



- СЕРВИС
- ПОДДЕРЖКА
- ТЕХНИЧЕСКАЯ ПОМОЩЬ
- ОБРАЗОВАНИЕ
- МАРКЕТИНГ
- ПРОДАЖИ
- ИЗНАЧАТЕЛЬ
- ИЗГОТОВИТЕЛЬ
- ПОСТАВЩИК
- ИМПОРТЕР
- ОПЕРАТОР
- ПОЛЬЗОВАТЕЛЬ



# APOLLO®

## valve automation products

- ИЗГОТОВИТЕЛЬ
- ИМПОРТЕР
- ОПЕРАТОР
- ПОЛЬЗОВАТЕЛЬ
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- ПОДДЕРЖКА
- СЕРВИС



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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.

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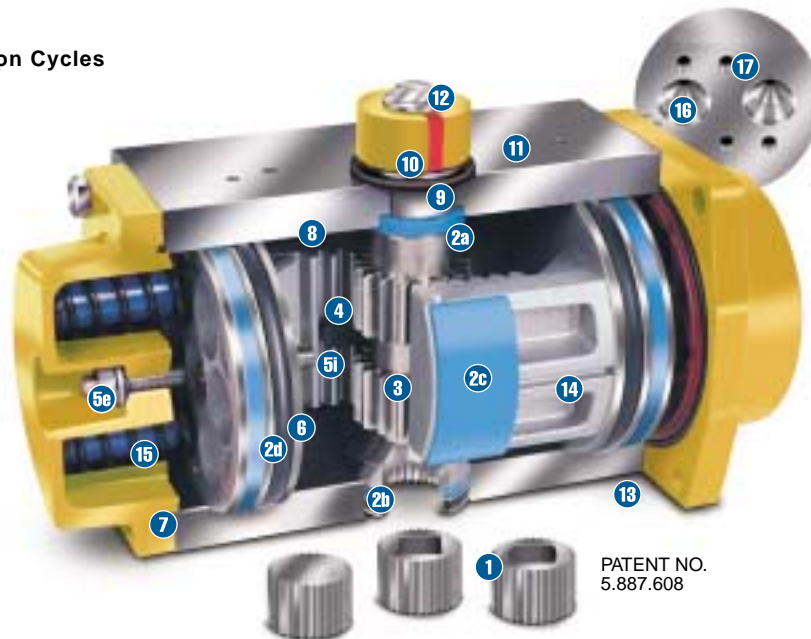
### General Information

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**



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

\* 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 |      |         |         |         |         |         |         |      |      |  |
|---|------|---------|---------|---------|---------|---------|---------|------|------|--|
| 130/132 Series Adapter Numbers  |      |         |         |         |         |         |         |      |      |  |
| Size  | 3T30 | 3T40    | 3T50    | 3T60    | 3T65    | 3T70    | 3T80    | 3T90 | 3TA0 |  |
| 1.5   |      |         |         |         |         |         |         |      |      |  |
| 2   |      | CX03430 | CX03430 | CX03433 | CX03433 |         |         |      |      |  |
| 2.5   |      | CX03430 | CX03430 | CX03433 | CX03433 |         |         |      |      |  |
| 3   |      | CX03430 | CX03430 | CX03433 | CX03433 |         |         |      |      |  |
| 4   |      | CX03431 | CX03431 | CX03434 | CX03434 | CX03438 |         |      |      |  |
| 5   |      |         | CX03432 | CX03435 | CX03435 | CX03439 |         |      |      |  |
| 6   |      |         | CX03432 | CX03435 | CX03435 | CX03439 |         |      |      |  |
| 8   |      |         |         | CX03437 | CX03437 | CX03441 | CX03444 |      |      |  |
| 10  |      |         |         |         |         | CX03442 | CX03445 |      |      |  |
| 12  |      |         |         |         |         |         | CX03446 |      |      |  |
| 140/142 Series Adapter Numbers  |      |         |         |         |         |         |         |      |      |  |
| 2   |      | CX03430 | CX03430 | CX03433 | CX03433 |         |         |      |      |  |
| 2.5   |      | CX03430 | CX03430 | CX03433 | CX03433 |         |         |      |      |  |
| 3   |      | CX03430 | CX03430 | CX03433 | CX03433 |         |         |      |      |  |
| 4   |      | CX03431 | CX03431 | CX03434 | CX03434 | CX03438 |         |      |      |  |
| 5   |      | CX03431 | CX03431 | CX03434 | CX03434 | CX03438 |         |      |      |  |
| 6   |      | CX03431 | CX03431 | CX03434 | CX03434 | CX03438 |         |      |      |  |
| 8   |      |         |         | CX03436 | CX03436 | CX03440 | CX03443 |      |      |  |
| 10  |      |         |         | CX03437 | CX03437 | CX03441 | CX03444 |      |      |  |
| 12  |      |         |         |         |         |         | CX03446 |      |      |  |
| 141/143 Series Adapter Numbers [Double "D"]   |      |         |         |         |         |         |         |      |      |  |
| 2   |      | CX03447 | CX03447 | CX03450 | CX03450 | CX03454 |         |      |      |  |
| 2.5   |      | CX03447 | CX03447 | CX03450 | CX03450 | CX03454 |         |      |      |  |
| 3   |      | CX03447 | CX03447 | CX03450 | CX03450 | CX03454 |         |      |      |  |
| 4   |      | CX03448 | CX03448 | CX03451 | CX03451 | CX03455 |         |      |      |  |
| 5   |      |         | CX03449 | CX03452 | CX03452 | CX03456 |         |      |      |  |
| 6   |      |         | CX03449 | CX03452 | CX03452 | CX03456 |         |      |      |  |
| 8   |      |         |         | CX03453 | CX03453 | CX03457 | CX03459 |      |      |  |
| 10  |      |         |         |         |         | CX03458 | CX03460 |      |      |  |
| 12  |      |         |         |         |         |         | CX03461 |      |      |  |
| 14  |      |         |         |         |         |         | CX03461 |      |      |  |

# Apollo® Compactorque Pneumatic Actuators Mounting

## Accessory Mounting

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

## Solenoid Mounting

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

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

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

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

| DOUBLE ACTING CHART                      |                |        |        |        |        |        |        |        |        |        |        |      |         |      |        |         |        |         |        |       |        |       |    |     |     |     |     |      |      |      |      |       |       |    |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |
|--|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|---------|------|--------|---------|--------|---------|--------|-------|--------|-------|----|-----|-----|-----|-----|------|------|------|------|-------|-------|----|-----|-----|-----|------|------|------|------|------|-------|-------|-----|-----|-----|-----|------|------|------|------|------|-------|-------|-----|-----|-----|-----|------|------|------|------|------|-------|-------|
| AIR SUPPLY IN PSIG                       | ACTUATOR MODEL |        |        |        |        |        |        |        |        |        |        |      |         |      |        |         |        |         |        |       |        |       |    |     |     |     |     |      |      |      |      |       |       |    |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |
|  | 3T-010         |        | 3T-020 |        | 3T-030 |        | 3T-040 |        | 3T-050 |        | 3T-060 |      | 3T-065  |      | 3T-070 |         | 3T-080 |         | 3T-090 |       | 3T-0A0 |       |    |     |     |     |     |      |      |      |      |       |       |    |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |
| 40                                       | 30             | 72     | 130    | 274    | 416    | 650    | 1075   | 1409   | 2771   | 5198   | 12631  | 45   | 108     | 194  | 411    | 623     | 975    | 1613    | 2114   | 4155  | 7797   | 18946 | 60 | 144 | 259 | 548 | 831 | 1300 | 2151 | 2819 | 5548 | 10396 | 25261 | 80 | 180 | 324 | 685 | 1039 | 1625 | 2689 | 3524 | 6929 | 12995 | 31577 | 100 | 216 | 389 | 822 | 1247 | 1950 | 3226 | 4228 | 8310 | 15594 | 37892 | 120 | 274 | 478 | 901 | 1344 | 2050 | 3375 | 4400 | 8610 | 16500 | 39600 |
| UNITS                                    | DA             | DA     | SR     | 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*<br>OPEN/CLOSE<br>SECONDS |                | .5/1.5 | .5/1.5 | .5/1.6 | .6/1.8 | .5/1.6 | .6/1.1 | .5/1.8 | .6/1.2 | .7/1.8 | 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    |       |    |     |     |     |     |      |      |      |      |       |       |    |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |     |     |     |     |      |      |      |      |      |       |       |

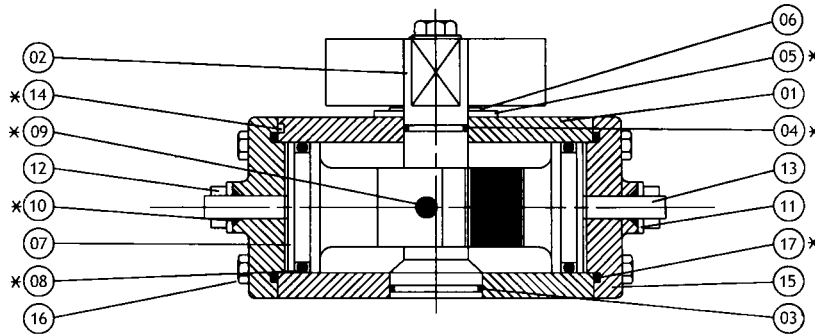
\*Actuator speed open/close based on 80 psi air at no load condition.

