



- REAL VALVES, AUTOMATIC & CONTROLS
- PRECISION
- VALVES
- POWER STEEL VALVES



**APOLLO<sup>®</sup>**

**actuators  
and controls**

- SAFETY VALVES
- STRUCTURAL
- PLUMBING & PIPING PRODUCTS
- HYDRAULIC VALVES



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## 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 one year from the date of delivery to you, our initial purchaser. Compactorque actuators are warranted for two years with the same terms and conditions.

Should any failure to conform to this warranty appear within one year 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.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER WARRANTY OF QUALITY, WHETHER EXPRESS OR IMPLIED, EXCEPT THE WARRANTY OF TITLE AND AGAINST PATENT INFRINGE-

MENT. 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 persons 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, DAMAGE OR 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.

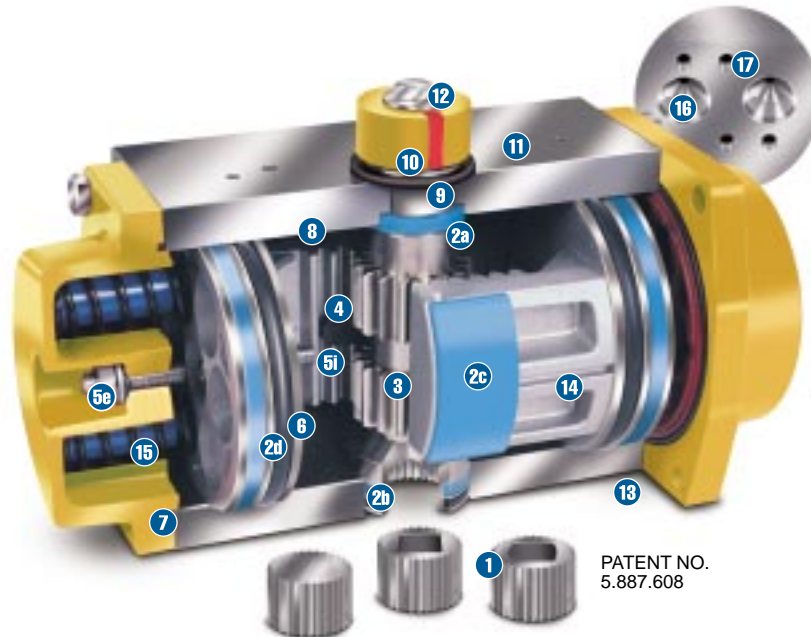
### General Information

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.

# Pneumatic Actuators

## Apollo® CompacTorque™ Rack & Pinion Actuator

2 Year Warranty



### 1. Unique Universal Shaft Adapter

Precision replaceable insert including variable internal geometry configuration meets any custom requirement. Standard insert is high strength FLN-C4408. Optional stainless steel insert available. \*Size 030 thru 080 only.

### 2. Bearings

Replaceable top (2a), bottom (2b), body (2c), and piston (2d) are manufactured of nylon 4-6. Benefits include low coefficient of friction, minimal moisture absorption, stability above 400°F, and excellent chemical resistance.

### 3. Output Shaft and Pinion Gear

One piece high strength alloy steel pinion shaft, precision machined gear teeth for precise fit, efficiency and long life. Standard pinion is electroless nickel coated for corrosion protection and is blowout proof. Optional stainless steel pinion shaft available.

### 4. Piston Guides

Piston guides maintain optimum piston position and prevent pinion shaft blowout.

### 5. Travel Stops

Provides for + or - 4 degrees travel adjustment in both directions, internal (5i) and external (5e).

### 6. Piston Seals

Replaceable pressure containment seals of permanently lubricated nitrile. Also available in fluorocarbon or other compounds for extreme temperature operation.

### 7. Die Cast Aluminum End Caps

Same end cap serves double acting and spring return models. Cast in spring pockets allow standard double acting actuator conversion to spring return by simply adding unique preloaded spring cartridges. Polyester powder coat is standard with additional protections available.

### 8. Extruded Aluminum Body

Precision extruded aluminum alloy with hard anodizing inside and out after finish machining. Additional protection coatings are available.

### 9. Thrust Washers

Double thrust washers of 45% glass reinforced, heat stabilized PPA backed by stainless steel provides extra protection against vertical thrust.

### 10. Position Indicator

Unique position indicator can be indexed to show alternate position. Plastic indicator inserts can be replaced with metal or magnetic targets for use with various proximity sensors.

### 11. Accessory Mounting

Manufactured in accordance with international specification VDI/VDE 3845 NAMUR to provide standardized drilled and tapped standard mounting for accessories such as positioners and limit switches.

### 12. Namur Slotted Shaft

In accordance with the international standard to provide a self-centering positive drive for positioners and switches.

### 13. Actuator Mounting

Manufactured in accordance with ISO 5211 promoting easy installation of the actuator directly on valves, gearboxes, or with ISO brackets. Conformance with DIN3337 is easily accomplished by rotating the Universal Shaft Adapter 45 degrees.

### 14. Die Cast Pistons

Precision die cast pistons are multiguided through full face engagement with the pinion and piston guide. Full depth machined piston teeth provide engagement with minimum backlash.

### 15. Pre-Loaded Spring Cartridges

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

### 16. Internal Porting

Large internal ports enhance quick operation and eliminates the cost of external tubing.

### 17. Namur Solenoid Mounting

Manufactured in accordance with this international standard permitting direct mounting of a wide variety of solenoid valves.

# Compactorque Pneumatic Actuators (Corrosion Protection)

## Specification

The Apollo® CompacTorque™ actuator is pneumatically operated and travels a minimum of 90 degrees in each direction and has internal and external travel stops to provide for + or - 4 degrees adjustment on a 90 degree stroke. The actuator is totally enclosed with no external moving parts. All pneumatic passageways are integral to the actuator housing so as to eliminate the need for external tubing. All solenoid mounting conforms to NAMUR specifications to permit direct mounting of a wide variety of solenoid valves. CompacTorque™ actuators are rack and pinion design; the output torque is linear throughout the travel and designed for pneumatic operation up to a maximum pressure of 142 psig (10 bar).

CompacTorque™ actuators are able to operate with other media such as hydraulic oil or water<sup>(1)</sup>. All double acting and spring return units are suitable for both on/off and throttling applications.

Spring return units are dimensionally the same as double acting units, which saves space and weight.

The actuator is supplied with the following as standard:

- External end of travel adjustments integral with the end caps.
- One piece output pinion manufactured of high strength steel and electroless nickel coated for corrosion protection. NAMUR slotted connection
- Replaceable splined adapter to accommodate custom shaft connections. Size 030 thru 080 only
- Pistons and pinion that have a Nylon 4-6 bearing pad and rings, which extends the life of the actuator and reduces friction
- Corrosion resistant polyester powder coated end caps
- Hard anodized aluminum housing
- All fasteners are 304 stainless steel
- Permanently lubricated nitrile seals
- Self contained spring cartridges, heat treated and polyester powder coated for corrosion protection, that ensure safe disassembly
- Yellow chromate coated pistons and endcaps for internal corrosion resistance

## The Apollo® CompacTorque™ Universal Shaft Adapter (U.S.A.)

Apollo® CompacTorque™ introduces the newest design concept in actuators, the Universal Shaft Adapter (U.S.A.). The universal shaft adapter concept, was designed and manufactured with ease of actuator mounting in mind. The actuator incorporates the use of a replaceable splined adapter instead of a drive shaft connection with a fixed machined dimension and configuration. ISO 5211 - DIN 3337 configuration can be obtained by indexing insert 45 degrees from parallel. Inserts with other shaft connections and configurations are available. Optional stainless steel inserts are available. Available on CT30 and larger actuators.

## Hard Anodized Protection

Hard Anodic oxidation is an electrolytic conversion process which forms an oxide film approximately one half of the total depth of the entire hard anodizing process. Continuation of this process produces the “hard” anodic coating to approximately 2 mils (50 microns). The oxide coating is integral with the base substrate and is one of the hardest materials known with a hardness of corundum (45 to 65 Rockwell C).

## EPC 316

Apollo® CompacTorque Numbering System						
	0- Std. (Protection A)	Size	Option	Spring Set	Less One Spring Imbalance	Rev. Level
<b>D - Double Acting</b>	1- ENC(Protection C)	1	0-Nitrile (Std.)	0	0	A-Standard
<b>S - Spring Return</b>	2- Seal Kit	2	-20°F to +250°F	2	3	B-Without Universal Shaft Adapter*
<b>K - Kit</b>	3- Spring Kit	3	1-Viton	3	4	M-Metric*
	4- Indicator Kit	4	32°F to +350°F	4	5	Z-Special**
	5- Stop Kit	5	2-Low Temp. Nitrile	5	6	
	6- Polyester Powder Coated (Protection B)***	6	-50°F to +250°F	6		
	7- Stainless Steel Epoxy Coated (Protection D)	65	3-Neoprene			
	8- Stainless Steel Epoxy Coated 316 SS Pinion (Protection E)	7				
	9	8				
	A	9				
	G- Red End Caps (Protection A)					
	H- Blue End Caps (Protection A)					
	J- Black End Caps (Protection A)					

(1) Water should be properly filtered and inhibited to prevent corrosion and biological fouling.

\* Select one USA (Universal Shaft Adapter) from selection chart  
 \*\* Select one USA, specify bolt pattern on bottom of Actuator  
 \*\*\* Specify if Polyester Coating is Yellow, Red, Blue or Black  
 Fail open (Reverse Rotation) CW Open  
 Add letter 'F' to end of part number  
 Example: 3TS06060AF

# Compactorque Pneumatic Actuators (Corrosion Protection)

EPC 316 is a FDA Epoxy Powder pigmented with 316L stainless steel flakes applied by an electrostatic spray finishing process on a super clean surface. After application the pieces must be cured at 350°F (177°C). With a normal thickness of 3.0 - 4.0 mils (76-102 microns) of EPC 316 coating, resistance to salt spray in accordance with ASTM B-117 exceeds 2000 hours and has a pencil hardness of 2H as per ASTM D-3363.

## Electroless Nickel Coating

Nickel deposits are produced by chemical reduction of nickel into catalytic metallic or catalyzed nonmetallic substrates without the use of electricity. Total "as plated" thickness is the same shape of the surface; therefore, close tolerances (within 20 to 30 microns) can be maintained. Normal hardness averages about 49 Rockwell C.

## Polyester Powder Coating

Apollo® CompacTorque™ uses only the most modern thermosetting polyester powder coating resin. When subjected to elevated temperatures, these coatings melt, flow, and chemically cross link within themselves or with other reactive components to form a higher molecular weight reaction product. This resin system can produce thin paint like surface coatings in the 1 to 3 mil thickness range (25 to 76 microns) having a 2H pencil hardness as per ASTM D3363 and a salt spray resistance of 1000 hours in accordance with ASTM B117. Unlike epoxy coatings, polyester powder coatings offer excellent resistance to UV rays.

## 3T Series Valve Mounting Configuration

The 3T series actuator family utilizes an ISO 5211 mounting bolt pattern for the attachment of valve mounting brackets. Conbraco has been utilizing ISO 5211 mounting configurations since 1990. Therefore, there exists an extensive selection of engineered stainless steel brackets for the 3T series. The variety of valve and actuator combinations is so extensive that mounting kit identification is provided in a separate document (Mounting Kit Selection Guide). Many of the 3T series actuators have multiple mounting bolt patterns (see dimensions w-w1-w2 on the 3T series dimensional drawings). These alternate bolt patterns may be used as attachment points to brackets that have not been supplied by Conbraco or the automation of other manufacturer's valves. This flexibility of bracket attachment is provided so that the actuator can be used to automate any device that requires 90 degrees or less rotary motion and fits within the torque profile available from the actuator.

Universal Shaft Adapters			
NUMBER	CONBRACO DESCRIPTION	NUMBER	CONBRACO DESCRIPTION
<b>CX01605</b>	<b>ADAPTER, 11MM SQ, 3T030/STD. REV. A</b>	<b>CX01637</b>	<b>ADAPTER, 19MM SQ, 3T060/STD. REV. A</b>
CX01458	ADAPTER, 11MM SQ, 3T030, SS	<b>CX01638</b>	<b>ADAPTER, 22MM SQ, 3T065/STD. REV. A</b>
CX01606	ADAPTER, 14MM SQ, 3T030	<b>CX01696</b>	<b>ADAPTER, 22MM SQ, 3T070/STD. REV. A</b>
<b>CX01614</b>	<b>ADAPTER, 14MM SQ, 3T040/STD. REV. A</b>	<b>CX03313</b>	<b>ADAPTER, 22MM SQ, 3T070/SS</b>
CX01493	ADAPTER, 14MM SQ, 3T040/3T050, SS	<b>CX01718</b>	<b>ADAPTER, 27MM SQ, 3T080/STD. REV. A</b>
CX01615	ADAPTER, 17MM SQ, 3T040/3T050	CX03314	ADAPTER, 27MM SQ, 3T080, SS
CX01494	ADAPTER, 17MM SQ, 3T040/3T050, SS	CX01604	ADAPTER, BLANK, 3T030
<b>CX01616</b>	<b>ADAPTER, 19MM SQ, 3T050/STD. REV. A</b>	CX01486	ADAPTER, BLANK, 3T040/3T050
CX01495	ADAPTER, 19MM SQ, 3T040/3T050, SS	CX01636	ADAPTER, BLANK, 3T060/3T065
		CX01695	ADAPTER, BLANK, 3T070
		CX01717	ADAPTER, BLANK, 3T080

Butterfly/Actuator Mounting Kit Chart for ISO Drilling (B) - CarbonSteel/Zinc Plated Hardware									
141/143 Series Adapter Numbers [Double "D"]									
2		CX03447	CX03447	CX03450	CX03450	CX03454			
2.5		CX03447	CX03447	CX03450	CX03450	CX03454			
3		CX03447	CX03447	CX03450	CX03450	CX03454			
4		CX03448	CX03448	CX03451	CX03451	CX03455			
5			CX03449	CX03452	CX03452	CX03456			
6			CX03449	CX03452	CX03452	CX03456			
8				CX03453	CX03453	CX03457	CX03459		
10						CX03458	CX03460		
12							CX03461		
14							CX03461		

# Apollo® Compactorque Pneumatic Actuators Mounting

## Accessory Mounting

The 3T series actuator conforms to NAMUR VDI/VDE 3845 dimensional mounting standards. This insures the greatest compatibility with actuator mounted accessories. Mounting brackets for positioners and limit switches will therefore become standardized. This is a significant advantage to the end user in that it reduces the number of unique parts necessary to support an automation program. Eventually all actuator manufacturers will have to provide their products with NAMUR interface compatibility, the 3T series has it now. Proprietary product uniqueness is sacrificed to provide end users with a recognized international standard mounting arrangement.

## Solenoid Mounting

The 3T series actuators also utilize NAMUR standard dimensions for this interface. Like the accessory interface this is an international standard set of dimensions. There are two methods of attaching solenoid control valves to the actuator. The most common is to use a NAMUR style solenoid of the correct designation. This solenoid is attached to the actuator with two 5 mm screws with O-Rings providing the required seals. A single pneumatic supply connection to a NPT threaded port is all that

is required to complete the air line assembly. The less common method is to remote mount the solenoid and connect it to the actuator with tubing and fittings. This configuration is necessary for 3TSOAO & 3TDOAO. The ports in the actuator are tapped with standard NPT pipe threads for this option. Electrical connections to the solenoids can be made in a variety of ways.

The 3TD-010 is so compact that the NAMUR mounting pattern had to be rotated 90°. An adapter has been designed that allows the installation of the Conbraco solenoid in the same orientation as the rest of the product family. To do this the adapter has to perform two tasks. First, it adapts the NAMUR mounting pattern to the Conbraco solenoid. Second, it rotates the solenoid so that the air connections are oriented the same as those on the rest of the product family.

Automated valve cycle time is dependent on many factors associated with each specific installation and is almost impossible to predict accurately. Cycle times of less than one second are generally not recommended. **Fast cycle times reduce seal life and expose the valve and actuator to shock loads that can reduce service life.**

DOUBLE ACTING CHART																			
AIR SUPPLY IN PSIG	ACTUATOR MODEL																		
	3T-010	3T-020		3T-030		3T-040		3T-050		3T-060		3T-065		3T-070		3T-080		3T-090	
40	30	72	130	274	416	650	1075	1409	2771	5198									
60	45	108	194	411	623	975	1613	2114	4155	7797									
80	60	144	259	548	831	1300	2151	2819	5548	10396									
100	74	180	324	685	1039	1625	2689	3524	6929	12995									
120	89	216	389	822	1247	1950	3226	4228	8310	15594									
UNITS	DA	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR	DA	SR
VOLUME CU. INCH**	3	13.4	7.9	27	10.5	37	14	56	21	98	40	159	61	220	92	483	196	855	366
WEIGHT LB.	1	2.3	2.8	3.4	3.9	6.3	6.9	9.1	10.1	13.4	15.2	19.3	22.4	26.9	30.4	50.4	56.5	97	115
ACTUATOR SPEED* OPEN/CLOSE SECONDS		.5/.5	.5/.5	.5/.6	.6/.8	.5/.6	.6/.1	.5/.8	.6/.1.2	.7/.8	1/1.2	.8/1	1.1/1.5	1/1	1.2/2	1.2/1.5	2/2.5	3.5/4.5	4.5/6

\*Actuator speed open/close based on 80 psi air at no load condition.

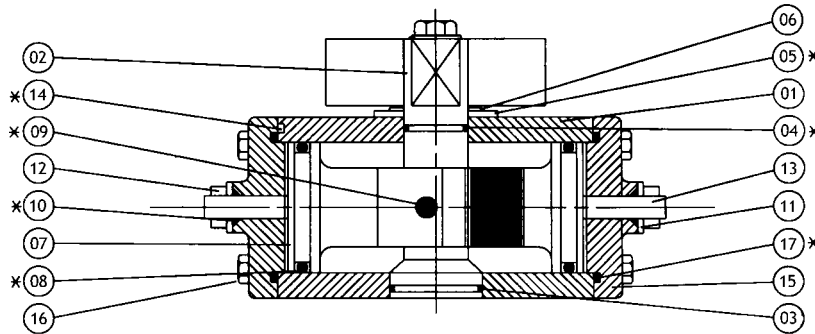
\*\* Air consumption expressed in cubic inches per stroke.

