PNEUMATIC RACK & PINION

Standard Features

TORQUE RANGES
The RP rack and pinion actuators are available with output torques ranging from 44 to 36,269 in-lbs depending on air supply pressure and/or spring sets.

ACCESSORY MOUNTING
The accessory mounting pad meets international NAMUR standards for ease of directly attaching accessories following the same standard.

ANTI BLOW-OUT PINION
The design of the pinion prevents blow out by securing it with the piston racks. The pinion is ground from hardened steel and then nickel plated for maximum corrosion and wear resistance.

SPRINGS
For fail safe requirements, reliable and high resistant steel springs are included. Springs are zinc phosphate coated for corrosion resistance.

SEALS
The standard actuator is supplied with NBR seals at piston, pinion, and end caps. Viton® is available for high temperature applications, and Silicon for low temperature applications.

POSITION INDICATOR
High visibility position indicator with snap on marks is easily converted to indicate 3-way positions or can be removed for other accessories.

ACTUATOR BODY
The body is a single piece extruded aluminum housing with anodized hard coat exterior finished to 45-50 microns. An optional nickel plated exterior is available for added corrosion resistance.

END CAPS
Ends caps are die cast aluminum with polyester powder coating. Nickel plated bodies also come with nickel plated end cap. Double-acting and spring-return actuators utilize the same end caps, allowing quick conversion by adding or removing springs as needed.

TRAVEL STOPS
Each size actuator comes standard with two travel stops for +/-5° of open and close travel adjustment at nominal positions of 0° and 90°. The stainless steel adjustment screws and cam are not located in the main pressure containing area of the body, reducing the number of possible leak paths and necessary seals.

PISTONS
Pistons are constructed of die cast aluminum and designed for strength and generous rack engagement.

PISTON GUIDES
Piston guides, constructed from POM materials, are designed with a large contact area and long life. The material offers low friction for self lubrication.

VALVE MOUNTING
The valve mounting follows ISO 5211 for direct mounting to valves with the same pattern. All output drive include an 8-point female drive (except the model 270 which has a single square 4-point female drive).

END CAP SCREWS
End caps are secured with extra length stainless steel screws for safe disassembly.

SOLENOID MOUNTING
Supply air connections follow the international NAMUR standard for direct mounting of like style solenoids and is included on all sizes.

Travel Stops

The travel stop cam is located separate from the pressure chamber of the actuator. This design eliminates two potential leak paths as well as the associated seal components. The cam is positively locked to the pinion and easily installed during maintenance via a guide in the cam chamber. The cam chamber is a sealed compartment that is protected from water and dirt ingress, ensuring trouble free operation.

Anti-Blowout Pinion

The RP actuators is designed with a grooved pinion and a corresponding flat key cast in the piston rack. This system creates an added mechanical lock that prevents the pinion from blowing out of the bottom of the housing. In this design, lower pinion clips and retainers that can wear out are eliminated.

CAM   GUIDE   STOP BOLT

PINION / PISTON GROOVE
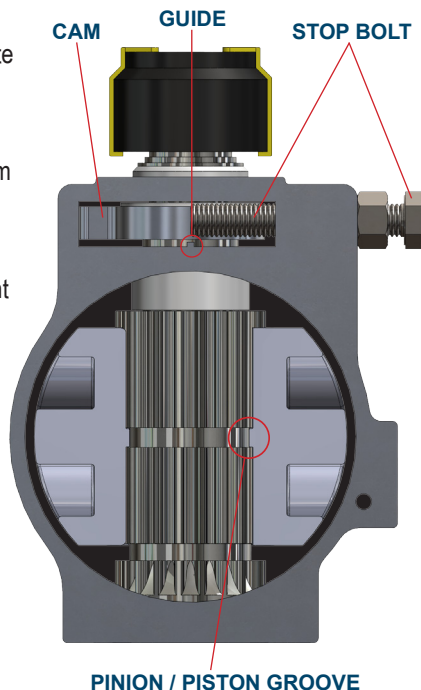
Standard Materials

- Body - UNI 6060 Aluminum, Hard Anodized (Optional Nickel Plating)
- End Caps - Die Cast Aluminum, Polyester Powder Coated (Nickel plated with nickel plated body)
- Pinion - Hardened Steel, Nickel Plated
- Pistons - Die Cast Aluminum
- Seals - NBR (Optional High Temperature Viton® or Low Temperature Silicon)
- Guides/Spacers/Anti-Friction Rings - POM (Acetal) (Model 270 uses PTFE and Graphite Filled PTFE anti-friction rings)
- Travel Stops/Cam/End Cap Screws - Stainless Steel
- Springs - Steel, Zinc Phosphate Coated (Spring return models only)
- Position Indicator - Nylon
- Travel Stop Housing - GGG40 Ductile Iron (Model 270 only)
- Upper Pinion Snap Ring - Steel, Nickel Plated