| Actuator Model | No. Springs per Piston | SIZING INFORMATION, END TORQUE (LB.-IN.) AIR SUPPLY AVAILABLE AT ACTUATOR (psig) |        |        |        |        |        |         |         |         |         |            |         | Spring Stroke End |       |       |       |       |       |       |       |       |      |       |
|----------------|------------------------|--|--------|--------|--------|--------|--------|---------|---------|---------|---------|------------|---------|-------------------|-------|-------|-------|-------|-------|-------|-------|-------|------|-------|
|                |                        | 40 End   | 50 End | 60 End | 70 End | 80 End | 90 End | 100 End | 110 End | 120 End | 130 End | 140 End    | 150 End |                   |       |       |       |       |       |       |       |       |      |       |
| 3TS-020-XX     | 2                      | 45   | 61     | 77     | 97     | 116    | 134    | 151     | 169     | 186     | 21      | 3TS-065-XX | 2       | 847               | 1165  | 1483  | 1869  | 2254  | 2587  | 2920  | 3259  | 3597  | 369  |       |
|                | 3                      | 39   | 54     | 70     | 90     | 110    | 127    | 144     | 161     | 179     | 27      |            | 3       | 709               | 1018  | 1328  | 1722  | 2116  | 2444  | 2772  | 3107  | 3442  | 462  |       |
|                | 3                      | 32   | 47     | 62     | 82.5   | 103    | 120    | 137     | 154     | 171     | 32      |            | 5       | 570               | 871   | 1172  | 1575  | 1977  | 2301  | 2624  | 2955  | 3286  | 555  |       |
|                | 3/4                    |  | 55     | 76     | 97     | 113    | 130    | 147     | 164     | 181     | 38      |            | 3/4     |                   | 1014  | 1427  | 1839  | 2158  | 2476  | 2801  | 3126  | 3467  | 647  |       |
|                | 4                      | 48   | 69     | 90     | 106    | 122    | 139    | 156     | 173     | 190     | 43      |            | 4       |                   | 856   | 1279  | 1701  | 2016  | 2328  | 2647  | 2966  | 3285  | 3604 | 604   |
|                | 4/5                    | 48   | 60     | 84     | 99     | 115    | 132    | 148     | 164     | 180     | 48      |            | 4/5     |                   | 747   | 1100  | 1563  | 1869  | 2176  | 2493  | 2811  | 3128  | 3445 | 680   |
| 3TS-030-XX     | 5                      |  |        |        | 77     | 93     | 108    | 124     | 140     | 53      | 5       |            |         |                   |       |       |       |       |       |       |       |       | 921  |       |
|                | 5/6                    |  |        |        | 71     | 86     | 101    | 117     | 133     | 59      | 5/6     |            |         |                   |       |       |       |       |       |       |       |       |      | 1014  |
|                | 6                      |  |        |        | 64     | 79     | 93     | 109     | 125     | 64      | 6       |            |         |                   |       |       |       |       |       |       |       |       |      | 1106  |
|                | 2                      | 79   | 108    | 137    | 173    | 208    | 239    | 269     | 300     | 330     | 35      | 2          | 847     | 1165              | 1483  | 1869  | 2254  | 2587  | 2920  | 3259  | 3597  | 3936  | 369  |       |
|                | 2/3                    | 67   | 95     | 124    | 160    | 196    | 226    | 256     | 286     | 317     | 44      | 2/3        | 709     | 1018              | 1328  | 1722  | 2116  | 2444  | 2772  | 3107  | 3442  | 3781  | 462  |       |
|                | 3                      | 55   | 83     | 110    | 147    | 183    | 213    | 242     | 273     | 303     | 53      | 3          | 570     | 871               | 1172  | 1575  | 1977  | 2301  | 2624  | 2955  | 3286  | 3625  | 453  |       |
| 3TS-040-XX     | 3/4                    |  | 96     | 134    | 171    | 200    | 229    | 259     | 290     | 62      | 3/4     |            | 1014    | 1427              | 1839  | 2158  | 2476  | 2801  | 3126  | 3467  | 3808  | 4149  | 830  |       |
|                | 4                      | 82   | 121    | 159    | 188    | 216    | 246    | 276     | 306     | 71      | 4       |            | 856     | 1279              | 1701  | 2016  | 2328  | 2647  | 2966  | 3285  | 3604  | 604   |      |       |
|                | 4/5                    | 76   | 105    | 147    | 175    | 203    | 232    | 262     | 292     | 80      | 4/5     |            | 747     | 1100              | 1563  | 1869  | 2176  | 2493  | 2811  | 3128  | 3445  | 680   |      |       |
|                | 5                      | 134  | 162    | 190    | 219    | 247    | 275    | 303     | 331     | 359     | 89      | 5          |         |                   |       |       |       |       |       |       |       |       | 921  |       |
|                | 5/6                    | 122  | 149    | 177    | 205    | 234    | 262    | 290     | 318     | 346     | 98      | 5/6        |         |                   |       |       |       |       |       |       |       |       |      | 1014  |
|                | 6                      | 109  | 136    | 163    | 192    | 220    | 248    | 276     | 304     | 332     | 106     | 6          |         |                   |       |       |       |       |       |       |       |       |      | 1106  |
| 3TS-050-XX     | 2                      | 165  | 227    | 288    | 364    | 439    | 504    | 568     | 634     | 699     | 72      | 2          | 1684    | 2311              | 2938  | 3695  | 4451  | 5107  | 5762  | 6424  | 7085  | 7746  | 735  |       |
|                | 2/3                    | 138  | 198    | 258    | 335    | 412    | 476    | 539     | 604     | 669     | 90      | 2/3        | 1416    | 2026              | 2636  | 3409  | 4183  | 4829  | 5475  | 6129  | 6783  | 7437  | 921  |       |
|                | 3                      | 111  | 169    | 227    | 306    | 385    | 448    | 510     | 574     | 638     | 108     | 3          | 1147    | 1741              | 2334  | 3124  | 3914  | 4551  | 5187  | 5834  | 6481  | 7128  | 1106 |       |
|                | 3/4                    |  | 197    | 277    | 358    | 419    | 481    | 544     | 608     | 672     | 126     | 3/4        |         | 2028              | 2837  | 3646  | 4270  | 4895  | 5537  | 6179  | 6821  | 7463  | 1292 |       |
|                | 4                      | 167  | 249    | 330    | 391    | 452    | 513    | 574     | 635     | 696     | 144     | 4          |         | 1721              | 2549  | 3377  | 3990  | 4603  | 5216  | 5829  | 6442  | 7055  | 1478 |       |
|                | 4/5                    | 146  | 215    | 284    | 353    | 423    | 485    | 547     | 609     | 671     | 162     | 4/5        |         | 1511              | 2205  | 3109  | 3712  | 4316  | 4919  | 5523  | 6127  | 6731  | 1664 |       |
| 3TS-060-XX     | 5                      | 276  | 335    | 393    | 455    | 516    | 577    | 638     | 699     | 180     | 5       |            |         |                   |       |       |       |       |       |       |       |       | 1850 |       |
|                | 5/6                    | 249  | 307    | 365    | 425    | 486    | 546    | 606     | 666     | 198     | 5/6     |            |         |                   |       |       |       |       |       |       |       |       | 2036 |       |
|                | 6                      | 222  | 279    | 336    | 396    | 455    | 515    | 574     | 634     | 693     | 216     | 6          |         |                   |       |       |       |       |       |       |       |       | 2222 |       |
|                | 2                      | 247  | 341    | 434    | 549    | 664    | 762    | 860     | 960     | 1059    | 106     | 2          | 3141    | 4312              | 5483  | 6908  | 8332  | 9558  | 10784 | 12029 | 13273 | 14517 | 1416 |       |
|                | 2/3                    | 205  | 296    | 387    | 504    | 622    | 718    | 815     | 913     | 1012    | 133     | 2/3        | 2629    | 3768              | 4907  | 6363  | 7820  | 9027  | 10235 | 11465 | 12696 | 13927 | 1770 |       |
|                | 3                      | 163  | 251    | 339    | 459    | 579    | 675    | 770     | 867     | 964     | 159     | 3          | 2116    | 3223              | 4330  | 5819  | 7307  | 8496  | 9685  | 10902 | 12119 | 13336 | 2124 |       |
| 3TS-070-XX     | 3/4                    |  | 292    | 414    | 537    | 631    | 724    | 820     | 917     | 186     | 3/4     |            | 3753    | 5274              | 6794  | 7965  | 9136  | 10339 | 11541 | 12743 | 13945 | 15147 | 2478 |       |
|                | 4                      | 244  | 370    | 495    | 587    | 678    | 774    | 869     | 964     | 212     | 4       |            | 3176    | 4729              | 6281  | 7434  | 8587  | 9777  | 10966 | 12155 | 13344 | 2832  |      |       |
|                | 4/5                    | 211  | 316    | 416    | 543    | 633    | 727    | 822     | 917     | 239     | 4/5     |            | 2776    | 4076              | 5476  | 6281  | 7434  | 8587  | 9777  | 10966 | 12155 | 13344 | 3186 |       |
|                | 5                      |  |        |        | 409    | 499    | 588    | 681     | 774     | 866     | 266     | 5          |         |                   |       |       |       |       |       |       |       |       |      | 3540  |
|                | 5/6                    |  |        |        | 368    | 455    | 543    | 634     | 726     | 817     | 293     | 5/6        |         |                   |       |       |       |       |       |       |       |       |      | 3894  |
|                | 6                      |  |        |        | 326    | 412    | 497    | 587     | 677     | 767     | 319     | 6          |         |                   |       |       |       |       |       |       |       |       |      | 4248  |
| 3TS-080-XX     | 2                      | 392  | 539    | 685    | 862    | 1039   | 1194   | 1349    | 1502    | 1654    | 171     | 2          | 7616    | 10458             | 13300 | 16768 | 20235 | 23212 | 26188 | 29209 | 32230 | 35251 | 3531 |       |
|                | 2/3                    | 328  | 471    | 613    | 794    | 975    | 1128   | 1281    | 1431    | 1582    | 215     | 2/3        | 6363    | 9127              | 11891 | 15436 | 18982 | 21914 | 24846 | 27833 | 30820 | 33807 | 4412 |       |
|                | 3                      | 264  | 403    | 541    | 726    | 911    | 1062   | 1212    | 1361    | 1510    | 258     | 3          | 5110    | 7799              | 10481 | 14105 | 17729 | 20616 | 23503 | 26457 | 29410 | 32363 | 5293 |       |
|                | 3/4                    |  | 469    | 659    | 850    | 996    | 1142   | 1292    | 1442    | 1592    | 301     | 3/4        |         | 9076              | 12776 | 16476 | 19318 | 22161 | 25081 | 28001 | 31001 | 34001 | 6174 |       |
|                | 4                      | 396  | 593    | 789    | 931    | 1072   | 1223   | 1373    | 1523    | 1673    | 344     | 4          |         | 7671              | 11447 | 15223 | 18021 | 20818 | 23705 | 26591 | 29478 | 32364 | 7054 |       |
|                | 4/5                    | 347  | 510    | 724    | 863    | 1003   | 1151   | 1300    | 1449    | 1598    | 387     | 4/5        |         | 6690              | 9938  | 13974 | 16727 | 19480 | 22333 | 25186 | 28039 | 30892 | 7935 |       |
| 3TS-090-XX     | 5                      | 659  | 796    | 933    | 1080   | 1227   | 1374   | 1521    | 1668    | 430     | 5       |            |         |                   |       |       |       |       |       |       |       |       | 8815 |       |
|                | 5/6                    | 594  | 730    | 866    | 1010   | 1154   | 1298   | 1442    | 1586    | 473     | 5/6     |            |         |                   |       |       |       |       |       |       |       |       |      | 9700  |
|                | 6                      | 529  | 664    | 799    | 940    | 1080   | 1227   | 1374    | 1521    | 1668    | 516     | 6          |         |                   |       |       |       |       |       |       |       |       |      | 10585 |
|                | 2                      | 392  | 539    | 685    | 862    | 1039   | 1194   | 1349    | 1502    | 1654    | 171     | 2          | 7616    | 10458             | 13300 | 16768 | 20235 | 23212 | 26188 | 29209 | 32230 | 35251 | 3531 |       |
|                | 2/3                    | 328  | 471    | 613    | 794    | 975    | 1128   | 1281    | 1431    | 1582    | 215     | 2/3        | 6363    | 9127              | 11891 | 15436 | 18982 | 21914 | 24846 | 27833 | 30820 | 33807 | 4412 |       |
|                | 3                      | 264  | 403    | 541    | 726    | 911    | 1062   | 1212    | 1361    | 1510    | 258     | 3          | 5110    | 7799              | 10481 | 14105 | 17729 | 20616 | 23503 | 26457 | 29410 | 32363 | 5293 |       |

