a white paper from Bodine Electric Company

Selecting Fractional Horsepower (FHP) Gearmotors for Long-Life Applications

Fractional horsepower motor and gearmotors (<746 Watts)

Buyers should first decide what kind of operating life is needed. If durability is not an issue, or if the duty is so intermittent that even a short-life, ("throw-away") motor will translate into years of operation, then you'll want to go with the best price.

But if product quality and reputation depends on reliability and high performance, or the gearmotor will be maintained rather than replaced, then other factors should be considered. A less expensive gearmotor that needs to be replaced several times will cost more in the long-run. And there may also be a more direct cost if the gearmotor fails before the product warranty has expired.

Total Operating Hours. To determine the correct gearmotor life, you need to calculate the total hours of operation.

Intermittent Duty. A gearmotor application that drives an actuator back and forth for 30 seconds every 10 minutes, and will run for one 8-hour shift five days a week, needs a gearmotor that will operate trouble-free for 416 hours (over 2 years).

**(1 min./cycle) x (6 cycles/hr.) x
(1 hr./60 min.) x (8 hrs./day) x (5 days/week) x
(52 weeks/year) x 2 years = 416 hours/2 years**

Continuous Duty. A gearmotor, that runs a conveyor continuously for three 8-hour shifts, seven days a week, needs to be trouble-free for 8,736 hours/ year. A huge difference in operating requirements.

**(24 hrs./day) x (7 days/week) x
(52 weeks/year) x 2 years = 17,472 hours/2 years**

Design Life. Finding a gearmotor with the life expectancy that your application requires is challenging. Most gearmotor manufacturers don't publish design life ratings. Some, because they haven't tested for it, others, because gear reducer life is dependent on a variety of variables which can include, but are not limited to, start frequency, shock loads, operating speed, actual load and operating temperature. These companies will have you talk to an application engineer about design life estimates.

Output Torque. It's an excellent example of how one specification can affect design life. One manufacturer may rate their gearmotor's output torque at 100 lb-in., however, it may last only 1,000 hours. A gearmotor rated at 40 lb-in. from a different supplier may last 10,000 hours or longer. How the specs are measured makes all the difference.

Another problem to watch out for is that while some manufacturers make integral gearmotors with a single nameplate, others mate a stand-alone motor to a separable gear reducer. In this case, the

BODINE ® ELECTRIC COMPANY	bodine-electric.com **Gearmotor** ✓ **RoHS**
S/N	1234AB7890
TYPE	34B6BFCI-WX3
VOLTS	115
HZ	60 PH 1 FF
A	1.7
HP	1/7 AMB°C 40
µF	27.5/250VAC INS B6
TIME	CONT
RATIO	65.5:1 RPM 26
TORQ	195 lb-in.

CE   c UL us   P

Nameplates don't tell the whole story. Talk to your motor manufacturer about product design life.

motor and the gear reducer may each have their own nameplates. The output torque rating of the gear reducer is what it is capable of, not necessarily what it will actually produce with a given motor. This matching may overload the gear reducer, greatly limiting its life.

Calculating the Output Torque of A Motor-Reducer Combination

Output torque = motor torque x gear ratio x gear efficiency (assume 80% gear efficiency; seal friction ignored for this example)

Example 1

    Reducer: 100 lb-in., 20:1 ratio
    Motor: 10 oz-in. @ 1,700 rpm
    Result: 10 lb-in. output torque

The mating of a 100 lb-in., 20:1 gear reducer to a 10 oz-in. at 1700 rpm (1/60 HP) motor produces only a 10 lb-in. output torque. This can mean overheating, slower output speed, or a gearmotor that can't even start the load. (10 oz-in. x 20 x .80 x [1 lb-in./16 oz-in.]) = 10 lb-in.)

**Conclusion: this reducer is rated at 100 lb-in.,
          but the motor is not strong enough**

Example 2

    Reducer: 100 lb-in., 20:1 ratio
    Motor: 300 oz-in. @ 1,700 rpm
   Result: 300 lb-in. theoretical output torque

On the other hand, if the same gear reducer is mated to a motor rated 300 oz-in. at 1,700 rpm (1/2 HP), then the output torque would be 300 lb-in., which is three times the rating of the gear reducer. This overloading of the gear reducer will greatly decrease its actual life.

Conclusion: the gear reducer is undersized

Brush-type DC Motors. Brushes are only a concern with PMDC, universal or series wound DC motors. By their design, they are intended to be replaced. So for applications that require long life and therefore will need regular maintenance and inspection, you'll want a motor designed with external access for easy replacement. Gearmotor manufacturers are reluctant to quote

brush life specifications because, even more so than gear reducers, brush life is dependent on more variables. A good example is motor speed; the higher the speed, the faster the brushes wear out. So you need to watch for manufacturers that may minimize the gearmotor size by using a very high speed motor to take advantage of the torque-multiplying effect of a high gear ratio. This combination has a smaller package size than a lower speed motor with a lower gear ratio, but it will also have a shorter brush life, a higher operating noise level, and brushes that need more frequent inspections and replacement. Another variable affecting brush life is the form factor of the DC current, if an SCR type speed control is used. A gearmotor used with an unfiltered full wave rectified control (1.6 form factor) will have about half the brush life than a gearmotor used with a filtered control (1.0 form factor).
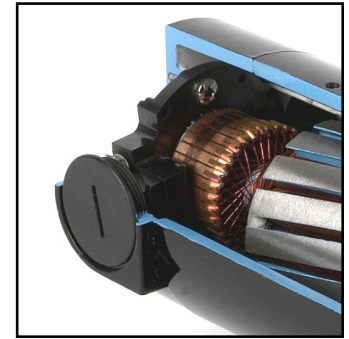
Ambient Temperature. Not all gearmotor manufacturers include an ambient temperature rating. Whether they do or don't, the gearmotor is restricted to a certain ambient temperature anyway. This is because the horsepower rating is based on keeping the sum of the increase in winding temperature plus the ambient temperature within the insulation class temperature limit. If there is no ambient temperature rating given on the nameplate, then ask the manufacturer what it is.

To illustrate the importance of knowing the ambient temperature rating, consider two gearmotors, both rated at 1/4 HP. One is rated at 25°C and the other is rated at 40°C. If the actual load really is 1/4 HP, and the actual ambient temperature is 25°C, then either gearmotor can be used. However, if the actual ambient temperature is 40°C, then the gearmotor rated at 25°C would run hotter than recommended for its insulation class, and its life would be reduced. As a general rule, both lubricant and insulation life is cut in half for every 10°C increase in operating temperature.