APOLLO®

valve automation products

PRODUCT CATEGORY

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

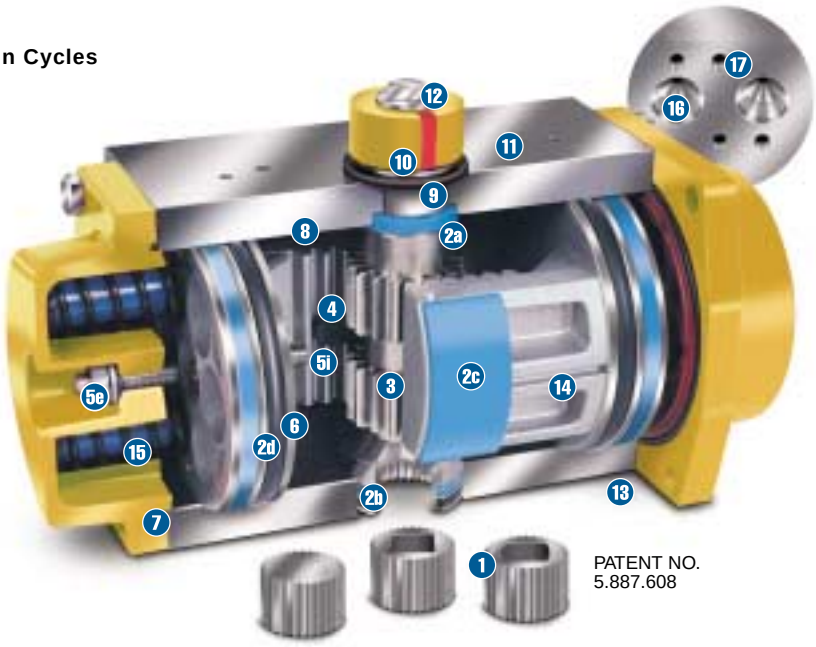
General Information

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
Tested to 2 Million Cycles



PATENT NO.
5.887.608

1. Unique Universal Shaft Adapter

Precision replaceable insert including variable internal geometry configuration meets any custom requirement. Standard insert is high strength FLN-4205. 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. 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.
- Mechanical visual position indicator and the pinion is designed to allow manual override by simply removing the position indicator.
- 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
- 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 high strength stainless steel
- Permanently lubricated nitrile seals
- Self contained spring cartridges, heat treated and polyester powder coated for corrosion protection, that ensure safe disassembly

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.

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

EPC 316 is a FDA Epoxy Powder pigmented with 316L stainless steel flakes applied by an electrostatic spray finishing

Apollo® CompacTorque Numbering System

3 T X - X X X - X X - X

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

* 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

Compactorque Pneumatic Actuators
(Corrosion Protection)

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
CX01605	**ADAPTER,11MM SQ,3T030/STD. REV. A**	**CX01637**	**ADAPTER,19MM SQ,3T060/STD. REV. A**
CX01458	ADAPTER,11MM SQ,3T030,SS	**CX01638**	**ADAPTER,22MM SQ,3T065/STD. REV. A**
CX01606	ADAPTER,14MM SQ,3T030	**CX01696**	**ADAPTER,22MM SQ,3T070/STD. REV. A**
CX01614	**ADAPTER,14MM SQ,3T040/3T050/STD. REV. A**	**CX01718**	**ADAPTER,27MM SQ,3T080/STD. REV. A**
CX01493	ADAPTER,14MM SQ,3T040/3T050,SS	CX01604	ADAPTER,BLANK,3T030
CX01615	ADAPTER,17MM SQ,3T040/3T050	CX01486	ADAPTER,BLANK,3T040/3T050
CX01494	ADAPTER,17MM SQ,3T040/3T050,SS	CX01636	ADAPTER,BLANK,3T060/3T065
CX01616	**ADAPTER,19MM SQ,3T040/3T050/STD. REV. A**	CX01695	ADAPTER,BLANK,3T070
CX01495	ADAPTER,19MM SQ,3T040/3T050,SS	CX01717	ADAPTER,BLANK,3T080

Butterfly/Actuator Mounting Kit Chart for ISO Drilling (B) - CarbonSteel/Zinc Plated Hardware

Size	3T30	3T40	3T50	3T60	3T65	3T70	3T80	3T90	3TAO
130/132 Series Adapter Numbers									
1.5									
2		CXO3430	CXO3430	CXO3433	CXO3433				
2.5		CXO3430	CXO3430	CXO3433	CXO3433				
3		CXO3430	CXO3430	CXO3433	CXO3433				
4		CXO3431	CXO3431	CXO3434	CXO3434	CXO3438			
5			CXO3432	CXO3435	CXO3435	CXO3439			
6			CXO3432	CXO3435	CXO3435	CXO3439			
8				CXO3437	CXO3437	CXO3441	CXO3444		
10						CXO3442	CXO3445		
12							CXO3446		
140/142 Series Adapter Numbers									
2		CXO3430	CXO3430	CXO3433	CXO3433				
2.5		CXO3430	CXO3430	CXO3433	CXO3433				
3		CXO3430	CXO3430	CXO3433	CXO3433				
4		CXO3431	CXO3431	CXO3434	CXO3434	CXO3438			
5		CXO3431	CXO3431	CXO3434	CXO3434	CXO3438			
6		CXO3431	CXO3431	CXO3434	CXO3434	CXO3438			
8				CXO3436	CXO3436	CXO3440	CXO3443		
10				CXO3437	CXO3437	CXO3441	CXO3444		
12							CXO3446		
141/143 Series Adapter Numbers [Double "D"]									
2		CXO3447	CXO3447	CXO3450	CXO3450	CXO3454			
2.5		CXO3447	CXO3447	CXO3450	CXO3450	CXO3454			
3		CXO3447	CXO3447	CXO3450	CXO3450	CXO3454			
4		CXO3448	CXO3448	CXO3451	CXO3451	CXO3455			
5			CXO3449	CXO3452	CXO3452	CXO3456			
6			CXO3449	CXO3452	CXO3452	CXO3456			
8				CXO3453	CXO3453	CXO3457	CXO3459		
10						CXO3458	CXO3460		
12							CXO3461		
14							CXO3461		

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

	ACTUATOR MODEL																				
AIR SUPPLY IN PSIG	3T-010	3T-020		3T-030		3T-040		3T-050		3T-060		3T-065		3T-070		3T-080		3T-090		3T-0A0	
40	30	72		130		274		416		650		1075		1409		2771		5198		12631	
60	45	108		194		411		623		975		1613		2114		4155		7797		18946	
80	60	144		259		548		831		1300		2151		2819		5548		10396		25261	
100	74	180		324		685		1039		1625		2689		3524		6929		12995		31577	
120	89	216		389		822		1247		1950		3226		4228		8310		15594		37892	
UNITS	DA	DA	SR	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	1343	610
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	198.5	247
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	5/5.5	6/7

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

Actuator Model	No. Springs per Piston	SIZING INFORMATION, END TORQUE (LB.-IN.) AIR SUPPLY AVAILABLE AT ACTUATOR (psig) 40 End	50 End	60 End	70 End	80 End	90 End	100 End	110 End	120 End	Spring Stroke End
	2	45	61	77	97	116	134	151	169	186	21
	2/3	39	54	70	90	110	127	144	161	179	27
	3	32	47	62	82.5	103	120	137	154	171	32
	3/4			55	76	97	113	130	147	164	38
3TS-020-XX	4			48	69	90	106	122	139	156	43
	4/5			42	60	84	99	115	132	148	48
	5					77	93	108	124	140	53
	5/6					71	86	101	117	133	59
	6					64	79	93	109	125	64
	2	79	108	137	173	208	239	269	300	330	35
	2/3	67	95	124	160	196	226	256	286	317	44
	3	55	83	110	147	183	213	242	273	303	53
	3/4			96	134	171	200	229	259	290	62
3TS-030-XX	4			82	121	159	188	216	246	276	71
	4/5			76	105	147	175	203	232	262	80
	5					134	162	190	219	247	89
	5/6					122	149	177	205	234	98
	6					109	136	163	192	220	106
	2	165	227	288	364	439	504	568	634	699	72
	2/3	138	198	258	335	412	476	539	604	669	90
	3	111	169	227	306	385	448	510	574	638	108
	3/4			197	277	358	419	481	544	608	126
3TS-040-XX	4			167	249	330	391	452	515	577	144
	4/5			146	215	303	363	423	485	547	162
	5					276	335	393	455	516	180
	5/6					249	307	365	425	486	198
	6					222	279	336	396	455	216
	2	247	341	434	549	664	762	860	960	1059	106
	2/3	205	296	387	504	622	718	815	913	1012	133
	3	163	251	339	459	579	675	770	867	964	159
	3/4			292	414	537	631	724	820	917	186
3TS-050-XX	4			244	370	495	587	678	774	869	212
	4/5			211	316	452	543	633	727	822	239
	5					409	499	588	681	774	266
	5/6					368	455	543	634	726	293
	6					326	412	497	587	677	319
	2	392	539	685	862	1039	1194	1349	1502	1654	171
	2/3	328	471	613	794	975	1128	1281	1431	1582	215
	3	264	403	541	726	911	1062	1212	1361	1510	258
	3/4			469	659	850	996	1142	1292	1442	301
3TS-060-XX	4			396	593	789	931	1072	1223	1373	344
	4/5			347	510	724	863	1003	1151	1300	387
	5					659	796	933	1080	1227	430
	5/6					594	730	866	1010	1154	473
	6					529	664	799	940	1080	516

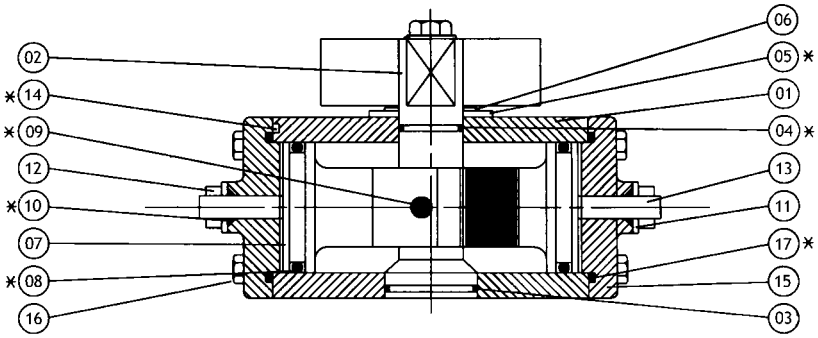
Actuator Model	No. Springs per Piston	SIZING INFORMATION, END TORQUE (LB.-IN.) AIR SUPPLY AVAILABLE AT ACTUATOR (psig) 40 End	50 End	60 End	70 End	80 End	90 End	100 End	110 End	120 End	Spring Stroke End
	2	639	880	1121	1415	1709	1962	2214	2471	2728	303
	2/3	529	763	998	1298	1599	1848	2097	2351	2605	378
	3	419	647	874	1182	1489	1734	1979	2230	2481	453
	3/4			751	1067	1383	1622	1862	2110	2358	529
3TS-065-XX	4			628	953	1277	1511	1744	1989	2234	604
	4/5			545	814	1168	1399	1631	1873	2115	680
	5					1058	1288	1517	1757	1996	755
	5/6					948	1174	1400	1636	1872	829
	6					838	1060	1282	1515	1748	903
	2	847	1165	1483	1869	2254	2587	2920	3259	3597	369
	2/3	709	1018	1328	1722	2116	2444	2772	3107	3442	462
	3	570	871	1172	1575	1977	2301	2624	2955	3286	555
	3/4			1014	1427	1839	2158	2476	2801	3126	647
3TS-070-XX	4			856	1279	1701	2016	2328	2647	2966	739
	4/5			747	1100	1563	1869	2176	2493	2811	830
	5					1424	1724	2023	2339	2655	921
	5/6					1282	1578	1875	2187	2499	1014
	6					1139	1433	1726	2035	2343	1106
	2	1684	2311	2938	3695	4451	5107	5762	6424	7085	735
	2/3	1416	2026	2636	3409	4183	4829	5475	6129	6783	921
	3	1147	1741	2334	3124	3914	4551	5187	5834	6481	1106
	3/4			2028	2837	3646	4270	4895	5537	6179	1292
3TS-080-XX	4			1721	2549	3377	3990	4603	5240	5877	1478
	4/5			1511	2205	3109	3712	4316	4943	5570	1664
	5					2840	3434	4028	4646	5263	1850
	5/6					2568	3154	3740	4351	4961	2036
	6					2295	2874	3452	4056	4659	2222
	2	3141	4312	5483	6908	8332	9558	10784	12029	13273	1416
	2/3	2629	3768	4907	6363	7820	9027	10235	11465	12696	1770
	3	2116	3223	4330	5819	7307	8496	9685	10902	12119	2124
	3/4			3753	5274	6794	7965	9136	10339	11541	2478
3TS-090-XX	4			3176	4729	6281	7434	8587	9777	10966	2832
	4/5			2776	4076	5769	6903	8038	9214	10390	3186
	5					5256	6372	7488	8651	9813	3540
	5/6					4744	5841	6939	8088	9236	3894
	6					4231	5310	6390	7525	8659	4248
	2	7616	10458	13300	16768	20235	23212	26188	29209	32230	3531
	2/3	6363	9127	11891	15436	18982	21914	24846	27833	30820	4412
	3	5110	7799	10481	14105	17729	20616	23503	26457	29410	5293
	3/4			9076	12776	16476	19318	22161	25081	28001	6174
3TS-0A0-XX	4			7671	11447	15223	18021	20818	23705	26591	7054
	4/5			6690	9938	13974	16727	19480	22333	25186	7935
	5					12725	15433	18141	20961	23781	8815
	5/6					11472	14135	16799	19585	22372	9700
	6					10219	12838	15456	18209	20962	10585

Apollo® CompacTorque™ Spring Return (Start Stroke) Torque Ratings

Actuator Model	No. Springs per Piston	SIZING INFORMATION, START TORQUE (LB.-IN.) AIR SUPPLY AVAILABLE AT ACTUATOR (psig) 40 Start	50 Start	60 Start	70 Start	80 Start	90 Start	100 Start	110 Start	120 Start	Spring Stroke Start
	2	52	69	86	106	125	143	160	177	194	30
	2/3	47	64	81	100	120	137	155	172	189	37
	3	42	59	75	95	115	132	149	166	183	44
	3/4			70	90	110	127	144	161	178	51
3TS-020-XX	4			64	85	105	122	139	156	172	58
	4/5					100	117	134	150	167	66
	5					95	112	128	145	161	74
	5/6					90	106	123	139	156	82
	6					85	101	117	134	150	89
	2	96	127	157	191	225	256	287	319	350	54
	2/3	88	118	148	182	217	248	278	309	341	68
	3	80	109	138	174	209	239	269	300	331	81
	3/4			129	165	201	231	261	291	322	94
3TS-030-XX	4			120	157	193	223	252	283	313	107
	4/5					185	214	244	274	304	121
	5					177	206	235	265	295	135
	5/6					169	198	227	256	286	148
	6					160	189	218	247	276	161
	2	208	273	337	410	482	548	614	681	747	118
	2/3	191	255	318	392	465	531	596	662	728	148
	3	174	237	299	374	448	513	578	644	709	177
	3/4			281	356	432	496	560	626	691	207
3TS-040-XX	4			262	339	415	479	542	608	673	236
	4/5					399	462	524	589	654	266
	5					382	445	507	571	635	296
	5/6					366	428	490	553	617	326
	6					349	411	472	535	598	355
	2	319	417	515	626	736	837	937	1039	1141	185
	2/3	295	391	488	600	712	811	911	1012	1114	231
	3	270	365	460	574	687	786	885	986	1086	277
	3/4			433	548	663	761	859	959	1059	323
3TS-050-XX	4			406	522	638	736	833	932	1031	369
	4/5					614	710	807	905	1004	415
	5					589	685	780	878	976	461
	5/6					565	659	754	850	946	507
	6					540	634	728	822	915	553
	2	491	644	796	967	1138	1296	1454	1614	1774	280
	2/3	452	602	752	925	1098	1255	1412	1570	1729	350
	3	412	560	707	883	1058	1214	1369	1527	1684	419
	3/4			663	767	1022	1174	1326	1482	1639	489
3TS-060-XX	4			618	652	985	1134	1282	1438	1593	558
	4/5					944	1293	1243	1395	1547	628
	5					903	1053	1203	1352	1501	697
	5/6					863	1011	1160	1308	1456	767
	6					822	969	1116	1263	1410	836