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

| Actuator Model | No. Springs per Piston | SIZING INFORMATION, START TORQUE (LB.-IN.) |       |       |       |       |       |       |       |       |       |       |       | Spring Stroke |       |       |       |       |       |       |       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |    |
|----------------|------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------------|-------|-------|-------|-------|-------|-------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---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|                |                        | AIR SUPPLY AVAILABLE AT ACTUATOR           |       |       |       |       |       |       |       |       |       |       |       |               |       |       |       |       |       |       |       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |    |
|                |                        | 40   |       | 50    |       | 60    |       | 70    |       | 80    |       | 90    |       |               | 100   |       | 110   |       | 120   |       |       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |    |
| Start          | Start                  | Start                                      | Start | Start | Start | Start | Start | Start | Start | Start | Start | Start | Start | Start         | Start | Start | Start | Start | Start | Start | Start |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |     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| 3TS-020-XX     | 2                      | 52   | 69    | 86    | 106   | 125   | 143   | 160   | 177   | 194   | 211   | 228   | 245   | 262           | 279   | 296   | 313   | 330   | 347   | 364   | 381   | 398 | 415 | 432 | 449 | 466 | 483 | 500 | 517 | 534 | 551 | 568 | 585 | 602 | 619 | 636 | 653 | 670 | 687 | 704 | 721 | 738 | 755 | 772 | 789 | 806 | 823 | 840 | 857 | 874 | 891 | 908 | 925 | 942 | 959 | 976 | 993 | 1010 | 1027 | 1044 | 1061 | 1078 | 1095 | 1112 | 1129 | 1146 | 1163 | 1180 | 1197 | 1214 | 1231 | 1248 | 1265 | 1282 | 1299 | 1316 | 1333 | 1350 | 1367 | 1384 | 1401 | 1418 | 1435 | 1452 | 1469 | 1486 | 1503 | 1520 | 1537 | 1554 | 1571 | 1588 | 1605 | 1622 | 1639 | 1656 | 1673 | 1690 | 1707 | 1724 | 1741 | 1758 | 1775 | 1792 | 1809 | 1826 | 1843 | 1860 | 1877 | 1894 | 1911 | 1928 | 1945 | 1962 | 1979 | 1996 | 2013 | 2030 | 2047 | 2064 | 2081 | 2098 | 2115 | 2132 | 2149 | 2166 | 2183 | 2200 | 2217 | 2234 | 2251 | 2268 | 2285 | 2302 | 2319 | 2336 | 2353 | 2370 | 2387 | 2404 | 2421 | 2438 | 2455 | 2472 | 2489 | 2506 | 2523 | 2540 | 2557 | 2574 | 2591 | 2608 | 2625 | 2642 | 2659 | 2676 | 2693 | 2710 | 2727 | 2744 | 2761 | 2778 | 2795 | 2812 | 2829 | 2846 | 2863 | 2880 | 2897 | 2914 | 2931 | 2948 | 2965 | 2982 | 2999 | 3016 | 3033 | 3050 | 3067 | 3084 | 3101 | 3118 | 3135 | 3152 | 3169 | 3186 | 3203 | 3220 | 3237 | 3254 | 3271 | 3288 | 3305 | 3322 | 3339 | 3356 | 3373 | 3390 | 3407 | 3424 | 3441 | 3458 | 3475 | 3492 | 3509 | 3526 | 3543 | 3560 | 3577 | 3594 | 3611 | 3628 | 3645 | 3662 | 3679 | 3696 | 3713 | 3730 | 3747 | 3764 | 3781 | 3798 | 3815 | 3832 | 3849 | 3866 | 3883 | 3900 | 3917 | 3934 | 3951 | 3968 | 3985 | 4002 | 4019 | 4036 | 4053 | 4070 | 4087 | 4104 | 4121 | 4138 | 4155 | 4172 | 4189 | 4206 | 4223 | 4240 | 4257 | 4274 | 4291 | 4308 | 4325 | 4342 | 4359 | 4376 | 4393 | 4410 | 4427 | 4444 | 4461 | 4478 | 4495 | 4512 | 4529 | 4546 | 4563 | 4580 | 4597 | 4614 | 4631 | 4648 | 4665 | 4682 | 4699 | 4716 | 4733 | 4750 | 4767 | 4784 | 4801 | 4818 | 4835 | 4852 | 4869 | 4886 | 4903 | 4920 | 4937 | 4954 | 4971 | 4988 | 5005 | 5022 | 5039 | 5056 | 5073 | 5090 | 5107 | 5124 | 5141 | 5158 | 5175 | 5192 | 5209 | 5226 | 5243 | 5260 | 5277 | 5294 | 5311 | 5328 | 5345 | 5362 | 5379 | 5396 | 5413 | 5430 | 5447 | 5464 | 5481 | 5498 | 5515 | 5532 | 5549 | 5566 | 5583 | 5600 | 5617 | 5634 | 5651 | 5668 | 5685 | 5702 | 5719 | 5736 | 5753 | 5770 | 5787 | 5804 | 5821 | 5838 | 5855 | 5872 | 5889 | 5906 | 5923 | 5940 | 5957 | 5974 | 5991 | 6008 | 6025 | 6042 | 6059 | 6076 | 6093 | 6110 | 6127 | 6144 | 6161 | 6178 | 6195 | 6212 | 6229 | 6246 | 6263 | 6280 | 6297 | 6314 | 6331 | 6348 | 6365 | 6382 | 6399 | 6416 | 6433 | 6450 | 6467 | 6484 | 6501 | 6518 | 6535 | 6552 | 6569 | 6586 | 6603 | 6620 | 6637 | 6654 | 6671 | 6688 | 6705 | 6722 | 6739 | 6756 | 6773 | 6790 | 6807 | 6824 | 6841 | 6858 | 6875 | 6892 | 6909 | 6926 | 6943 | 6960 | 6977 | 6994 | 7011 | 7028 | 7045 | 7062 | 7079 | 7096 | 7113 | 7130 | 7147 | 7164 | 7181 | 7198 | 7215 | 7232 | 7249 | 7266 | 7283 | 7300 | 7317 | 7334 | 7351 | 7368 | 7385 | 7402 | 7419 | 7436 | 7453 | 7470 | 7487 | 7504 | 7521 | 7538 | 7555 | 7572 | 7589 | 7606 | 7623 | 7640 | 7657 | 7674 | 7691 | 7708 | 7725 | 7742 | 7759 | 7776 | 7793 | 7810 | 7827 | 7844 | 7861 | 7878 | 7895 | 7912 | 7929 | 7946 | 7963 | 7980 | 7997 | 8014 | 8031 | 8048 | 8065 | 8082 | 8099 | 8116 | 8133 | 8150 | 8167 | 8184 | 8201 | 8218 | 8235 | 8252 | 8269 | 8286 | 8303 | 8320 | 8337 | 8354 | 8371 | 8388 | 8405 | 8422 | 8439 | 8456 | 8473 | 8490 | 8507 | 8524 | 8541 | 8558 | 8575 | 8592 | 8609 | 8626 | 8643 | 8660 | 8677 | 8694 | 8711 | 8728 | 8745 | 8762 | 8779 | 8796 | 8813 | 8830 | 8847 | 8864 | 8881 | 8898 | 8915 | 8932 | 8949 | 8966 | 8983 | 9000 | 9017 | 9034 | 9051 | 9068 | 9085 | 9102 | 9119 | 9136 | 9153 | 9170 | 9187 | 9204 | 9221 | 9238 | 9255 | 9272 | 9289 | 9306 | 9323 | 9340 | 9357 | 9374 | 9391 | 9408 | 9425 | 9442 | 9459 | 9476 | 9493 | 9510 | 9527 | 9544 | 9561 | 9578 | 9595 | 9612 | 9629 | 9646 | 9663 | 9680 | 9697 | 9714 | 9731 | 9748 | 9765 | 9782 | 9799 | 9816 | 9833 | 9850 | 9867 | 9884 | 9901 | 9918 | 9935 | 9952 | 9969 | 9986 | 10003 | 10020 | 10037 | 10054 | 10071 | 10088 | 10105 | 10122 | 10139 | 10156 | 10173 | 10190 | 10207 | 10224 | 10241 | 10258 | 10275 | 10292 | 10309 | 10326 | 10343 | 10360 | 10377 | 10394 | 10411 | 10428 | 10445 | 10462 | 10479 | 10496 | 10513 | 10530 | 10547 | 10564 | 10581 | 10598 | 10615 | 10632 | 10649 | 10666 | 10683 | 10700 | 10717 | 10734 | 10751 | 10768 | 10785 | 10802 | 10819 | 10836 | 10853 | 10870 | 10887 | 10904 | 10921 | 10938 | 10955 | 10972 | 10989 | 11006 | 11023 | 11040 | 11057 | 11074 | 11091 | 11108 | 11125 | 11142 | 11159 | 11176 | 11193 | 11210 | 11227 | 11244 | 11261 | 11278 | 11295 | 11312 | 11329 | 11346 | 11363 | 11380 | 11397 | 11414 | 11431 | 11448 | 11465 | 11482 | 11499 | 11516 | 11533 | 11550 | 11567 | 11584 | 11601 | 11618 | 11635 | 11652 | 11669 | 11686 | 11703 | 11720 | 11737 | 11754 | 11771 | 11788 | 11805 | 11822 | 11839 | 11856 | 11873 | 11890 | 11907 | 11924 | 11941 | 11958 | 11975 | 11992 | 12009 | 12026 | 12043 | 12060 | 12077 | 12094 | 12111 | 12128 | 12145 | 12162 | 12179 | 12196 | 12213 | 12230 | 12247 | 12264 | 12281 | 12298 | 12315 | 12332 | 12349 | 12366 | 12383 | 12400 | 12417 | 12434 | 12451 | 12468 | 12485 | 12502 | 12519 | 12536 | 12553 | 12570 | 12587 | 12604 | 12621 | 12638 | 12655 | 12672 | 12689 | 12706 | 12723 | 12740 | 12757 | 12774 | 12791 | 12808 | 12825 | 12842 | 12859 | 12876 | 12893 | 12910 | 12927 | 12944 | 12961 | 12978 | 12995 | 13012 | 13029 | 13046 | 13063 | 13080 | 13097 | 13114 | 13131 | 13148 | 13165 | 13182 | 13199 | 13216 | 13233 | 13250 | 13267 | 13284 | 13301 | 13318 | 13335 | 13352 | 13369 | 13386 | 13403 | 13420 | 13437 | 13454 | 13471 | 13488 | 13505 | 13522 | 13539 | 13556 | 13573 | 13590 | 13607 | 13624 | 13641 | 13658 | 13675 | 13692 | 13709 | 13726 | 13743 | 13760 | 13777 | 13794 | 13811 | 13828 | 13845 | 13862 | 13879 | 13896 | 13913 | 13930 | 13947 | 13964 | 13981 | 13998 | 14015 | 14032 | 14049 | 14066 | 14083 | 14100 | 14117 | 14134 | 14151 | 14168 | 14185 | 14202 | 14219 | 14236 | 14253 | 14270 | 14287 | 14304 | 14321 | 14338 | 14355 | 14372 | 14389 | 14406 | 14423 | 14440 | 14457 | 14474 | 14491 | 14508 | 14525 | 14542 | 14559 | 14576 | 14593 | 14610 | 14627 | 14644 | 14661 | 14678 | 14695 | 14712 | 14729 | 14746 | 14763 | 14780 | 14797 | 14814 | 14831 | 14848 | 14865 | 14882 | 14899 | 14916 | 14933 | 14950 | 14967 | 14984 | 15001 | 15018 | 15035 | 15052 | 15069 | 15086 | 15103 | 15120 | 15137 | 15154 | 15171 | 15188 | 15205 | 15222 | 15239 | 15256 | 15273 | 15290 | 15307 | 15324 | 15341 | 15358 | 15375 | 15392 | 15409 | 15426 | 15443 | 15460 | 15477 | 15494 | 15511 | 15528 | 15545 | 15562 | 15579 | 15596 | 15613 | 15630 | 15647 | 15664 | 15681 | 15698 | 15715 | 15732 | 15749 | 15766 | 15783 | 15800 | 15817 | 15834 | 15851 | 15868 | 15885 | 15902 | 15919 | 15936 | 15953 | 15970 | 15987 | 16004 | 16021 | 16038 | 16055 | 16072 | 16089 | 16106 | 16123 | 16140 | 16157 | 16174 | 16191 | 16208 | 16225 | 16242 | 16259 | 16276 | 16293 | 16310 | 16327 | 16344 | 16361 | 16378 | 16395 | 16412 | 16429 | 16446 | 16463 | 16480 | 16497 | 16514 | 16531 | 16548 | 16565 | 16582 | 16599 | 16616 | 16633 | 16650 | 16667 | 16684 | 16701 | 16718 | 16735 | 16752 | 16769 | 16786 | 16803 | 16820 | 16837 | 16854 | 16871 | 16888 | 16905 | 16922 | 16939 | 16956 | 16973 | 16990 | 17007 | 17024 | 17041 | 17058 | 17075 | 17092 | 17109 | 17126 | 17143 | 17160 | 17177 | 17194 | 17211 | 17228 | 17245 | 17262 | 17279 | 17296 | 17313 | 17330 | 17347 | 17364 | 17381 | 17398 | 17415 | 17432 | 17449 | 17466 | 17483 | 17500 | 17517 | 17534 | 17551 | 17568 | 17585 | 17602 | 17619 | 17636 | 17653 | 17670 | 17687 | 17704 | 17721 | 17738 | 17755 | 17772 | 17789 | 17806 | 17823 | 17840 | 17857 | 17874 | 17891 | 17908 | 17925 | 17942 | 17959 | 17976 | 17993 | 18010 | 18027 | 18044 | 18061 | 18078 | 18095 | 18112 | 18129 | 18146 | 18163 | 18180 | 18197 | 18214 | 18231 | 18248 | 18265 | 18282 | 18299 | 18316 | 18333 | 18350 | 18367 | 18384 | 18401 | 18418 | 18435 | 18452 | 18469 | 18486 | 18503 | 18520 | 18537 | 18554 | 18571 | 18588 | 18605 | 18622 | 18639 | 18656 | 18673 | 18690 | 18707 | 18724 | 18741 | 18758 | 18775 | 18792 | 18809 | 18826 | 18843 | 18860 | 18877 | 18894 | 18911 | 18928 | 18945 | 18962 | 18979 | 18996 | 19013 | 19030 | 19047 | 19064 | 19081 | 19098 | 19115 | 19132 | 19149 | 19166 | 19183 | 19200 | 19217 | 19234 | 19251 | 19268 | 19285 | 19302 | 19319 | 19336 | 19 |

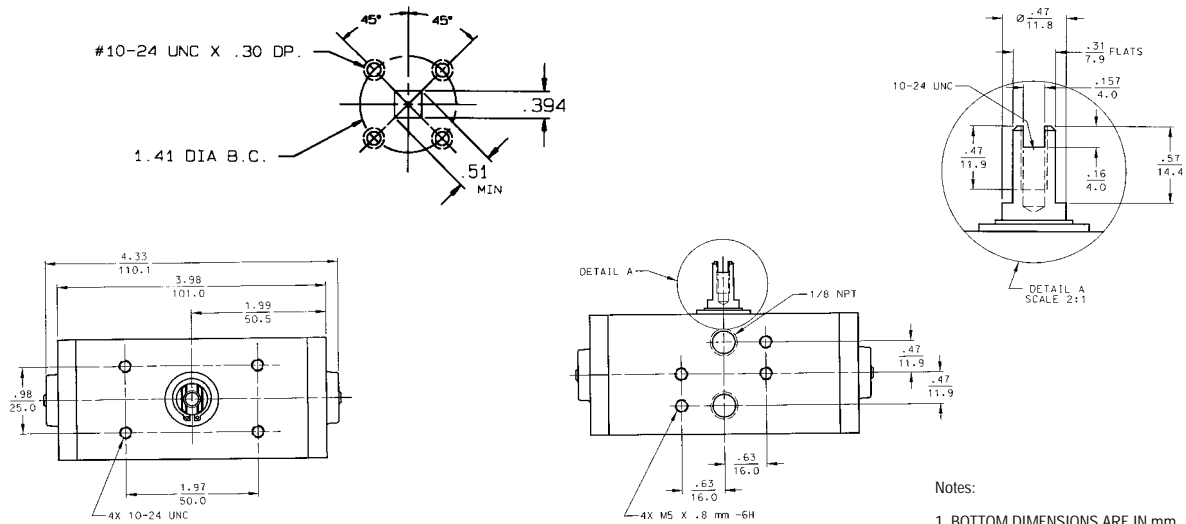
# Apollo® CompactTorque™ 3TD-010-00



*\* 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

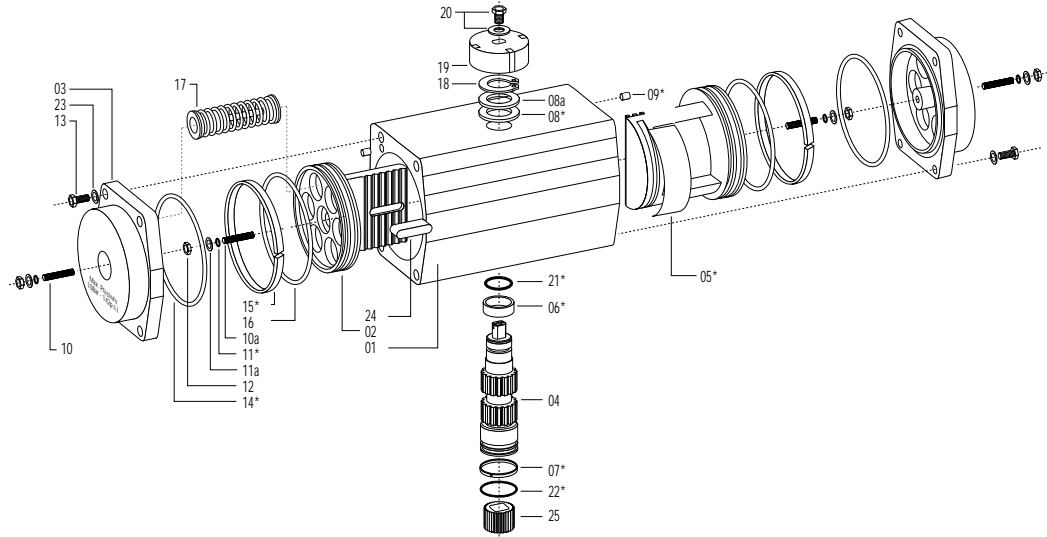
|                 |      |      |    |      |      |    |      |     |
|-----------------|------|------|----|------|------|----|------|-----|
| AIR SUPPLY PSIG | 40   | 50   | 60 | 70   | 80   | 90 | 100  | 120 |
| TORQUE Lb. In.  | 29.3 | 36.6 | 44 | 51.3 | 58.6 | 66 | 73.3 | 88  |