Actuator Model	No. Springs per Piston	SIZING INFORMATION, END TORQUE (LB.-IN.)												SIZING INFORMATION, END TORQUE (LB.-IN.)												Spring Stroke	Spring End																								
		AIR SUPPLY AVAILABLE AT ACTUATOR						AIR SUPPLY AVAILABLE AT ACTUATOR						AIR SUPPLY AVAILABLE AT ACTUATOR						AIR SUPPLY AVAILABLE AT ACTUATOR																															
		40	50	60	70	80	90	40	50	60	70	80	90	40	50	60	70	80	90	40	50	60	70	80	90			110	120																						
3TS-020-XX	2	45	61	77	97	116	134	151	169	186	211	45	61	77	97	116	134	151	169	186	211	45	61	77	97	116	134	151	169	186	211	45	61	77	97	116	134	151	169	186	211	21	27	32	38	43	48	53	59	64	303
	3	39	54	70	90	110	127	144	161	179	206	39	54	70	90	110	127	144	161	179	206	39	54	70	90	110	127	144	161	179	206	39	54	70	90	110	127	144	161	179	206	378									
	3	32	47	62	82.5	103	120	137	154	171	198	32	47	62	82.5	103	120	137	154	171	198	32	47	62	82.5	103	120	137	154	171	198	32	47	62	82.5	103	120	137	154	171	198	453									
	3/4																																									529									
	4																																									604									
	4/5																																									680									
3TS-030-XX	2	79	108	137	173	208	239	269	300	330	369	79	108	137	173	208	239	269	300	330	369	79	108	137	173	208	239	269	300	330	369	79	108	137	173	208	239	269	300	330	369	35	44	53	62	71	80	89	98	106	369
	3	67	95	124	160	196	226	256	286	317	348	67	95	124	160	196	226	256	286	317	348	67	95	124	160	196	226	256	286	317	348	67	95	124	160	196	226	256	286	317	348	462									
	3	55	83	110	147	183	213	242	273	303	333	55	83	110	147	183	213	242	273	303	333	55	83	110	147	183	213	242	273	303	333	55	83	110	147	183	213	242	273	303	333	555									
	3/4																																									647									
	4																																									739									
	4/5																																									830									
3TS-040-XX	2	165	227	288	364	439	504	568	634	699	764	165	227	288	364	439	504	568	634	699	764	165	227	288	364	439	504	568	634	699	764	165	227	288	364	439	504	568	634	699	764	72	90	108	126	144	162	180	198	216	735
	3	138	198	258	335	412	476	539	604	669	734	138	198	258	335	412	476	539	604	669	734	138	198	258	335	412	476	539	604	669	734	138	198	258	335	412	476	539	604	669	734	921									
	3	111	169	227	306	385	448	510	574	638	702	111	169	227	306	385	448	510	574	638	702	111	169	227	306	385	448	510	574	638	702	111	169	227	306	385	448	510	574	638	702	1106									
	3/4																																									1292									
	4																																									1478									
	4/5																																									1664									
3TS-050-XX	2	247	341	434	549	664	762	860	960	1059	1158	247	341	434	549	664	762	860	960	1059	1158	247	341	434	549	664	762	860	960	1059	1158	247	341	434	549	664	762	860	960	1059	1158	106	133	159	186	212	239	266	293	319	1416
	3	205	296	387	504	622	718	815	913	1012	1111	205	296	387	504	622	718	815	913	1012	1111	205	296	387	504	622	718	815	913	1012	1111	205	296	387	504	622	718	815	913	1012	1111	1770									
	3	163	251	339	459	579	675	770	867	964	1061	163	251	339	459	579	675	770	867	964	1061	163	251	339	459	579	675	770	867	964	1061	163	251	339	459	579	675	770	867	964	1061	2124									
	3/4																																									2478									
	4																																									2832									
	4/5																																									3186									
3TS-060-XX	2	328	471	613	794	975	1128	1281	1431	1582	1732	328	471	613	794	975	1128	1281	1431	1582	1732	328	471	613	794	975	1128	1281	1431	1582	1732	328	471	613	794	975	1128	1281	1431	1582	1732	171	215	258	301	344	387	430	473	516	4248
	3	264	403	541	726	911	1062	1212	1361	1510	1659	264	403	541	726	911	1062	1212	1361	1510	1659	264	403	541	726	911	1062	1212	1361	1510	1659	264	403	541	726	911	1062	1212	1361	1510	1659	4248									
	3/4																																									8659									
	4																																									8659									
	4/5																																									8659									
	5/6																																									8659									

# Apollo® CompactTorque™ Spring Return (Start Stroke) Torque Ratings

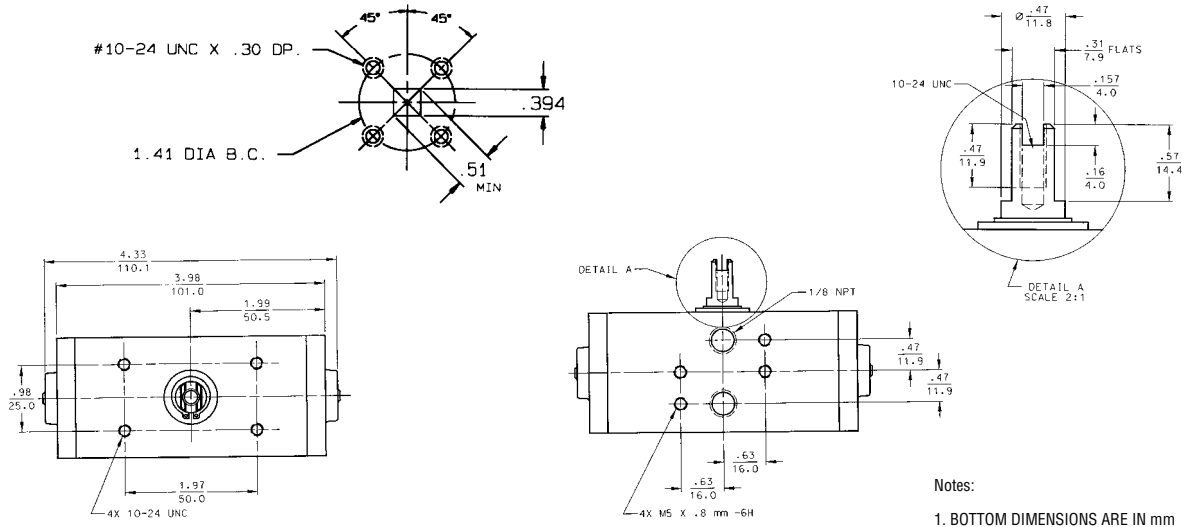
Actuator Model	No. Springs per Piston	SIZING INFORMATION, START TORQUE (LB.-IN.)												Spring Stroke Start																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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3TS-020-XX	2	Start	52	69	86	106	125	143	160	177	194	211	228	245	262	279	296	313	330	347	364	381	398	415	432	449	466	483	500	517	534	551	568	585	602	619	636	653	670	687	704	721	738	755	772	789	806	823	840	857	874	891	908	925	942	959	976	993	1010	1027	1044	1061	1078	1095	1112	1129	1146	1163	1180	1197	1214	1231	1248	1265	1282	1299	1316	1333	1350	1367	1384	1401	1418	1435	1452	1469	1486	1503	1520	1537	1554	1571	1588	1605	1622	1639	1656	1673	1690	1707	1724	1741	1758	1775	1792	1809	1826	1843	1860	1877	1894	1911	1928	1945	1962	1979	1996	2013	2030	2047	2064	2081	2098	2115	2132	2149	2166	2183	2200	2217	2234	2251	2268	2285	2302	2319	2336	2353	2370	2387	2404	2421	2438	2455	2472	2489	2506	2523	2540	2557	2574	2591	2608	2625	2642	2659	2676	2693	2710	2727	2744	2761	2778	2795	2812	2829	2846	2863	2880	2897	2914	2931	2948	2965	2982	2999	3016	3033	3050	3067	3084	3101	3118	3135	3152	3169	3186	3203	3220	3237	3254	3271	3288	3305	3322	3339	3356	3373	3390	3407	3424	3441	3458	3475	3492	3509	3526	3543	3560	3577	3594	3611	3628	3645	3662	3679	3696	3713	3730	3747	3764	3781	3798	3815	3832	3849	3866	3883	3900	3917	3934	3951	3968	3985	4002	4019	4036	4053	4070	4087	4104	4121	4138	4155	4172	4189	4206	4223	4240	4257	4274	4291	4308	4325	4342	4359	4376	4393	4410	4427	4444	4461	4478	4495	4512	4529	4546	4563	4580	4597	4614	4631	4648	4665	4682	4699	4716	4733	4750	4767	4784	4801	4818	4835	4852	4869	4886	4903	4920	4937	4954	4971	4988	5005	5022	5039	5056	5073	5090	5107	5124	5141	5158	5175	5192	5209	5226	5243	5260	5277	5294	5311	5328	5345	5362	5379	5396	5413	5430	5447	5464	5481	5498	5515	5532	5549	5566	5583	5600	5617	5634	5651	5668	5685	5702	5719	5736	5753	5770	5787	5804	5821	5838	5855	5872	5889	5906	5923	5940	5957	5974	5991	6008	6025	6042	6059	6076	6093	6110	6127	6144	6161	6178	6195	6212	6229	6246	6263	6280	6297	6314	6331	6348	6365	6382	6399	6416	6433	6450	6467	6484	6501	6518	6535	6552	6569	6586	6603	6620	6637	6654	6671	6688	6705	6722	6739	6756	6773	6790	6807	6824	6841	6858	6875	6892	6909	6926	6943	6960	6977	6994	7011	7028	7045	7062	7079	7096	7113	7130	7147	7164	7181	7198	7215	7232	7249	7266	7283	7300	7317	7334	7351	7368	7385	7402	7419	7436	7453	7470	7487	7504	7521	7538	7555	7572	7589	7606	7623	7640	7657	7674	7691	7708	7725	7742	7759	7776	7793	7810	7827	7844	7861	7878	7895	7912	7929	7946	7963	7980	7997	8014	8031	8048	8065	8082	8099	8116	8133	8150	8167	8184	8201	8218	8235	8252	8269	8286	8303	8320	8337	8354	8371	8388	8405	8422	8439	8456	8473	8490	8507	8524	8541	8558	8575	8592	8609	8626	8643	8660	8677	8694	8711	8728	8745	8762	8779	8796	8813	8830	8847	8864	8881	8898	8915	8932	8949	8966	8983	9000	9017	9034	9051	9068	9085	9102	9119	9136	9153	9170	9187	9204	9221	9238	9255	9272	9289	9306	9323	9340	9357	9374	9391	9408	9425	9442	9459	9476	9493	9510	9527	9544	9561	9578	9595	9612	9629	9646	9663	9680	9697	9714	9731	9748	9765	9782	9799	9816	9833	9850	9867	9884	9901	9918	9935	9952	9969	9986	10003	10020	10037	10054	10071	10088	10105	10122	10139	10156	10173	10190	10207	10224	10241	10258	10275	10292	10309	10326	10343	10360	10377	10394	10411	10428	10445	10462	10479	10496	10513	10530	10547	10564	10581	10598	10615	10632	10649	10666	10683	10700	10717	10734	10751	10768	10785	10802	10819	10836	10853	10870	10887	10904	10921	10938	10955	10972	10989	11006	11023	11040	11057	11074	11091	11108	11125	11142	11159	11176	11193	11210	11227	11244	11261	11278	11295	11312	11329	11346	11363	11380	11397	11414	11431	11448	11465	11482	11499	11516	11533	11550	11567	11584	11601	11618	11635	11652	11669	11686	11703	11720	11737	11754	11771	11788	11805	11822	11839	11856	11873	11890	11907	11924	11941	11958	11975	11992	12009	12026	12043	12060	12077	12094	12111	12128	12145	12162	12179	12196	12213	12230	12247	12264	12281	12298	12315	12332	12349	12366	12383	12400	12417	12434	12451	12468	12485	12502	12519	12536	12553	12570	12587	12604	12621	12638	12655	12672	12689	12706	12723	12740	12757	12774	12791	12808	12825	12842	12859	12876	12893	12910	12927	12944	12961	12978	12995	13012	13029	13046	13063	13080	13097	13114	13131	13148	13165	13182	13199	13216	13233	13250	13267	13284	13301	13318	13335	13352	13369	13386	13403	13420	13437	13454	13471	13488	13505	13522	13539	13556	13573	13590	13607	13624	13641	13658	13675	13692	13709	13726	13743	13760	13777	13794	13811	13828	13845	13862	13879	13896	13913	13930	13947	13964	13981	13998	14015	14032	14049	14066	14083	14100	14117	14134	14151	14168	14185	14202	14219	14236	14253	14270	14287	14304	14321	14338	14355	14372	14389	14406	14423	14440	14457	14474	14491	14508	14525	14542	14559	14576	14593	14610	14627	14644	14661	14678	14695	14712	14729	14746	14763	14780	14797	14814	14831	14848	14865	14882	14899	14916	14933	14950	14967	14984	15001	15018	15035	15052	15069	15086	15103	15120	15137	15154	15171	15188	15205	15222	15239	15256	15273	15290	15307	15324	15341	15358	15375	15392	15409	15426	15443	15460	15477	15494	15511	15528	15545	15562	15579	15596	15613	15630	15647	15664	15681	15698	15715	15732	15749	15766	15783	15800	15817	15834	15851	15868	15885	15902	15919	15936	15953	15970	159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# Apollo® CompacTorque™ 3TD-010-00A



*\* Suggested spare parts; Included in repair kit  
Factory lubricated with Whitmore Matrix EP grease  
Rebuild with calcium sulfonate grease or lithium complex grease*

**Actuator Temperature Limits**  
Nitrile (Buna) seals: -20°F to +200°F



Notes:  
1. BOTTOM DIMENSIONS ARE IN mm

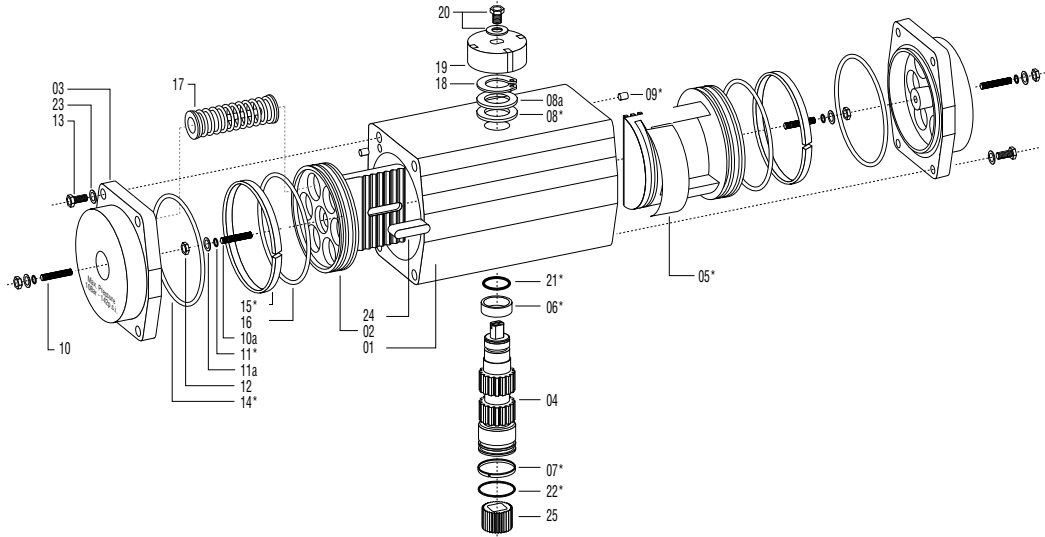
<b>AIR SUPPLY PSIG</b>	40	50	60	70	80	90	100	120
<b>TORQUE Lb. In.</b>	29.3	36.6	44	51.3	58.6	66	73.3	88

## 3TD-010-00A Parts List

ITEM	DESCRIPTION	MATERIAL	TREATMENT	UNIT QTY.
1	Body	Extruded Aluminum Alloy	Hard Anodized	1
2	Pinion	High Strength Alloy Steel	Nickel Plated	1
*3	O-Ring (Lower Pinion)	Nitrile (Buna-N)	N/A	1
*4	O-Ring (Upper Pinion)	Nitrile (Buna-N)	N/A	1
*5	Thrust Bearing (Pinion)	Nylon 4-6	N/A	1
6	Retaining Ring (Pinion)	Stainless Steel	N/A	1
7	Piston	Die Cast Aluminum	N/A	2
*8	O-Ring (Piston)	Nitrile (Buna-N)	N/A	2
*9	Bearing (Piston)	Nylon 4-6	N/A	2
*10	O-Ring (Adjustment Screw)	Nitrile (Buna-N)	N/A	2
11	Washer (Adjustment Screw)	Stainless Steel	N/A	2
12	Nut (Adjustment Screw)	Stainless Steel	N/A	2
13	Adjustment Screw	Stainless Steel	N/A	2
14	Left End Cap	Die Cast Aluminum	Powder Coat	1
15	Right End Cap	Die Cast Aluminum	Powder Coat	1
16	Screw (End Cap)	Stainless Steel	N/A	8
*17	O-Ring (End Cap)	Nitrile (Buna-N)	N/A	2

\*Suggested spare parts; Included in repair kit (3TK-210-00).

# Materials of Construction and Operation



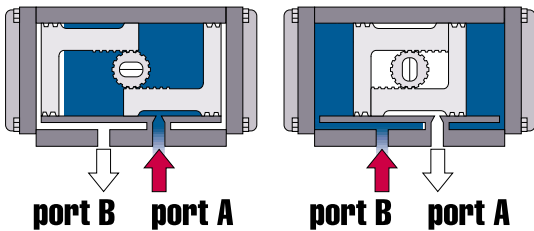
## CompacTorque Part Number Designations

Part #	Unit Qty.	Part Description	Material	Specifications	Optional Materials	Protection
01	1	Body	Extruded aluminum alloy	ASTM 6063 T6		A, B, C, D, E, F
02	2	Piston	Aluminum	ASTM B179-DIN 1725/5		
03	2	End caps	Aluminum alloy	ASTM B179-DIN 1725/5		C, D, E, F
04	1	Drive shaft	Steel alloy	AISI 1144	SS	Nickel plated
05*	2	Bearing (piston back)	Nylon 46			
06*	1	Bearing (pinion top)	Nylon 46			
07*	1	Bearing (pinion bottom)	Nylon 46			
08*	1	Thrust bearing (pinion)	Polyphthalamide (PPA)			
08a	1	Thrust washer (pinion)	SS	AISI 304		
09*	2	Plug (transfer port)	Nitrile (NBR)		For extreme temperature	
10	2	Screw (ext. stroke adj.)	SS	18-8		
10a	1	Screw (int. stroke adj.)	SS	18-8		
11*	4	O-Ring (screw seal)	Nitrile (NBR)		For extreme temperature	
11a	4	Washer (seal)	SS	AISI 304		
12	4	Nut (stop adjustment)	SS	18-8		
13	8	Cap screw (end cap)	SS	18-8		
14*	2	O-Ring (end cap)	Nitrile (NBR)		For extreme temperature	
15*	2	Bearing (piston head)	Nylon 46			
16*	2	O-Ring (piston head)	Nitrile (NBR)		For extreme temperature	
17	12 (max)	Spring (cartridge)	High alloy spring steel			Polyester powder coating Nickel plated
18	1	Spring clip (pinion)	High alloy spring steel			
19**	1	Position indicator	Polyamide			
20**	1	Cap screw/washer	SS	18-8		
21*	1	O-Ring (pinion top)	Nitrile (NBR)		For extreme temperature	
22*	1	O-Ring (pinion bottom)	Nitrile (NBR)		For extreme temperature	
23	8	Washer (cap screw)	SS	18-8		
24***	2	Piston guide	Polyphthalamide (PPA)			
25	1	Universal shaft adapter	Sintered metal	FLN-4205-40	SS	

NOTES: (1) \*Suggested spare parts; included in repair kit. Factory lubricated w/Whitmore Matrix EP grease. Rebuild with calcium sulfonate grease or lithium complex grease. Actuator temp. limits: Nitrile (BUNA) seals: -20°F to +200°F (2) \*\* Optional. (3) Model OAO Part No. 23 and 13 unit quantity is 12 pieces. (3) \*\*\* 3T 010 thru 3T 060 is cast onto piston

### Diagram 3

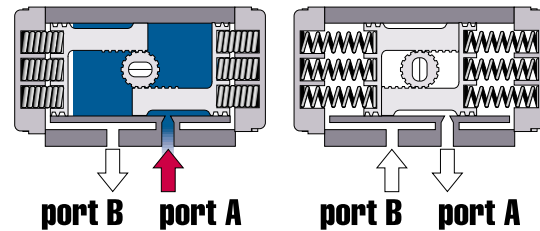
#### Double-Acting (TOP VIEW)



Air supplied to port A forces pistons apart and toward end positions with exhaust air exiting at port B. (A CW rotation is obtained.)

Air supplied to port B forces pistons toward center with exhaust air exiting at port A. (A CCW rotation is obtained.)

