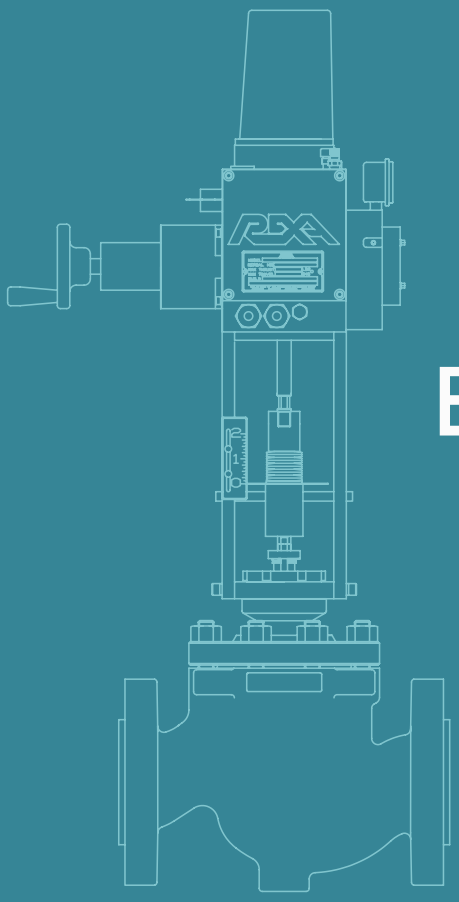


Electraulic™ Actuation

Xpac/Mpac

Rotary, Linear Actuators, and Drives

Manufactured by KOSO AMERICA, Inc.

ISO 9001:2000 Certified

Xpac Series

The REXA Xpac is a superior positioning device that is particularly well suited for applications requiring critical control and high reliability. The product is designed to thrive in the most hostile ambient environments and will harness control of the most severe process conditions. Our actuators and drives provide to final control elements capabilities to match the most sophisticated instrumentation and Distributed Control Systems.

Basic Components

There are two major components to the Xpac: the actuator, which mounts to the driven device, consists of the cylinder, feedback and Electraulic™ power module; and, the control enclosure, which is separately mounted, consists of the electronics and power supplies. The Electraulic™ power module is REXA's patented self-contained hydraulic pumping system that manages oil pressure and flow rates to and from a double acting cylinder. A dedicated microprocessor, the CPU, in the control enclosure operates the Xpac. This combination of mechanical, hydraulic and electronic technologies produces the state-of-the-art actuator design.

Standard Configurations

REXA offers as standard: linear actuators (L series) with thrusts ranging from 2 000 to 120 000 lb and strokes to six inches; rotary units (R series) with rotations up to 90 degrees and torques ranging from 600 to 400 000 lb·in; and drive configurations (D series) with torques up to 200 000 lb·in and rotations up to 120 degrees.

Custom crafted units can provide considerably greater thrust or torque and longer strokes or rotation. Drives with multi-million pound inch capabilities are available.

The Electraulic power module is available in B, C, ½D and D sizes. The different power modules provide various stroking speeds for a given cylinder size as well as enhanced frequency response. This approach to product configuration offers a high degree of commonality to reduce spare parts inventory.

Advantages

- **Controllability**—low deadband, immediate response, high stiffness, 100% modulating duty cycle
  The unit can respond to control signal changes as low as 0.05%.
- **Hydraulic stability**
  The process forces acting on the final control element will not move the Xpac.
- **Total electric operation**—self-contained, discrete movement, consistency of operation
  A single electrical power source supplied directly to the control enclosure operates all aspects of the Xpac. Remote pumps or hydraulic sources are not required. Low power consumption is inherent, with the motor only turning when repositioning is required.
- **Low maintenance**
  Few moving parts (most of which are immersed in high quality motor oil) and sealed construction eliminate the need for routine maintenance. Parts inventory and repairs are simplified through consistent and modular design.
- **Electronic calibration**
  Set-up is quick and simple with keypad calibration. There are no torque switches to adjust, potentiometers to turn, or dip switches to set.
- **Custom mounting**
  REXA's linear, rotary and drive configurations can be applied to virtually any installation.
- **Failure position**
  A known position upon loss of electrical power can be provided by either a mechanical spring or hydraulic accumulator.