### 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



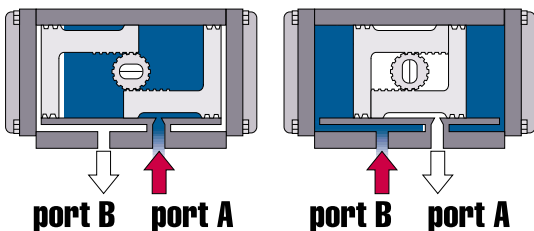
## CompacTorque Part Number Designations

| 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<br>Nickel plated |
| 18     | 1         | Spring clip (pinion)     | High alloy spring steel |                      |                         |   |
| 19**   | 1         | Position indicator       | Polyamide               |                      |                         |   |
| 20**   | 1         | Cap screw/washer         | SS                      | 18-8                 |                         |   |
| 21*    | 1         | O-Ring (pinion top)      | Nitrile (NBR)           |                      | For extreme temperature |   |
| 22*    | 1         | O-Ring (pinion bottom)   | Nitrile (NBR)           |                      | For extreme temperature |   |
| 23     | 8         | Washer (cap screw)       | SS                      | 18-8                 |                         |   |
| 24***  | 2         | Piston guide             | Polyphthalamide (PPA)   |                      |                         |   |
| 25     | 1         | Universal shaft adapter  | Sintered metal          | FLN-4205-40          | SS                      |   |

NOTES: (1) \*Suggested spare parts; included in repair kit. Factory lubricated w/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

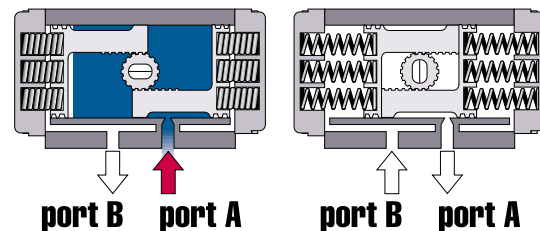
### Double-Acting (TOP VIEW)



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

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

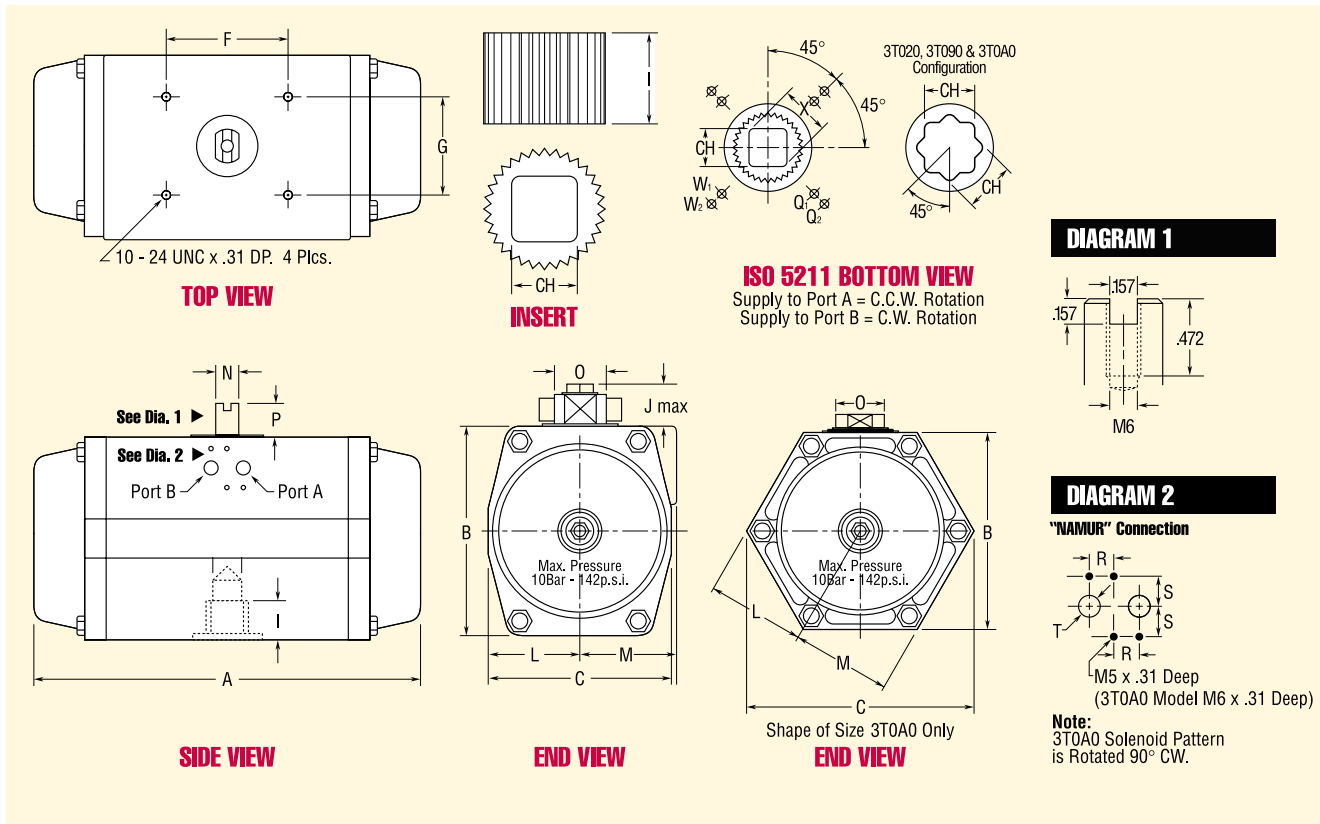
### Spring Return (TOP VIEW)



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

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

# Engineering



| Dimensions          |            |            |             |             |             |             |             |            |            |            |
|---------------------|------------|------------|-------------|-------------|-------------|-------------|-------------|------------|------------|------------|
|                     | 3T-20      | 3T-30      | 3T-40       | 3T-50       | 3T-60       | 3T-65       | 3T-70       | 3T-80      | 3T-90      | 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 Consistent with Conbraco's Mounting Bracket  
 \*\* Alternate ISO 5211 Dimension Utilized  
 \*\*\* Rev. B = 4.921/4.015 Dia. B.C.

# OSHA Lockout Device

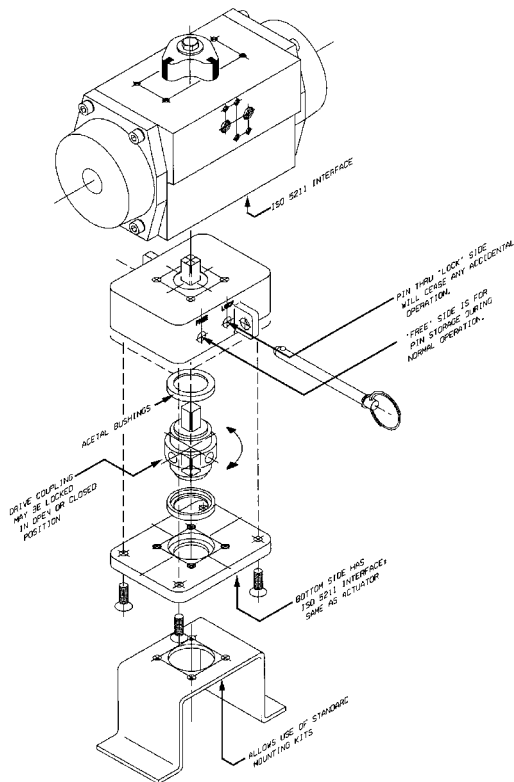
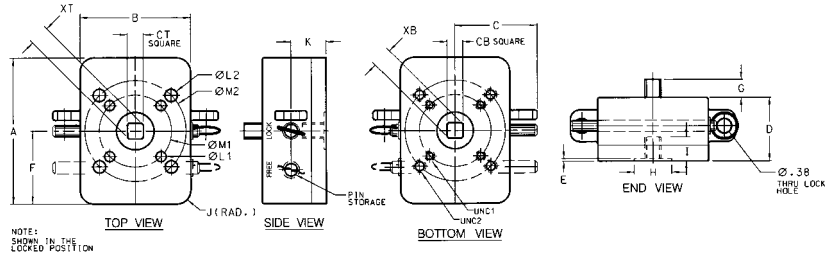
The Apollo® Lockout Tagout accessory for actuators complies with OSHA 1910.147 guidelines. It insures complete lockout capability in both the fully open or the fully closed position. Its design prevents accidental or malicious tampering of an automated valve's orientation.

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 CompactTorque Rack and Pinion Actuator and Apollo® Ball Valve. The design results in a safe automated package that will satisfy the concerns of the most discriminating safety engineer.

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

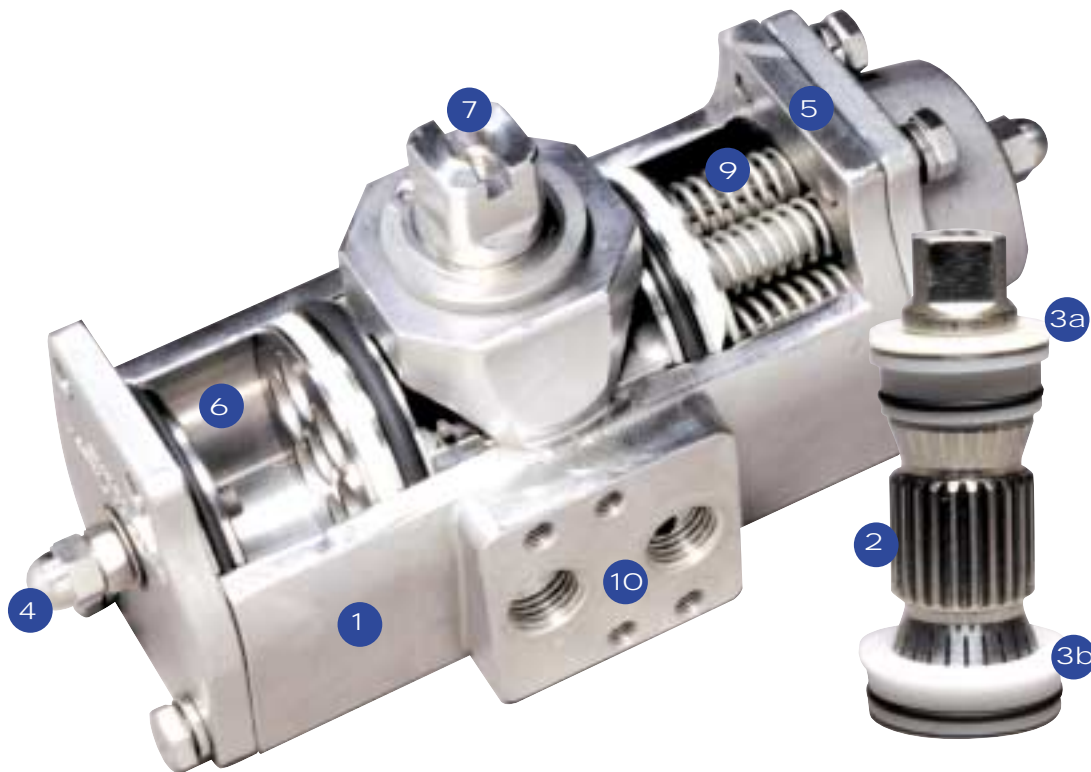


## Material Specifications

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

\*F Patterns Designated are Conbraco's Standard Mounting Arrangement

# New Apollo "Acutorque" Stainless Steel Actuator Design and Construction



## 1. Investment Cast Body

Assures manufacturing of other special alloys, such as Monel

## 2. Unique Drive Pinion

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

## 3. Bearings

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

## 4. Travel Stops

Provides +/-4° travel adjustment in outboard direction

## 5. Accessory Mounting

Manufactured to NAMUR to provide international standardized mounting

## 6. Stainless Steel Pistons

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

## 7. NAMUR Slotted Shaft

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

## 8. Actuator Mounting

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

## 9. Pre-loaded Cartridges

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

## 10. NAMUR Solenoid Mounting

International standard for direct mounting of solenoid valves

# Operation

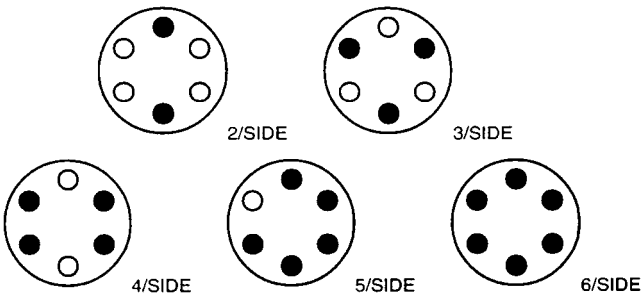
The Apollo® Acutorque actuator is manufactured with an integral and internal air manifold. The solenoid mounting pad is manufactured to Namur dimensional standards as to allow for the direct mounting of various manufacturers' solenoid valves and other flow control devices. For applications not requiring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

## Reverse Rotation

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

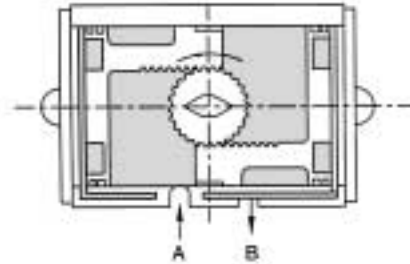
## Spring Configuration

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

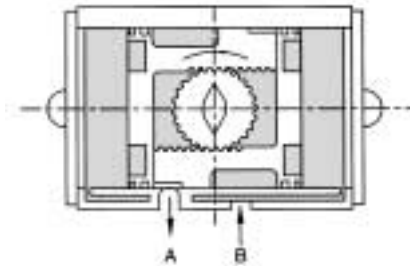


## How the Actuator Works

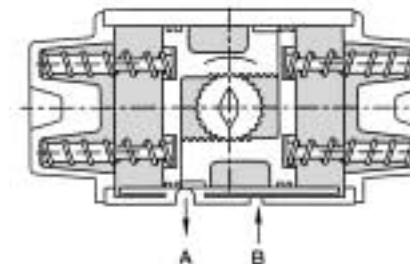
**Air to PORT A** - Pressure applied enters center of chamber forcing the pistons outward and rotating the drive pinion in a counter-clockwise direction and forcing exhaust air out of PORT B.



