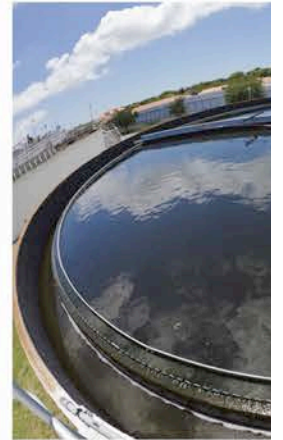


ACTUATION CATALOG



"Apollo" Valves
manufactured in the USA
by CONBRACO Industries

ACTUATORS

INDEX

	PAGE
I) Pneumatic Actuators	3-21
Apollo® Pneumatic Rack and Pinion Actuators	3-10
Apollo® Actuator Parts List Model A0025-A1600	4
Apollo® Actuator Parts List Model A2500-A4000	5
Apollo® Actuator Dimensions Models A0025-A4000	6-7
Apollo® Actuator Dimensions Model 32	8
Apollo® Double Acting Torque	8
Apollo® Spring Return Torque	9
Apollo® Actuator Technical Data	10
Apollo® Acutorque SS Actuators	11-16
G Series Actuators	17-21
II) Electric Actuators	22-30
AE Actuator	22-25
AE Actuator Wiring Diagram	25
CS and CL Electric Actuators	26-27
LB Series Electric Actuators	28-30
III) Accessories	31-38
Apollo® Solenoids	31-32
Stonel Limit Switch Assemblies	33
VRC Positioners	34
PMV Positioners	35-36
Proximity Valve Position Monitoring Systems	37
OSHA Lockout Tagout Device	38
IV) Apollo® Ball Valve Information	39-44
V) Apollo® Butterfly Valves	45-46
NOTES	47

GENERAL INFORMATION

Conbraco Industries, Inc. certifies that the published torque values are the minimum values to be expected from a new actuator. A properly applied and maintained actuator should produce the published torque values throughout its service life. Conbraco Industries Inc. reserves the right without notice to alter designs, specifications or availability of the products described herein. Mounting brackets should only be made from certified dimensional drawings.

CONBRACO INDUSTRIES STATEMENT OF WARRANTY AND LIMITATIONS OF LIABILITY

Conbraco Industries, Inc. warrants, to its initial purchaser only, that its products which are delivered to this initial purchaser will be of the kind described in the order or price list and will be free of defects in workmanship or material for a period of **TWO years** from the date of delivery to you, our initial purchaser.

Should any failure to conform to this warranty appear within two years after the date of the initial delivery to our initial purchaser, Conbraco will, upon written notification thereof and substantiation that the goods have been stored, installed, maintained and operated in accordance with Conbraco's recommendations and standard industry practice, correct such defects by suitable repair or replacement at Conbraco's own expense.

New For April 2009: Extension of Warranty for Apollo products manufactured in the USA. Conbraco warrants those products that are manufactured in our USA facilities for an additional 3 years; making the total warranty **FIVE years**. This extended warranty applies to Apollo brand product with "Made in the USA" markings only.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OTHER WARRANTY OF QUALITY, WHETHER EXPRESSED OR

IMPLIED, EXCEPT THE WARRANTY OF TITLE AND AGAINST PATENT INFRINGEMENT. Correction of non-conformities, in the manner and for the period of time provided above, shall constitute fulfillment of all liabilities of Conbraco to our initial purchaser, with respect to the goods, whether based on contract, negligence, strict tort or otherwise. It is the intention of Conbraco Industries, Inc. that no warranty of any kind, whether expressed or implied shall pass through our initial purchaser to any other person or corporation.

LIMITATION OF LIABILITY: Conbraco Industries, inc. SHALL NOT UNDER ANY CIRCUMSTANCES BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES SUCH AS, BUT NOT LIMITED TO, DAMAGES OR TO LOSS OF OTHER PROPERTY OR EQUIPMENT, LOSS OF PROFITS OR REVENUE, COST OF CAPITAL, COST OF PURCHASED OR REPLACEMENT GOODS, OR CLAIMS OF CUSTOMERS OF OUR INITIAL PURCHASER. THE REMEDIES OF OUR INITIAL PURCHASER, AND ALL OTHERS, SET FORTH HEREIN, ARE EXCLUSIVE, AND THE LIABILITY OF CONBRACO WITH RESPECT TO SAME SHALL NOT, EXCEPT AS EXPRESSLY PROVIDED HEREIN, EXCEED THE PRICE OF THE GOODS UPON WHICH SUCH LIABILITY IS BASED.

Apollo® Rack & Pinion

Designed and manufactured for the ultimate in durability and reliability, the new Apollo® Pneumatic Rack & Pinion Actuators provide outstanding service life.

Apollo Actuation's new Rack & Pinion actuator reintroduces the replaceable insert drive adapters in all but the largest models. Many units retain dual "F" series bolt patterns and this combination of features will facilitate direct mounting of several valve styles.



FEATURES

1. **Cast Aluminum Body**
Yellow Chromate Coated
Epoxy Finish
2. **Die Cast Aluminum End Caps**
Yellow Chromate Coated
Epoxy Finish
3. **Die Cast Aluminum Pistons**
Yellow Chromate Coated
4. **Aluminum Alloy Pinion**
7075-T6
Hard-coat Anodized Finish
5. **Drive Inserts**
Extruded Aluminum
Hard-coat Anodized Finish
6. **Preloaded Concentric Springs**
Deltatone® Coated
7. **Piston Guides**
Molybdenum Disulfide filled Polyamide
8. **Bushings**
Polyoxymethylene (POM)
9. **O-Ring Seals**
Standard Temp. (-4°F to 180°F): Buna-N
High Temp. (-4°F to 250°F): Fluorocarbon
Low Temp. (-40°F to 180°F): Silicone
10. **Capscrews, Nuts & Other Hardware**
304 Stainless Steel

BENEFITS

- ✓ Compact Rack & Pinion Design
- ✓ Quarter-Turn Operation
- ✓ Designed for use on a variety of Valve Types; Ball Valves, Butterfly Valves, Plug Valves
- ✓ Applicable to Damper and Door Openers
- ✓ Thirteen Distinct Sizes
- ✓ Both Single Stop and Double Stop Versions**
- ✓ Both Double-Acting and Spring-Return Units
- ✓ Double-Acting Torque Outputs from 119 in-lbs to 40273 in-lbs with an 80 psi Air Supply
- ✓ Removable/Replaceable Drive Inserts*



- ✓ Pre-loaded Spring Assemblies
- ✓ ISO 5211 Valve Mounting
- ✓ NAMUR (VDI/VDE) Accessory Mounts
- ✓ ATEC Classification II, 2 GD, Zones 1 or 2 (Gases) and 21 or 22 (Dust)
- ✓ Anti Blow-Out Pinion Design
- ✓ Maximum Pressure Rating: 116 psig (8 bar)
- ✓ Compatible Media: Clean, Dry Air, Filtered Non-corrosive Gas or Light Hydraulic Oil
- ✓ Pre-lubricated for the life of the Actuator
- ✓ Chromate Corrosion Protection on all Aluminum Components
- ✓ Each Unit is Serialized
- ✓ **5 Year Apollo Warranty**

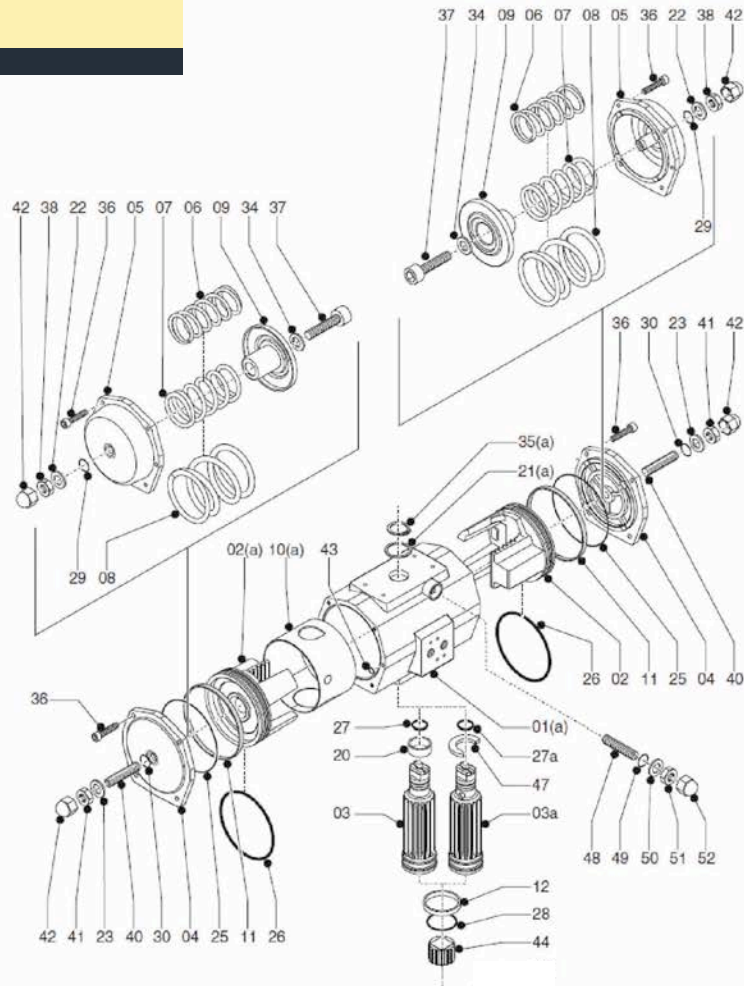
Notes:

* A wide selection of standard inserts is available for Square, DIN and Double-D drives.

** Single Stop units are used where the open position of the valve requires precise adjustment. These are standard on all actuators with the exception of the two larger sizes where single stops are optional. Actuators with dual adjustable stops are also available for those applications on butterfly valves, for example, to allow precise adjustment of both the open and closed positions.

Actuators and Controls

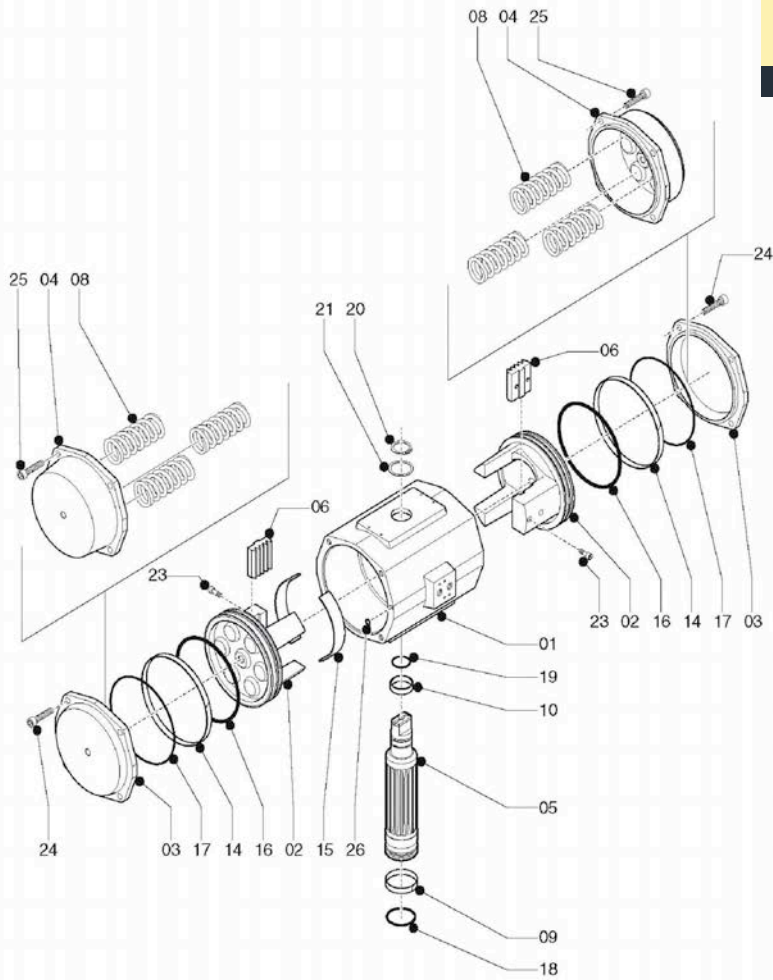
A0025 to A1600 Parts List



01	(1) Body	21*	(1) Thrust Washer	38	(2) Stop Adjustment Nut
02	(2) Piston	22*	(2) Stop Screw Washer	40	(2) Limit Stop Bolt
03	(1) Pinion	23*	(2) Stop Screw Washer	41	(2) Stop Adjustment Nut
04	(2) D-A End Cap	25*	(2) End Cap O-ring	42	(2) Nut Cover
05	(2) S-R End Cap	26*	(2) Piston O-ring	43	(2) Port O-ring
06	(0 to 2) Inner Spring	27*	(1) Upper Pinion O-ring	44	(1) Insert/Adapter
07	(0 to 2) Middle Spring	28*	(1) Lower Pinion O-ring	47	(1) Stroke Cam
08	(0 to 2) Outer Spring	29*	(2) Stop Screw O-ring	48	(1) Dual Stop Bolt
09	(2) Spring Holder	30*	(2) Stop Screw O-ring	49*	(1) Dual Stop O-ring
10*	(1) Guide Band	34	(2) Stop Screw Washer	50*	(1) Dual Stop Washer
11*	(2) Piston Guide	35	(1) Spring Clip	51	(1) Dual Stop Lock Nut
12	(1) Lower Bearing	36	(8) End Cap Bolt	52	(1) Dual Stop Nut Cover
20*	(1) Upper Bearing	37	(2) Limit Stop Bolt		

* Contained in Repair Kit

A2500 to A4000 Parts List

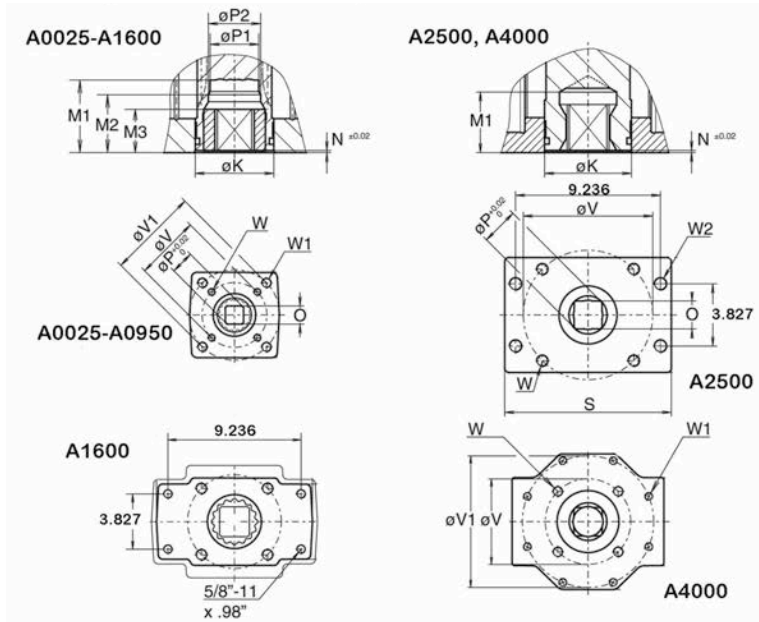
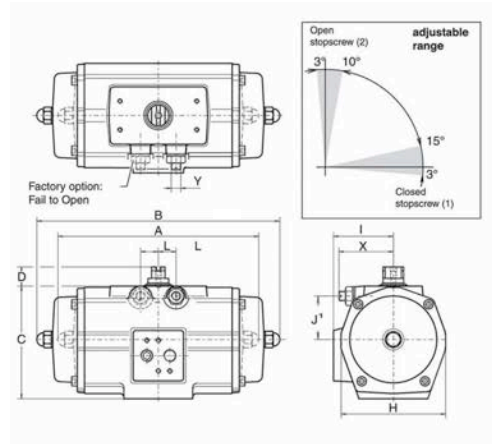
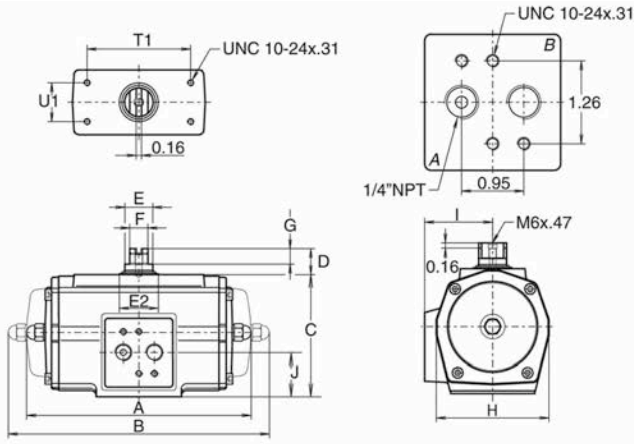


- | | | | | | |
|-----|-----------------------|-----|-------------------------|-----|---------------------------|
| 01 | (1) Body | 10* | (1) Upper Bearing | 21* | (1) Thrust Washer |
| 02 | (2) Piston | 14* | (2) Piston Guide | 23 | (2 or 4) Rack Capscrew |
| 03 | (2) D-A End Cap | 15* | (2) Heel Guide | 24 | (8 or 20) DA End Cap Bolt |
| 04 | (2) S-R End Cap | 16* | (2) Piston O-ring | 25 | (8 or 20) SR End Cap Bolt |
| 05 | (1) Pinion | 17* | (2) End Cap O-ring | 26 | (2) Port O-ring |
| 06 | (2) Gear Rack | 18* | (1) Lower Pinion O-ring | | |
| 08 | (0 to 14) Coil Spring | 19* | (1) Upper Pinion O-ring | | |
| 09* | (1) Lower Bearing | 20* | (1) Spring Clip | | |

* Contained in Repair Kit

Actuators and Controls

Dimensional Data



Rack & Pinion Actuator Envelop Dimensions

(Inches)	Overall Length	Overall Length	Body Height	Body Width	Solenoid Pad Offset	Port Location	Adjustable Closed Stop	Adjustable Closed Stop	Stop Size	Stop Protrusion
	A (DA)	B (SR)	C	H	I	J	J1*	L*	Y*	X max.*
A0025	6.26	6.77	3.15	2.91	1.81	1.26	1.11	0.45	1/4"-20	1.63
A0040	7.09	8.03	3.66	3.39	2.09	1.32	1.38	0.61	5/16"-18	1.91
A0065	7.83	9.80	4.13	3.86	2.26	1.54	1.57	0.61	5/16"-18	1.91
A0100	8.70	10.51	4.65	4.25	2.48	1.59	1.72	0.73	3/8"-16	2.30
A0150	10.00	12.20	5.51	4.76	2.76	1.59	1.92	0.97	3/8"-16	2.64
A0200	11.40	14.17	5.63	5.04	2.87	1.99	2.12	0.97	1/2"-13	2.91
A0350	12.01	15.24	7.13	6.81	3.71	2.85	2.85	0.97	1/2"-13	3.31
A0600	15.24	18.78	8.66	8.15	4.45	3.33	3.50	1.63	5/8"-11	4.51
A0950	16.69	20.35	10.20	9.09	4.96	4.15	4.03	1.63	5/8"-11	4.51
A1600	20.31	25.08	11.69	10.43	5.59	4.74	4.50	1.87	3/4"-10	4.88
A2500	14.88	22.40	14.02	13.78	7.28	7.01	N/A	N/A	N/A	N/A
A4000	19.76	32.83	14.96	14.96	7.87	7.48	N/A	N/A	N/A	N/A

