Product Data Sheet
PDS-02-01-98-3050-EN Rev. 1
March 2019

Bettis M Series

Stainless Steel Actuators (Metric)

- Stainless Steel Spring-Return And Double-Acting Pneumatic Quarter-Turn Actuators.
- Output Torques To 13560 Nm.

BETTIS™

EMERSON™

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General Applications

For remote control of any quarter-turn application: ball, butterfly, rotary plug or damper style valves, etc. To be used in chemical process, food and beverage, iron and steel, off-shore marine, pharmaceutical, power, oil and gas, pulp and paper, and textile industries.

Technical Data

Supply pressure:	3 to 11 bar (see torque charts)
Supply medium:	Air or any gas compatible with materials of construction
Temperature rating	
Standard range:	-29°C to 99°C
Optional range:	-54°C to 149°C
Angular rotation:	90 degrees (adjustable between 82 and 98 degrees)
Ingress Protection:	IP66, Optional IP67, IP68
Certification:	SIL3 capable

Features and Benefits

- Innovative stainless steel construction provides superior internal and external corrosion resistance.
- Scotch yoke design using precision bearings eliminates dead band in the yoke mechanism, providing the greatest torque output at the beginning and end of stroke.
- High strength 17-4PH stainless output shaft transmits torque and gives long service life.
- Heat-treated stainless steel thrust pin and rollers transfer piston force to yoke to reduce friction for longer life and more efficient torque transmission.
- Bi-directional travel stops provide accurate valve rotation adjustment.
- PTFE piston bearings, piston rod bushings and output shaft bushings provide longer life, reduce maintenance and require no lubrication.
- Universal design position indicator and pointer allows for either parallel or perpendicular mounting.
- Stainless steel construction allows proximity switches to be direct-mounted in the actuator housing, eliminating the need to mount bracket and cam assemblies on top.
- NAMUR drive slot maintains a compact assembly for accessory-driven components with no couplings necessary.
- Available in symmetrical and canted yoke design to suit application.
- Spring-Return model design requires no special tools to disarm springs safely and easily, reducing down time.

Designed with a Heart of Stainless Steel

Stainless Steel Yoke

The heart of any scotch yoke actuator is the yoke. S series actuators use 17-4PH stainless for this critical area as standard.

The yoke is the mechanism used to convert linear force to torque. This area is most often where the life of the actuator is controlled.

Principles of Construction

Using high quality materials of construction and modern rugged design concepts provides the standard for high quality, low cost valve actuation.

The M actuator housings are all machined from 316 stainless steel castings. This produces a rugged, low cost product through reduced machining time and by eliminating wasteful excess material.

Any components that rotate or slide during operation, such as the high strength stainless steel output shaft, stainless steel piston rod, stainless steel thrust pin or the stainless steel piston, are all supported by replaceable friction reducing bearings.

Bi-directional Travel Stops

Adjustable stops on each end cap provide the flexibility of accurate valve rotation positioning at the end of the 'open' and 'close' stroke. Both stops are located on the cylinder centerline, the optimal position to maximize travel adjustment and eliminate any detrimental side loading on the travel stops. Adjustable from 82° to 98°.

Ingress Protection

Standard IP66. Optional IP67, IP68.

Spring Designed for Safety

All Spring-Return models incorporate a 'man-safe' spring design that allows the actuator to be safely assembled and disassembled in the field without the need for special tools. The integral tie rods are bored and tapped to provide a means of loading and unloading the spring in a safe and convenient manner.

Figure 1.

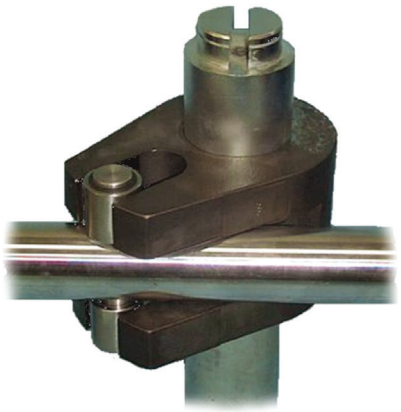
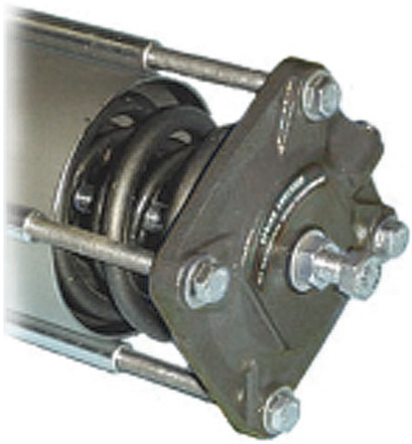


Figure 2.



Available Options

- Jackscrew override
- Hydraulic override
- Full stroke adjustment
- Proximity preparation
- Lockout device
- Partial stroke test

Materials of Construction

Figure 3.

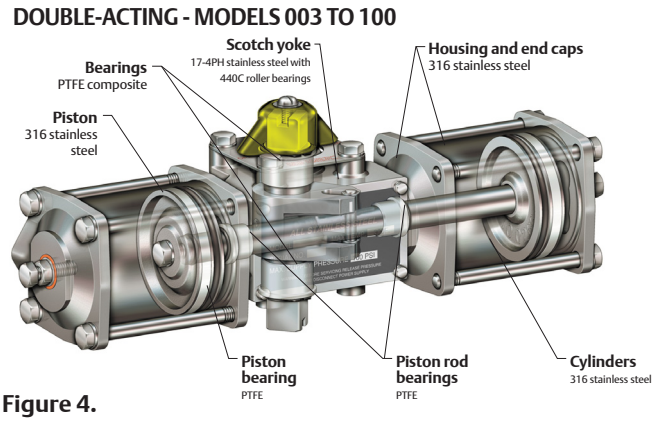
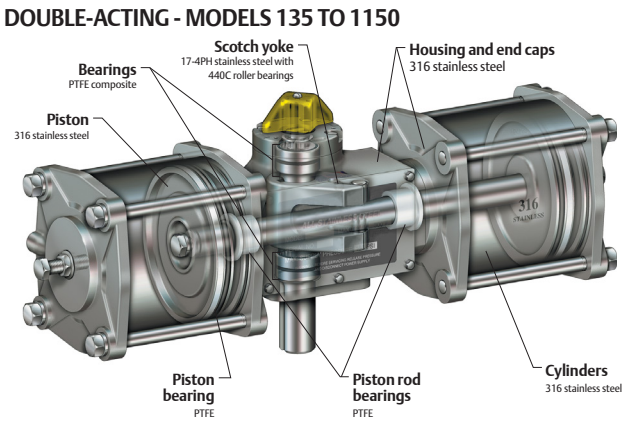


Figure 4.



