

Quadra-Powr® X Spring Diaphragm Actuators

Installation, Maintenance and
Operating Instructions

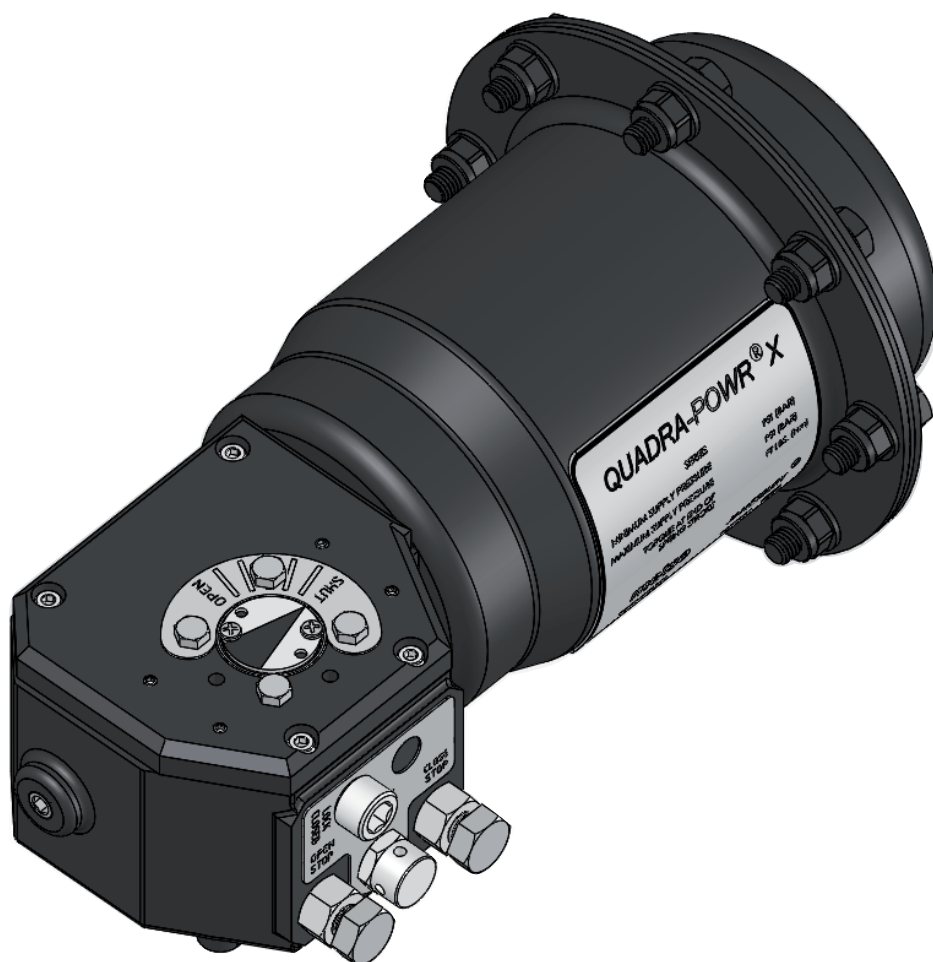


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READ THESE INSTRUCTIONS FIRST!

These instructions provide information about safe handling and operation of the actuator.

If you require additional assistance, please contact the manufacturer or manufacturer's representative.

Addresses and phone numbers are printed on the back cover.

SAVE THESE INSTRUCTIONS!

Subject to change without notice.

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1 GENERAL

This instruction manual contains important information regarding the installation, operation and troubleshooting of *Quadra-Powr X* Spring-Diaphragm Actuators.

This unique spring-diaphragm actuator designed for rotary valves provides safe, smooth and reliable valve actuation at minimal pressures and up to 100 psi (6.9 BAR).

Please read these instructions carefully and save them for further reference.

Table 1

Handling <i>Quadra-Powr X</i> Actuators	
Actuator Series	Approx. Weight kg (Lb.)
QPX1	12 (26)
QPX2	18 (39)
QPX3	30 (65)
QPX4	48 (105)
QPX5	94 (205)

1.1 WARNING

KEEP HANDS AND CLOTHING AWAY FROM THE VALVE PORTS AT ALL TIMES.

DO NOT ATTEMPT TO DISASSEMBLE THE SPRING CARTRIDGE. DISASSEMBLY OF THE SPRING PACKAGE MAY RESULT IN SERIOUS PERSONAL INJURY. IF MAINTENANCE IS REQUIRED, THE ENTIRE ACTUATOR MUST BE RETURNED TO METSO.

SHUT-OFF AND BLEED ALL SUPPLY LINES BEFORE INSTALLATION OR SERVICING. DO NOT REMOVE DIAPHRAGM CASING HEX HEAD SCREWS (27), NUTS (29) OR DIAPHRAGM CASING (15) WHILE ACTUATOR IS PRESSURIZED.

BEFORE INSTALLING THE VALVE AND ACTUATOR, BE SURE THAT THE INDICATOR POINTER ON TOP OF THE ACTUATOR (AND THE IDENTIFICATION PLATE IN FEMALE ACTUATORS) ARE CORRECTLY INDICATING THE VALVE POSITION. FAILURE TO ASSEMBLE THESE PRODUCTS TO INDICATE THE CORRECT VALVE POSITION COULD RESULT IN PERSONAL INJURY.

AN ACTUATOR MUST BE SIZED ACCURATELY FOR PROPER OPERATION. REFER TO INFORMATION ON ACTUATOR END OF STROKE TORQUES AND THE APPROPRIATE VALVE BULLETIN FOR OPERATING TORQUES.

WHEN SERVICING A VALVE ACTUATOR ASSEMBLY, THE BEST PRACTICE IS TO REMOVE THE ENTIRE ASSEMBLY FROM SERVICE. IF THE ACTUATOR IS REMOVED FROM THE VALVE, IT SHOULD BE REMOUNTED ON THAT SAME VALVE AFTER SERVICING IS COMPLETED. THE ACTUATOR MUST BE READJUSTED FOR PROPER OPEN AND CLOSE POSITION EACH TIME IT IS REMOUNTED.

