

SPRING FAILURE

Among the many advantages of **REXA**'s unique Electraulic technology is the capability of providing a simple, reliable and compact spring failure upon power loss. The spring failure option is an integral part of the actuator's design, yet still functions in a totally independent and virtually fail safe manner.

A normally open solenoid operates a zero leakage valve in a bypass port of the power module. As long as electrical power is present, the solenoid is energized and the actuator will operate in its normal control mode. Upon power loss, the bypass valve opens directly connecting both chambers of the hydraulic piston. The spring will now move the actuator stem to the selected failure position.

Applying to the Driven Device

Selection of the appropriate spring and actuator depends on the driven device. The forces or torques to seat, to unseat and to fully open the device must be known. The direction of these forces, either In Fail Direction (IFD) or Opposite Fail Direction (OFD) must also be specified.

The spring, which operates the driven device upon loss of power, is determined first (section A, charts I & II). The minimum size spring to supply the required force or torque should be selected. The size of the spring is reduced by installing the driven device in the flow direction that assists failure. The spring should always have sufficient output to overcome the estimated friction of the driven device.

The actuator must be checked to insure that its output (section B, charts I and II) is sufficient to compress the spring and move the driven device. When the actuator is compressing the spring, its output is reduced by the spring force or torque.

Standard Spring Ranges

The spring tables indicate the standard springs available for the linear and rotary actuators. Values shown as spring *end* are the maximum for the spring when fully extended at rated stroke. An output less than the maximum may be specified. In such cases, the spring *start* is decreased and more of the actuator output is available to move the driven device.

A spring's output may be increased on applications requiring less than the full rated stroke or 90° rotation. For instance, a spring *end* of 3000 lb could be achieved on an L4000-2HI actuator with one inch stroke.

Charts I and II provide a selection procedure to follow when applying springs to Rexa actuators. Although useful, not all valve types or categories could be covered by such a brief document. There is no shortcut to having an understanding of the force interaction between the driven device, spring and actuator.

Your local representative is available to assist in the proper selection of a **REXA** actuator with failure spring.

Standard Spring Ranges

Spring ranges have been selected to maximize the useful range for a given actuator output.

L and ML series Linear Actuators

(All forces in pounds)

Spring **CLOSES** Driven Device Upon Power Failure

MODEL	ACTUATOR		VALVE POSITION	SPRING			POWER TO CLOSE (includes spring assist)	POWER TO OPEN (against spring)
	OUTPUT (AO)	STROKE (INCHES)		OUTPUT AT RATED STROKE	RATE (LB/INCH)			
L2000-.75 ML2000-.75	2000	.75	closed open	<i>end</i> <i>start</i>	1025 1300	300	2975 3300	1025 700
L2000-2 ML2000-2	2000	2	closed open	<i>end</i> <i>start</i>	650 1300	300	2600 3300	1400 700
L2000-4 ML2000-4	2000	4	closed open	<i>end</i> <i>start</i>	500 1300	180	2460 3300	1540 700
L4000-.75 ML4000-.75	4000	.75	closed open	<i>end</i> <i>start</i>	1300 1550	195	5300 5550	2700 2450
L4000-2 ML4000-2	4000	2	closed open	<i>end</i> <i>start</i>	1050 1550	195	5050 5550	2950 2450
L4000-2HI ML4000-2HI	4000	2	closed open	<i>end</i> <i>start</i>	2500 3675	500	6500 7675	1500 325
L4000 - 4 ML4000-4	4000	4	closed open	<i>end</i> <i>start</i>	675 1550	195	4670 5550	3330 2450
L4000-4HI ML4000-4HI	4000	4	closed open	<i>end</i> <i>start</i>	1500 3675	500	5500 7675	2500 325
L10000-2 ML10000-2	10000	2	closed open	<i>end</i> <i>start</i>	850 2000	525	10750 12050	9250 7950
L10000-2HI ML10000-2HI	10000	2	closed open	<i>end</i> <i>start</i>	4500 5750	500	14500 15750	5500 4250
L10000-6 ML10000-6	10000	6	closed open	<i>end</i> <i>start</i>	2500 5750	500	12500 15750	7500 4250

Note: All thrusts in this table are for maximum strokes. On applications requiring less than full stroke, the spring *End* may be increased by the product of the spring rate times the difference between the rated and required strokes.

Spring *End*: Maximum spring force available to move stem at the fully extended spring position and rated actuator stroke. This value may be reduced for lower thrust applications. At strokes less than the maximum, the spring *End* may be increased by the spring rate times the reduced stroke. Actuator friction has been deducted from the spring output.

Spring *Start*: Spring force in the fully compressed condition at the selected *End* and rated stroke. Includes actuator friction.

$$\text{Start} = \text{End} + \text{actuator friction} + (\text{rate} \times \text{stroke})$$

Rate: Spring rate. Constant for the selected spring.

Friction for L & ML series:

2000	50 lb
4000	100 lb
10000	150 lb

Standard Spring Ranges

Spring ranges have been selected to maximize the useful range for a given actuator output.

