970 rpm / 1352 = 11.99 watts**

Note: (loaded speed will be somewhat less than no-load speed, but this will yield a more conservative answer) This value compared with the value given in the motor literature (13.0 watts), shows the choice is appropriate. The correct part numbers would be:

- Motor – C13-L19W30

- Gearhead – 32-59:1

Notes:

1. **Please be aware that in some cases, the output torque of the gearbox will be much greater than input torque rating of the motor. An example would be:**

   In example #2 the output torque requirement was 2400 oz-in (12.5 ft-lbs). Suppose the requirement was 4800 oz-in (25.0 ft-lbs). This is well within the rating for the **81mm - 14:1 ratio** (44.25 ft-lbs), but the required input torque - **T_i = 4800 oz-in / (13.73 x .75) = 466.1 oz-in** is much greater than the available torque for a **BN34-55AF** (max = 258.0 oz-in).

2. **Input speed (motor speed) must be limited to 3000 rpm.**

3. **This application guide is intended to provide some fundamental insights into mating our motors and gearheads. Our staff of applications engineers is ready to assist you in selecting motors and gearheads based on your application. Please contact an applications engineer with your questions and requests.**

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