Due to continuing design changes and improvements, all specifications are subject to change.

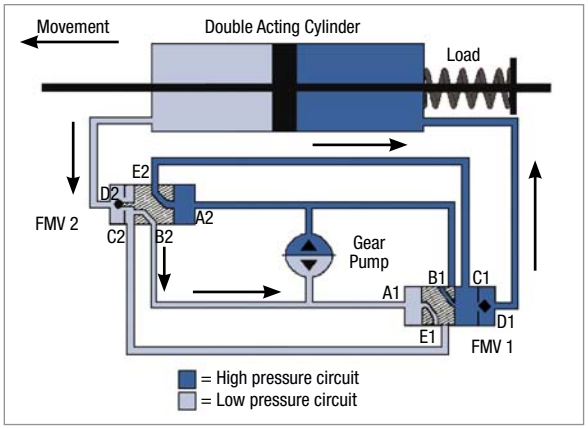
Operation

By using the stroke and signal ranges set during calibration, the Central Processing Unit (CPU) converts the control signal into a target position. The actual position is determined through the active feedback assembly mounted on the actuator. The difference between the target and actual position is the error. If the error exceeds the deadband (user set), then the CPU will initiate corrective action by starting the motor.

A reversible hydraulic pump, driven by the motor, can pressurize either side of a double acting cylinder through one of two Flow Matching Valves. Each FMV is comprised of a ported spool with an integral pilot operated check valve. The construction of both FMVs is identical.

To move the cylinder shaft to the left, the pump turns in the direction to pressurize FMV-2 through port A. The spool in FMV-2 becomes unbalanced by the pressure differential and moves to the left, opening port A to port E. The check valve is lifted by the spool pilot to allow cylinder backflow.

High pressure fluid flows through the check valve of FMV-1 in the normal direction and into the right side chamber of the cylinder. Since the hydraulic circuit is closed, the same amount of oil that flows into the right side of the piston must be extracted from the left side. This oil flows through the open check valve of FMV-2 and into pump suction via port B.



Hydraulic Schematic

By reversing the direction of pump rotation, the FMVs operate in reverse to move the cylinder shaft to the right. When the pump stops, both check valves close. The hydraulic oil is locked within the cylinder. Motor operation is not required to maintain position.

Applications

Any industry involved with process control will improve the bottom line by using Electraulic™ technology. Electric power generation, oil and gas pipelines, municipal water and wastewater head the list, but many others (paper, mining, refining/chemical, etc.) benefit also. Different applications present many challenges to valves and dampers. When control is the issue, you can rely on REXA.

Please refer to REXA's application memos for descriptions of typical installations.

Super-Critical
Start-Up Valving
- Boiler Throttle (BT)
- Boiler Extraction Valve (BE)
- Feedwater Bypass Valve (FWB)
- Spillover Valve (SP)
- Superheater Injection PRV (ISPR)
- Boiler Throttle Bypass (BTB)
- Water Drain Valve (WD)
- Steam Drain Valve (SD)
- Reheat Injection Valves (IR)
- Superheater Injection Valves (IS)
- Condensate Injector (IC)

Damper Control
- Auxiliary Air Damper
- Secondary Air Dampers
- Wind Box
- ID or FD Fans
- Scrubbers

Feedwater Regulators

Main FeedPump Recirculation
Deaerator Level Control
Attemperator Spray Valves
Burner Tilts
B&W's once through Boilers
BW (200, 201, 202, 207, etc.)
Steam Turbine Controls
- Main Steam Inlet Valve
- Steam Control Valve
- Reheat Steam Inlet Valve

Pressure Control
Flow Control
Pump Control
Filter Effluent Control
Inlet Guide Vane Control
Autoclave Discharge Isolation
Catalyst Slurry Isolation
Well Head Level Control
- GOSP
- Geothermal

Xpac Product Features and Options

The content of this brochure is in condensed format. Notations refer to specific product memos (PM), technical memos (TM), and application memos (ANP). Unabridged memos are in our sales catalog and on our Web site (WWW.REXA.COM); please refer to them for more detailed information.