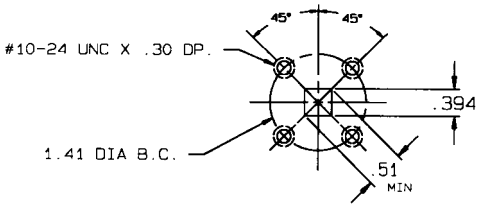
Actuator Model	No. Springs per Piston	SIZING INFORMATION, START TORQUE (LB.-IN.) AIR SUPPLY AVAILABLE AT ACTUATOR (psig) 40 Start	50 Start	60 Start	70 Start	80 Start	90 Start	100 Start	110 Start	120 Start	Spring Stroke Start
	2	795	1048	1300	1586	1871	2130	2389	2646	2902	473
	2/3	726	974	1222	1512	1802	2058	2315	2569	2824	593
	3	657	901	1144	1439	1733	1987	2240	2493	2746	712
	3/4			1062	1363	1664	1913	2162	2415	2668	830
3TS-065-XX	4			979	1287	1595	1840	2084	2337	2590	947
	4/5					1522	1766	2010	2261	2513	1067
	5					1448	1692	1935	2185	2435	1186
	5/6					1379	1620	1861	2109	2357	1306
	6					1310	1549	1787	2033	2279	1425
	2	1066	1398	1730	2106	2482	2819	3156	3501	3845	611
	2/3	981	1307	1634	2015	2397	2731	3065	3407	3749	762
	3	895	1217	1538	1925	2311	2642	2973	3313	3652	912
	3/4			1442	1834	2226	2554	2882	3219	3556	1063
3TS-070-XX	4			1346	1743	2140	2465	2790	3125	3460	1213
	4/5					2055	2379	2703	3033	3364	1368
	5					1969	2292	2615	2942	3268	1522
	5/6					1880	2200	2520	2846	3172	1673
	6					1790	2107	2424	2750	3076	1823
	2	2091	2744	3396	4127	4858	5528	6198	6871	7543	1177
	2/3	1920	2562	3204	3946	4687	5351	6015	6683	7351	1469
	3	1749	2381	3012	3764	4516	5174	5832	6495	7158	1761
	3/4			2820	3584	4349	4999	5649	6310	6971	2058
3TS-080-XX	4			2627	3405	4182	4824	5466	6125	6783	2354
	4/5					4011	4647	5283	5937	6591	2646
	5					3840	4470	5100	5749	6398	2938
	5/6					3670	4295	4921	5564	6206	3235
	6					3499	4121	4742	5378	6014	3531
	2	3889	5127	6365	7723	9080	10333	11586	12851	14115	2230
	2/3	3563	4771	5979	7367	8755	9996	11237	12493	13749	2788
	3	3238	4416	5593	7011	8429	9659	10888	12135	13382	3346
	3/4			5227	6665	8104	9322	10540	11778	13016	3904
3TS-090-XX	4			4861	6320	7778	8985	10191	11421	12650	4461
	4/5					7453	8648	9843	11063	12284	5019
	5					7128	8311	9494	10706	11918	5576
	5/6					6803	7974	9145	10349	11552	6134
	6					6477	7637	8796	9991	11186	6691
	2	9373	12325	15277	18635	21993	25032	28071	31139	34207	5443
	2/3	8564	11465	14367	17775	21184	24194	27204	30250	33296	6806
	3	7754	10605	13456	16915	20374	23355	26336	29361	32385	8169
	3/4			12545	16055	19565	22514	25464	28467	31470	9528
3TS-0A0-XX	4			11634	15195	18755	21674	24592	27573	30554	10886
	4/5					17941	20833	23725	26684	29644	12249
	5					17127	19993	22858	25796	28733	13612
	5/6					16318	19154	21991	24906	27822	14971
	6					15508	18316	21123	24017	26911	16330

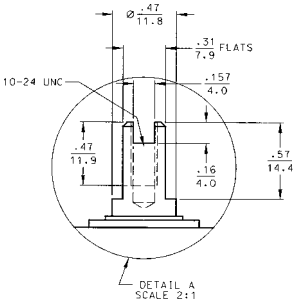
Apollo® CompacTorque™ 3TD-010-00

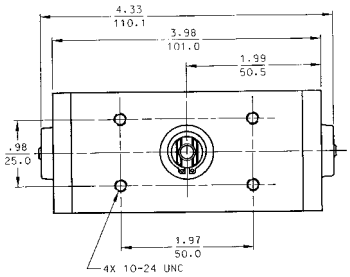


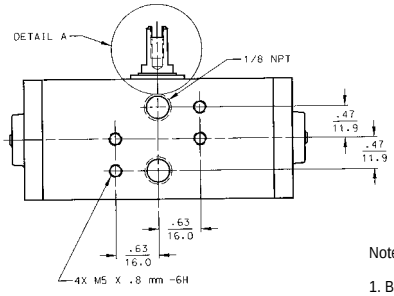
**** Suggested spare parts; Included in repair kit***
Factory lubricated with IMSCO poly U-II grease
Rebuild with High temp, disk brake, wheel bearing grease

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









Notes:

1. BOTTOM DIMENSIONS ARE IN mm

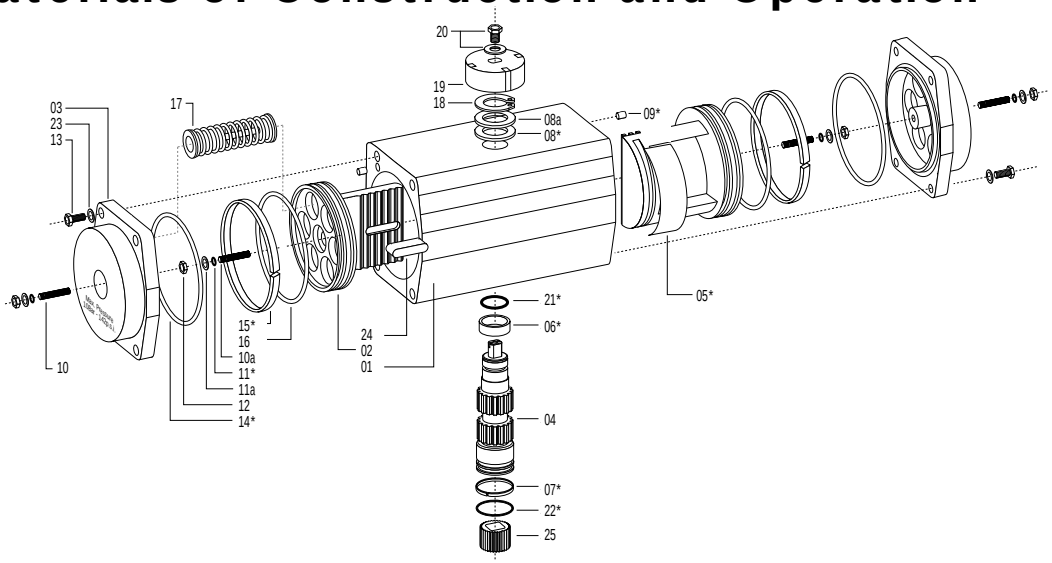
AIR SUPPLY PSIG	40	50	60	70	80	90	100	120
TORQUE Lb. In.	29.3	36.6	44	51.3	58.6	66	73.3	88

3TD-010-00 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



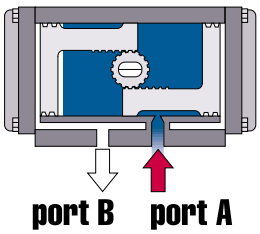
CompacTorque Part Number Designations

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
18	1	Spring clip (pinion)	High alloy spring steel			Nickel plated
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	

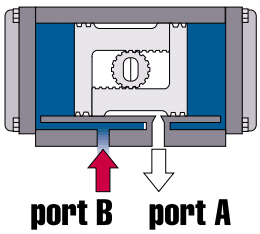
NOTES: (1) *Suggested spare parts; included in repair kit. Factory lubricated w/IMSCO poly U-11 grease. Rebuild w/ high temperature disc brake wheel bearing grease. Actuator temp. limits: Nitrile (BUNA) seals: -20˚F to +200˚F (2) •• Optional. (3) Model OAO Part No. 23 and 13 unit quantity is 12 pieces. (3) *** 3T 010 thru 3T 060 is cast onto piston

Diagram 3

Double-Acting (TOP VIEW)

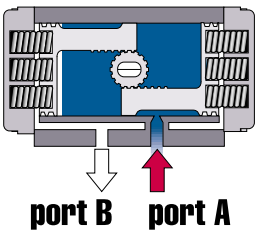


Air supplied to port A forces pistons apart and toward end positions with exhaust air exiting at port B. (A CCW rotation is obtained.)

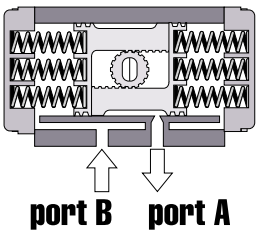


Air supplied to port B forces pistons toward center with exhaust air exiting at port A. (A CW rotation is obtained.)

Spring Return (TOP VIEW)

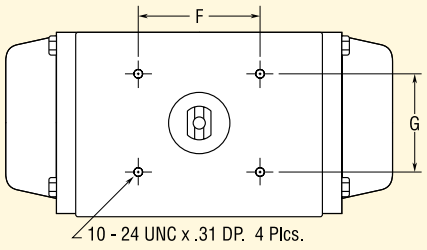


Air supplied to port A forces pistons apart and toward end position compressing springs. Exhaust air exits at port B. (A CCW rotation is obtained.)

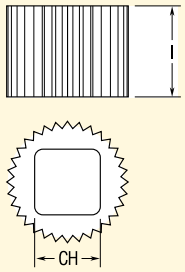


Air or electric failure allows springs to force pistons toward center position with exhaust air exiting at port A. (A CW rotation is obtained.)

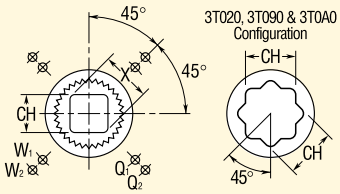
Engineering



TOP VIEW

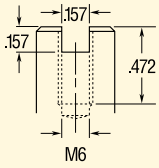


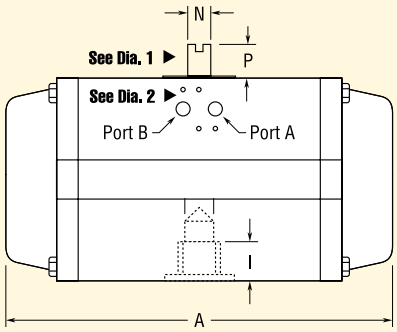
INSERT



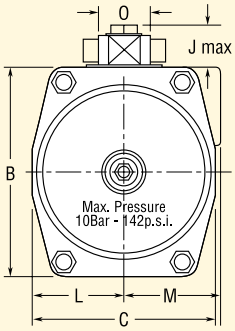
ISO 5211 BOTTOM VIEW
Supply to Port A = C.C.W. Rotation
Supply to Port B = C.W. Rotation

DIAGRAM 1

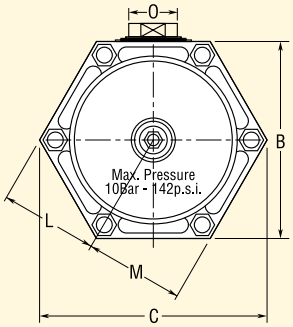




SIDE VIEW

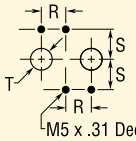


END VIEW



Shape of Size 3T0A0 Only
END VIEW

DIAGRAM 2
"NAMUR" Connection



M5 x .31 Deep
(3T0A0 Model M6 x .31 Deep)

Note:
3T0A0 Solenoid Pattern
is Rotated 90° CW.

Dimensions

	3T-20	3T-30	3T-40	3T-50	3T-60	3T-65	3T-70	3T-80	3T-90	3T-0A
A	5.30	5.98	7.95	9.05	10.66	12.13	14.17	18.18	22.60	26.93
B	2.63	3.26	3.93	4.33	4.92	5.59	6.10	7.70	9.44	13.00
C	2.28	2.87	3.34	3.85	4.33	5.04	5.51	6.92	8.66	13.78
F	1.97	3.15	3.15	3.15	3.15	5.12	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	1.18
I	.51	.59	.748	.94	1.18	1.18	1.18	1.45	1.96	1.97
J	1.00	1.00	1.00	1.00	1.00	1.38	1.42	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	6.04
M	1.45	1.61	1.81	2.08	2.36	2.52	2.87	3.58	4.33	6.32
N	.31	.31	.55	.55	.55	1.06	1.06	1.06	1.26	2.16
O	.47	.47	.70	.70	.70	1.42	1.42	1.42	1.66	3.15
P	.78	.78	.78	.78	.78	1.18	1.18	1.18	1.18	1.18
R	.47	.47	.47	.47	.47	.47	.47	.47	.47	.65
S	.63	.63	.63	.63	.63	.63	.63	.63	.63	.75
T-NPT	1/8"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/2"
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	6.50
CH	.43/11mm	.43/11mm	.55/14mm	.748/19mm	.748/19mm	.86/22mm	.86/22mm	1.06/27mm	1.41/36mm	1.81
X MIN.	.55	.55	.71	.87	.87	1.11	1.11	1.42	1.89	2.46
'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	3/4-10X.90
'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*	F16*

* F pattern Consistant with Conbraco's Mounting Bracket
** Alternate ISO 5211 Dimension Utilized
***Rev. B = 4.921/4.015 Dia. B.C.