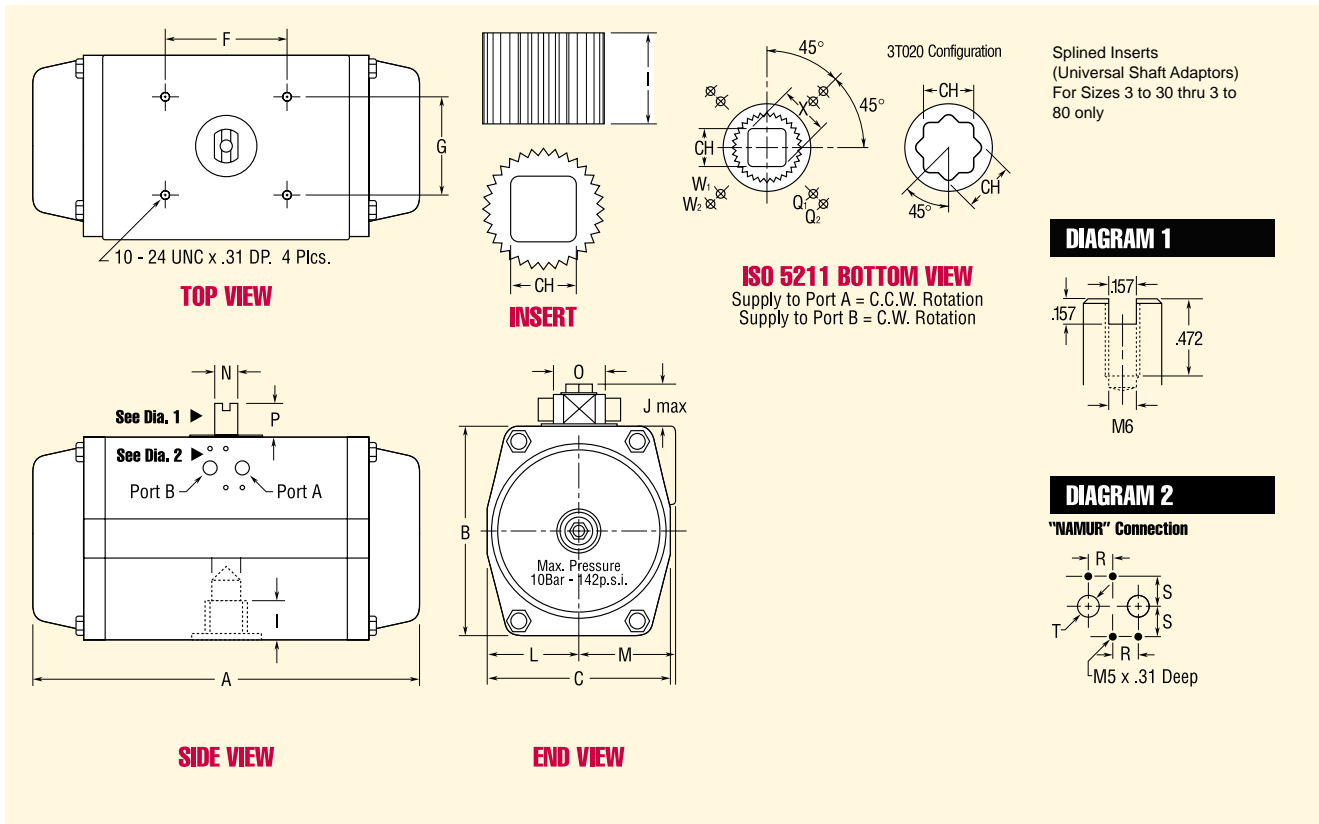
#### Spring Return (TOP VIEW)



Air supplied to port A forces pistons apart and toward end position compressing springs. Exhaust air exits at port B. (A CCW rotation is obtained.)

Air or electric failure allows springs to force pistons toward center position with exhaust air exiting at port A. (A CW rotation is obtained.)

# Engineering



Dimensions										
	3T-20	3T-30	3T-40	3T-50	3T-60	3T-65	3T-70	3T-80	3T-90	
A	5.30	5.98	7.95	9.05	10.66	12.13	14.17	18.18	22.60	
B	2.63	3.26	3.93	4.33	4.92	5.59	6.10	7.70	9.44	
C	2.28	2.87	3.34	3.85	4.33	5.04	5.51	6.92	8.66	
F	1.97	3.15	3.15	3.15	3.15	5.12	5.12	5.12	5.12	
G	.98	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	
I	.51	.59	.748	.94	1.18	1.18	1.18	1.45	1.96	
J	1.00	1.00	1.00	1.00	1.00	1.38	1.42	1.42	1.42	
L	1.14	1.44	1.67	1.93	2.16	2.68	2.75	3.46	4.33	
M	1.45	1.61	1.81	2.08	2.36	2.52	2.87	3.58	4.33	
N	.31	.31	.55	.55	.55	1.06	1.06	1.06	1.26	
O	.47	.47	.70	.70	.70	1.42	1.42	1.42	1.66	
P	.78	.78	.78	.78	.78	1.18	1.18	1.18	1.18	
R	.47	.47	.47	.47	.47	.47	.47	.47	.47	
S	.63	.63	.63	.63	.63	.63	.63	.63	.63	
T-NPT	1/8"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	
Q1-Q2 DIA B.C.	1.65	1.97	1.97-2.75	1.97-2.75	2.75-4.01	2.75-4.01	2.75-4.01	4.01-4.92	5.51**	
CH	.43/11mm	.43/11mm	.55/14mm	.748/19mm	.748/19mm	.86/22mm	.86/22mm	1.06/27mm	1.41/36mm	
X MIN.	.55	.55	.71	1.02	1.02	1.11	1.11	1.42	1.89	
'W1' THD x 'Y' DEEP	1/4-20X.31	1/4-20X.33	1/4-20X.39	1/4-20X.35	5/16-18X.39	5/16-18X.39	5/16-18X.39	3/8-16X.47	5/8-11X.78	
'W2' THD x 'Y' DEEP	—	—	5/16-18X.47	5/16-18X.47	3/8-16X.47	3/8-16X.47	3/8-16X.47	1/2-13X.59	—	
ISO 5211	F04*	F05*	F05*-F07	F05-F07*	F07*-F10	F07-F10*	F07-F10*	F10-F12*	F14*	

\* F pattern Consistent with Conbraco's Mounting Bracket  
 \*\* Rev. B = 4.92/6.50 Dia B.C. with 1/2-13 Threads (F12)

# OSHA Lockout Device

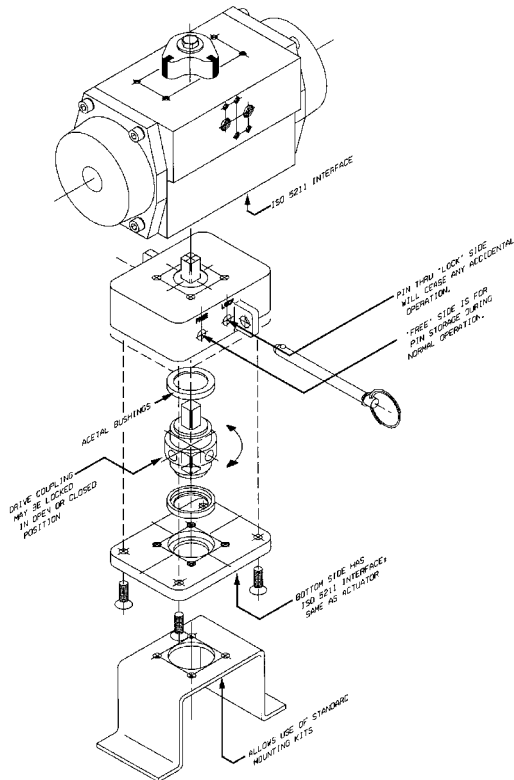
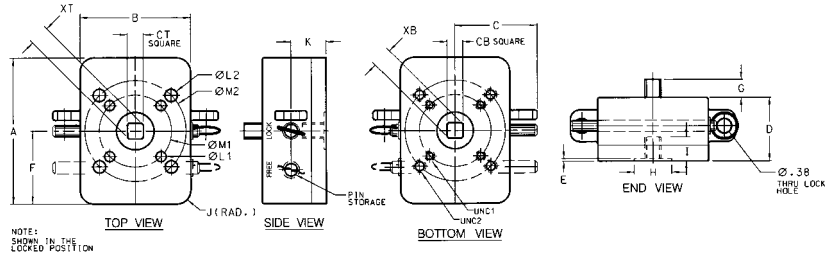
The Apollo® Lockout Tagout accessory for actuators complies with OSHA 1910.147 guidelines. It insures complete lockout capability in both the fully open or the fully closed position. Its design prevents accidental or malicious tampering of an automated valve's orientation.

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 CompactTorque 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.

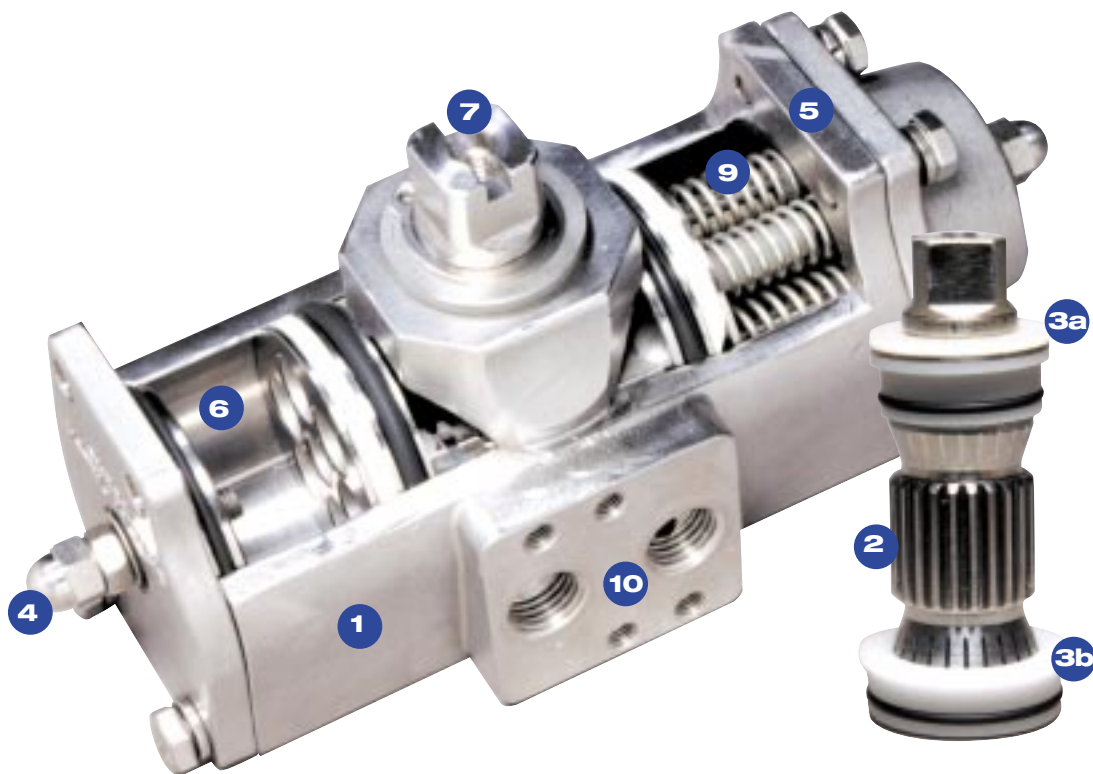


## Material Specifications

	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)
M1 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

# New Apollo "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

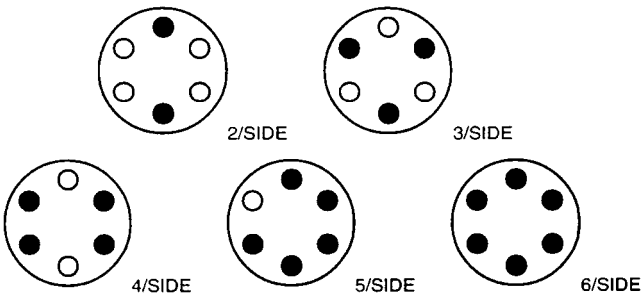
The Apollo® Acutorque actuator is manufactured with an integral and internal air manifold. The solenoid mounting pad is manufactured to Namur dimensional standards as to allow for the direct mounting of various manufacturers' solenoid valves and other flow control devices. For applications not requiring 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).

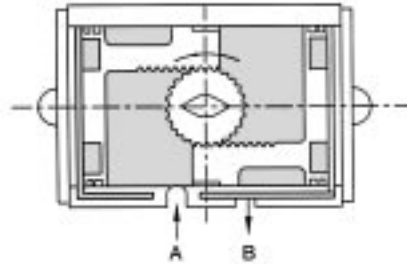
## Spring Configuration

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.

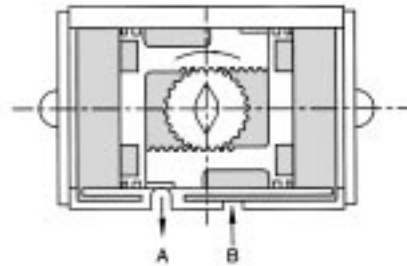


## How the Actuator Works

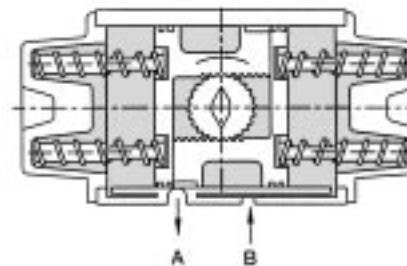
**Air to PORT A** - Pressure applied enters center of chamber forcing the pistons outward and rotating the drive pinion in a counter-clockwise direction and forcing exhaust air out of PORT B.



**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.



Note: Acutorque Solenoid mounting is 180° from Compact Tourque

# Features

## 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

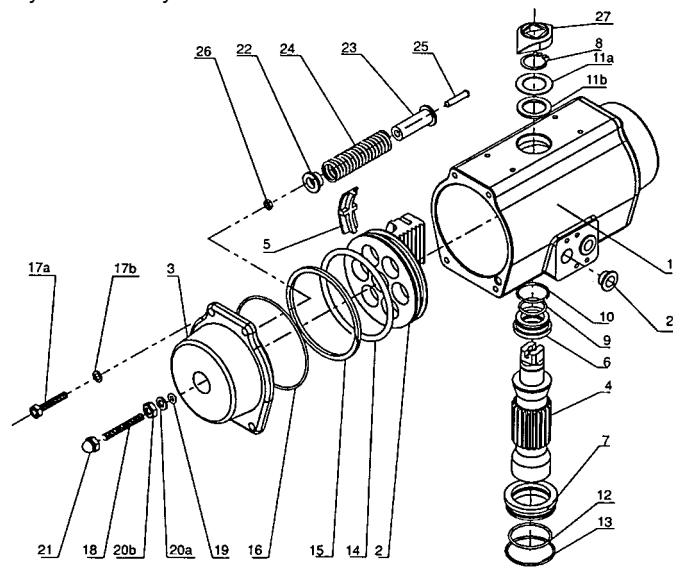
By using ISO/NAMUR standards, our actuators lend themselves to a host of various manufacturers' direct mount accessories. Solenoid valves, limit switches, positioners, etc. bolt directly to the actuator and in turn reduces the cost of assembly and installation of automated packages. Flexibility for future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

## 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.

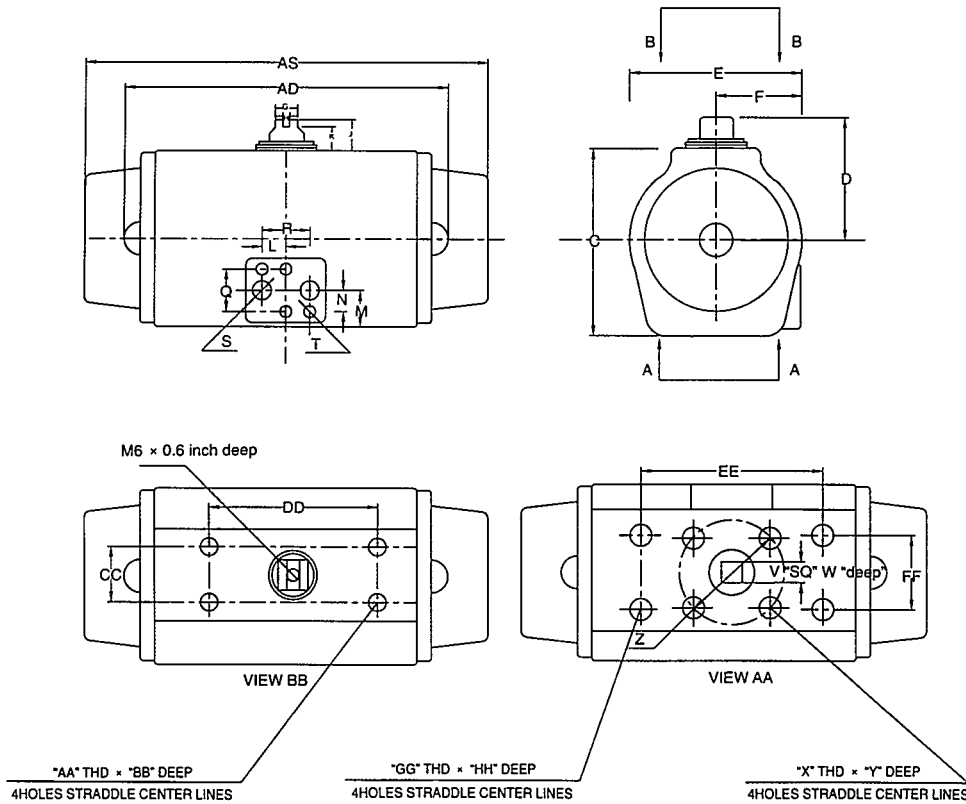
## Safety

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	Stainless Steel	16	O-Ring-End Cap	2	Nitrile
2	Piston	2	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 Piston	1	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				

# Dimensional Data



## Mounting Dimensions

MODEL		R	S	T	V	W	X	Y	Z	AA	BB	CC	DD	EE	FF	GG	HH
3SD04500 3SS04560	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	11 0.4	15 0.59	M5 M5	8 0.31	42 1.65	M5 M5	6 0.24	30 1.18	80 3.15	88.9 3.5	31.75 1.25	M5 M5	8 0.31
3SD06000 3SS06060	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	14 0.55	15 0.59	M6 M6	8 0.31	50 1.97	M5 M5	6 0.24	30 1.18	80 3.15	88.9 3.5	31.75 1.25	M6 M6	8 0.31
3SD08500 3SS08560	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	19 0.75	17 0.68	M8 M8	12 0.47	70 2.75	M5 M5	6 0.24	30 1.18	80 3.15	114 4.5	38 1.5	M8 M8	12 0.47
3SD09500 3SS09560	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	19 0.75	20 0.79	M8 M8	12 0.47	70 2.75	M5 M5	6 0.24	30 1.18	80 3.15	114 4.5	38 1.5	M8 M8	12 0.47
3SD10500 3SS10560	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	19 0.75	20 0.79	M8 M8	12 0.47	70 2.75	M5 M5	6 0.24	30 1.18	80 3.15	114 4.5	38 1.5	M8 M8	12 0.47
3SD12500 3SS12560	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	22 0.87	30 1.2	M8 M8	18 0.71	102 4.02	M5 M5	8 0.31	30 1.18	130 5.12	NA	50.8 2	NA	NA
3SD14000 3SS14060	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	22 0.87	27 1.06	M10 M10	18 0.71	102 4.02	M5 M5	8 0.31	30 1.18	130 5.12	NA	50.8 2	NA	NA
3SD17000 3SS17060	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	32 1.26	36 1.42	M12 M12	24 0.95	125 4.92	M5 M5	8 0.31	30 1.18	130 5.12	NA	76 3	NA	NA
3SD19000 3SS19060	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	32 1.26	38 1.55	M8 M8	26 1	130 5	M5 M5	8 0.31	30 1.18	130 5.12	NA	76 3	NA	NA
3SD21000 3SS21060	MM IN	24 0.95	1/4"NPT 1/4"NPT	M5 M5	36 1.42	43 1.69	M20 M20	28 1.1	140 5.51	M5 M5	8 0.31	30 1.18	130 5.12	NA	76 3	NA	NA

## 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
3SD09500	489	680	924	1156	1387	1752
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
3SD19000	3889	5948	7932	9910	11897	14876
3SD21000	5328	8462	11188	13884	16709	20929

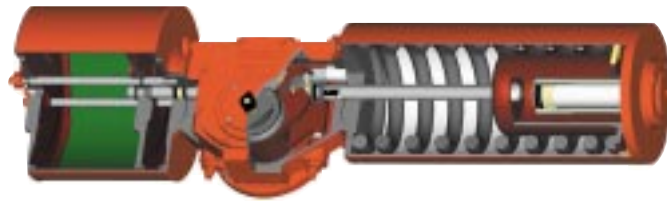
### General Dimensions

MODEL		AD	AS	C	D	E	F	G	H	J	K	L	N	M	Q
3SD04500	MM	138	168	65	52.5	62.5	35	16	4	20	10	12	16	23	32
3SS04560	IN	5.43	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	154	180	81	60.5	74	39	16	4	20	10	12	16	23	32
3SS06060	IN	6.06	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	168	222	108	74	100.5	52	16	4	20	10	12	16	24	32
3SS08560	IN	6.61	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
3SD09500	MM	186	280	120	81.5	112	54.5	16	4	20	10	12	16	30	32
3SS09560	IN	7.9	10.5	4.8	2.96	3.96	2.15	0.63	0.16	0.79	0.39	0.47	0.63	1.18	1.26
3SD10500	MM	214	290	133	86.5	117	58.5	16	4	20	10	12	16	30	32
3SS10560	IN	8.43	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	260	390	155	110.2	136	68	20	4	30.5	10.5	12	16	40	32
3SS12560	IN	10.25	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	317	420	176	116.5	156	79	20	4	30.5	10.5	12	16	40	32
3SS14060	IN	12.48	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	428	538	210	131.5	193	98	20	4	30.5	10.5	12	16	50	32
3SS17060	IN	16.85	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
3SD19000	MM	480	590	230	140	201	102	20	4	30.5	10.5	12	16	56	32
3SS19060	IN	18.5	24.5	9.17	5.42	8.56	3.99	0.79	0.16	1.2	0.41	0.47	0.63	2.5	1.26
3SD21000	MM	514	698	258	156	236	120	32	4	30.5	10.5	12	16	68	32
3SS21060	IN	20.24	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