Stroking Speed

An important selection criteria for any application is the speed of actuator motion. A technical memo lists the stroking speed for the different standard actuator sizes and power module combination. All speeds are at a 100% setting and may be lowered to 25% without affecting rated output. Speed can be adjusted in 1% steps.

Refer to TM1-2.

Power Consumption

The electrical power requirements of the Xpac series actuators can be divided into four system components:

1. The CPU (Central Processing Unit) continuously monitors the position of the actuator. [50 watts, continuous]
2. The motor operates only when the actuator moves to a new position. Various size power modules are available and the electrical power requirement varies accordingly. [150 watts–20 kilowatts, intermittent]
3. The oil heater is installed on all power modules with an ambient temperature below 50 °F (10 °C). [Standard; 150 watts for each power module, intermittent]
4. The spring failure solenoid which is only included on actuators with a fail-safe spring. [Standard, 30 watts continuous; optional, high capacity, 50 watts continuous]

Refer to TM2-2.

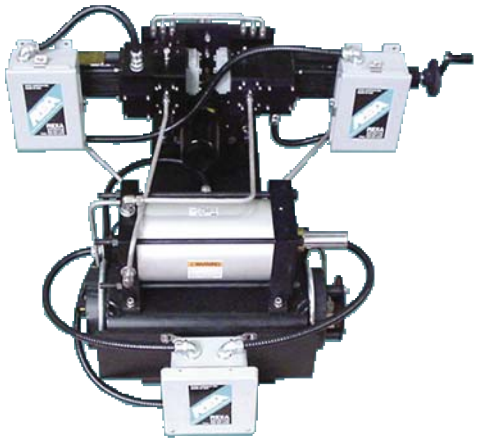
Temperature Guidelines

REXA actuators and drives are fluidic devices that use oil as an energy transfer medium. The standard oil (Castrol® Syntec SAE 5W-50) allows operation of the units over a wide ambient temperature range without additional equipment. Units have been in operation on power plant boiler fronts at temperatures in excess of 200 °F and on hydrocarbon pipelines in northern Canada and Alaska.

Refer to TM19-2.

Resolution and Deadband

Many factors determine an actuator's ability to provide stable and accurate positioning of the Final Control Element. Resolution is a measure of



an actuator's ability to follow small step changes. This is directly related to the actuator's deadband. The deadband of the REXA Xpac is adjustable down to 0.05%; which results in a resolution of <0.1%. This, combined with Repeatability of <0.1% and a Linearity capability of <0.05%, results in the REXA Xpac being the only actuator product line truly capable of matching the potential of modern control systems.

Refer to TM11 and the Theory of Operation.

Frequency Response

The frequency response indicates how a unit will react to small, constantly varying changes in signal (modulating). Based on testing, REXA rates the corner frequency for the B and C power modules, which use stepper motors, at 1.5 Hz. The ½D and D size power modules use a higher performing servo motor. These units exhibit a corner frequency in excess of 5 Hz.

Refer to TM11.

Spring Failure on Loss of Power

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.

Refer to PM4-2 - Spring Fail-Safe Option.

Position Transmitter

The position transmitter provides a two-wire 4-20 mA signal that is proportional to actuator position. A passive (requires external DC power supply) position transmitter is provided as a standard feature. An active (includes 24 Vdc power supply) position transmitter is also available.

Limit Switches

Limit switches provide a contact closure when an actuator or drive reaches a predetermined point in its stroke. The standard electrical enclosure includes two SPDT relays which can be used to indicate user defined stroke limits. Optionally available independent mechanical limit switches can be yoke or feedback housing mounted.

Refer to PM13-2 - Limit Switches.

Alarm Indicator

Two additional relays are provided as standard equipment and dedicated to operational indication. The Alarm relay will signal when the actuator is unable to follow the control signal for any reason. The Warning relay signals a condition that requires attention, but does not prevent normal operation of the unit.