*Applies to double stop versions only

Rack & Pinion Actuator Drive Details

(Inches)	Bottom Pinion Diameter	Valve Stem Clearance	Insert or Adapter Height	Pinion Recess	Standard Square Output	Standard Square Output	Across Corners Diameter
	K	M1	M3	N	O max	O min	P1
A0025	0.94	1.36	0.67	0.04	0.437	0.433	0.555
A0040	1.30	1.36	0.67	0.04	0.555	0.551	0.713
A0065	1.30	1.36	0.67	0.04	0.556	0.551	0.713
A0100	1.50	1.36	0.79	0.06	0.753	0.748	0.992
A0150	2.17	1.97	0.79	0.04	0.753	0.748	1.004
A0200	2.17	1.97	1.16	0.06	0.871	0.866	1.100
A0350	2.17	1.97	1.16	0.06	1.068	1.063	1.425
A0600	2.68	2.05	1.16	0.06	1.068	1.063	1.425
A0950	2.95	2.52	1.95	0.06	1.424	1.417	1.898
A1600	3.74	3.23	2.30	0.06	1.817	1.811	2.370
A2500	3.35	2.60	N/A	0.12	1.817	1.811	2.370
A4000	4.72	3.03	N/A	0.06	2.173	2.165	2.843

Rack & Pinion Actuator Mounting Dimensions

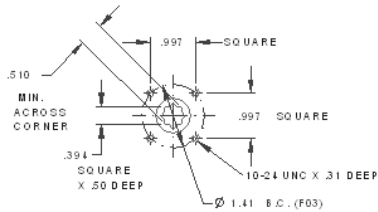
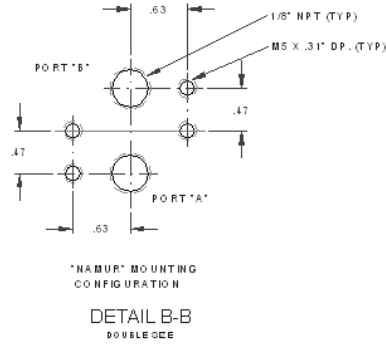
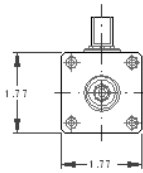
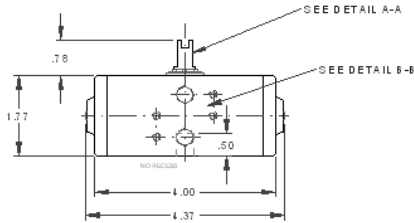
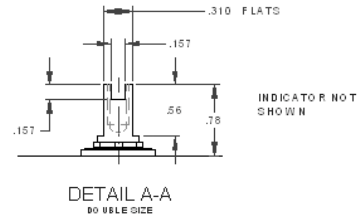
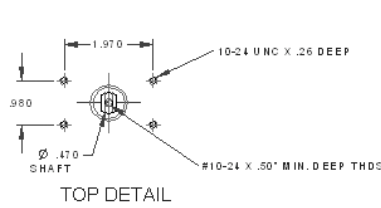
(Inches)	Primary ISO "F" Pattern	Primary Bolt Circle	Primary Fastener	Secondary ISO "F" Pattern	Secondary Bolt Circle	Secondary Fastener
		V	W		V1	W1
A0025	F04	1.65	1/4"-20 x .39"	N/A	N/A	N/A
A0040	F05	1.969	1/4"-20 x .39"	F07	2.756	5/16"-18 x .39
A0065	F05	1.969	1/4"-20 x .39"	F07	2.756	5/16"-18 x .39
A0100	F05	1.969	1/4"-20 x .39"	F07	2.756	5/16"-18 x .39
A0150	F07	2.756	5/16"-18 x .39	F10	4.016	3/8"-16 x .63"
A0200	F07	2.756	5/16"-18 x .39	F10	4.016	3/8"-16 x .63"
A0350	F07	2.756	5/16"-18 x .39	F10	4.016	3/8"-16 x .63"
A0600	F10	4.016	3/8"-16 x .63"	F12	4.921	1/2"-13 x .79"
A0950	F10	4.016	3/8"-16 x .63"	F14	5.512	5/8"-11 x .98"
A1600	F16	6.496	3/4"-10 x 1.14"	N/A	N/A	N/A
A2500	F16	6.496	3/4"-10 x 1.14"	N/A	N/A	N/A
A4000	F16	6.496	3/4"-10 x 1.14"	F25	10.000	5/8"-11 x .98"

Rack & Pinion Actuator Mounting Details

(Inches)	Namur Shaft Extension	Namur Shaft Diameter	Thrust Bearing Diameter	Namur Shaft Flats	Namur Flat Length	Namur Bolt Pattern	Namur Bolt Pattern
	D	E	E2	F	G	T1	U1
A0025	0.79	0.63	0.91	0.39	0.47	3.15	1.181
A0040	0.79	0.87	1.18	0.55	0.47	3.150	1.181
A0065	0.79	0.87	1.18	0.55	0.47	3.150	1.181
A0100	0.79	0.87	1.18	0.55	0.47	3.150	1.181
A0150	0.79	1.42	1.77	0.75	0.47	3.150	1.181
A0200	0.79	1.42	1.77	0.75	0.47	3.150	1.181
A0350	0.79	1.42	1.77	0.75	0.47	3.150	1.181
A0600	1.18	2.17	2.56	1.42	0.39	5.118	1.181
A0950	1.18	2.17	2.56	1.42	0.39	5.118	1.181
A1600	1.18	2.52	2.95	1.42	0.39	5.118	1.181
A2500	1.18	2.17	2.56	1.42	0.39	5.118	1.181
A4000	1.18	2.52	3.15	1.42	0.39	5.118	1.181

Actuators and Controls

Dimensions Model 32



NOTES:

- 1) ACTUATOR SHOWN IN CLOSED POSITION.
- 2) MAX. RATED OPERATING PRESSURE (10 BAR) 142 PSIG
- 3) REFER TO APOLLO ACTUATORS & CONTROLS CATALOG FOR TORQUE OUTPUT INFORMATION.
- 4) PRESSURE TO PORT "A" - C.C.W. ROTATION (NORMALLY OPEN)
PRESSURE TO PORT "B" - C.W. ROTATION (NORMALLY CLOSED)

3TD01000 EST. WEIGHT = 1 LB.

Model	Torque Output (in-lb)							
	Supply Pressure (psi)							
	40	50	60	70	80	90	100	115
DA32	34	43	55	64	71	82	87	101

Double Acting Actuator

Sizing Apollo® Rack & Pinion

Actuator Size	Torque Output of Double Acting Actuators (in-lb)										
	Supply Pressure (psi)										
	40	45	50	55	60	70	75	80	90	100	120
AD0012	58.9	66.4	73.9	81.4	88.9	104	111	119	134	149	179
AD0025	109	123	137	151	165	193	206	220	248	276	332
AD0040	205	231	257	283	309	361	387	413	466	518	622
AD0065	312	352	392	431	471	551	590	630	709	789	948
AD0100	461	520	578	637	696	813	872	930	1048	1165	1400
AD0150	739	833	927	1021	1115	1303	1397	1491	1680	1868	2244
AD0200	1011	1140	1269	1398	1527	1784	1913	2042	2299	2557	3072
AD0350	1757	1981	2205	2428	2652	3100	3323	3547	3994	4442	5337
AD0600	2986	3366	3747	4127	4507	5267	5647	6028	6788	7548	9069
AD0950	4458	5025	5593	6160	6728	7862	8430	8997	10132	11267	13537
AD1600	7369	8307	9245	10183	11121	12998	13936	14874	16750	18626	22379
AD2500	11825	13270	14768	16267	17847	20858	22363	23869	26880	29891	35912
AD4000	19962	22495	25035	27576	30127	35210	37751	40293	45375	50458	60623

Actuators and Controls

Technical Data

Double Acting		AD0012	AD0025	AD0040	AD0065	AD0100	AD0150	AD0200	AD0350	AD0600	AD0950	AD1600	AD2500	AD4000
Weight	(lbs)	1.3	2.9	4.0	5.3	6.8	10.5	12.8	23.0	43.0	58.0	95.0	125.0	191.0

Spring Return		AS0012	AS0025	AS0040	AS0065	AS0100	AS0150	AS0200	AS0350	AS0600	AS0950	AS1600	AS2500	AS4000
Weight	(lbs)	1.5	3.7	5.3	7.9	10.1	15.2	20.1	37.0	61.0	85.0	145.0	194.0	291.0

Displacement	(cu in.)	AD0012	AD0025	AD0040	AD0065	AD0100	AD0150	AD0200	AD0350	AD0600	AD0950	AD1600	AD2500	AD4000
		AS0012	AS0025	AS0040	AS0065	AS0100	AS0150	AS0200	AS0350	AS0600	AS0950	AS1600	AS2500	AS4000
Port A	CCW	3.1	6.1	9.8	20	21	45	49	110	177	287	445	488	824
Port B	CW	3.7	6.7	13	22	30	40	61	116	189	299	488	568	1068

Air consumption (scf per 90°) = (Displacement/1728)*(Supply Pressure + 14.7)/14.7

Operating Time	AD0012	AD0025	AD0040	AD0065	AD0100	AD0150	AD0200	AD0350	AD0600	AD0950	AD1600	AD2500	AD4000
	AS0012	AS0025	AS0040	AS0065	AS0100	AS0150	AS0200	AS0350	AS0600	AS0950	AS1600	AS2500	AS4000
Seconds	0.4	0.5	0.7	1.1	1.2	1.8	2.3	3.6	4.5	5.4	6.9	7	12

Selecting/Sizing Apollo Rack & Pinion Actuators

Establish the valve operating torque beginning with the torque constants for the appropriate pressure and valve as found on pages 41 or 42. Use the torque adjustment factors found on page 43 to arrive at an in-service torque figure. Multiple adjustment factors may be required. Do not forget to include adjustments for graphite stem packings (valve options -21, 24 or 65 for conventional ball valves, BO, BS, EV, FD and FP for TEVs')

For Double Acting Actuators

Based on the available air supply select an actuator with torque outputs that exceed the in-service torque by at least 10%.

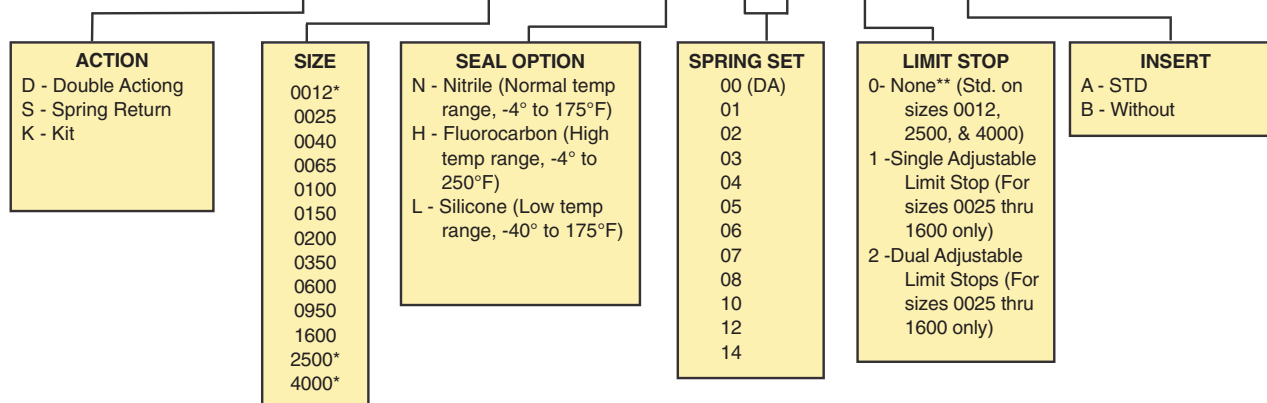
For Spring Return Actuators

Considering the available air supply, select an actuator where both the Spring-Ending torque figure and the Air-Ending torque figure exceeds the in-service torque by at least 10%.

Note: Single-Stop actuators are appropriate for use on ball valves. Dual-Stop actuators are required for most butterfly valve applications with a few exceptions but may also be used on ball valves.

Apollo® Pneumatic Actuator Numbering System

A X - XXXX - X - XX - X - X



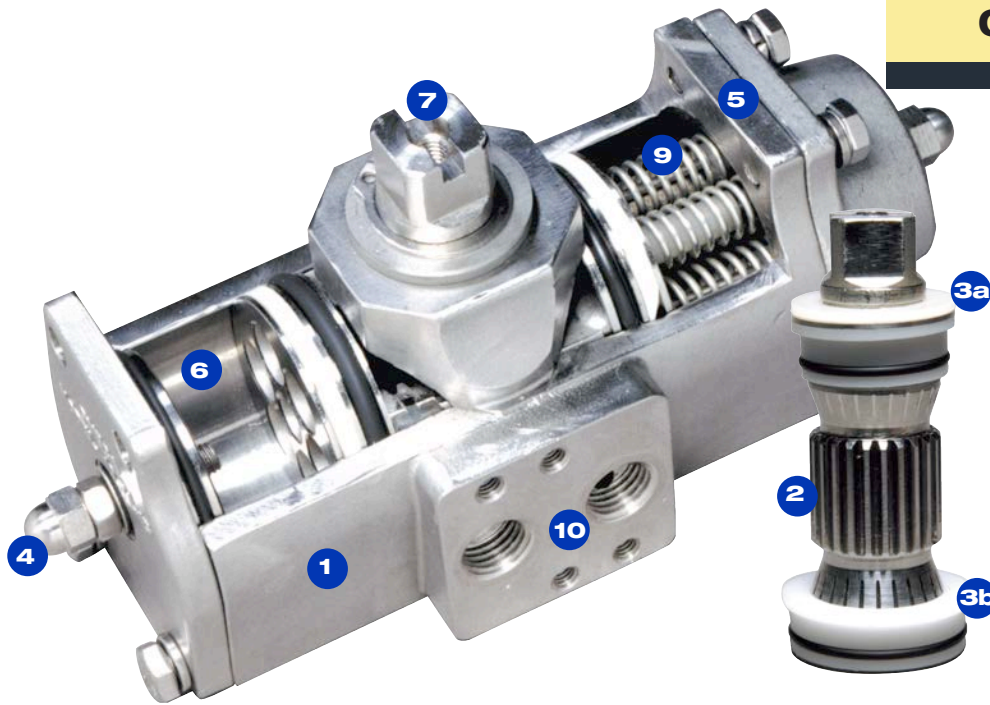
* Units with no adapters option

** Optional double stroke adjustment plate is available for 2500 & 4000 (see price list)

NOTE: Add suffix "F" for fail open units

"Acutorque" Stainless Steel Actuator

Design and Construction



1. Investment Cast Body

Assures manufacturing of other special alloys, such as Monel

2. Unique Drive Pinion

One piece stainless steel alloy shaft, precision machined gear and teeth for precise control

3. Bearings

Replaceable top and bottom TFE Pinion Bearings to ensure low friction, stability above 400°F, and chemical resistance

4. Travel Stops

Provides +/-4° travel adjustment in outboard direction

5. Accessory Mounting

Manufactured to NAMUR to provide international standardized mounting

6. Stainless Steel Pistons

Precision cast pistons are guided through full face engagement with the pinion and piston guide

7. NAMUR Slotted Shaft

Standard to provide a self-centering positive drive for positioners, a variety of switches

8. Actuator Mounting

Manufactured in accordance with ISO 5211 to ensure mounting the actuator directly on valves

9. Pre-loaded Cartridges

Converts a standard double acting actuator to a spring return unit by simply removing the end caps and adding the spring cartridges

10. NAMUR Solenoid Mounting

International standard for direct mounting of solenoid valves

Operation

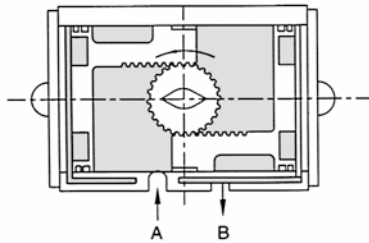
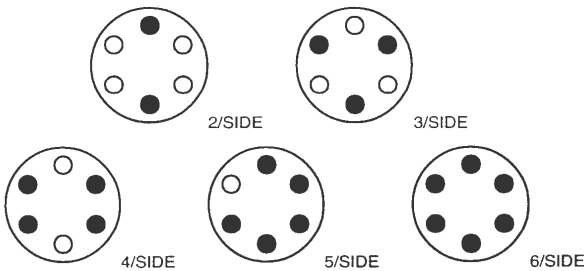
The Apollo® Acutorque actuator is manufactured with an integral and internal air manifold. The solenoid mounting pad is manufactured to Namur dimensional standards as to allow for the direct mounting of various manufacturers' solenoid valves and other flow control devices. For applications not requiring a direct mount solenoid valve, ports are tapped to NPT standards (American National Standard taper threads).

Reverse Rotation

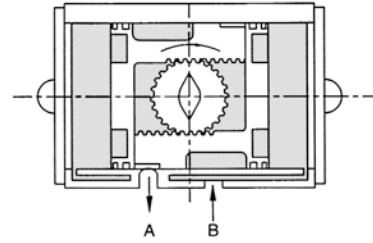
When required, a clockwise rotation of the drive pinion, by means of air to PORT A can be achieved by reversing the pistons inside the actuator body (rotate 180 degrees).

Spring Configuration

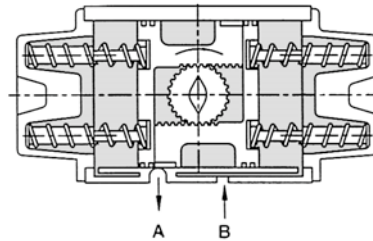
Each Acutorque actuator comes with a complete spring pack (6 springs per side with nylon retainers) unless otherwise specified. When less than the full spring pack is desired for various torque outputs (see torque chart); springs can be removed from the actuator end caps. It is very important that springs can be arranged in a symmetrical manner (positioned as shown below) so that unwarranted side-load does not occur between the pistons and actuator body. **CAUTION:** Refer to operation and maintenance instructions before disassembly and removal of springs.