# Spring Return Torque (Supply Pressure in PSI)

ACTUATOR SIZE	SPRING SET#*	TORQUE (INCH/LBS) VS. AIR SUPPLY PRESSURE (PSI)												SPRING STROKE			
		40		60		80		100		120		150					
		0	90	0	90	0	90	0	90	0	90	0	90	0	90	0	90
3SS04560	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		
3SS06060	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		
3SS08560	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		
3SS09560	2	331	226	591	483									227	117		
	3	280	119	525	363	736	584							345	183		
	4			460	245	668	462	923	734	1110	888	1380	1100	458	253		
	5					605	350	861	618	1030	741	1295	928	577	318		
	6					542	245	790	503	940	605	1180	755	682	381		
3SS10560	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		
3SS12560	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		
3SS14060	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		
3SS17060	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		
3SS19060	2	2793	2020	4950	4480									1817	1042		
	3	2267	1118	4425	3270	6245	5157							2722	1561		
	4			3900	2365	5770	4250	7660	6128	9231	7500	11540	9375	3635	2025		
	5			3368	1455	5265	3344	7060	5160	8592	6316	10714	7895	4546	2622		
	6					4739	2434	6556	4238	8000	5217	10000	6528	5450	3145		
3SS21060	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	G0108	Start/End	12465	14543	16620	18698	20775	22853	24930	31163	36356	41550		
		Minimum			6579	7675	8772	9868	10965	12061	13158	16447	19188	21929
3TG100900	G0109	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									

# Torque Ratings - G Series Actuators

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			11844	22441	25647	28852	32058	35264	38470	48087	56102	
		Minimum			13536	15228	16920	18612	20304	25379	29609			
3TG201000	G2010	Start/End		21254	25504	29755	34006	38257	42507	46758	51009			
		Minimum		11217	13461	15704	17948	20191	22434	24678	26921			
3TG201200	G2012	Start/End	24371	30464	36556	42649	48742	54835	60927					
		Minimum	12862	16078	19294	22509	25725	28941	32156					
3TG201400	G2014	Start/End	29636	37046	44455	51864	59273							
		Minimum	15641	19552	23462	27373	31283							
3TG201600	G2016	Start/End	39118	48897	58677									
		Minimum	20646	25807	30968									
3TG301000	G3010	Start/End				35888	41015	46142	51269	56396	61523	76903	89721	102538
		Minimum				18941	21647	24353	27059	29764	32470	40588	47352	54117
3TG301200	G3012	Start/End		36847	44216	51585	58955	66324	73693	81063	88432			
		Minimum		19447	23336	27226	31115	35004	38894	42783	46672			
3TG301400	G3014	Start/End	35887	44859	53831	62803	71775	80747	89719	98690				
		Minimum	18941	23676	28411	33146	37881	42616	47351	52087				
3TG301600	G3016	Start/End	47430	59288	71145	83003	94860							
		Minimum	25033	31291	37549	43807	50065							
3TG302000	G3020	Start/End	75266	94082										
		Minimum	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	G0108-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	G0109-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	G01010-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	G0108-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	G0109-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										

# G Series Actuators

## 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	G0108-SR2	15526									8443	10521	16753	21947	27141
		7352									3692	4796	8109	10857	13598
		13037									5692	7770	14002	19196	24390
3TG100902	G0109-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	G0108-SR1	18470										8599	14831	20025	25219
		8749										3364	6703	9463	12223
		14776										4516	10748	15942	21136
3TG100901	G0109-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										

# Torque Ratings - G Series

All published torques are guaranteed minimum values.

<b>Spring-Return Actuator</b>												
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			

# 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 General Specifications

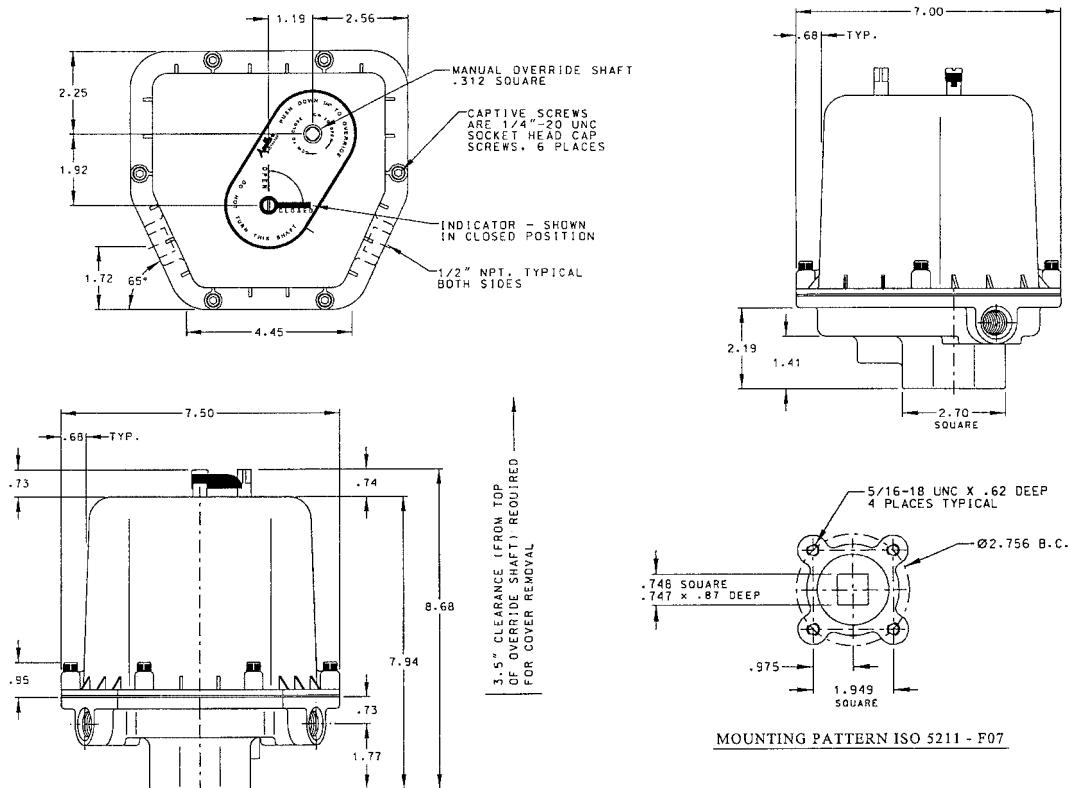
Actuator Model	Breakaway Torque Output (in.-lbs.)	Cycle Time 90° Travel (50% Load)	Duty Cycle	Amperage Draw (max.)			
				115 VAC	230 VAC	12 VDC	24 VDC
AE200	200 in-lbs	5.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE400	400 in-lbs	10.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE600	600 in-lbs	15.0 sec.	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

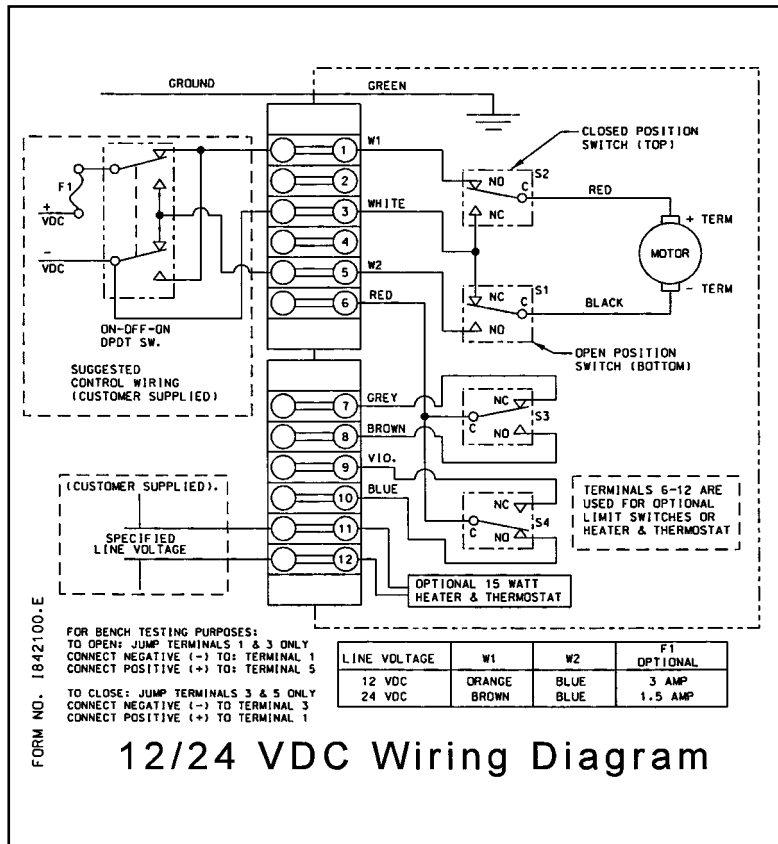
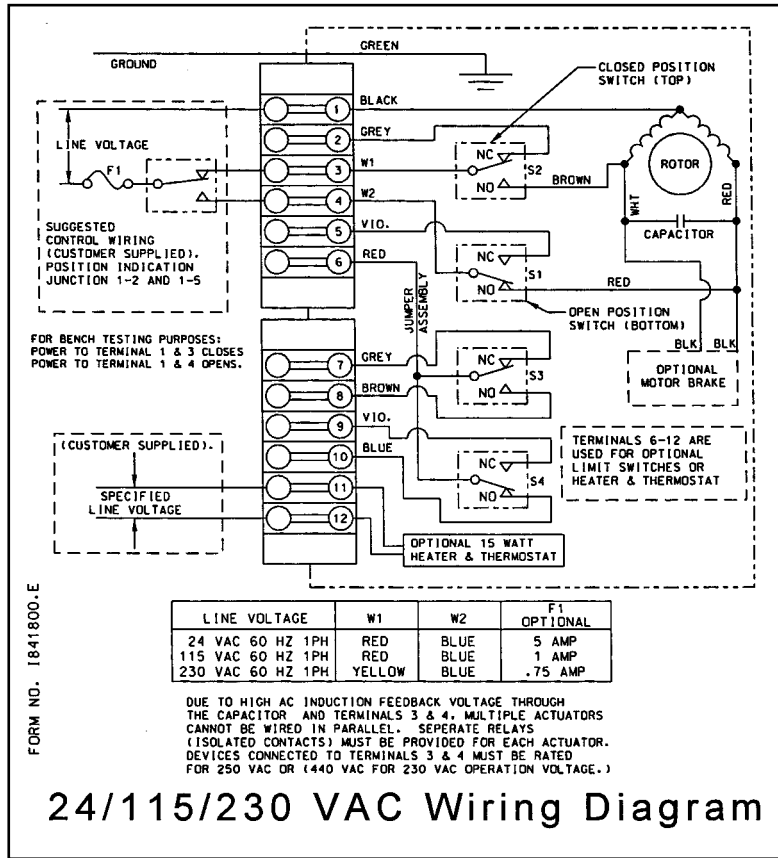
24 VAC current draw at locked rotor 4.6 amp

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

## AE Dimensions



# AE Series Actuators



# CS & CL Electric Actuators

Conbraco's CS and CL electric actuators are split phase reversing AC and DC motors. Eight sizes are available which produce breakaway torques between 150 lbs. ins. and 3000 lbs. ins.



They are excellent industrial quality units capable of on/off, fail safe, and modulating applications. The efficient spur gear drive train is supported by needle bearings which make it very secure while eliminating the potential for side loading of the output shaft.

Conbraco offers as standard a 75% AC extended duty cycle motor. 100% DC motors are also readily available. All units are rated for use in ambient temperatures of -40°F (with heater & thermostat) to 150°F max. Choose from standard NEMA 4 enclosures and combination NEMA 4, 4x, 7 and 9 enclosures with CSA approvals. Units are also available with CE approvals and some UL listings (consult factory).

Other standard features include:

- Locked rotor protection
- Dual conduits
- Position indicators
- Composite PVC plastic covers on CL Series NEMA 4/4X only
- Captive cover bolts on CS Series
- Declutchable overrides or with optional handwheel manual overrides

### Three New Boards to Simplify Inventory, Set-up and Calibration

All "Standard" actuators will have the new boards installed. Features of the new Motor Boards include:

- Plug-in connectors for the motor, the brake option, the heater/ther-

mostat option and the new Control Board - field upgrades are easier than ever.

- 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.

### Introducing Simplicity for Calibrating Modulating Actuators

The new 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.

### Limit Switches and Feedback Pots with Flying Leads

These options are now provided without terminal strips. Instead, they have "flying leads" to which the user may wire directly. If users require internal terminal block connections, you can order either of the two new Terminal Block Kits (6 position or 12 position, depending upon how many wires you need to connect).

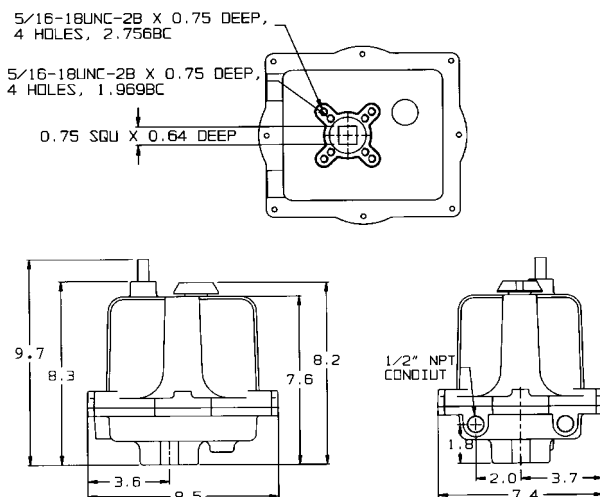
### Speed Control with a Positioner?

Yes. It is a standard feature of the new Control Board. Simply adjust a pot (a little dial on the board) to slow the actuator to up to six times its normal cycle time.

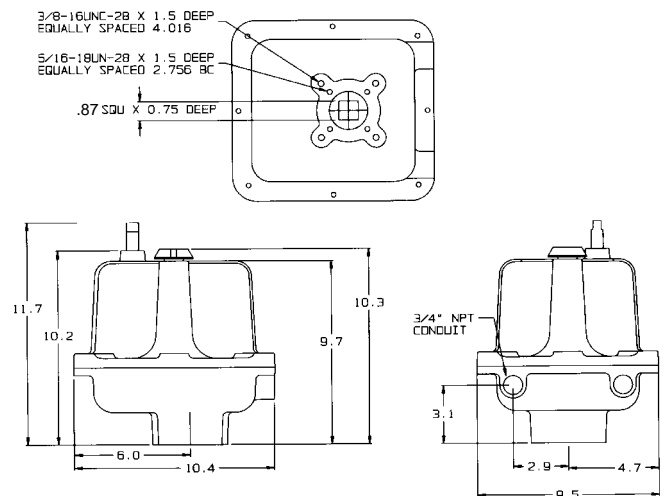
### The new "MSB series"

Totally mechanical failsafe arrangement with true spring return back up power. Contact factory for complete details and ordering information.

## CS Dimensions



## CL Dimensions



# CS & CL Specifications and Options

## 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	75%	92vA	161vA	.8 amps	.7 amps	1.66 amps	1.29 amps

## TECHNICAL DATA—12VDC & 24VDC Models\*

Torque Output (breakaway)	Speed (seconds per 90° rotation)		Duty Cycle	Current Draw at full running	
	12VDC	24VDC		12VDC	24VDC
150 in lb	5	3	Continuous	1.9 amps	2.4 amps
300 in lb	10	5	Continuous	1.9 amps	2.4 amps
600 in lb	15	8	Continuous	1.9 amps	2.4 amps
1000 in lb	15	15	Continuous	3.5 amps	3.5 amps
1500 in lb	20	20	Continuous	3.5 amps	3.5 amps
2000 in lb	25	25	Continuous	4.8 amps	4.8 amps
2500 in lb	30	30	Continuous	4.8 amps	4.8 amps
3000 in lb	30	30	Continuous	4.8 amps	4.8 amps

\*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 DC 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.
- DC actuators have motors that do not generate excessive heat, so they are not limited by duty cycle restraints. However, due to limited brush life of the motors, Conbraco does not recommend using them in applications that require constant (24 hours per day/7 days per week) cycling. All DC voltage models provide 100% duty cycle for 1 hour after which DC motor is reduced to 80% duty cycle.

### ACTUATOR MODEL#'s/DESCRIPTION

230 VAC	230 VAC MOTOR
24 VAC	24 VAC MOTOR
12/24 VDC	12 OR 24 VDC MOTOR
X	NEMA 7
W	NEMA 4 (WEATHER PROOF)
E	EXTENDED DUTY CYCLE (APOLLO® STD)
S1	ONE AUXILIARY SWITCH SPDT
S2	TWO AUXILIARY SWITCHES SPDT
T	HEATER AND THERMOSTAT
K	MOTOR BRAKE
Z	DECLUTCHABLE HANDWHEEL OVERRIDE

### CONTROL OPTIONS\*

R	SINGLE RELAY 2 WIRE CONTROL
C	POSITIONER (SPECIFY SIGNAL)
CL2	POSITIONER WITH FAIL SAFE BACKUP FOR CS SERIES
CL3	POSITIONER WITH FAIL SAFE BACKUP FOR CL SERIES
L2	FAIL SAFE BATTERY BACKUP FOR CS SERIES
L3	FAIL SAFE BATTERY BACKUP FOR CL SERIES
A	TIMER, SELECTABLE ON AND OFF TIMES
B	ROTATION CYCLE RATE REGULATOR

NOTE: NO MANUAL OVERRIDE ON FAILSAFE UNITS

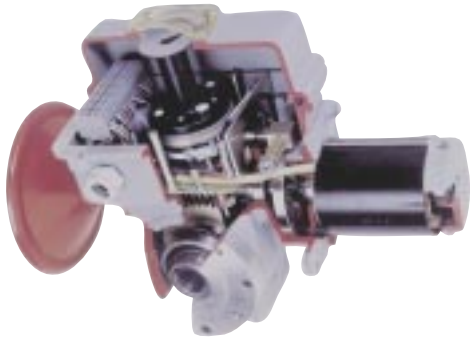
\*CONTACT ACTUATOR ENGINEERING FOR APPLICATIONS NOT COVERED BY INDICATED OPTIONS

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

### How To Order Examples

ACTUATOR MODEL	TORQUE	ENCLOSURE	OPTIONS	DUTY CYCLE	VOLTAGE
CS XXX	600	W-NEMA IV	C (POSITIONER)	E-EXTENDED	115VAC
CL XXX	2500	W-NEMA IV	S2 (TWO SWITCHES)	E-EXTENDED	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-metres). 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
OA3	310	5					
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