Standard Operation - Double Acting
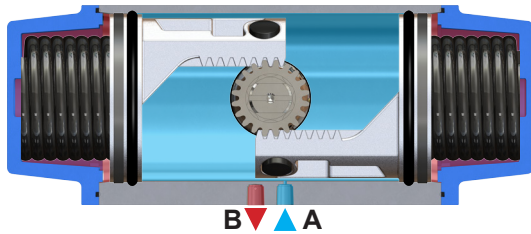

B ▼ ▲ A
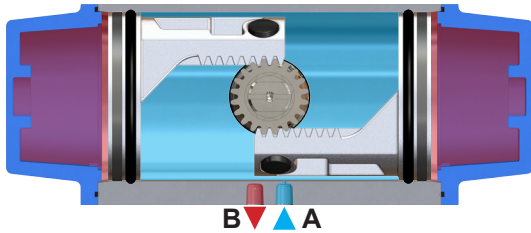
The RP rack and pinion actuator operates (turns) CCW by supplying compressed air to port A. The pressure drives the pistons outward, turning the drive pinion CCW. Air on the outside of the pistons is exhausted out of port B.

B ▲ ▼ A
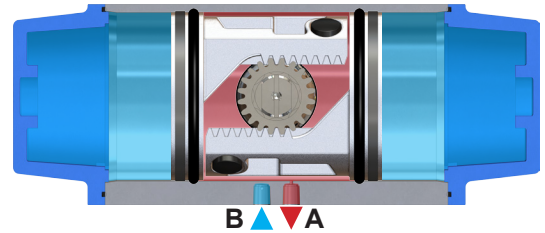
The RP rack and pinion actuator operates (turns) CW by supplying compressed air to port B. The pressure drives the pistons inward, turning the drive pinion CW. Air on the inside of the pistons is exhausted out of port A.

## Standard Operation - Spring Return

B ▼ ▲ A

The RP rack and pinion actuator operates (turns) CCW by supplying and holding compressed air at port A. The pressure drives the pistons outward, turning the drive pinion CCW and compressing the spring sets. Air on the outside of the pistons is exhausted out of port B.

B ▮ ▼ A
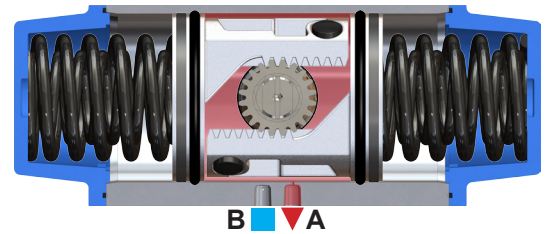
The RP rack and pinion actuator operates (turns) CW by releasing the compressed air at port A. This allows the spring sets to decompress as they drive the pistons inward and the pinion turns CW. Make-up air is drawn in through port B from the atmosphere.

Reversible Operation

Standard Rotation

CCW   CW
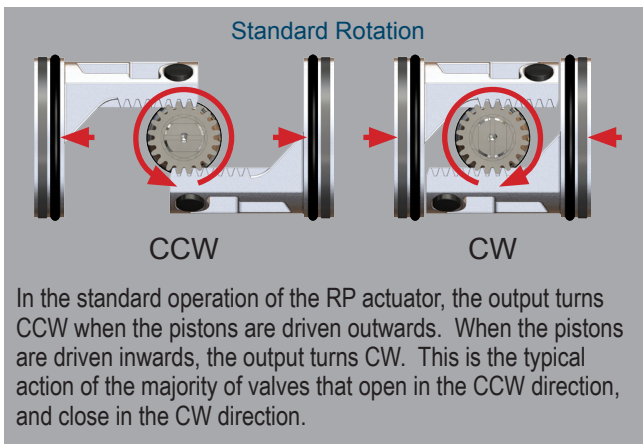
In the standard operation of the RP actuator, the output turns CCW when the pistons are driven outwards. When the pistons are driven inwards, the output turns CW. This is the typical action of the majority of valves that open in the CCW direction, and close in the CW direction.