ACTUATORS ARE NOT TO BE LIFTED USING THE 3/8" NPT IN THE DIAPHRAGM CASING. HANDLING OF THE ACTUATOR IS ACCOMPLISHED BY USING LIFTING STRAPS. SEE SECTION 1.2.

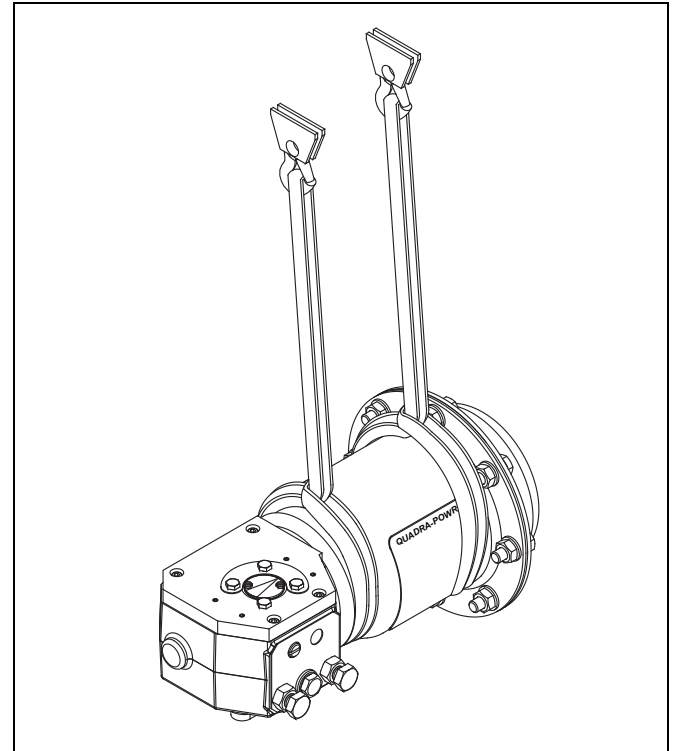


Figure 1

1.2 Handling *Quadra-Powr X* Actuators

Handling of the actuator is to be accomplished by using lifting straps. (See Table 1) for approximate actuator weights. Follow (Figure 1) for proper strap lifting technique.

2 INSTALLATION

1. Check to see that the position indicator on the actuator is assembled correctly for the desired failure mode, either spring-to-close or spring-to-open. In the spring-to-close mode, the actuator will cycle clockwise to close upon loss of pressure. In the spring-to-open mode, the actuator will cycle counterclockwise to open upon loss of pressure.
2. If the actuator is not set up in the configuration desired, remove the four hex head screws (33), indicator plate (12), indicator pointer (24), and remount them on the opposite mounting surface. In the female actuators, the fastener identification plate shows the failure mode of the actuator.

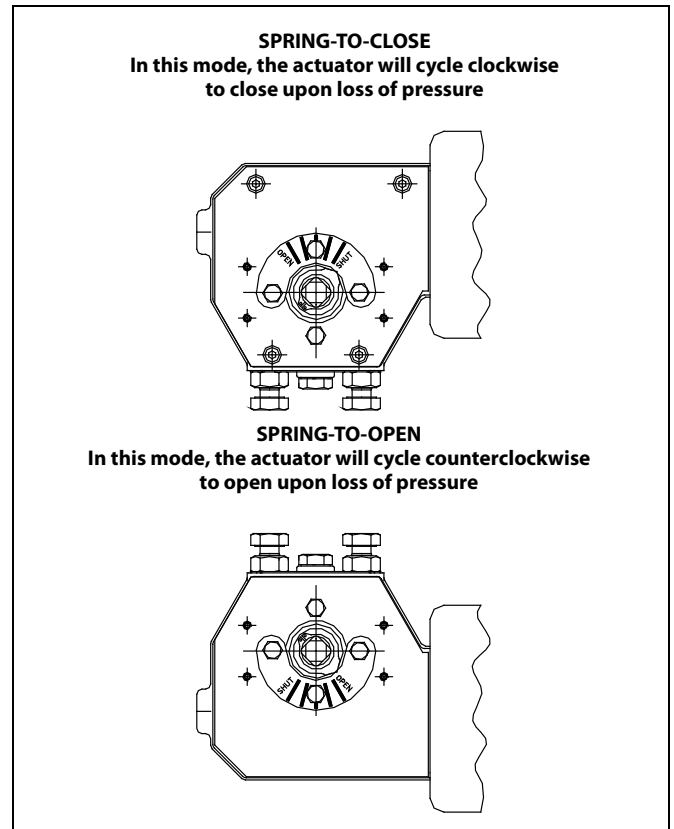


Figure 2

- Mount the actuator to the valve following the directions in the AMI (Actuator Mounting Instructions) or valve IMO.
- Connect a regulated air supply to the 3/8" NPT fitting in the diaphragm casing (15). **CAUTION:** The maximum operating pressure is 100 psi (6.9 BAR).
- Adjust the stop screws (19) by releasing the jam nut (23) and turning. Stops can only be adjusted when driver arm (3) is off the stop screws being adjusted. (Maximum rotation adjustment $\pm 5^\circ$.) Be sure to retighten jam nut (23).

2.1 Operation

The operating pressure, output torque and drive type is determined by the actuator designation. Maximum operating pressure is 100 psi (6.9 BAR). (See **Table 2**)

Actuator designation example: QPX4C/K40 is a series QPX4 spring diaphragm actuator that has a 60 psi (4.1 BAR) spring, an end of air pressure stroke output torque of 200 FT•LBS (272 N•m) and uses a 40 mm female key to drive the valve.

Before operating make sure all tapped holes in the body which are not being used are resealed with fasteners.

3 MAINTENANCE

Although Metso's Jamesbury actuators are designed to work under severe conditions, proper preventative maintenance can significantly help to prevent unplanned downtime and in real terms reduce the total cost of ownership. Metso recommends inspecting actuators at least every five (5) years. The inspection and maintenance frequency depends on the actual application and process condition.

Before working on a Quadra-Powr X actuator, note that all fasteners except socket head shoulder screw (8) and hex head cap screw (88, on QPX4 & QPX5) are metric.