L and ML series Linear Actuators

(All forces in pounds)

Spring OPENS Driven Device Upon Power Failure

MODEL	ACTUATOR		VALVE POSITION	SPRING			POWER TO CLOSE (against spring)	POWER TO OPEN (includes spring assist)
	OUTPUT (AO)	STROKE (INCHES)		OUTPUT AT RATED STROKE	RATE (LB/INCH)			
L2000-.75	2000	.75	open	<i>end</i>	1025	300	1025	2975
ML2000-.75			closed	<i>start</i>	1300			
L2000-2	2000	2	open	<i>end</i>	650	300	1400	2600
ML2000-2			closed	<i>start</i>	1300			
L2000-4	2000	4	open	<i>end</i>	500	180	1540	2460
ML2000-4			closed	<i>start</i>	1300			
L4000-.75	4000	.75	open	<i>end</i>	1300	195	2700	5300
ML4000-.75			closed	<i>start</i>	1550			
L4000-2	4000	2	open	<i>end</i>	1050	195	2950	5050
ML4000-2			closed	<i>start</i>	1550			
L4000-2HI	4000	2	open	<i>end</i>	2500	500	1500	6500
ML4000-2HI			closed	<i>start</i>	3675			
L4000 - 4	4000	4	open	<i>end</i>	675	195	3330	4670
ML4000-4			closed	<i>start</i>	1550			
L4000-4HI	4000	4	open	<i>end</i>	1500	500	2500	5500
ML4000-4HI			closed	<i>start</i>	3675			
L10000-2	10000	2	open	<i>end</i>	850	525	9250	10750
ML10000-2			closed	<i>start</i>	2000			
L10000-2HI	10000	2	open	<i>end</i>	4500	500	5500	14500
ML10000-2HI			closed	<i>start</i>	5750			
L10000-6	10000	6	open	<i>end</i>	2500	500	7500	12500
ML10000-6			closed	<i>start</i>	5750			

Note: All thrusts in this table are for maximum strokes. On applications requiring less than full stroke, the spring *End* may be increased by the product of the spring rate times the difference between the rated and required strokes.

Spring *End*: Maximum spring force available to move stem at the fully extended spring position and rated actuator stroke. This value may be reduced for lower thrust applications. At strokes less than the maximum, the spring *End* may be increased by the spring rate times the reduced stroke. Actuator friction has been deducted from the spring output.

Spring *Start*: Spring force in the fully compressed condition at the selected *End* and rated stroke. Includes actuator friction.

$$\text{Start} = \text{End} + \text{actuator friction} + (\text{rate} \times \text{stroke})$$

Rate: Spring rate. Constant for the selected spring.

Friction for L & ML series:

2000	50 lb
4000	100 lb
10000	150 lb

Standard Spring Ranges

Spring ranges have been selected to maximize the useful range for a given actuator output.

R and MR series Rotary Actuators

(Torques are in pound-inch)

Spring **CLOSES** Driven Device Upon Power Failure

MODEL	RATED OUTPUT (AO)	VALVE POSITION	SPRING OUTPUT		RATE @ 90° ROTATION	POWER TO CLOSE (includes spring)	POWER TO OPEN (against spring)
			<i>end</i>	<i>start</i>			
R600 MR600	600	closed	<i>end</i>	240	150	840	360
		open	<i>start</i>	390		990	210
R1200 MR1200	1200	closed	<i>end</i>	480	300	1680	720
		open	<i>start</i>	780		1980	420
R2500 MR2500	2500	closed	<i>end</i>	1000	625	3500	1500
		open	<i>start</i>	1625		4125	875
R5000 MR5000	5000	closed	<i>end</i>	2000	1250	7000	3000
		open	<i>start</i>	3250		8250	1750
R10000 MR10000	10000	closed	<i>end</i>	4000	2500	14000	6000
		open	<i>start</i>	6500		16500	3500
R20000 MR20000	20000	closed	<i>end</i>	8000	5000	28000	12000
		open	<i>start</i>	13000		33000	7000
R50000 MR50000	50000	closed	<i>end</i>	20000	12500	70000	30000
		open	<i>start</i>	32500		82500	17500
R100000 MR100000	100000	closed	<i>end</i>	40000	25000	140000	60000
		open	<i>start</i>	65000		165000	35000

Spring **OPENS** Driven Device Upon Power Failure

MODEL	RATED OUTPUT (AO)	VALVE POSITION	SPRING OUTPUT		RATE @ 90° ROTATION	POWER TO CLOSE (against spring)	POWER TO OPEN (includes spring)
			<i>end</i>	<i>start</i>			
R600 MR600	600	open	<i>end</i>	240	150	360	840
		closed	<i>start</i>	390		210	990
R1200 MR1200	1200	open	<i>end</i>	480	300	720	1680
		closed	<i>start</i>	780		420	1980
R2500 MR2500	2500	open	<i>end</i>	1000	625	1500	3500
		closed	<i>start</i>	1625		875	4125
R5000 MR5000	5000	open	<i>end</i>	2000	1250	3000	7000
		closed	<i>start</i>	3250		1750	8250
R10000 MR10000	10000	open	<i>end</i>	4000	2500	6000	14000
		closed	<i>start</i>	6500		3500	16500
R20000 MR20000	20000	open	<i>end</i>	8000	5000	12000	28000
		closed	<i>start</i>	13000		7000	33000
R50000 MR50000	50000	open	<i>end</i>	20000	12500	30000	70000
		closed	<i>start</i>	32500		17500	82500
R100000 MR100000	100000	open	<i>end</i>	40000	25000	60000	140000
		closed	<i>start</i>	65000		35000	165000