Symmetrical and Canted Yokes

It's about fitting the torque curve of the actuator to the valve. It's about lower cost, lighter weight, smaller actuators.

It's about CHOICE.

Symmetric

Symmetrical yoke design offers the standard torque curve seen most often in relation to scotch yoke actuators. It offers the increased torque advantage at both ends of the 90° stroke as shown on the blue curve below. This torque curve covers most quarter-turn applications.

Canted

Canted yoke design moves the torque curve to where it's needed most, gaining as much as 35% more break and reseat torque for the same size actuator. The canted yoke curve is shown in red below. Canted yoke actuators allow selection of smaller, lighter, and less expensive actuator packages.

Figure 5.

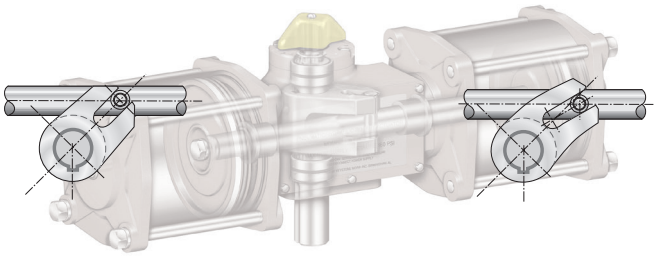
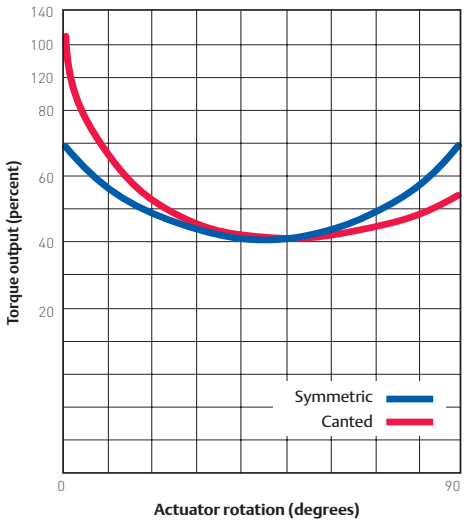


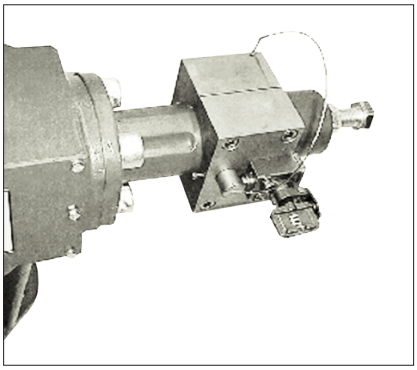
Figure 6.



Manual Options

To provide the actuation package best suited for your application, we offer a full range of manual accessories.

Figure 7.

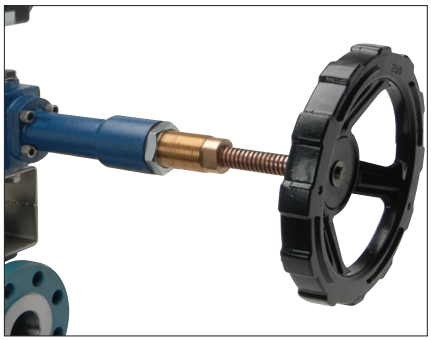


Partial stroke test device (PSTD)
Provides a method of testing ESD packages without shutdown.

Figure 8.

Lockout
Integral lockout allows safe shutdowns for maintenance and isolation of systems.

Figure 9.

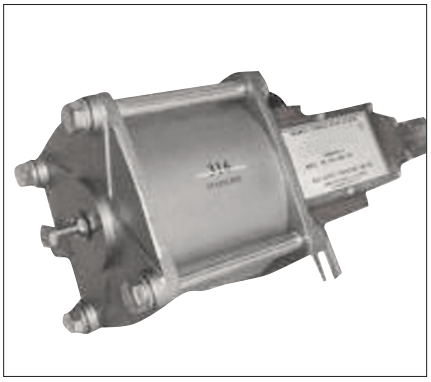


Jackscrew override (JSO)
Manual operation when power is lost. Simple and effective.

Figure 10.

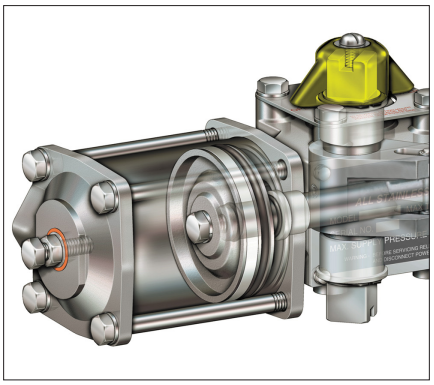
Hydraulic override (MHP)
Manual operation when power is lost. Includes speed controls.

Figure 11.



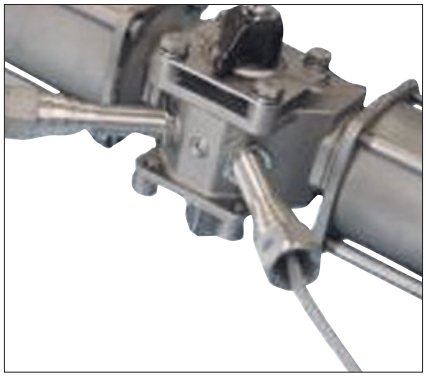
AWWA
American Waterworks Association (AWWA) C541 option. Available for pneumatic or water service operation.