Accumulator Failure System

REXA's unique accumulator technology uses the power module to automatically recharge the accumulator, thus eliminating the need for a separate recharge system. A failure may be initiated by loss of electrical power or an independent trip signal. After a failure the accumulator is recharged by the actuator's power module prior to resuming normal operation.

Refer to PM21-2 - Accumulator Option.

Manual Override

When electric power is unavailable, movement of REXA actuators or drives can be provided by a manual operator. Two types are available:

1. Handwheel/Drill Drive—declutchable, attached to the outboard end of the motor.
2. Manual Hydraulic Pump—connected to the cylinder side of the hydraulic circuit.

Both methods make use of the unit's hydraulic system.

Pulse Operating System

This unique operating system allows control of the Xpac via pulsed voltage signals. In most installations, the Xpac will directly replace an obsolete gear motor operator and eliminate the requirement of interposing relays or contactors.

Refer to PM16-2 - Pulse Operating System.

Ancillary Control

The touch pad mounted on the door of the control enclosure provides non-intrusive access for control and calibration of each unit. An additional manual control station may be located remote from the control enclosure.

Booster Pump Configuration

A dual pump operator utilizing a standard Xpac power module and a large capacity Booster Pump is available. The power module provides fine positioning, while a separate volume booster pump provides the speed. Duty cycle for the booster pump is low because it only responds to large position changes. The power module will make small changes in position. This dual pump operation allows REXA to extend its unique capabilities to large thrust or torque units with high-speed operation.

Refer to PM23-2 - Booster Pump Option.

Surge or Trip Control

The purpose of a surge or trip feature is to provide high speed motion in one direction to limit the effect of an infrequent process upset. This motion can be to an intermediate point (surge) or to the end of stroke (trip). The surge control package consists of three main components: mechanical spring, solenoid and solid state relay. An additional calibration parameter is included in the setup menu to allow user-defined surge or trip activation settings.

Environmental Ratings

The standard environmental rating for the electrical enclosure and actuator is NEMA 4. Optional electrical enclosures are available in either stainless steel or fiberglass to meet a NEMA 4X rating.

Hazardous Location Ratings

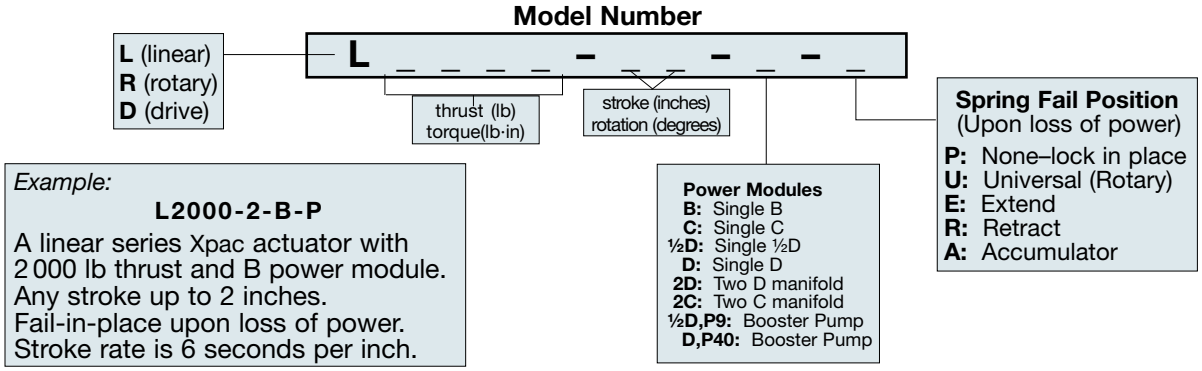
Due to the remote capability of the Xpac control enclosure, the actuator and enclosure are offered with several rating combinations to meet various installation requirements.

The standard construction for the actuator portion of an Xpac is rated by CSA for use in Class 1, Division 2, Groups B, C & D areas. The optional construction is rated for Class 1, Division 1, Groups B, C & D.