Reversed Rotation

CW   CCW
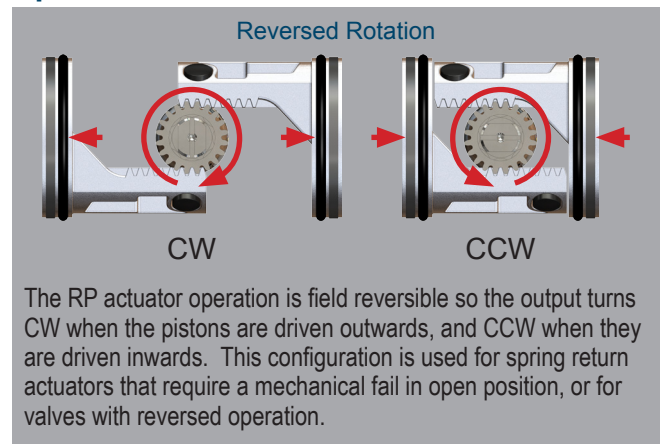
The RP actuator operation is field reversible so the output turns CW when the pistons are driven outwards, and CCW when they are driven inwards. This configuration is used for spring return actuators that require a mechanical fail in open position, or for valves with reversed operation.

Spring Return Spring Set Configurations

The RP rack and pinion actuators are stocked with full spring sets (spring set 05 for models 52 to 140, spring set 06 for models 160 to 230, and spring set 08 for the model 270).

Spring sets can be modified by removal of springs, as indicated in the spring set charts, to alter the actuator's torque curve as shown on the torque charts. Full spring sets provides the maximum spring return torque for a given size actuator, but can be reduced for situations where increased torque in the air stroke is desired.

Models 52 to 140

Spring Set	Spring Quantity	
	Outer	Inner
01	1	1
02	2	
03	1	2
04	2	1
05	2	2

Models 160 to 200
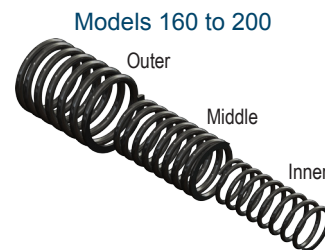
Spring Set	Spring Quantity		
	Outer	Middle	Inner
01		2	
02	2		
03	1	2	
04	2		2
05	2	2	
06	2	2	2

Models 230* & 270

Spring Set	Springs/Side	
	Side A	Side B
01	2	3
02	3	3
03	3	4
04	4	4
05	4	5
06	5	5
07	5	6
08	6	6

* Model 230 has maximum spring set of 06.

Weight (Pounds)

Model	52	63	75	85	100	115	125	140	160	180	200	230	270
Double Acting	2.47	3.66	6.13	8.60	12.13	19.51	23.81	35.94	47.95	63.93	81.57	128.97	182.26
Spring Return	2.87	4.34	7.47	10.58	15.43	25.24	31.04	47.40	65.04	87.96	121.25	156.53	221.06

Air Consumption Per Stroke (Cubic Inches)

Model	52	63	75	85	100	115	125	140	160	180	200	230	270
CCW (DA & SR)	6.10	11.59	21.97	31.12	48.21	78.72	99.47	137.91	220.30	282.54	347.84	651.73	915.36
CW (DA)	7.93	14.04	26.85	39.06	61.02	104.35	134.86	192.84	306.34	402.76	643.80	918.41	1,086.22

Stroke Speed (Seconds)*

Model		52	63	75	85	100	115	125	140	160	180	200	230	270
Double Acting	CCW	0.07	0.11	0.18	0.36	0.38	0.60	0.80	1.13	1.43	1.99	3.08	4.15	6.16
	CW	0.05	0.10	0.15	0.25	0.34	0.54	0.70	0.94	1.25	1.80	2.41	3.80	5.47
Spring Return	CCW	0.07	0.13	0.32	0.32	0.54	0.92	1.20	1.64	2.27	3.08	3.58	6.20	8.97
	CW	0.07	0.13	0.22	0.30	0.48	0.75	0.94	1.25	1.60	2.38	2.80	5.40	6.62

* Note: Stroke speeds listed are based on actuator alone (no valve) with 6 Bar (87 PSI) supply air pressure. Valve torques and flow characteristics of control accessories will have an affect on overall stroke speed.

Temperature Ranges

Configuration	Working Temperature
Standard	-4° to 185°F (-20°C to 85°C)
High Temp.	-4° to 302°F (-20°C to 150°C)
Low Temp.	-40° to 185°F (-40°C to 85°C)

High and low temperature configurations must be specified separately.