Figure 12.



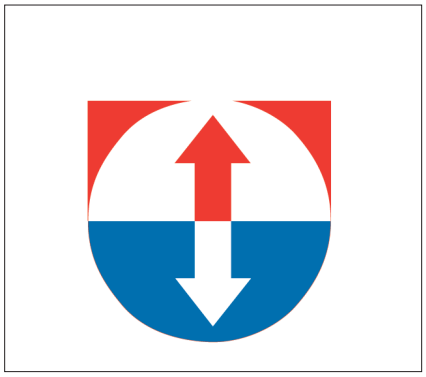
Full stroke adjustment
Provides mechanical control of maximum and/or minimum valve stroke.

Figure 13.



Proximity switch preparation
Allows installation of cartridge style proximity switches. Leaves top works open for mounting of other devices.

Figure 14.



High or low temperature ratings
Standard rating of -20°F to 210°F [-29°C to 99°C] covers most applications. Optional ratings down to -65°F [-54°C and up to 300°F [149°C].

Mechanical Data

Table 1. Double-Acting

Actuator model	Number of pistons	Cylinder bore (mm)	Stroke (mm)	Volume[1] (liters) 90° stroke	Cycle time[2] (seconds) 90° stroke	Weight (kg)
003	1	57.2	38.1	0.10	0.3	2.27
006	1	69.9	50.8	0.20	0.5	4.54
012	2	69.9	50.8	0.38	0.7	5.44
023	1	111.1	76.2	0.74	1.0	12.25
036	1	138.1	76.2	1.15	1.5	133.61
050	1	158.8	76.2	1.51	2.2	14.97
059	2	111.1/138.1	76.2	1.84	2.4	16.33
072	2	138.1	76.2	2.25	2.5	17.23
100	2	158.8	76.2	2.98	3.0	20.87
135	1	209.6	127.0	4.38	4.5	74.84
210	1	260.4	127.0	6.77	5.0	83.91
270	2	209.6	127.0	8.62	6.0	95.25
345	2	209.6/260.4	127.0	11.00	7.0	104.78
370	1	311.2	152.4	11.59	8.0	176.90
420	2	260.	127.0	13.37	8.5	116.57
575	1	393.7	152.4	18.55	9.5	235.41
740	2	311.2	152.4	22.86	10.0	240.40
945	2	311.2/393.7	152.4	29.82	11.0	296.20
1150	2	393.7	152.4	36.79	12.0	351.53
1480	2	311.2	304.8	44.97	20.0	385.55
2380	2	393.7	304.8	72.82	24.0	476.27

Table 2. Spring-Return

Actuator model	Number of pistons	Cylinder bore (mm)	Stroke (mm)	Volume[1] (liters) 90° stroke	Cycle time[2] (seconds) 90° stroke	Weight (kg)
003	1	57.2	38.1	0.10	0.3	2.72
006	1	69.9	50.8	0.20	0.5	4.99
012	2	69.9	50.8	0.38	0.7	6.35
023	1	111.1	76.2	0.74	1.0	15.42
036	1	138.1	76.2	1.15	1.5	19.05
046	2	111.1	76.2	1.44	2.0	19.50
058	2	138.1/111.1	76.2	1.84	2.3	23.13
059	2	111.1/138.1	76.2	1.84	2.4	23.13
072	2	138.1	76.2	2.25	2.5	24.95
100	2	158.8	127.0	2.98	3.0	29.03
135	1	209.6	127.0	4.38	4.5	95.25
210	1	260.4	127.0	6.77	5.0	106.59
270	2	209.6	127.0	8.62	6.0	113.40
344	2	260.4/209.6	152.4	11.00	7.0	143.00
345	2	209.6/260.4	127.0	11.00	7.0	143.00
370	1	311.2	152.4	11.59	8.0	244.94
420	2	260.4	152.4	13.37	8.5	171.91
575	1	393.7	152.4	18.55	9.5	353.35
740	2	311.2	152.4	22.86	10.0	319.33
944	2	393.7/311.2	304.8	29.82	11.0	395.00
945	2	311.2/393.7	304.8	29.82	11.0	395.00
1150	2	393.7	2	36.79	12.0	490.79
1480	2	311.2	2	44.97	20.0	748.43
2380	2	393.7	2	72.82	24.0	839.15

Notes:

1. Air consumption:
   Liter shown in chart represent actual free air volume in cylinder between piston and end cap when furthest apart.
   Air consumption will vary depending on supply pressure.
   To determine standard cubic meter per second use the following formula:

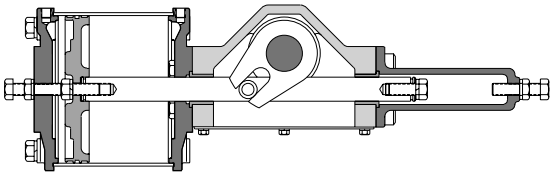
$$\left(\frac{\text{Vol. ltr.}}{1000}\right)\left(\frac{\text{Supply air barg} + 1}{1\ \text{barg}}\right)\left(\frac{\text{Strokes / min}}{60}\right)$$

2. Example: Calculate SCMS for model 023 double-acting using 5.5 barg air supply and 5 strokes/minute.

$$\text{SCFM} = \left(\frac{0.737}{1000}\right)\left(\frac{5.5 + 1}{1\ \text{barg}}\right)\left(\frac{5\ /\ 60}{0.000401}\right)$$

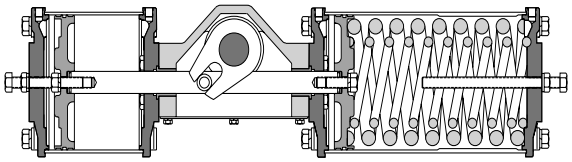
3. Cycle times shown represent average time to stroke 90 degrees using standard pilot valves and should be used as a guide only. Cycle times can be increased or decreased dramatically by using speed controls, oversized pilot valves or quick exhaust valves.