Table 2

Actuator Series	Spring Version	Operating Pressure in psi (BAR)	End of Spring Stroke Torque in FT•LBS (N•m)	Drive Type
QPX1	C	60 (4.1)	25 (34)	K15 - 15 mm Keyed M - 9/16" Square
QPX2	A**	20* (1.4)	11 (15)	
	B	40 (2.8)	38 (52)	K20 - 20 mm Keyed M - 9/16" Square
	C	60 (4.1)	57 (77)	
	D	80 (5.5)	74 (100)	
QPX3	A	20* (1.4)	26 (35)	K35 - 35 mm Keyed M - 3/4" Square
	B	40 (2.8)	76 (103)	
	C	60 (4.1)	114 (155)	
	D	80 (5.5)	146 (198)	
QPX4	B	40 (2.8)	153 (207)	K40 - 40 mm Keyed M - 1" Square
	C	60 (4.1)	229 (310)	
	D	80 (5.5)	294 (399)	
QPX5	B	40 (2.8)	305 (414)	K40 - 40 mm Keyed M - 1" Square
	C	60 (4.1)	458 (621)	
	D	80 (5.5)	587 (796)	

* For Direct Control Application
 ** QPX2A only available with QPX1 drive type options.

Under normal operating conditions the actuator requires only periodic observation to ensure proper adjustment. Standard replacement of "soft" parts in *Quadra-Powr* II actuators consists of items numbered 6, 14, 31, 62 and 64. See **REPAIR KITS/SPARE PARTS** Section.

- When replacing the diaphragm use caution and be sure the air supply is disconnected. Back off nuts (29) from the hex head screws (27), holding the diaphragm casing and spring housing together until the nuts are flush with the hex head screw ends. Do not remove the nuts completely from the hex head screws. If tension still exists on the hex head screws, then the spring package is not properly contained. Stop disassembly: retighten nuts and return the actuator to the factory. If the spring package proves to be intact remove the nuts (29) and remove the hex head screws (27).
- Lift off diaphragm casing (15). Remove hex head cap screw (88) and retaining washer (89). Remove diaphragm (14).
- Inspect the inside of both the diaphragm casing (15) and the spring housing (32) for any rough spots or foreign matter which may cause abrasion to the diaphragm.
- Place the new diaphragm (14) on the diaphragm retainer (10). Do not pinch or stretch the diaphragm. Attach with washer (89) and cap screw (88). Tighten to value in (**Table 3**) keeping spring housing (32) holes aligned with diaphragm (14) holes. Place the diaphragm casing (15) on the spring housing (32) and line up all the holes.
- Insert hex head screws (27) in all holes. Do not force the hex head screws through the diaphragm. Install nuts (29) on screws and tighten uniformly using the standard practice of tightening diametrically opposite bolts in sequence with the torque requirements from (**Table 3**).

3.1 Disassembly

When disassembly of the actuator is required for maintenance, remove the actuator to a clean well lit area. Handling of the actuator is accomplished by using lifting straps. See Section 1.2.

Prior to disassembling the actuator, obtain the following tools: two (2) M10 wrenches, preferably one being a ratchet, one (1) hex (Allen) wrench, 3 mm for QPX1, 5 mm for QPX2, 3 and 4, 6 mm for QPX5, one (1) screwdriver, one (1) plastic faced mallet.

- Remove the cover (5) by removing six (four on QPX1) socket cap screws (21). If the cover cannot be removed, tap it with a plastic hammer to break the adhesion of the paint between the body and cover joint.
- Use air pressure to remove spring preload by partially stroking the actuator. If the diaphragm (14) is ruptured, replace as instructed in the previous section.
- To remove the socket shoulder screw (8) (or socket cap screw in QPX1) that holds the clevis (7) to the driver arm (3), first apply some heat to the lower arm to loosen the Loctite® on threads of the socket shoulder screw.

4. Slowly increase air pressure until the driver arm (3) moves slightly off the stop screw (19). Remove the socket shoulder screw (8).
5. Slowly relieve the air pressure in the actuator. The clevis (7) should be set against the spring retainer (30), and positioned symmetrically about the slot in the spring housing.
6. Shut off and bleed the air pressure to zero. Disconnect the air lines.
7. Remove the hex head screws (27) and hex nuts (29) holding the diaphragm casing and spring housing together.
8. Lift off diaphragm casing (15), remove hex head cap screw (88), washer (89) and diaphragm (14). Inspect the diaphragm for signs of wear, rupture or mechanical damage.
9. Inspect the inside of both the diaphragm casing and spring housing, as well as the outside of the diaphragm retainer for any rough spots or foreign matter which may cause abrasion of the diaphragm.
10. Lift the entire spring cartridge out of the unit

WARNING: DISASSEMBLY OF THE SPRING PACKAGE SHOULD NOT BE ATTEMPTED. SPECIAL EQUIPMENT IS REQUIRED. DISASSEMBLY OF THE SPRING PACKAGE MAY RESULT IN SERIOUS PERSONAL INJURY. IF MAINTENANCE IS REQUIRED SHIP THE ENTIRE ACTUATOR TO METSO.

It is usually not necessary to remove the spring housing (32) from the body (1). However, if removal is required, heat must be used to loosen the Loctite®. When reassembling, the information in (Table 1), torque and Loctite® recommendations must be met. All fasteners should use Loctite® 271 on the threads. Inspect and clean all components.

Good practice dictates that all bearings should be removed and replaced. See the **SERVICE KIT** section 5 of this IMO for the proper actuator series repair kit number.

3.2 Assembly

To aid assembly, spread light oil or grease on the outside diameter of the new bearings.

