DC MOTOR AND SPEED CONTROL FORM FACTOR

Pure DC power as delivered by a battery, for example, has a form factor of 1.0. When a "full-wave" SCR control converts AC power to rectified DC, the form factor ranges from 1.3 to 1.4 or higher because of the pulsing nature of the AC. This characteristic of the control output causes additional heating in the motor. All DC SCR drive motors in this catalog have been selected for unfiltered power of this type. If a control is chosen that has a filtering network or is of PWM type, resulting in an improved form factor (usually a form factor of 1.1) a smaller motor may be possible.

SCR RATED DC MOTORS ON PWM POWER SUPPLIES

Pulse width modulated DC controls have a voltage output similar to pure direct current which has a form factor of 1.00. SCR thyristor drives, such as the SPEEDMASTER™ controls listed on page 27, have a form factor of 1.4.

LEESON NEMA and IEC frame stock SCR rated motors can also be used with PWM controls. In fact, the motor's HP rating can be increased because of less heating in the motor. In addition, the motor will operate quieter and the brush life will be extended.

Rated HP 1.40 FF	Rated RPM	Rated Volts	Catalog Number	Rated HP 1.05 FF
1/4	1750	90	**098002**	0.40
	1750	90	**108423**	0.30
	1750	180	**098003**	0.50
1/3	1750	90	**098004**	0.50
	1750	90	**108424**	0.56
	1750	180	**098005**	0.50
1/2	2500	90	**098006**	0.75
	2500	180	**098007**	0.70
	1750	90	**098000**	0.70
	1750	90	**108014**	0.75
	1750	90	**108226**	0.75
	1750	180	**098008**	0.56
	1750	180	**108015**	0.70
	1750	180	**108227**	0.70
3/4	2500	90	**098009**	1.00
	2500	90	**108016**	1.00
	2500	180	**098010**	1.00
	2500	180	**108017**	0.86
	1750	90	**098032**	1.00
	1750	90	**108018**	1.00
	1750	90	**108228**	1.25
	1750	180	**098069**	1.00
	1750	180	**108019**	1.00
	1750	180	**108229**	1.25
1	2500	90	**108020**	1.50
	2500	180	**108021**	1.50
	1750	90	**108022**	1.25
	1750	90	**108230**	1.25
	1750	180	**108023**	1.25
	1750	180	**108231**	1.25
1½	2500	180	**108265**	2.00
	1750	180	**108092**	1.75
	1750	180	**108262**	1.75
	1750	180	**108232**	1.75
	1750	180	**128000**	—
2	2500	180	**108266**	3.00
	1750	180	**108010**	—
	1750	180	**128001**	—
3	1750	180	**108502**	—

DC MOTOR SPEED RANGE

The speed ranges noted for PM DC motors and gearmotors in this catalog are based upon ideal conditions and can vary due to the nature of the load and the load regulation or IR compensation of the speed control. The upper end of the speed range is usually not critical. However, in some applications, and some motor and speed control combinations, erratic operation or "cogging" of the motor's speed may be noticed in the lower extremes of the listed speed range. Often, this can be eliminated through adjustment of the control or increasing the ratio of the drive train to reduce the minimum speed at which the motor is required to operate.

ENCLOSURES AND ENVIRONMENT

DRIP-PROOF: Venting in end frame and/or main frame located to prevent drops of liquid from falling into motor within a 15° angle from vertical. Designed for use in areas that are reasonably dry, clean, and well ventilated (usually indoors). If installed outdoors, it is recommended that the motor be protected with a cover that does not restrict the flow of air to the motor.

TOTALLY ENCLOSED NON-VENTILATED (TENV): No vent openings, tightly enclosed to prevent the free exchange of air, but not airtight. Has no external cooling fan and relies on convection for cooling. Suitable for use where exposed to dirt or dampness, but not for very moist or hazardous (explosive) locations.

TOTALLY ENCLOSED FAN COOLED (TEFC): Same as the TENV except has external fan as an integral part of the motor, to provide cooling by blowing air around the outside frame of the motor.

TOTALLY ENCLOSED, HOSTILE AND SEVERE ENVIRONMENT MOTORS: Designed for use in extremely moist or chemical environments, but not for hazardous locations.

EXPLOSION-PROOF MOTORS: These motors meet Underwriters Laboratories and Canadian Standards Association standards for use in hazardous (explosive) locations, as indicated by the UL label affixed to the motor. Locations are considered hazardous because the atmosphere does or may contain gas, vapor, or dust in explosive quantities. The motor user must specify the explosion proof motors required.

U.L., CSA, ISO AND OTHER STANDARDS & APPROVALS

UNDERWRITERS LABORATORIES INC.