The electrical enclosure can be rated for Class 1, Division 2 Groups B, C & D. This may be combined with either Division 1 or Division 2 actuators. The optional enclosure rated for Class 1, Division 1, Groups B, C & D is only supplied with a Division 1 actuator.

Xpac Model Selection Guide

The model number provides a physical description of the mechanical portion of the actuator. The thrust or torque output, power modules and failure mode are described in this simple system. The stroke or rotation rate specifies the maximum speed of operation for a particular actuator and power module combination.



Typical Xpac Stroke & Rotation Times‡

Linear: Thrust 2 000-120 000 lb (8 896 N-533 786 N)
Stroke (in inches) .75, 2, 4, 6, 8, 11, 16, 22 (.02, .05, .10, .15, .20, .28, .40, .56 m)

Stroke Rate (seconds per inch stroke)

Thrust lb (N)	Power Module B	C	½D/2C	D	2D	½D,P9[2]	D,P40[2]	SF[1]	AF[3]
2 000 (8 896 N)	6	2	1	0.5	NA	NA	NA	0.6	<1.0
4 000 (17 790 N)	12	4	2	1	.5	NA	NA	1	<1.0
5 000 (22 240 N)	15	5	2.5	1.25	.6	.25	NA	1.25	<1.0
10 000 (44 480 N)	30	10	5	2.5	1.25	.5	CF	2.5	<1.0
15 000 (66 725 N)	NA	15	7.5	3.75	1.8	.75	CF	3.75	<1.0
20 000 (88 965 N)	NA	20	10	5	2.5	1	.25	5	<1.0
40 000 (177 928 N)	NA	NA	20	10	5	2	.5	10	<1.0
60 000 (266 893 N)	NA	NA	NA	15	7.5	3	.75	16	<1.0
80 000 (355 858 N)	NA	NA	NA	20	10	4	1	20	1.5
120 000 (533 786 N)	NA	NA	NA	30	15	6	1.5	30	2.0

Rotary and Drive*:
*Conventional drives are limited to 200 000 lb·in (22 597 N·m).
Larger drives are available with REXA's linear configurations.

Rotation Rate (seconds per 90° rotation)

Torque lb·in (N·m)	Power Module B	C	½D/2C	D	2D	½D,P9[2]	D,P40[2]	SF[1]	AF[3]
600 (68 N·m)	3.25	1.1	NA	NA	NA	NA	NA	<.5	<1.0
1 200 (136 N·m)	6.5	2.2	1.1	0.55	NA	NA	NA	.75	<1.0
2 500 (282 N·m)	13	4.5	2.25	1.1	.55	NA	NA	1.25	<1.0
5 000 (565 N·m)	26	9	4.5	2.25	1.1	NA	NA	2.5	<1.0
10 000 (1 130 N·m)	50	17	8.5	4	2	1	NA	5	<1.0
20 000 (2 260 N·m)	100	34	17	8	4	2	NA	10	<1.0
50 000 (5 650 N·m)	NA	85	43	22	11	4.5	1	20	1.5
100 000 (11 300 N·m)	NA	NA	85	43	22	8.5	2	40	3.0
200 000 (22 597 N·m)*	NA	NA	NA	85	43	17	4	80	6.0
400 000 (45 194 N·m)*	NA	NA	NA	170	85	34	8	160	12.0

‡ The stroke or rotation rate specifies the typical maximum speed of operation for a particular actuator and power module combination in a standard setup.

In most installations, these speeds may be reduced by a factor of four without affecting the rated output.

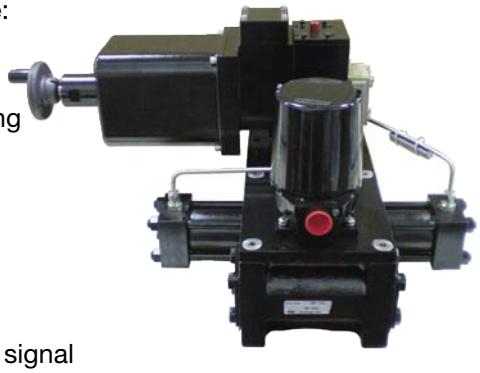
[1] SF - Spring Failure. Estimated time is for the standard solenoid and spring. The actual times may vary based on spring force and temperature. Faster times are available.