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



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



# 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

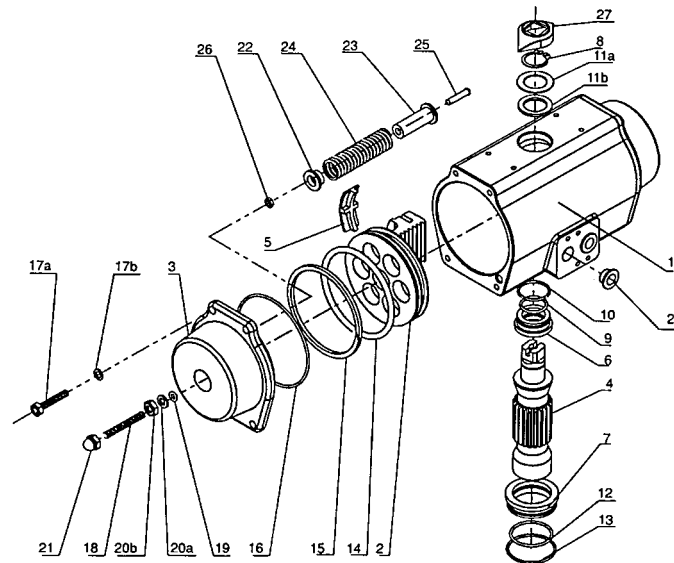
By using ISO/NAMUR standards, our actuators lend themselves to a host of various manufacturers' direct mount accessories. Solenoid valves, limit switches, positioners, etc. bolt directly to the actuator and in turn reduces the cost of assembly and installation of automated packages. Flexibility for future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

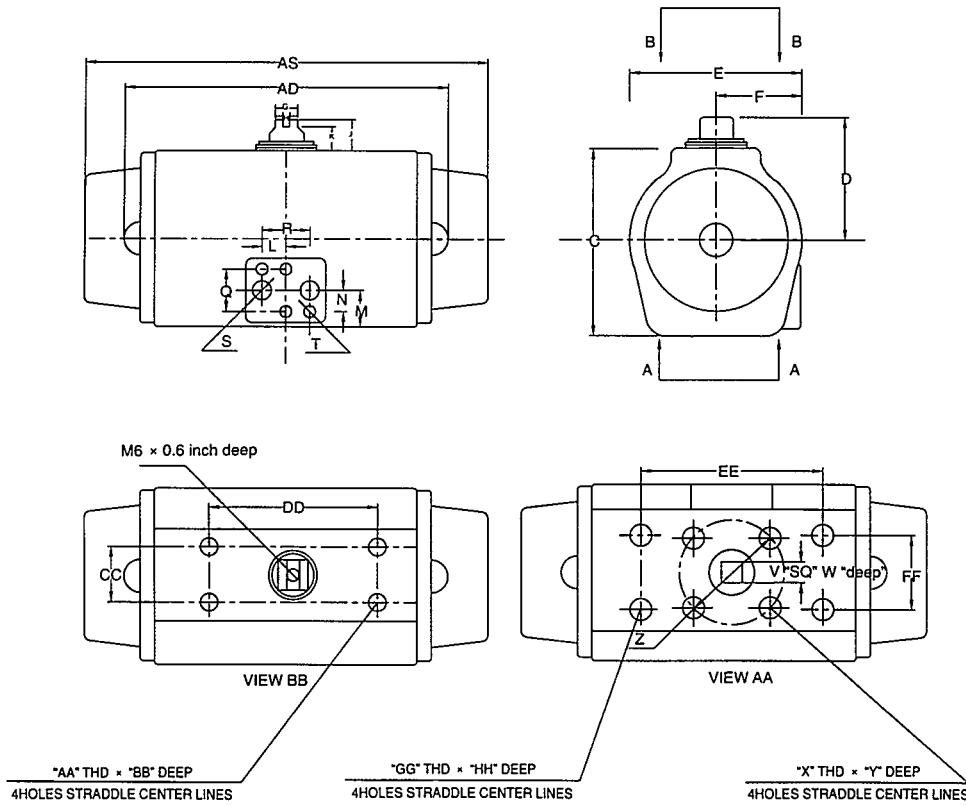
## Safety

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

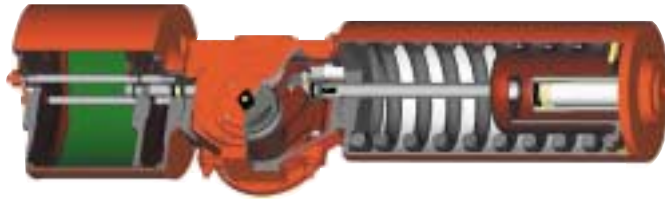
## General Dimensions

| 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.

| <b>G Series Pneumatic Double-Acting Actuator Torque Chart</b> |                 |                           |       |       |       |       |       |       |       |       |       |       |        |
|---|-----------------|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
| 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       |                           |       | 11844 | 22441 | 25647 | 28852 | 32058 | 35264 | 38470 | 48087 | 56102 |        |
|   | Minimum         |                           |       | 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 |
|   | Minimum         |                           |       |       | 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 |       |       |       |       |       |       |       |       |       |        |

| <b>Spring Return G1 Pneumatic Actuator Torque Chart</b> |                                      |                           |       |       |       |       |       |       |       |       |       |       |       |
|---|--------------------------------------|---------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 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.

| <b>Spring-Return Actuator</b> |   |   |                         |                         |                         |                         |                         |                         |                         |                         |
|-------------------------------|---|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| <b>Actuator Model</b>         | <b>Spring Torque (in-lbs) Start/Min/End</b> | <b>Operating Pressure (psig)</b>            |                         |                         |                         |                         |                         |                         |                         |                         |
|                               |   | <b>40</b>                                   | <b>50</b>               | <b>60</b>               | <b>70</b>               | <b>80</b>               | <b>90</b>               | <b>100</b>              | <b>110</b>              | <b>120</b>              |
|                               |   | <b>Torque Output Start/Min/End (in-lbs)</b> |                         |                         |                         |                         |                         |                         |                         |                         |
| G2009-SR2                     | 26818<br>12882<br>22074                     |   |                         |                         |                         |                         |                         |                         |                         | 14072<br>5964<br>8829   |
| G2010-SR2                     | 26818<br>12882<br>22074                     |   |                         |                         |                         |                         | 13859<br>5848<br>8616   | 18810<br>8110<br>12866  | 22361<br>10369<br>17117 | 26611<br>12628<br>21368 |
| G2012-SR2                     | 26818<br>12882<br>22074                     |   |                         | 12159<br>4926<br>6915   | 18252<br>8185<br>13008  | 24344<br>11423<br>19101 | 30437<br>14661<br>25194 | 36530<br>17896<br>31286 |                         |                         |
| G2014-SR2                     | 26818<br>12882<br>22071                     |   | 12648<br>5191<br>7404   | 20057<br>9145<br>14814  | 27466<br>13082<br>22223 | 34875<br>17020<br>29632 |                         |                         |                         |                         |
| G2016-SR2                     | 26818<br>12882<br>22074                     | 14720<br>6308<br>9477                       | 24500<br>11506<br>19256 | 34279<br>16703<br>29036 |                         |                         |                         |                         |                         |                         |
| G2009-SR1                     | 30997<br>14742<br>25004                     |   |                         |                         |                         |                         |                         |                         |                         |                         |
| G2010-SR1                     | 30997<br>14742<br>25004                     |   |                         |                         |                         |                         |                         | 14871<br>5957<br>8248   | 19122<br>8249<br>12498  | 23373<br>10508<br>16749 |
| G2012-SR1                     | 30997<br>14742<br>25004                     |   |                         |                         |                         | 21106<br>9303<br>14482  | 27199<br>12541<br>20575 | 33291<br>15779<br>26668 |                         |                         |
| G2014-SR1                     | 30997<br>14742<br>25004                     |   |                         | 16819<br>7014<br>10195  | 24228<br>10962<br>17604 | 31637<br>14900<br>25013 |                         |                         |                         |                         |
| G2016-SR1                     | 30997<br>14742<br>25004                     |   | 21261<br>9386<br>14638  | 31041<br>14583<br>24417 |                         |                         |                         |                         |                         |                         |
| G2009-SR4                     | 20678<br>9903<br>16917                      |   |                         |                         |                         |                         | 10155<br>4185<br>5998   | 13361<br>5900<br>9204   | 16567<br>7603<br>12410  | 19772<br>9307<br>15616  |
| G2010-SR4                     | 20678<br>9903<br>16917                      |   |                         |                         | 11058<br>4675<br>6901   | 15308<br>6935<br>11152  | 19559<br>9194<br>15402  | 23810<br>11453<br>19653 | 28061<br>13712<br>23904 | 32311<br>15956<br>28155 |
| G2012-SR4                     | 20678<br>9903<br>16917                      |   | 11766<br>5052<br>7609   | 17859<br>8290<br>13702  | 23952<br>11528<br>19795 | 30044<br>14760<br>25888 | 36137<br>17975<br>31980 | 42230<br>21191<br>38073 |                         |                         |
| G2014-SR4                     | 20678<br>9903<br>16917                      | 10939<br>4610<br>6782                       | 18348<br>8550<br>14191  | 25757<br>12488<br>21600 | 33166<br>16407<br>29009 | 40575<br>20318<br>36419 |                         |                         |                         |                         |
| G2016-SR4                     | 20678<br>9903<br>16917                      | 20420<br>9652<br>16264                      | 30200<br>14842<br>26043 | 39979<br>20003<br>35823 |                         |                         |                         |                         |                         |                         |
| G2009-SR3                     | 24139<br>11457<br>19390                     |   |                         |                         |                         |                         |                         |                         | 13833<br>5833<br>8584   | 17039<br>7539<br>11790  |
| G2010-SR3                     | 24139<br>11457<br>19390                     |   |                         |                         |                         | 12575<br>5150<br>7326   | 16826<br>7426<br>11577  | 21077<br>9685<br>15828  | 25327<br>11944<br>20078 | 29578<br>14203<br>24329 |
| G2012-SR3                     | 24139<br>11457<br>19390                     |   |                         | 15126<br>6522<br>9877   | 21219<br>9760<br>15970  | 27311<br>12998<br>22062 | 33404<br>16236<br>28155 | 39497<br>19460<br>34248 |                         |                         |

# Torque Ratings - G Series

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



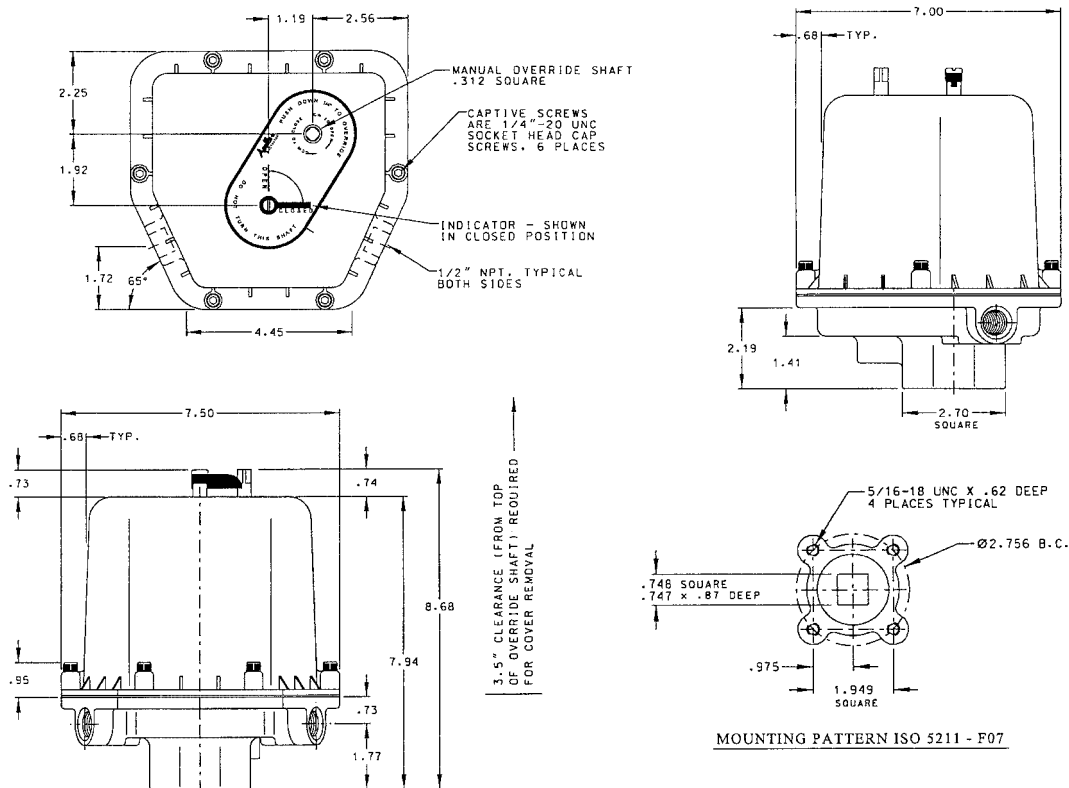
# AE Actuator General Specifications

| Actuator Model | Breakaway Torque Output (in.-lbs.) | Cycle Time 90° Travel (50% Load) | Duty Cycle | Amperage Draw (max.) 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 |