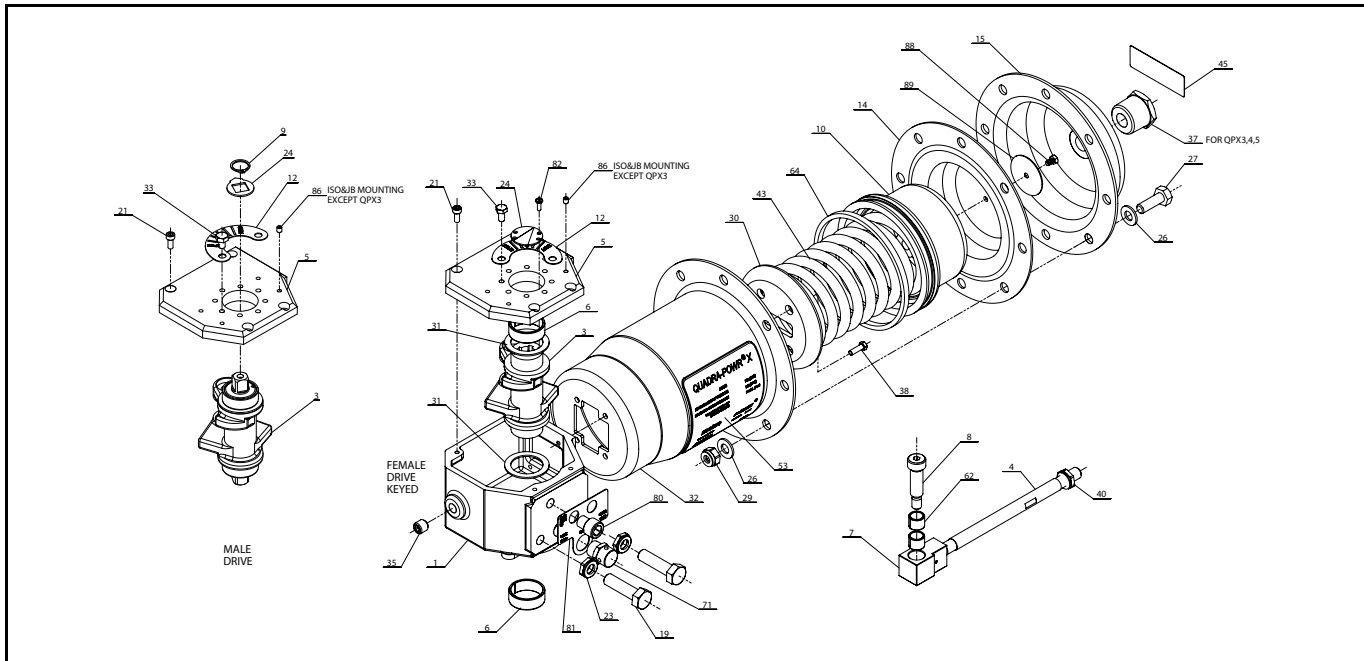
1. Press driver arm bearings (6) into the body (1) and covers (5). This is best done in an arbor press, but a vise could be used if care is taken not to damage the bearing. Driver arm bearings are to be pressed in until they are flush or 0.015 in. (0.38 mm) below the body counterbore or the inside cover surface. Press clevis bearings (62) into the clevis (7).
2. Apply lubricant, MOLYKOTE® GN grease on shoulder screw (8) barrel prior to assembly. Also, apply MOLYKOTE® GN grease to driver arm bearings (6).
3. Place the thrust bearing (31) into the counterbore in the body of QPX1-QPX5 actuators. Slide the other thrust bearing onto the trunnion of the driver arm (3). Place the driver in the body.

4. Spring housing (32), diaphragm retainer (10) and springs shall be lubricated with Kendall L-427 Super Blu® or Mobilgrease™ XHP 222. Lower the spring cartridge into the spring housing (32). Make sure that the spring package is not resting on the hex head cap screws (38) which hold the spring housing and body together. If bearing (64) has separated from diaphragm retainer (10), hold in place while lowering spring cartridge into housing.
5. Place the new diaphragm (14) on the diaphragm plate. Attach diaphragm (14) to diaphragm retainer (10) using washer (89) and hex head cap screw (88). Torque to the value specified in (Table 3).
6. Insert the hex head bolt (27) in all holes. Do not force the bolts through the diaphragm. Install nuts (29) and tighten uniformly using the standard practice of tightening diametrically opposite bolts in sequence. Follow (Table 3) for tightening torques.
7. Connect a regulated air supply to the pressure port and slowly increase the air pressure until the holes in the clevis and driver arm are aligned. Turn clevis a few degrees, if required, to align holes.
8. Apply Loctite® 271 on the threads of the shoulder screw. Insert it through the driver arm and clevis. Tighten per (Table 3).
9. Slowly release air pressure. Assemble cover by using the socket head screws (21). Apply tightening torque per (Table 3).
10. Install the indicator pointer (24) if this was previously disassembled. In female actuators make certain that the indicator points to the inscribed line in the driver arm. In male actuators, hold the indicator pointer in place with a retaining ring (9). **NOTE:** Refer to Installation instructions for spring-to-close or spring-to-open configuration.

Table 3

Torque Requirements					
Required Tightening Torques In FT•LBS (N•m) For Various Fasteners					
	QPX1	QPX2	QPX3	QPX4	QPX5
Nuts for Hex Head Screws through Diaphragm Casing (29)	24 (32)	24 (32)	24 (32)	24 (32)	24 (32)
Socket Head Cover Screws (21)	4 (5)	6 (8)	6 (8)	6 (8)	15 (20)
Socket Head Shoulder Screw (8)	35 (48)	55 (75)	132 (179)	132 (179)	132 (179)
Nuts on Actuator Rod (74)	55 (74)	55 (75)	88 (119)	132 (176)	176 (239)
Hex Head Screws between Body and Spring Housing (38)	5 (7)	18 (24)	30 (40)	30 (40)	55 (75)
Hex Head Cap Screws for Attaching Diaphragm to Diaphragm Retainer (88)	19 IN•LBS (1)	19 IN•LBS (1)	27 IN•LBS (2)	10 FT•LBS (14)	17 FT•LBS (23)