[2] ½D,P9 and D,P40. Booster pumps provide high speed operation, while maintaining our fine positioning capability. Quoted times are 98% of full travel. *(Refer to PM23 - Booster Pump Configuration.)*

[3] AF - Accumulator Failure. Estimated time will vary with ambient temperature. An adjustable fail speed limiter is available. Consult factory for details.

Mpac Series

The Mpac is ideal for many routine applications where resolution and response requirements are not demanding. Field wiring is direct to the actuator and consists only of electrical power, control signal and position information (if required). As a full-featured, self-contained electraulic actuator and drive, the standard Mpac provides various input and output capabilities which include:



Inputs

1. Analog – 4-20 mA control signal
2. Manual – two contact input; open/close with intermediate positioning
3. Two Position – single contact input; open/close to endpoints
4. External Operation – pushbutton stroke control
5. Declutchable hand wheel – uses the unit's hydraulic system

Outputs

1. Position Transmitter – 4-20 mA
2. Limit Switches – electronic; end-of-travel only
3. Alarm Relay – signifies when the unit is unable to follow the control signal

Linear (ML series), rotary (MR series), or drive (MD series) are available to fit virtually any installation.

Typical Mpac Stroke & Rotation Times‡

ML - Linear
Stroke Rate (seconds per inch stroke)

Thrust lb (N)	B	Power Module C[2]	2C[2]	SF[1]
2 000 (8 896 N)	4.5	NA	NA	0.5
4 000 (17 793 N)	9	3	NA	1
10 000 (44 482 N	22	7.5	4	2.5
20 000 (88 964 N)	44	15	7.5	5

MR & MD - Rotary & Drive
Rotation Rate (seconds per 90° rotation)

Torque lb·in (N·m)	B	Power Module C[2]	2C[2]	SF[1]
600 (68 N·m)	2.5	NA	NA	NA
1 200 (136 N·m)	5	NA	NA	0.55
2 500 (282 N·m	10	NA	NA	1.1
5 000 (565 N·m)	20	6.5	NA	2.25
10 000 (1 130 N·m)	40	13	6.5	4
20 000 (2 260 N·m)	80	26	13	8
50 000 (5 650 N·m)	NA	60	30	22
100 000 (11 300 N·m	NA	120	60	43
200 000 (22 597 N·m)	NA	240	120	85
400 000 (45 194 N·m)	NA	NA	240	170

‡ The stroke or rotation rate specifies the typical maximum speed of operation for a particular actuator and power module combination in a standard setup.

[1] SF - Spring Failure. Estimated time is for the standard solenoid and spring. The actual times may vary based on spring force and temperature. Faster times are available.

[2] The C size power modules have a start up delay. Please add one second to the total stroke time.

Estimated times are calculated at 70 °F (21 °C).

Options

Fail Open or Closed (upon loss of power)
A spring and normally open solenoid can be added to the Mpac to provide a failure position upon loss of electrical power.

Separate Electronics
For installations that subject the actuator to aggressive environments such as excessive temperature, vibration or shock, the control compartment may be separated from the power module up to 100 feet.

Remote Controls
To allow operation of the Mpac from a remote location, a manual station is available. REXA offers two types of manual stations:
DX - pushbuttons plus position indication;
BB - pushbutton only
A manual station can also be supplied by the user.

Mechanical Limit Switches
Independent mechanical switch - yoke or feedback housing mounted - 2 or 4 SPDT.

Common Mpac Applications:

Sludge Line to Filter Press, Influent Valve, Backwash Valve, Air Scour Valve, Altitude Valve

Due to continuing design changes and improvements, all specifications are subject to change.

