Consideraitons for Actuator Loading

Forces acting upon actuators consist of a combination of direct forces pushing in from any axis and a twisting force that may be applied due to offset loads.

Direct Forces placed on the Actuator

F.t. : Thrust Force operating in the direction of travel.

Mechanically Limiting Factor: For Lead Screw Actuators, this is typically the thrust bearings and/or lead nut.

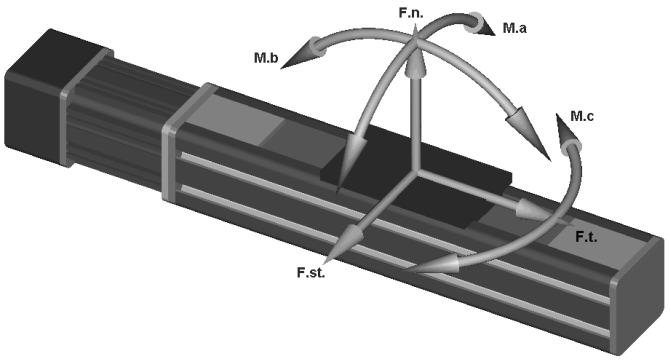
For Harmonic Belt drives, the limiting factor is typically the belt. It may be based on shear strength of the belt teeth or on the actual tensile strength of the belt itself. In a welded belt, it would most likely be based on the weld strength of that belt.

F.st. : Side Thrust Force, acts upon the carriage from one side or the other.

The bearing support is typically the limiting factor. The choice of bearings and their orientation will greatly affect the maximum permissible force.

F.n. : Normal Force downward.

Similar to side force, the limit is based on the bearings and their orientation. It is very common to have a much higher normal downward force capacity than a side force capacity. Since Gravity typically plays a roll in Horizontal applications, most actuators are designed to deal with downward force effectively.



Moment Loading Forces:

This is the twisting force similar to a Moment arm force applying a torque to the supporting bearings.

To insure long life of the actuator it is imperative to not exceed the Moment loading specifications.

In the above diagram, three Moment loads are depicted.

All three Moment loading forces may exist on a given application. It is important to remember that any offset load from the center surface of the actuator carriage will induce one or more of these Moment forces.

While accelerating, that Moment load may increase drastically.

For Example: Suppose in the above diagram, you place a load offset from the center of the carriage in upward direction. Any time the load is accelerated, the M.b. Moment loading will increase.

If the load is placed horizontally offset to one side or the other, dynamic motion will increase the M.c. component of Moment loading of that actuator.

The M.a. component is the only Moment loading that will not typically change with the dynamics of load motion. However, offset side loading is the greatest contributor to the M.a. component.

Understanding Thrust Curves

Actuator Thrust Curves are very similar to Servo Torque Curves, but relate to linear motion performance instead of shaft rotation performance. All thrust curves show continuous and peak performance based on the coupled system of Servo and Actuator together. The following examples show the 2 exceptions to the previous statement, where the actuators limitations are taken into account.

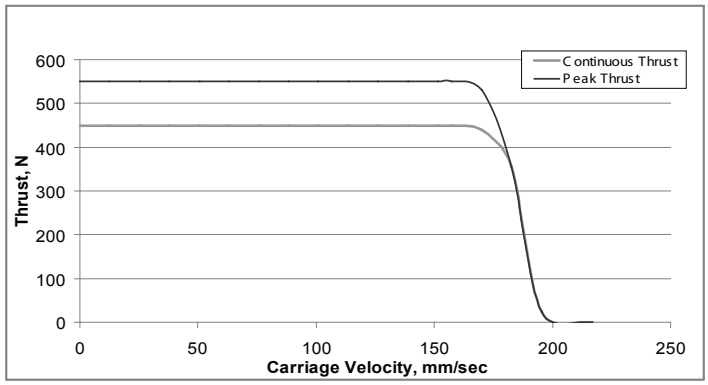
Note: The continuous thrust region is where the system should be operated, except for short hard accelerations required in your motion profile. Sustained Operation outside the continuous region will reduce the rated life on the actuator/integrated motor system. Please check the specifications of each actuator for limiting factors such as mechanical critical speed and thrust limits.

Limitation on Thrust Output Example

The curve to the right shows that there is a maximum amount of thrust the actuator can put out continuously and peak. That is why the curve abruptly flattens out (horizontal line) at speeds less than 150 mm/sec. This curve shows that the motor can provide more input torque than the actuator can handle at speeds less than 150 mm/sec.

Note: In this example, the maximum allowable thrust is limited to 550 N. Exceeding that could potentially damage the actuator even if the motor limits are not exceeded.

HLD60 Single Rail/Internal Rollers
SM2316DT @ 48V, 2.5mm/rev



Limitation of Actuator's Speed Example

The curve to the right shows that at 500 mm/sec, the thrust abruptly goes to zero (the vertical line). This means that the actuator has a maximum carriage velocity of 500 mm/sec usually due to ball screw limitations.

Note: This speed limitation is mechanically based. It is possible to command a servo speed in excess of the Critical speed limits of the actuator. Doing so increases risk of damage and will shorten the life of the actuator.

VL-ST45 - SM2316D @ 48V, 6mm/rev lead ball screw