OSHA Lockout Device

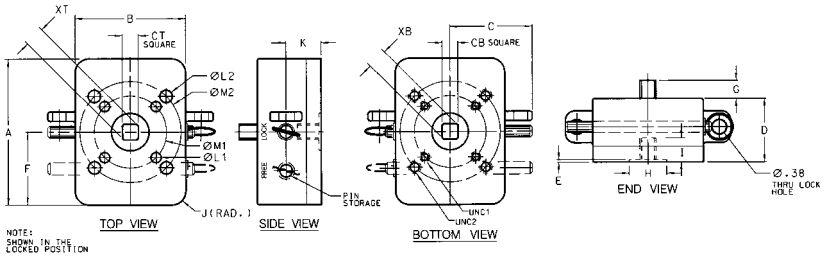
The Apollo® Lockout Tagout accessory for actuators complies with OSHA 1910.147 guidelines. It insures complete lockout capability in both the fully open or the fully closed position. Its design prevents accidental or malicious tampering of an automated valve's orientation.

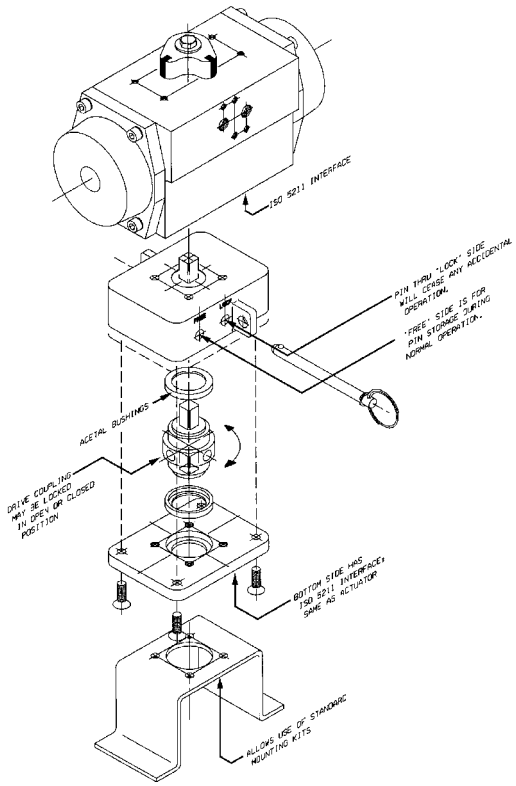
The housing is constructed in investment cast 316SS, the fasteners, the lock pin, and the coupling are made of 300 Series stainless steel. This rugged construction, plus two acetal bushings located above and below the coupling, assures the strength and support necessary to withstand the torque and torsion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





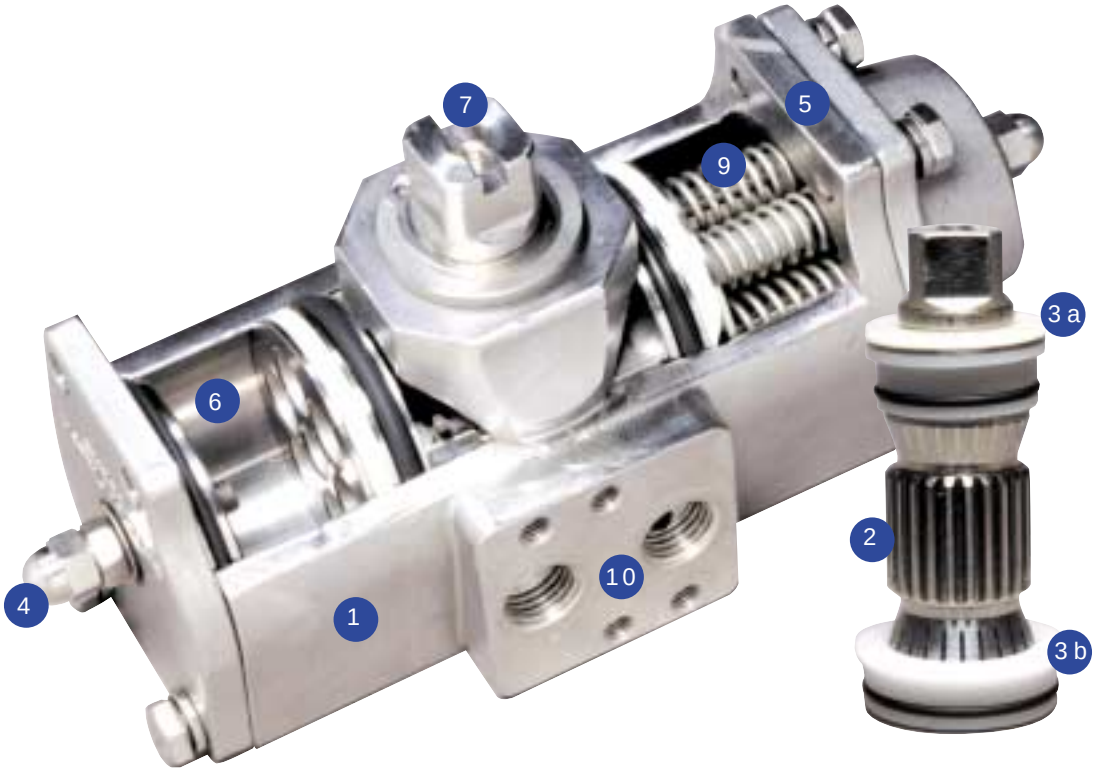
Material Specifications

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

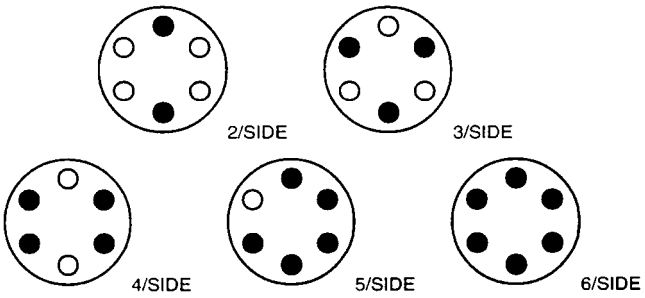
The Apollo® Acutorque actuator is manufactured with an integral and internal air manifold. The solenoid mounting pad is manufactured to Namur dimensional standards as to allow for the direct mounting of various manufacturers' solenoid valves and other flow control devices. For applications not requiring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

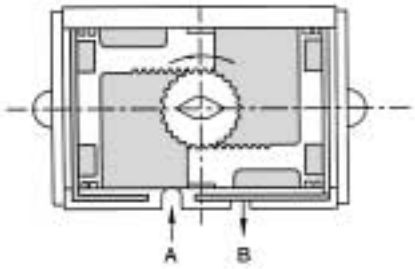
Spring Configuration

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.

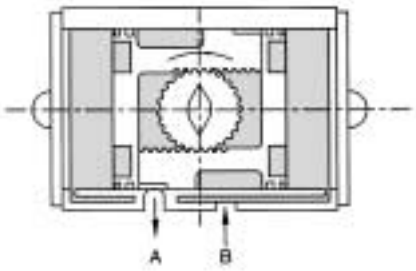


How the Actuator Works

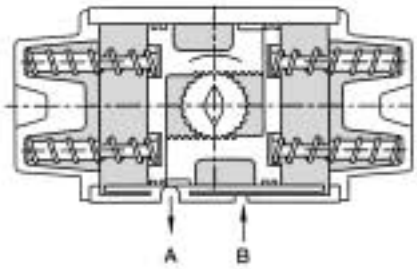
Air to PORT A - Pressure applied enters center of chamber forcing the pistons outward and rotating the drive pinion in a counter-clockwise direction and forcing exhaust air out of PORT B.



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.



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

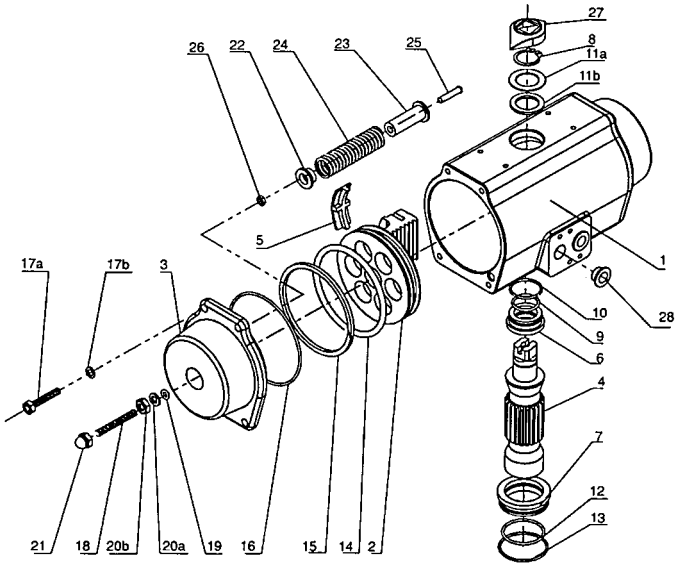
By using ISO/NAMUR standards, our actuators lend themselves to a host of various manufacturers' direct mount accessories. Solenoid valves, limit switches, positioners, etc. bolt directly to the actuator and in turn reduces the cost of assembly and installation of automated packages. Flexibility for future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

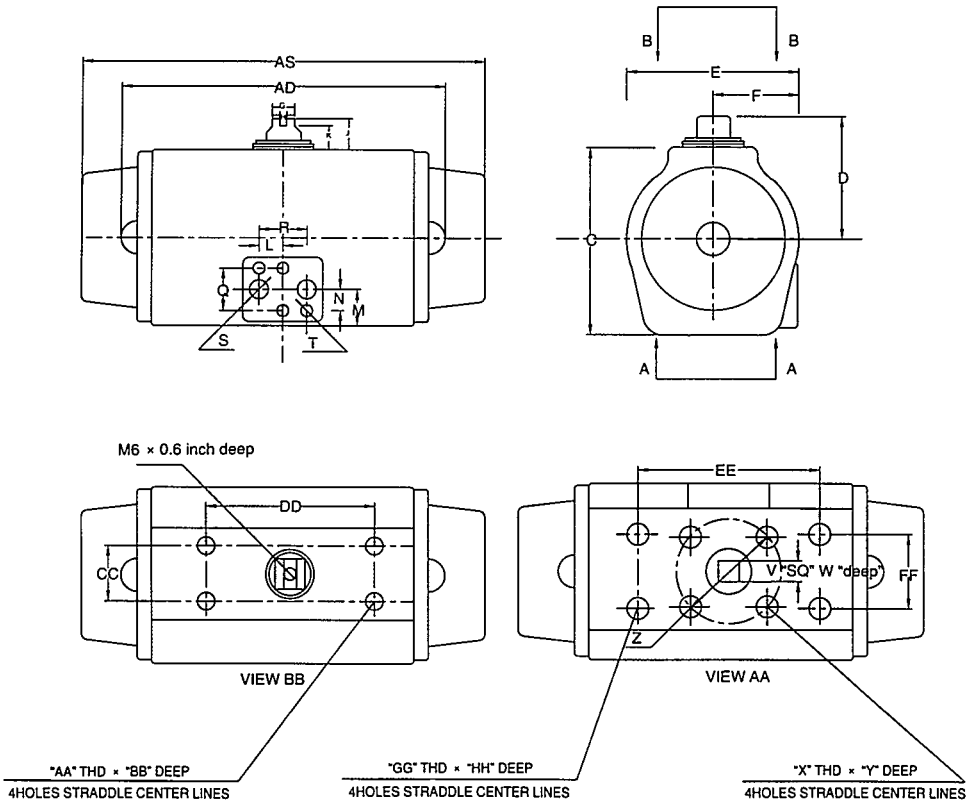
Safety

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	38 155	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

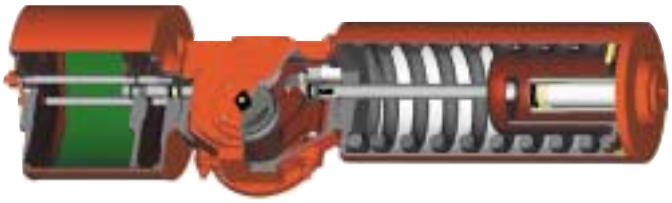
General Dimensions

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	1.98	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	0.19	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) 40		60		80		100		120		150		SPRING STROKE	
		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

Actuator Model	Stroke Position	Operating Pressure (psig)											
		40	50	60	70	80	90	100	110	120	150	175	200
		Output Torque (in-lbs)											
G0108	Start/End	12465	14543	16620	18698	20775	22853	24930	31163	36356	41550		
	Minimum			6579	7675	8772	9868	10965	12061	13158	16447	19188	21929
G0109	Start/End	10593	13241	15890	18538	21186	23835	26483	29131	31779	39724		
	Minimum	5591	6989	8386	9784	11182	12579	13977	15375	16772	20966		
G01010	Start/End	14046	17557	21069	24580	28092	31603	35115	38626				
	Minimum	7413	9266	11120	1973	14826	16680	18533	20386				
G01012	Start/End	20133	25166	30199	35232								
	Minimum	10626	13282	15938	18595								
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

Actuator Model	Stroke Position	Operating Pressure (psig)											
		40	50	60	70	80	90	100	110	120	150	175	200
		Output Torque (in-lbs)											
G2009	Start/End				22441	25647	28852	32058	35264	38470	48087	56102	
	Minimum			11844	13536	15228	16920	18612	20304	25379	29609		
G2010	Start/End		21254	25504	29755	34006	38257	42507	46758	51009			
	Minimum		11217	13461	15704	17948	20191	22434	24678	26921			
G2012	Start/End	24371	30464	36556	42649	48742	54835	60927					
	Minimum	12862	16078	19294	22509	25725	28941	32156					
G2014	Start/End	29636	37046	44455	51864	59273							
	Minimum	15641	19552	23462	27373	31283							
G2016	Start/End	39118	48897	58677									
	Minimum	20646	25807	30968									
G3010	Start/End				35888	41015	46142	51269	56396	61523	76903	89721	102538
	M inimum				18941	21647	24353	27059	29764	32470	40588	47352	54117
G3012	Start/End		36847	44216	51585	58955	66324	73693	81063	88432			
	Minimum		19447	23336	27226	31115	35004	38894	42783	46672			
G3014	Start/End	35887	44859	53831	62803	71775	80747	89719	98690				
	Minimum	18941	23676	28411	33146	37881	42616	47351	52087				
G3016	Start/End	47430	59288	71145	83003	94860							
	Minimum	25033	31291	37549	43807	50065							
G3020	Start/End	75266	94082										
	Minimum	39724	49654										

Spring Return G1 Pneumatic Actuator Torque Chart

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)											
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
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		
G1010-SR4	11614		6488	10000	13511	17023	20534	24046	27557				
	5708		2938	4804	6664	8518	10371	12224	14078				
	10015		4721	4232	11744	15255	18767	22278	25790				
G01012-SR4	11614	9063	14096	19130	24163								
	5708	4306	6973	9630	12286								
	10015	7296	12329	17362	22395								
G01014-SR4	11614	13413	19534	25654									
	5708	6613	9843	13073									
	10015	11646	17766	23887									
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
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		
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				
G01012-SR3	13598	7483	12516	17550	22583								
	6605	3289	5964	8634	11291								
	11445	5104	10137	15170	20203								
G01014-SR3	13598	11833	17954	24074									
	6605	5601	8848	12078									
	11445	9453	15574	21695									

G Series Actuators

Spring Return G1 Pneumatic Actuator Torque Chart

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)											
G0108-SR2	15526								8443	10521	16753	21947	27141
	7352								3692	4796	8109	10857	13598
	13037								5692	7770	14002	19196	24390
G0109-SR2	15526					6777	9425	12074	14722	17370	25315		
	7352					2800	4214	5622	7029	8437	12635		
	13037					4026	6674	3923	11971	14619	22564		
G01010-SR2	15526			6660	10171	13683	17194	20706	24217				
	7352			2736	4611	6477	8348	10202	12055				
	13037			3909	7420	10932	14443	17955	21466				
G01012-SR2	15526	5723	10756	15789	20823								
	7352	2228	4922	7597	10264								
	13037	2972	8005	13039	18072								
G01014-SR2	15526	10073	16194	22314									
	7352	4559	7811	11051									
	13037	7322	13443	19563									
G0108-SR1	18470									8599	14831	20025	25219
	8749									3364	6703	9463	12223
	14776									4516	10748	15942	21136
G0109-SR1	18470						7503	1152	12800	15448	23393		
	8749						2764	4207	5623	7030	11253		
	14776						3420	6069	8717	11365	19310		
G01010-SR1	18470				8249	11761	15272	18784	22295				
	8749				3174	5071	6937	8803	10669				
	14776				4166	7678	11189	14701	18212				
G01012-SR1	18470		8834	13868	18901								
	8749		3492	6190	8865								
	14776		4752	9785	14818								
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.