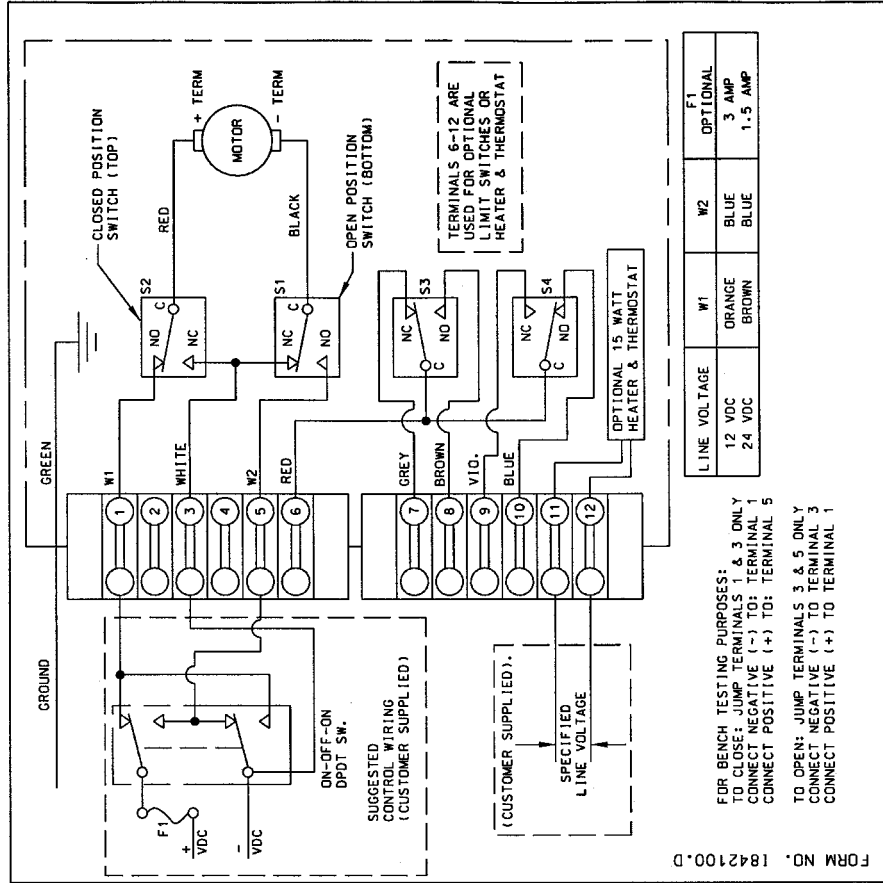
Note: 90° Travel = Travel From Closed position to Open position or vice versa

|                             |  |
|-----------------------------|--|
| Motor                       | AC models: 120 VAC or 230 VAC, Reversible 3 wire, capacitor run. Self-resetting (thermal) overload protection, Class B insulation, sub-fractional horsepower.<br>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 <b>25% duty cycle</b> at temperatures below 100°F. See <i>Electrical Operation</i> . (24 AC-20% duty cycle below 100°F)   |
| Temperature Operating Range | 32°F to 150°F standard<br>-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         | <b>Clockwise to Close, Counterclockwise to Open</b> (Position indicator shaft only, manual override shaft rotates opposite)  |

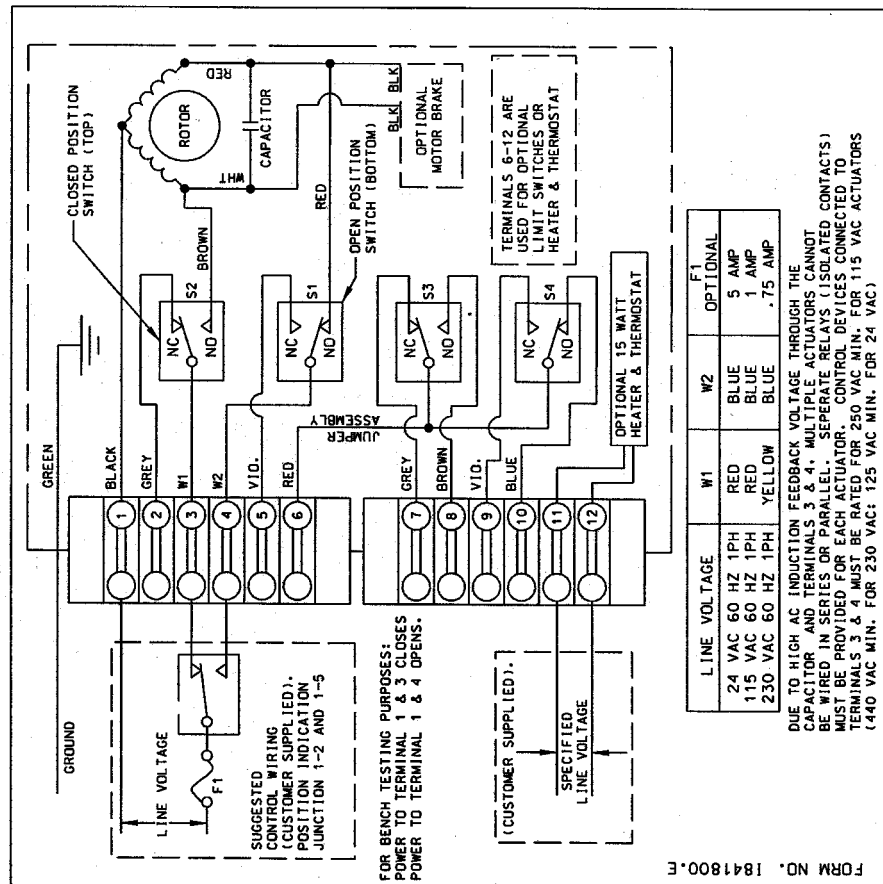
## AE Dimensions



# 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
- Decutchable 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

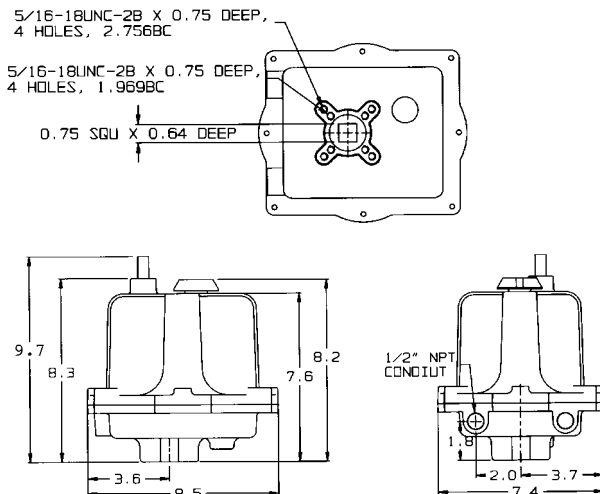
- Locked Rotor Protection if the actuator cannot achieve the position commanded by the control signal, it will cut power to the motor. Repeated stalls will not damage the actuator.
- Reverse acting operation with no rewiring.
- Split range operation with no rewiring.

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).

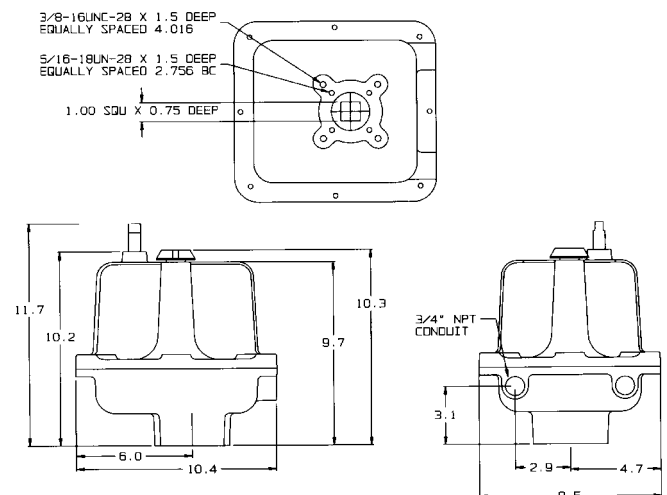
Speed Control with a Positioner?

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:

- The Current Draws stated above include all options. If the brake and/or heater & thermostat are not installed, the actual current draws will be less.
- For DC models, Current Draws are provided at full running torque. If the actuator encounters an overtorque condition, such as a stall condition, the Current Draw will be vastly increased.
- DC actuators have motors that do not generate excessive heat, so they are not limited by duty cycle restraints. However, due to limited brush life of the motors, Conbraco does not recommend using them in applications that require constant (24 hours per day/7 days per week) cycling.

### ACTUATOR MODEL#/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

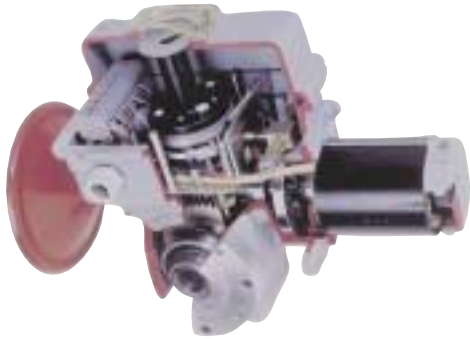
\*CONTACT ACTUATOR ENGINEERING FOR APPLICATIONS NOT COVERED BY INDICATED OPTIONS

\*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   |       |       |       |
|  |                     | Speed (Sec/90°)          |        | 115VAC 1 Ph 60Hz 460 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  |

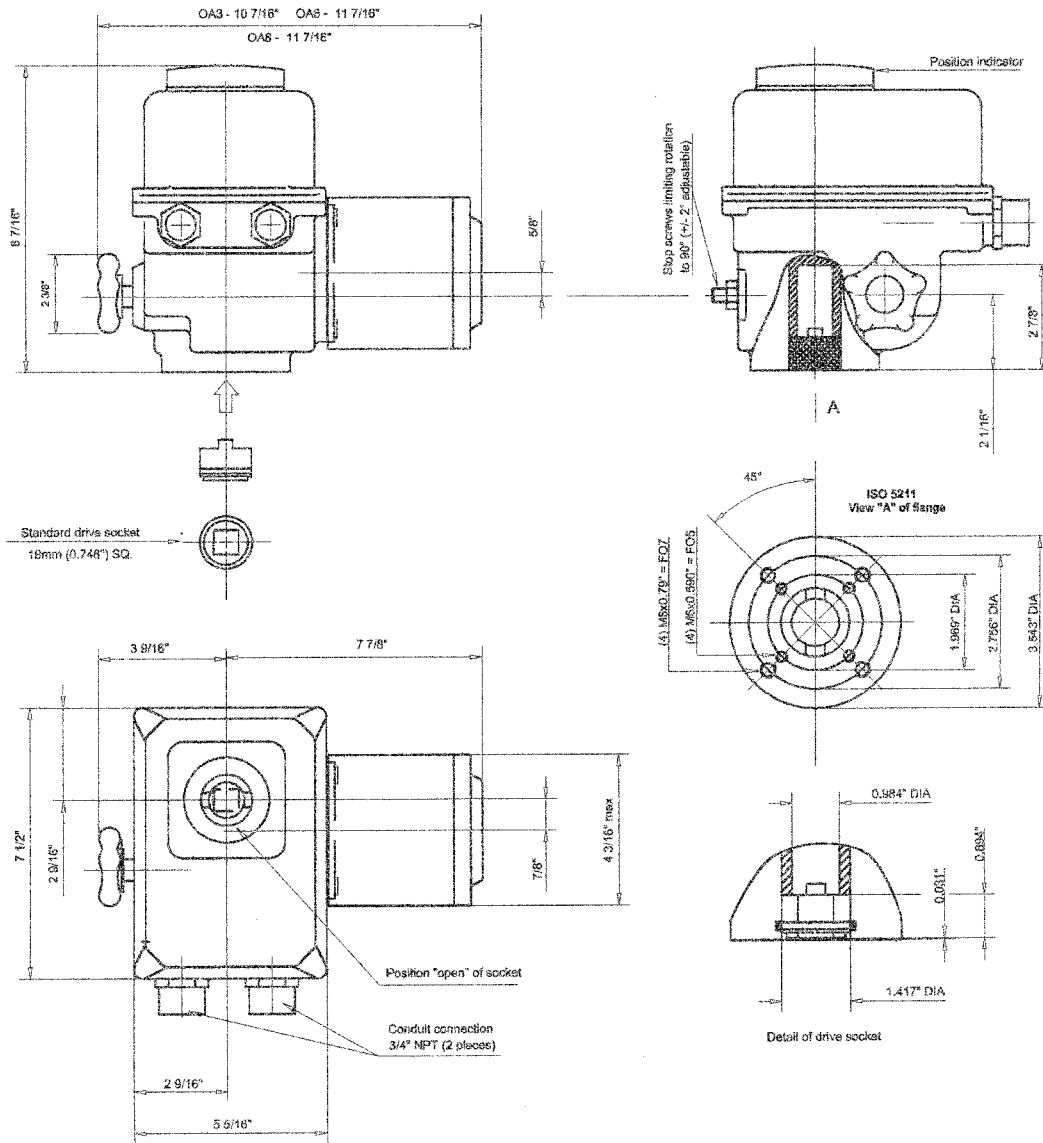
**NOTES:**

- 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 additional ratings, such as, explosion proof or submersible, etc., to meet special service requirements.
- All actuators utilize a self-locking gear train design and have provision for manual override.
- All actuators have both electrical and mechanical travel stop provisions.
- **FQ Series are Spring Return Failsafe models. Contact factory for model number and price.**