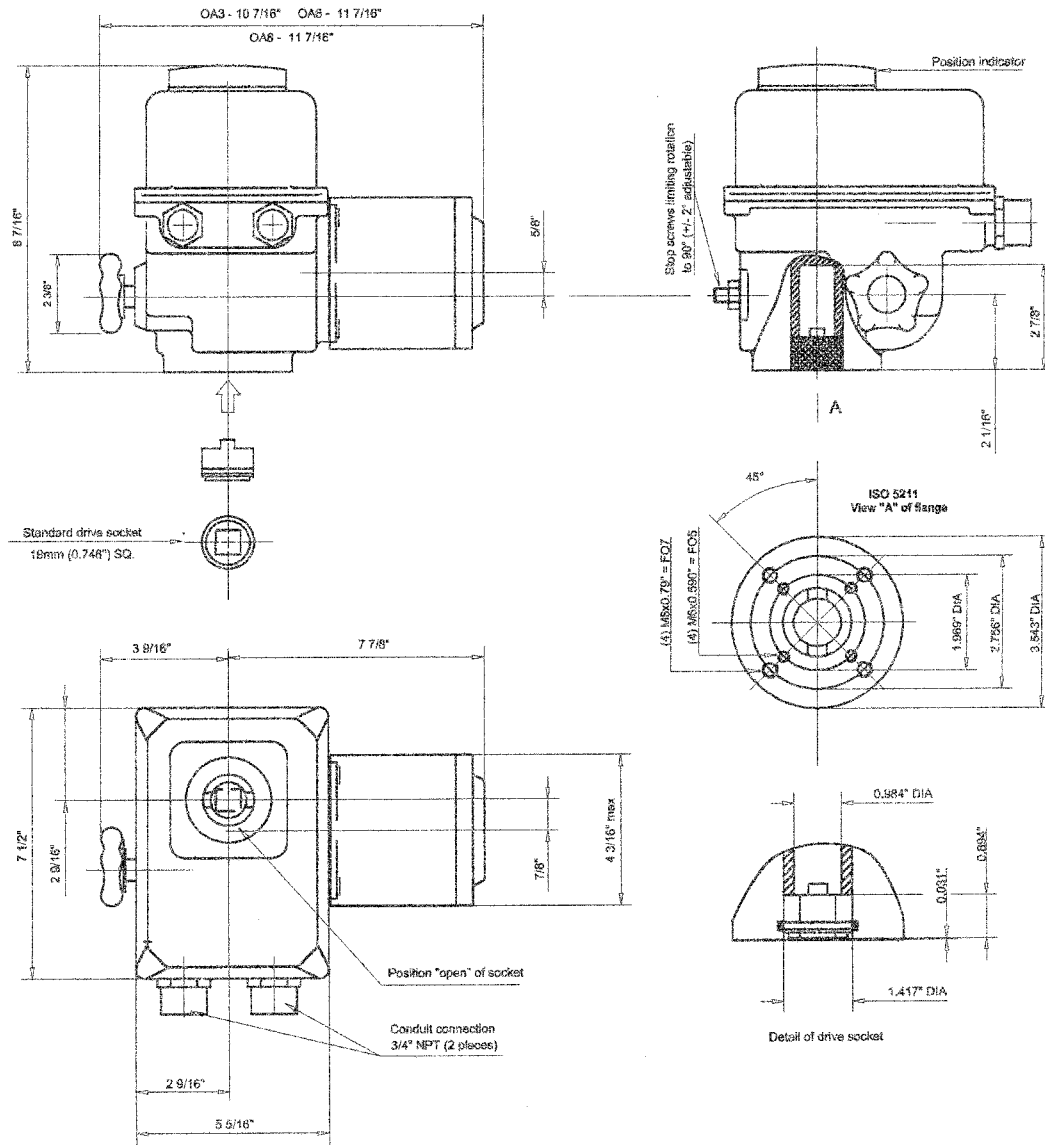
### NOTES:

- 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 Electric Actuators

## Types OA3 and OA8

Standard specification: Weatherproof to NEMA 4, fitted with two adjustable SPDT travel limit switches (one for each extreme position); without torque limiting device and with handwheel for manual operation. Includes built-in motor thermal cutouts. Duty rating 30%.



Female socket dimension = .748 square

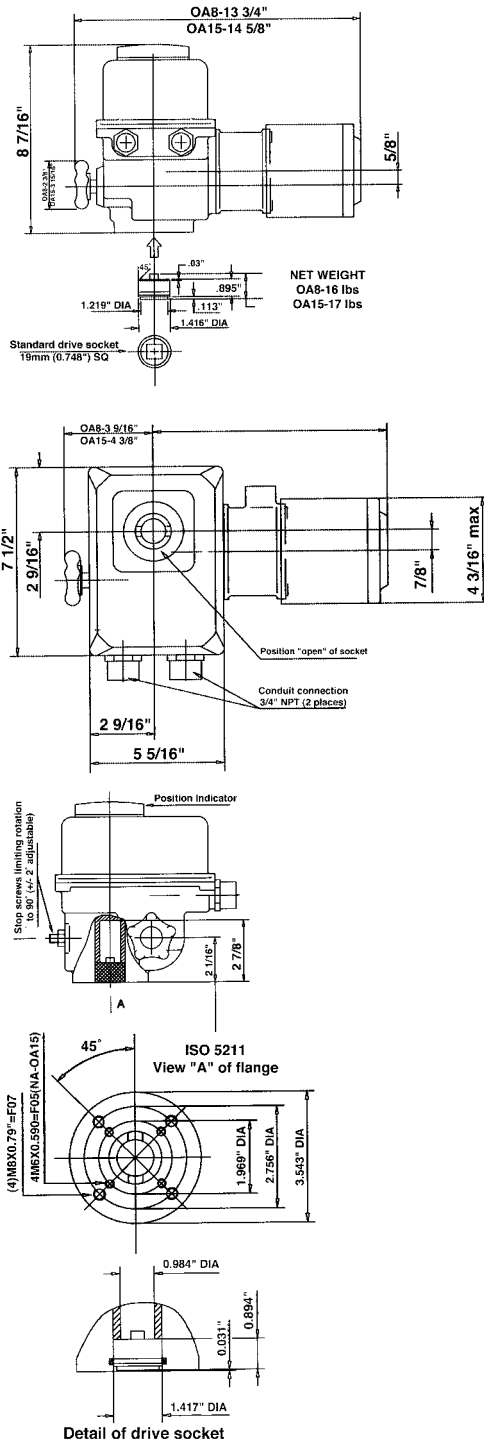
### Net Weight

OA3 - 12 lbs  
OA8 - 15 lbs

# LB Series Dimensions

## Types OA8 and OA15

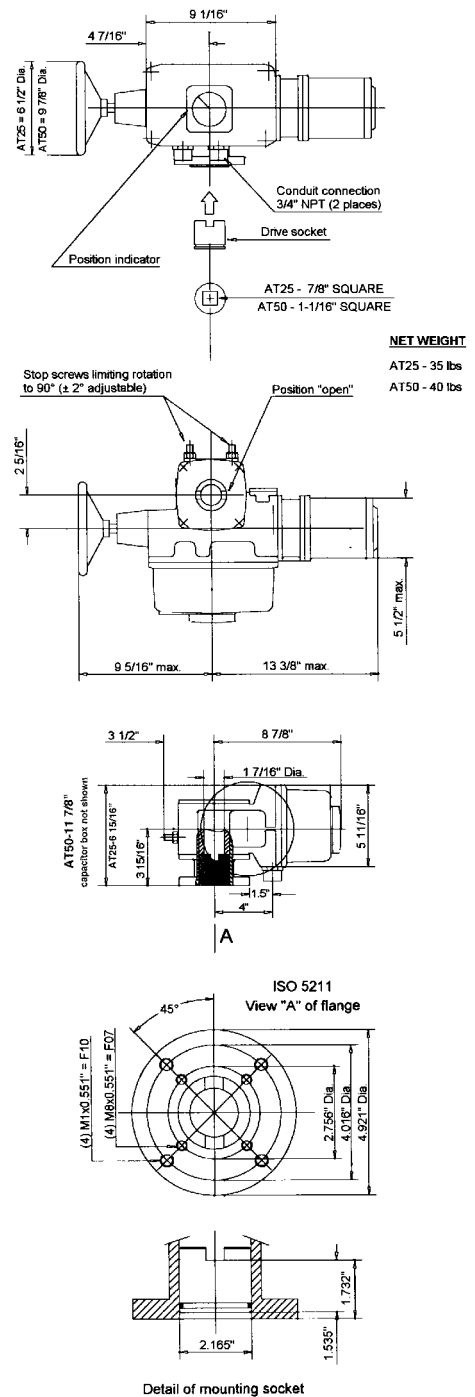
Standard specification: Weatherproof NEMA 4, with two adjustable SPDT limit switches; with built-in motor thermal cutouts, with handwheel for manual operation. Duty rating 30%.



Female socket dimension = .748 square

## 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.

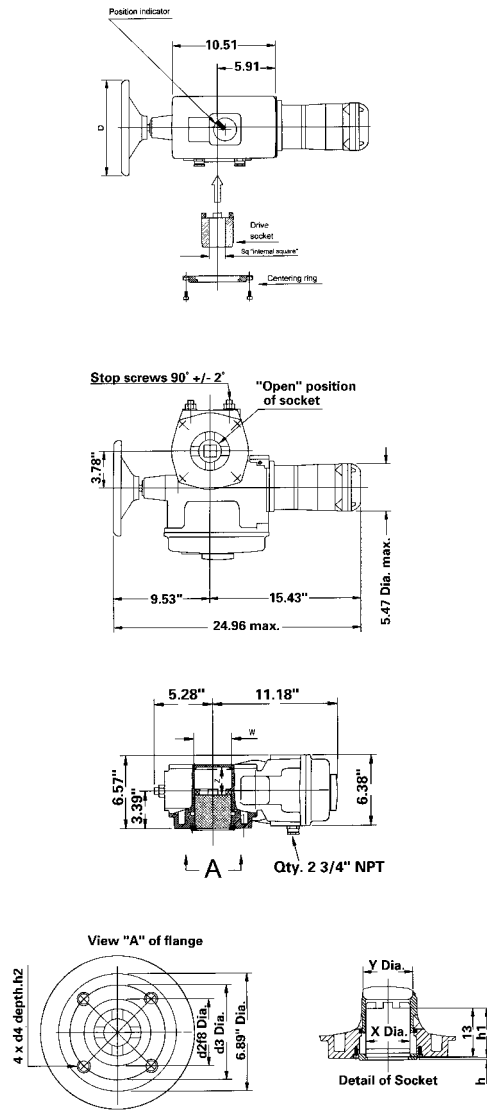


AT25 female socket dimension = .866 square  
AT50 female socket dimension = 1.063 square

# 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	I3	h1
BT100	9.84	3.35	3.23	2.36	2.52	2.99	3.01
Type	h	d3	d2f8	d4	h2	Sq.	Weight
BT100	0.16	5.51	3.94	M16	0.79	1.417	60 lbs.

# Accessories Compactorque Solenoids

## Direct Mounted NAMUR Solenoid Valves

### Solenoid General Specifications:

#### Temperature limits:

- Media: -40F to +180F.
- Ambient:
  - 1: NEMA 4, 4X -40F to +180F.
  - 2: NEMA 4-4X-7-9, -40F to +125F.

#### 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.

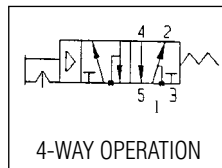
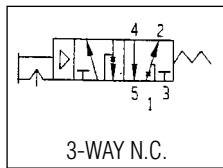
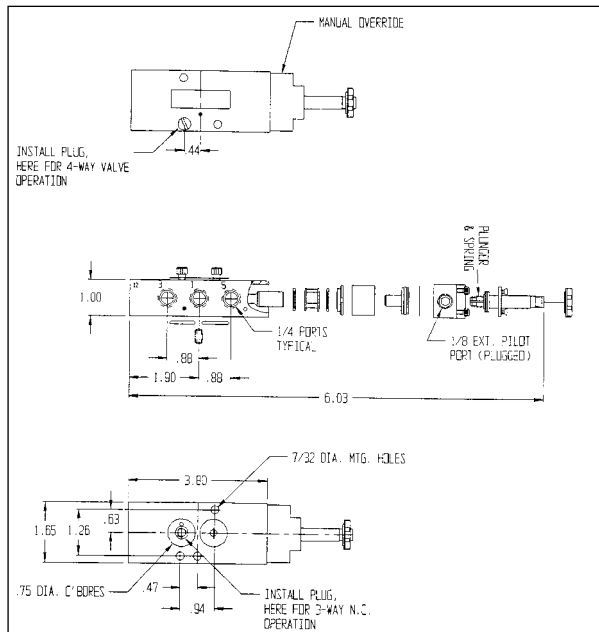
### Power Consumption: 6 Watts

#### Materials:

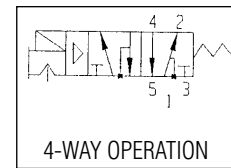
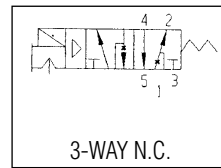
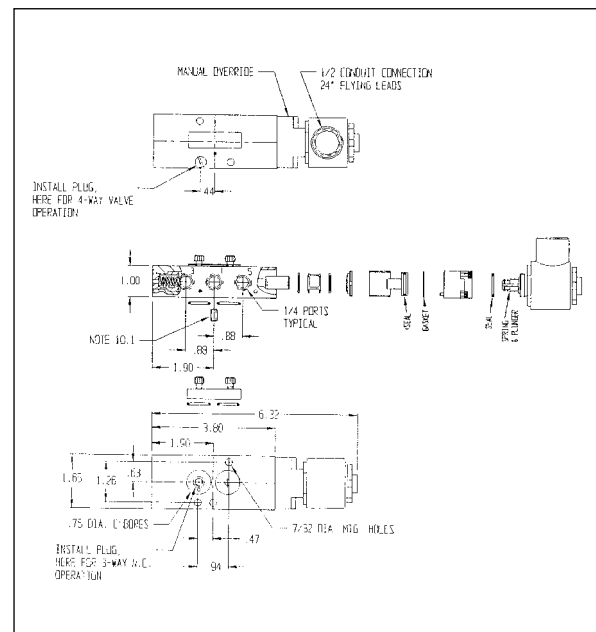
- Valve Body=Aluminum, anodized.
- Fasteners=Stainless Steel
- Seals & O-Rings=Nitrile.

Cv flow rate = 1.8

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



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



### AVC NAMUR \*Three & Four Way, End Mounted Coil Solenoids

3T8-411-10	115 VAC NEMA 4	3TD10 only	3T8-411-20	115 VAC NEMA 4	3T20 thru 3T90
3T8-421-10	12 VDC/24 VAC NEMA4	3TD10 only	3T8-421-20	12 VDC/24 VAC NEMA4	3T20 thru 3T90
3T8-431-10	24 VDC/48 VAC NEMA4	3TD10 only	3T8-431-20	24 VDC/48 VAC NEMA4	3T20 thru 3T90
3T8-441-10	220 VAC NEMA4	3TD10 only	3T8-441-20	220 VAC NEMA4	3T20 thru 3T90
3T8-711-10	115 VAC NEMA7	3TD10 only	3T8-711-20	115 VAC NEMA7	3T20 thru 3T90
3T8-721-10	12 VDC/24 VAC NEMA7	3TD10 only	3T8-721-20	12 VDC/24 VAC NEMA7	3T20 thru 3T90
3T8-731-10	24 VDC/48 VAC NEMA7	3TD10 only	3T8-731-20	24 VDC/48 VAC NEMA7	3T20 thru 3T90
3T8-741-10	220 VAC NEMA7	3TD10 only	3T8-741-20	220 VAC NEMA7	3T20 thru 3T90

All above include adapters to turn "NAMUR 90°"

All are direct mount NAMUR - no adapter necessary

# Westlock Valve Monitoring System

## Rotary Valve Monitors

Since 1984, Westlock has been committed to developing innovative solutions for monitoring process control valves.

Westlock's introduction of Dual-Display Monitors, TouchSet™ cams, and integrated components propelled the company to the industry forefront. Today, Westlock has more than 450,000 valve monitors in operation throughout the world. Applications span the chemical, food and beverage, pulp and paper, petroleum, and pharmaceutical industries.



## BEACON™



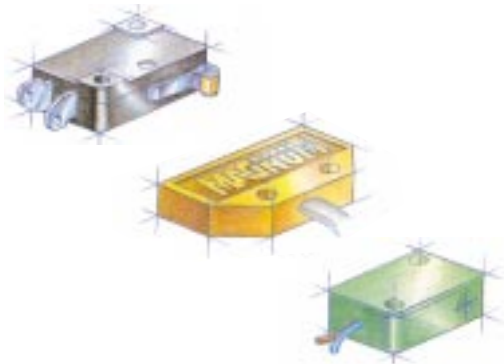
### Beacon™ II Ektar

A non-metallic high visibility valve performance monitor for instant determination of valve position. Displays valve performance clearly up to 150 feet.

### 3-Way Beacon

A high visibility Flow Path Monitor for multiport valves.

## SENSORS



### Standard Switch Options

#### Mechanical SPDT & DPDT

SPDT & DPDT  
Form C & ZZ

#### Magnum® XT-90

High Current Proximity Sensor  
SPDT Form C (Hermetically Sealed)  
Simple Apparatus

#### Pepperl & Fuchs

Intrinsically Safe, Proximity Type

## ACCUTRAK™



### AccuTrak™ 2000 Dual Display Monitor

#### Features:

- Beacon Visual Monitor
- Touchset Cams
- Prewired Terminal Strips
- Full Range Monitoring

#### Nema 4, 4X, 7, 9,

Class I, Groups C & D,  
Class II, Groups E, F & G,  
Divisions 1 & 2

# Westlock Valve Monitoring System

## ACCUTRAK/ELIMINATOR 360™



The Westlock 360 is specifically engineered to meet all hazardous area classifications and groups. Certified to UL and CSA, the unit has the flexibility to satisfy a wide range of diverse requirements.

Employing standard Westlock design features, (Beacon® performance monitors, Touch-Set® cams and pre-wired components), the 360 is available with a wide range of position sensors and integrally mounted solenoid valves. Optional stainless steel housing is also available.

## ELIMINATOR™ 3000



### **Eliminator® 3000**

The Eliminator 3000 is a highly reliable position monitor, junction housing and prewired, integrally mounted ASCO solenoid valve. Compatible with all PCs, the 3000 series is available with mechanical or proximity switches and a broad selection of solenoid valves.

**Nema 4, 4X, 7, 9,**

**Class I, Groups C & D, Class II, Groups E, F & G,  
Divisions 1 & 2**

## SERIES 9000



Series 9000, available in both aluminum and engineered resin enclosures and supported by UL, FM and CSA certification applies the economic advantages offered by the National Electrical Code. Through the utilization of hermetically sealed high-current carrying sensors, cost saving benefits are realized by the consolidation of components and elimination of Division 2 hazardous location seal fittings, wiring, conduit and their associated labor costs.

## TRANSMITTERS



Available in three separate configurations (analog resistive, analog current, or digital sensing with analog current output), Westlock transmitters offer complete travel range display for continuous remote monitoring. The RS, CS, and DT options monitor control valves throughout a 0-100% range. At full open or closed, sensors will additionally confirm end position limits.

**Note: All Westlock models are available. Contact factory for further information.**

# Stonel Limit Switch Assemblies

## Features

**Quick Access Cover:** A lockable, part turn cover ensures fast access for rapid set-up.

**High Visibility Indicator:** The Red/Green indicator offers clear indication of the current valve position from up to 20 meters (65 feet).

**Quick Set Cams:** Touch & Tune Switch Cams are set without the need for additional tools further reducing installation time.

**Compact Design:** The SolaR Series is a compact construction, minimizing valve package envelope size.

**Easy Wiring:** Despite its compact design, the SolaR Series is surprisingly easy to wire up with plenty of room to bring wires into the enclosure.

**Engineered Resin Enclosure:** A rugged engineered resin enclosure offers excellent impact and chemical resistance.

**IP67 & NEMA 4, 4X Protection:** The SolaR Series is suitable for most intrinsically safe and general purpose applications.

**Back-Wire Facility:** With 2 conduit entries standard and two additional termination points, solenoid valves may be terminated within the enclosure, reducing installation costs.