Spring-Return Actuator										
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)								
G2009-SR2	26818 12882 22074									14072 5964 8829
G2010-SR2	26818 12882 22074						13859 5848 8616	18810 8110 12866	22361 10369 17117	26611 12628 21368
G2012-SR2	26818 12882 22074			12159 4926 6915	18252 8185 13008	24344 11423 19101	30437 14661 25194	36530 17896 31286		
G2014-SR2	26818 12882 22071		12648 5191 7404	20057 9145 14814	27466 13082 22223	34875 17020 29632				
G2016-SR2	26818 12882 22074	14720 6308 9477	24500 11506 19256	34279 16703 29036						
G2009-SR1	30997 14742 25004									
G2010-SR1	30997 14742 25004							14871 5957 8248	19122 8249 12498	23373 10508 16749
G2012-SR1	30997 14742 25004					21106 9303 14482	27199 12541 20575	33291 15779 26668		
G2014-SR1	30997 14742 25004			16819 7014 10195	24228 10962 17604	31637 14900 25013				
G2016-SR1	30997 14742 25004		21261 9386 14638	31041 14583 24417						
G2009-SR4	20678 9903 16917						10155 4185 5998	13361 5900 9204	16567 7603 12410	19772 9307 15616
G2010-SR4	20678 9903 16917				11058 4675 6901	15308 6935 11152	19559 9194 15402	23810 11453 19653	28061 13712 23904	32311 15956 28155
G2012-SR4	20678 9903 16917		11766 5052 7609	17859 8290 13702	23952 11528 19795	30044 14760 25888	36137 17975 31980	42230 21191 38073		
G2014-SR4	20678 9903 16917	10939 4610 6782	18348 8550 14191	25757 12488 21600	33166 16407 29009	40575 20318 36419				
G2016-SR4	20678 9903 16917	20420 9652 16264	30200 14842 26043	39979 20003 35823						
G2009-SR3	24139 11457 19390								13833 5833 8584	17039 7539 11790
G2010-SR3	24139 11457 19390					12575 5150 7326	16826 7426 11577	21077 9685 15828	25327 11944 20078	29578 14203 24329
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.)

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)								
G2014-SR3	24139 11457 19390		15615 6782 10366	23024 10720 17775	30433 14657 25184	37842 18587 32593				
G2016-SR3	24139 11457 19390	17687 7883 12438	27467 13081 22218	37246 18273 31997						
G3010-SR2	49017 22571 36975									20655 6848 7346
G3012-SR2	49017 22571 36975						25456 9568 12147	32826 13568 19516	40195 17516 26886	47564 21433 34255
G3014-SR2	49017 22571 36975				21936 7591 8626	30907 12527 17598	39879 17349 26570	48851 22117 35542	57823 26885 44514	
G3016-SR2	49017 22571 36975			30278 12185 16968	42135 18548 28826	53993 24849 40683				
G3020-SR2	49017 22571 36975	34398 14422 21089	53215 24436 39905							
G3010-SR1	54045 25307 42224									
G3012-SR1	54045 25307 42224							27024 10497 13960	34394 14497 21329	41763 18420 28698
G3014-SR1	54045 25307 42224					25106 9456 12041	34078 14326 21013	43050 19104 29985	52022 23873 38957	
G3016-SR1	54045 25307 42224			24476 9107 11412	36334 15535 23269	48191 21837 35127				
G3020-SR1	54045 25307 42224	28597 11351 15532	47413 21423 34349							
G3010-SR4	36568 17123 28566							19695 7867 10851	24822 10637 15978	29949 13361 21105
G3012-SR4	36568 17123 28566				20012 8038 11168	27381 11996 18537	34751 15913 25906	42120 19830 33276	49489 23746 40676	56858 27663 48014
G3014-SR4	36568 17123 28566			22258 9257 13414	31239 14042 22385	40201 18810 31357	49173 23578 40329	58145 28347 49301	67117 33089 58273	
G3016-SR4	36568 17123 28566	15857 5764 7013	27714 12174 18870	39572 18475 30728	51429 24777 42585	63287 31068 54443				
G3010-SR3	42128 19573 32379								20609 7746 9833	25735 10528 14960
G3012-SR3	42128 19573 32379					23167 9135 12392	30537 13115 19761	37906 17032 27130	45275 20949 34500	52645 24865 41869
G3014-SR3	42128 19573 32379			18044 6305 7268	27016 11223 15240	35988 16012 25212	44960 20781 34184	53931 25549 43156	62903 30317 52127	
G3016-SR3	42128 19573 32379		23501 9315 12725	35358 15678 24582	47216 21980 36440	59073 28282 48297				
G3020-SR3	42128 19573 32379	39479 17868 28703	58295 27868 47519							

AE Actuator

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

Five Output Torques, One Housing

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

Easy To Use

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

Many Standard Features

- Stainless steel push-and-turn manual override shaft, position indicator shaft and female output
- ISO 5211 F07 drive output reduces inventory of mounting kits
- 115 AC & 220 AC models feature a 25% duty cycle below 100˚F (24AC — 20% duty cycle below 100˚F)
- 12 and 24 DC — all DC voltage models provide 100% duty cycle
- Reversible rotation

Broad Temperature Range

- Operates from -40˚F (when equipped with heater and thermostat) to 150˚F

Available Options

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

AE Series Numbering System

AE - X - X X X X

TORQUE
200
400
600
800
1000
Enter all digits of Torque Value

VOLTAGE
1 – 115 vac
2 – 24 vac
3 – 220 vac
4 – 12 vdc
5 – 24 vdc

OPTIONS
0 – Standard
A – One extra switch & cam
B – Two extra switches & cams
C – Three extra switches and cams
D – Heater and Thermostat
E – Single Potentiometer
F – Motor Brake (115 VAC & 24 VAC Only)

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

Example:

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

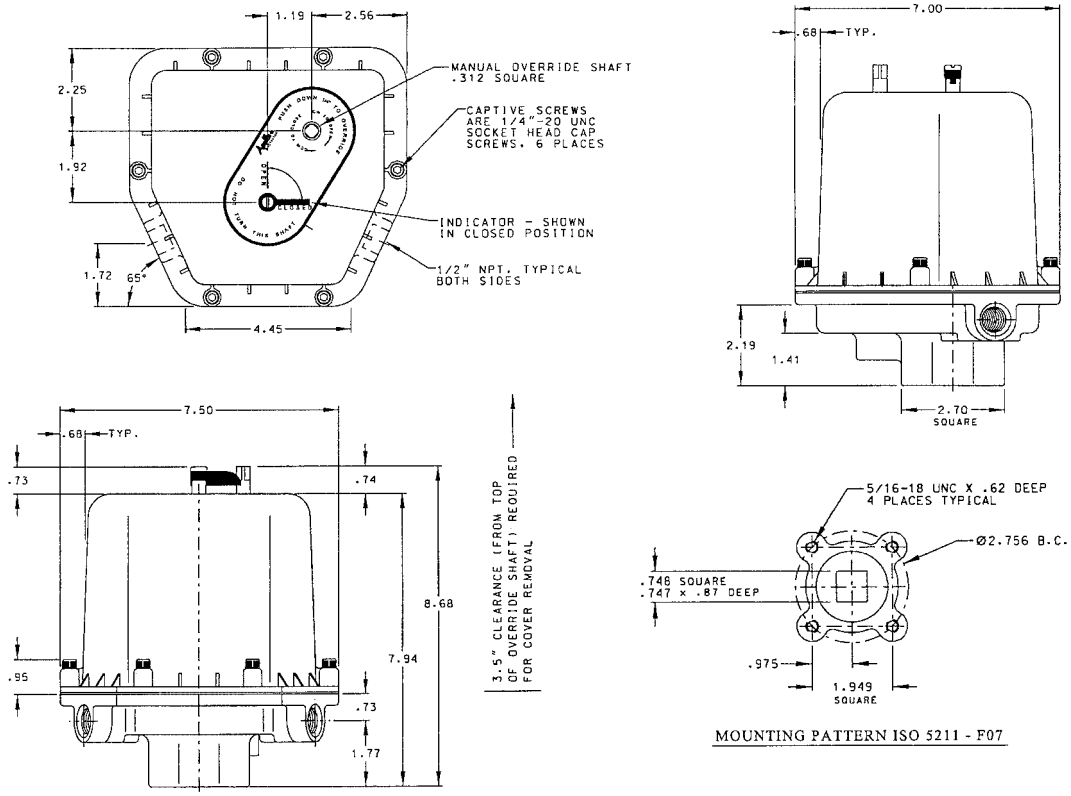
AE Actuator General Specifications

Actuator Model	Breakaway Torque Output (in.-lbs.)	Cycle Time 90˚ Travel (50% Load)	Duty Cycle	Amperage Draw (max.) Starting or locked rotor current voltage 115 VAC	230 VAC	12 VDC	24 VDC
AE200	200 in-lbs	5.0 sec.	25%	.74 amp	.44 amp	2.00 amp	1.38 amp
AE400	400 in-lbs	10.0 sec.	25%	.74 amp	.44 amp	2.00 amp	1.38 amp
AE600	600 in-lbs	15.0 sec.	25%	.74 amp	.44 amp	2.00 amp	1.38 amp
AE800	800 in-lbs	20.0 sec.	25%	.74 amp	.44 amp	2.00 amp	1.38 amp
AE1000	1000 in-lbs	25.0 sec	25%	.74 amp	.44 amp	2.00 amp	1.38 amp

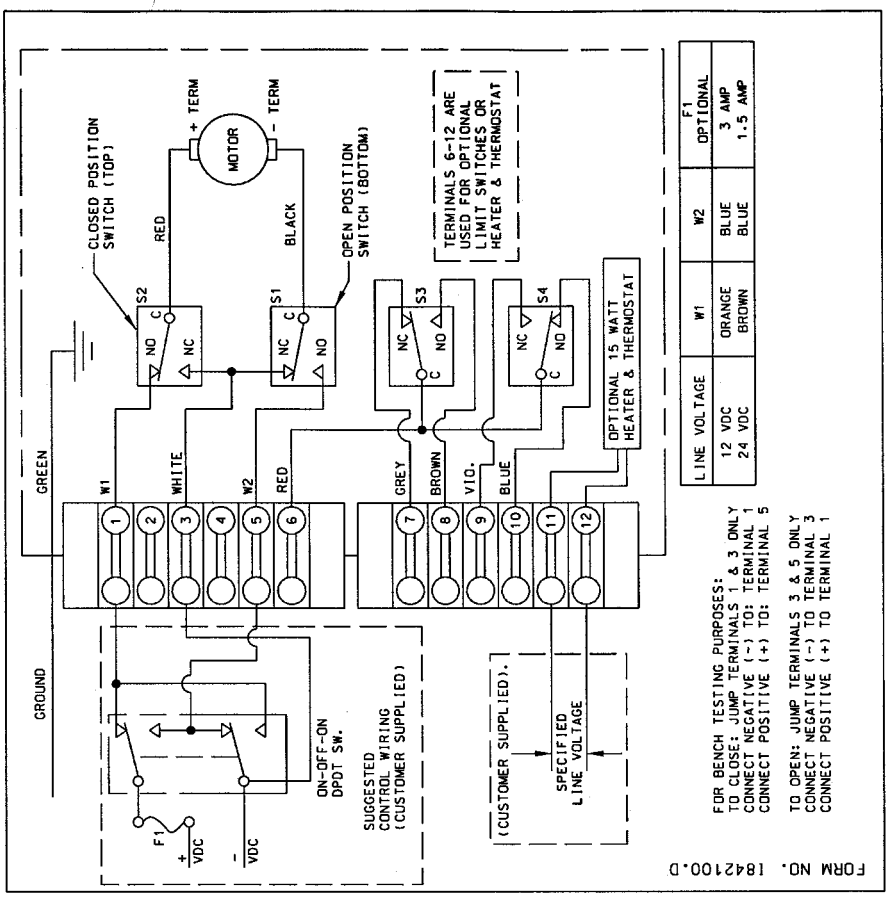
Note: 90˚ Travel = Travel From Closed position to Open position or vice versa

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

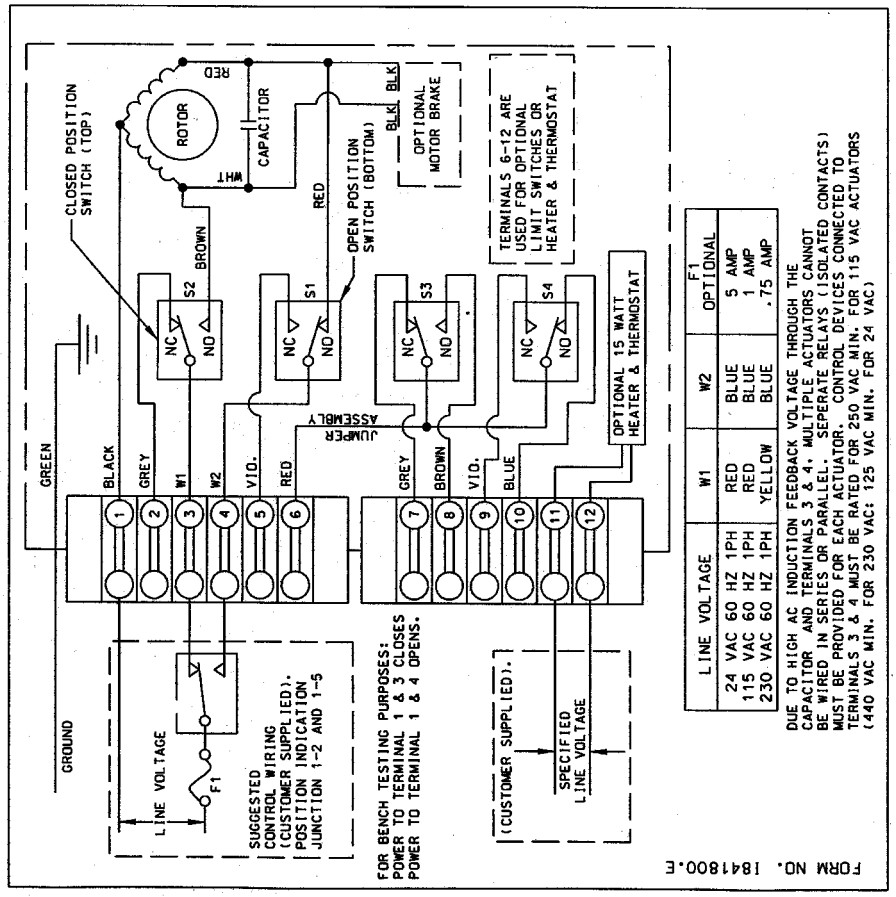
AE Dimensions



AE Series Actuators



12/24 VDC Wiring Diagram



115/230 VAC Wiring Diagram

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/thermostat 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.

