Overview and Applications for Medical Device Motion and Actuation

This article compares the specific characteristics of solenoids and motors, their common properties, and those attributes that make each of these electromechanical devices unique for a specific medical motion application. Each motion control component is also presented with a number of applications for which it is best suited to help illustrate how each device best functions.

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Johnson Medtech stepper motors provide accurate positioning suitable for robotic applications.

Today's medical market is expanding with many new innovative devices to improve healthcare through the monitoring and control of medical conditions and treatments. These range from small, portable, battery-operated devices-insulin pumps and glucose monitoring-to large, sophisticated machines-pill dispensing, drug metering, medical imaging, and therapeutic systems. What all these medical innovations have in common is the need for electromechanical sub-systems to accomplish mechanical actuation from some form of programmed control. Two of the most common devices used to convert these programmed instructions into mechanical actuation are solenoids and motors. While these devices might overlap in functionality and while there are circumstances where electromechanical actuation could be accomplished by either choice, the specifics of the applications will typically dictate the optimal solution.

Solenoid and Motor Characteristics

The defining application characteristics for choosing the best electromechanical prime moving device are:

- Power source (AC, DC, battery)
- Mechanical work required (force, watts, HP)
- Physical size (space envelope)
- Total cycle life (cycles, on/off time)
- Stroke or travel
- Cost value management (budget)

Solenoids

Solenoids are known for fast and repeatable linear force or rotary torque produced, and are available with on/off snap engagement or controlled movement. Solenoids provide compact, constant, or controlled actuation. They are also found with or without magnetic latching or a spring return. Solenoids can run on a range of AC, DC, or battery power sources, and can have very fast acceleration profiles. They are compact and perfect for intermittent actuation cycles with very short or very long life needs up to 100 million cycles.

Motors

Motors are known for the torque produced, and can drive added kinematics such as gears, belts, and pumps. Motors can also run on AC, DC, or battery power sources. They come in many types from traditional brush commutated armatures to electrically commutated brushless, ceramic motors, and can be controlled for precise linear or rotary motion. Motors provide a better power to work efficiency ratio for longer battery run time, but a motor's acceleration is not as fast nor is it as compact as a solenoid. Motors are preferred for larger power loads that are continuous or long. Motor life is less than a typical solenoid, as it is more dependent on the motor application power and the radial bearing loads.

Johnson Medtech solenoids are used in valves for drug delivery devices.

Locking Mechanism

Solenoids are the preferred choice in access doors, centrifuge locks, sterilizer door locks, and position locks for medical instruments, and are perfect for small, light locking loads.

Motors could also provide this function when combined with kinematics for a larger locking system that may need more power, where the shear mass is too great for the solenoid.

Latch Release Mechanism

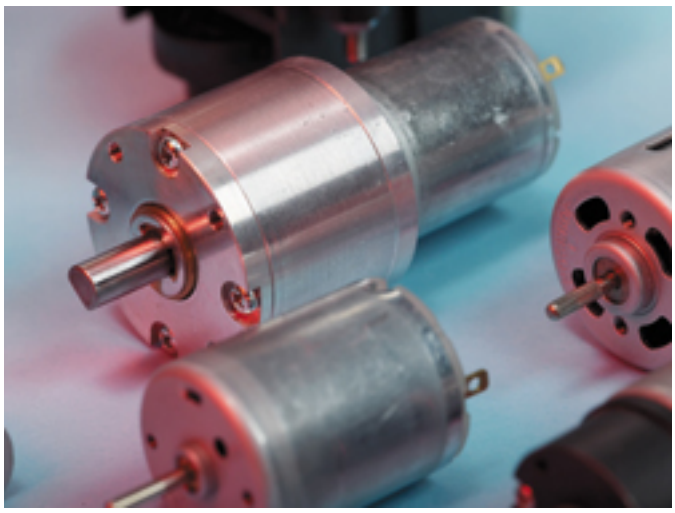
Linear or rotary solenoids are the preferred choice in securing a brake system in critical care and transport systems. These applications benefit from solenoid acceleration rates and small package sizes.

Motors in latch systems could be the preferred choice if the load and other defining application characteristics exceed the capability of the solenoid.

Pinching Mechanism

The SoftShift solenoids, from Ledex, feature soft impact and low noise and are preferred in tubing pinch valve applications. Speed controlled solenoids are conducive for regulating IV administration and surgical irrigation. Solenoids can regulate dosing of medicines and chemical reagents used in immunoassay or other diagnostic instruments.

A motor would be applied with a peristaltic pump to move larger amounts of fluid. The Saia 20-mm linear stepper motor, from Johnson Motor, is well-suited for this longer stroke application that requires quiet, battery driven operation.



Johnson Medtech permenant magnet DC motors provide a steady flow of liquid for peristaltic pumps.

Optical Shutter Mechanism

Solenoids are also preferred for open/close laser or optical shutters due to the need for fast acting shutter operation and long life.

Motors would be better suited for aperture or focusing applications where a control system is used to regulate optics. A motor would be feasible for such a system if multiple shutter positions are required.

Conclusion

In most medical devices, there is a need for both solenoids and motors. Choosing the best suited motion technology for the customer's application, a motion control supply partner should be able to deliver optimal solutions that enable customers to quickly introduce smaller and smarter products to the market.

Online

For additional information on the technologies and products discussed in this article, see *MDT* online at www.mdtmag.com and the following websites:

- www.johnsonmedtech.com
- www.ledex.com
- www.johnsonmotor.com
- www.saia-motor.com

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