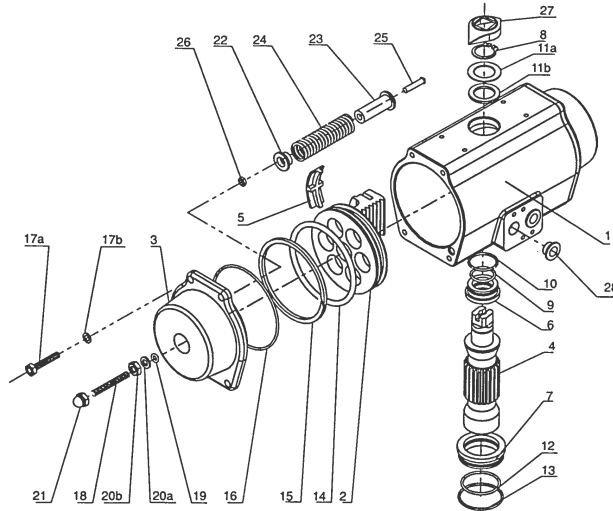
Air to PORT A - Pressure applied enters center of chamber forcing the pistons outward and rotating the drive pinion in a counter-clockwise direction and forcing exhaust air out of PORT B.



Air to PORT B - Air pressure enters the outer chambers forcing the pistons inward and rotating the drive pinion in a clockwise direction while forcing exhaust air out of PORT A.



Loss of air pressure in the center chamber allows energy in the compressed springs to force the pistons inward, resulting in a clockwise rotation of the drive pinion while exhaust air leaves via PORT A.



Corrosion Resistance

All metal components are cast or machined from Stainless Steel or Monel, which offers excellent resistance to most corrosive chemicals as well as industrial atmospheres.

No Lubrication

All actuators are factory lubricated for the optimum life of the actuator under normal conditions. Teflon® piston bearings are used because of their self-lubricating properties.

Simple Maintenance

Each actuator is designed for ease of maintenance. Should you wish simply to change a spring rating or completely rebuild a unit, total disassembly and reassembly is easily performed in just minutes with standard shop tools.

ISO/NAMUR Mounting

By using ISO/NAMUR standards, our actuators lend themselves to a host of various manufacturers' direct mount accessories. Solenoid valves, limit switches, positioners, etc. bolt directly to the actuator and in turn reduces the cost of assembly and installation of automated packages. Flexibility for future system modifications is greatly enhanced.

fications is greatly enhanced.

Quality

Each part of the actuator must pass a stringent quality test before it can be incorporated into an assembly. All materials used in construction must be certified and tested to prove their proper composition. Every cast part must pass an X-ray test before proceeding to the machining process. After machining every part is dimensionally calibrated in order to assure it meets acceptable tolerance.

Safety

All actuator bodies and end caps are investment cast stainless steel, rugged and built to last. It may be argued that the mechanical properties of stainless steel permit the ability to use this wall tubing in the construction of an actuator. However, that is not the case with our actuator. Thick wall castings mean protection for actuator internal porting and components as well as maintenance and operating personnel. Our unique drive pinion design ensures blowout proof protection. Spring retainers are incorporated to allow safe removal of end caps during spring torque rating change or rebuild process.

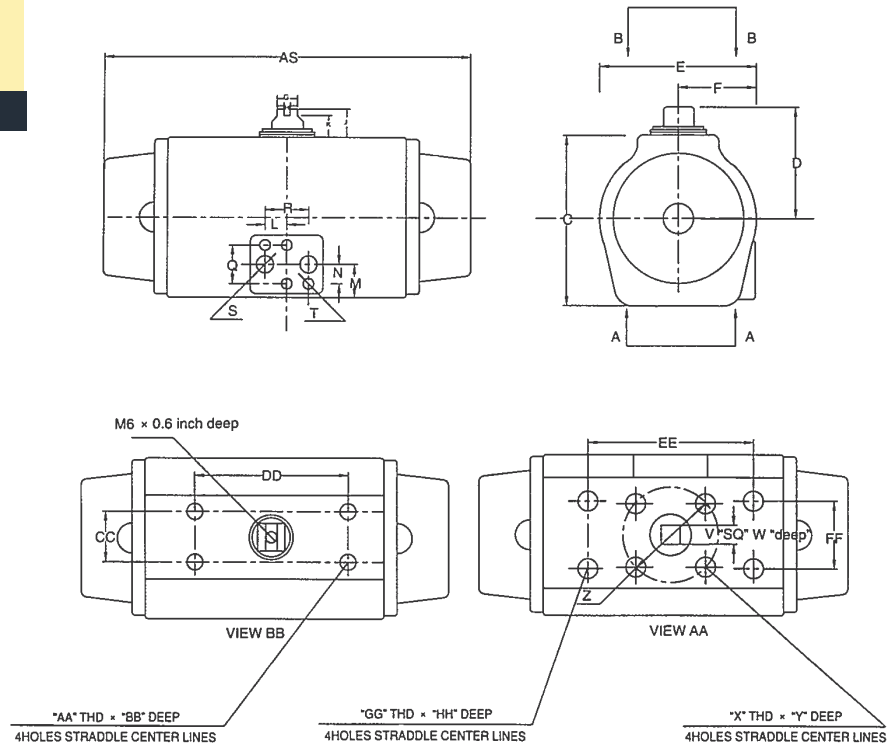
P/N	DESCRIPTION	QTY	MATERIAL	P/N	DESCRIPTION	QTY	MATERIAL
1	Body	1	304 Stainless Steel	16	O-Ring-End Cap	2	Nitrile
2	Piston	2	303 Stainless Steel	17a	Bolts-End Cap	8	Stainless Steel
3	End Caps-Double Acting	2	Stainless Steel	17b	Spring Bearing	8	Stainless Steel
4	Drive Pinion	1	17-4 Stainless Steel	18	Adjusting Travel Stop	2	Stainless Steel
5	Guide Bearing Plate	2	Nylon 6	19	O-Ring-Travel Stop	2	Nitrile
6	Pinion Bearing Top	1	Teflon	20a	Washer	2	Stainless Steel
7	Pinion Bearing Bottom	1	Teflon	20b	Nut-Travel Stop	2	Stainless Steel
8	Snap Ring	1	Stainless Steel	21	End Nut-Travel	2	Stainless Steel
9	O-Ring-Inner Top	1	Viton	22	Spring Retainer (S)	*	Nylon 6
10	O-Ring-Outer Top	1	Viton	23	Spring Retainer (L)	*	Nylon 6
11a	Washer	1	Stainless Steel	24	Spring	*	Plated CS
11b	Bearing	1	Nylon 6	25	Spring Screw	*	Stainless Steel
12	O-Ring-Inner Bottom	1	Viton	26	Spring Nut	*	Stainless Steel
13	O-Ringer-Outer Bottom	1	Viton	27	Positioner Indicator	1	Nylon
14	O-Ring-Piston	2	Viton	28	Plug	2	Nylon 6
15	Bearing-Piston	2	Nylon 6				

Grade of Stainless Steel

Body & End Caps	304
Shaft	17-4 ph
Piston	303
Bolts	18-8

Actuators and Controls

Dimensional Data



Mounting Dimensions

MODEL		R	S	T	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH
3SD04500	mm	24	1/4"NPT	M5	11	15	M5	8	42	M5	6	30	80	88.9	31.75	M5	8
3SS04560	in	0.95	1/4"NPT	M5	0.4	0.59	M5	0.31	1.65	M5	0.24	1.18	3.15	3.5	1.25	M5	0.31
3SD06000	mm	24	1/4"NPT	M5	14	15	M6	8	50	M5	6	30	80	88.9	31.75	M6	8
3SS06060	in	0.95	1/4"NPT	M5	0.55	0.59	M6	0.31	1.97	M5	0.24	1.18	3.15	3.5	1.25	M6	0.31
3SD08500	mm	24	1/4"NPT	M5	19	17	M8	12	70	M5	6	30	80	114	38	M8	12
3SS08560	in	0.95	1/4"NPT	M5	0.75	0.68	M8	0.47	2.75	M5	0.24	1.18	3.15	4.5	1.5	M8	0.47
3SD10500	mm	24	1/4"NPT	M5	19	20	M8	12	70	M5	6	30	80	114	38	M8	12
3SS10560	in	0.95	1/4"NPT	M5	0.75	0.79	M8	0.47	2.75	M5	0.24	1.18	3.15	4.5	1.5	M8	0.47
3SD12500	mm	24	1/4"NPT	M5	22	30	M8	18	102	M5	8	30	130	NA	50.8	NA	NA
3SS12560	in	0.95	1/4"NPT	M5	0.87	1.2	M8	0.71	4.02	M5	0.31	1.18	5.12		2		
3SD14000	mm	24	1/4"NPT	M5	22	27	M10	18	102	M5	8	30	130	NA	50.8	NA	NA
3SS14060	in	0.95	1/4"NPT	M5	0.87	1.06	M10	0.71	4.02	M5	0.31	1.18	5.12		2		
3SD17000	mm	24	1/4"NPT	M5	32	36	M12	24	125	M5	8	30	130	NA	76	NA	NA
3SS17060	in	0.95	1/4"NPT	M5	1.26	1.42	M12	0.95	4.92	M5	0.31	1.18	5.12		3		
3SD21000	mm	24	1/4"NPT	M5	36	43	M20	28	140	M5	8	30	130	NA	76	NA	NA
3SS21060	in	0.95	1/4"NPT	M5	1.42	1.69	M20	1.1	5.51	M5	0.31	1.18	5.12		3		

Double Acting Torque

ACTUATOR SIZE	TORQUE (INCH/LBS) VS. AIR SUPPLY PRESSURE (PSI)					
	40	60	80	100	120	150
3SD04500	74	116	152	199	239	289
3SD06000	151	234	328	413	499	600
3SD08500	365	548	732	915	1097	1315
3SD10500	701	1068	1436	1829	2184	2632

ACTUATOR SIZE	TORQUE (INCH/LBS) VS. AIR SUPPLY PRESSURE (PSI)					
	40	60	80	100	120	150
3SD12500	1355	2069	2759	3449	4115	5168
3SD14000	2018	3032	4039	5046	6056	6615
3SD17000	2868	4050	5324	6640	7987	10042
3SD21000	5328	8462	11188	13884	16709	20929

General Dimensions

MODEL	AS	C	D	E	F	G	H	J	K	L	N	M	Q	
3SD04500	mm	168	65	52.5	62.5	35	16	4	20	10	12	16	23	32
3SS04560	in	6.61	2.56	2.07	2.46	1.38	0.63	0.16	0.79	0.39	0.47	0.63	0.91	1.26
3SD06000	mm	180	81	60.5	74	39	16	4	20	10	12	16	23	32
3SS06060	in	7.09	3.19	2.38	2.91	1.54	0.63	0.16	0.79	0.39	0.47	0.63	0.91	1.26
3SD08500	mm	222	108	74	100.5	52	16	4	20	10	12	16	24	32
3SS08560	in	8.74	4.25	2.91	3.96	2.05	0.63	0.16	0.79	0.39	0.47	0.63	0.95	1.26
3SD10500	mm	290	133	86.5	117	58.5	16	4	20	10	12	16	30	32
3SS10560	in	11.42	5.24	3.41	4.61	2.3	0.63	0.16	0.79	0.39	0.47	0.63	1.18	1.26
3SD12500	mm	390	155	110.2	136	68	20	4	30.5	10.5	12	16	40	32
3SS12560	in	15.5	5.02	3.59	5.65	2.91	0.79	0.16	1.2	0.41	0.47	0.63	1.57	1.26
3SD14000	mm	420	176	116.5	156	79	20	4	30.5	10.5	12	16	40	32
3SS14060	in	16.54	6.93	4.59	6.14	3.11	0.79	0.16	1.2	0.41	0.47	0.63	1.57	1.26
3SD17000	mm	538	210	131.5	193	98	20	4	30.5	10.5	12	16	50	32
3SS17060	in	21.18	8.27	5.18	7.6	3.86	0.79	0.16	1.2	0.41	0.47	0.63	1.97	1.26
3SD21000	mm	698	258	156	236	120	32	4	30.5	10.5	12	16	68	32
3SS21060	in	27.48	10.16	6.14	9.29	4.72	1.26	0.16	1.2	0.41	0.47	0.63	2.68	1.26

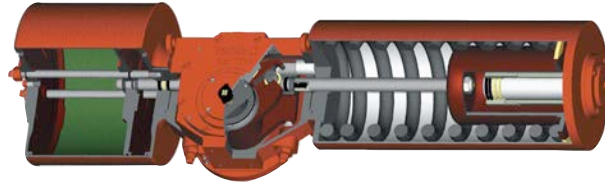
Actuators and Controls

Spring Return Torque

Supply Pressure in PSI

ACTUATOR SIZE	SPRING SET#*	TORQUE (INCH/LBS) VS. AIR SUPPLY PRESSURE (PSI)													
		40		60		80		100		120		150		SPRING STROKE	
		0	90	0	90	0	90	0	90	0	90	0	90	90	0
3SS045X0	2	56	43	98	84	136	121	178	162	220	203	256	230	34	21
	3	45	24	88	65	126	93	165	142	204	179	238	204	49	29
	4			72	42	115	90	154	126	196	163	218	175	71	43
	5					109	76	147	109	182	184	209	156	88	52
	6					97	58	135	91	172	103	190	129	107	64
3SS060X0	2	101	79	167	140	237	214	304	278	369	345	435	399	61	37
	3	84	48	147	107	219	185	284	248	352	315	405	350	93	55
	4			129	77	203	157	268	219	331	276	380	315	124	75
	5			110	45	187	131	250	189	315	250	359	272	156	93
	6					171	102	233	158	296	218	335	228	186	112
3SS085X0	2	275	206	450	369	645	572	821	744	999	919	1175	1065	172	93
	3	236	126	403	281	602	493	773	661	949	884	1105	945	257	139
	4			354	192	558	414	729	574	901	743	1042	825	343	185
	5					516	303	683	490	853	651	975	705	428	232
	6					473	258	636	405	800	564	915	580	515	288
3SS105X0	2	527	394	852	703									325	182
	3	443	246	759	537	1137	939							483	256
	4			665	369	1051	790	1374	1099	1703	1413	1975	1570	643	358
	5			556	119	974	641	1291	934	1615	1241	1852	1340	805	447
	6					888	493	1195	777	1519	1077	1705	1100	964	537
3SS125X0	2	1025	730	1724	1435									628	343
	3	860	425	1545	1118	2310	1864							945	510
	4			1370	806	2068	1480	2720	2158	3333	2450	4166	3062	1259	687
	5			1199	483	1875	1160	2545	1835	3157	2185	3947	2728	1579	865
	6					1690	850	2371	1528	2915	1846	3628	2310	1895	1040
3SS140X0	2	1478	1092	2469	2088									905	520
	3	1215	642	2210	1639	3195	2620							1355	780
	4			1956	1197	2935	2180	3960	3175	5000	4000	6250	5010	1808	1035
	5			1692	739	2680	1750	3700	2748	4608	3425	5760	4290	2257	1301
	6					2441	1279	3444	2290	4280	2852	5362	3568	2708	1562
3SS170X0	2	1985	1494	3411	2923									1227	738
	3	1824	1087	3045	2347	3945	3626							1830	1092
	4			2695	1713	4012	3035	4307	4291	6305	5221	7890	6526	2417	1446
	5			2329	1104	3647	2417	4934	3700	6000	4608	7495	5760	3044	1811
	6					3295	1817	4579	3093	5719	3750	7149	4680	3653	2166
3SS210X0	2	4080	2988	7149	6112									2425	1388
	3	3388	1831	6456	4899	9205	7626							3640	2080
	4			5750	3675	8510	6438	11150	9082	9231	12900	16100	12835	4857	2769
	5			5070	2475	7772	5224	10400	5160	7835	12000	15000	11030	6060	3465
	6					7125	4010	9700	4238	6616	10909	13650	9150	7270	4165

G Series



• NAMUR

The shaft driven accessory interface conforms to the NAMUR standard and is identical on all G-Series actuators, allowing for standardization of accessory mounting hardware and installation practices

- Pneumatic and hydraulic scotch-yoke actuators
- Automates ball, butterfly, plug valves and any other 90° rotating mechanisms
- Salt Spray Testing per ASTM B117 criteria. Construction features prevent water ingress, allowing G-Series actuators to meet IP 66 and IP 67M specifications and severe high pressure water deluge test

• Operating Ranges

G-Series double acting actuators produce guaranteed minimum torque outputs from 10,000 lb-in. up to 6,000,000 lb-in. The spring return units produce spring torques from 2,500 lb-in. to 3,000,000 lb-in.

- Standard operating pressures:
Pneumatic — to 200 psig (14 BAR)
- Standard operating temperature is -20°F to +200°F (-29°C to +93°C)
Optional trims available:
0°F to +350°F (-18°C to +177°C)
-50°F to +180°F (-46°C to +82°C)
- Mechanical and hydraulic manual overrides are available
- MSS and ISO Valve Mounting
The G-Series valve interface meets the dimensional requirements of MSS SP-101 or ISO 5211 defined for each torque range

Double Acting G1 Pneumatic Actuator Torque Chart

Part No.	Actuator Model	Stroke Position	Operating Pressure (psig)											
			40	50	60	70	80	90	100	110	120	150	175	200
			Output Torque (in-lbs)											
3TG100800	G01008	Start/End	12465	14543	16620	18698	20775	22853	24930	31163	36356	41550		
		Minimum			6579	7675	8772	9868	10965	12061	13158	16447	19188	21929
3TG100900	G01009	Start/End	10593	13241	15890	18538	21186	23835	26483	29131	31779	39724		
		Minimum	5591	6989	8386	9784	11182	12579	13977	15375	16772	20966		
3TG101000	G01010	Start/End	14046	17557	21069	24580	28092	31603	35115	38626				
		Minimum	7413	9266	11120	1973	14826	16680	18533	20386				
3TG101200	G01012	Start/End	20133	25166	30199	35232								
		Minimum	10626	13282	15938	18595								
3TG101400	G01014	Start/End	24482	30603	36723									
		Minimum	12921	16152	19382									

Actuators and Controls

Torque Ratings G Series

All published torques are guaranteed minimum values.