Figure 15. Typical Section - Double-Acting / One Piston



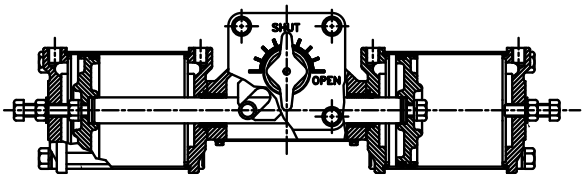
Model number: M-135U-D000

Figure 16. Typical Section - Spring-Return / Two Pistons



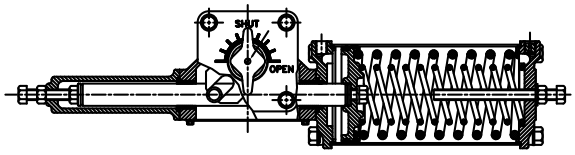
Model number: M-270U-S080

Figure 17. Double-Acting Two Pistons



Model number: M-270U-D000

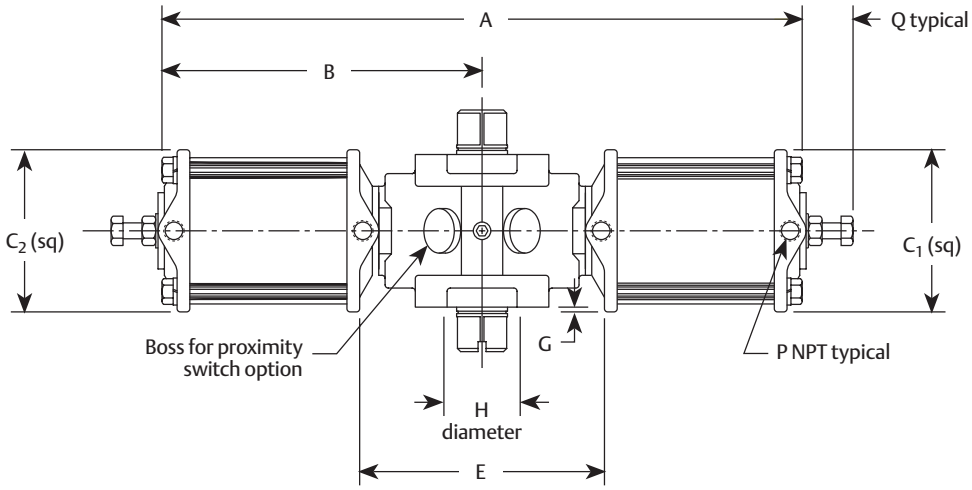
Figure 18. Single-Acting One Piston



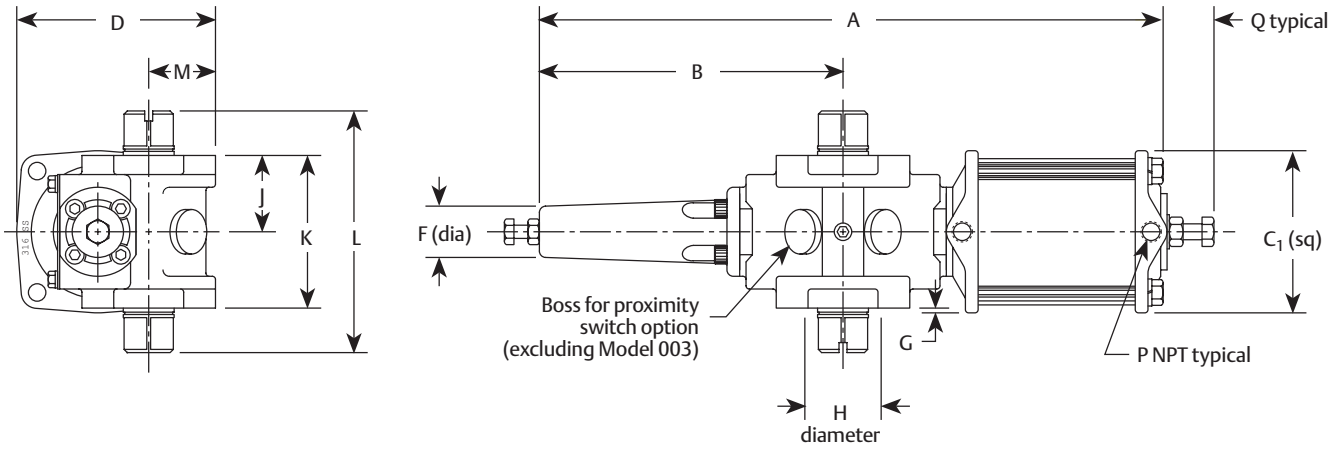
Model number: M-135U-S080

Dimensions

MODELS 012, 046, 058, 059, 072 AND 100



MODELS 003, 006, 023, 036 AND 050



Notes:

1. Shown without pointer for clarity.
2. For mounting dimensions, refer to pages 11 and 12.

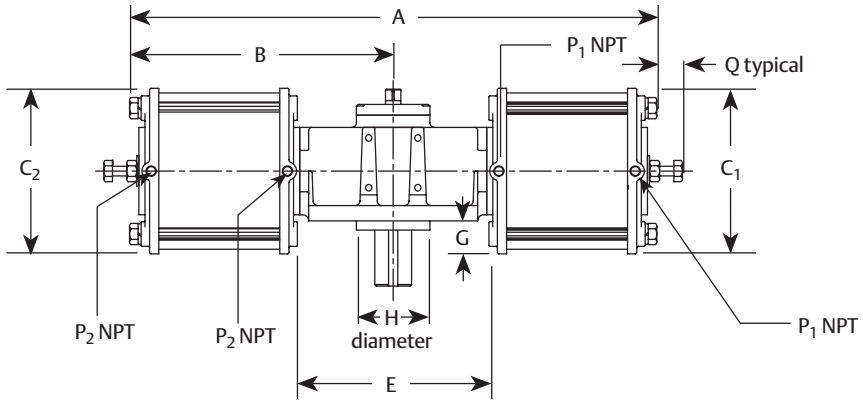
Table 3. Dimensions (mm) Double-Acting

Model	A	B	C_1	C_2	D	E	F	G	H	J	K	L	M	P	Q
003DA	9.06	3.50	2.69	-	3.06	-	0.75	-	1.00	1.37	2.75	3.25	1.00	1/8	0.62
006DA	12.34	5.97	3.18	-	3.91	-	1.00	0.10	1.38	1.50	3.00	4.75	1.31	1/8	1.00
012DA	12.74	6.37	3.18	3.18	3.91	4.81	-	0.10	1.38	1.50	3.00	4.75	1.31	1/8	1.00
023DA	18.60	8.81	4.81	-	5.78	-	1.43	0.25	1.75	2.16	4.31	6.69	1.88	1/4	1.15
036DA	18.48	8.81	5.81	-	6.28	-	1.43	0.75	1.75	2.16	4.31	6.69	1.88	1/4	1.25
050DA	18.49	8.81	7.13	-	6.94	-	1.43	1.41	1.75	2.16	4.31	6.69	1.88	1/4	1.25
059DA	19.40	9.66	4.81	5.81	6.66	6.34	-	0.75	1.75	2.16	4.31	6.69	2.25	1/4	1.00
072DA	19.33	9.67	5.81	5.81	6.28	6.38	-	0.75	1.75	2.16	4.31	6.69	1.88	1/4	0.83
100DA	19.35	9.68	7.12	7.12	6.94	6.38	-	1.41	1.75	2.16	4.31	6.69	1.88	1/4	0.75

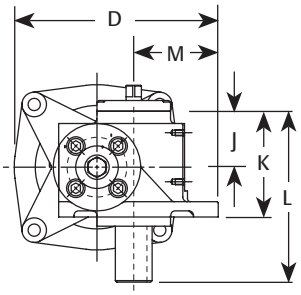
Table 4. Dimensions (mm) Spring-Return

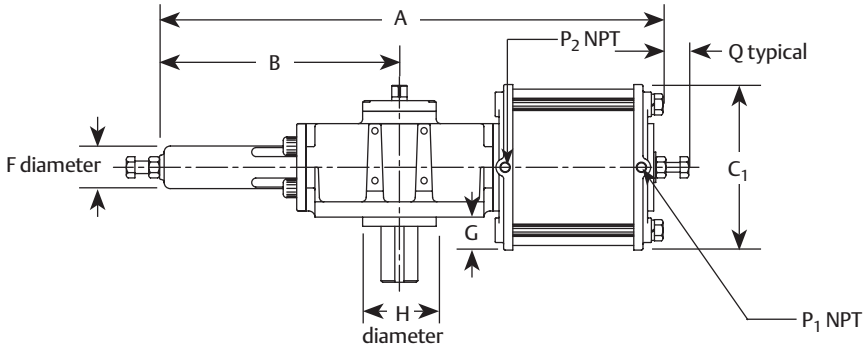
Model	A	B	C_1	C_2	D	E	F	G	H	J	K	L	M	P	Q
003SR	9.06	3.50	2.69	-	3.06	-	0.75	-	1.00	1.37	2.75	3.25	1.00	1/8	0.62
006SR	14.44	5.97	3.18	-	3.91	-	1.00	0.10	1.38	1.50	3.00	4.75	1.31	1/8	1.00
012SR	14.84	6.37	3.18	3.18	3.91	4.55	-	0.10	1.38	1.50	3.00	4.75	1.31	1/8	1.00
023SR	21.82	8.81	4.81	-	5.78	-	1.43	0.25	1.75	2.16	4.31	6.69	1.88	1/4	1.25
036SR	23.51	8.81	5.81	-	6.28	-	1.43	0.75	1.75	2.16	4.31	6.69	1.88	1/4	1.25
046SR	22.80	9.79	4.81	4.81	5.93	6.24	-	0.25	1.75	2.16	4.31	6.69	1.88	1/4	1.25
058SR	22.79	9.73	5.81	4.81	6.66	5.58	-	0.75	1.75	2.16	4.31	6.69	2.25	1/4	1.25
059SR	24.44	9.66	4.81	5.81	6.66	5.44	-	0.75	1.75	2.16	4.31	6.69	2.25	1/4	1.25
072SR	24.37	9.67	5.81	5.81	6.28	5.99	-	0.75	1.75	2.16	4.31	6.69	1.88	1/4	1.25
100SR	24.38	9.68	7.12	7.12	6.94	5.99	-	1.41	1.75	2.16	4.31	6.69	1.88	1/4	1.25

MODELS 270, 344, 345, 420, 740, 944, 945 AND 1150

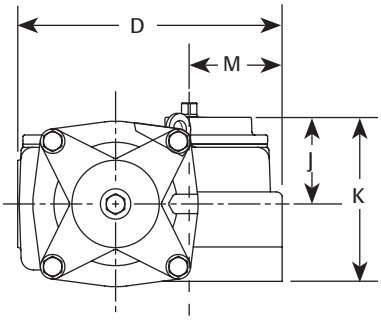


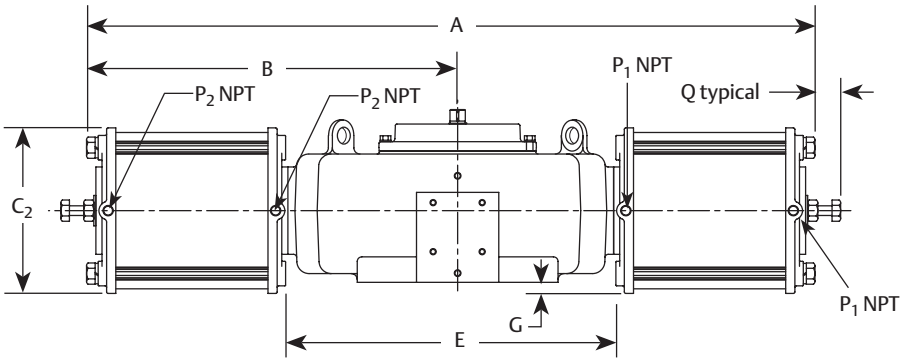
MODELS 135, 210, 370 AND 575





MODELS 1480 AND 2380





Notes:
1. Shown without pointer for clarity.
2. For mounting dimensions, refer to pages 11 and 12.