Model Number Matrix

FNW RP 52 A DA

SIZES

52	140
63	160
75	180
85	200
100	230
115	270
125	

FINISH

A = Anodized Aluminum
(with polyester powder coated end caps)
N = Nickel Plated
(with nickel plated end caps)

Actuators stocked standard for CCW rotation at supply port A, CW rotation at supply port B. Standard spring return configuration is fail CW on loss of supply air. Spring return actuators stocked with full (maximum) spring sets. When applications require it, rotation, fail position, and spring sets can be modified, but must be specified separately.

ACTION

DA = Double Acting
SR = Spring Return

Double Acting Actuator Sizing
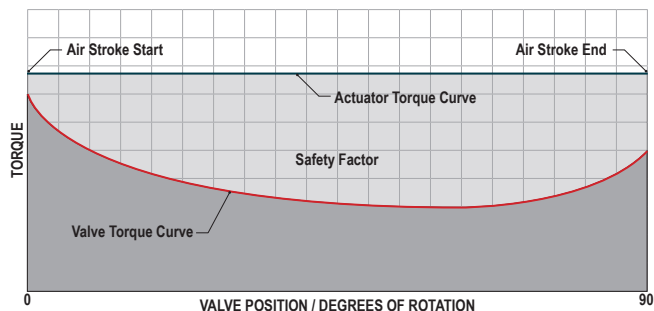
The figure RP double acting rack and pinion actuator has a constant torque output. This is represented by the horizontal line in the diagram. Sizing is simply a matter of selecting the column for the amount of supply air pressure available for the actuator, then choosing the actuator that has more torque than the highest torque requirement of the valve plus a safety factor. Any amount of torque between the valve and actuator's torque curve is the safety factor and that percentage should be chosen based on the type of valve and working conditions.

Spring Return Actuator Sizing
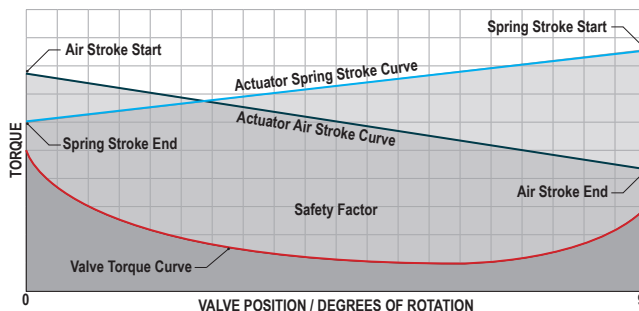
The torque output of the figure RP spring return actuators is not constant, but decreases during both the air stroke and spring stroke due to losses from compression and decompression of springs. When sizing, care must be taken to select an actuator whose end-of-air and end-of-spring stroke torque is greater than the valve's torque plus a safety factor. The RP has maximum spring strength as standard, but lower spring sets can be obtained by removing the appropriate springs.

Double Acting (Air-Air) Torque Chart

Model	Air Supply Pressure (PSI)							
	40	50	60	70	80	90	100	115
	Air Stroke Torque Output (in-lbs)							
52	88	112	133	158	178	201	227	263
63	152	193	238	282	320	361	405	469
75	283	356	435	513	586	659	736	851
85	406	514	628	744	853	960	1,072	1,237
100	645	814	989	1,163	1,333	1,505	1,681	1,939
115	1,065	1,344	1,640	1,932	2,212	2,488	2,779	3,211
125	1,402	1,771	2,153	2,539	2,905	3,274	3,650	4,220
140	2,003	2,504	3,005	3,506	4,006	4,509	5,009	5,764
160	2,804	3,501	4,196	4,899	5,596	6,292	6,987	8,045
180	3,860	4,825	5,790	6,746	7,711	8,661	9,627	11,081
200	5,198	6,494	7,796	9,089	10,393	11,670	12,972	14,924
230	8,589	10,738	12,880	15,031	17,180	19,289	21,440	24,671
270	12,625	15,777	18,935	22,093	25,246	28,361	31,511	36,269