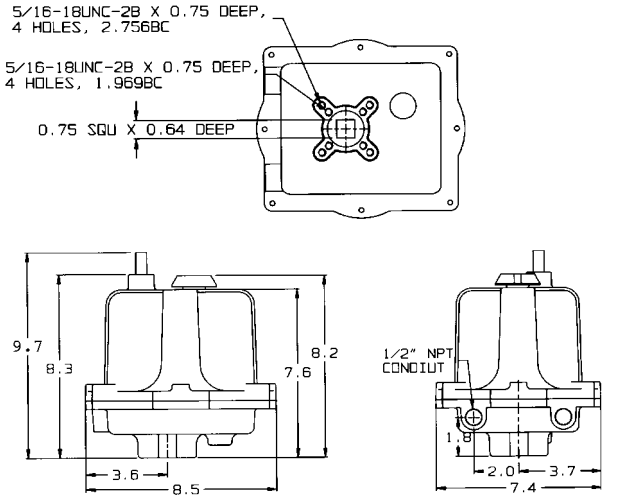
Limit Switches and Feedback Pots with Flying Leads

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).

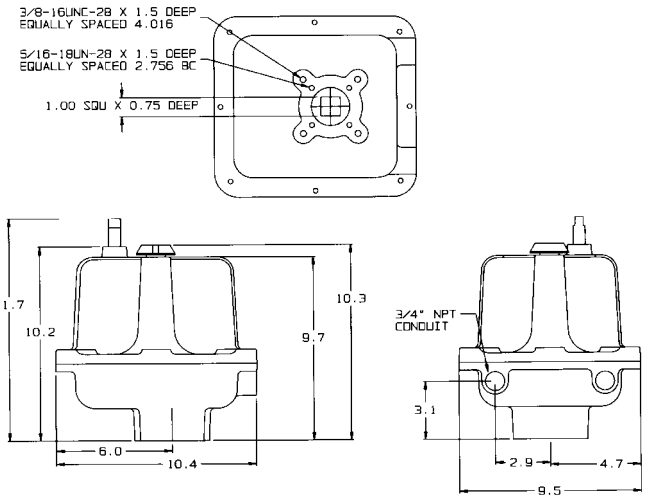
Speed Control with a Positioner?

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" is a totally mechanical failsafe arrangement with true spring return back up power. Contact factory for

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:
1. 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.
2. 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.
3. 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.

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

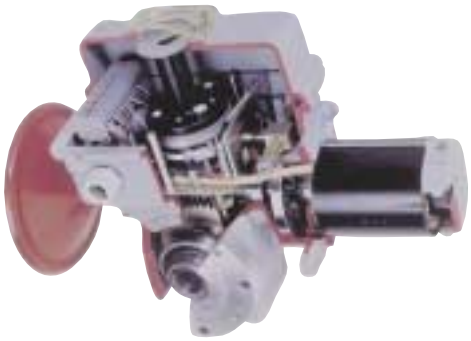
CONTROL OPTIONS*

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

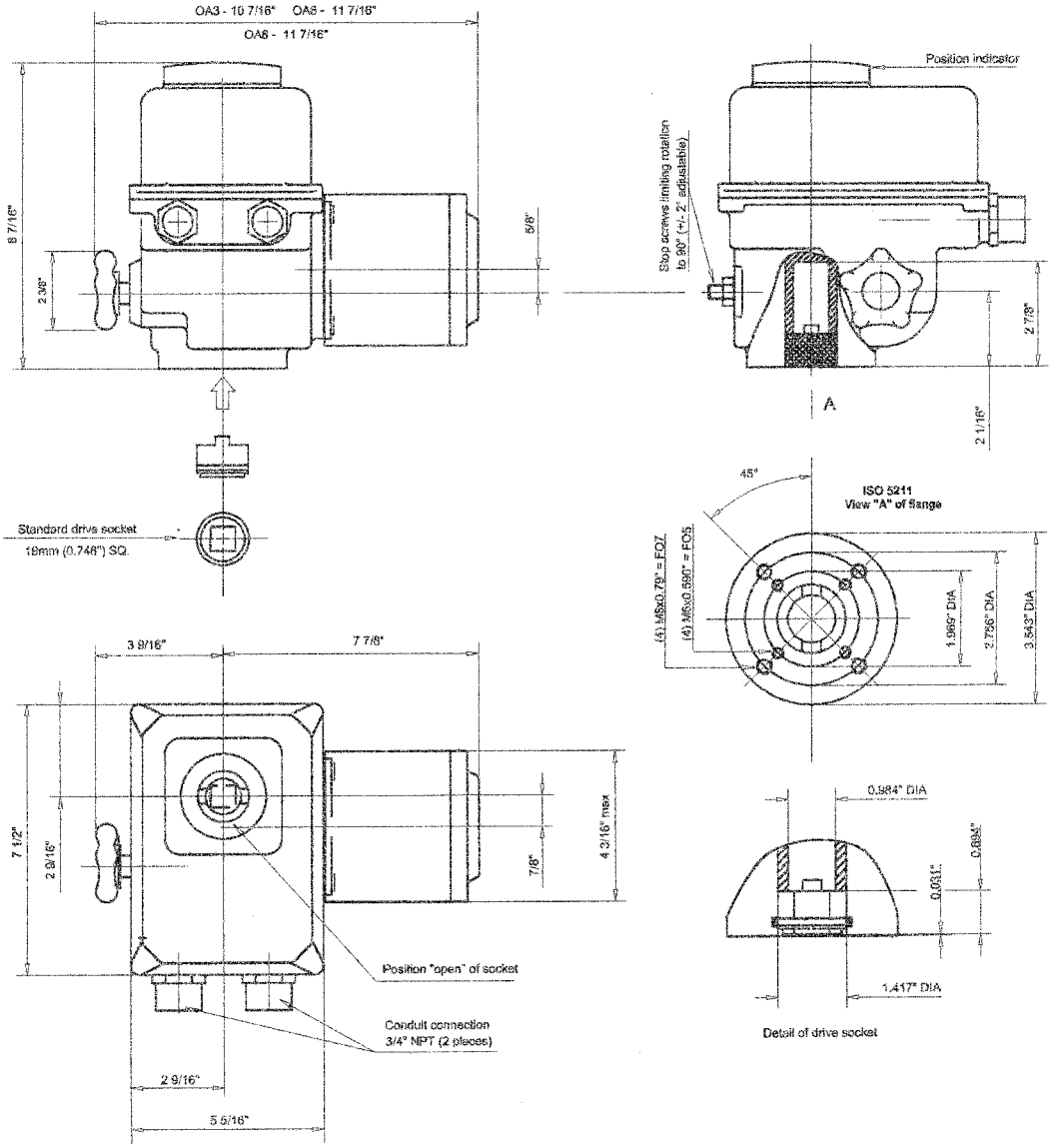
L-B Series Model Number	Torque Output Lb-In	Rotating Speed (Sec/90˚)		Power Requirements 30% Duty Cycle 115VAC 1 Ph 60Hz460 VAC 3 Ph 60 HZ			
		Std	Opt	RATED	START	RATED	START
OA6	530	5		1.95	3.3	0.39	0.78
OA8	720	5		1.95	3.3	0.63	1.15
OA8	720	25	50	1.25	2	0.39	0.78
OA15	1,350	15	25	1.95	3.3	0.39	0.78
AT18	1,600	4		4.6	12	0.45	1.8
AT25	2,250		4	6.2	8	0.9	2
AT25	2,250	15		1.95	3.3	0.63	1.15
ATP25	2,250	25	50	1.95	3.3	0.39	0.78
AT50	4,500	25	50	4.6	12	0.63	1.15
AT80	7,000	25	50	6.2	8	0.63	1.15
BT50	4,500	8,1Ph	6,3Ph	5	7.5	0.85	2.6
BT50	4,500	16,1Ph	12,3Ph	4.6	12	0.63	1.15
BT100	9,000		25	6.2	8	0.63	1.15
BT	9,000	50		4.6	12	0.63	1.15
BT100	9,000		100	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 except for model Z3 which has a 20% duty cycle-10 minute operation, 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 additonal 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 overide.
- All actuators have both electrical and mechanical travel stop provisions.
- **FQ Series are Spring Return Failsafe models. Contact factory for model number and price.**

LB Series Electric Actuators

Types OA3, OA6 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

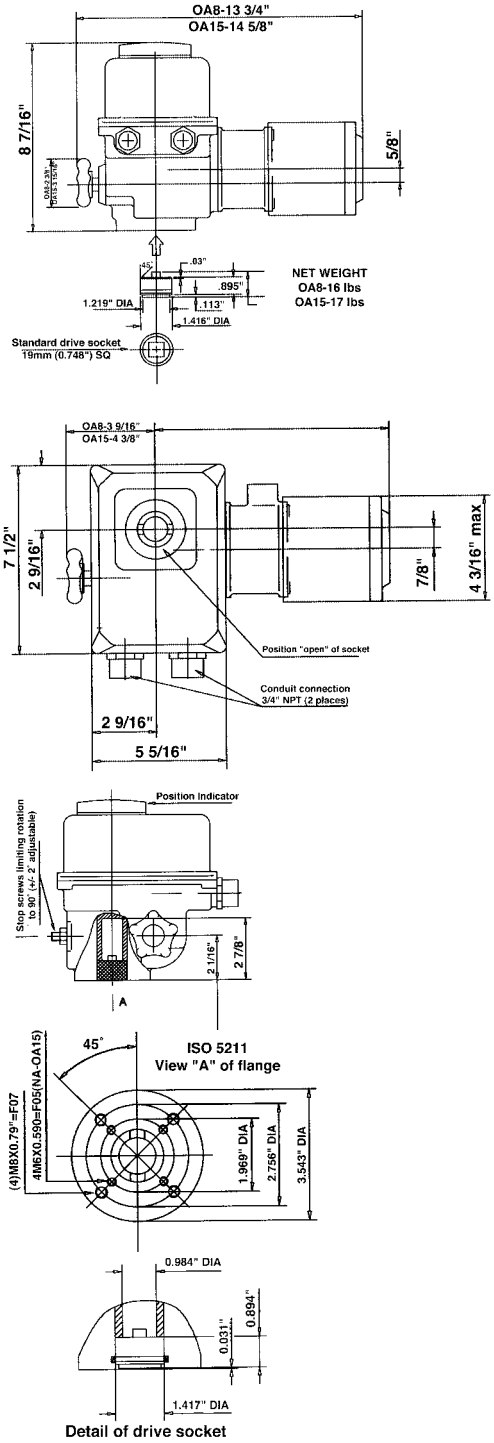
Net Weight

OA3 - 12 lbs
OA6 - 13 lbs
OA8 - 15 lbs

LB Series Dimensions

Types OA8 and OA15

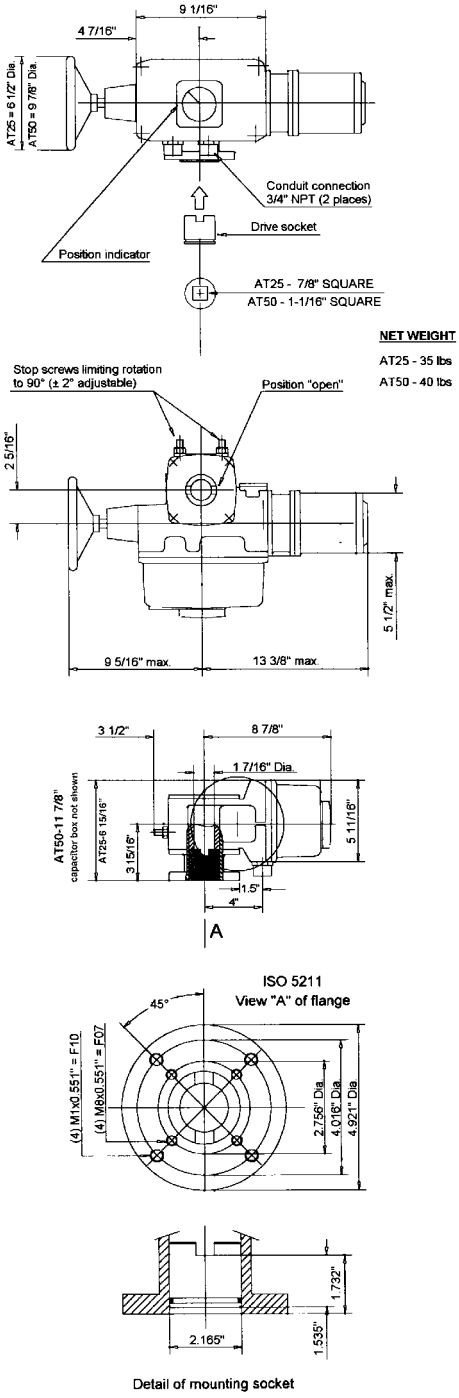
Standard specification: Weatherproof NEMA 4, with two adjustable SPDT limit switches; with built-in motor thermal cutouts, with handwheel for manual operation. Duty rating 30%.



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.

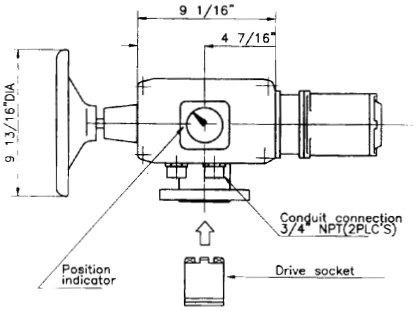


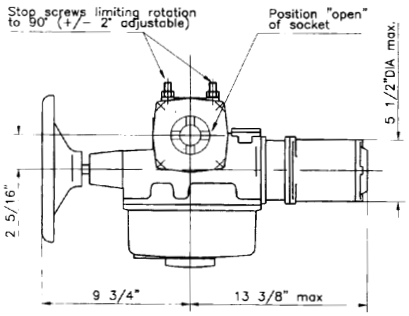
AT25 female socket dimension = .866 square
AT50 female socket dimension = 1.063 square

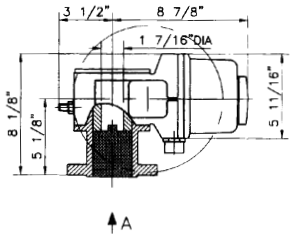
LB Series Dimensions

Type AT80

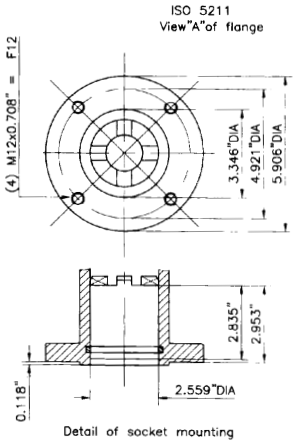
Standard specification: Weatherproof to NEMA 4, fitted with two adjustable SPDT travel limit switches (one for each extreme position); two SPDT torque limit switches (one for each direction of rotation) and with handwheel for manual operation. Duty rating 30%. Net weight: 44 lbs.