## Materials of Construction

Housing Material	Calibre <sup>1</sup> Polycarbonate
Cover Material	Calibre <sup>1</sup> Polycarbonate
Shaft	303 Stainless Steel
Namur Bracket	Stainless Steel

## Ratings

Enclosure Protection	NEMA 4, 4X & IP67
Intrinsically Safe	EEx ia IIC T6 (sensors only)

Other Specifications	
Temperature Range	-40° to 82°C (-40° to 180°F)
Warranty, Mechanical Parts	Two Years
Warranty, Maxx-Guard Sensors	Two Years
Warranty, Sensor & Communication Modules	Five Years

## Electrical Switch Ratings

V3 Mechanical (SPDT)	10 AMPS @ 120 VAC
V3 Gold Mechanical (SPDT)	0.5 Amps @ 30 VDC
Maxx-Guard (SPST)	0.15 Amps @ 120 VAC/30 VDC
Max. Volt Drop (no LED)	0.5 V @ 100 mA
Max. Volt Drop (LED)	3.5 V @ 10 mA; 6.5 V @ 100 mA
Min. LED Current	2.0 mA

<sup>1</sup> Calibre is a Registered Trade Mark of the Dow Chemical Company

**Note: All Stonel Switches are available. Contact Factory for further information.**

## Sensor/Communication Module Ratings

### AS-i Communication Module

Protocol	Actuator Sensor Interface (AS-i)	
Configuration	Open/Closed Inputs & (2) Power Outputs	
Voltage Output	24 to 30 VDC	
Max. Current Output	160 mA, (1) or (2) outputs combined	
Max. Power Output	4 watts, (1) or (2) outputs combined	
Temperature Range	-25° to 82°C (-13° to 180°F)	
Operating Life	Unlimited	

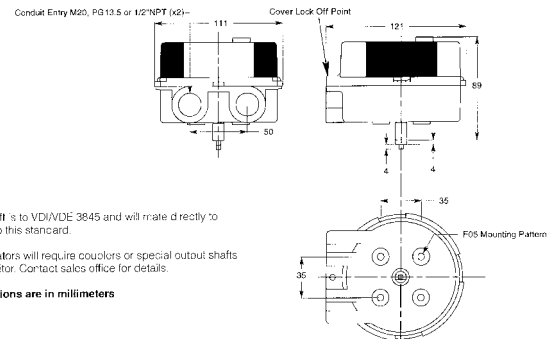
### NAMUR Sensor Module

Configuration	(2) NAMUR Sensors; DIN 19234 Standard	
Current with Target Present	Current < 1.0 mA	
Current with Target not Present	Current > 3.0 mA	
Voltage Range	6 to 29 VDC	
Temperature Range	-40° to 82°C (-40° to 180°F)	
Operating Life	Unlimited	

### SST Sensor Module

Configuration	(2) Solid State Sensors	
Max. Inrush Current	2.0 Amps	
Max. Continuous Current	0.3 Amps	
Min. on Current	2.0 mA	
Max. Leakage Current	0.25 mA	
Voltage Range	8 to 125 VDC; 24 to 125 VAC	
Max. Volt Drop	6.5 V @ 10 mA; 7.0 V @ 100 mA	
Temperature Range	-40° to 82°C (-40° to 180°F)	
Operating Life	Unlimited	

## Dimensional Data



# Stonel Limit Switch Assemblies

## Approvals

### ISQ:

Factory Mutual approved for:  
 Class I, Groups A, B, C & D, Divisions 1 and 2  
 Class II, Groups E, F & G, Divisions 1 and 2  
 Class III, Divisions 1 and 2

#### Entity Parameters:

(Values apply to all ISQ sensors, transmitters and potentiometers.)  
 Voltage Maximum (Vmax) = 40 VDC  
 Current Maximum (max) = 100 milliamps  
 Input Capacitance (Ci) = 0  
 Input Inductance (Li) = 0

### PQ:

Factory Mutual and Canadian Standards approved for:  
 Class I\*, Groups A & B, Division 2  
 Class I, Groups C & D, Divisions 1 and 2  
 Class II, Groups E, F & G, Divisions 1 and 2  
 NEMA 1, 3, 4, 4X, 5, 6, 7, 9, 12 & 13  
 No Seal-offs required in Division 1 and 2  
 \*Consult factory for Group B, Division 1 approval

#### Clear Cover:

Factory Mutual and Canadian Standards approved for:  
 Class I, Groups A, B, C & D, Division 2  
 Class II, Groups E, F & G, Division 2  
 NEMA 1, 3, 4, 4X, 5, 6, 7, 9, 12 & 13  
 No Seal-offs required in Division 2

### MQ:

#### Aluminum Enclosure

Factory Mutual and Canadian Standards approved for:  
 Class I\*, Groups C & D, Divisions 1 and 2  
 Class II, Groups E, F & G, Divisions 1 and 2  
 NEMA 1, 3, 4, 4X, 5, 6, 7, 9, 12 & 13  
 No Seal-offs required in Division 1 and 2  
 \*Consult factory for Group B, Division 1 and 2 approval

#### Clear Cover

NEMA 1, 3, 4, 4X, 5, 6, 7, 9, 12 & 13

## Potentiometer Specifications

Power Rating 1 Watt @ 40°C  
 Resistance\* 10 K ohms over 340°  
 Max. Linearity Error ±0.85°  
 Operating Life 2,000,000 rotations

\*Consult factory for other resistance ranges.

## Other Specifications

#### Temperature:

-40° to 82°C (-40° to 180°F) for mechanical switches, position transmitters and potentiometers (See Maxx-Guard Specifications for Temp. Range)

#### Operating Life:

Mechanical Switches — 1,000,000 cycles  
 Maxx-Guard Sensors — 10,000,000 cycles  
 (See Potentiometer and Position Transmitter for Operating Life)

## Warranty

2 Years  
 5 Years

All Mechanical  
 Maxx-Guard Sensors



## Maxx-Guard Specifications

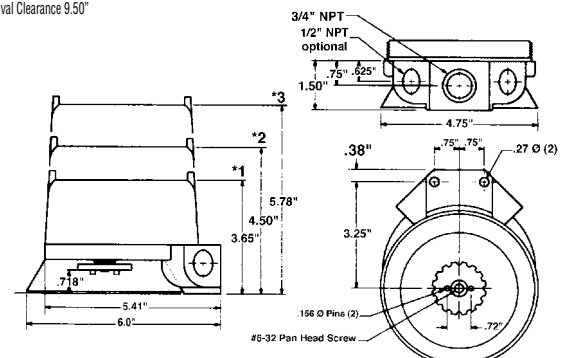
Sensors:	SPST	SPDT
Typical Operate Time	1.0 millisecond	3.0 millisecond
Contact Composition	Ruthenium	Tungsten
Temperature Range	-40° to 82°C (-40° to 180°F)	-30° to 82°C (-23° to 180°F)
Seal	Hermetically Sealed	Hermetically Sealed
Leakage Current	None	None
Operating Life	10,000,000 Cycles	10,000,000 Cycles
Maximum Voltage Drop	0.1 volts @ 10 milliamps	3.5 volts @ 10 milliamps
	0.5 volts @ 100 milliamps	6.5 volts @ 100 milliamps
Max. Current for LED Illumination	No LED	2.0 milliamps
LED Operating Life	No LED	minimum of 11 years

## Position Transmitter Specification

Output Signal	Two wire 4 to 20mA
Recommended Supply	24 VDC, 50mA minimum
Voltage Range	10 to 40 VDC at terminals
Span Range	Adjustable from 50° to 270° (50° to 270° for HP-7)
Maximum Loading	700 ohms @ 24VDC
Maximum Linearity Error	±0.85° (±0.35 for HP-7)
Maximum Potentiometer Life	2 million rotations (50 million rotations for HP-7)
Rotation	Selectable clockwise or counter-clockwise

## Dimensional Data

\*1 -(1) & (2) Switch Unit: Cover Removal Clearance 5.65"  
 \*2 -(4) Switch Unit (MQ), Transmitter or Potentiometer without switches:  
 Cover Removal Clearance 7.25"  
 \*3 -(4) Switch Unit (PQ), Transmitter or Potentiometer with switches:  
 Cover Removal Clearance 9.50"





# 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

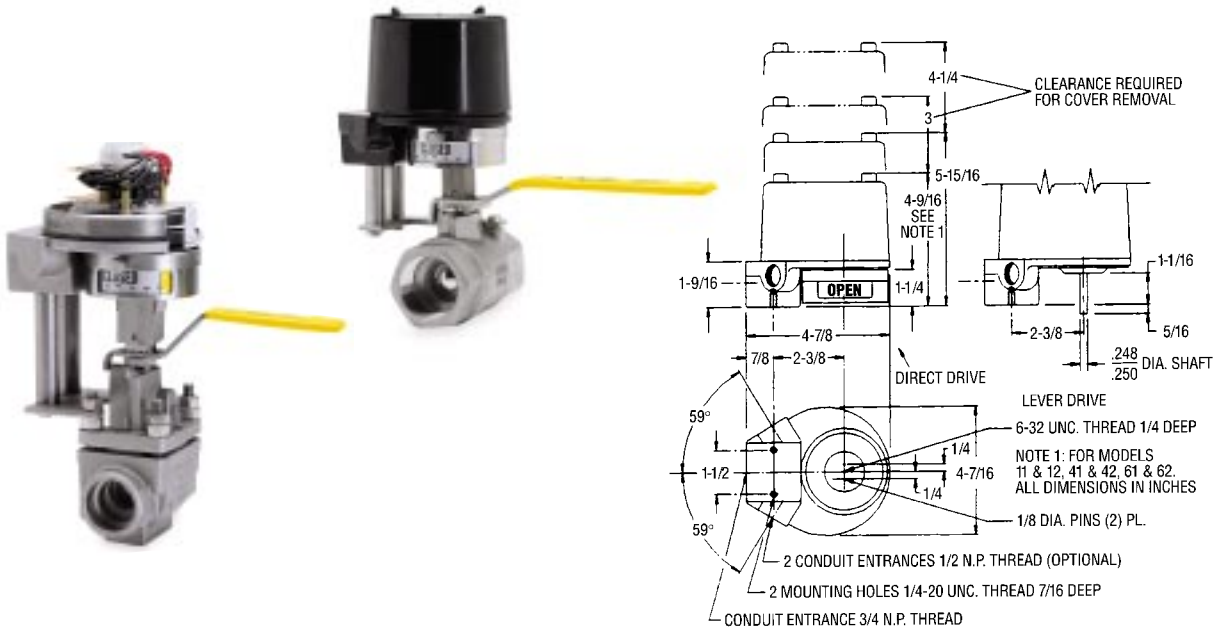
	P1200/20	P1500/20	P2000/20	P5/EP5*
Connections:	1/4"	1/8"	1/4"	1/4"
Supply Pressure:	150 psig	150 psig	120 psig	145 psig
Hysteresis:	.7%	.7%	.5%	.5%
Linearity:	1.0%	.5%	2.0%	.5%
Repeatability:	.5%	.5%	.5%	.5%
Sensitivity:	.4%	.3%	.5%	.25%
Input Signal:	3-15/6-30	3-15/6-30	4-20 mA	3-15, 4-20mA
Temperature - Standard	+5 - 175°F	-40 - 195°F	+5 - 175°F	+5 - 185°F
Temperature - Optional	+5 - 320°F	-85 - 266°F	+5 - 230°F	+5 - 230°F
Weight	3.3 lbs.	4.2 lbs.	5.9 lbs.	2.9/4.1 lbs.
Air Consumption @ 85 psig	35/.71 scfm	-----		.75 scfm
Air delivery @ 57 psig	14/16.8 scfm	8.4/16 scfm	12/15.7 scfm	12.6 scfm
Gain factor	120/135	250/310	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.

# 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
42AD0	4,4X,7,9	2 SPDT MECH, Anodized Aluminum Housing	15 amps ac, 5 amps dc
42DD0	4,4X,7,9	2 DPDT MECH, Anodized Aluminum Housing	10 amps ac, 10 amps dc
42RDM	4,4X	2 SPDT PROX, Herm Sealed Reed, Plastic Cover	3 amps ac, 2 amps dc
42RD0	4,4X,7,9	2 SPDT PROX, Herm Sealed Reed, Anodized Al.	3 amps ac, 2 amps dc
42VD0J1	4,4X,7,9	2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al.	10 amps ac, 10 amps dc
42RD0J1	4,4X,7,9	2 SPDT PROX, 3/4" & 1/2" NPT Entry, Anodized Al.	3 amps ac, 2 amps dc
44AD0	4,4X,7,9	4 SPDT MECH, Anodized Aluminum Housing	15 amps ac, 5 amps dc
45VD0	4,4X,7,9	2 SPDT MECH, & Transmitter, Anodized Aluminum	10 amps / 4-20 mA out
45RD0	4,4X,7,9	2 SPDT PROX, & Transmitter, Anodized Aluminum	3 amps / 4-20 mA out
62LDM	4,4X	2 SPST PROX, 2 LED'S, Clear Plastic Cover	Herm Sealed Reed (mA)
62PD0	4,4X,7,9	2 SPST PROX, Anodized Aluminum Housing	Herm Sealed Reed (mA)
62QD0	4,4X,7,9	2 SPDT PROX, Anodized Aluminum Housing	Herm Sealed Reed (mA)
35OD0*	Mag Coupling	MULTI-TURN Transmitter, Anodized Aluminum	No Switch / 4-20 mA
12AD0 **	Mag Coupling	2 SPDT MECH, Anodized Aluminum Housing	15 amps ac, 5 amps dc
15VD0	Mag Coupling	2 SPDT MECH, & Transmitter, Anodized Aluminum	10 amps / 4-20 mA out
12VD0J1	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.

# APOLLO<sup>®</sup>

## Actuator Ready Ball Valves

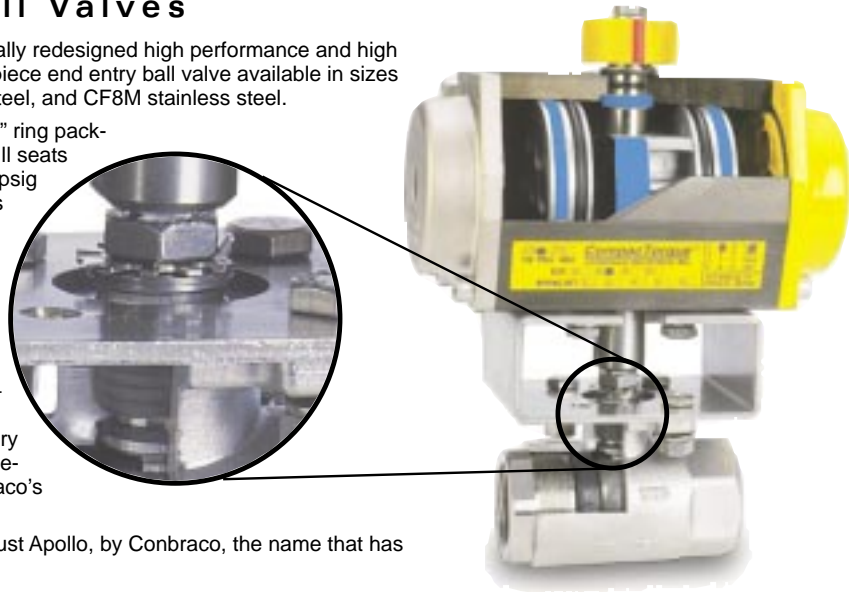
Conbraco Industries introduces the first in a new line of totally redesigned high performance and high cycle Actuator-Ready ball valves. The Apollo AR™ is a 2-piece end entry ball valve available in sizes 1/4" through 3". It is constructed in bronze, WCB carbon steel, and CF8M stainless steel.

All sizes feature ISO-5211 style mounting pads, stacked "V" ring packing, live loading, stainless steel balls and stems, and multifill seats which can be rated up to 2,000 psig, or to 500°F, or to 250 psig saturated steam. This combination of design and materials yields a low breakaway torque which is desirable in actuator sizing. Optional seating materials are available, as well as latch lock handles (-27 suffix).

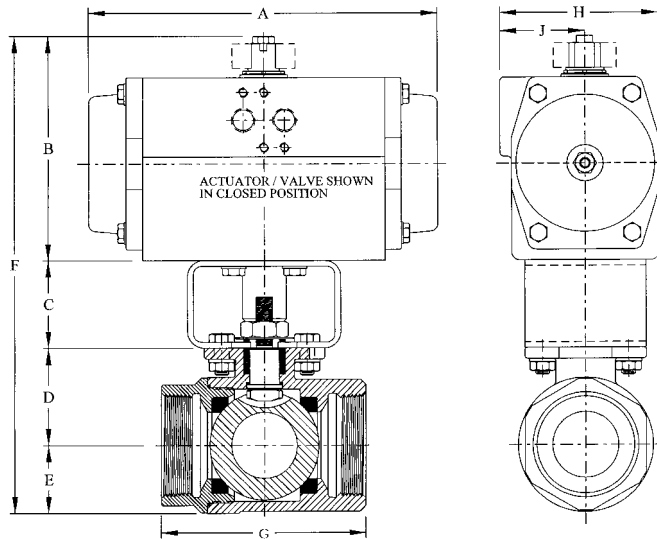
### Get a Complete American Made Package

Order the Apollo AR™ with an advanced-design CompacTorque™ actuator, and you'll get a completely American-made automation package. Every component – valve actuator and stainless steel bracket – is designed, built and backed in the U.S. and 100% tested before delivery to you. The "AR" valve is designed to be the perfect complement to these or any of the other actuators found in Conbraco's Valve Automation Catalog.

For true single source responsibility in valve automation, trust Apollo, by Conbraco, the name that has become synonymous with the ball valve industry.



For Additional Valve Data and Information Refer to Apollo Engineering Binder Section "M"



### How To Order

XX-ARX-64-XX

FIGURE NUMBER	CONSTANTS	SIZE (In.)	SEATS	OPTIONS
71 Standard Port Bronze	AR-Actuator Ready	1 1/4	64 Multifill (Standard)	27 Latch Lock handle
76 Standard Port SS CF8M	(316 SS Ball & Stem	2 3/8	35 PTFE, (option)	14 Vented ball
77 Full Port Bronze	Multifill Stem Packing,	3 1/2	21 UHMWPE, (option)	57 Oxygen cleaned
89 Std. Port CS WCB	Live Load Washers)	4 3/4		
		5 1		
		6 1-1/4		
		7 1-1/2		
		8 2		
		9 2-1/2		
		0 3		

# Apollo® Actuator Ready (AR) Ball Valve

Construction Materials			
DESCRIPTION	BRONZE (71 & 77 AR) STEEL	CARBON (89 AR) STEEL	STAINLESS (76 AR)
STEM	316 SS	316 SS	316 SS
HEX NUT	ZINC PLT. STEEL	ZINC PLT. STEEL	304 SS
LOCK PLATE	304/316 SS	304/316 SS	304/316 SS
GLAND	B16 BRASS	316 SS	316 SS
PACKING SET	RPTFE (MULTIFILL)	RPTFE (MULTIFILL)	RPTFE (MULTIFILL)
BEARING	RPTFE	RPTFE	RPTFE
BODY	C84400 BRNZ.	A216WCB CS	A351 CF8M SS
RETAINER	C36000 BRASS	1210 CS	316 SS
SEATS	RPTFE (MULTIFILL)	RPTFE (MULTIFILL)	RPTFE (MULTIFILL)
BALL	316 SS	316 SS	316 SS
BODY SEAL *	PTFE	PTFE	PTFE
Live Load Washers	302 SS	302 SS	302 SS

\*SIZES 1 1/2" AND LARGER

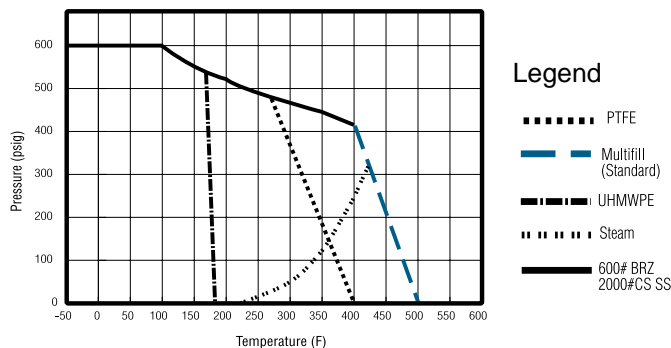
## CV Factors

77-ARX-64								
SIZE (In.)		1/4	3/8	1/2	3/4	1	1-1/2	2
DEGREE ROTATION	OPEN 90°	8.1	15	15	51	68	177	389
	80°	6.9	11	11	31	44	108	195
	70°	4.2	6.1	5.4	15	24	52	92
	60°	2.5	3.4	3.2	8.3	13	30	54
	50°	1.4	2.0	1.9	4.4	7.5	17	31
	40°	0.8	1.0	1.0	2.5	4.0	9.3	16
	30°	0.4	0.4	0.4	1.1	2.1	4.7	7.8
	20°	0.1	0.1	0.1	0.2	0.5	1.3	2.1
	10°	0	0	0	0	0	0	0
	CLOSED 0°	0	0	0	0	0	0	0