REXA Xpac/Mpac Specifications

		Xpac		Mpac		
Output:✣ **Linear** **Rotary** **Drive**		2 000 lbf–120 000 lbf (8 896 N–533 786 N) 600 lbf·in–400 000 lbf·in (68 N·m–45 194 N·m) 600 lbf·in–200 000 lbf·in (68 N·m–22 597 N·m)		2 000 lbf–20 000 lbf (8 896 N–88 964 N) 600 lbf·in–400 000 lbf·in (68 N·m–45 194 N·m) 600 lbf·in–200 000 lbf·in (68 N·m–22 597 N·m)		
Control Signal		Analog: 4–20 mA (STD) Pulse: 24–120 Vac or Vdc Digital: 4–20 mA HART or FOUNDATION Fieldbus™		Analog: 4–20 mA Single input 24–120 Vac or Vdc, dry contact		
Deadband		Adjustable from 5% to 0.05%		Within 2%		
Failure Mode		Fail-in-place (STD); Spring or Accumulator for fail open/closed (OPT))		Spring, Fail-in-place open or closed (STD)		
Type		Self-contained, Electraulic		Self-contained, Electraulic		
Materials of Construction		Anodized aluminum (Electraulic module), anodized aluminum and steel (rack and pinion cylinder), steel or iron (D series mounting base)		Anodized aluminum (power module, rotary feedback housing and ML series cylinder), iron and steel (ML, MR and MD series cylinders and MD mounting base)		
Environmental Rating		NEMA 4 (STD); NEMA 4X (OPT)		NEMA 4 (STD); NEMA 4X (OPT)		
Hazardous Location Rating		CSA approved Cl I, Div 2, grps B, C, & D (OPT) CSA approved Cl I, Div 1, grps B, C, & D (OPT)		CSA approved Cl I, Div 2, grps B, C, & D (OPT)		
Temperature Range	**Actuator**	**Linear:** -30 °F‡ to +200 °F (-34 °C to 93 °C) , optional to 250°F (121 °C) **Rotary & drive:** -10 °F‡ to +200 °F (-23 °C to 93 °C), optional to 250 °F (121 °C)		-10 °F to +140 °F* (-29 °C to +60 °C)		
	Electronics	-40 °F to +140 °F (-40 °C to +60 °C)	-40 °F to +120 °F (-40 °C to +49 °C)	-40 °F to +130 °F (-40 °C to +54 °C)		
Motor		Stepping type (B & C)	Servo Type (½D–D)	115 Vac–induction, limited to 20 cycles per minute		
Electronics		Separate Control Enclosure with CPU, motor driver, power supply, transient protection and termination.		Actuator mounted, self-contained, digital. Solid state motor relays. Remote mount optional.		
Feedback		**Linear:** thin film potentiometer (50×10^6 cycles) / non-contacting potentiometer [dependent on stroke length and temperature] **Rotary:** non-contacting potentiometer [Standard] thin film potentiometer (10×10^6 cycles) [High Temp.]		**Linear:** thin film potentiometer (50×10^6 cycles) **Rotary:** thin film potentiometer (10×10^6 cycles)		
Motor Type		**Stepper**		**Servo**		B	C	2C
Motor Designation		**B**	**C**	**½D**	**D**			
Power Requirements†	**12 Vdc**	OPT	CF	CF	—	115 Vac–4 amp	115 Vac–12 amp	115 Vac–24 amp
	24 Vdc	OPT	CF	CF	—			
	48 Vdc	OPT	CF	CF	—			
	120 Vac	STD	STD	STD	OPT			
	208 Vac	OPT	OPT	OPT	OPT			
	240 Vac	OPT	OPT	OPT	STD			
	480 Vac	OPT	OPT	OPT	OPT			

✣ *Contact the factory for information on additional capacity.*

‡ *Lower temperature range requires supplemental thermal blanketing (not supplied).*

* *Higher temperature range with separate electronics.*

† *Optional power voltages may require separate transformers.*
Check with factory about Booster Pumps, Accumulators, and other options.

REXA is continually improving the design of its products. As such, specifications are subject to change.

10/08

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