Spring Return (Air-Spring) Torque Chart

| Model | Spring Set | Spring Stroke (in-lbs) | | Air Supply Pressure (PSI) — Air Stroke Torque Output (in-lbs) | | | | | | | | | | | | | | | |
| | | | | 40 | | 50 | | 60 | | 70 | | 80 | | 90 | | 100 | | 115 | |
		Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
52	01	44	32	48	23	72	47	95	70										
	02	59	42			61	31	84	54	108	77								
	03	66	46					80	47	104	70	127	94	150	117				
	04	82	57					70	31	93	55	116	78	140	101	163	125		
	05	105	72							78	32	101	55	125	78	148	102	183	137
63	01	85	44	92	38	134	80	176	122										
	02	109	58			120	56	162	98	204	140								
	03	128	71					149	79	191	121	233	162	275	204				
	04	152	85					136	54	177	96	219	138	261	180	303	222		
	05	196	111							151	53	193	95	235	136	276	178	339	241
75	01	172	89	168	63	244	138	319	214										
	02	226	118			215	85	291	160	366	235								
	03	249	133					275	137	351	212	426	288	502	363				
	04	303	162					247	83	322	158	398	234	473	309	549	385		
	05	380	205							279	81	354	157	430	232	505	308	618	421
85	01	242	143	238	109	349	219	460	330										
	02	298	176			316	163	427	274	537	384								
	03	361	215					387	211	498	322	609	432	720	543				
	04	417	248					354	155	465	265	576	376	687	487	797	633		
	05	536	321							392	146	503	257	614	368	725	478	891	645
100	01	395	218	384	154	556	326	728	499										
	02	521	288			485	199	658	372	830	544								
	03	564	318					628	329	801	502	973	674	1,146	847				
	04	691	389					558	203	730	375	903	548	1,075	720	1,248	893		
	05	860	489							630	206	802	378	975	551	1,147	723	1,406	982
115	01	658	363	650	270	935	555	1,220	840										
	02	835	449			848	378	1,133	663	1,419	949								
	03	957	538					1,044	541	1,329	827	1,615	1,112	1,900	1,397				
	04	1,133	625					958	365	1,243	650	1,528	935	1,813	1,220	2,098	1,505		
	05	1,432	800							1,067	352	1,352	637	1,638	922	1,923	1,207	2,350	1,635
125	01	877	470	850	328	1,224	703	1,599	1,077										
	02	1,040	560			1,135	400	1,400	840	2,000	1,883								
	03	1,313	718					1,351	640	1,725	1,015	2,099	1,389	2,474	1,763				
	04	1,477	808					1,261	477	1,636	851	2,010	1,226	2,384	1,600	2,758	1,974		
	05	1,913	1,055							1,388	415	1,762	789	2,136	1,164	2,511	1,538	3,072	2,099
140	01	1,346	726	1,240	508	1,742	1,010	2,244	1,512										
	02	1,523	815			1,642	821	2,144	1,323	2,646	1,825								
	03	1,958	1,036					1,910	856	2,412	1,358	2,914	1,861	3,408	2,355				
	04	2,126	1,134					1,810	668	2,312	1,170	2,814	1,672	3,308	2,166	3,810	2,668		
	05	2,728	1,453							1,979	515	2,481	1,017	2,975	1,511	3,477	2,013	4,233	2,769
160	01	1,159	735	2,036	1,585	2,741	2,290												
	02	1,664	1,053			2,405	1,532	3,085	2,438										
	03	1,991	1,266			2,184	1,405	2,863	2,084	3,552	2,773								
	04	2,584	1,637					2,465	1,456	3,153	2,463	3,859	2,850						
	05	2,823	1,788							2,985	1,896	3,691	2,603	4,405	3,317				
	06	3,744	2,372									3,080	1,620	3,795	2,335	4,474	3,014	5,528	4,069
180	01	1,487	903	2,540	1,921	3,239	2,620												
	02	2,230	1,416			2,691	1,823	4,089	3,222										
	03	2,602	1,611			2,487	1,434	3,885	2,832	5,275	4,222								
	04	3,664	2,319					3,133	1,735	4,523	3,124	5,222	3,824						
	05	3,717	2,319							4,523	3,036	5,222	3,735	5,921	4,434				
	06	5,151	3,222									4,266	2,248	4,965	2,947	6,364	4,346	7,762	5,744
200	01	2,222	1,496	3,638	2,895	4,954	4,211												
	02	3,124	2,098			4,264	3,211	5,531	4,477										
	03	3,788	2,549			3,812	2,556	5,080	3,823	6,338	5,081								
	04	4,620	2,992					4,549	2,885	5,807	4,144	7,132	5,468						
	05	5,346	3,593							5,196	3,418	6,521	4,742	7,837	6,058				
	06	6,842	4,487									5,539	3,150	6,854	4,465	8,122	5,732	10,066	7,677
230	01	5,895	3,443	4,124	1,522	5,682	3,080	8,789	6,187										
	02	7,072	4,124			4,956	1,823	8,063	4,930										
	03	8,258	4,815					7,328	3,682	10,444	6,797								
	04	9,435	5,505					6,603	2,425	9,718	5,541	11,276	7,098						
	05	10,612	6,196					5,868	1,177	8,984	4,293	10,541	5,850	12,090	7,399				
	06	11,789	6,877							8,258	3,036	9,815	4,594	11,364	6,142	14,480	9,258	17,586	12,364
270	01	7,001	4,478	8,096	5,530	11,308	8,742	14,548	11,982										
	02	8,399	5,372	7,141	4,061	10,353	7,273	13,627	10,513										
	03	9,798	6,266	5,229	2,592	9,397	5,804	12,637	9,044	15,877	12,284								
	04	11,196	7,169			8,450	4,344	11,690	7,583	14,930	10,823	18,141	14,036						
	05	12,595	8,063					10,734	6,114	13,974	9,354	17,185	12,566	20,397	18,478				
	06	13,993	8,957					9,778	4,645	13,018	7,885	16,230	11,097	19,441	14,308				
	07	15,400	9,851					8,823	3,216	12,062	6,416	15,275	9,628	18,486	12,839	21,717	16,071		
	08	16,799	10,745					7,867	1,707	11,107	4,947	14,319	8,159	17,530	11,370	20,762	14,602	25,593	19,434