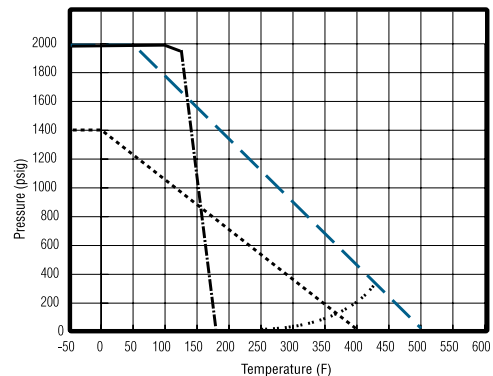
71-ARX-64, 76-ARX-64, 89-ARX-64												
SIZE (In.)		1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	
DEGREE ROTATION	OPEN 90°	8.4	7.2	15	30	43	48	84	108	503	370	
	80°	5.3	4.6	9.3	17	28	33	54	75	316	225	
	70°	2.5	2.4	5.0	9.0	16	19	31	44	167	137	
	60°	1.2	1.2	2.9	5.1	9.2	12	20	28	86	84	
	50°	0.6	0.6	1.8	2.9	5.8	7.6	12	17	55	54	
	40°	0.2	0.2	1.0	1.5	3.1	4.2	6.3	9.6	32	31	
	30°	0.1	0.1	0.4	0.7	1.6	2.1	3.2	4.8	18	16	
	20°	0	0	0.1	0.1	0.4	0.7	0.8	1.3	7.4	6.1	
	10°	0	0	0	0	0	0	0	0	0.5	0.1	
	CLOSED 0°	0	0	0	0	0	0	0	0	0	0	

## Pressure-Temperature Charts

600# Bronze P.T. Rating



2000# CS and SS P.T. Rating



**Apollo® Actuator Ready (AR) Ball Valve**
**76 & 89 Series**

SERIES	SIZE (In.)	ACTUATOR	MTG. KIT	A	B	C	D	E	F	G	H	J
76 / 89 AR	1/4 - 3/8	3T10	78-1518-01	4.52	2.72	1.50	.786	.531	5.54	2.06	1.77	.89
76 / 89 AR	1/4 - 3/8	3T20	78-1519-01	5.30	3.60	"	"	"	6.42	"	2.60	1.46
76 / 89 AR	1/4 - 3/8	3T30	78-1521-01	5.98	4.32	"	"	"	7.14	"	3.17	1.74
76 / 89 AR	1/4 - 3/8	3T40	78-1522-01	7.95	5.13	"	"	"	7.95	"	3.60	1.93
76 / 89 AR	1/2	3T10	78-1518-01	4.52	2.72	1.50	.988	.593	5.80	2.25	1.77	.89
76 / 89 AR	1/2	3T20	78-1519-01	5.30	3.60	"	"	"	6.68	"	2.60	1.46
76 / 89 AR	1/2	3T30	78-1521-01	5.98	4.32	"	"	"	7.40	"	3.17	1.74
76 / 89 AR	1/2	3T40	78-1522-01	7.95	5.13	"	"	"	8.21	"	3.60	1.93
71,76,89 AR	3/4	3T10	78-1526-01	4.52	2.72	1.50	1.325	.783	6.33	3.00	1.77	.89
71,76,89 AR	3/4	3T20	78-1527-01	5.30	3.60	"	"	"	7.21	"	2.60	1.46
71,76,89 AR	3/4	3T30	78-1529-01	5.98	4.32	"	"	"	7.93	"	3.17	1.74
71,76,89 AR	3/4	3T40	78-1530-01	7.95	5.13	"	"	"	8.74	"	3.60	1.93
71,76,89 AR	3/4	3T50	78-1532-01	9.05	5.41	"	"	"	9.02	"	4.01	2.08
71,76,89 AR	1	3T10	78-1526-01	4.52	2.72	1.50	1.449	.906	6.58	3.37	1.77	.89
71,76,89 AR	1	3T20	78-1527-01	5.30	3.60	"	"	"	7.46	"	2.60	1.46
71,76,89 AR	1	3T30	78-1529-01	5.98	4.32	"	"	"	8.18	"	3.17	1.74
71,76,89 AR	1	3T40	78-1530-01	7.95	5.13	"	"	"	8.99	"	3.60	1.93
71,76,89 AR	1	3T50	78-1532-01	9.05	5.41	"	"	"	9.27	"	4.01	2.08
71,76,89 AR	1-1/4	3T30	78-1535-01	5.98	4.32	2.00	1.767	1.156	9.24	3.97	3.17	1.74
71,76,89 AR	1-1/4	3T40	78-1536-01	7.95	5.13	"	"	"	10.05	"	3.60	1.93
71,76,89 AR	1-1/4	3T50	78-1538-01	9.05	5.41	"	"	"	10.33	"	4.01	2.08
71,76,89 AR	1-1/4	3T60	78-1538-01	10.66	5.99	"	"	"	12.01	"	4.59	2.46
71,76,89 AR	1-1/4	3T65	78-1540-01	12.13	7.08	"	"	"	12.00	"	5.20	2.70
71,76,89 AR	1-1/4	3T70	78-1540-01	14.17	7.54	"	"	"	12.46	"	5.62	2.87
71,76,89 AR	1-1/2	3T30	78-1535-01	5.98	4.32	2.00	1.993	1.310	9.62	4.37	3.17	1.74
71,76,89 AR	1-1/2	3T40	78-1536-01	7.95	5.13	"	"	"	10.43	"	3.60	1.93
71,76,89 AR	1-1/2	3T50	78-1538-01	9.05	5.41	"	"	"	10.71	"	4.01	2.08
71,76,89 AR	1-1/2	3T60	78-1538-01	10.66	5.99	"	"	"	11.29	"	4.59	2.46
71,76,89 AR	1-1/2	3T65	78-1540-01	12.13	7.08	"	"	"	12.38	"	5.20	2.70
71,76,89 AR	1-1/2	3T70	78-1540-01	14.17	7.54	"	"	"	12.84	"	5.62	2.87
71,76,89 AR	2	3T30	78-1535-01	5.98	4.32	2.00	2.151	1.530	10.0	* 4.68	3.17	1.74
71,76,89 AR	2	3T40	78-1536-01	7.95	5.13	"	"	"	10.81	"	3.60	1.93
71,76,89 AR	2	3T50	78-1538-01	9.05	5.41	"	"	"	11.09	"	4.01	2.08
71,76,89 AR	2	3T60	78-1538-01	10.66	5.99	"	"	"	11.67	"	4.59	2.46
71,76,89 AR	2	3T65	78-1540-01	12.13	7.08	"	"	"	12.76	"	5.20	2.70
71,76,89 AR	2	3T70	78-1540-01	14.17	7.54	"	"	"	13.22	"	5.62	2.87
71,76,89 AR	2	3T80	78-1541-01	18.18	9.06	"	"	"	14.74	"	7.04	3.58
71,76,89 AR	2-1/2	3T30	78-1535-01	5.98	4.32	2.00	2.696	2.030	11.05	3.97	3.17	1.74
71,76,89 AR	2-1/2	3T40	78-1536-01	7.95	5.13	"	"	"	11.86	"	3.60	1.93
71,76,89 AR	2-1/2	3T50	78-1538-01	9.05	5.41	"	"	"	12.14	"	4.01	2.08
71,76,89 AR	2-1/2	3T60	78-1538-01	10.66	5.99	"	"	"	12.72	"	4.59	2.46
71,76,89 AR	2-1/2	3T65	78-1540-01	12.13	7.08	"	"	"	13.81	"	5.20	2.70
71,76,89 AR	2-1/2	3T70	78-1540-01	14.17	7.54	"	"	"	14.57	"	5.62	2.87
71,76,89 AR	2-1/2	3T80	78-1541-01	18.18	9.06	"	"	"	15.79	"	7.04	3.58
71,76,89 AR	3	3T30	78-1535-01	5.98	4.32	2.00	3.020	2.340	11.68	6.75	3.17	1.74
71,76,89 AR	3	3T40	78-1536-01	7.95	5.13	"	"	"	12.49	"	3.60	1.93
71,76,89 AR	3	3T50	78-1538-01	9.05	5.41	"	"	"	12.77	"	4.01	2.08
71,76,89 AR	3	3T60	78-1538-01	10.66	5.99	"	"	"	13.35	"	4.59	2.46
71,76,89 AR	3	3T65	78-1540-01	12.13	7.08	"	"	"	14.44	"	5.20	2.70
71,76,89 AR	3	3T70	78-1540-01	14.17	7.54	"	"	"	14.90	"	5.62	2.87
71,76,89 AR	3	3T80	78-1541-01	18.18	9.06	"	"	"	16.42	"	7.04	3.58
77 AR	1/4 - 3/8	3T10	78-1518-01	4.52	2.72	1.50	.786	.531	5.54	2.25	1.77	.89
77 AR	1/4 - 3/8	3T20	78-1519-01	5.30	3.60	"	"	"	6.42	"	2.60	1.46
77 AR	1/4 - 3/8	3T30	78-1521-01	5.98	4.32	"	"	"	7.14	"	3.17	1.74
77 AR	1/4 - 3/8	3T40	78-1522-01	7.95	5.13	"	"	"	7.95	"	3.60	1.93
77 AR	1/2	3T10	78-1518-01	4.52	2.72	1.50	.944	.590	5.75	2.25	1.77	.89
77 AR	1/2	3T20	78-1519-01	5.30	3.60	"	"	"	6.63	"	2.60	1.46
77 AR	1/2	3T30	78-1521-01	5.98	4.32	"	"	"	7.35	"	3.17	1.74
77 AR	1/2	3T40	78-1522-01	7.95	5.13	"	"	"	8.16	"	3.60	1.93
77 AR	3/4	3T10	78-1526-01	4.52	2.72	1.50	1.447	.905	6.57	3.12	1.77	.89
77 AR	3/4	3T20	78-1527-01	5.30	3.60	"	"	"	7.45	"	2.60	1.46
77 AR	3/4	3T30	78-1529-01	5.98	4.32	"	"	"	8.17	"	3.17	1.74
77 AR	3/4	3T40	78-1530-01	7.95	5.13	"	"	"	8.98	"	3.60	1.93
77 AR	3/4	3T50	78-1532-01	9.05	5.41	"	"	"	9.26	"	4.01	2.08
77 AR	3/4	3T60	78-1532-01	10.66	5.99	"	"	"	9.84	"	4.59	2.46
77 AR	1	3T30	78-1535-01	5.98	4.32	2.00	1.802	1.125	9.25	3.62	3.17	1.74
77 AR	1	3T40	78-1536-01	7.95	5.13	"	"	"	10.06	"	3.60	1.93
77 AR	1	3T50	78-1538-01	9.05	5.41	"	"	"	10.34	"	4.01	2.08
77 AR	1	3T60	78-1538-01	10.66	5.99	"	"	"	10.92	"	4.59	2.46
77 AR	1	3T65	78-1540-01	12.13	7.08	"	"	"	12.00	"	5.20	2.70
77 AR	1	3T70	78-1540-01	14.17	7.54	"	"	"	12.47	"	5.62	2.87
77 AR	1	3T80	78-1541-01	18.18	9.06	"	"	"	13.99	"	7.04	3.58
77 AR	1-1/2	3T30	78-1535-01	5.98	4.32	2.00	2.211	1.560	10.09	4.75	3.17	1.74
77 AR	1-1/2	3T40	78-1536-01	7.95	5.13	"	"	"	10.90	"	3.60	1.93
77 AR	1-1/2	3T50	78-1538-01	9.05	5.41	"	"	"	11.18	"	4.01	2.08
77 AR	1-1/2	3T60	78-1538-01	10.66	5.99	"	"	"	11.76	"	4.59	2.46
77 AR	1-1/2	3T65	78-1540-01	12.13	7.08	"	"	"	12.85	"	5.20	2.70
77 AR	1-1/2	3T70	78-1540-01	14.17	7.54	"	"	"	13.31	"	5.62	2.87
77 AR	1-1/2	3T80	78-1541-01	18.18	9.06	"	"	"	14.83	"	7.04	3.58
77 AR	2	3T30	78-1535-01	5.98	4.32	2.00	2.696	2.030	11.05	5.37	3.17	1.74
77 AR	2	3T40	78-1536-01	7.95	5.13	"	"	"	11.86	"	3.60	1.93
77 AR	2	3T50	78-1538-01	9.05	5.41	"	"	"	12.14	"	4.01	2.08
77 AR	2	3T60	78-1538-01	10.66	5.99	"	"	"	12.72	"	4.59	2.46
77 AR	2	3T65	78-1540-01	12.13	7.08	"	"	"	13.81	"	5.20	2.70
77 AR	2	3T70	78-1540-01	14.17	7.54	"	"	"	14.27	"	5.62	2.87
77 AR	2	3T80	78-1541-01	18.18	9.06	"	"	"	15.79	"	7.04	3.58

**71, 76 & 89 Series**
**77 Series**

\*Dimension "G" is 4.68" for 2" Size Bronze Valve: 5.50" for Carbon &amp; Stainless.

# APOLLO<sup>®</sup>

## Actuator Ready Ball Valves

It's never been easier to select the right ball valve for your application. Whether you need manually operated or automated valves, there's a new family of Apollo<sup>®</sup> steel valves that's right for you. Meet the new Apollo<sup>®</sup> three-piece AR ball valve. This new generation of three piece valves uses time-tested design features, but upgrades the packing and mounting to meet the most demanding automated service requirements.

The Apollo<sup>®</sup> three piece ball valve comes equipped with a lever operator as a standard, to meet your manual service needs. The packing is a multi-piece MPTFE/CHV style for extended service life in any application. A wide variety of options, including locking levers, round handwheels, locking handwheels, stem extensions and Belleville washers to compensate for thermal cycling are available when you order the Apollo<sup>®</sup> three piece ball valve as a manual valve. The array of options makes this one of the most versatile lines of manual valves available, and its superior construction makes it the perfect choice for automated service as well.

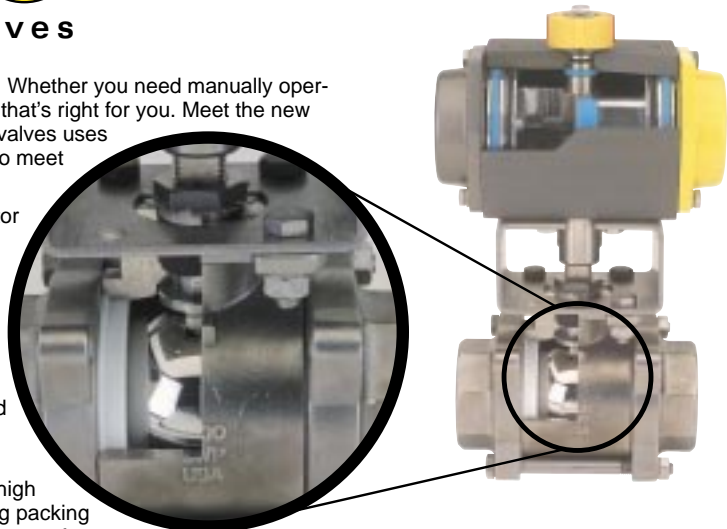
For actuation, the lever is removed, and Belleville spring washers are added as standard making the Apollo<sup>®</sup> three piece ball valve ideal for high cycle and thermal cycle applications. With Belleville washers the V-ring packing is self-adjusting. This packing arrangement has been tested well in excess of 100,000 cycles and has seen years of successful field operation in a wide range of demanding applications. It is the same packing used in Apollo's popular line of two-piece Actuator-Ready (AR) valves. Standard ISO 5211-style mounting pads make it easy to add the actuator of your choice.

You'll also find many of the features that have become synonymous with Apollo<sup>®</sup> three piece valves, such as a one-piece seat and seal design for ease of repair, a true swing-out body section for quick maintenance, and the legendary Apollo<sup>®</sup> quality assurance. Every valve is fully tested and inspected to MSS and Apollo<sup>®</sup> standards before being prepared for shipment.

### A Perfect-Fit Replacement For Current Apollo<sup>®</sup> Installations

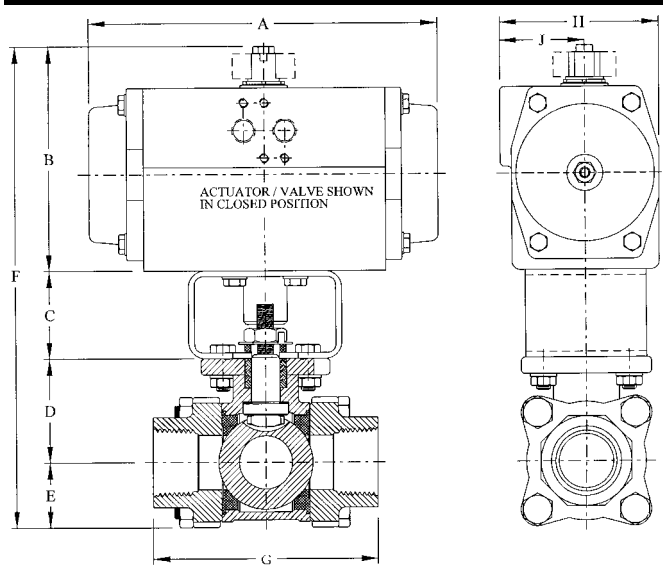
Here's more good news for current users of Apollo<sup>®</sup> three piece valves! The new Apollo<sup>®</sup> three piece ball valve is completely interchangeable with the body sections of our previous 83, 85 and 86 Series models. The end-to-end dimensions are unchanged. The bolting is the same. The body center section will fit exactly in the space of the old body. No piping changes are necessary.

For manual or automated applications, new or replacement, picking the right valve is simple when you pick new Apollo<sup>®</sup> three- piece ball valves.



Construction Materials		
ITEM DESCRIPTION	CARBON STEEL (83R)	STAINLESS STEEL (85R & 86R)
1 STEM	A108-CS	A276-316
2 JAM NUT	steel, zinc plate	SS
3 LOW PROFILE NUT	316 SS	316 SS
4 GLAND	A108-CS	A276-316
5 STEM BEARING	Ryton TFE	Ryton TFE
6 END CAP (2)	A108-CS (1/4" TO 1") A216-WCB (1-1/4" TO 2")	ASTM A351-CF3M
7 HEX NUT (4)	Stl-gr. 8-zinc plate	18-8 SS
8 SEAT (2)	RPTFE	RPTFE
9 BALL	A108-CS chrome plate	316 SS
10 BODY BOLT (4)	Stl-gr. 8-zinc plate	18-8 SS
11 STEM PACKING	MPTFE	MPTFE
12 BODY	ASTM A216-WCB	ASTM A351-CF8M
13 LOCK TAB WASHER	304SS	304 SS
14 LEVER AND GRIP	Stl-zinc plate w/vinyl	304 SS w/vinyl

### Dimensions (with Actuator)



For valve dimensional data only, refer to Section M of the Apollo Engineering Binder.