3.3 PARTS LIST AND BILL OF MATERIALS



Bills Of Materials And Parts

ITEM NO.	PART DESCRIPTION	QPX1	QPX2	QPX3	QPX4	QPX5
1	Driver housing	1	1	1	1	1
3	Driver arm	1	1	1	1	1
4	Actuator rod	1	1	1	1	1
5	Cover	1	1	1	1	1
6	Driver arm bearing	2	2	2	2	2
7	Clevis	1	1	1	1	1
8	Shoulder screw	1	1	1	1	1
9	Retaining ring*	1	1	1	1	1
10	Diaphragm retainer	1	1	1	1	1
12	Indicator plate	1	1	1	1	1
14	Diaphragm with centering hole	1	1	1	1	1
15	Diaphragm casing	1	1	1	1	1
19	Hex head cap screw	2	2	2	2	2
21	Socket head cap screw	4	4 or 6	6	6	6
23	Hex Jam Nut	2	2	2	2	2
24	Indicator pointer	1	1	1	1	1
26	Washer	16	24	24	32	48
27	Hex head cap screw	8	12	12	16	24
29	Nylon insert lock nut	8	12	12	16	24
30	Spring retainer	1	1	1	1	1
31	Thrust bearing	2	2	2	2	2
32	Spring housing	1	1	1	1	1
33	Hex head cap screw	4	4	4	4	4
35	Set screw	1	1	1	1	1
37	NTP adapter	N/A	N/A	1	1	1
38	Hex head cap screw	4	4	6	10	10
40	Hex Jam Nut	1	1	1	1	1
43	Compression Spring	1	1	1	1	1
45	Attention plate	1	1	1	1	1
53	Identification tag	1	1	1	1	1
62	Clevis bearing	2	2	2	2	2
64	Bearing, diaphragm retainer	1	1	1	1	1
71	Breather	1	1	1	1	1
80	Hex Head Cap Screw	1	1	1	1	1
81	Name plate	1	1	1	1	1
82	Screw **	2	2	2	2	2
86	Socket set screw**	8	8	8	8	8
88	Hex head cap screw	1	1	1	1	1
89	Diaphragm washer	1	1	1	1	1

*MALE ACTUATORS ONLY.

**FEMALE ACTUATORS ONLY.

4 ACCESSORIES

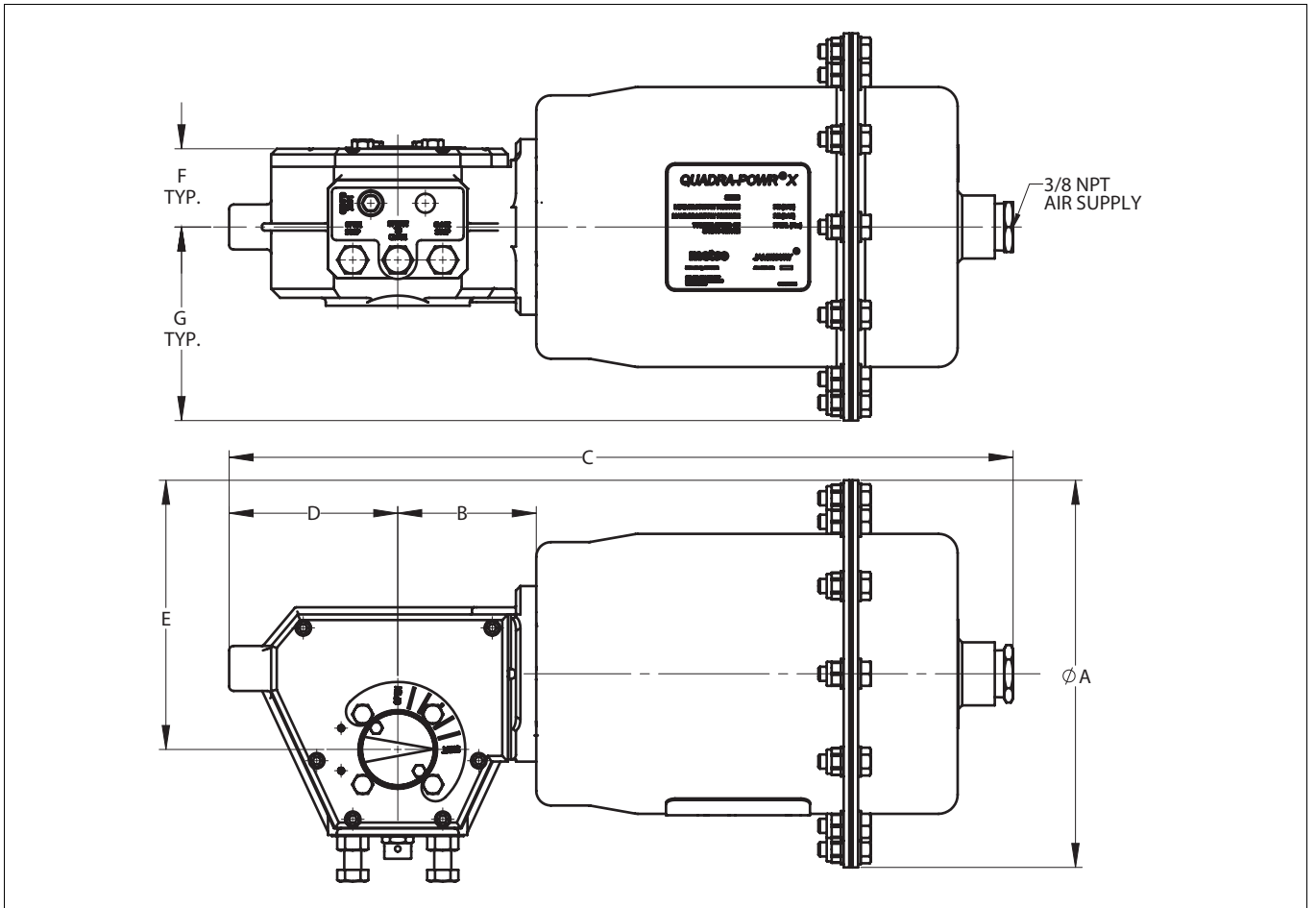
Quadra-Powr X actuators can be locked in the spring uncompressed mode. Refer to IMO-30 for more information.

Quadra-Powr X actuators are designed with one or two accessory mounting pads; ISO and Metso's Jamesbury standard. Refer to Figure "5". Consult Metso's Jamesbury linkage manual for accessory linkage kits.

5 REPAIR KITS/SPARE PARTS

SERVICE KITS		
Model	Complete	Diaphragm
QPX1 Actuator	RKQ-68	RKQ-75
QPX2 Actuator	RKQ-70	RKQ-76
QPX3 Actuator	RKQ-71	RKQ-77
QPX4 Actuator	RKQ-72	RKQ-78
QPX5 Actuator	RKQ-73	RKQ-79

For further information on spare parts and service or assistance visit our web-site at www.metso.com/valves.

