WHITE PAPER

Application Considerations

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In many cases it is beneficial to understand the mechanical limitations of an actuator system to enable a successful application of linear motion devices. The following information covers a variety of technical information which will assist in understanding application of linear motion devices as it applies to Tol-O-Matic actuator systems.

ACCURACY

Accuracy needs to be considered from two perspectives. First being the accuracy of the actuator itself. This relates to the actuator's moving element ability to travel in an ideal single axis path or straight line. This is primarily concerning the base or cylinder tube and the bearing or guidance system employed (ball bearings, slide bearings etc.) For example, the motion provided by the actuator will only be as true as the mechanical components. Second being the actuator's ability to provide precision increments of motion along this axis. This is primarily concerning the lead screw or ball screw as well as the feedback device (encoder, linear scale etc.). Lead accuracy of the screw, resolution of encoders and ability of the controller must be capable of the desired accuracy. Both of the above describe accuracy and need to be considered in application.

REPEATABILITY

Repeatability is the ability of a device to reach a specific location or position in successive attempts. Unlike accuracy, repeatability does not take into consideration the actuators ability to travel in an ideal axis. Many times the actuator will travel through a slightly bowed or twisting motion due to the components used in its construction. Repeatability will be influenced by the direction of approach to the target point. For example, approaching the target point from the same direction every time would indicate an uni-directional repeatability tolerance would apply. Approaching the same target point from two directions would indicate a bi-directional repeatability tolerance would apply. Bi-directional repeatability will include the effects of lead screw backlash, which in some cases will dramatically influence the repeatability tolerance.
It is possible that an actuator may be highly repeatable without being highly accurate.

RESOLUTION

Resolution is the smallest positional increment which can be asked of a motion system. Motors, encoders, controllers and the mechanical components will act together in defining system resolution. For example, in a system which uses a stepper motor and a micro stepper drive set at (2000 steps per rev) and a 5 turns per inch ball screw will combine to offer resolution of .0001 inches. It is possible to select systems which have substantially smaller resolution values however there are limits to which smaller resolution remains practical. Mechanical limitations such as friction and nut backlash in bi-directional moves renders very small move commands ineffective in these systems.

MOUNTING

Mounting of linear motion systems needs to be considered for each application to be successful. Many times mounting influences the actuators' ability to attain the desired results. For example, actuators which are built using extruded aluminum profiles commonly exhibit conditions of bow and or twist in addition to dimensional variances. If such an actuator is mounted rigidly to a known true flat surface, the resultant accuracy of the move will not include the tolerance of bow and or twist. It will typically only include the dimensional variance. This type of mount will have the effect of straightening out the actuator's extruded aluminum profile. This will typically have no effect on repeatability. Conversely, mounting such an actuator by a single point or by two points a substantial distance from one another will not straighten out the actuator and moves will typically follow the bow and or twist of the base extruded aluminum profile. Here accuracy is effected by bow and or twist, however repeatability is typically not effected.
Mounting a linear motion system to machinery members, which are not flat, will effect the outcome as well. For example, machinery framework, which is not flat, will tend to make the actuator motion follow it by virtue of bending the actuator to match the framework.
In cases where accuracy and repeatability are required it may become necessary to take extra steps in the mounting of these devices. These may include the use of shims and or jackscrews to influence each actuator and adjust it to the desired condition.