1. All motor models listed with prefix "C" have U.L. component recognition (without thermal overload). File Number E57948, Guide Number PRGY2.
2. All units have U.L. recognized Class B insulation system unless otherwise noted. File Number E55555, Guide Number OBJY2.
3. Permanent Magnet DC motors, except PZ and P300 gearmotors, are recognized components under File Number E57948, Guide Number PRGY2.
4. PZ and P300 Permanent Magnet DC gearmotors and Low Voltage IEC metric motors: File Number E49849 or E49747, Guide Number PRGY2.
5. Speedmaster SCR Drives, Component Recognition, File E35603, except catalog numbers 174709, 174902 and 174903.
6. Speedmaster SCR Drives, catalog numbers 174902 and 174903. File Number E78180.

CANADIAN STANDARDS ASSOCIATION

1. Permanent Magnet DC motors are listed under File Number LR33543.
2. Speedmaster SCR Drives, catalog numbers 174902 and 174903. File Number LR 85877.

ISO QUALITY CERTIFICATION

Grafton and Saukville, Wisconsin administrative, design and manufacturing facility, ISO 9001, Certificate Number RvC #93-102. EN29001, BS5750: Part 1 and ANSI/ASQC Q91-19.

Black River Falls, Wisconsin manufacturing facility, ISO 9002, Certificate Number RvC #93-090.

Mississauga (Toronto), Ontario, administrative, distribution facility, ISO 9002, Certificate Number QMI #003027.

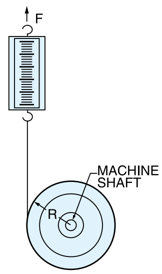
Hanover, Ontario, manufacturing facility, ISO 9002, Certificate Number QMI #003028.

SELECTING A DC MOTOR OR GEARMOTOR

When applying larger motors, it is only HP and speed, rather than torque (the twisting force that produces rotation) that are key elements of concern. However, for sub-fractional HP motors and gearmotors, the speed and torque required are more critical.

GEARMOTORS

In most applications using geared motors, the running torque required is approximately the same or less than the starting torque, where the load consists primarily of friction. In these instances, the torque required can be determined simply by applying a rope and pulley with scale to the driven shaft and measuring the torque required to turn the shaft. An even simpler method is to use a mechanic's torque wrench.



ROPE & PULLEY METHOD—Fix a pulley to the shaft of the machine. Secure and wrap a rope around the pulley. Using a spring scale, measure the force required in pounds or ounces to turn the shaft. The force measured by the spring, multiplied by the radius of the pulley will equal the inch-pounds or inch-ounces required. The reading obtained just as the shaft begins to rotate is the starting torque. The force required to continue turning the shaft is the running torque. The measurements should be taken several times and averaged.

TORQUE WRENCH METHOD—Using a torque wrench, turn the shaft and read the torque values from the wrench's scale.

INPUT HORSEPOWER

After determining the torque speed, input HP can be determined by the following formula:

$$HP = \frac{\text{RPM x Torque (Inch-Pounds)}}{63{,}025}$$

USING A MOTOR TO CONFIRM THE RESULTS

While the above methods usually yield adequate results, the measurements can be confirmed using the data to select a test motor or gearmotor. Using performance data from the motor's manufacturer, the amperage or wattage required by the application can be compared for confirmation of the sizing.

OTHER TYPES OF LOADS

Applications having other characteristics may require different techniques to select an optimum sized motor. Fan and pump manufacturers can usually supply characteristic curves of their loading requirements that can be matched to a motor's performance curve.

GEARMOTOR EFFICIENCY

Gearmotor efficiency is determined by the type of gearing and the number of stages of reduction. Efficiency can also be affected by ambient temperatures, lubricant, and the actual transmitted torque relative to the rated torque of the gearmotor.

Parallel shaft gearmotor efficiency is equal to .96n, where n is the number of stages of reduction indicated by the last digit of the gear type number (for example, PZ2 or P302 are two-stage reducers).

Right-angle, worm-type gearmotors are not as efficient as parallel shaft gearmotors and can vary greatly depending upon the size and ratio. A conservative formula for worm reducers is:

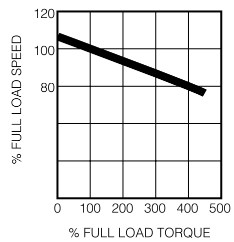
$$E = \frac{74 - .66r}{100}$$

where r = the gear ratio

PEAK LOADS, SHOCK LOADS AND GEARMOTOR LIFE

Some applications subject gearmotors to periodic, unusually heavy, "shock" loads. LEESON gearmotors are designed to withstand periodic overloads of up to 200% of the listed safe torques. The frequency and duration of such shock loading must be carefully considered and compared to the safe torque values for reasonable gear life.