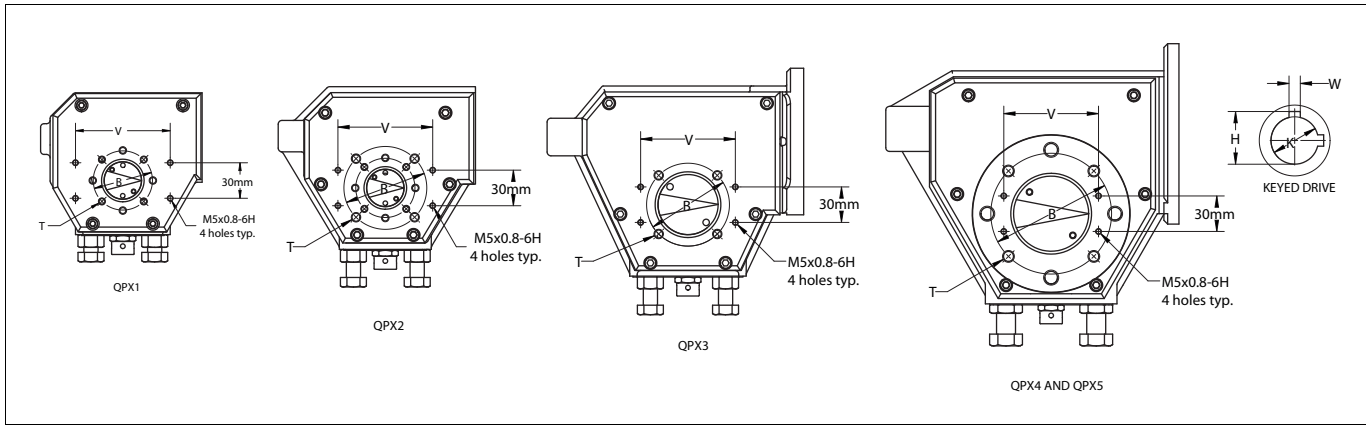


Actuator	Approximate dimensions - mm								Approx. weight kg
	A	B	C	D	E	F K drive	F M drive	G	
QPX1	197	67	360	70	135	49	49	99	12
QPX2	228	75	430	91	156	52	52	114	18
QPX3	274	98	553	119	190	56	56	137	30
QPX4	320	108	621	140	228	62	62	160	48
QPX5	382	130	754	160	276	77	77	191	94

Actuator	Approximate dimensions - inches								Approx. weight lb.
	A	B	C	D	E	F K drive	F M drive	G	
QPX1	7.75	2.64	14.17	2.76	5.31	1.93	1.93	3.88	26
QPX2	8.98	3.00	16.93	3.58	6.14	2.05	2.05	4.49	39
QPX3	10.79	3.85	21.77	4.69	7.48	2.20	2.20	5.39	65
QPX4	12.60	4.25	24.45	5.51	8.98	2.44	2.44	6.30	105
QPX5	15.04	5.13	29.69	6.30	10.87	3.03	3.03	7.52	205

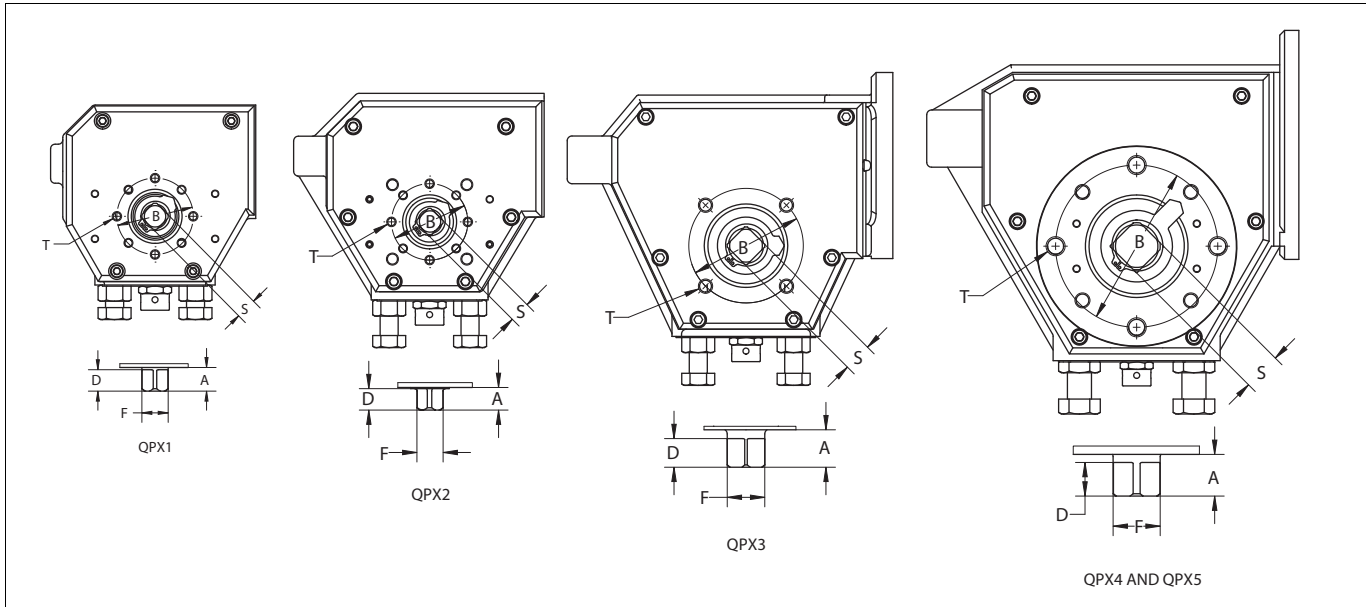
6 MOUNTING DIMENSIONS

KEYWAY



Approximate dimensions								
Actuator	Actuator/accessory mounting dimensions			Key dimensions				
	B	T	V	K	H		W	
	Bolt circle mm	Thread size	Namur/ VDI/VDE 3845	Key diameter mm	mm	inches	mm	inches
QPX1, QPX2A	50	M6	80	15	17	0.67	4.8	0.19
QPX2 (not QPX2A)	70	M8	80	20	23	0.89	4.8	0.19
QPX3	70	M8	80	35	40	1.56	9.6	0.38
QPX4	102	M10	80	40	45	1.75	9.6	0.38
QPX5	125	M12	80	40	45	1.75	9.6	0.38