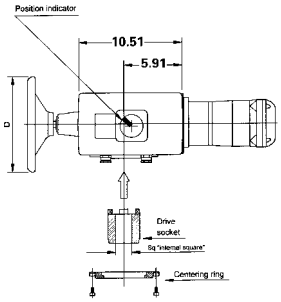


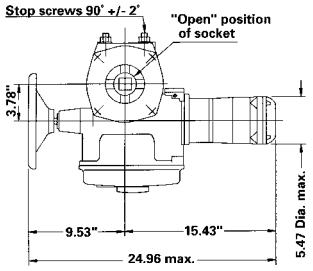


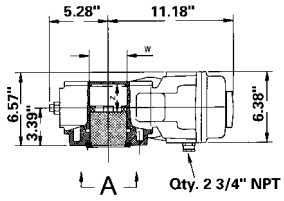


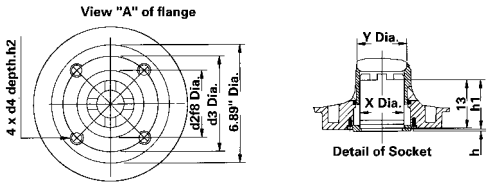
A











Type	D	W	X	Y	Z	I3	h1
BT50	6.5	2.64	2.56	1.58	2.6	2.84	2.91
BT100	9.84	3.35	3.23	2.36	2.52	2.99	3.01
BT150	9.84	3.35	3.23	2.36	2.52	2.99	3.01
Type	h	d3	d2f8	d4	h2	Sq.	Weight
BT50	0.12	4.92	3.35	M12	0.59	1.063	60 lbs.
BT100	0.16	5.51	3.94	M16	0.79	1.417	60 lbs.
BT150	0.16	5.51	3.94	M16	0.79	1.417	64 lbs.

Types BT50, BT100, and BT150

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%.

Female socket dimension = 1.063 square

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.

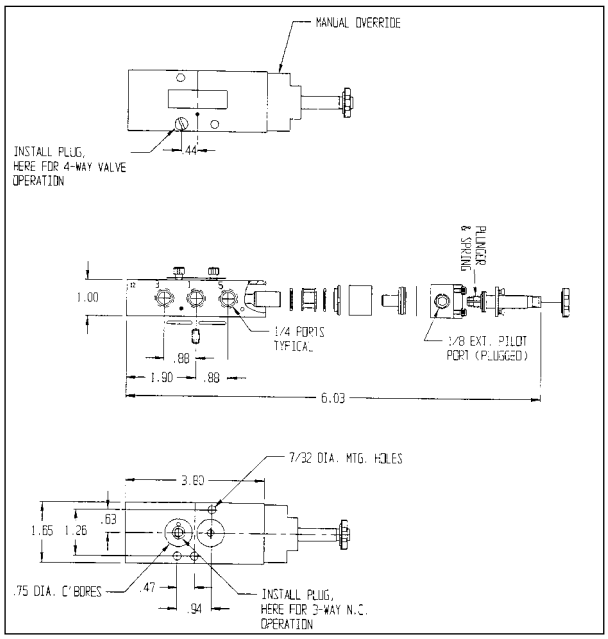
Power Consumption: 6 Watts

Materials:

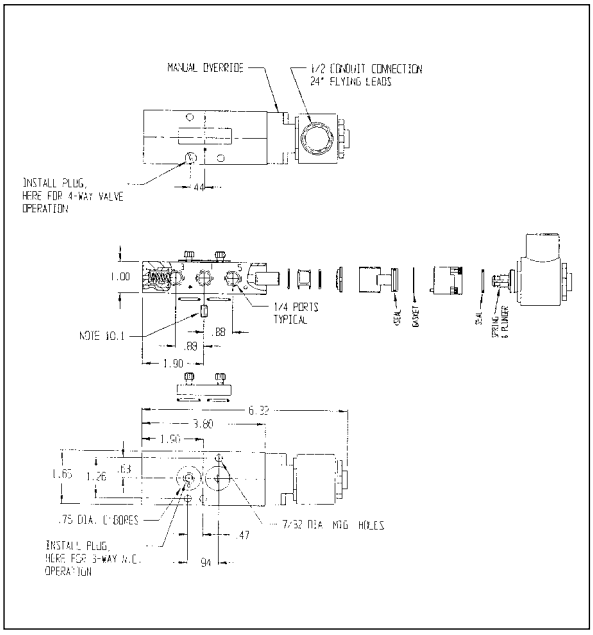
Valve Body=Aluminum, anodized.
Fasteners=Stainless Steel
Seals & O-Rings=Nitrile.

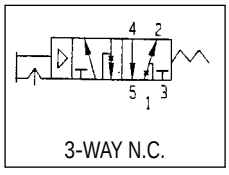
Cv flow rate = 1.8

NEMA 4-4X

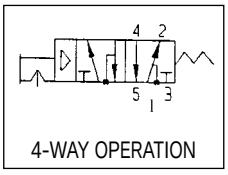


NEMA 4, 4X, 7 & 9 UL&CSA

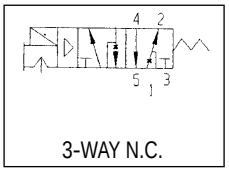




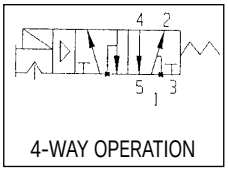
3-WAY N.C.



4-WAY OPERATION



3-WAY N.C.



4-WAY OPERATION

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 90º"				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, TouchSetTM 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™

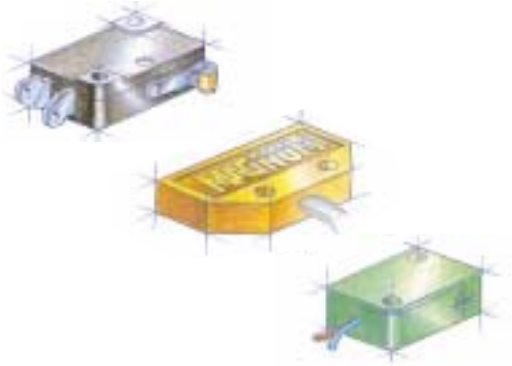
Beacon™ II Ektar

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™

AccuTrakTM 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 Acess 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[1] Polycarbonate
Cover Material	Calibre[1] 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

1 Calibre is a Registered Trade Mark of the Dow Chemical Company

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

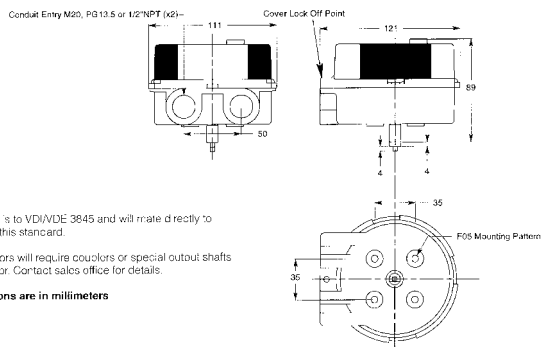
Sensor/Communication Module Ratings

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 potientiometers (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	**All Mechanical**
5 Years	**Maxx-Guard Sensors**

Maxx-Guard Specifications

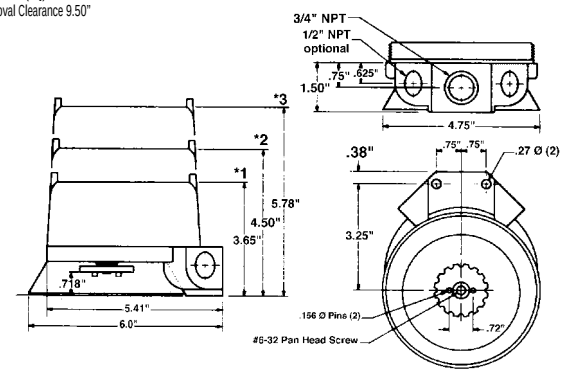
Sensors:	SPST	SPDT
Typical Operate Time	1.0 millisecond	3.0 millisecond
Contact Composition	Ruthenium	Tungsten
Temperature Range	-40˚ to 82˚C	-30˚ to 82˚C
	(-40˚ to 180˚F)	(-23˚ to 180˚F)
Seal	Hermetically Sealed	Hermetically Sealed
Leakage Current	None	None
Operating Life	10,000,000 Cycles	10,000,000 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 Liniarity 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"



VRC Positioners

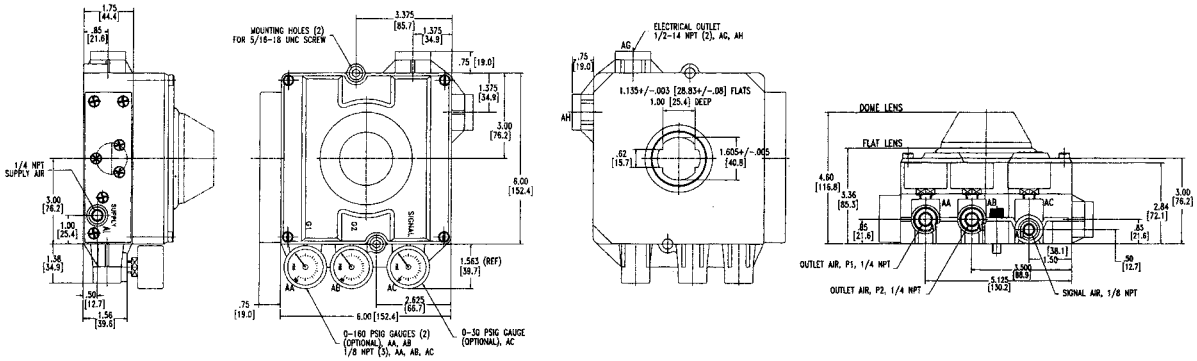
Performance

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

Construction

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

Dimensional Diagrams



Model Number Specifications

Required Selections	Optional Selections											
Model Type	**Position Indicator**		**Characterizing Cam**		**Spool Valve**		**Port Gauges**		**Position Transmitter**		**Limit Switch**	
VP Pneumatic	Flat 90˚	7	Linear	0	Standard	0	Brass	G	4-20 MA	T1	Mechanical	S1
3-15 psig	Flat 180˚	8	Square Root	1	Maximum	1	Stainless	Z	1 Kohm	T2	(2) SPDT	
VE	Dome 90˚	9	Square	2	Extreme Service Standard Flow	2					Proximity	S2
Electro-Pneumatic			0-60˚	3	Extreme Service Max. Flow	3					(2) SPST	
4-20 MA			Equal Percent	4								
VI			Custom	5								
Electro-Pneumatic			Tangent	6								
General Purpose & Hazardous Locations			0-45˚	7								

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

Note: See Price List for Cii Part Numbers

PMV Positioners

Features & Benefits

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

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

Product Specifications

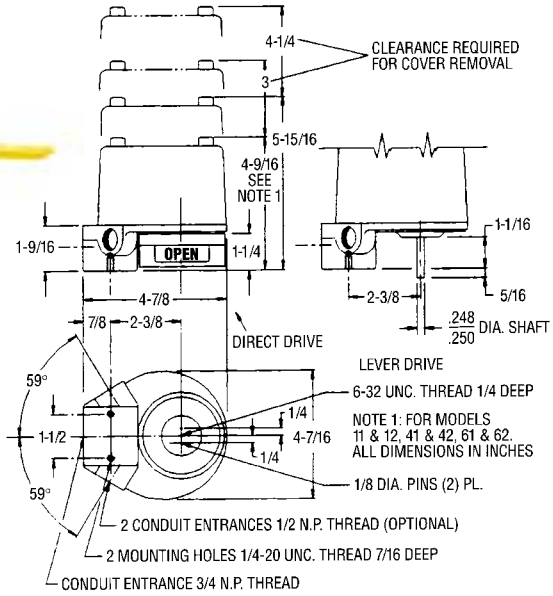
	P1200/20	P1500/20	P2000/20	P5/EP5*
Connections:	1/4”	1/8”	1/4”	1/4”
Supply Pressure:	150 psig	150 psig	120 psig	145 psig
Hysteresis:	.7%	.7%	.5%	.5%
Linearity:	1.0%	.5%	2.0%	.5%
Repeatability:	.5%	.5%	.5%	.5%
Sensitivity:	.4%	.3%	.5%	.25%
Input Signal:	3-15/6-30	3-15/6-30	4-20 mA	3-15, 4-20mA
Temperature - 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.

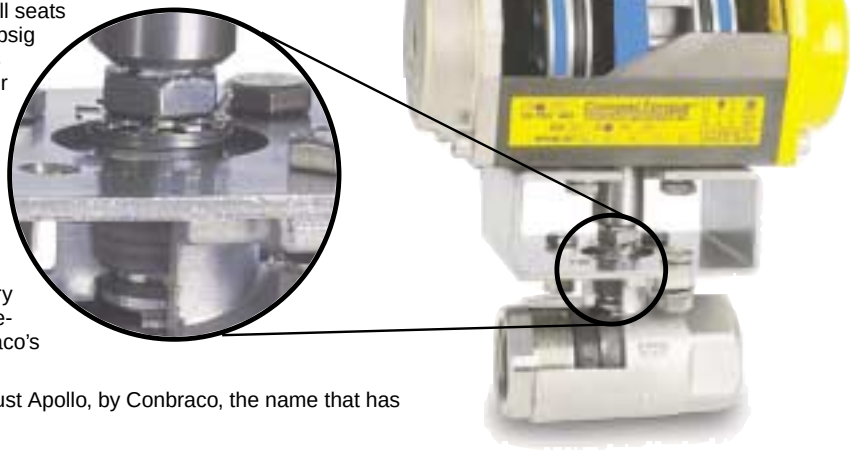
** Conbraco maintains the 12ADO in stock, Conbraco part number with indicator M-1161-00 and without indicator M-1059-00.

APOLLO®

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).