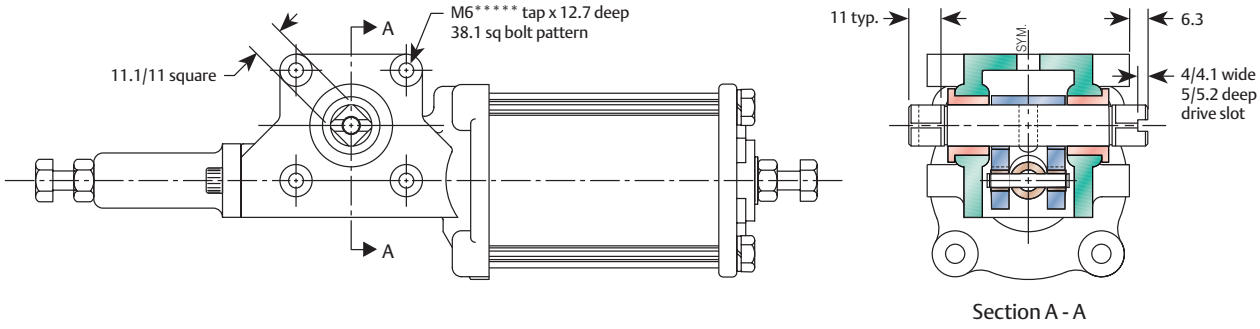
Table 5. Dimensions (mm) Double-Acting

Model	A	B	C_1	C_2	D	E	F	G	H	J	K	L	M	P_1	P_2	Q
135DA	32.74	15.88	9.50	-	10.44	-	2.75	1.00	-	4.38	8.13	11.82	3.19	3/8	3/8	1.75
210DA	33.26	15.88	11.50	-	11.44	-	2.75	2.00	-	4.38	8.13	11.82	3.19	1/2	1/2	2.12
270DA	33.77	16.89	9.50	9.50	10.44	11.72	-	1.00	-	4.38	8.13	11.82	3.19	3/8	3/8	1.75
345DA	34.26	16.89	9.50	11.50	11.44	11.47	-	2.00	-	4.38	8.13	11.82	3.19	3/8	1/2	2.12
370DA	41.64	19.56	13.50	-	16.75	-	3.50	2.69	5.90	5.44	9.50	14.81	6.88	1/2	1/2	1.75
420DA	34.75	17.38	11.50	11.50	11.44	11.22	-	2.00	-	4.38	8.13	11.82	3.19	1/2	1/2	2.12
575DA	42.26	19.56	17.00	-	18.50	-	3.50	4.44	5.90	5.44	9.50	14.81	6.88	3/4	3/4	2.50
740DA	44.15	22.07	13.50	13.50	16.75	15.62	-	2.69	5.90	5.44	9.50	14.81	6.88	1/2	1/2	1.75
945DA	44.77	22.07	13.50	17.00	18.50	15.25	-	4.44	5.90	5.44	9.50	14.81	6.88	1/2	3/4	2.50
1150DA	45.39	22.69	17.00	17.00	18.50	14.88	-	4.44	5.90	5.44	9.50	14.81	6.88	3/4	3/4	2.50
1480DA	77.15	38.58	13.50	13.50	21.57	33.44	-	0.56	-	7.96	15.30	-	7.58	1/2	1/2	2.12
2380DA	78.39	39.20	17.00	17.00	22.08	32.69	-	1.18	-	7.96	15.30	-	7.58	3/4	3/4	2.67

Table 6. Dimensions (mm) Spring-Return

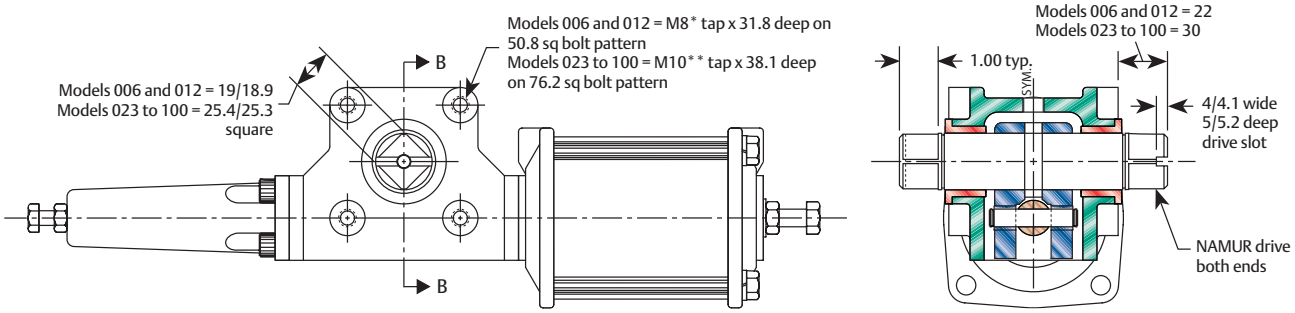
Model	A	B	C_1	C_2	D	E	F	G	H	J	K	L	M	P_1	P_2	Q
135SR	39.46	15.88	9.50	-	10.44	-	2.75	1.00	-	4.38	8.13	11.82	3.19	3/8	3/8	1.75
210SR	42.67	15.88	11.50	-	11.44	-	2.75	2.00	-	4.38	8.13	11.82	3.19	1/2	1/2	2.12
270SR	40.57	16.99	9.50	9.50	10.44	10.95	-	1.00	-	4.38	8.13	11.82	3.19	3/8	3/8	1.75
344SR	40.95	17.38	11.50	9.50	11.44	10.70	-	2.00	-	4.38	8.13	11.82	3.19	1/2	3/8	2.12
345SR	43.79	16.99	9.50	11.50	11.44	10.61	-	2.00	-	4.38	8.13	11.82	3.19	3/8	1/2	2.12
370SR	51.48	19.56	13.50	-	16.75	-	3.50	2.69	5.90	5.44	9.50	14.81	6.88	1/2	1/2	1.75
420SR	44.17	17.38	11.50	11.50	11.44	10.36	-	2.00	-	4.38	8.13	11.82	3.19	1/2	1/2	2.12
575SR	54.12	19.56	17.00	-	18.50	-	3.50	4.44	5.90	5.44	9.50	14.81	6.88	3/4	3/4	2.50
740SR	53.99	22.07	13.50	13.50	16.75	14.75	-	2.69	5.90	5.44	9.50	14.81	6.88	1/2	1/2	1.75
944SR	54.59	22.67	17.00	13.50	18.50	14.37	-	4.44	5.90	5.44	9.50	14.81	6.88	3/4	1/2	2.50
945SR	56.63	22.07	13.50	17.00	18.50	14.16	-	4.44	5.90	5.44	9.50	14.81	6.88	1/2	3/4	2.50
1150SR	57.22	22.69	17.00	17.00	18.50	13.79	-	4.44	5.90	5.44	9.50	14.81	6.88	3/4	3/4	2.50
1480SR	93.49	38.58	13.50	13.50	21.57	32.57	-	0.56	-	7.96	15.30	-	7.58	1/2	1/2	2.12
2380SR	94.70	39.20	17.00	17.00	22.08	31.61	-	1.18	-	7.96	15.30	-	7.58	3/4	3/4	2.50