G Series Pneumatic Double-Acting Actuator Torque Chart

Part No.	Actuator Model	Stroke Position	Operating Pressure (psig)											
			40	50	60	70	80	90	100	110	120	150	175	200
			Output Torque (in-lbs)											
3TG200900	G2009	Start/End Minimum			11844	22441	25647	28852	32058	35264	38470	48087	56102	
3TG201000	G2010	Start/End Minimum		21254	25504	29755	34006	38257	42507	46758	51009			
3TG201200	G2012	Start/End Minimum	24371	30464	36556	42649	48742	54835	60927					
3TG201400	G2014	Start/End Minimum	12862	16078	19294	22509	25725	28941	32156					
3TG201600	G2016	Start/End Minimum	29636	37046	44455	51864	59273							
			15641	19552	23462	27373	31283							
3TG301000	G3010	Start/End Minimum	39118	48897	58677									
			20646	25807	30968									
3TG301200	G3012	Start/End Minimum		36847	44216	51585	58955	66324	73693	81063	88432			
3TG301400	G3014	Start/End Minimum		19447	23336	27226	31115	35004	38894	42783	46672			
3TG301600	G3016	Start/End Minimum	35887	44859	53831	62803	71775	80747	89719	98690				
			18941	23676	28411	33146	37881	42616	47351	52087				
3TG302000	G3020	Start/End Minimum	47430	59288	71145	83003	94860							
			25033	31291	37549	43807	50065							
			75266	94082										
			39724	49654										

Spring Return G1 Pneumatic Actuator Torque Chart

Part No.	Actuator Model	Spring Torque (in-lbs) Start/Min/End	Operating Pressure (psig)											
			40	50	60	70	80	90	100	110	120	150	175	200
			Torque Output Start/Min/End (in-lbs)											
3TG100804	G01008-SR4	11614					5551	7628	9706	11783	13861	20093	25287	30481
		5708					2439	3543	4648	5752	6849	10138	12880	15621
		10015					3783	5861	7938	10016	12093	18326	23520	28713
3TG100904	G01009-SR4	11614			4820	7469	10117	12765	15414	18062	20710	28655		
		5708			2051	3459	4866	6271	7669	9066	10464	14657		
		10015			3053	5701	8350	10998	13646	16295	18943	26888		
3TG101004	G1010-SR4	11614		6488	10000	13511	17023	20534	24046	27557				
		5708		2938	4804	6664	8518	10371	12224	14078				
		10015		4721	4232	11744	15255	18767	22278	25790				
3TG101204	G01012-SR4	11614	9063	14096	19130	24163								
		5708	4306	6973	9630	12286								
		10015	7296	12329	17362	22395								
3TG101404	G01014-SR4	11614	13413	19534	25654									
		5708	6613	9843	13073									
		10015	11646	17766	23887									
3TG100803	G01008-SR3	13598						6048	8126	10203	12281	18513	23707	28901
		6605						2523	3631	4735	5839	9143	11884	14625
		11445						3669	5746	7824	9901	16434	21327	26521
3TG100903	G01009-SR3	13598				5889	8537	11185	13834	16482	19130	27075		
		6605				2437	3850	5257	6665	8071	9469	13662		
		11445				3509	6157	8806	11454	14102	16751	24695		
3TG101003	G01010-SR3	13598		4908	8420	11931	15443	18954	22466	25977				
		6605		1904	3787	5653	7520	9376	11229	13082				
		11445		2529	6040	9552	13063	16574	20086	23597				
3TG101203	G01012-SR3	13598	7483	12516	17550	22583								
		6605	3289	5964	8634	11291								
		11445	5104	10137	15170	20203								
3TG101403	G01014-SR3	13598	11833	17954	24074									
		6605	5601	8848	12078									
		11445	9453	15574	21695									

Spring Return G1 Pneumatic Actuator Torque Chart

Part No.	Actuator Model	Spring Torque (in-lbs) Start/Min/End	Operating Pressure (psig)													
			40	50	60	70	80	90	100	110	120	150	175	200		
			Torque Output Start/Min/End (in-lbs)													
3TG100802	G01008-SR2	15526									8443	10521	16753	21947	27141	
		7352									3692	4796	8109	10857	13598	
		13037									5692	7770	14002	19196	24390	
3TG100902	G01009-SR2	15526						6777	9425	12074	14722	17370	25315			
		7352						2800	4214	5622	7029	8437	12635			
		13037						4026	6674	3923	11971	14619	22564			
3TG101002	G01010-SR2	15526			6660	10171	13683	17194	20706	24217						
		7352			2736	4611	6477	8348	10202	12055						
		13037			3909	7420	10932	14443	17955	21466						
3TG101202	G01012-SR2	15526	5723	10756	15789	20823										
		7352	2228	4922	7597	10264										
		13037	2972	8005	13039	18072										
3TG101402	G01014-SR2	15526	10073	16194	22314											
		7352	4559	7811	11051											
		13037	7322	13443	19563											
3TG100801	G01008-SR1	18470										8599	14831	20025	25219	
		8749										3364	6703	9463	12223	
		14776										4516	10748	15942	21136	
3TG100901	G01009-SR1	18470						7503	1152	12800	15448	23393				
		8749						2764	4207	5623	7030	11253				
		14776						3420	6069	8717	11365	19310				
3TG101001	G01010-SR1	18470				8249	11761	15272	18784	22295						
		8749				3174	5071	6937	8803	10669						
		14776				4166	7678	11189	14701	18212						
3TG101201	G01012-SR1	18470		8834	13868	18901										
		8749		3492	6190	8865										
		14776		4752	9785	14818										
3TG101401	G01014-SR1	18470	8151	14272	20392											
		8749	3121	6405	9658											
		14776	4068	10189	16309											

Actuators and Controls

Torque Ratings - G Series

All published torques are guaranteed minimum values.

Spring-Return Actuator											
Part No.	Actuator Model	Spring Torque (in-lbs) Start/Min/End	Operating Pressure (psig)								
			40	50	60	70	80	90	100	110	120
			Torque Output Start/Min/End (in-lbs)								
3TG200902	G2009-SR2	26818 12882 22074									14072 5964 8829
3TG201002	G2010-SR2	26818 12882 22074						13859 5848 8616	18810 8110 12866	22361 10369 17117	26611 12628 21368
3TG201202	G2012-SR2	26818 12882 22074			12159 4926 6915	18252 8185 13008	24344 11423 19101	30437 14661 25194	36530 17896 31286		
3TG201402	G2014-SR2	26818 12882 22071		12648 5191 7404	20057 9145 14814	27466 13082 22223	34875 17020 29632				
3TG201602	G2016-SR2	26818 12882 22074	14720 6308 9477	24500 11506 19256	34279 16703 29036						
3TG200901	G2009-SR1	30997 14742 25004									
3TG201001	G2010-SR1	30997 14742 25004							14871 5957 8248	19122 8249 12498	23373 10508 16749
3TG201201	G2012-SR1	30997 14742 25004					21106 9303 14482	27199 12541 20575	33291 15779 26668		
3TG201401	G2014-SR1	30997 14742 25004			16819 7014 10195	24228 10962 17604	31637 14900 25013				
3TG201601	G2016-SR1	30997 14742 25004		21261 9386 14638	31041 14583 24417						
3TG200904	G2009-SR4	20678 9903 16917						10155 4185 5998	13361 5900 9204	16567 7603 12410	19772 9307 15616
3TG201004	G2010-SR4	20678 9903 16917				11058 4675 6901	15308 6935 11152	19559 9194 15402	23810 11453 19653	28061 13712 23904	32311 15956 28155
3TG201204	G2012-SR4	20678 9903 16917		11766 5052 7609	17859 8290 13702	23952 11528 19795	30044 14760 25888	36137 17975 31980	42230 21191 38073		
3TG201404	G2014-SR4	20678 9903 16917	10939 4610 6782	18348 8550 14191	25757 12488 21600	33166 16407 29009	40575 20318 36419				
3TG201604	G2016-SR4	20678 9903 16917	20420 9652 16264	30200 14842 26043	39979 20003 35823						
3TG200903	G2009-SR3	24139 11457 19390								13833 5833 8584	17039 7539 11790
3TG201003	G2010-SR3	24139 11457 19390					12575 5150 7326	16826 7426 11577	21077 9685 15828	25327 11944 20078	29578 14203 24329
3TG201203	G2012-SR3	24139 11457 19390			15126 6522 9877	21219 9760 15970	27311 12998 22062	33404 16236 28155	39497 19460 34248		

Actuators and Controls

Torque Ratings G Series

Spring-Return Actuator (cont.)

Part No.	Actuator Model	Spring Torque (in-lbs) Start/Min/End	Operating Pressure (psig)								
			40	50	60	70	80	90	100	110	120
			Torque Output Start/Min/End (in-lbs)								
3TG201403	G2014-SR3	24139		15615	23024	30433	37842				
		11457		6782	10720	14657	18587				
		19390		10366	17775	25184	32593				
3TG201603	G2016-SR3	24139	17687	27467	37246						
		11457	7883	13081	18273						
		19390	12438	22218	31997						
3TG301002	G3010-SR2	49017									20655
		22571									6848
		36975									7346
3TG301202	G3012-SR2	49017						25456	32826	40195	47564
		22571						9568	13568	17516	21433
		36975						12147	19516	26886	34255
3TG301402	G3014-SR2	49017			21936	30907	39879	48851	57823		
		22571			7591	12527	17349	22117	26885		
		36975			8626	17598	26570	35542	44514		
3TG301602	G3016-SR2	49017			30278	42135	53993				
		22571			12185	18548	24849				
		36975			16968	28826	40683				
3TG302002	G3020-SR2	49017	34398	53215							
		22571	14422	24436							
		36975	21089	39905							
3TG301001	G3010-SR1	54045									
		25307									
		42224									
3TG301201	G3012-SR1	54045							27024	34394	41763
		25307							10497	14497	18420
		42224							13960	21329	28698
3TG301401	G3014-SR1	54045					25106	34078	43050	52022	
		25307					9456	14326	19104	23873	
		42224					12041	21013	29985	38957	
3TG301601	G3016-SR1	54045			24476	36334	48191				
		25307			9107	15535	21837				
		42224			11412	23269	35127				
3TG302001	G3020-SR1	54045	28597	47413							
		25307	11351	21423							
		42224	15532	34349							
3TG301004	G3010-SR4	36568							19695	24822	29949
		17123							7867	10637	13361
		28566							10851	15978	21105
3TG301204	G3012-SR4	36568			20012	27381	34751	42120	49489	56858	
		17123			8038	11996	15913	19830	23746	27663	
		28566			11168	18537	25906	33276	40676	48014	
3TG301404	G3014-SR4	36568			22258	31239	40201	49173	58145	67117	
		17123			9257	14042	18810	23578	28347	33089	
		28566			13414	22385	31357	40329	49301	58273	
3TG301604	G3016-SR4	36568	15857	27714	39572	51429	63287				
		17123	5764	12174	18475	24777	31068				
		28566	7013	18870	30728	42585	54443				
3TG301003	G3010-SR3	42128								20609	25735
		19573								7746	10528
		32379								9833	14960
3TG301203	G3012-SR3	42128					23167	30537	37906	45275	52645
		19573					9135	13115	17032	20949	24865
		32379					12392	19761	27130	34500	41869
3TG301403	G3014-SR3	42128			18044	27016	35988	44960	53931	62903	
		19573			6305	11223	16012	20781	25549	30317	
		32379			7268	15240	25212	34184	43156	52127	
3TG301603	G3016-SR3	42128		23501	35358	47216	59073				
		19573		9315	15678	21980	28282				
		32379		12725	24582	36440	48297				
3TG302003	G3020-SR3	42128	39479	58295							
		19573	17868	27868							
		32379	28703	47519							

AE Actuator



AE Series Numbering System

AE - X X X - X X - X

TORQUE

200
400
600
800
1000

Enter all digits of Torque Value

VOLTAGE

1 - 115 vac
2 - 24 vac
3 - 220 vac
4 - 12 vdc
5 - 24 vdc

OPTIONS

0 - Standard
A - One extra switch & cam*
B - Two extra switches & cams*
C - Three extra switches and cams*
D - Heater and Thermostat (15 watt)
F - Motor Brake (115 VAC & 24 VAC Only)
P - Positioner 4-20 mA
T - Transmitter 4-20 mA

Note: AE will always be the first two characters of the part number, all digits from torque value must be entered into part number (i.e. 400, 1000 etc.) Only use one digit for voltage depiction (i.e. 1-5). For the options listing you may use more than one character, up to three, (i.e. O, AD or BD etc.)

AE-400-3BF : 400 lb. in.; 220 VAC; 2 extra switches and cam, motor brake
AE-1000-1D : 1000 lb. in.; 115 VAC; Heater and thermostat

Example:

- 1 Year warranty on positioner & positioner with transmitter
- Transmitter available with (P) positioner option only
- **Positioner & Transmitter are not CSA listed**
- * Not available with "P" option

AE Series Actuators



Ruggedly built and designed for easy installation, new Apollo® AE Series electric actuators deliver the most standard features and performance in their class. Now CSA listed all sizes as standard.

Five Output Torques, One Housing

- 200, 400, 600, 800 and 1,000 inch-pounds
- Long Service Life
- Newly developed anodized die cast aluminum housing
- Fiberglass reinforced nylon cover resists corrosion
- Nitrile gasket and seals cover all penetration points in housing and cover
- Precision cut and heat treated alloy spur gears
- Permanently lubricated enclosed gear train
- NEMA 4, 4X

Easy To Use

- Two separate 1/2" NPT conduit entrances for easier wiring and signal separation
- 12-position pre-wired terminal strip includes standard connections for remote open/closed position indicators; lots of room for wiring options
- Unrestricted mounting orientation
- Built-in thermal overload protection in all AC motor actuators
- Limit switches have an 11 amp rating at 115 VAC
- High visibility valve position indicator standard on all models

Many Standard Features

- Stainless steel push-and-turn manual override shaft, position indicator shaft and female output
- ISO 5211 F07 drive output reduces inventory of mounting kits
- 115 AC & 220 AC models feature a 25% duty cycle below 100°F (24AC — 20% duty cycle below 100°F)
- 12 and 24 DC — all DC voltage models provide 100% duty cycle for 1 hour after which DC motor is reduced to 80% duty cycle.
- Reversible rotation

Broad Temperature Range

- Operates from -40°F (when equipped with 15 watt heater and thermostat) to 150°F

Available Options

- Actuators can be ordered with one, two or three additional limit switches
- For low temperatures: actuators can be equipped with a thermostatically controlled heater element
- Motor brake is necessary when mounting actuator to a butterfly valve

4-20mA Positioner Features (P - Option)

Advanced Protection Features

- A) Stall Detection
 - Motor will not burn out from stalling
- B) Fault Signal
 - a. Fault LED on DHC-100 front panel
- C) Duty Cycle Protection
 - a. Allows actuators rated for 25% duty, or more, to be safely modulated
 - b. Activates prior to tripping of thermal overload protector, which prevents long shut down periods due to tripping thermal overload protector; allows the actuator to continue to move to set-point at a 25% duty cycle speed

Performance Features

- A) High Resolution ($\pm 0.1^\circ$)
 - a. 450 points of resolution on a 1/4 turn valve
- B) Dynamic Braking
 - a. Stops motor before changing actuator direction
 - b. Stops motor before mechanical brake engages, which reduces break wear
- C) Adaptive Control - Designed to maintain high resolution and accuracy by continuously monitoring and compensating for actuator backlash, motor coast, and load changes to eliminate positioner deadband

4-20mA Positioner Features (T - Option)

- A) High Resolution Feedback Transmitter
 - a. Provides voltage or mA output that can be set for any range (0 to 10 VDC in 0.0016 V steps or 0 to 20 mA in 0.0031 mA steps)
- B) Auto/Manual Station (Local Control Unit - LCU)
- C) Polarity Detection

Actuators and Controls

AE Actuator General Specifications

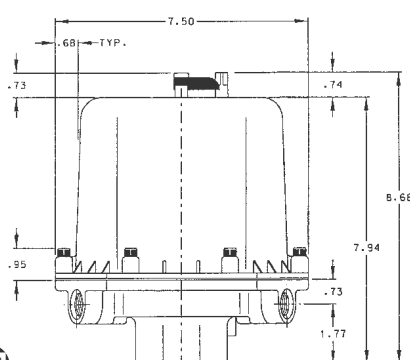
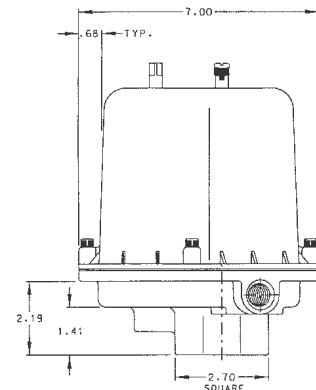
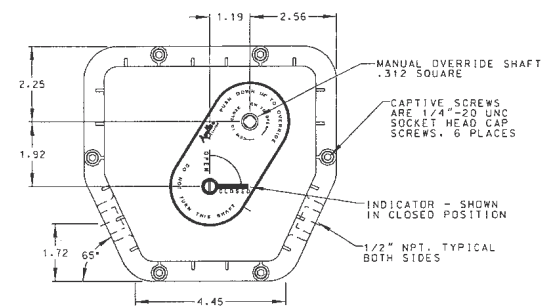
Actuator Model	Breakaway Torque Output (in.-lbs.)	Cycle Time 90° Travel (50% Load)	Duty Cycle	Amperage Draw (max.) Starting or locked rotor current voltage			
				115 VAC	230 VAC	12 VDC	24 VDC
AE200	200 in-lbs	5.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE400	400 in-lbs	10.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE600	600 in-lbs	15.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE800	800 in-lbs	20.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE1000	1000 in-lbs	25.0 sec	25%	.74 amp	.44 amp	1.6 amp	1.7 amp

Note: 90° Travel = Travel From Closed position to Open position or vice versa.
DC current draw is at max. torque

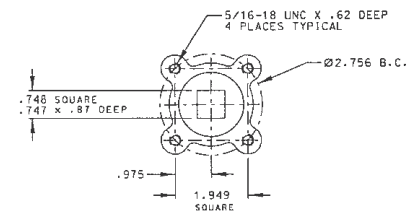
24 VAC current draw at locked rotor 4.6 amp

Motor	AC models: 120 VAC or 230 VAC, Reversible 3 wire, capacitor run. Self-resetting (thermal) overload protection, Class B insulation, sub-fractional horsepower. DC models: 12 VDC or 24 VDC, Reversible 2 wire, POS & NEG. No thermal overload (external circuit breaker or fuse suggested for protection.)
Lubrication	Permanently lubricated gear train and bearings
Duty Cycle	The AE-Series actuators are designed to operate at 25% duty cycle at temperatures below 100°F. See <i>Electrical Operation</i> . (24 AC-20% duty cycle below 100°F)
Temperature Operating Range	32°F to 150°F Max -40°F to 150°F with optional heater & thermostat
Thermal Protection	Self-resetting (AC Motors Only)
Conduit Connections	(2) 1/2"-NPT female
Direction Of Travel	Clockwise to Close, Counterclockwise to Open (Position indicator shaft only, manual override shaft rotates opposite)