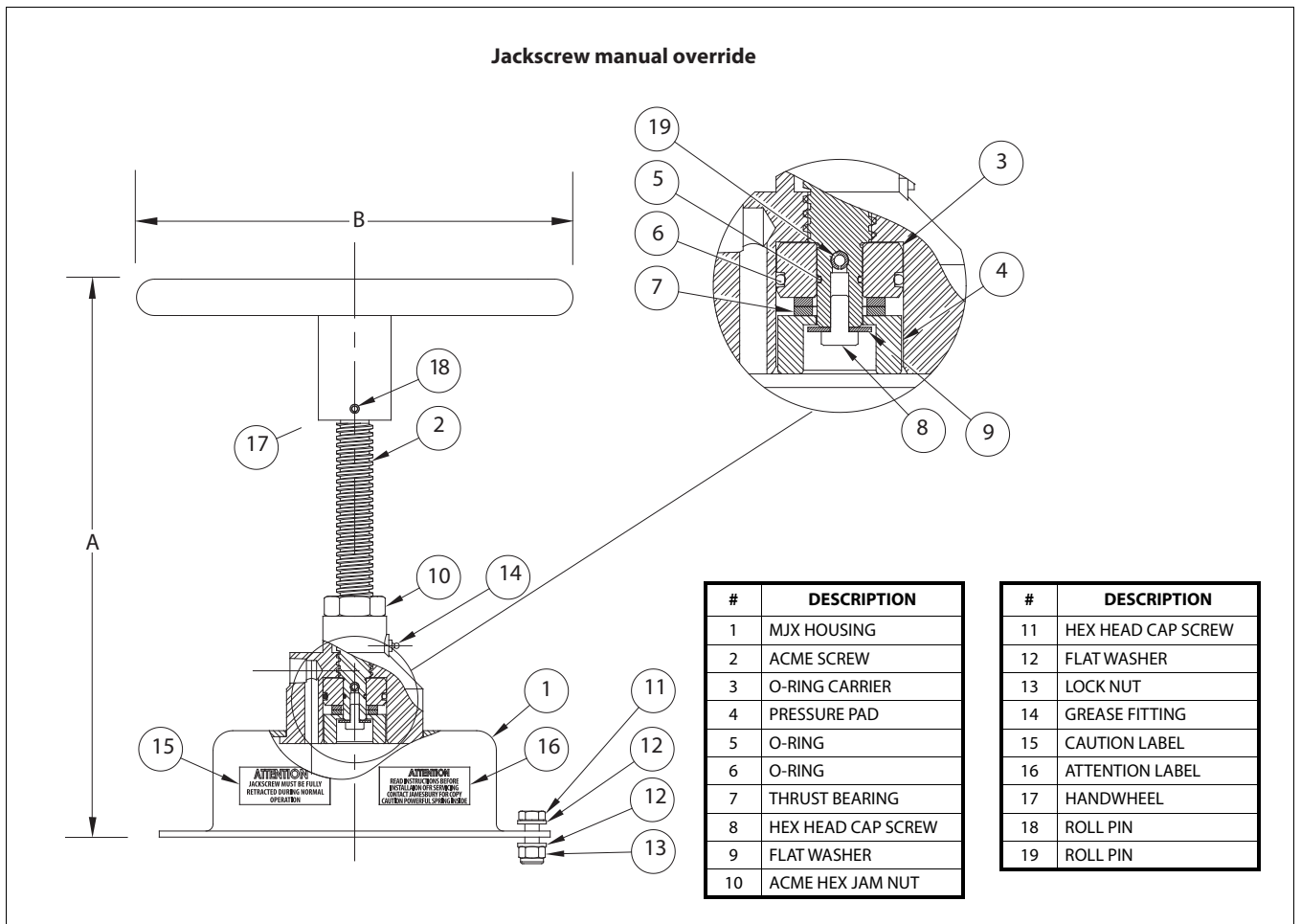
SQUARE



Approximate dimensions - mm						
Actuator	B Bolt circle	T Thread size	S Square	A	D	F
QPX1	51	1/4-20unc-2B	14	15-17	14	18
QPX2	51	1/4-20unc-2B	14	15-17	14	18
QPX3	76	3/8-16unc-2B	19	24-26	19	25
QPX4	108	1/2-13unc-2B	25	28-30	22	31
QPX5	108	1/2-13unc-2B	25	28-30	22	31

Approximate dimensions - inches						
Actuator	B Bolt circle	T Thread size	S Square	A	D	F
QPX1	2	1/4-20unc-2B	0.55	0.60-0.65	0.55	0.69
QPX2	2	1/4-20unc-2B	0.55	0.60-0.65	0.55	0.69
QPX3	3	3/8-16unc-2B	0.75	0.94-1.04	0.75	0.98
QPX4	4.25	1/2-13unc-2B	1.00	1.10-1.18	0.88	1.23
QPX5	4.25	1/2-13unc-2B	1.00	1.10-1.18	0.88	1.23

Jackscrew manual override: A jackscrew device is available on the QPX1, 2, 3, 4 and 5 actuators. When the handwheel of this device is turned, force is exerted on the diaphragm plate, compressing the actuator spring and operating the valve in the direction of the air stroke.