MODEL 003 - TOP AND BOTTOM OF HOUSING



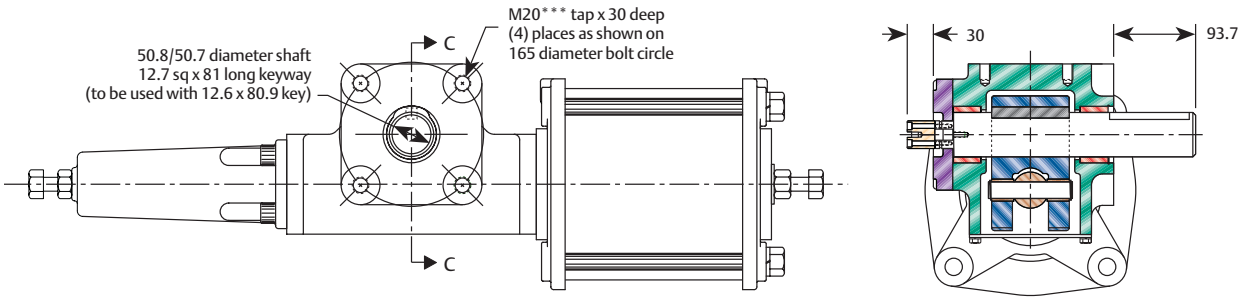
Section A - A

MODELS 006 TO 100 - TOP AND BOTTOM OF HOUSING



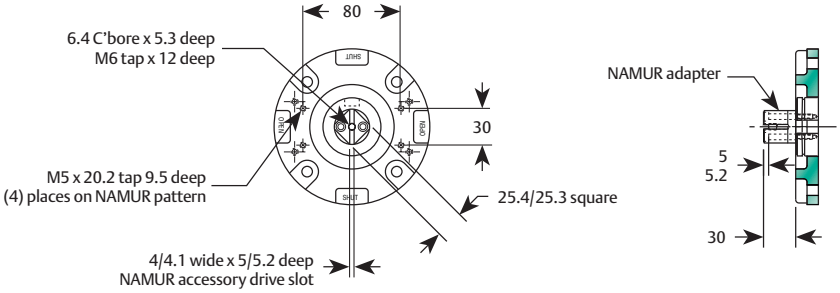
Section B - B

MODELS 135, 210, 270, 344, 345 AND 420 - BOTTOM OF HOUSING ISO 5211-F16



Section C - C

MODELS 135, 210, 270, 344, 345 AND 420 - TOP OF HOUSING - MOUNTING DETAILS



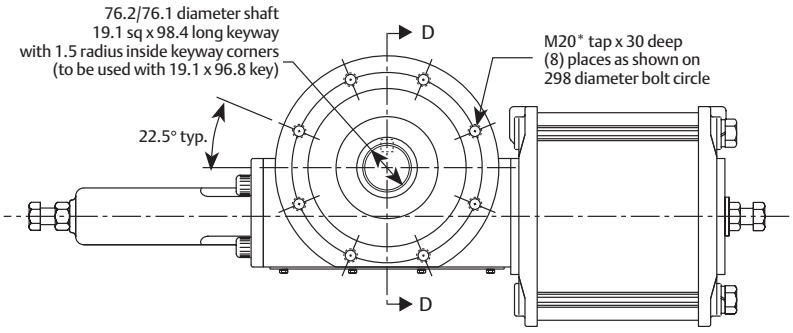
IMPERIAL THREAD OPTION

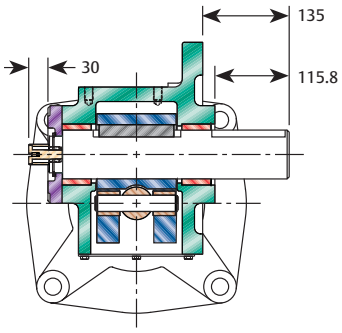
Standard tap		Model number
*****	1/4 - 20 UNC	003
*	5/16 - 18 UNC	006 and 012
**	3/8 - 16 UNC	023 to 100
***	3/4 - 10 UNC	135 to 1150

Replace 'M' with 'U' in order number designation (refer to page 13).