AE Dimensions

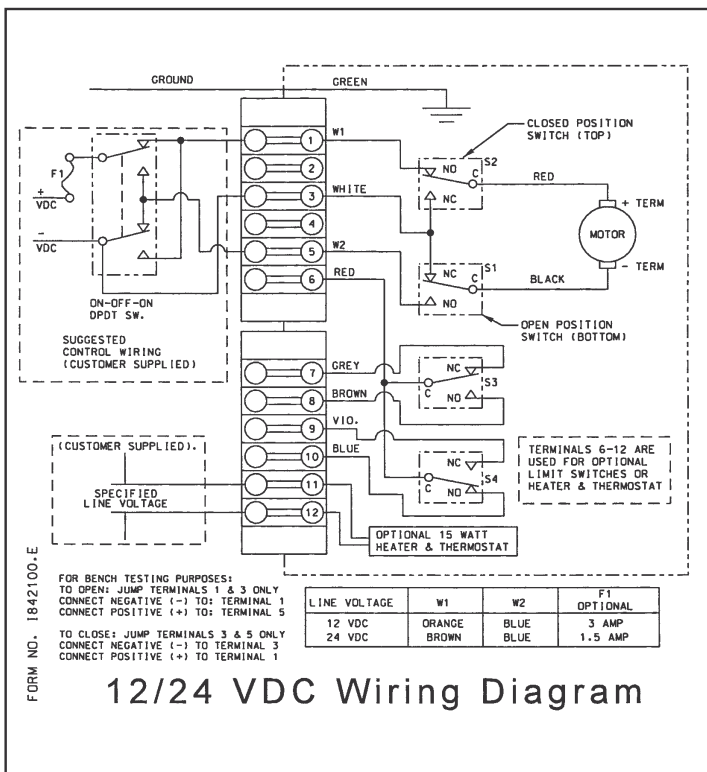
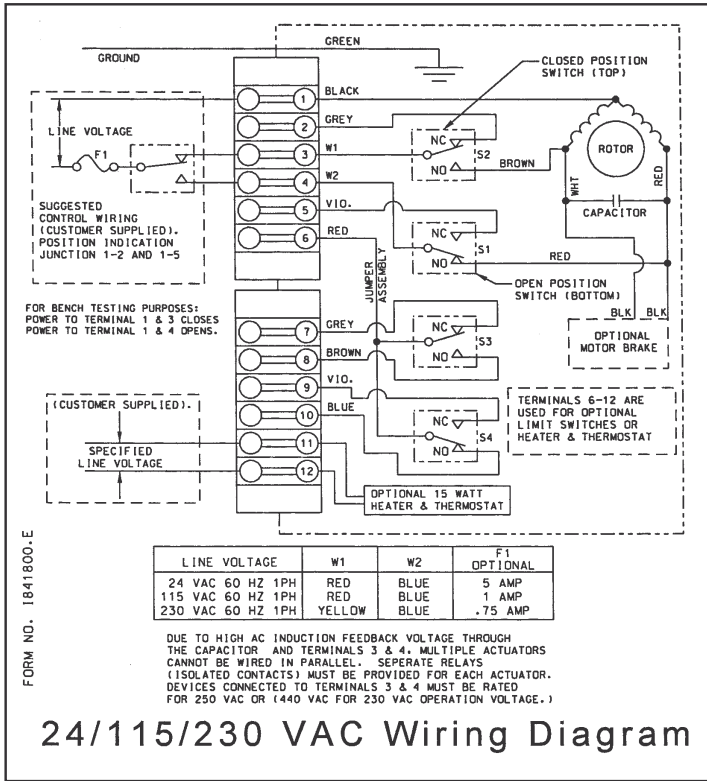


3.5" CLEARANCE (FROM TOP OF OVERRIDE SHAFT) REQUIRED FOR COVER REMOVAL



MOUNTING PATTERN ISO 5211 - F07

AE Series Actuators



CS & CL Electric Actuators

Conbraco's CS and CL electric actuators are split phase reversing AC motors for standard duty or brushless DC Motors for continuous duty. Eight sizes are available which produce breakaway torques between 150 and 3000 lb-in. They are excellent industrial quality units capable of on/off, fail safe, and modulating applications. The efficient spur gear drive train is supported by permanently-lubricated bearings making it very secure while eliminating the potential for side loading of the output shaft.



Conbraco offers as standard a 75% duty cycle AC motor. Continuous-duty brushless DC motors are also available for a range of input voltages. All units are rated for use in ambient environments from -40°F (with optional heater & thermostat) to 150°F (note that units equipped with an internal battery are rated to 130°F).

Hazardous Location Enclosures

The standard enclosures (CS and CL) are rated for NEMA 4/4X (weather tight and corrosion resistant). The Hazardous Location enclosures are rated for NEMA 4/4X/7 & 9, Class I, Div 1, Groups C&D; Class II, Div. 1, Groups E, F, & G; Class III.

(CSA) Certifications

Certification by the Canadian Standards Association of either hazardous or weatherproof locations is standard on all CS & CL models with 75% duty cycles.

- Features-

- Plug-in connectors for the motor, the brake option and the heater/thermostat option
- All connectors are coded to prevent mis-wiring.
- Limit switch wires are soldered to the board - no more loose connections.
- A six position terminal strip clearly labeled so it can be wired up in the field without an instruction manual.

Other standard features include:

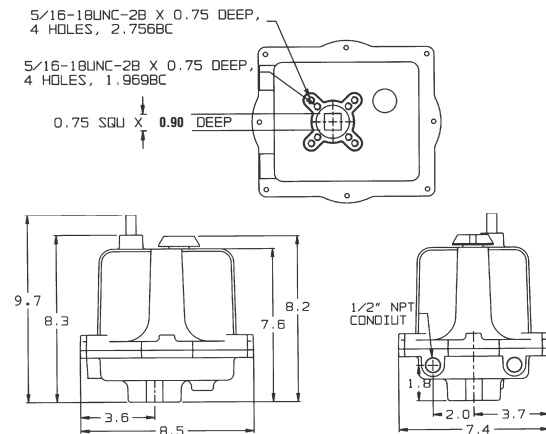
- Thermal overload protection (AC motors)
- Dual conduit openings; 3/4" (1/2" with supplied bushings)
- Visual position indication
- All aluminum enclosure
- Captive cover bolts on CS Series
- Manual override shaft (optional handwheel override with de-clutchable shaft)

Introducing Simplicity for Calibrating Modulating Actuators

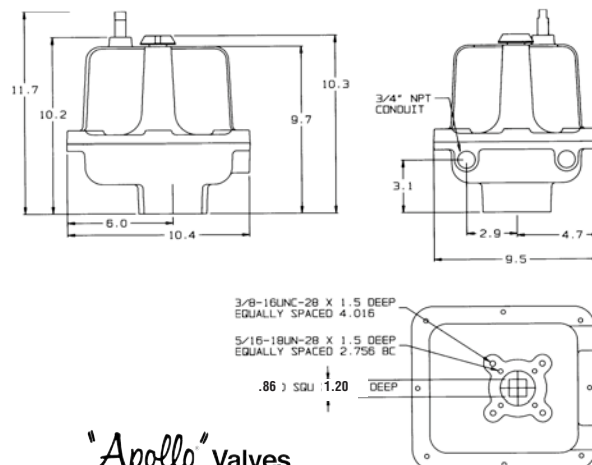
The Control Board brings a whole new level of simplicity to the field. It will work with either of the Motor Boards (115VAC or 230VAC). Features include:

- Switch selector for 4-20mA or 0-10VDC input
- Switch selector for 4-20mA or 0-10VDC position readback
- Switch selector for either "fail in-place" or "fail to zero" upon loss of control signal (provided input power remains)
- On-board push buttons to manually position the actuator
- An adjustable pot for Speed Control (motor pulsing)
- An adjustable pot for deadband adjustment
- A "Mode Selector" switch with LEDs, which are used for:
 - "No tools" pot calibration
 - Setting Zero and Span
 - Manually positioning the actuator
- Locked Rotor Protection if the actuator cannot achieve the position commanded by the control signal, it will cut power to the motor. Repeated stalls will not damage the actuator.
- Reverse acting operation with no rewiring.
- Split range operation with no rewiring.

CS Dimensions



CL Dimensions



CS & CL Extended Duty Data

TECHNICAL DATA—115VAC AND 230VAC Models*

Torque Output (breakaway)	Speed (seconds per 90° rotation)	Duty Cycle	VA Rating		Max Running Current at Full Load (True RMS)		Max Effective Peak Inrush Current (= .66 x peak inrush)	
			115VAC	230VAC	115VAC	230VAC	115VAC	230VAC
150 in lb	8	75%	70vA	115vA	.6 amps	.5 amps	1.25 amps	.924 amps
300 in lb	15	75%	70vA	115vA	.6 amps	.5 amps	1.25 amps	.924 amps
600 in lb	30	75%	70vA	115vA	.6 amps	.5 amps	1.25 amps	.924 amps
1000 in lb	25	75%	92vA	161vA	.8 amps	.7 amps	1.66 amps	1.29 amps
1500 in lb	40	75%	92vA	161vA	.8 amps	.7 amps	1.66 amps	1.29 amps
2000 in lb	55	75%	92vA	161vA	.8 amps	.7 amps	1.66 amps	1.29 amps
2500 in lb	70	75%	92vA	161vA	.8 amps	.7 amps	1.66 amps	1.29 amps
3000 in lb	75	55%	92vA	161vA	.8 amps	.7 amps	1.66 amps	1.29 amps

CS & CL Continuous Duty Data

Torque (in-lbs)	Duty Cycle	12VDC		24VDC		24VAC		115VAC		230VAC	
		Cycle Time (sec/90°)	Current Draw Amps	Cycle Time (sec/90°)	Current Draw Amps	Cycle Time (sec/90°)	Current Draw Amps	Cycle Time (sec/90°)	Current Draw Amps	Cycle Time (sec/90°)	Current Draw Amps
150	100%	11	2.2	13	1.2	8	1.8	9	0.4	9	0.4
300	100%	17	2.5	13	1.4	12	2.1	13	0.5	13	0.4
600	100%	17	2.8	13	1.7	13	2.5	14	0.6	14	0.5
1000	100%	21	4	14	2.4	15	3.5	15	0.9	15	0.6
1500	100%	40	4	24	2.4	27	3.5	29	0.9	29	0.6
2000	100%	40	4.3	33	2.4	28	3.5	29	0.9	29	0.6
2500	100%	55	3.3	40	2	38	3.1	39	0.8	39	0.6
3000	100%	60	3.7	42	2.2	40	3.5	42	0.8	43	0.6

*Notes:

- The Current Draws stated above include all options. If the brake and/or heater & thermostat are not installed, the actual current draws will be less.
- For Extended Duty Cycle Models, Current Draws are provided at full running torque. If the actuator encounters an overtorque condition, such as a stall condition, the Current Draw will be vastly increased.
- "Continuous Duty actuators contain brushless DC motors and are therefore not limited by duty cycle restraints in environments at or below 104°F; in ambient environments above this temperature the duty cycle is de-rated to 80%."

ACTUATOR MODEL #'s/DESCRIPTION

230 VAC 230 VAC MOTOR
 24 VAC 24 VAC MOTOR ⁽¹⁾ (Continuous Duty only)
 12/24 VDC 12 OR 24 VDC MOTOR (Continuous Duty only)
 X NEMA 4,4X,7, & 9
 W NEMA 4 & 4X
 H TROPICAL HEATER
 S2 TWO AUXILIARY SWITCHES SPDT
 T HEATER AND THERMOSTAT
 K MOTOR BRAKE⁽²⁾
 Z DECLUTCHABLE HANDWHEEL OVERRIDE

⁽¹⁾ NOT AVAILABLE WITH CSA LISTING. CONTACT FACTORY FOR CSA LISTING ON OPTION COMBINATIONS

⁽²⁾ NOT REQUIRED ON CONTINUOUS DUTY CYCLE UNITS

CONTROL OPTIONS FOR CONTINUOUS DUTY CYCLE⁽¹⁾

R2 SINGLE RELAY 2 WIRE CONTROL
 C POSITIONER (SPECIFY SIGNAL)**
 CL2 POSITIONER WITH FAIL SAFE BACKUP FOR CS SERIES⁽¹⁾
 CL3 POSITIONER WITH FAIL SAFE BACKUP FOR CL SERIES⁽¹⁾
 L2 FAIL SAFE BATTERY BACKUP FOR CS SERIES⁽¹⁾
 L3 FAIL SAFE BATTERY BACKUP FOR CL SERIES⁽¹⁾

NOTE: NO MANUAL OVERRIDE ON FAILSAFE UNITS

*CONTACT ACTUATOR ENGINEERING FOR APPLICATIONS NOT COVERED BY INDICATED OPTIONS

**OPTION AVAILABILITY AND PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

**OPTION "C" INCLUDES POSITION TRANSMITTER & CYCLE RATE REGULATOR

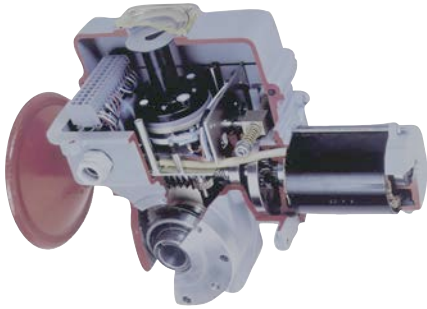
***OPTION "CL2", "CL3", "L2", & "L3" INCLUDE POSITION TRANSMITTER

A BOARD OPTION MUST BE SELECTED WITH CONTINUOUS DUTY CYCLE. ONLY ONE BOARD OPTION CAN BE INSTALLED IN THE ACTUATOR.

How To Order Examples

ACTUATOR MODEL	TORQUE	ENCLOSURE	OPTIONS	DUTY CYCLE	VOLTAGE
CS XXX	600	W-NEMA IV	C (POSITIONER)	E - Standard	115VAC
CL XXX	2500	W-NEMA IV	S2 (TWO SWITCHES)	E - Standard	230 VAC

LB Series Electric Actuators



The LB-Series is available in several basic designs with a wide variety of configurations from which to select torque and speeds to meet specific application requirements. These rugged and uncomplicated actuators provide a practical and reliable method for turning any mechanism 90°. Torques range from 540 inch-pounds to 54,000 inch-pounds (6.25 to 625 kilogram-meters). Electrical models are available in 115 VAC-50/60 Hz single phase, 200 VAC-50/60 single phase; and 220/440 VAC-50/60 Hz three phase. Models are available for on/off modulating control.

Listed below are performance specifications for a limited sampling of LB-Series electric actuators. This product family is available with a such a variety of options and features that they can not be represented in this catalog. Options such as positioners, transmitters, special enclosure ratings, extra switches, or motor voltages are optionally available. Contact Conbraco's Actuator Engineering Department for the proper actuator to fit non standard or unique requirements.

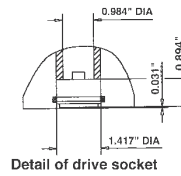
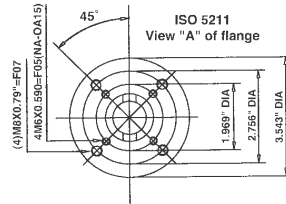
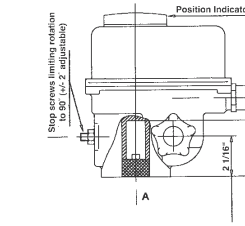
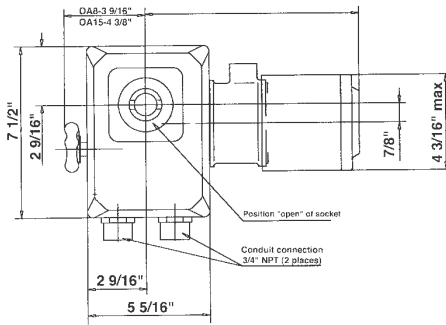
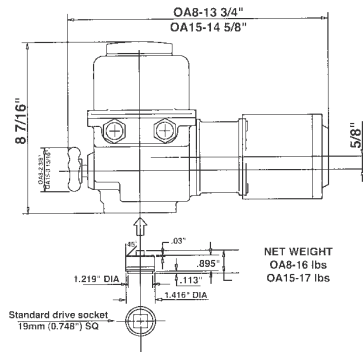
LB Series Electric Actuator Performance Data							
L-B Series Model Number	Torque Output Lb-In	Rotating Speed (Sec/90 degree)		Power Requirements 30% Duty Cycle			
		Std	Opt	115VAC 1 Ph 60Hz		460 VAC 3 Ph 60 HZ	
				RATED	START	RATED	START
OA8	885	5		1.95	3.3	0.63	1.15
OA8	885	25		1.25	2	0.39	0.78
OA15	1350	15	25	1.95	3.3	0.39	0.78
AT25	2250	15		1.95	3.3	0.63	1.15
AT25	2250	25	50	1.95	3.3	0.39	0.78
AT50	4500	25		4.6	12	0.63	1.15
BT100	10600	50		4.6	12	0.63	1.15

Contact factory for part numbers of actuators with options & other voltages

NOTES:

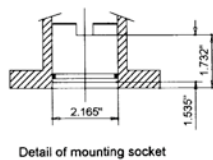
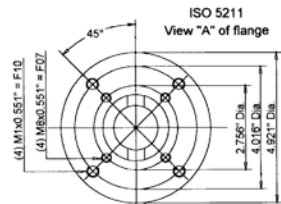
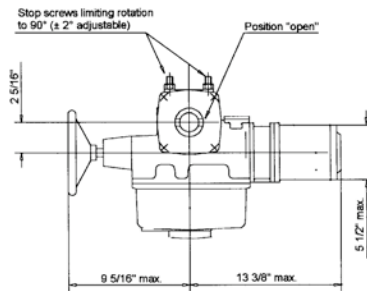
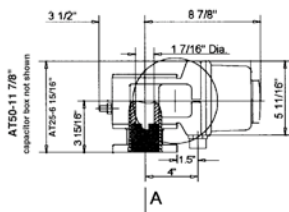
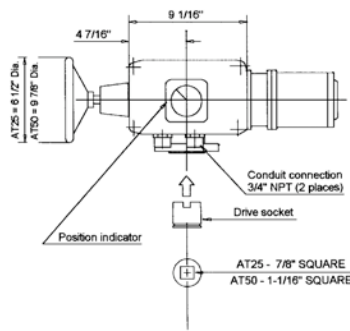
- Operating speed is based on an actuator operating at rated output torque. Actual operating speed will vary depending on actual output torque.
- All torque and speed ratings are based on a plus or minus 10% motor voltage variation.
- All torque ratings represent the maximum torque available during both breakaway (start) and run (dynamic) conditions.
- Each actuator is supplied, as standard, with a 30% duty cycle, F insulation, TENV design motor rated for 360 starts per hour at 104°F.
- All actuators are NEMA 4 rated as standard. Many are optionally available with additional ratings, such as, explosion proof or submersible, etc., to meet special service requirements.
- All actuators utilize a self-locking gear train design and have provision for manual override.
- All actuators have both electrical and mechanical travel stop provisions.
- **FQ Series are Spring Return Failsafe models. Contact factory for model number and price (not listed above).**

LB Series Actuator Dimensions



Types OA8 and OA15

Standard specification: Weatherproof NEMA 4, with two adjustable SPDT limit switches; with built-in motor thermal cutouts, with handwheel for manual operation. Duty rating 30%.