TYPICAL SPEED TORQUE CURVE



Permanent magnet DC motors have linear speed/torque characteristic over the entire speed range. Their very high starting and maximum torque capability make them ideal for intermittent duty applications. DC permanent magnet powered gearmotors can produce sufficient peak torques to damage the gear train or driven equipment. Failures of the gear train caused by these maximum torques should be prevented by fusing or the current limit feature of adjustable speed controls. Gear train failures caused by locked torques are not covered by the warranty.

MOTOR AND GEARMOTOR NOISE

While electric motor noise alone is usually not objectionable in even the most sensitive applications, the use of SCR or thyristor-type speed controls with DC motors and the addition of a gear reducer to the equation may be of concern.

The "pulsed-power" output of SCR controls can introduce noise into DC motors that may be a problem in noise sensitive applications. This can usually be eliminated by the addition of resiliency to the motor mounting or in extreme conditions through the addition of a filter network to the control system that "smooths" the flow of power to the motor or a PWM type control.

The stock gearmotors in this catalog have been designed for general purpose use in industrial applications where noise is not generally a critical factor. For maximum performance of these motors, LEESON has chosen all-steel gearing for parallel shaft reducers and bronze worm wheels for the right-angle gearing. While this substantially increases the shock and maximum load capacity of the gearmotors, it does result in a unit somewhat more noisy than is possible with the use of thermoplastic or laminated gearing as used by many manufacturers in their stock and custom products. For noise sensitive applications, LEESON can supply gearmotors with gearing specially designed for the application.

OVERHUNG LOAD

When a sprocket, pulley or gear is mounted to a gearmotor shaft, a load perpendicular to the shaft is exerted. This is commonly known as overhung load. The listings in this catalog are for the center of the output shaft. Exceeding these values can result in bearing, shaft or mounting failure. The need to consider overhung load can be eliminated by direct coupling of gearmotors to the load. The formula for overhung load is:

$$\text{OHL (pounds)} = \frac{\text{Torque (Inch-Pounds) x K (Load Factor)}}{\text{R (Radius of Pulley or Sprocket)}}$$

The result of this calculation must be corrected for the device mounted using the factors noted below:

Chain and Sprocket —1.00

Gear—1.25

V-Belt—1.50

FOR CUSTOM MOTORS OR GEARMOTORS, COMPLETE THE EASY-TO-USE DESIGN OUTLINE ON THE NEXT PAGE AND FAX TO LEESON.

☛

DC CUSTOM MOTOR/GEARMOTOR DESIGN OUTLINE

Company: ______________________ Contact: ______________________

Address: ______________________ Title: ______________________

City: ______________ State: ______________ Zip: ______________

Phone: ______________________ Fax: ______________________

Application of motor/gearmotor: ____

____

Current Supplier: ______________________ New Application ______________________

Estimated annual quantity: ______________________ Price Target: ______________________

Please complete applicable portions of the data below.

MOTOR DATA

Enclosure: ☐ TEFC ☐ TENV ☐ TEAO ☐ ODP ☐ Other ______________

HP: __________ RPM: __________ Frame: __________ Voltage: __________ Insul. Class: __________

(If gearmotor, also complete "Gearhead" section below.)

Power Source: ☐ SCR* ☐ PWM* ☐ Rectifier* ☐ Battery ☐ Generator

*Please Note: AC Input Voltage: __________ Form Factor: __________ Armature Voltage: __________

Thermostat: Normally Closed ______________________ Normally Open ______________________

Duty: ☐ Continuous ______________________ Ambient Temperature ______________________

☐ Intermittent (Describe On/Off Cycle and Speed Range) ______________________

GEARHEAD DATA

Output Torque: ______________________ Ratio ______________________

Gear Type Preferred: Parallel Shaft ______________________ Right-Angle Shaft ______________________

Overhung Load (lbs.) ____

Shock Load (lbs.) ______________________ How Often? ______________________

Other ____

Mounting position (i.e. gearhead relative to motor) ____

____

Environmental conditions ____

Desired life requirements ____

Weight requirements ____

Dimensional characteristics. Specify any space restrictions. Use additional page for sketch.

PLEASE SPECIFY: Shaft Extension Length: ______________________ Diameter: ______________________

Keyway or flat dimension, other shaft features: ____

Conduit Box: ☐ None ☐ Side Box ☐ Built-In ☐ Terminal Posts

Conduit Box Location: ☐ Standard ☐ Special ______________________

Mounting: ☐ None ☐ Rigid ☐ Resilient ☐ C Face ☐ Other ______________

Mounting Position: ☐ Horizontal ☐ Shaft Up ☐ Shaft Down ☐ Other ______________

Any other critical mounting dimensions: ____

Other special features: ____

____

____

Fax to LEESON Electric at 262/377-9025