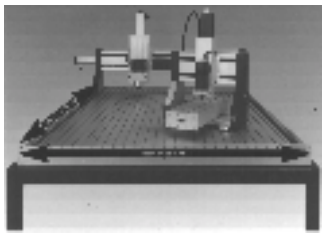
## Choosing Between Stepper and Servo Motors

### Cost Comparison

In general, **stepper motor systems** tend to be less expensive than servo motor systems. Stepper and servo systems often become comparable in price when the stepper system uses motors larger than NEMA23 or when micro-stepping is used.

**Servo motors** in the NEMA23 frame size tend to be 10% to 30% more expensive than similar stepper systems. Brushless servo motor systems tend to be 50% to 100% more.





| Stepper Technology | Servo Technology |
|---|---|

### Reliability and Maintenance

**Stepper motors** are brushless. They experience little or no wear, and are virtually maintenance-free.

Brush-type **servo motors** require a change of brushes, typically, every 5,000 hours. Like steppers, brushless servo motors have virtually no servicing requirements.

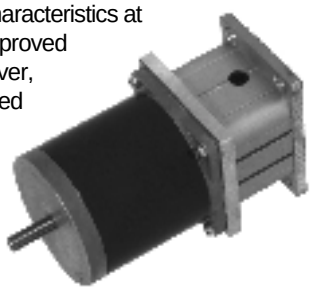
### Resolution and Accuracy

For a given screw pitch, typical four phase **stepper motors** can produce 200 full steps, 400 half steps, and up to 25,000 micro steps per revolution. It is significant to note that since the stepper motor is open loop, it does not necessarily achieve the desired location, especially under load. Particularly poor positional accuracy can result when using microstepping, which is primarily useful for smoothness of motion.

**Servo motor** resolution depends upon the encoder used. Typical encoders produce 2,000 to 4,000 pulses per revolution, and encoders with up to 10,000 pulses per revolution are available. Since servos, which are closed loop, can and do achieve the available resolution, they are able to maintain positional accuracy.

### Speed and Power

**Steppers** have very poor torque characteristics at higher speeds. This condition is improved somewhat by microstepping, however, unless the stepper is used in a closed loop mode, it does not usually perform as well as a servo.



**Servos** can produce speeds and powers two to four times that of similarly sized steppers. This improvement is a direct result of the closed loop (i.e., constant position feedback), which allows for higher speed and greater reliability. The closed loop nature of the servo also allows such a system to better utilize peak torque capabilities.

### Closed Loop Vs. Open Loop

**Stepper motors** are almost always used in an open loop configuration. If used in a closed loop, they typically become as, if not more, expensive than servo motor systems. The open loop nature of stepper motors is their principal drawback. Commands are issued to move prescribed amounts, and barring unforeseen circumstances, the motor moves the amounts prescribed. In rare cases, resonances or unexpected forces can cause a stepper motor to lose steps or stall out. Although rare, this is an ever present possibility.

By nature, **servo motors** have constant positional feedback. The positional feedback is used to correct any discrepancy between a desired and an actual position. This constant corrective action results in faster speeds (up to three times the throughput), and increased power (up to three times the torque) at high speeds. The closed loop nature of the servo also ensures that stalling cannot occur unless there is an immovable object in the path.

### Choosing a System

In general, we recommend **stepper systems** for cost sensitive applications requiring low-to-moderate volume production capabilities. Servo systems are recommended for high-speed, high-volume, high-reliability applications. A typical **Techno servo gantry** system sells for about $2,700 more than a stepper system. Servos can perform high-speed continuous motion reliably, making them particularly superior in three-dimensional contouring applications. We have found time reductions of up to 80% on some applications. The continuous motion also results in better finish quality without the fine faceting that is found with stepper systems. In addition, the servo's reliable high-speed continuous motion can reduce the possibility of scorching and melting when working with woods and plastics.