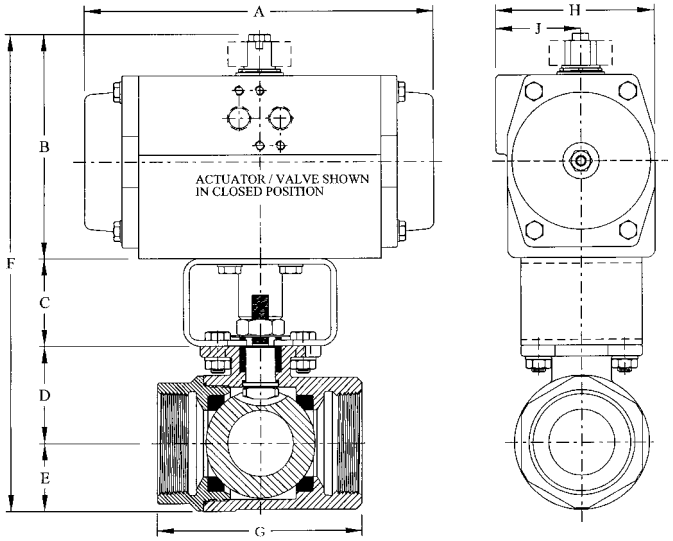


Get a Complete American Made Package

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

Apollo® Actuator Ready (AR) Ball Valve

Construction Materials			
DESCRIPTION	**BRONZE (71 & 77 AR) STEEL**	**CARBON STEEL (89 AR)**	**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 *SIZES 1 1/2" AND LARGER	302 SS	302 SS	302 SS

CV Factors

77-ARX-64

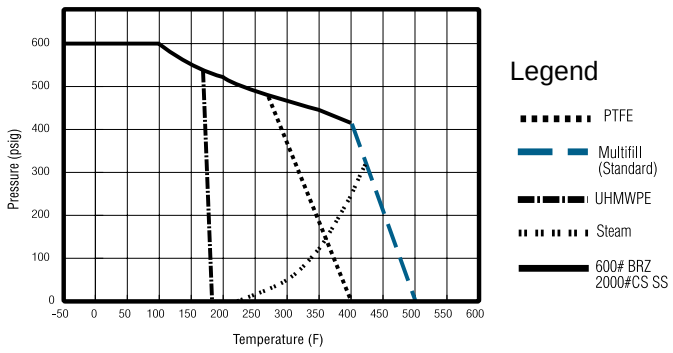
SIZE		1/4"	3/8"	1/2"	3/4"	1"	1-1/2"	2"
OPEN	90˚	8.1	15	15	51	68	177	389
DEGREE ROTATION	80˚	6.9	11	11	31	44	108	195
	70˚	4.2	6.1	5.4	15	24	52	92
	60˚	2.5	3.4	3.2	8.3	13	30	54
	50˚	1.4	2.0	1.9	4.4	7.5	17	31
	40˚	0.8	1.0	1.0	2.5	4.0	9.3	16
	30˚	0.4	0.4	0.4	1.1	2.1	4.7	7.8
	20˚	0.1	0.1	0.1	0.2	0.5	1.3	2.1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

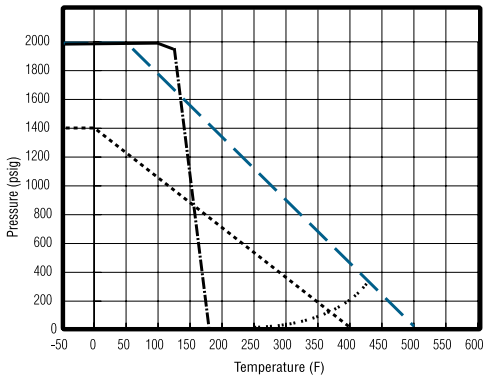
SIZE		1/4"	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"
OPEN	90˚	8.4	7.2	15	30	43	48	84	108	503	370
DEGREE ROTATION	80˚	5.3	4.6	9.3	17	28	33	54	75	316	225
	70˚	2.5	2.4	5.0	9.0	16	19	31	44	167	137
	60˚	1.2	1.2	2.9	5.1	9.2	12	20	28	86	84
	50˚	0.6	0.6	1.8	2.9	5.8	7.6	12	17	55	54
	40˚	0.2	0.2	1.0	1.5	3.1	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

SERIES	SIZE	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	"	"	"	10.91	"	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

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

76 & 89 Series

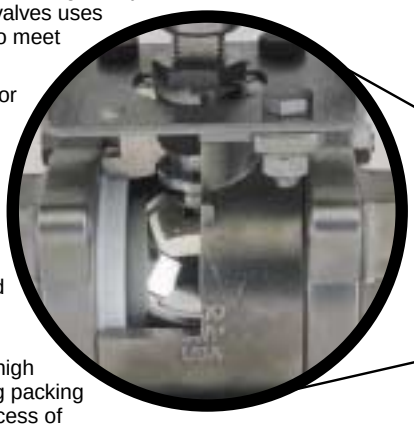
71, 76 & 89 Series

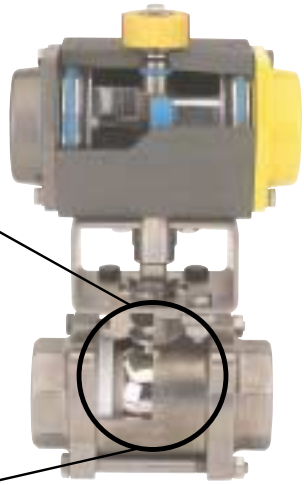
77 Series

APOLLO®

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® steel valves that's right for you. Meet the new Apollo® 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.





New Design!

The Apollo® 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® 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® 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® 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® quality assurance. Every valve is fully tested and inspected to MSS and Apollo® standards before being prepared for shipment.

A Perfect-Fit Replacement For Current Apollo® Installations

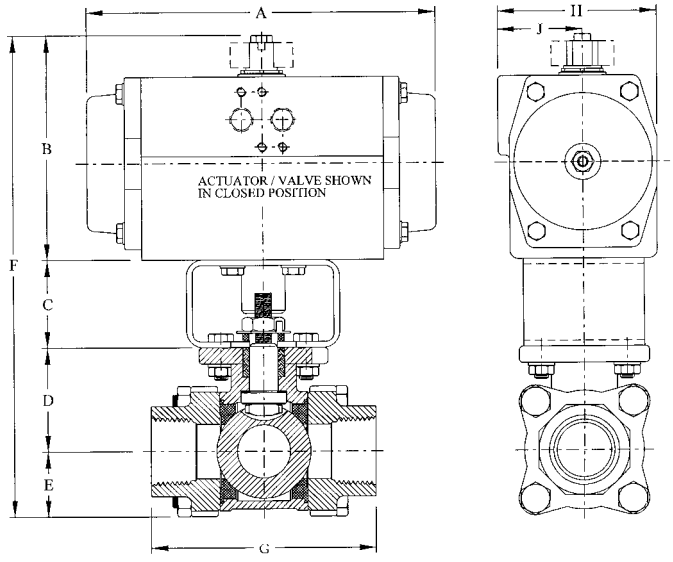
Here's more good news for current users of Apollo® three piece valves! The new Apollo® three piece ball valve is completely interchangeable with the body sections of our previous 83, 85 and 86 Series models. The end-to-end dimensions are unchanged. The bolting is the same. The body center section will 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® 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-CF8M
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.

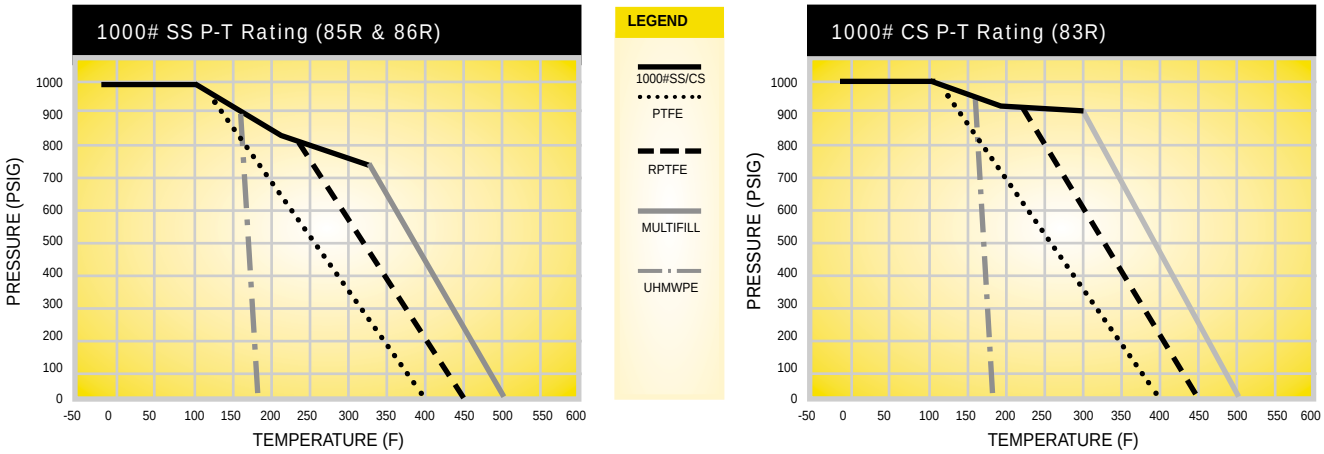
Apollo® Actuator Ready 3-Piece Ball Valve

CV Factors

83R-100, 83R-200, 83R-700, 86R-100, 86R-200 & 86R-700 Series									
SIZE		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
	10°	0	0	0	0	0	0	0	0
CLOSED	0°	0	0	0	0	0	0	0	0

85R-100 & 85R-200 Series						
SIZE		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
	10°	0	0	0	0	0
CLOSED	0°	0	0	0	0	0

Pressure-Temperature Charts



How To Order

X X X - X O X - X X

FIGURE NUMBERS
83R Carbon Steel Full Port
85R Stainless Steel Std. Port
86R Stainless Steel Full Port

END CONNECTIONS
1 - Threaded
2 - Socket Weld
7 - Butt Weld*
* Not Available
With 85R Series

SIZE **
1 - 1/4"
2 - 3/8"
3 - 1/2"
4 - 3/4"
5 - 1"
6 - 1-1/4"
7 - 1-1/2"
8 - 2"
** 85R available
in 3/4" to 2"

VARIATIONS
4 - 316 SS Trim (83R Series)

OPTIONS AVAILABLE

-Ø2	GROUNDED
-Ø3	1 1/4" EXT. STEM
-Ø4	2 1/4" EXT. STEM
-10	SS LEVER & NUT (83R SERIES)
-14	VENTED BALL (UNIDIRECTIONAL)
-21	UHMWPE SEATS (GRAPHITE PACKING)
-24	GRAPHITE STEM PACKING
-27	SS LATCH LOCK LEVER
-35	VIRGIN TFE TRIM (PTFE)
-39	SS EXT'D. LOCKING ROUND HANDLE
-57	CLEANED FOR OXYGEN SERVICE (85R & 86R ONLY)
-59	SS EXTERNAL TRIM (83R SERIES)
-60	GROUNDED BALL & STEM
-62	CENTER SECTION ONLY
-63	NPT X SOCKET WELD
-PØ1	BSPP (PARALLEL) THREAD CONNECTION
-TØ1	BSPT (TAPERED) THREAD CONNECTION
-AR	LEVER AND STOP REMOVED, BELLEVILLE WASHERS ADDED, SEATS CHANGE TO MPTFE (MULTIFILL)
-WB	STANDARD VALVE WITH BELLEVILLE WASHERS ADDED

Dimensions (with Apollo® CompacTorque™ Actuator)

SERIES	SIZE	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.**

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.

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	1,000	1,500	2,000
Valve Model	Size								
*STD PORT **71-ARX-64 89-ARX-64 76-ARX-64	1/4 - 1/2	25	26	27	28	30	32	35	38
	3/4	50	50	52	54	57	60	64	72
	1	85	86	88	90	94	97	110	138
	1-1/4	140	140	145	156	160	172	194	
	1-1/2	160	164	173	186	195	201	235	
	2	220	230	258	270	310	350	460	
	2-1/2	450	495	576	680	790	900		
	3	500	540	700	820	920	1030		
*FULL PORT **77-ARX-64	1/4 - 1/2	25	26	27	28				
	3/4	50	54	60	70				
	1	140	148	160	180				
	1-1/2	290	300	310	340				
	2	340	355	420	563				

* Torques tested with multifilled seats. Does not require torque adjustment of -20%.
** 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	1,000	1,500
Valve Model	Size						
STD PORT	1/4 - 1/2	35	35	40	43	46	48
70-64X	3/4	50	50	54	59	62	64
71-14X	1	101	101	103	106	116	130
76-10X	1-1/4	171	171	205	216	246	286
76-60X	1-1/2	192	192	216	265	280	311
89-14X	2	271	271	276	300	309	354
399-10X	2-1/2 & 3	715	715	790		1,200	
FULL PORT BRONZE 77-14X	1/4 - 1/2	35	35	40			
	3/4	74	74	84			
	1	234	234	250			
	1-1/4	286	286	321			
	1-1/2	357	357	398			
	2	650	650	722			
	2-1/2 & 3	715	715	790			
STD PORT 3-PIECE 83-34X & 44X 85R-10X & 20x	1/2	35	35	40	43	46	48
	3/4	78	78	90	123	140	157
	1	156	156	178	201	229	257
	1-1/4	208	208	230	248	282	317
	1-1/2	234	234	276	309	352	395
	2	350	350	390	450	513	576
FULL PORT 3-PIECE 82-14X & 24X 83R-14X, 24X & 74X 83-54X & 64X 86R-10X, 20X & 70X 86-50X & 60X 401-10X	1/4 - 1/2	78	78	90	123	140	157
	3/4	156	156	178	201	229	257
	1	208	208	230	248	282	317
	1-1/4	234	234	276	309	352	395
	1-1/2	350	350	390	450	513	576
	2	715	715	755	800	912	1,024
	3	1,030	1,030	1,087	1,148	1,212	
	4	1,830					

Torque Constants for Apollo® Flanged Ball Valves

Torques Shown in lb-in. — Pressure (psig)

Valve Series	Valve Size	0	100	200	300	400	500	600	700	740
87A-100's	1-1/2" SP 150	122	125	127	129					
88A-140's	2" SP 150	293	298	302	311					
	2-1/2" SP 150	280	286	291	312					
	3" SP 150	342	355	367	380					
	4" SP 150	1,032	1,062	1,092	1,122					
	6" SP 150	1,692	1,752	1,812	1,872					
	8" SP 150	1,800	2,050	2,300	2,550					
	10" SP 150	6,600	7,000	7,400	8,350					
87A - 200's	1/2" FP 150	32	32	32	32					
88A - 240's	3/4" FP 150	58	58	58	58					
	1" FP 150	122	125	127	129					
	1-1/2" FP 150	293	298	302	311					
	2" FP 150	280	286	291	312					
	2-1/2" FP 150	342	355	367	380					
	3" FP 150	1,032	1,062	1,092	1,122					
	4" FP 150	1,692	1,752	1,812	1,872					
	6" FP 150	1,800	2,050	2,300	2,550					
	8" FP150	6,600	7,000	7,400	8,350					
87A - 700's	1-1/2" SP 300	122	125	127	129	131	141	151	173	182
88A - 740's	2" SP 300	293	298	302	311	326	339	351	365	371
	2-1/2" SP 300	280	286	291	312	332	343	361	382	391
	3" SP 300	342	355	367	380	393	410	426	441	447
	4" SP 300	1,032	1,062	1,092	1,122	1,152	1,212	1,272	1,377	1,452
	6" SP 300	1,692	1,752	1,812	1,872	1,932	1,992	2,052	2,181	2,232
	8" SP 300	1,800	2,050	2,300	2,550	2,800	3,300	3,800	4,900	6,000
	10" SP 300	6,600	7,000	7,400	8,350	9,300	10,300	11,300	12,650	14,000
87A - 900's	1/2" FP 150	32	32	32	32	32	32	32	32	32
88A - 940's	3/4" FP 150	58	58	58	58	58	58	58	58	58
	1" FP 300	122	125	127	129	131	141	151	173	182
	1-1/2" FP 300	293	298	302	311	326	339	351	365	371
	2" FP 300	280	286	291	312	332	343	361	382	391
	2-1/2" FP 300	342	355	367	380	393	410	426	441	447
	3" FP 300	1,032	1,062	1,092	1,122	1,152	1,212	1,272	1,377	1,452
	4" FP 300	1,692	1,752	1,812	1,872	1,932	1,992	2,052	2,181	2,232
	6" FP 300	1,800	2,050	2,300	2,550	2,800	3,300	3,800	4,900	6,000
	8" FP 300	6,600	7,000	7,400	8,350	9,300	10,300	11,300	12,650	14,000

Note (1) Constants are used to determine the in-service torque requirements of Conbraco's valves.
Note (2) Constants are based on RPTFE seats and clean dry air at the stated differential pressure.