Types AT25 and AT50

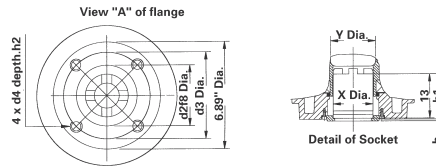
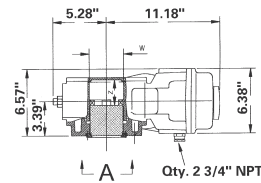
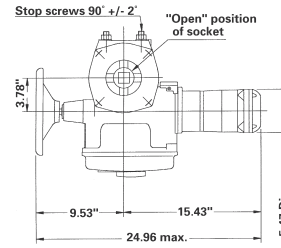
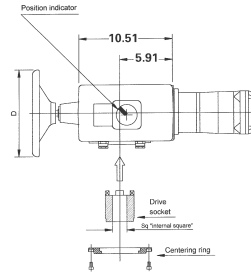
Standard specification: Weatherproof to NEMA 4, fitted with two adjustable SPDT travel limit switches (one for each extreme position); two SPDT torque limit switches (one for each direction of rotation) and with handwheel for manual operation. Duty rating 30%. Net weight: 40 lbs.

AT25 female socket dimension = .866 square
AT50 female socket dimension = 1.063 square

LB Series Dimensions

Types BT100

Standard specification: Weatherproof to NEMA 4, fitted with two adjustable SPDT travel limit switches (one for each extreme position); two SPDT torque limit switches (one for each direction of rotation) and with handwheel for manual operation. Duty rating 30%.



Type	D	W	X	Y	Z	l3	h1
BT100	9.84	3.35	3.23	2.36	2.52	2.99	3.01
Type	h	d3	d218	d4	h2	Sq.	Weight
BT100	0.16	5.51	3.94	M16	0.79	1.417	60 lbs.

Solenoids

Direct Mounted NAMUR Solenoid Valves

Solenoid General Specifications:

Temperature limits:

- Media: 0°F to +180°F.
 Ambient:
 1: NEMA 4, 4X 0°F to +180°F.
 2: NEMA 4-4X-7-9, 0°F to +125°F.

Coil Ratings:

- 1: NEMA 4, 4X: Continuous duty molded Class H insulation.
 2: NEMA 4-4X-7-9: Continuous duty molded Class F

Coil Voltages Available:

Coil Voltage Variation: +/-10% of Nominal

- 1: 120 VAC-60 Hz/110 VAC-50 Hz.
 2: 240 VAC-60 Hz/220 VAC-50 Hz/120 VDC.
 3: 48 VAC-60 Hz/44 VAC-50 Hz/24 VDC.
 4: 24 VAC-60 Hz/22 VAC-50 Hz/12 VDC.

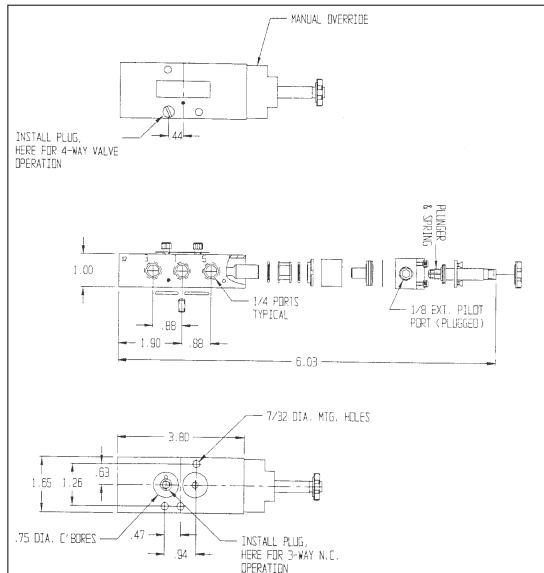
Power Consumption: 6 Watts

Materials:

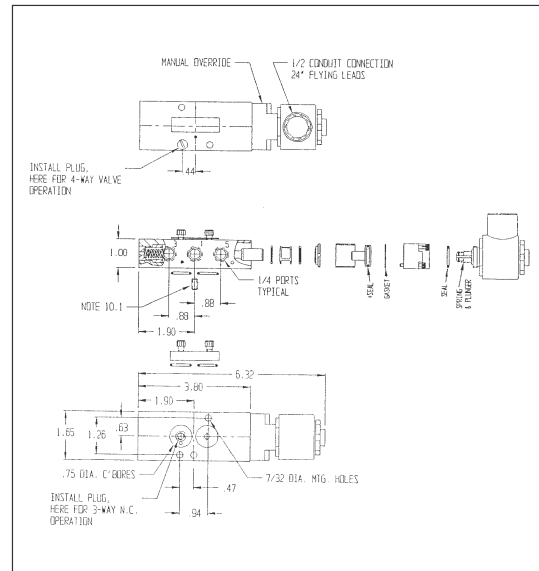
Valve Body=Aluminum, anodized.
 Fasteners=Stainless Steel
 Seals & O-Rings=Nitrile.

Cv flow rate = 1.8

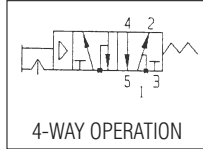
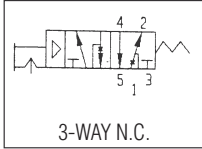
NEMA 4-4X UL, CSA, PTB&CE



NEMA 4, 4X, 7 & 9 UL, CSA, PTB&CE



Solenoids



Solenoid Valves

AVC NAMUR *Three & Four-way, end mounted coil Solenoids: Cv=1.8
For NAMUR Direct Mount

Part No.			Price
3T8-411-40A	115 VAC NEMA 4	0025 thru 4000	158.22
3T8-421-40A	12 VDC/24 VAC NEMA4	0025 thru 4000	158.22
3T8-431-40A	24 VDC/48 VAC NEMA4	0025 thru 4000	158.22
3T8-441-40A	220 VAC NEMA4	0025 thru 4000	158.22
3T8-711-40A	115 VAC NEMA7	0025 thru 4000	255.61
3T8-721-40A	12 VDC/24 VAC NEMA7	0025 thru 4000	255.61
3T8-731-40A	24 VDC/48 VAC NEMA7	0025 thru 4000	255.61
3T8-741-40A	220 VAC NEMA7	0025 thru 4000	255.61

Part No.			Price
3T8-411-20A	115 VAC NEMA 4	052 thru 160	158.22
3T8-421-20A	12 VDC/24 VAC NEMA4	052 thru 160	158.22
3T8-431-20A	24 VDC/48 VAC NEMA4	052 thru 160	158.22
3T8-441-20A	220 VAC NEMA4	052 thru 160	158.22
3T8-711-20A	115 VAC NEMA7	052 thru 160	255.61
3T8-721-20A	12 VDC/24 VAC NEMA7	052 thru 160	255.61
3T8-731-20A	24 VDC/48 VAC NEMA7	052 thru 160	255.61
3T8-741-20A	220 VAC NEMA7	052 thru 160	255.61

All are direct mount NAMUR - no adapter necessary

Solenoid Valves (cont'd)

Part No.			Price
3T8-411-32A	115 VAC NEMA 4	032, 200 & 270	210.04
3T8-421-32A	12 VDC/24 VAC NEMA4	032, 200 & 270	210.04
3T8-431-32A	24 VDC/48 VAC NEMA4	032, 200 & 270	210.04
3T8-441-32A	220 VAC NEMA4	032, 200 & 270	210.04
3T8-711-32A	115 VAC NEMA7	032, 200 & 270	255.19
3T8-721-32A	12 VDC/24 VAC NEMA7	032, 200 & 270	255.19
3T8-731-32A	24 VDC/48 VAC NEMA7	032, 200 & 270	255.19
3T8-741-32A	220 VAC NEMA7	032, 200 & 270	255.19
<i>All above include adapters to turn "NAMUR 90°"</i>			
3T8-000-32B	Adapter	032, 200 & 270	35.00
3T8-000-32A	Adapter	0025-4000	5.00

The Quartz is available in explosion proof (QX), nonincendive and intrinsically safe (QN) and general purpose (QG) versions. The robust epoxy coated anodized aluminum construction makes this platform extremely durable and well suited for use in corrosive, heavy wash down environments. A broad range of switching, position transmitter and communication options may be selected to accommodate most applications.

This versatile platform adapts to a wide variety of valve systems. Attach the Quartz to quarter-turn actuators, manual operators, linear operators and positioners using readily available stainless steel mounting systems.

Stonel Quartz Limit Switch

1. Enclosures Optimized for Environment



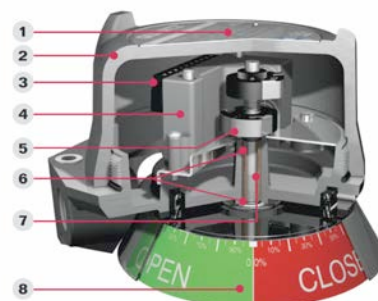
QX: Explosion proof, water tight and corrosion-proof enclosure is approved for use in div. 1/zone 1 hazardous areas.



QN: Nonincendive is approved for all div.2/zone 2 hazardous environments with proximity sensors using a clear cover. Intrinsically safe Namur sensors or passive switches are available for div. 1/zone 0 applications.



QG: General purpose features a clear Lexan cover with mechanical switches. All enclosures are rated NEMA 4, 4x, and 6.



2. Rapid Enclosure Access

Screw-on cover allows quick enclosure access, saving you valuable maintenance and set-up time. The cover provides a vapor tight seal and allows entry to internal components in less than five seconds.

3. Faster Wiring

Pre-wired and labeled terminal strip enables quick, convenient attachment of field wires.

4. Wide Variety of Switching & Communication

Switching options include dual module sensors and communication, Maxx-Guard proximity switches and mechanical switches. Continuous signal output is available in a 4 to 20 mA position transmitter.

5. Quick Set Cams are Easy to Adjust

Touch and Tune switch settings allow you to make adjustments in seconds without the use of tools.

6. Dual Shaft O-ring Seals Eliminate Corrosion

Top inner and bottom outer shaft o-rings seal the drive bushing from both external corrosives and internal contaminants that enter the enclosure.

7. Special drive bushing assures long cycle life

The oil impregnated bronze bushing maintains smooth operation and eliminates the potential for shaft seizure due to actuator shaft eccentricity.

8. Space Saving Visual Indication

Visual indicator offers excellent viewability without sacrificing accessibility or adding to space requirements. Indicators are also available with continuous percentage or three-way indication.

Eliminate Seal Fittings in Division 2 and 2 Areas

FMus ratings certify the Quartz QX series with proximity switches for use without seal fittings in all hazardous areas. By passing special pressure piling tests, the all aluminum enclosure was certified for this elite distinction. Now, a time-consuming procedure can be safely eliminated in division 1 and division 2 areas.

Consolidate Your Components and Minimize Costs

The Quartz design offers up to three conduit entries with extra wire terminations. By terminating solenoid valves in the switch enclosure, significant savings are realized by eliminating a junction box, wiring, conduit materials and labor.



VRC Positioners

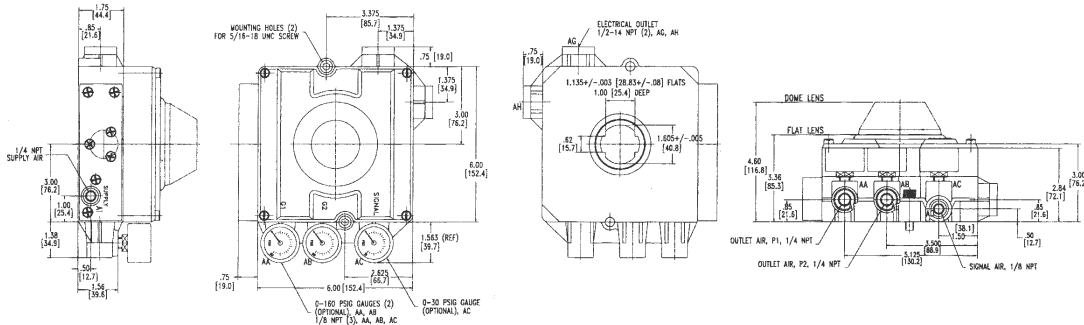
Construction

Part	Materials
Enclosure	PPA Composite, 300 Stainless Steel Port Rings, Cover and Mounting Bolts
Indicator Lens Internals	LEXAN™ PPA, PPS and PEEK Composites 300 Series Stainless Steel
Nickel Plated Brass Spool Valve	Carpenter 70 Grade Stainless Steel
I/P Converter (VK02) VE Model	PPA Composite, TEFLON™ Coated Carbon Steel, Nickel Plated Carbon Steel, High Density Polyethylene DELRIN™
Signal Diaphragm/ O-Rings	BUNA N

Performance

Parameter	Specification
Resolution	1.25% Maximum 0.10% Typical
Repeatability	99.75% Minimum 99.90% Typical
Hysteresis	0.50% Maximum 0.25% Typical
Linearity	1.0% Maximum
Gain @ 80 psig	250 Single Acting 500 Double Acting
Air Consumption @80 psig	0.25 SCFM. Standard Flow Spool Valve 0.45 SCFM Maximum Flow Spool Valve
Temp. Range	-40 to 150°F/-40 to 65°C

Dimensional Diagrams



Model Number Specifications

Required Selections	Optional Selections	Characterizing Cam		Spool Valve		Port Gauges		Position Transmitter		Limit Switch	
Model Type	Position Indicator										
VP Pneumatic 3-15 psig VE	Flat 90° Flat 180° Dome 90°	7 8 9	Linear Square Root Square	0 1 2	Standard Maximum Extreme Service Standard Flow Extreme Service Max. Flow	0 1 2	Brass Stainless	G Z	4-20 MA 1 Kohm	T1 T2	Mechanical (2) SPDT Proximity S2
Electro-Pneumatic 4-20 MA VI Electro-Pneumatic General Purpose & Hazardous Locations			0-60° Equal Percent Custom Tangent 0-45°	3 4 5 6 7		3					(2) SPST

Model Number Example:

A Model VE900-G-T1-S2 is a (Model VE) electro-pneumatic positioner with a (9) DOME style, 2-quadrant position indicator; (0) linear Cam; and (0) Standard Flow Spool Valve. Optional fields specify (G) Brass Gauges; (T1) 4-20 MA position transmitter; and (S2) (2) SPST Proximity Limit Switches.

Note: See Price List for Cii Part Numbers

PMV Positioners



Features & Benefits

Simple design makes this product easy to understand, calibrate and repair. Rugged construction provides operation in a variety of tough applications. Compact size minimizes space requirements. A complete package means the user can select the right positioner for his application.

A bright indicator makes it easy for operators to visually check valve position. Spool valve design requires very little maintenance. Electro-pneumatic unit eliminates the need for an extra product and additional connections. Recognized product name means a proven product with many years of service.

Product Specifications		
	P2000/20	P5/EP5*
Connections:	1/4"	1/4"
Supply Pressure:	120 psig	145 psig
Hysteresis:	.5%	.5%
Linearity:	2.0%	.5%
Repeatability:	.5%	.5%
Sensitivity:	.5%	.25%
Input Signal:	4-20 mA	3-15, 4-20mA
Temperature - Standard	+5 - 175° F	+5 - 185° F
Temperature - Optional	+5 - 230° F	+5 - 230° F
Weight	5.9 lbs.	2.9/4.1 lbs.
Air Consumption	35/.71 scfm-----	-----75 scfm
@ 85 psig		
Air delivery	12/15.7 scfm	12.6 scfm
@ 57 psig		
Gain factor	50/400	10,000

*PMV New Modular Unit P5-Pneumatic; EP5 Electropneumatic

Valve positioners are an excellent tool for increasing the gain of your valve package, often reducing your actuator size due to your increased ability to accurately control higher air deliveries, and the flexibility to add options and accessories to complete your control package's performance.

Our standard positioners include both pneumatic and electropneumatic positioners. Electropneumatic Positioners may be used on either double acting or spring return actuators. The anodized aluminum housing provides excellent product integrity and good corrosion resistance. Options including special coatings, stainless steel housings, and a variety of accessory items which provide the flexibility to meet your most demanding control applications.

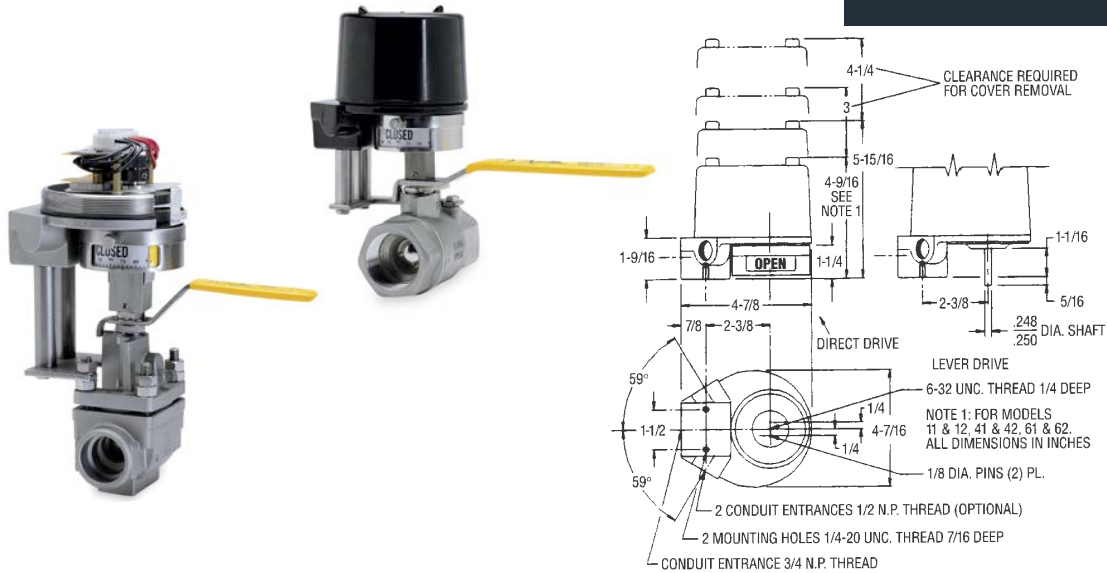
PMV Positioners Cont'd

Part Numbers		
CII Part #'s	PMV Model #'s	Description
3T-200-01	P-2000	Double Acting, Electro-Pneumatic, 1
3T-202-01	P-2020	Double Acting, Electro-Pneumatic, 2
3T-200-02	P-2000EX	Double Acting, Electro-Pneumatic, Intrinsically Safe, 1
3T-202-02	P-2020EX	Double Acting, Electro-Pneumatic, Intrinsically Safe, 2
3T-500-01	P5	Double Acting, Hi Capacity & Gain
3T-250-01	EP5	Electro Pneumatic, Hi Capacity & Gain
3T-250-02	EP5-EX	Double Acting, Hi Capacity & gain, Explosion Proof

- NOTE:**
1. Normal Capacity
 2. High Capacity
 3. Accessories such as pressure gauges, limit switches, transmitters, and potentiometers are available. Please consult the factory for pricing

PMV Mounting Kits for Apollo Actuators		
3T 10 & 20	63-002-01	Stainless Steel
3T 30-60	63-001-89	Stainless Steel
3T 65-90	63-001-91	Stainless Steel

Proximity Valve Position Monitoring Systems



Valve Position Monitoring Systems

Proximity Controls' flexible Valve Position Monitoring Systems give users the ability to reliably monitor both manual and actuated valves. The durable position monitoring system features mounting hardware available in zinc plated steel, stainless steel, and Namur standards for all Proximity indicator models.

