Components of an Electric Linear Actuator
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Welcome to part two of our six part discussion on the basics of an electric actuator and factors to consider when purchasing an electric motion system. TiMOTION is a manufacturer of electric linear actuators and related components, which is able to customize to specifications. In order to have a better foundation and understanding of how an actuation system works, we will now look at the components that go into manufacturing an electric linear actuator.

A. Front / Rear Clevis - Attachments on the front and rear of the actuator that allow it to be mounted to the application. Attachment styles from TiMOTION include round, U-shaped (or slotted) or with a punched hole. Clevises can be customized by TiMOTION to best fit the application they are being used on.

B. Outer Tube - Also known as the cover tube. This extruded aluminum or steel tube protects the outside of the linear actuator and houses all of the inner components of the actuator.

C. Inner Tube - Also known as the extension tube, drive tube, translating tube or piston. This tube is usually made out of aluminum or steel. While retracted, the inner tube is where the spindle is located. This tube is attached to the threaded drive nut and extends and retracts when the nut moves along the rotating spindle.
D. **Spindle** - Also known as the lead screw, rotating screw or lifting screw. This part of the linear actuator rotates, extending or retracting the nut/inner tube, which creates a linear motion. Our steel spindle ensures durability and strength. The spindle can be threaded in different ways for various load and speed capabilities. Additional details of this will be covered in another section.

E. **Safety Stop** - Located on the end of the spindle, its function is to prevent the inner tube from overextension.

F. **Wiper** - A sealing component attached to the end of the outer tube which prevents contaminants like dust and liquids from entering the spindle area of the actuator. It also ensures a proper seal between the inner and outer tubes which influences the IP rating of the linear actuator. TiMOTION's electric linear actuators can be rated anywhere between IP42 and IP66.

G. **Drive Nut** - The nut, which can be acme or ball, is attached to the inner tube and travels along the spindle. The nut is the component that allows extension or retraction of the inner tube. It can be made of metal or plastic and is sometimes keyed to prevent inner tube rotation.

H. **Limit Switches** - Limit switches control the fully extended and retracted position of the inner tube by electrically cutting current to the motor. These switches prevent the actuator from over extending or over retracting. In addition to cutting current, limit switches can also be used as a signal sending device.

I. **Gear** - A gear is made of steel or plastic and mates with other gears to alter the relation between the speed of a driving mechanism (such as the engine of a vehicle) and the speed of the driven parts (the vehicle's wheels). The gear connected to a power source, such as the motor, is called the "drive gear". TiMOTION has different gear options depending on the application (such as a worm gear or spur gear which was covered in our "Common Styles" white paper).

J. **Motor Housing** - The motor housing contains all the internal parts to the gear motor without leaving anything exposed for external damage. TiMOTION's motor housing is typically made of high quality plastic.

K. **DC Motor** - The DC (Direct Current) motor is where all the power is generated for the electric linear actuator. There are several types of DC motors, but TiMOTION uses brushed DC motors which are composed of:
1. **Stator**: The stationary, outside portion of the motor made up of the motor housing, two permanent magnets, and motor caps. The stator generates a stationary magnetic field that surrounds the rotor.

2. **Rotor**: Also known as the armature is the inner part of the motor which rotates. The rotor is mainly made up of silicon steel laminate, motor shaft, commutator, and copper windings.

3. **Commutator**: The commutator is a pair of plates attached to the motor shaft. These plates provide two connections for the coil of the electromagnet. The commutator is used to reverse polarity of current in the motor and essentially keep the motor rotating without losing torque.

4. **Carbon brushes**: Carbon brushes use sliding friction to transmit electrical current from the stator to the rotor in the motor.

5. **Motor Shaft**: The motor shaft connects the gear motor to the bottom of the stator on the DC motor.

**Note**: Alternating Current Motors (AC Motors) are also an option that TiMOTION manufactures. This type of motor is an available option that can be seen in our MA1 Model.

**L. Output/Feedback Sensors**: Output (or feedback) sensors are used to communicate the actuator’s stroke position. The feedback that it gives is sent to the control box MCU (micro control unit). Linear actuators
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with position feedback are typically required when an application requires high level functions such as synchronization and memory positioning. Output sensor options include:

1. Hall Effect Sensor: The output signal from a Hall Effect sensor is the function of magnetic field density around the device. When the magnetic flux density around the sensor exceeds a certain pre-set threshold (set in the MCU), the sensor detects it and generates an output voltage called the Hall Voltage. A linear actuator with position feedback is important because of its reliability and accuracy, which is exactly what the Hall Sensor provides.

2. Potentiometer (POT) Sensor: A POT sensor consists of a wiper/slider and two end connections to change an electrical signal output. As the linear actuator lead screw (spindle) turns, the resistance between the wiper/slider and the two end connections will change. Each resistance value will correspond to a position in the actuator's stroke.

3. Reed Sensor: The reed sensor is a magnetic positional sensor. It is an electrical switch operated by an applied magnetic field. It consists of a pair of contacts on ferrous metal reeds in a sealed glass envelope. The contacts may be normally open, but closing when a magnetic field is present (closing the circuit and cutting the power of the actuator).

We hope that this has helped you develop a better understanding and foundation for electric linear actuators. Next, we will cover the safety feature options that can be added to an actuator. If you have further questions and/or would like help with your next application, TiMOTION would be glad to assist you. We specialize in partnering with our clients while providing quality solutions for their actuation needs.