Torque Constants For Top Entry Valves (1)

Seat Options	Valve Size	Differential Pressure (psig) 100	285	500	740	1,480
1 7	1/2 thru 1	85	110	140	180	290
	1-1/2	205	260	330	415	660
2 A	2	350	430	550	735	1,200
	3	950	1,250	1,650	2,000	3,200
3 C	4	2,000	2,500	3,300	4,100	6,500
	6	5,300	6,700	8,200	11,400	18,000
5 D U	8	11,000	14,000	18,500	25,000	36,000
6 Z	10	18,500	22,000	30,000	40,000	62,000
	1/2 thru 1	115	160	210	260	450
4	1-1/2	270	370	480	590	1,000
8	2	475	650	860	1,050	1,750
****9	3	1,250	1,850	2,400	2,950	4,900
	4	2,700	3,700	4,900	5,900	10,000
B	6	7,410	10,100	13,400	16,400	25,300
	8	15,000	20,000	26,000	32,000	56,000
	10	25,000	32,000	45,000	60,000	96,000

** 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	0.5 TO 1
	OXYGEN, CHLORINE	0.5
FREQUENCY OF OPERATION	ONCE PER DAY OR MORE	0
	ONCE PER DAY TO ONCE PER WEEK	0.2
	ONCE PER WEEK TO ONCE PER MONTH	0.5
	ONCE PER MONTH OR LESS	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.

Apollo® Ball 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.*

APPLICATION GUIDELINES FOR CHOOSING CORRECT TORQUE SERVICE FACTOR

Experience has shown that actuators cannot be properly sized to a particular butterfly valve in a particular service by simply choosing a *Wet and Dry Service* torque chart. For this reason, Apollo® has performed extensive testing to assure that you neither oversize nor undersize your Apollo® Actuator. Apollo® has provided Torque Values for four different service factors. These four service factors are described as follows:

SERVICE FACTOR I

Values under this service factor should only be used for ideal conditions and proportioning service where full closure is not a requirement. To use the valves under Service Factor I, the following requirements must be met:

No flow media effect on seat materials.

No exceeding temperature range of seat materials.

Valve disc must be totally corrosion resistant to flow media.

Flow media must be self-lubricating.

Frequency of operation must be at least once every 24 hours.

Torque values under Service Factor I are a result of short term testing with new equipment. Only select proportioning type Apollo® actuators under this Service Factor, where shut-off requirements are not critical.

SERVICE FACTOR I+

Values under this Service Factor may be used where experience has shown Service Factor II values to be an extreme, but where all of the Service Factor I criteria cannot be met. To use the Values under Service Factor I+, the following requirements must be met:

Butterfly Valve Actuator Sizing Procedures

Maximum shutoff pressure of 150 psig.

Temperature extremes not to exceed +60˚F to +150˚F.

Valve disc must be totally corrosion resistant to flow media.

Flow media must be self-lubricating - such as potable water, liquid food products such as beer (within temperature guidelines) or clean oil such as mineral oil.

Frequency of operation must be at least once every 7 days.

Torque values under Service Factor I+ provide allowance for increases of 50% above tested torque values.

SERVICE FACTOR II

Values under this Service Factor are considered to be normal conditions for the operation of most butterfly valves. Selection of Apollo® actuators based on values under this Service Factor should provide satisfactory results except in severe applications. To use values under this Service Factor, the following requirements must be met.

Minor chemical effect on seat material.

Temperature well within seat material limitations.

Valve disc corrosion to be mild.

Flow media to be self-lubricating aqueous liquid.

Frequency of operation must be at least once every 30 days.

Torque values under Service Factor II provide allowances for increase of a factor of two over tests in establishing frictional resistance of media-exposed elements.

SERVICE FACTOR III

Values under this Service Factor are considered to be severe operating conditions, or *Dry Service*. To use valves under this Service Factor, the following requirements are usually met:

Severe chemical effect on seat material.

Temperature at extreme limitations of seat material.

Valve disc corrosion moderate to severe.

Flow media non-lubricating; air, gas or dry bulk service.

Frequency of operation uncontrollable or unknown.

Torque values under Service Factor III provide allowances for increase of a factor of three over tests in establishing frictional resistance of media exposed elements.

GENERAL FACTORS AFFECTING SEATING AND UNSEATING TORQUE:

1. For pneumatic conveying of dry bulk materials, it is recommended that the valve be specified with a reduced diameter (under cut) disc, for lower operating torque. Note that valves with reduced diameter discs are rated for 65 psi maximum service.
2. Please consult the material selection guide for trim recommendations. Please consult the factory for proper sizing of Apollo® actuators.

Seating and Unseating Torque Apollo® Resilient Seated Butterfly Valves

130/132 Series: SIZES 2" - 12" Full DISC DIAMETER and 140/142 Series: SIZES 2" - 24" Full DISC DIAMETER

VALVE	SERVICE FACTOR I				SERVICE FACTOR 1+				SERVICE FACTOR II				SERVICE FACTOR III			
SIZE	ΔP0	ΔP50	ΔP100	ΔP150	ΔP0	ΔP50	ΔP100	ΔP150	ΔP0	ΔP50	ΔP100	ΔP150	ΔP0	ΔP50	ΔP100	ΔP150
2"	100	105	115	125	150	155	165	170	200	205	210	220	300	310	320	330
2 1/2"	135	145	155	165	202	212	222	232	270	280	290	300	400	410	420	430
3"	140	160	175	195	210	230	250	265	280	300	320	335	420	440	460	475
4"	210	240	265	290	315	345	370	400	420	450	475	500	630	660	700	725
5"	285	330	375	420	430	475	520	565	570	620	660	700	855	900	950	990
6"	395	485	575	660	595	685	770	860	790	880	975	1050	1185	1275	1375	1450
8"	660	835	1010	1180	990	1165	1350	1525	1320	1500	1675	1850	1980	2150	2350	2500
10"	1015	1275	1540	1800	1525	1800	2050	2325	2030	2300	2550	2800	3045	3300	3600	3850
12"	1365	1800	2250	2700	2050	2500	2950	3375	2730	3200	3600	4100	4095	4550	5000	5400
14"	2150	2950	3750	4550	3225	4025	4825	5625	4300	5100	5900	6700	6450	7250	8050	8850
16"	2750	3950	5150	6350	4125	5325	6625	7725	5500	6700	7900	9100	8250	9450	10650	11850
18"	3450	5250	7050	8850	4575	6375	8175	9975	6900	8700	10500	12300	10350	12150	13950	15750
20"	4250	6750	9250	11750	6375	8875	11375	13875	8500	11000	13500	16000	12750	15250	17750	20250
24"	6000	9000	12500	15500	9000	12000	15000	18000	11500	14500	18000	21000	15650	19500	22500	26000

Apollo® Butterfly Valves

Seating and Unseating Torque Apollo® Resilient Seated Butterfly Valves

130/132 Series: Sizes 2" - 12" Reduced Disc Diameter and 140/142 Series: Sizes 2" - 24" Reduced Disc Diameter (UNDER CUT DISC) 65 PSI Max Δ P

VALVE SIZE	SERVICE FACTOR I		SERVICE FACTOR 1+		SERVICE FACTOR II		SERVICE FACTOR III	
	ΔPO	ΔP65	ΔPO	ΔP65	ΔPO	ΔP65	ΔPO	ΔP65
2"	30	40	45	55	60	75	90	120
2-1/2"	45	60	68	85	90	120	135	160
3"	60	85	90	110	120	160	180	210
4"	145	170	220	265	290	320	435	465
5"	195	235	295	370	390	435	585	625
6"	270	360	405	485	540	625	810	895
8"	440	620	660	750	880	1060	1320	1500
10"	660	925	990	1165	1320	1600	1980	2250
12"	880	1320	1320	1525	1760	2200	2640	3050
14"	1450	2250	-	-	2900	3700	4350	5150
16"	1850	3050	-	-	3700	4900	5550	6750
18"	2350	4150	-	-	4700	6500	7050	8850
20"	2850	5350	-	-	5700	8200	8550	11060
24"	N/A	N/A	-	-	6500	9900	N/A	N/A

These charts should be used as GENERAL GUIDES. It does not mean that the rating necessarily applies to every possible criteria which may affect seating and unseating torque.

NOTES:

1. Above figures are applicable to 130/132 & 140/142 Series Apollo® Resilient Seated Butterfly Valves.
2. The charted torque values above are the total of all internal frictional resistances for opening or closing against indicated pressure.
3. The effect of Dynamic Torsion is not considered in this chart.
4. Pressure capacity (rating) of valves is not considered in this chart.
5. Torsional capacity of valve shafts is not considered in this chart.
6. Generally, Apollo® Actuator selection is based on a minimum of Service Factor II Torque Values. Service Factor I or I+ should not be used unless all of the requirements for it are met.
7. For Elastomer covered discs, do not use less than service Factor II Values.
8. All Torque Value testing done with Apollo® seat compound #600.

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

Seating and Unseating Torque Apollo® Resilient Seated Butterfly Valves

141 and 143 SERIES: 2"-24"

Valve Size	Standard Disc Differential Pressure			
	50 PSIΔP Bushing PTFE	100 PSIΔP Bushing PTFE	150 PSIΔP Bushing PTFE	200 PSIΔP 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!**

Notes

Notes

CONBRACO

Sales Department
P.O. Box 247
Matthews, NC 28106
Phone: 704-841-6000
Fax: 704-841-6021
E-mail: conbraco@conbraco.com

Customer Service Department
P.O. Box 247
Matthews, NC 28106
Phone: 704-841-6000
Fax: 704-841-6020
E-mail: conbraco@conbraco.com

			E/Mail Address	Phone	Fax
Southeast Region	**B. Lynch & Assoc.**	Florida	sales@blynchandassociates.com	813-901-0988	813-901-8403
	Valves & Fittings, Inc.	Georgia/Alabama/Tennessee-East	sales@valves-fittings.com	770-483-3057	770-483-3110
	Pro Marketing, Inc.	North Carolina/South Carolina	sales@promarketinginc.net	864-578-4334	864-578-4889
	Mid South Marketing	Virginia/Maryland/Washington, D.C./WV-East	midsouth7@aol.com	804-749-8712	804-749-8717
Southern Region	**Southern Marketing Group**	MS/TN-West/AR/Bowie Cty.-TX	SMG49@bellsouth.net	901-547-0042	901-547-0035
	AVC Mechanical	Oklahoma/Texas-North	valvesales@avalve.com	817-649-2229	817-649-2225
	Knox & Associates, Inc.	Texas-South/Louisiana	knox1@pdq.net	713-462-7766	713-690-6228
Midwestern Region	**HEBCO, Inc.**	Kansas/Missouri-West	chuckHEBCO@aol.com	913-491-0797	913-491-5126
	New Tech Marketing, Inc.	IL/WI-East/IN-North/MI-Upper Peninsula/IA-River Counties	ntm12@ameritech.net	630-378-4300	630-378-0343
	New Tech Marketing, Inc.	Eastern Missouri/Southern Illinois	ntm112@aol.com	618-394-0329	618-394-0427
	L.J. Whitfill & Associates, Inc.	Kentucky/Indiana-South/Ohio-South	ljwhitfill@aol.com	502-459-4545	502-459-9944
	V.E. Sales Co., Inc.	Michigan (Except Upper Peninsula)	tomv@vesalesinc.com	586-774-7760	586-774-1490
	Northstar Valve & Fitting, Inc.	Minnesota/North & South Dakota/Wisconsin-West	nsvalve@aol.com	952-937-0108	952-937-0803
	Willco, Inc.	Nebraska/Iowa (Except River Counties)	willcoinc@att.net	402-573-7000	402-573-7371
	Morrissey Associates, Inc.	Ohio-North/Pennsylvania-West/West Virginia-West	sales@morrisseyassoc.com	330-538-0406	330-538-0410
Western Region	**Specified Process Equipment**	California-North	john@specifiedprocess.com	707-747-3466	707-747-4957
	Socal Controls, Inc.	California-South	sales@socalcontrols.com	714-935-9533	714-935-9503
	Marshall-Rodeno Associated	CO/WY/MT/ID-SE/UT/NV-NE/NM/El Paso-TX	trodeno@marshall-rodeno.com	303-575-6701	303-575-6706
	J.P. Harris & Associates, Inc.	Washington/Oregon/Idaho-North West/Alaska	jim@jpharrisassoc.com	360-944-8457	360-944-8459
	Layden Valve Sales & Solutions	Hawaii	will@laydenvalve.com	808-456-3331	808-455-1064
	Southwestern Mechnical Sales Co.	Arizona/Nevada-SW	sales@swmech.com	480-813-1313	480-813-2286
		Las Vegas/Clark County/Nevada	sales@swmech.com	702-368-2561	702-368-1784
Northeast Region	**Urell, Inc.**	Massachusetts/New England States	doug@urell.com	617-923-9500	617-926-9414
	Pence & Associates	New York-Upstate/New York-West	penceassociates@aol.com	315-423-0066	315-423-0290
	Continuous Sales Corporation	New York-East/New Jersey-North	csc07@aol.com	516-248-5177	516-248-5187
	J.A. Layden Co.	Pennsylvania-East/Delaware/New Jersey-South	sales@jalayden.com	610-353-2311	610-359-1299
Canada	**Conbraco Industries, Canada**	160 Pennsylvania Ave., Unit 3, Concord, Ontario L4K 4A9	conbraco@conbraco.on.ca	905-761-6161	905-761-6666
	M.A. Stewart & Sons, Ltd.	British Columbia, Alberta,Ontario,Quebec	surrey@mastewart.com	604-594-8431	604-594-4335
Int'l./ Puerto Rico	**Rafael Rodriguez Barril, Inc.**	Puerto Rico	rauli@rrbarril.com	787-759-8680	787-759-8986
	Conbraco Industries, Int'l. (Europe)	Manchester, England	sales@conbraco.co.uk	+44-161-908-2340	+44-161-908-2359

For Representatives And Distributors In Your International Area
Please Contact The Closest Conbraco Industries International Office

Conway, SC • Matthews, NC • Pageland, SC • Customer Service 1-704-841-6000 • www.conbraco.com