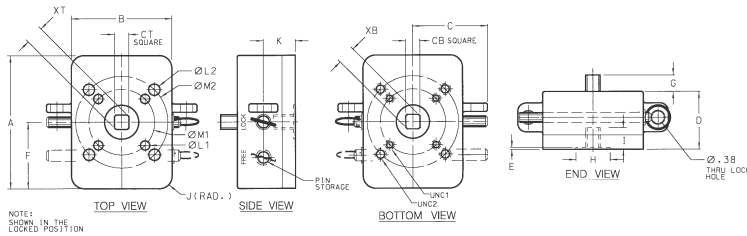
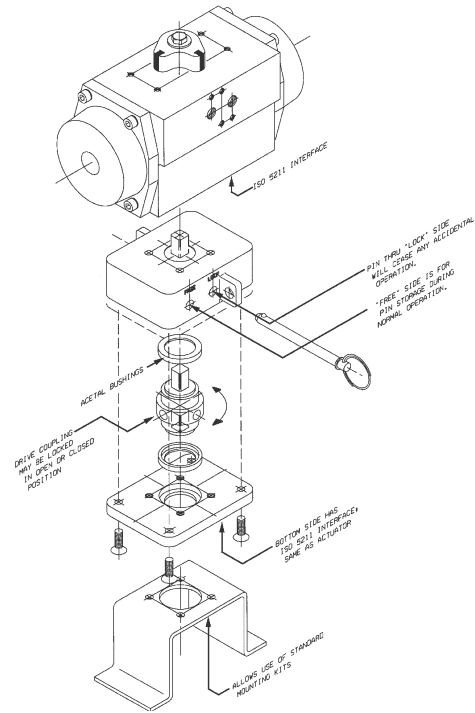
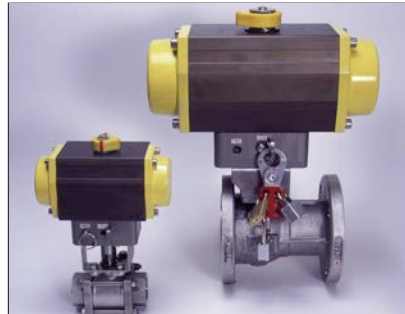
Proximity Model #	NEMA	Model Description	Switch/Transmitter Specifications
42ADM	4,4X	2 SPDT MECH, Clear Plastic Cover	15 amps ac, 5 amps dc
42ADO	4,4X,7,9	2 SPDT MECH, Anodized Aluminum Housing	15 amps ac, 5 amps dc
42DDO	4,4X,7,9	2 DPDT MECH, Anodized Aluminum Housing	10 amps ac, 10 amps dc
42RDO	4,4X,7,9	2 SPDT PROX, Herm Sealed Reed, Anodized Al.	3 amps ac, 2 amps dc
42VDOJ1	4,4X,7,9	2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al.	10 amps ac, 10 amps dc
42RDOJ1	4,4X,7,9	2 SPDT PROX, 3/4" & 1/2" NPT Entry, Anodized Al.	3 amps ac, 2 amps dc
44ADO	4,4X,7,9	4 SPDT MECH, Anodized Aluminum Housing	15 amps ac, 5 amps dc
45VDO	4,4X,7,9	2 SPDT MECH, & Transmitter, Anodized Aluminum	10 amps / 4-20 mA out
45RDO	4,4X,7,9	2 SPDT PROX, & Transmitter, Anodized Aluminum	3 amps / 4-20 mA out
62PDO	4,4X,7,9	2 SPST PROX, Anodized Aluminum Housing	Herm Sealed Reed (mA)
62QDO	4,4X,7,9	2 SPDT PROX, Anodized Aluminum Housing	Herm Sealed Reed (mA)
35ODO*	Mag Coupling	MULTI-TURN Transmitter, Anodized Aluminum	No Switch / 4-20 mA
12ADO**	Mag Coupling	2 SPDT MECH, Anodized Aluminum Housing	15 amps ac, 5 amps dc
15VDO	Mag Coupling	2 SPDT MECH, & Transmitter, Anodized Aluminum	10 amps / 4-20 mA out
12VDOJ1	Mag Coupling	2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al.	10 amps ac, 10 amps dc
12AD6	Mag Coupling - ST STL	2 SPDT MECH, 304 Stainless Steel Housing	15 amps ac, 5 amps dc
15VD6	Mag Coupling - ST STL	2 SPDT MECH, & Transmitter, 304 Stainless Steel	10 amps / 4-20 mA out

*No Visual Indicator Mag (Magnetic) Coupling - Maximum hazard protection and submersible. Prox (Proximity) sensors are all Herm (Hermetically) Sealed Reeds. Anodized aluminum housing is standard. 316 Stainless Steel is optional.

When ordering, please specify requirements for explosion proof certifications (US, CSA OR CENELEC), or Intrinsic Safety. Standard temperature (180°F) switches are available. White epoxy is optional. When you need a junction package, specify your solenoid valve requirement(s). For factory sealed lead orders, please specify number of leads and desired length (36" standard). Let us know if you need special cables or connectors, and specify your mounting hardware requirements.

** Conbraco maintains the 12ADO in stock, Conbraco part number with indicator M-1161-00 and without indicator M-1059-00.

OSHA Lockout Device



Material Specifications

The Apollo® Lockout Tagout accessory for actuators complies with OSHA 1910.147 guidelines. It insures complete lockout capability in both the fully open or the fully closed position. Its design prevents accidental or malicious tampering of an automated valve's orientation.

The housing is constructed in investment cast 316SS, the fasteners, the lock pin, and the coupling are made of 300 Series stainless steel. This rugged construction, plus two acetal bushings located above and below the coupling, assures the strength and support necessary to withstand the torque and torsion generated by the actuator mounted above.

The top and bottom of the housing feature ISO 5211 mounting patterns. This design allows the accessory to be fitted between existing actuators and stainless steel bracketry that also comply with the ISO 5211 standard.

Available in six sizes, it is the perfect compliment to the Apollo® Rack and Pinion Actuator and Apollo® Ball Valve. The design results in a safe automated package that will satisfy the concerns of the most discriminating safety engineer.

The lockout device may be used with electric actuators. However, caution should be exercised due to the possibility of motor burnout in an energized and locked position.

	HOUSING: INVESTMENT CAST 316 SS		BASE PLATE: 316 SS		DRIVE COUPLING: 303 SS	
	BUSHINGS: ACETAL		LOCK PIN: 303 SS		FASTENERS: 18-8 SS	
DIMENSION	3TL3000	3TL4000	3TL5060	3TL6570	3TL8000	3TL9000
A	4.00	4.00	6.00	6.00	8.00	8.00
B	3.00	3.00	4.25	4.25	6.00	6.00
C	2.25	2.25	3.12	3.12	4.25	4.25
D	1.75	1.75	2.37	2.37	3.50	3.50
E	0.06	0.06	0.10	0.10	0.18	0.18
F	2.00	2.00	3.00	3.00	4.00	4.00
G	0.50	0.70	0.87	0.87	1.38	1.38
H	1.02	1.02	1.75	1.75	2.50	2.50
I	0.62	0.70	1.17	1.17	2.00	2.00
J(RAD.)	0.37	0.37	0.50	0.50	0.75	0.75
K	0.96	0.96	1.50	1.50	2.50	2.50
L1	0.265	0.265	0.328	0.328	0.515	0.640
L2	NA	NA	0.390	0.390	NA	NA
UNC1	1/4-20UNC	1/4-20UNC	5/16-18UNC	5/16-18UNC	1/2-20UNC	5/8-11UNC
UNC2	NA	NA	0.390	0.390	NA	NA
M1 B.C.	1.970 (F05)	1.970 (F05)	2.756 (F07)*	2.756 (F07)	4.920 (F12)	5.510 (F12)
M2 B.C.	NA	NA	4.016 (F10)	4.016 (F10)*	NA	NA
XT (MAX.)	0.540	0.690	0.955	1.080	1.325	1.780
XB (MIN.)	0.551	0.710	0.985	1.105	1.420	1.890
3T	.430/.432	.547/.550	.744/.747	.862/.865	1.056/1.059	1.413/1.416
CB	.433/.435	.551/.553	.748/.750	.866/.868	1.060/1.063	1.419/1.422
WEIGHT	3.65	3.75	9.90	10.40	28.90	29.50

*F Patterns Designated are Conbraco's Standard Mounting Arrangement

VALVE MOUNTING

Mounting of Apollo® actuators to quarter turn valves is a very straight forward task. Conbraco provides stainless steel brackets and couplings that are precision made to fit each of its Apollo® valve and actuator combinations. The simplicity of valve mounting hardware is deceptive and may cause carelessness in the assembly operation.

CAUTION

It is mandatory that the actuator to valve mounting procedure be performed by personnel that have been properly trained and informed of the importance of this assembly operation.

Conbraco's brackets and couplings have been engineered to have the required strength and precision fit to insure reliable valve operation. Each mounting kit has all the required components to mate specific valves and actuators (refer to the mounting kit selection guide).

CAUTION

Brackets and couplings of lesser quality can expose the stem of the valve to side loads that will ultimately cause premature stem leakage. It is essential that the actuator to valve mounting be treated as a critical assembly operation. All brackets and couplings must be properly aligned prior to tightening the attachment bolts. The assembly should undergo an operational test to insure that there is no binding during operation. There must be no discernible flexing of the bracket. If either is noted corrective action must be taken before the assembly is considered acceptable for use.

ALL AUTOMATED VALVES must undergo an operational test to insure that both the valve and actuator function properly. The valve must be properly aligned in both the open and closed positions. Spring return actuators must perform their intended safety function such as: fail closed, fail open. Modulating actuators should operate the valve in the correct direction in response to the required instrument signal.

BALL VALVE TORQUE

Before an actuator can be selected, the in-service torque requirement of the valve must be determined. The in-service valve torque is influenced by many factors. Packing and seating materials are fundamental to the construction of the valve and therefore establish the basic required torque. Service conditions which include differential pressure, frequency of operation and flow media also have a significant effect on the valve's in-service torque. Refer to the Torque Constants Chart for valve torque requirements under defined conditions. The torque required to operate a ball valve is the result of friction between the moving and stationary components of the valve. The stem to packing friction and the ball to seat friction combine to establish the minimum torque requirement. **Conbraco recommends the use of a stainless steel ball and stem on automated valves.**

LONG STAND STILL TORQUE (LSST)

Common to soft seated ball valves is the phenomena of Long Stand Still Torque (LSST). For floating ball valves, LSST is typically twice the normal rated torque. The phenomena occurs when a valve remains idle for an extended period of time, typically a month or more, but the time period can vary by application. Even if "normal" operation is daily or even more frequent, if the valve sits idle LSST still need to be taken into account when sizing an actuator. Once the valve has been operated a couple of times, the operating torque returns to normal levels.

Apollo Ball Valves

BALL & SEAT

Valve torque is primarily dependent on the friction between the moving ball and the stationary seat. Seating material and surface finish of the ball establish the basic frictional characteristics of the combination. Service conditions also play a major roll in modifying the effects of friction. A floating ball valve utilizes the difference between the upstream and downstream pressures to force the ball into the downstream seat. When this force exceeds the forces in the original assembly, the torque required to rotate the ball increases. Process media may also increase or decrease the friction between the ball and seat. To insure reliable actuator selection, the service conditions of the installed valve must be carefully determined and considered for their effect on torque.

STEM & PACKING

Stem torque is primarily dependent on the frictional characteristics of the packing material and the tightness of the packing adjustment. Proper adjustment of the packing is important not only to the leak tight performance of the valve but also minimizes the operating torque. Tightening the packing more than is required to establish a proper seal, only increases torque requirements and stem wear. Packing adjustment can be abused to the point that a properly selected actuator may not be able to operate the valve. Stem packing friction is essentially unaffected by the media and operating pressures within the valve.

-24/-29 GRAPHITE STEM PACKING ADDER

The selection of graphite packing contributes significantly to the operating torque of a valve. The friction factor for graphite is a magnitude different than that of PTFE based packings. The contribution to torque is a function of the stem diameter and is reflected in each of the following tables. When selecting either the -24, -29 or -65 options use the appropriate adder listed in the table for each valve as a direct increase to the base torque constant.

BREAKWAY TORQUE

Torque required to initiate the opening of a valve from the fully closed position. This is the highest torque requirement anywhere within the Apollo® Ball Valve's rotation. The Torque Constants Chart lists breakaway torques for Apollo® valves under defined operation conditions.

Note: For double acting actuators, the torque output at the given air supply pressure must exceed the breakaway torque of the valve.

CLOSING TORQUE

Torque required to rotate the valve from the open position, into the fully closed position. A conservative approach is taken when determining closing torque because operating conditions have a significant effect on its value. It is safest to assume that closing torque is equal to breakaway torque. In actual service conditions the closing torque may be less, but this margin is used as a sizing safety factor.

GUIDELINES FOR DETERMINING IN-SERVICE VALVE TORQUE

Actual service conditions must be considered when determining a valve's required torque. Torque Adjustment Factors have been established to convert the Torque Constant value to an in-service torque. Multiple Torque Adjustment Factors may be required to establish the proper in-service torque requirement. All valve torque determinations begin with the Torque Constant value at the appropriate differential pressure. Adjustment factors must be used to determine the in-service valve torque requirement (see page 43, Torque Adjustment Factors Chart). Each applicable adjustment factor is applied to the value from the Torque Constants chart. The sum of all appropriate adjustments of the valve's torque are added to the original value from the Torque Constants chart. The result is the in-service torque requirement. This torque value is to be used in actuator selection.

Note: For fail closed applications, the closing torque must be exceeded by the "spring end" force of the actuator. For fail open applications, the closing torque must be exceeded by the "air end" (at the given supply pressure) force of the actuator.

Actuators and Controls

Apollo Ball Valves

* Torques tested with multifilled seats. Does not require torque adjustment of -20%.

** 71-ARX-64 and 77-ARX-64 rated to 600 psig maximum.

*** LSST - Long Stand Still Torque

Torque Constants for Apollo End Entry Valves (1),(2)									
TORQUE CONSTANT (lb-in) AT DIFFERENTIAL PRESSURE INDICATED (psig)									
DIFFERENTIAL PRESSURE psig		200	400	600	800	1000	1500	LSST***	-24 / -29 Adder
Valve Model	Size							(in.-lbs)	(in.-lbs.)
STD PORT 70-64X 71-14X 76-10X 76-60X 89-14X 399-10X	1/4 - 1/2	35	35	40	43	46	48	70	45
	3/4	50	50	54	59	62	64	100	45
	1	101	101	103	106	116	130	202	56
	1-1/4	171	171	205	216	246	286	342	96
	1-1/2	192	192	216	265	280	311	384	96
	2	271	271	276	300	309	354	542	96
	2-1/2 & 3	715	715	790		1200		1430	96
FULL PORT BRONZE 77-14X	1/4 - 1/2	35	35	40				70	45
	3/4	74	74	84				148	56
	1	234	234	250				468	56
	1-1/4	286	286	321				552	56
	1-1/2	357	357	398				714	96
	2	650	650	722				1300	96
FULL PORT BRONZE 77D-14X	1/2	25	25	25	25			50	
	3/4	55	55	55	55			110	
	1	87	87	87	87			174	
	1-1/2	120	120	120	120			240	
	2	280	280	280	280			560	
**STD PORT **71-ARX-64 89-ARX-64 76-ARX-64	1/4 - 1/2	26	27	28	30	32	35	50	45
	3/4	50	52	54	57	60	64	100	45
	1	86	88	90	94	97	110	170	56
	1-1/4	140	145	156	160	172	194	280	96
	1-1/2	164	173	186	195	201	235	320	96
	2	230	258	270	310	350	460	440	96
	2-1/2	495	576	680	790	900		900	96
3	540	700	820	920	1030		1000	96	
*FULL PORT **77-ARX-64	1/4 - 1/2	50	52	54				100	45
	3/4	86	88	90				170	56
	1	148	160	180				280	56
	1-1/2	300	310	340				580	96
	2	355	420	563				680	96
FULL PORT 3-PIECE 82-14X & 24X	1/4 - 1/2	78	78	90	123	140	157	156	56
	3/4	156	156	178	201	229	257	312	56
	1	208	208	230	248	382	317	416	96
	1-1/4	234	234	276	309	352	395	468	96
	1-1/2	350	350	390	450	513	576	700	96
	2	715	715	755	800	912	1024	1430	96
	3	710						1100	292
4	1052						1540	292	
FULL PORT 3-PIECE 83A-14X & 24X 83B-14X & 24X 86A-10X & 20X 86B-10X & 20X	1/4 - 1/2	25	26	26	27	28	30	48	45
	3/4	61	62	63	63	64	66	121	68
	1	97	104	110	117	124	141	180	68
	1-1/4	182	198	213	228	243	281	335	96
	1-1/2	182	198	213	228	243	281	335	96
	2	355	420	563				680	96
FULL PORT 3-PIECE 83R-108-01 & 83R-100-01 86R-108-01 & 86R-100-01	2	715	715	755	800	912	1024	1430	96
	3	1030	1030	1087	1148	1212		2060	201

"Apollo" Valves

Actuators and Controls

Apollo Ball Valves

Torque Constants for Apollo PEEK Seated 83B/86B with Graphite Stem Packing

TORQUE CONSTANT (lb-in) AT DIFFERENTIAL PRESSURE INDICATED (psig)										
DIFFERENTIAL PRESSURE psig		200	400	600	800	1000	1200	1400	1500	LSST
Valve Model	Size									(in.-lbs)
FULL PORT 3-PIECE 83B/86B	1/4 - 1/2	75	80	86	91	98	105	111	118	112
	3/4	130	150	170	177	185	194	204	210	195
	1	250	263	276	289	302	315	328	345	375
	1-1/4	420	463	506	549	592	635	678	720	630
	1-1/2	420	463	506	549	592	635	678	720	630
	2	840	922	1004	1086	1168	1250	1332	1410	1260

Caution: 2" PEEK seated valves operating at pressures higher than 1000 psig. should be automated or have a gear operator installed. Lever operation is not suggested. All values are stated in (in. lbs.)