Dimensional Drawing - Models 52 to 230

M6 x 0.47 deep
Ø10-24 UNC 2B (x4 or 8)

ØI
ØK

B A

.63
.63

ØT
.47 .47
M5 (X4)

O

.16 .16

F
E

C D

ØP
CH
ØS

N (deep)

ØRR
ØQ
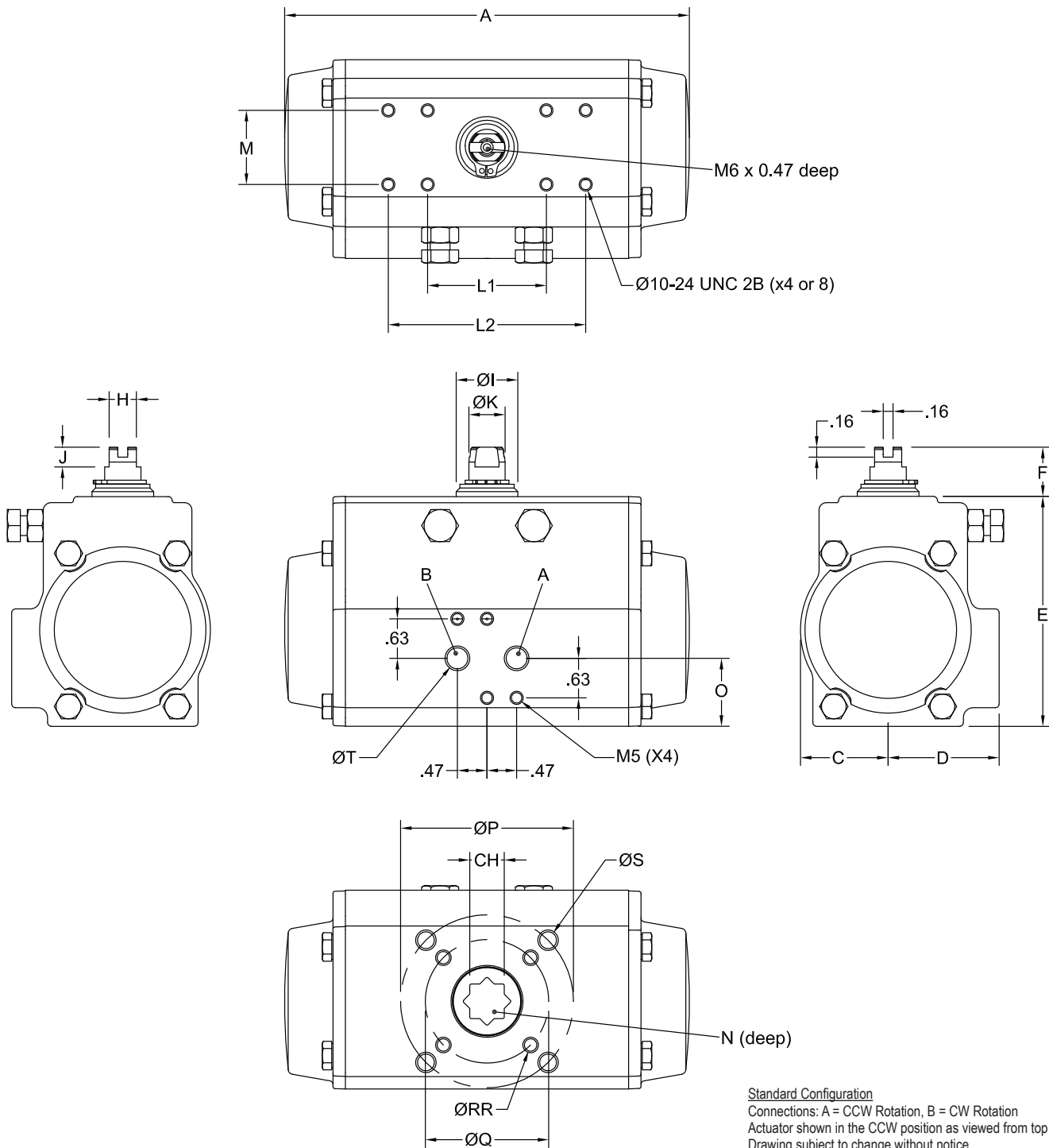
Model	Mtg (ISO 5211)	CH	A	C	D	E	F	H	øI	J	øK	L1	L2	M	N	O	P	Q	R (UNC 2B)	S (UNC 2B)	T (NPT)
52	F03/F05	0.43	5.55	1.18	1.61	3.21	0.79	0.35	0.83	0.31	0.47	3.15		1.18	0.47	1.04	1.97	1.42	10-24	1/4"-20	1/8"
63	F05/F07	0.55	6.46	1.40	1.77	3.66	0.79	0.43	0.98	0.31	0.59	3.15		1.18	0.63	1.08	2.76	1.97	1/4"-20	5/16"-18	1/8"
75	F05/F07	0.67	8.27	1.65	2.07	4.37	0.79	0.51	1.14	0.31	0.75	3.15		1.18	0.75	1.38	2.76	1.97	1/4"-20	5/16"-18	1/8"
85	F05/F07	0.67	9.47	1.87	2.30	4.92	0.79	0.59	1.38	0.31	0.87	3.15		1.18	0.75	1.65	2.76	1.97	1/4"-20	5/16"-18	1/8"
100	F07/F10	0.67	10.83	2.17	2.68	5.43	0.79	0.59	1.38	0.31	0.87	3.15		1.18	0.81	1.97	4.02	2.76	5/16"-18	3/8"-16	1/4"