# 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

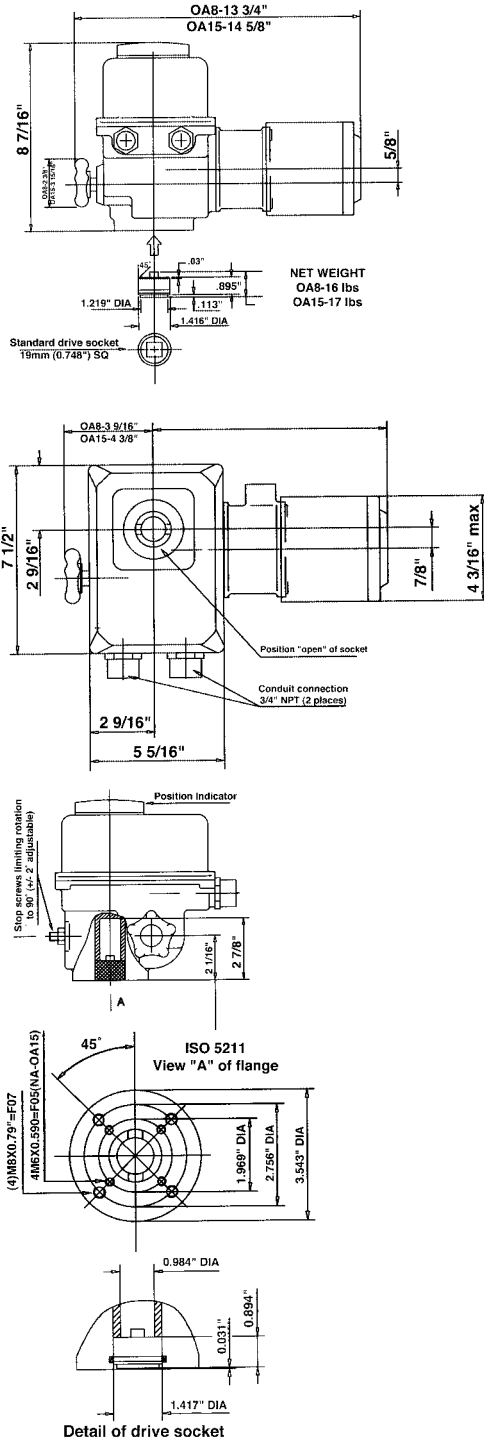
**Net Weight**

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

# LB Series Dimensions

## Types OA8 and OA15

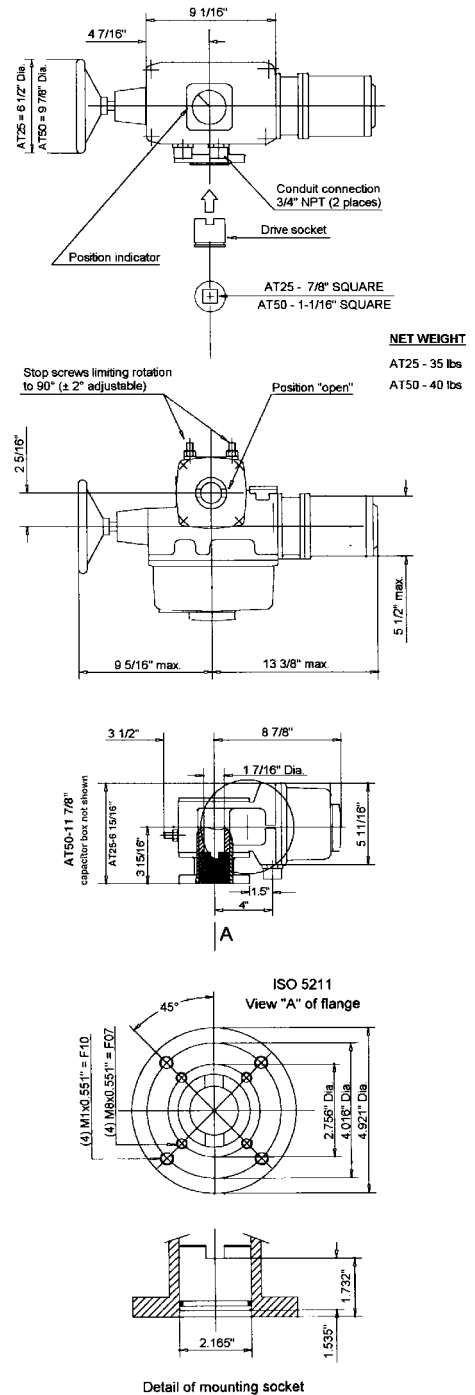
Standard specification: Weatherproof NEMA 4, with two adjustable SPDT limit switches; with built-in motor thermal cutouts, with handwheel for manual operation. Duty rating 30%.



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.

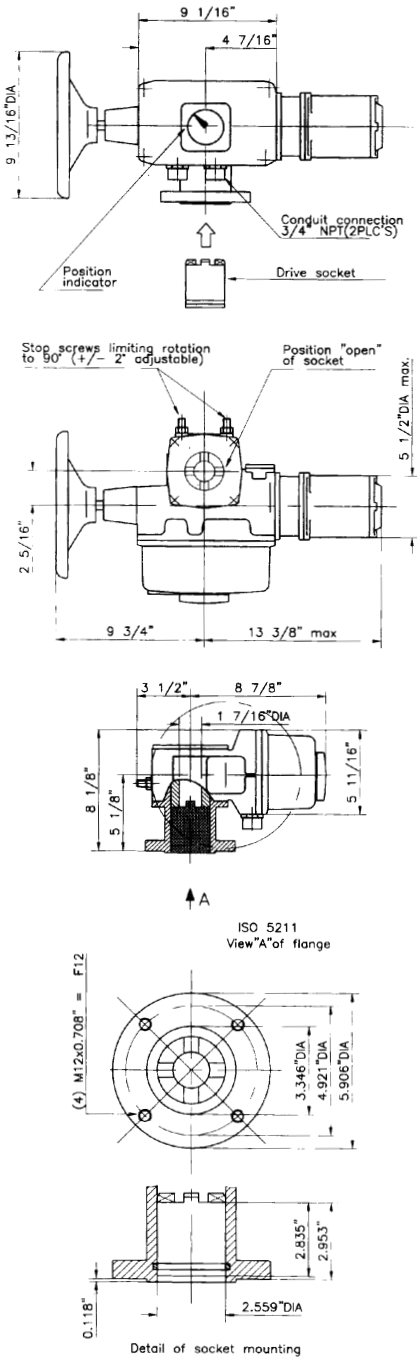


AT25 female socket dimension = .866 square  
AT50 female socket dimension = 1.063 square

# LB Series Dimensions

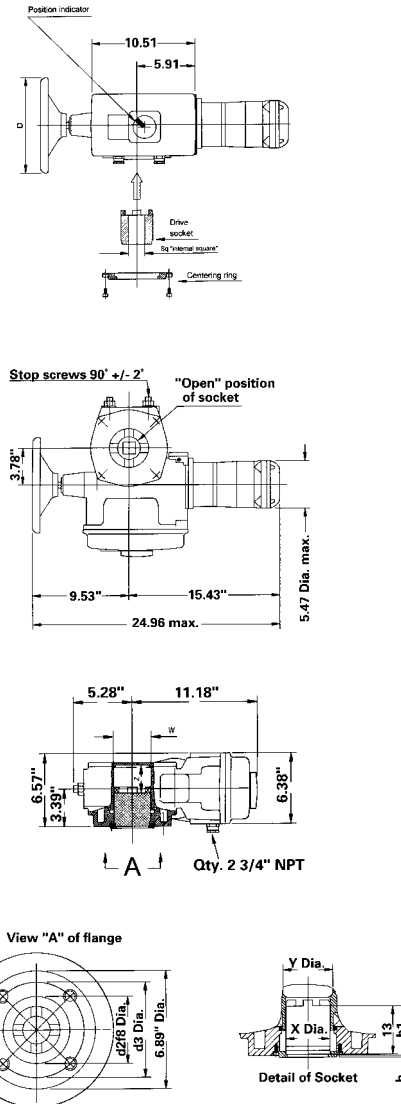
## Type AT80

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.



## 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%.



| 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. |

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:

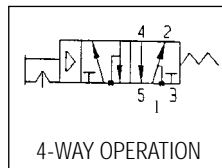
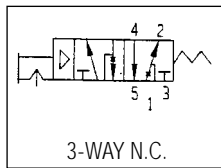
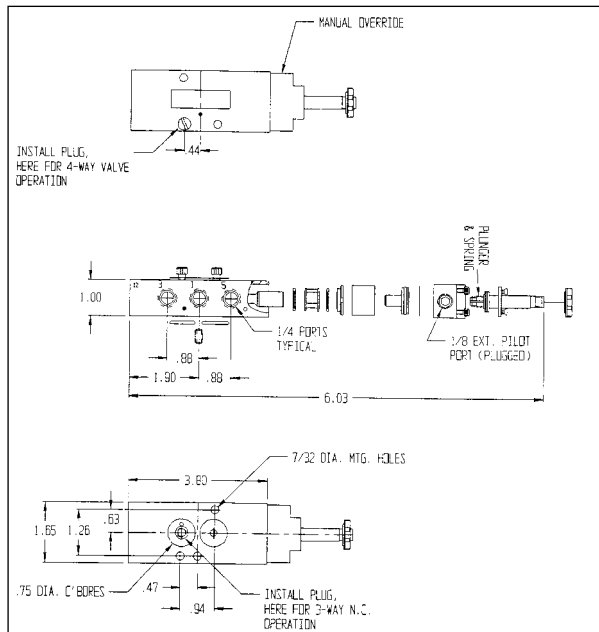
Valve Body=Aluminum, anodized.

Fasteners=Stainless Steel

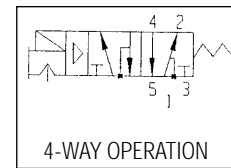
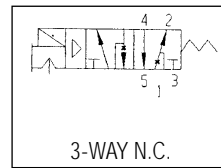
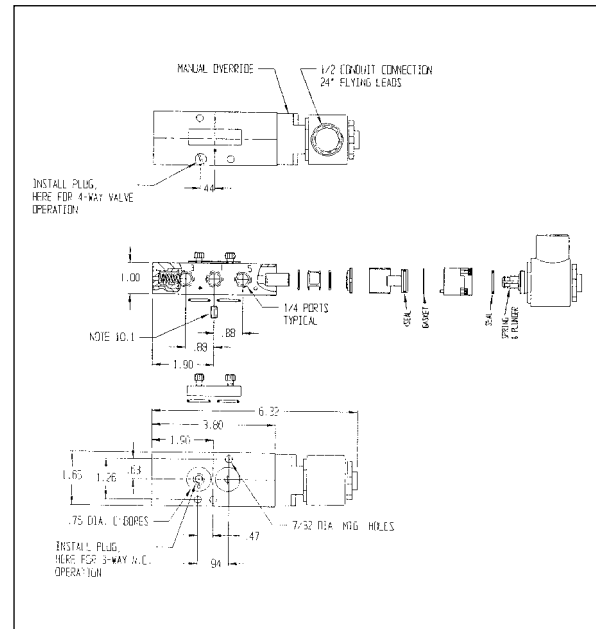
Seals & O-Rings=Nitrile.

Cv flow rate = 1.8

NEMA 4-4X



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



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

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

All above include adapters to turn \*NAMUR 90°

All are direct mount NAMUR - no adapter necessary

# Westlock Valve Monitoring System

## Rotary Valve Monitors

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

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



## BEACON™



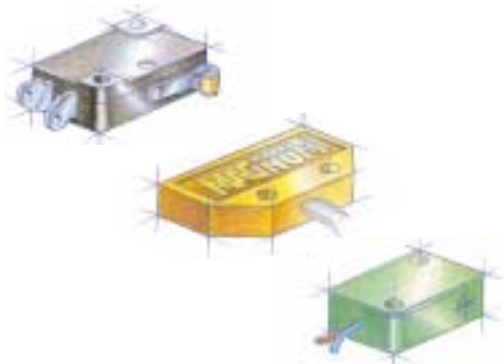
### Beacon™ II Ektar

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

### 3-Way Beacon

A high visibility Flow Path Monitor for multiport valves.