Torque Constants for Apollo Flanged Ball Valves

Torques Shown in lb-in.		Working Pressure (psig)									LSST*	-24 Adder	
Valve Series	Valve Size	0	100	200	300	400	500	600	700	740	(in.-lbs)	(in.-lbs.)	
87A-100's 88A-140's 87B-100's 88B-100's	1-1/2" SP 150	132	144	155	167						264	68	
	2" SP 150	176	193	211	228						352	96	
	2-1/2" SP 150	231	254	277	300						462	127	
	3" SP 150	253	327	402	476						506	127	
	4" SP 150	550	630	710	790						1100	292	
	6" SP 150	770	911	1052	1193						1540	292	
	8" SP 150	2200	2494	2788	3081						4400	661	
	10" SP 150	3300	3580	3860	4140						6600	661	
	87A-200's 88A-240's	1/2" FP 150	22	22	22	22						44	45
		3/4" FP 150	39	43	47	51						77	68
1" FP 150		132	144	155	167						264	68	
1-1/2" FP 150		176	193	211	228						352	96	
2" FP 150		231	254	277	300						462	127	
2-1/2" FP 150		253	327	402	476						506	127	
3" FP 150		550	630	710	790						1100	292	
4" FP 150		770	911	1052	1193						1540	292	
6" FP 150		2200	2494	2788	3081						4400	661	
8" FP 150		3300	3580	3860	4140						6600	661	
87A-700's 88A-740's	10" FP 150	4400	5059	5718	6377						8800	988	
	12" FP 150	4950	8300	11650	15000						9900	988	
	1-1/2" SP 300	132	144	155	167	178	190	201	213	217	264	68	
	2" SP 300	176	193	211	228	245	262	280	297	304	352	96	
	2-1/2" SP 300	231	254	277	300	323	346	369	392	401	462	127	
	3" SP 300	253	327	402	476	551	625	700	774	804	506	127	
	4" SP 300	550	630	710	790	870	950	1030	1110	1142	1100	292	
	6" SP 300	770	911	1052	1193	1333	1474	1615	1756	1812	1540	292	
	8" SP 300	2200	2494	2788	3081	3375	3669	3963	4257	4374	4400	661	
	10" SP 300	3300	3580	3860	4140	4420	4700	4980	5260	5372	6600	661	
87A-900's 88A-940's	1/2" FP 300	22	22	22	22	23	23	23	23	23	44	45	
	3/4" FP 300	39	43	47	51	55	59	63	67	69	77	68	
	1" FP 300	132	144	155	167	178	190	201	213	217	264	68	
	1-1/2" FP 300	176	193	211	228	245	262	280	297	304	352	96	
	2" FP 300	231	254	277	300	323	346	369	392	401	462	127	
	2-1/2" FP 300	253	327	402	476	551	625	700	774	804	506	127	
	3" FP 300	550	630	710	790	870	950	1030	1110	1142	1100	292	
	4" FP 300	770	911	1052	1193	1333	1474	1615	1756	1812	1540	292	
	6" FP 300	2200	2494	2788	3081	3375	3669	3963	4257	4374	4400	661	
	8" FP 300	3300	3580	3860	4140	4420	4700	4980	5260	5372	6600	661	
	10" FP 300	4400	5059	5718	6377	7036	7696	8355	9014	9277	8800	988	
	12" FP 300	4950	8300	11650	15000	18349	21699	25049	28399	29739	9900	988	

Note (1) Constants are used to determine the in-service torque requirements of Conbraco's valves.

Note (2) Constants are based on RPTFE seats and clean dry air at the stated differential pressure.

*LSST - Long Stand Still Torque

Actuators and Controls

Torque Constants For Top Entry Valves (1)

Seat Options		Valve Size		Differential Pressure (psig)					LSST* (in.-lbs.)	Graphoil® Adder (in.-lbs.)
		Std. Port	Full Port	100	285	500	740	1480		
1	7	1	1/2-3/4	85	110	140	180	290	170	68
2	A	1 1/2	1	205	260	330	415	660	410	96
3	F	2	1 1/2	350	430	550	735	1200	700	127
5	L	3	2	950	1250	1650	2000	3200	1900	245
	D	4	3	2000	2500	3300	4100	6500	4000	399
	T	6	4	5300	6700	8200	11,400	18,000	10,600	661
	U	8	6	11,000	14,000	18,500	25,000	36,000	22,000	900
6	Z	10	8	18,500	22,000	30,000	40,000	62,000	37,000	1326
	H	1	1/2-3/4	115	160	210	260	450	230	68
4		1 1/2	1	270	370	480	590	1000	540	96
8		2	1 1/2	475	650	860	1050	1750	950	127
****	9	3	2	1250	1850	2400	2950	4900	2500	245
		4	3	2700	3700	4900	5900	10,000	5400	399
	B	6	4	7410	10,100	13,400	16,400	25,300	14,820	661
		8	6	15,000	20,000	26,000	32,000	56,000	30,000	900
		10	8	25,000	32,000	45,000	60,000	96,000	50,000	1326

* LSST - Long Stand Still Torque

** Rated torque for #6 and U seat add 30%

*** Rated torque for #1 & #7 PTFE seats can be reduced by 30%.

**** Rated torque for #9 ceramic seat is to be increased by 10%.

BALL VALVE TORQUE ADJUSTMENT FACTORS		
PROVISION	CONDITION	FACTOR
TYPE OF OPERATION	ON/OFF SERVICE	0
	MODULATING SERVICE	0.25
PROCESS MEDIA	LIQUID, CLEAN PARTICLE FREE	0
	LIQUID, DIRTY, SLURRY, RAW WATER	0.3 TO 0.8
	LIQUID, BLACK LIQUOR, LIME SLURRY	0.8
	LIQUID, OIL, LUBRICATING	0
	LIQUID, VISCOUS, MOLASSES	0.3
	GAS, CLEAN & WET	0
	GAS, DRY	0.3 TO 0.5
	GAS, DIRTY, AIR SLURRY, NATURAL GAS	0.5 TO 1
	OXYGEN, CHLORINE	0.5
SUPERHEATED STEAM, SATURATED STEAM	Refer to Process Temp.	
FREQUENCY OF OPERATION**	ONCE PER DAY OR MORE	0
	ONCE PER WEEK	0.2
	ONCE PER MONTH	0.5
	LESS THAN ONCE PER MONTH (LSST)	1
PROCESS TEMPERATURE	APPLICATIONS ABOVE 225 DEG F	0.50
	APPLICATIONS BELOW -20 DEG F	0.25
VALVE SEATING MATERIAL	PTFE	-0.3
	*MULTIFILL	0
	*PEEK	Contact Factory
	*UHMWPE	Contact Factory
OPTION	-49 ASSEMBLED DRY	0.3
	-57 OXYGEN CLEANED	0.3
	-67 CLEANED FOR INDUSTRIAL GAS	0.3
	-90 DOUBLE PACKED EXTENDED BONNET	0.2
CUSTOMER SPECIFIED	PRESCRIBED SAFETY FACTOR	0.2 TO 2

* Do not consider when calculating Top Entry Valve Torques. Apply all applicable Torque Adjustment Factors to the Valve Torque Constant to determine the in-service torque requirement.
 ** If accounting for LSST disregard frequency of operation.

Example:

To find adjusted torque: 1" 76-AR5-64 used on Oxygen service once per week to once per month. Find the torque constant of the valve at 200 psig DP, then add together the adjustment factors, and add 1 to that number. Then multiply the sum of the adjustment times the torque.

86" lbs x (.5 + .5 + 1) = 172" lbs. adjusted torque.

Apollo Butterfly Valves

Butterfly Valve Actuator Sizing procedures

Double Acting Actuator: Air to Open, Air to Close

- ✓ Choose an actuator whose output torque at the given air supply is greater than the butterfly valve's seating/unseating torque. (See Page 8)
- ✓ Unseating torque is also known as the breakaway torque.
- ✓ Seating torque is also known as the closing torque.

Spring Return Fail Closed: Air to Open, Spring to Close

- ✓ Select an actuator whose ending spring stroke is greater than the butterfly valve's seating/unseating torque. (See Page 9)
- ✓ Select an actuator whose starting air stroke is greater than the butterfly valve's seating/unseating torque at the given air supply pressure. (See Page 9)
- ✓ Above must be found on the same spring set line.

Spring Return Fail Open: Air to Close Spring to Open

- ✓ Select an actuator whose end of air stroke is greater than the butterfly valve's seating/unseating torque at the given air supply pressure. (See Page 9)
- ✓ Select an actuator whose start of spring stroke is greater than the butterfly valve's seating/unseating torque. (See Page 9)
- ✓ Above must be found on the same spring set line. See Actuator Part Numbering System-"F" Suffix for Fail Open

Factors Affecting Seating and Unseating Torque and Application Guidelines

Operating Frequency

The first operation of a valve after a sustained period of closure will require above normal torque.

Lubricating Characteristics of Flow Media

Water is one of the best lubricants for metal-elastomer contact. Judge your flow media on this basis-better than or worse than water. Examples of lubricating media are: water, lubricating oils, aqueous process flow, beverage service, etc. Examples of non-lubricating media are: air, dry gases, dry bulk services, solvents, diesel oil, etc.

Condition of Disc Edge and Seat

An iron disc in corrosive service will corrode. This corrosion deposits a build-up on the disk edge and raises required torque. Similar flow media deposits on the seat material can increase torque or prevent proper valve operation.

Temperature Extremes

Sustained operating temperatures approaching the upper or lower limits of the seat material will increase required torque. Refer to the seat temperature range on Apollo® Butterfly Valve Seat Materials page in the catalog. Consult the factory for anticipated torque increase of certain seat materials due to temperature extremes.

Elastomer Swell

Certain elastomers tend to swell from contact with some chemicals. This elastomer swell will increase required torque.

*The wide selection of Apollo® Available Materials of Construction will allow you to choose the correct butterfly valve materials for your service. All of the above **Torque Affecting Factors** can be accommodated with the correct choice of materials. Consult the factory for assistance in choosing the correct torque value for your service.*

NOTE: Please consult the material selection guide for trim recommendations. Please consult the factory for proper sizing of Apollo® actuators.

Apollo Butterfly Valves

Seating and Unseating Torque Apollo® Resilient Seated Butterfly Valves

141 and 143 SERIES: 2"-24"

Valve Size (In.)	Standard Disc Differential Pressure			
	50 PSI Δ P Bushing PTFE	100 PSI Δ P Bushing PTFE	150 PSI Δ P Bushing PTFE	200 PSI Δ P Bushing PTFE
2	100	106	111	117
2 1/2	150	163	176	189
3	207	220	232	244
4	290	323	357	390
5	423	481	540	598
6	599	691	783	875
8	1060	1183	1307	1430
10	1671	1872	2074	2275
12	2568	2795	3023	3250
14	2640	3070	3500	-
16	4260	4880	5500	-
18	6287	7243	8200	-
20	8360	9180	10000	-
24	15427	16813	18200	-

All torque values shown on chart are for *wet* (water and other non-lubricating media) on-off service. For *dry* (non-lubricating, dry gas media), multiply values by 1.15. For *lubed* service (clean, nonabrasive lubricating media), multiply values by 0.85.

Under certain conditions, hydrodynamic torque can meet or exceed seating and unseating torques. When designing valve systems, hydrodynamic torque must be considered to help ensure correct selection of actuation.

***ALL PUBLISHED BUTTERFLY TORQUE CHARTS HAVE NO BUILT-IN SAFETY FACTORS. A PRESCRIBED 25% SAFETY FACTOR IS RECOMMENDED!**



SALES & CUSTOMER SERVICE:

Phone: (704) 841-6000

Fax: (704) 841-6020

www.apollovalves.com

			email	phone	fax
SOUTHEAST REGION	Spirit Group	FL (except Pan Handle)	info@spiritgroupinc.com	407-291-6035	407-299-0378
	Spotswood Associates	GA/AL	dlewis@spotswoodassociates.com	770-447-1227	770-263-6899
	Pro Marketing, Inc.	NC/SC/TN-East	sales@promarketinginc.net	864-578-4334	864-578-4889
	Mid South Marketing, Inc.	VA/MD/Washington, D.C./WV-East	midsouth7@aol.com	804-213-3801	804-213-3802
SOUTHERN REGION	Southern Marketing Group	MS/TN-West/AR/Bowie Cty.-TX	SMG49@bellsouth.net	901-547-0042	901-547-0035
	Marathon Flow Control	TX, OK, KS except Northeast, LA (Industrial)	sales@marathonflowcontrol.com	855-483-5029	855-483-5030
	BWC Inc.	LA (Commercial Products)	chuck@bwcassoc.com	504-734-0229	504-734-3711
MIDWESTERN REGION	New Tech Marketing	Northern-IL/WI-East/IN/MI-UP/IA-River Counties	sales@new-techmarketing.com	630-378-4300	630-378-0343
	New Tech Marketing	MO/Southern IL/Northeast Kansas	ntm112@aol.com	618-394-0329	618-394-0427
	V.E. Sales Co., Inc.	MI (Except Upper Peninsula)	tomv@vesalesinc.com	586-774-7760	586-774-1490
	FourMation Sales	MN/ND/SD/WI-West	ryan@fourmationsales.com	763-420-6900	763-420-6993
	Marshall-Rodeno Heartland	NE/IA (Except River Counties)	trodeno@marshallrodeno.com	303-575-6701	303-575-6706
	Midwest Spec	KY/OH/PA-West/WV-West	glsales@mwspec.com	330-538-0406	330-538-0410
WESTERN REGION	Spec Management Group	HI	msmarch4@cox.net	949-481-4225	949-487-0990
	Elmco Duddy	CA - South	tduddy@elmcoduddy.com	626-333-9942	626-855-4811
	Marshall-Rodeno Associated	CO/WY/MT/ID-SE/UT/NV-NE/NM/EI Paso-TX	trodeno@marshallrodeno.com	303-575-6701	303-575-6706
	Gordon & Associates	WA, OR, AK, Northern counties ID	laura@gordonandassoc.com	360-566-1470	360-566-1478
	Southwestern Industrial Sales Co.	AZ/Nevada-SW	eduardop@sw-ind.com	480-458-5838	480-458-5843
Southwest Valves	CA (Waterworks and Fire Protection)	d.burell@southwestvalve.com	559-261-2703	559-261-2711	
NORTHEAST REGION	Urell, Inc.	MA/New England States	apollo@urell.com	617-923-9500	617-926-9414
	Conroy & Griese Sales, Inc.	NY-East/NJ-North	iezzi52@aol.com	856-663-4440	856-663-6644
	Layden Company	NY-Upstate/PA-East/DE/NJ-South	joejr@laydencompany.com	610-363-6657	877-529-3361
	Keith Engle & Associates	OEM accounts	keith.engle@verizon.net	610-827-9560	610-827-9561
IRRIGATION ONLY REFS	Active Sales Northwest, Inc.	OR, WA, Western ID	skactive@aol.com	541-726-0320	541-726-1148
	Biz Sales Company	OH, KY, MI, IN, parts of PA, WV, WI	dzavelson@bizpvf.com	216-595-2888	216-595-2899
	Formation Sales	MN/ND/SD/WI-West	dean@formationsales.com	763-262-4700	763-262-4740
	Jim Benton & Associates	AL, FL Panhandle	jim@bentonandassoc.com	205-664-1221	205-664-1277
	J&J Midwest Sales	NE, IA, MO, KS	info@jjsls.com	815-806-0202	815-806-0303
	Marel Enterprises	New England, NY, DE, MD, VA, DC, parts of PA & WV	marelenterprise@gmail.com	631-271-1718	631-427-8558
	Marshall-Rodeno Associated	CO/WY/MT/ID-SE/UT/NV-NE	trodeno@marshallrodeno.com	303-575-6701	303-575-6706
	NSC Marketing Group Inc.	OK	nsc_tulsa@sbcglobal.net	918-627-5340	918-664-1408
	Pro Marketing, Inc.	NC/SC/TN-East	sales@promarketinginc.net	864-578-4334	864-578-4889
	Southern Marketing Group	MS/TN-West/AR/Bowie Cty.-TX	SMG49@bellsouth.net	901-547-0042	901-547-0035
	Spec Management Grop	CA-South, HI			
CANADA	Conbraco Industries, Canada	178 Pennsylvania Ave., Unit 1, Concord, Ontario L4K 4B1	conbraco.canada@conbraco.com	905-761-6161	905-761-6666
	Barclay Sales Ltd.	British Columbia	bbarclay@barclaysales.com	604-945-1010	604-945-3030
	D & M Mechanical Sales	Ontario/East	don@dandmsales.ca	613-384-7084	613-384-3407
	Dynamic Agencies, Ltd.	Saskatchewan	doug.dynamicage@sasktel.net	306-343-1901	306-343-1901
	Tom Beggs Agencies Ltd.	Manitoba/NW Ontario	tba@mts.net	204-953-1900	204-774-6915
	Task Controls, Inc.	Ontario	infotoronto@taskcontrols.com	416-291-3004	416-754-3481
	Agences J. Pierre Sylvain, Inc.	Quebec	agencespsylvain@golden.net	450-655-9588	450-641-2737
	Kern Industries, Ltd.	Alberta-North	kernind@telusplanet.net	780-451-2056	780-454-6687
	Kern Industries Calgary, Ltd.	Alberta-South	marty.yucytus@kernindustries.ca	403-730-7791	403-239-8179
	J. Levandier Sales, Inc.	Nova Scotia, New Brunswick, Prince Edward Island & Newfoundland	service@jlevandiersales.ca	506-858-1615	506-858-1084
	Key to the North Sales Agency, Inc.	Ontario-North	hmehes@keytothenorth.ca	705-524-6714	705-566-0148
INTERNATIONAL	Conbraco International Sales:	Mexico	jose.arias@conbraco.com	956-631-4542	956-631-4681
		Caribbean	luis.guzman@conbraco.com	787-739-5620	
		Central & South America	jr.jefferson@conbraco.com	832-220-3783	
		Asia Pacific/India	jonathan.yap@conbraco.com	65-9626-9241	65-6753-0131
		Europe/Africa/Australia/Israel	CONTACT CUSTOMER SERVICE	704-841-6000	704-841-6021
	Sadek Trading	Middle East (except Israel)	ysadek@aol.com	704-618-6613	980-233-8437

APOLLO VALVES REGIONAL MANAGERS

P.O. Box 247, Matthews, NC 28106

Brian Blalock (East) brian.blalock@conbraco.com phone: (704) 614-3744 fax: (704) 841-6021	Steve Brown (Northwest) steve.brown@conbraco.com phone: (425) 985-5095 fax: (253) 862-3548	Ron Fortner (South Central) ron.fortner@conbraco.com phone: (713) 203-9207 fax: (281) 464-3736
Skip Wilson (West) skip.wilson@conbraco.com phone: (760) 330-3293 fax: (775)854-5722	Sanford Pauly (North Central) sanford.pauly@conbraco.com phone: (513) 716-7772 fax: (513) 321-7717	

LASCO FITTINGS IRRIGATION REGIONAL MANAGERS P.O. Box 116, Brownsville, TN 38012

Jimmy White (Central) jwhite@lascofittings.com phone: (731) 234-2372 fax: (731) 779-3608	Ron Modugno (West) rmodugno@lascofittings.com phone: (661) 910-5058 fax: (661) 775-0713
David Beyer (Northeastern) dbeyer@lascofittings.com phone: (561) 718-9379	Rick Williamson (Southeast) rwilliamson@lascofittings.com phone: (386) 451-2307