
The machine should not be able to run again until a “reset” button has been pressed. If the EStop button locks when pushed, then the machine should not start when you release it by turning its head.

It will not generally be possible to continue machining a part after an EStop event, but you and the machine will at least be safe.

4.4 Axis Drive Options

4.4.1 Steppers and Servos

There are two possible types of motive power for axis drives:

- Stepper motor
- Servo motor (either AC or DC)

Either of these types of motor can drive the axes through leadscrews (plain- or ball-nut), belts, chains, or rack and pinion. The mechanical drive method will determine the speed and torque required from the motors and hence any gearing required between the motor and machine.

Properties of a bipolar stepper motor drive include:

- **Low cost.**
- Simple 4-wire connection to motor.
- Low maintenance.
- Motor speed limited to about 1000 rpm and torque limited to about 3000 ounce inches. (21 Nm). Getting the maximum speed depends on running the motor or the drive electronics at their maximum permitted voltage. Getting the maximum torque depends on running the motor at its maximum permitted current (amps).
- For practical purposes on a machine tool, steppers need to be driven by a chopped micro-stepping controller to ensure smooth operation at any speed with reasonable efficiency.
- **Provides open loop control, which means it is possible to lose steps under high loading, and this may not immediately be obvious to the machine user.** In practice, stepper motor drives give satisfactory performance with conventional machine tools up to a Bridgeport turret mill or a 12” swing (6" center height) lathe unless you want exceptional accuracy and speed of operation.

On the other hand, a servo motor drive:

- Is relatively expensive (especially if it has an AC motor).
- Needs wiring for both the motor and encoder.
- Requires maintenance of brushes on DC motors.
- Allows motor speed of 4000 rpm or more, and a practically unlimited torque (if your budget can stand it!)
- **Provides closed loop control so drive position is always known to be correct (or a fault condition will be raised if an error occurs).**

It is worth giving two warnings here. First, servo systems on old machines are probably not digital. That is, they are not controlled by a series of step pulses and a direction signal as required by Mach3. To use an old motor with Mach3, you will need to discard the resolver (which gave the position) and install a quadrature encoder, and you will have to replace **all** the electronics. Second, beware of second-hand stepper motors unless you can get manufacturer's data for them. They might be designed for 5-phase operation, may not work well with a modern chopped micro-stepping controller and might