115	F07/F10	0.87	13.11	2.52	2.87	6.39	1.18	0.87	1.93	0.55	1.26	5.12		1.18	0.95	1.97	4.02	2.76	5/16"-18	3/8"-16	1/4"
125	F07/F10	0.87	14.65	2.68	3.15	6.87	1.18	0.87	1.93	0.55	1.26	5.12		1.18	0.95	2.40	4.02	2.76	5/16"-18	3/8"-16	1/4"
140	F10/F12	1.06	17.13	3.01	3.44	7.76	1.18	0.94	1.93	0.63	1.38	5.12		1.18	1.14	2.80	4.92	4.02	3/8"-16	1/2"-13	1/4"
160	F10/F12	1.06	19.69	3.43	3.90	8.70	1.18	1.18	2.24	0.63	1.57	3.15	5.12	1.18	1.26	3.15	4.92	4.02	3/8"-16	1/2"-13	1/4"
180	F14	1.42	19.41	3.86	4.53	9.96	1.18	1.42	2.44	0.63	1.77	3.15	5.12	1.18	1.69	3.90	5.51			5/8"-11	1/4"
200	F14	1.42	22.78	4.25	4.29	10.94	1.18	1.42	2.64	0.63	1.97	3.15	5.12	1.18	1.46	3.07	5.51			5/8"-11	1/4"
230	F16	1.81	27.17	4.88	4.90	12.80	1.18	1.42	2.64	0.63	1.97	3.15	5.12	1.18	1.97	3.62	6.50			3/4"-10	1/4"

Dimensional Drawing - Model 270

DETAIL A

M6 x 0.47 deep

M

Ø10-24 UNC 2B (x8)