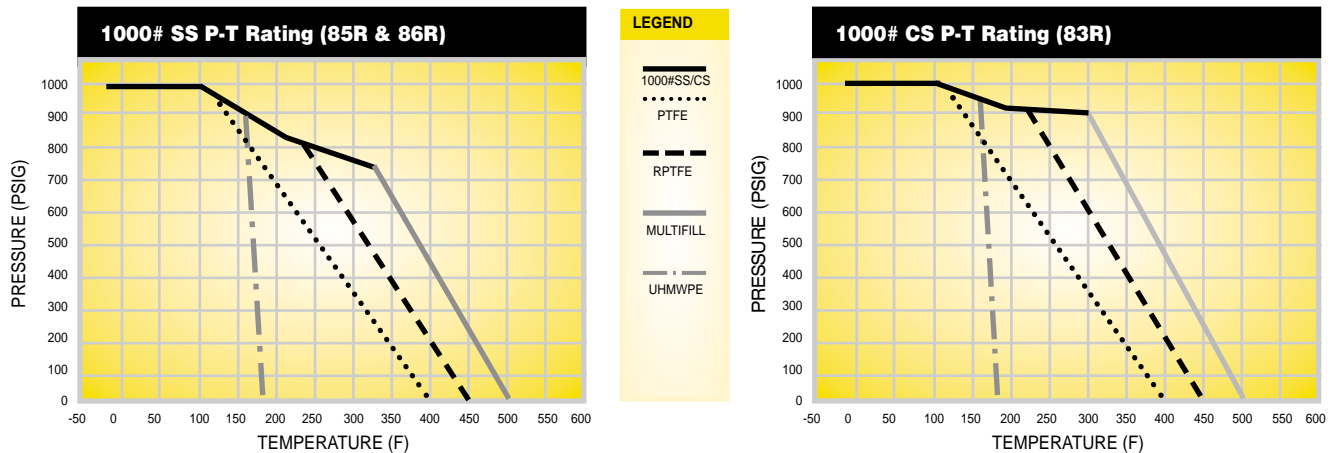
# Apollo® Actuator Ready 3-Piece Ball Valve

## CV Factors

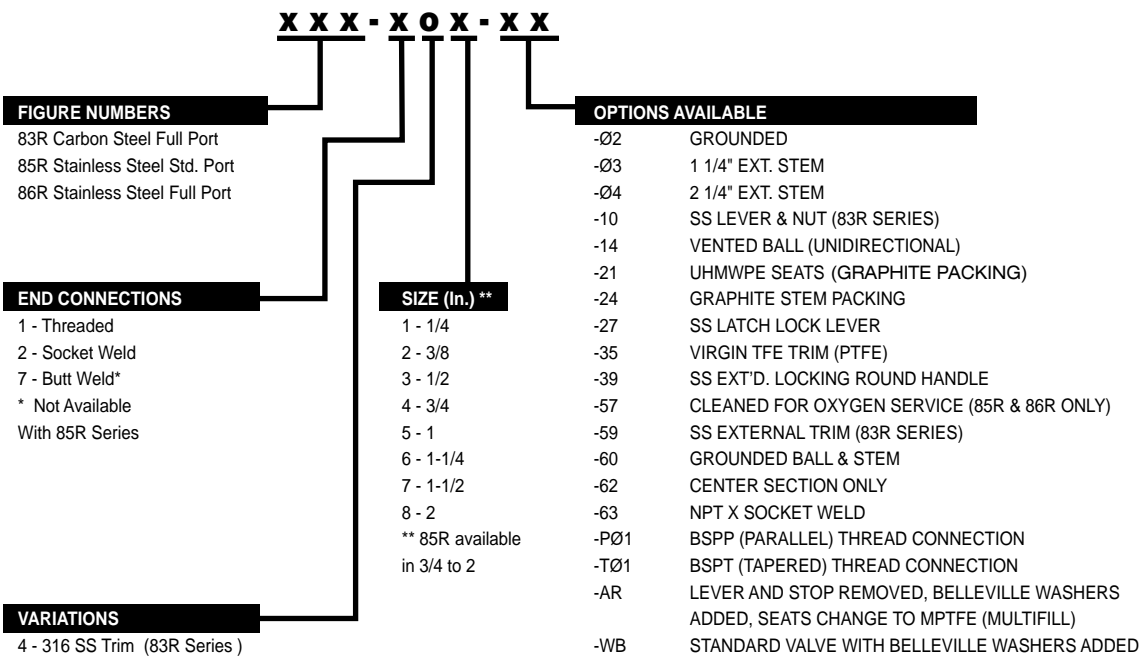
83R-100, 83R-200, 83R-700, 86R-100, 86R-200 & 86R-700 Series									
SIZE (In.)		1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2
OPEN	90°	8.1	14	26	51	68	120	170	376
DEGREE ROTATION	80°	6.9	10	19	33	46	70	99	190
	70°	4.2	5.8	8.8	15	24	33	47	90
	60°	2.6	3.4	4.4	8.2	13	20	29	53
	50°	1.6	1.8	2.3	4.3	7.5	12	17	30
	40°	1.0	1.0	1.2	2.3	4.0	6.3	9.2	16
	30°	0.4	0.5	0.5	1.0	2.1	3.2	4.6	7.6
	20°	0.1	0.1	0.1	0.3	0.5	0.7	1.3	2.0
CLOSED	10°	0	0	0	0	0	0	0	0
	0°	0	0	0	0	0	0	0	0

85R-100 & 85R-200 Series						
SIZE (In.)		3/4	1	1-1/4	1-1/2	2
OPEN	90°	18	35	48	84	104
DEGREE ROTATION	80°	13	23	32	53	73
	70°	7.6	13	19	30	43
	60°	4.6	7.3	12	20	27
	50°	2.7	4.5	7.2	12	16
	40°	1.5	2.5	3.8	6.3	9.4
	30°	0.7	1.1	2.1	3.2	4.7
	20°	0.2	0.3	0.7	0.8	1.3
CLOSED	10°	0	0	0	0	0
	0°	0	0	0	0	0

## Pressure-Temperature Charts



## How To Order



**Dimensions (with Apollo® CompacTorque™ Actuator)**

SERIES	SIZE (In.)	ACTUATOR	MTG. KIT	A	B	C	D	E	F	G	H	J
83R/86R	1/4-1/2	3T10	78-1518-01	4.52	2.72	1.50	1.44	.89	6.55	2.81	1.77	.89
83R/86R	1/4-1/2	3T20	78-1519-01	5.30	3.60	1.50	1.44	.89	7.43	2.81	2.60	1.46
83R/86R	1/4-1/2	3T30	78-1521-01	5.98	4.32	1.50	1.44	.89	8.15	2.81	3.17	1.74
83R/86R	1/4-1/2	3T40	78-1522-01	7.95	5.13	1.50	1.44	.89	8.96	2.81	3.60	1.93
83R/86R	1/4-1/2	3T50	78-1524-01	9.05	5.41	1.50	1.44	.89	9.24	2.81	4.01	2.08
83R/86R	3/4	3T10	78-1526-01	4.52	2.72	1.50	1.58	.99	6.79	3.42	1.77	.89
83R/86R	3/4	3T20	78-1527-01	5.30	3.60	1.50	1.58	.99	7.67	3.42	2.60	1.46
83R/86R	3/4	3T30	78-1529-01	5.98	4.32	1.50	1.58	.99	8.39	3.42	3.17	1.74
83R/86R	3/4	3T40	78-1530-01	7.95	5.13	1.50	1.58	.99	9.20	3.42	3.60	1.93
83R/86R	3/4	3T50	78-1532-01	9.05	5.41	1.50	1.58	.99	9.48	3.42	4.01	2.08
83R/86R	1	3T10	78-1526-01	4.52	2.72	1.50	1.70	1.11	7.03	3.85	1.77	.89
83R/86R	1	3T20	78-1527-01	5.30	3.60	1.50	1.70	1.11	7.91	3.85	2.60	1.46
83R/86R	1	3T30	78-1529-01	5.98	4.32	1.50	1.70	1.11	8.63	3.85	3.17	1.74
83R/86R	1	3T40	78-1530-01	7.95	5.13	1.50	1.70	1.11	9.44	3.85	3.60	1.93
83R/86R	1	3T50	78-1532-01	9.05	5.41	1.50	1.70	1.11	9.72	3.85	4.01	2.08
83R/86R	1	3T60	78-1532-01	10.66	5.99	1.50	1.70	1.11	10.30	3.85	4.59	2.46
83R/86R	1-1/4	3T30	78-1535-01	5.98	4.32	2.00	2.00	1.35	9.67	4.70	3.17	1.74
83R/86R	1-1/4	3T40	78-1536-01	7.95	5.13	2.00	2.00	1.35	10.48	4.70	3.60	1.93
83R/86R	1-1/4	3T50	78-1538-01	9.05	5.41	2.00	2.00	1.35	10.76	4.70	4.01	2.08
83R/86R	1-1/4	3T60	78-1538-01	10.66	5.99	2.00	2.00	1.35	11.34	4.70	4.59	2.46
83R/86R	1-1/4	3T65	78-1540-01	12.33	7.08	2.00	2.00	1.35	12.43	4.70	5.20	2.70
83R/86R	1-1/4	3T70	78-1540-01	14.17	7.54	2.00	2.00	1.35	12.89	4.70	5.62	2.87
83R/86R	1-1/2	3T30	78-1535-01	5.98	4.32	2.00	2.33	1.53	10.18	5.18	3.17	1.74
83R/86R	1-1/2	3T40	78-1536-01	7.95	5.13	2.00	2.33	1.53	10.99	5.18	3.60	1.93
83R/86R	1-1/2	3T50	78-1538-01	9.05	5.41	2.00	2.33	1.53	11.27	5.18	4.01	2.08
83R/86R	1-1/2	3T60	78-1538-01	10.66	5.99	2.00	2.33	1.53	11.85	5.18	4.59	2.46
83R/86R	1-1/2	3T65	78-1540-01	12.33	7.08	2.00	2.33	1.53	12.94	5.18	5.20	2.70
83R/86R	1-1/2	3T70	78-1540-01	14.17	7.54	2.00	2.33	1.53	13.40	5.18	5.62	2.87
83R/86R	2	3T40	78-1536-01	7.95	5.13	2.00	2.79	2.00	11.92	6.03	3.60	1.93
83R/86R	2	3T50	78-1538-01	9.05	5.41	2.00	2.79	2.00	12.20	6.03	4.01	2.08
83R/86R	2	3T60	78-1538-01	10.66	5.99	2.00	2.79	2.00	12.78	6.03	4.59	2.46
83R/86R	2	3T65	78-1540-01	12.33	7.08	2.00	2.79	2.00	13.87	6.03	5.20	2.70
83R/86R	2	3T70	78-1540-01	14.17	7.54	2.00	2.79	2.00	14.33	6.03	5.62	2.87
83R/86R	2	3T80	78-1541-01	18.18	9.06	2.00	2.79	2.00	15.85	6.03	7.04	3.58
85R	3/4	3T10	78-1518-01	4.52	2.72	1.50	1.44	.89	6.55	2.81	1.77	.89
85R	3/4	3T20	78-1519-01	5.30	3.60	1.50	1.44	.89	7.43	2.81	2.60	1.46
85R	3/4	3T30	78-1521-01	5.98	4.32	1.50	1.44	.89	8.15	2.81	3.17	1.74
85R	3/4	3T40	78-1522-01	7.95	5.13	1.50	1.44	.89	8.96	2.81	3.60	1.93
85R	3/4	3T50	78-1524-01	9.05	5.41	1.50	1.44	.89	9.24	2.81	4.01	2.08
85R	1	3T10	78-1526-01	4.52	2.72	1.50	1.58	.99	6.79	3.42	1.77	.89
85R	1	3T20	78-1527-01	5.30	3.60	1.50	1.58	.99	7.67	3.42	2.60	1.46
85R	1	3T30	78-1529-01	5.98	4.32	1.50	1.58	.99	8.39	3.42	3.17	1.74
85R	1	3T40	78-1530-01	7.95	5.13	1.50	1.58	.99	9.20	3.42	3.60	1.93
85R	1	3T50	78-1532-01	9.05	5.41	1.50	1.58	.99	9.48	3.42	4.01	2.08
85R	1	3T60	78-1532-01	10.66	5.99	1.50	1.58	.99	10.06	3.42	4.59	2.46
85R	1-1/4	3T10	78-1526-01	4.52	2.72	1.50	1.70	1.11	7.03	3.85	1.77	.89
85R	1-1/4	3T20	78-1527-01	5.30	3.60	1.50	1.70	1.11	7.91	3.85	2.60	1.46
85R	1-1/4	3T30	78-1529-01	5.98	4.32	1.50	1.70	1.11	8.63	3.85	3.17	1.74
85R	1-1/4	3T40	78-1530-01	7.95	5.13	1.50	1.70	1.11	9.44	3.85	3.60	1.93
85R	1-1/4	3T50	78-1532-01	9.05	5.41	1.50	1.70	1.11	9.72	3.85	4.01	2.08
85R	1-1/4	3T60	78-1532-01	10.66	5.99	1.50	1.70	1.11	10.30	3.85	4.59	2.46
85R	1-1/2	3T30	78-1535-01	5.98	4.32	2.00	2.00	1.35	9.67	4.70	3.17	1.74
85R	1-1/2	3T40	78-1536-01	7.95	5.13	2.00	2.00	1.35	10.48	4.70	3.60	1.93
85R	1-1/2	3T50	78-1538-01	9.05	5.41	2.00	2.00	1.35	10.76	4.70	4.01	2.08
85R	1-1/2	3T60	78-1538-01	10.66	5.99	2.00	2.00	1.35	11.34	4.70	4.59	2.46
85R	1-1/2	3T65	78-1540-01	12.33	7.08	2.00	2.00	1.35	12.43	4.70	5.20	2.70
85R	1-1/2	3T70	78-1540-01	14.17	7.54	2.00	2.00	1.35	12.89	4.70	5.62	2.87
85R	1-1/2	3T80	78-1541-01	18.18	9.06	2.00	2.00	1.35	14.41	4.70	7.04	3.58
85R	2	3T30	78-1535-01	5.98	4.32	2.00	2.33	1.52	10.17	5.18	3.17	1.74
85R	2	3T40	78-1536-01	7.95	5.13	2.00	2.33	1.52	10.98	5.18	3.60	1.93
85R	2	3T50	78-1538-01	9.05	5.41	2.00	2.33	1.52	11.26	5.18	4.01	2.08
85R	2	3T60	78-1538-01	10.66	5.99	2.00	2.33	1.52	11.84	5.18	4.59	2.46
85R	2	3T65	78-1540-01	12.33	7.08	2.00	2.33	1.52	12.93	5.18	5.20	2.70
85R	2	3T70	78-1540-01	14.17	7.54	2.00	2.33	1.52	13.39	5.18	5.62	2.87
85R	2	3T80	78-1541-01	18.18	9.06	2.00	2.33	1.52	14.91	5.18	7.04	3.58

# Apollo® Ball Valves

## VALVE MOUNTING

Mounting of Apollo® CompacTorque™ 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.

## 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.*

## OPENING TORQUE

Torque required to rotate the valve into the fully open position. The magnitude of the opening torque is 70% or 0.7 times the breakaway torque.

*Note: For spring return fail closed applications the "air end" stroke (at given air supply pressure) must exceed the opening torque requirement. For spring return fail open applications the "spring end" stroke must exceed the opening torque requirement.*

## 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.

# Apollo® Ball Valves

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.

## 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 46, 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.

### Torque Constants for Apollo AR™ Two Piece Actuator Ready Valves

DIFFERENTIAL PRESSURE psig		100	200	400	600	800	1000	1500	2000	LSST***	-24 Adder
Valve Model	Size (in.)									(in.-lbs.)	(in.-lbs.)
*STD PORT **71-ARX-64 89-ARX-64 76-ARX-64	1/4 - 1/2	25	26	27	28	30	32	35	38	50	45
	3/4	50	50	52	54	57	60	64	72	100	45
	1	85	86	88	90	94	97	110	138	170	56
	1-1/4	140	140	145	156	160	172	194		280	96
	1-1/2	160	164	173	186	195	201	235		320	96
	2	220	230	258	270	310	350	460		440	96
	2-1/2	450	495	576	680	790	900			900	96
	3	500	540	700	820	920	1030			1000	96
	1/4 - 1/2	25	26	27	28					50	45
	3/4	50	54	60	70					100	56
*FULL PORT **77-ARX-64	1	140	148	160	180					280	56
	1-1/2	290	300	310	340					580	96
	2	340	355	420	563					680	96

\* Torques tested with multifilled seats. Does not require torque adjustment of -20%. \*\*\* LSST - Long Stand Still Torque  
 \*\* 71-ARX-64 and 77-ARX-64 rated to 600 psig maximum.

### 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.)							(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
2-1/2 & 3	715	715	790				1430	111	
STD PORT 3-PIECE 83-34X & 44X 85R-10X & 20X	1/2	35	35	40	43	46	48	70	45
	3/4	78	78	90	123	140	157	156	56
	1	156	156	178	201	229	257	312	56
	1-1/4	208	208	230	248	282	317	416	96
	1-1/2	234	234	276	309	352	395	468	96
	2	350	350	390	450	513	576	700	96
FULL PORT 3-PIECE 82-14X & 24X 83R-14X, 24X & 74X 83-54X & 64X 86R-10X, 20X & 70X 86-50X & 60X 401R-10X	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	282	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	1030	1030	1087	1148	1212		2060	201
	4	1830						3660	399

\* LSST - Long Stand Still Torque

## Torque Constants for Apollo® Flanged Ball Valves

Torques Shown in lb-in.		Pressure (psig)									LSST*	-24 Adder
Valve Series	Valve Size (In.)	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	122	125	127	129						244	68
	2 SP 150	293	298	302	311						586	96
	2-1/2 SP 150	280	286	291	312						560	127
	3 SP 150	342	355	367	380						684	127
	4 SP 150	1032	1062	1092	1122						2064	292
	6 SP 150	1692	1752	1812	1872						3384	292
	8 SP 150	1800	2050	2300	2550						3600	661
	10 SP 150	6600	7000	7400	8350						13,200	661
87A - 200's 88A - 240's	1/2 FP 150	32	32	32	32						64	45
	3/4 FP 150	58	58	58	58						116	68
	1 FP 150	122	125	127	129						244	68
	1-1/2 FP 150	293	298	302	311						586	96
	2 FP 150	280	286	291	312						560	127
	2-1/2 FP 150	342	355	367	380						684	127
	3 FP 150	1032	1062	1092	1122						2064	292
	4 FP 150	1692	1752	1812	1872						3384	292
87A - 700's 88A - 740's	1-1/2 SP 300	122	125	127	129	131	141	151	173	182	244	68
	2 SP 300	293	298	302	311	326	339	351	365	371	586	96
	2-1/2 SP 300	280	286	291	312	332	343	361	382	391	560	127
	3 SP 300	342	355	367	380	393	410	426	441	447	684	127
	4 SP 300	1032	1062	1092	1122	1152	1212	1272	1377	1452	2064	292
	6 SP 300	1692	1752	1812	1872	1932	1992	2052	2181	2232	3384	292
	8 SP 300	1800	2050	2300	2550	2800	3300	3800	4900	6000	3600	661
	10 SP 300	6600	7000	7400	8350	9300	10,300	11,300	12,650	14,000	13,200	661
87A - 900's 88A - 940's	1/2 FP 150	32	32	32	32	32	32	32	32	32	64	45
	3/4 FP 150	58	58	58	58	58	58	58	58	58	116	68
	1 FP 300	122	125	127	129	131	141	151	173	182	244	68
	1-1/2 FP 300	293	298	302	311	326	339	351	365	371	586	96
	2 FP 300	280	286	291	312	332	343	361	382	391	560	127
	2-1/2 FP 300	342	355	367	380	393	410	426	441	447	684	127
	3 FP 300	1032	1062	1092	1122	1152	1212	1272	1377	1452	2064	292
	4 FP 300	1692	1752	1812	1872	1932	1992	2052	2181	2232	3384	292
	6 FP 300	1800	2050	2300	2550	2800	3300	3800	4900	6000	3600	661
	8 FP 300	6600	7000	7400	8350	9300	10,300	11,300	12,650	14,000	13,200	661

## Torque Constants For Top Entry Valves (1)

Seat Options	Valve Size		Differential Pressure (psig)						
	Std. Port	Full Port	100	285	500	740	1480	LSST* (in.-lbs.)	Graphoil® Adder (in.-lbs.)
***1 7***	1	1/2-3/4	85	110	140	180	290	170	68
	1 1/2	1	205	260	330	415	660	410	96
2 A	2	1 1/2	350	430	550	735	1200	700	127
	3	2	950	1250	1650	2000	3200	1900	245
3 C	4	3	2000	2500	3300	4100	6500	4000	399
5 D	6	4	5300	6700	8200	11,400	18,000	10,600	661
	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
4	1	1/2-3/4	115	160	210	260	450	230	68
	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%.

### 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.

### 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	-0.3
	LIQUID, VISCOUS, MOLASSES	0.3
	GAS, CLEAN & WET, SATURATED STEAM	0
	GAS, DRY, SUPERHEATED STEAM	0.3 TO 0.5
	GAS, DIRTY, AIR SLURRY, NATURAL GAS OXYGEN, CHLORINE	0.5 TO 1 0.5
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 400 DEG F	0.25
	APPLICATIONS BELOW -20 DEG F	0.25
VALVE SEATING MATERIAL	PTFE	-0.3
	*MULTIFILL	-0.2
	*PEEK	0.4
	*UHMWPE	0.3
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.

# 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 6)
- √ 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 7)
- √ 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 8)
- √ 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 7)
- √ Select an actuator whose start of spring stroke is greater than the butterfly valve's seating/unseating torque. (See Page 8)
- √ Above must be found on the same spring set line.

## 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 $\Delta$ P Bushing PTFE	100 PSI $\Delta$ P Bushing PTFE	150 PSI $\Delta$ P Bushing PTFE	200 PSI $\Delta$ 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!**









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