maxon precision motors, inc.
125 Dever Drive
Taunton, MA 02780

Phone: 508-677-0520
info.us@maxongroup.com
www.maxongroup.us

Machine Optimization through DC Motor Selection

Selecting the right DC motor is an important aspect of optimizing medical machine performance.

There are so many motors on the market today, from heavy-duty AC motors to tiny DC brushless and stepper motors. To use any of the motors users must have a full understanding of the application parameters, including power, speed, torque, physical size, efficiency, lifetime expectations, and other requirements. There have literally been books published about each of these aspects, and to define them all accurately in a short article would be difficult to say the least.

The Koax-Drive, KD 32, by maxon is a high-torque, but extremely quiet drive designed and manufactured specifically for medical technology (including surgical tools). The drive's unique torque conversion system is a breakthrough for noise-sensitive environments, even under high loads.

What this article will do is spell out the primary differences between DC brushed and brushless motors, what they can do, where they fit best, and how to decide which to use in your application. DC motors are being used in more and more industrial applications because of their flexibility and long life. Therefore, DC motor selection is often one of the most important steps in providing motion control of a medical machine, whether for prosthetics, medical tools, robotics, or medical training aids.

Defining the Application

The medical market is unique in that most devices and machines are operated in a clean environment and around people as opposed to an industrial application. This means that long life and low noise are key characteristics the drives need to have in order to fit the requirements of many medical machines. DC motors are noted for their life-spans, particularly DC brushless motors which can last tens of thousands of hours in continuous operation, and much longer when operated intermittently.

Key criteria for selecting a DC motor for a medical machine application includes finding out what voltage is readily available for the application and what physical size the motor needs to be. Speed and torque can be determined once these two parameters are determined.

Voltage availability is a critical element in motor selection. Prosthetics, for example, are battery operated, while many rack-mounted devices and surgical tools operate from a 24 V power supply. DC motors are available for use at voltages as low as 1.5V and as high as 48V dependent on required power.

Physical size is often one of the limiting factors in motor selection for medical machines. Often a compromise needs to be made between which motor to use and the available space it needs to fit into. The prosthetics talked about earlier would need a small frame motor, while rack-mounted devices can be designed to accommodate larger devices

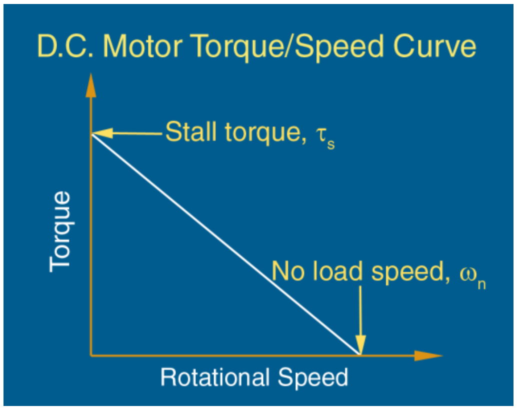
Efficiency becomes a primary concern when you need to worry about power consumption to maximize battery life in a prosthetic hand or in a portable surgical tool like a drill or saw. Such concerns are not so evident in robotic machines used to perform many surgeries today. As mentioned before, torque and speed also have an affect on motor frame size. High torque motors are often larger in size than their low-torque counterparts, which means that larger mounting hardware and larger housings may be a requirement of the machine. For example, it takes a larger motor to rotate the magnets in an MRI than it does to run the infusion pump for drug delivery.

Motor duty cycle could be one of the most telling aspects of a medical machine. Intermittent operation not only reduces the wear and tear on the motor and increases the life of the motor, but it also means that a smaller motor size can be used without depleting the positive characteristics of the machine itself.

Brush or Brushless

Key specifications quickly show that brushless motors last much longer than brushed motors, which rely on a mechanical connection for operation. And brushless motors run much faster as well. If you're using a brushless motor for reliability, you won't want to add a gearhead to the mix, though. The mechanical nature of a gearhead automatically means that it'll have a shorter life cycle. Using a gearhead with a brushless motor will only negate the longevity of the combined system, and therefore reduce the longevity of the medical machine it was designed into. On the other hand, there are times when using a gearhead on a brushless motor is advised. For example, if the environment is such that noise is a concern or that a higher torque is needed, a gearhead will do the job very well.

Brushed motors would need a mechanical gearhead to increase speeds close to those of brushless motors. Using a gearhead with a brushed motor won't change the life cycle to any great extent. Both are mechanical components that are subject to wear and tear. For medical machines, though, you don't have to be concerned with dirt or grime mucking up the system. The cleanliness of the hospital allows you to get the most out of your mechanical components.



Although speed and torque are independent requirements in many applications, typically when the torque increases the speed will decrease – if the voltage stays the same. This connection is based on the slope of the speed/torque curve (called the speed/torque gradient), calculated using the formula below and shown in the sample curve shown here.

Torque = {power [kw] • 30,000} / π • rotational speed [rpm]

A real issue in selecting between a brushed and brushless motor is the expertise of the machine builder. Brushless motors either come with built in electronics or with external electronics to operate the motor. It takes some experience to provide the custom electronics many machine builders choose to provide. But for high sales volumes, the costs are easily regained.

Brushed motors, on the other hand, don't need electronics to run the motor, offering a plug-and-play option to the designer. This means that if the machines are expected to sell in low quantities, a brushed motor will save on the overall cost of the system. A final concern is the power needed for the motors. maxon motors are available in power ratings up to 250 Watts for brushed motors and 400 watts for brushless motors.

Overall, many medical machine builders are selecting to use brushless motors whenever possible. Long life and high speeds make these motors applicable to a broader array of applications. But as development costs increase and quantities decrease, brushed motors come to the rescue.

For information:

maxon
125 Dever Drive
Taunton, MA 02780
T: +1 508 677 0520
F: +1 508 677 0530
S: www.maxongroup.us