Mounting Details

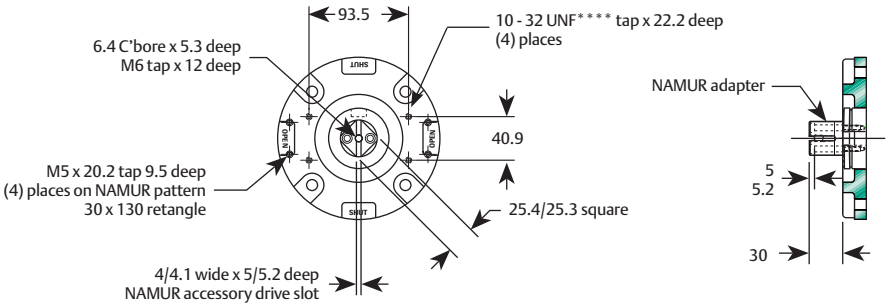
MODELS 370, 575, 740, 944, 945 AND 1150 - BOTTOM OF HOUSING ISO 5211-F30



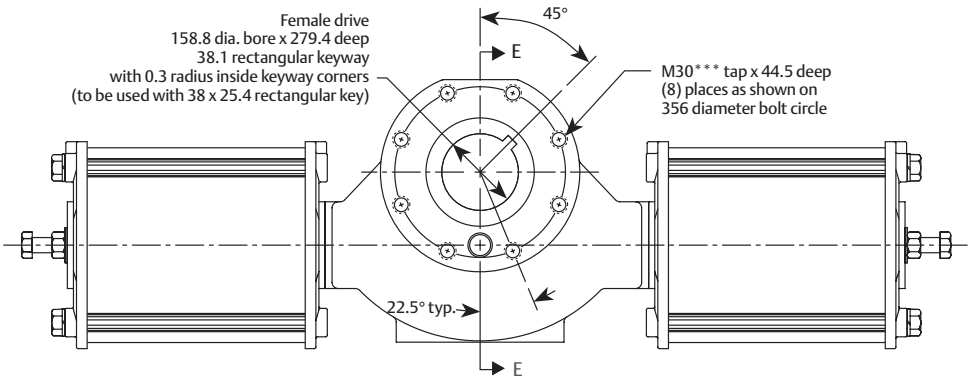


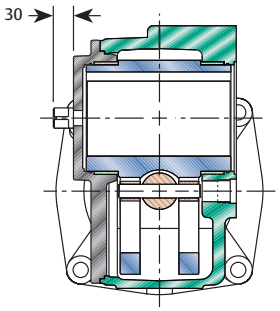
Section D - D

MODELS 370, 575, 740, 944, 945 AND 1150 - TOP OF HOUSING - MOUNTING DETAILS



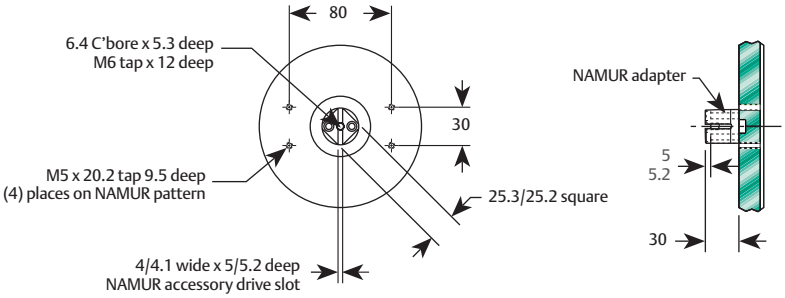
MODELS 1480 AND 2380 - BOTTOM OF HOUSING ISO 5211-F35





Section E - E

MODELS 1480 AND 2380 - TOP OF HOUSING - MOUNTING DETAILS



IMPERIAL THREAD OPTION

Standard tap		Model number
*	¾ - 10 UNC	370 and 575 to 1150
***	1 - 8 UNC	1480 and 2380

Replace 'M' with 'U' in order number designation (refer to page 13).

Ordering Information

Table 7. Selection Guide

Actuator model														
M-	Stainless steel													
		Actuator size Model code based on approximate torque of symmetrical double-acting at 5.5 barg												
		270	**003**	**058**	**344**	**945**								
			006	**059**	**345**	**1150**								
			012	**072**	**370**	**1480**								
			023	**100**	**420**	**2380**								
			036	**135**	**575**									
			046	**210**	**740**									
			050	**270**	**944**									
				Interface bolting										
				U –	UNC mounting threads									
				M –	Metric mounting threads									
					Yoke design									
					(blank) – Symmetrical yoke									
					C –	Canted yoke								
						Function								
						D –	Double-Acting							
						S –	Spring-Return							
							Spring code							
							00	**00** – No spring - Double-Acting						
								04 – 40 pound spring						
								05 – 50 pound spring						
								06 – 60 pound spring						
								Etc. see Morin Torque Book for available springs						
									Spring-Return failure rotation					
									0 –	No spring (double-acting OR actuator rotates clockwise on loss of air)				
									1 –	Actuator rotates counterclockwise on loss of air				
											Option			
												(blank) – No options (standard configuration)		
												See complete modules code listing **Note:** Some codes can be used in combination. Indicate by "stacking" separated by "-". Consult factory for possible combinations combinations.		
M-		270		U		C	-	D		00		0	-	JSO	= Model number **M-270UC-D000-JSO**

Table 8. How to Order

1. Double-Acting example	2. Spring-Return example	3. For all Spring-Return models
Air supply: 5.5 barg	Air supply: 5.5 barg	Use air pressure to determine spring set
Break torque: 813.6 Nm	Ending torque: 1463.4 Nm	All spring sets ending with "0" fail clockwise (40, 50, 60, etc.)
	Fail rotation: clockwise	All spring sets ending with "1" fail counterclockwise (41, 51, 61, etc.)
M-072U-D00	M-370U-S080	
M Series	M Series	
072 Model number	370 Model number	
U UNC mounting threads	U UNC mounting threads	
D000 Double-Acting	S080Spring set	

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