Note: All torques in this table are the maximum values for an actuator size. For rotations of less than 90°, the spring start is linearly

Spring **End**: Maximum spring torque available to rotate shaft at the fully extended spring position and 90° rotation. This value may be reduced for lower torque applications. At rotations less than 90°, the spring **End** may be increased by the spring rate times the reduced rotation divided by 90. Actuator friction has been deducted from the spring output.

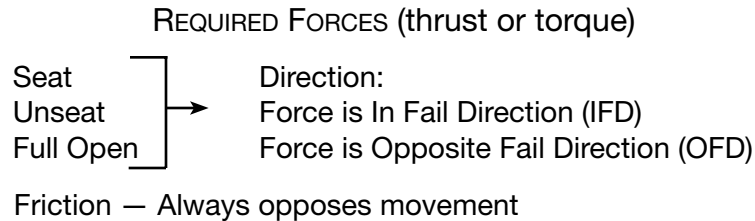
Spring **Start**: Spring force in the fully compressed condition at the selected **End** and 90° rotation.

Start = **End** + (rate @ required rotation)

Rate: Spring rate. Constant for the selected spring.

SPRING FAILURE

I. SPRING CLOSES DRIVEN DEVICE UPON POWER FAILURE



A. SPRING (select first)

1. Seated

Required forces are In Fail Direction (IFD).

Spring must only overcome friction.

➤ **End** > friction

Required forces are Opposite Fail Direction (OFD).

Spring must overcome driven device forces.

➤ **End** > seat force + friction

2. Full Open

Required forces are In Fail Direction (IFD).

Spring must only overcome friction.

➤ **Start** > friction

Required forces are Opposite Fail Direction (OFD).

Spring must overcome driven device forces.

➤ **Start** > full open force + friction

B. ACTUATOR (check output in direction to *open* the driven device)

1. Seated

Required forces are In Fail Direction (IFD).

Actuator must overcome spring and driven device forces.

➤ Rated Actuator Output (AO) > **End** + unseat force + friction

Required forces are Opposite Fail Direction (OFD).

Actuator must overcome spring and friction.

➤ Rated Actuator Output (AO) > **End** + friction

2. Full Open

Required forces are In Fail Direction (IFD).

Actuator must overcome spring and driven device forces.

➤ Rated Actuator Output (AO) > **Start** + full open force + friction

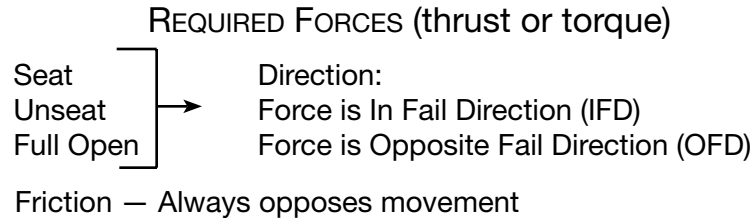
Required forces are Opposite Fail Direction (OFD).

Actuator must overcome spring and friction.

➤ Rated Actuator Output (AO) > **Start** + friction

SPRING FAILURE

II. SPRING OPENS DRIVEN DEVICE UPON POWER FAILURE



A. SPRING (select first)

1. Seated

Required forces are In Fail Direction (IFD).

Spring must only overcome friction.

➤ **Start** > friction

Required forces are Opposite Fail Direction (OFD).

Spring must overcome driven device forces.

➤ **Start** > unseat force + friction

2. Full Open

Required forces are In Fail Direction (IFD).

Spring must only overcome friction.

➤ **End** > friction

Required forces are Opposite Fail Direction (OFD).

Spring must overcome driven device forces.

➤ **End** > full open force + friction

B. ACTUATOR (check output in direction to *close* the driven device)

1. Seated

Required forces are In Fail Direction (IFD).

Actuator must overcome spring and driven device forces.

➤ Rated Actuator Output (AO) > **Start** + seat force + friction

Required forces are Opposite Fail Direction (OFD).

Actuator must overcome spring and friction.

➤ Rated Actuator Output (AO) > **Start** + friction

2. Full Open

Required forces are In Fail Direction (IFD).

Actuator must overcome spring and driven device forces.

➤ Rated Actuator Output (AO) > **End** + full open force + friction

Required forces are Opposite Fail Direction (OFD).

Actuator must overcome spring and friction.

➤ Rated Actuator Output (AO) > **End** + friction