DETAIL A

Standard Configuration
Connections: A = CCW Rotation, B = CW Rotation
Actuator shown in the CCW position as viewed from top
Drawing subject to change without notice
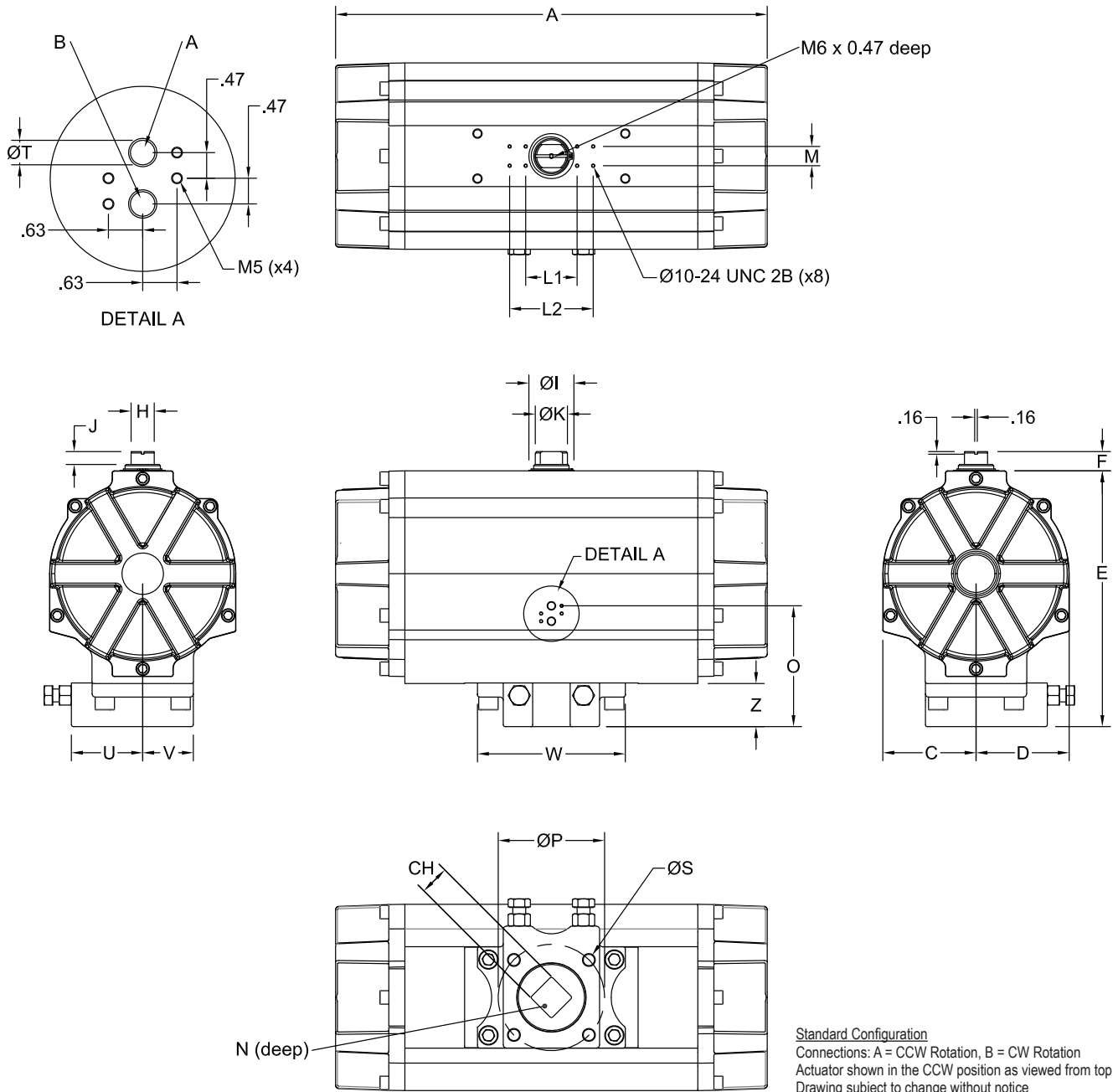
Model	Mtg (ISO 5211)	CH	A	C	D	E	F	H	øI	J	øK
270	F16	1.81	26.46	5.71	5.71	15.71	1.18	1.42	2.76	0.79	1.97

Model	L1	L2	M	N	O	P	S (UNC 2B)	T (NPT)	U	V	W	Z
270	3.15	5.12	1.18	1.97	7.40	6.50	3/4"-10	1/4"	4.37	3.11	9.06	2.68

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