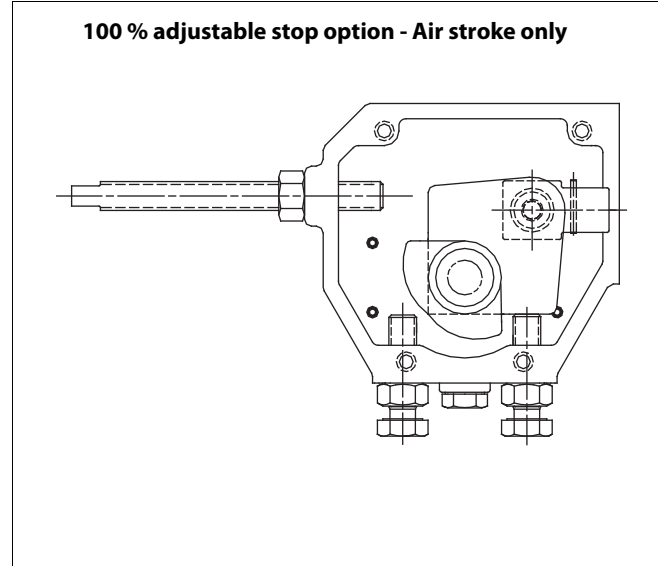
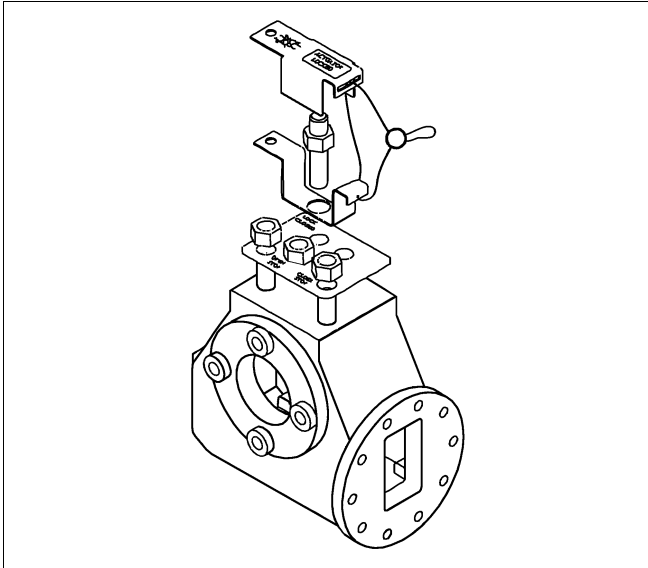


Jackscrew specification					
Model	For actuator series	Max. input torque* (N-m)	Number of turns to fully compress spring	Approximate dimensions (Millimeters)	
				A	B
MJX-1	QPX-1	11	17	358.9	200
MJX-2	QPX-2	22	18	409.4	300
MJX-3	QPX-3	49	21	457.5	400
MJX-4	QPX-4	56	25	532.4	500
MJX-5	QPX-5	89	35	603.8	600

Jackscrew specification					
Model	For actuator series	Max. input torque* (ftlbs)	Number of turns to fully compress spring	Approximate Dimensions (inches)	
				A	B
MJX-1	QPX-1	8	17	14.13	7.87
MJX-2	QPX-2	16	18	16.12	11.81
MJX-3	QPX-3	36	21	18.01	15.75
MJX-4	QPX-4	41	25	20.96	19.69
MJX-5	QPX-5	66	35	23.77	23.62

*Based on typical valve with 80-psi (5.5) bar actuator spring.

7 ACTUATOR ACCESSORIES AND CONTROLS CONSTRUCTION OPTIONS



Mechanical lockout option

To comply with the intent of QSHA requirements for locking spring-driven actuators in the spring-driven position, every Quadra-Powr X actuator can have the mechanical lockout option added to it. Design of the output shaft allows for locking the actuator in the spring-fail position. Actuators equipped with this option have a special lockout screw and a tamperproof cover attached to the housing of the actuator with a stainless steel wire. The lockout parts are readily available to permanently lock the actuator in place and padlock the locking device to prevent unwanted

operation.

When limiting the rotation of the air stroke of a *Quadra-Powr X* actuator, 100% adjustable stop option can be added. In the spring-to-close mode this option limits the opening stroke only; in the spring-to-open mode it limits the closing stroke only. The stop screw for this option is located in the housing end of the actuator.

Wet conditions (tropicalization) kit

All standard QPX actuators are shipped with all open mounting and accessory holes filled with fasteners. This reduces the possibility of “standing water” to enter into the driver housing. But in extremely moist environments, water can still potentially make its way inside the unit. In fact, all spring return actuators are subject to this. Every time a QPX strokes air inside the actuator (on the non-pressure side of the diaphragm) is pushed outside via the breather. This is due to the decreasing volume and differential pressures that are present. In contrast, when the actuator returns on the spring stroke the exact opposite happens- air must be pulled inside the actuator, and in a humid environment, taking along moisture with it. To block off all openings in the actuator would stop the oper-

ation, as this “breathing” needs to happen for a spring-return diaphragm actuator to function.

The only realistic way to eliminate all moisture from getting inside the actuator is to regulate the air that is being transferred in and out of the actuator. This can be done with an accessory called the Tropicalization kit. This accessory kit takes exhaust air from the solenoid valve or positioner (clean dry air) and re-directs it into the housing in place of the breather fitting. This air is dumped inside the housing during the spring stroke, thus keeping a positive pressure in the housing, and keeping out atmospheric air (and moisture). This kit should be considered in any application where excessive moisture exists.

Fusible plug

A fusible plug option is available for all *Quadra-Powr X* actuators to allow for automatic closing or opening of the valve in the event of a fire or excessive environmental temperature. The standard plug is designed to melt when the tem-

perature reaches an approximate level of 74 °C (165 °F). This releases the air from the diaphragm case and rotates the valve to its fail-closed or fail-open position. To order a fusible plug kit specify LK3116.

8 PNEUMATIC, SPRING-DIAPHRAGM ACTUATOR, Series QPX

1.	2.	3.		4.	5.	6.
QPX	1	C	/	M	AS	

1.	Actuator series
QPX	<i>Quadra-Powr X</i> , spring-diaphragm actuator.

2.	Size
1	QPX1
2	QPX2
3	QPX3
4	QPX4
5	QPX5

3.	Spring option
A	1,3 bar / 20 psi (QPX2 and QPX3 only)
B	2,8 bar / 40 psi
C	4,1 bar / 60 psi
D	5,5 bar / 80 psi

4.	Driver
Male square drive	
M	Male Square
Keyed female drive	
K15	15 mm when QPX1, QPX2A
K20	20 mm when QPX2 (not QPX2A)
K35	35 mm when QPX3
K40	40 mm when QPX4 or QPX5

5.	Options
--	No sign, Standard version, full reversible version
MJX	Handwheel override

6.	Model version indicator
-	No sign, model B
C	Model C

Subject to change without prior notice

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