## SENSORS



### Standard Switch Options

Mechanical SPDT & DPDT  
SPDT & DPDT  
Form C & ZZ

Magnum® XT-90  
High Current Proximity Sensor  
SPDT Form C (Hermetically Sealed)  
Simple Apparatus

Pepperl & Fuchs  
Intrinsically Safe, Proximity Type

## ACCUTRAK™



### AccuTrak™ 2000 Dual Display Monitor

Features:

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

Nema 4, 4X, 7, 9,

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

# Westlock Valve Monitoring System

## ACCUTRAK/ELIMINATOR 360™



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

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

## ELIMINATOR™ 3000



Eliminator® 3000

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

Nema 4, 4X, 7, 9,

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

## SERIES 9000



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

## TRANSMITTERS



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

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

# Stonel Limit Switch Assemblies

## Features

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

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

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

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

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

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

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

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



## Materials of Construction

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

## Ratings

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

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

## Electrical Switch Ratings

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

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

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

## Sensor/Communication Module Ratings

### AS-i Communication Module

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

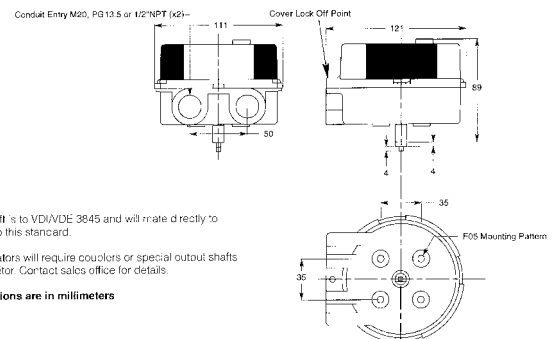
### NAMUR Sensor Module

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

### SST Sensor Module

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

## Dimensional Data



# Stonel Limit Switch Assemblies

## Approvals

### ISQ:

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

#### Entity Parameters:

(Values apply to all ISQ sensors, transmitters and potentiometers.)  
 Voltage Maximum (V<sub>max</sub>) = 40 VDC  
 Current Maximum (max) = 100 milliamps  
 Input Capacitance (C<sub>i</sub>) = 0  
 Input Inductance (L<sub>i</sub>) = 0

### PQ:

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

#### Clear Cover:

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

### MQ:

#### Aluminum Enclosure

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

#### Clear Cover

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

## Potentiometer Specifications

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

\*Consult factory for other resistance ranges.

## Other Specifications

#### Temperature:

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

#### Operating Life:

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

## Warranty

2 Years  
 5 Years

All Mechanical  
 Maxx-Guard Sensors



## Maxx-Guard Specifications

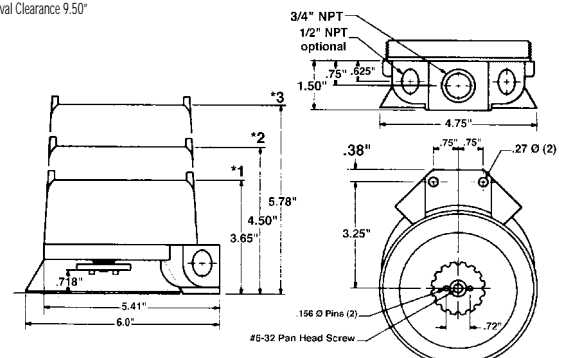
| Sensors:                          | SPST                            | SPDT                            |
|-----------------------------------|---------------------------------|---------------------------------|
| Typical Operate Time              | 1.0 millisecond                 | 3.0 millisecond 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

## Position Transmitter Specification

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

## Dimensional Data

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



# VRC Positioners

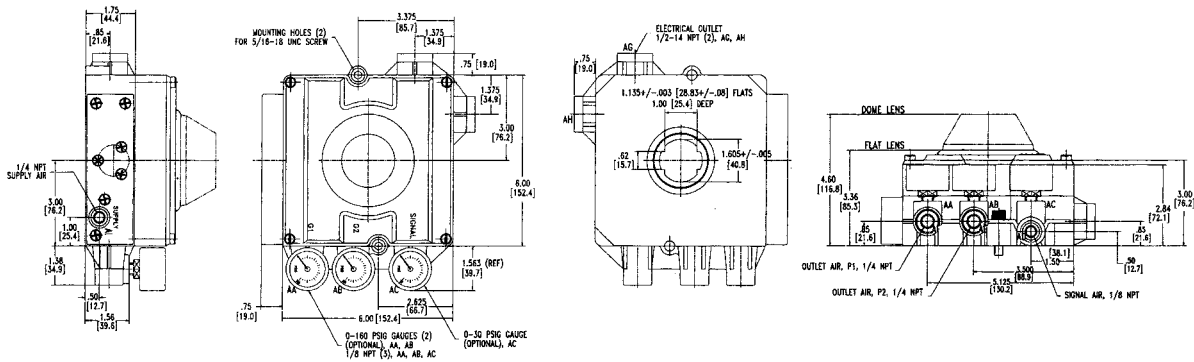
## Performance

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

## Construction

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

## Dimensional Diagrams



## Model Number Specifications

| Required Selections                   | Optional Selections |                    |               |   |                                  |             |           |                      |         |              |            |    |
|---------------------------------------|---------------------|--------------------|---------------|---|----------------------------------|-------------|-----------|----------------------|---------|--------------|------------|----|
| Model Type                            | Position Indicator  | Characterizing Cam | Spool Valve   |   |                                  | Port Gauges |           | Position Transmitter |         | Limit Switch |            |    |
| VP<br>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   | S2 |
| VE                                    | Dome 90°            | 9                  | Square        | 2 | Extreme Service<br>Standard Flow | 2           |           |                      |         |              | Proximity  |    |
| Electro-Pneumatic                     |                     |                    | 0-60°         | 3 | Extreme Service<br>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

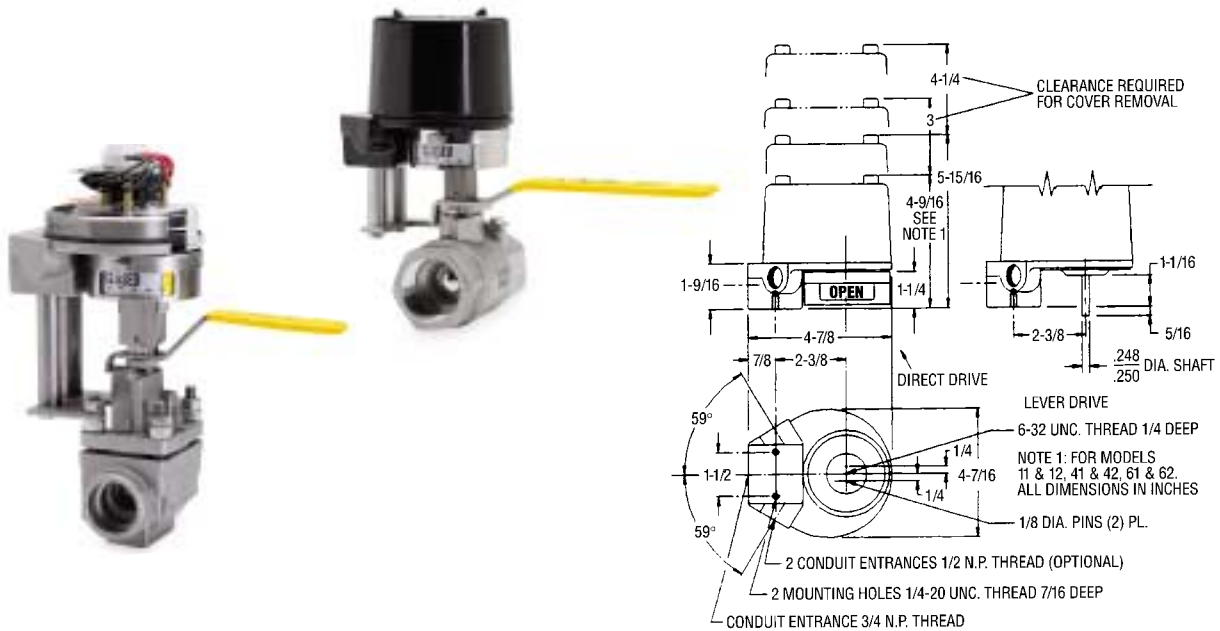
|                           | P1200/20     | P1500/20    | P2000/20     | P5/EP5*      |
|---------------------------|--------------|-------------|--------------|--------------|
| Connections:              | 1/4"         | 1/8"        | 1/4"         | 1/4"         |
| Supply Pressure:          | 150 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 | 35/7.1 scfm  | -----       |              | .75 scfm     |
| Air delivery @ 57 psig    | 14/16.8 scfm | 8.4/16 scfm | 12/15.7 scfm | 12.6 scfm    |
| Gain factor               | 120/135      | 250/310     | 50/400       | 10,000       |

\*PMV New Modular Unit P5-Pneumatic; EP5 Electropneumatic

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

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

# Proximity Valve Position Monitoring Systems



## Valve Position Monitoring Systems

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

| Proximity Model # | NEMA                  | Model Description                                | Switch/Transmitter Specifications |
|-------------------|-----------------------|--|-----------------------------------|
| 42ADM             | 4,4X                  | 2 SPDT MECH, Clear Plastic Cover                 | 15 amps ac, 5 amps dc             |
| 42AD0             | 4,4X,7,9              | 2 SPDT MECH, Anodized Aluminum Housing           | 15 amps ac, 5 amps dc             |
| 42DD0             | 4,4X,7,9              | 2 DPDT MECH, Anodized Aluminum Housing           | 10 amps ac, 10 amps dc            |
| 42RDM             | 4,4X                  | 2 SPDT PROX, Herm Sealed Reed, Plastic Cover     | 3 amps ac, 2 amps dc              |
| 42RD0             | 4,4X,7,9              | 2 SPDT PROX, Herm Sealed Reed, Anodized Al.      | 3 amps ac, 2 amps dc              |
| 42VD0J1           | 4,4X,7,9              | 2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al. | 10 amps ac, 10 amps dc            |
| 42RD0J1           | 4,4X,7,9              | 2 SPDT PROX, 3/4" & 1/2" NPT Entry, Anodized Al. | 3 amps ac, 2 amps dc              |
| 44AD0             | 4,4X,7,9              | 4 SPDT MECH, Anodized Aluminum Housing           | 15 amps ac, 5 amps dc             |
| 45VD0             | 4,4X,7,9              | 2 SPDT MECH, & Transmitter, Anodized Aluminum    | 10 amps / 4-20 mA out             |
| 45RD0             | 4,4X,7,9              | 2 SPDT PROX, & Transmitter, Anodized Aluminum    | 3 amps / 4-20 mA out              |
| 62LDM             | 4,4X                  | 2 SPST PROX, 2 LED'S, Clear Plastic Cover        | Herm Sealed Reed (mA)             |
| 62PD0             | 4,4X,7,9              | 2 SPST PROX, Anodized Aluminum Housing           | Herm Sealed Reed (mA)             |
| 62QD0             | 4,4X,7,9              | 2 SPDT PROX, Anodized Aluminum Housing           | Herm Sealed Reed (mA)             |
| 35OD0*            | Mag Coupling          | MULTI-TURN Transmitter, Anodized Aluminum        | No Switch / 4-20 mA               |
| 12AD0**           | Mag Coupling          | 2 SPDT MECH, Anodized Aluminum Housing           | 15 amps ac, 5 amps dc             |
| 15VD0             | Mag Coupling          | 2 SPDT MECH, & Transmitter, Anodized Aluminum    | 10 amps / 4-20 mA out             |
| 12VD0J1           | Mag Coupling          | 2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al. | 10 amps ac, 10 amps dc            |
| 12AD6             | Mag Coupling - ST STL | 2 SPDT MECH, 304 Stainless Steel Housing         | 15 amps ac, 5 amps dc             |
| 15VD6             | Mag Coupling - ST STL | 2 SPDT MECH, & Transmitter, 304 Stainless Steel  | 10 amps / 4-20 mA out             |

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

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

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

# APOLLO<sup>®</sup>

## Actuator Ready Ball Valves

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

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

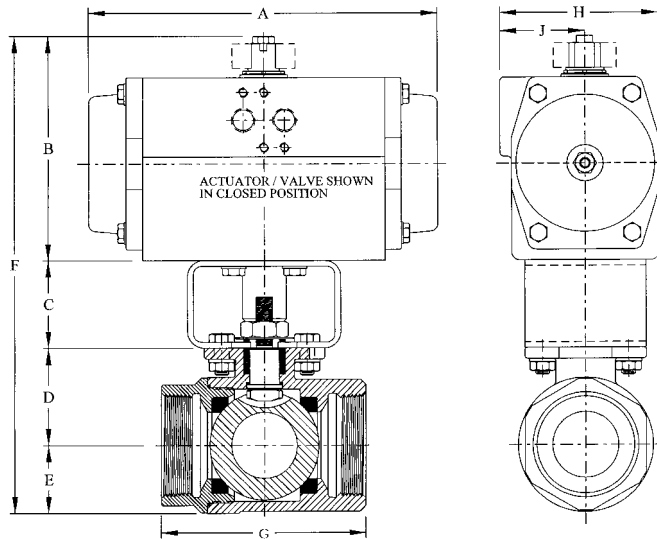
Get a Complete American Made Package

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

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



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



### How To Order

#### XX-ARX-64-XX

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

# Apollo® Actuator Ready (AR) Ball Valve

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

\*SIZES 1 1/2" AND LARGER

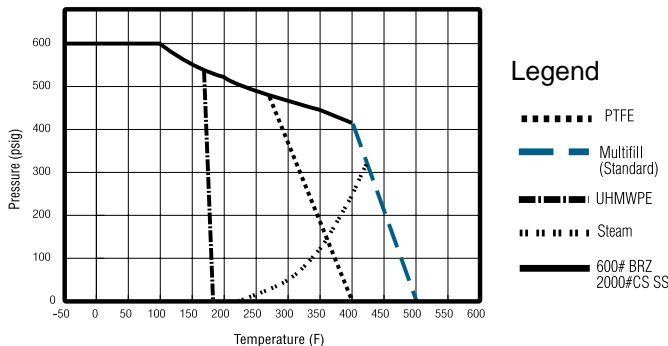
## CV Factors

| 77-ARX-64       |        |      |      |      |     |        |     |     |
|-----------------|--------|------|------|------|-----|--------|-----|-----|
| SIZE            | 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   |

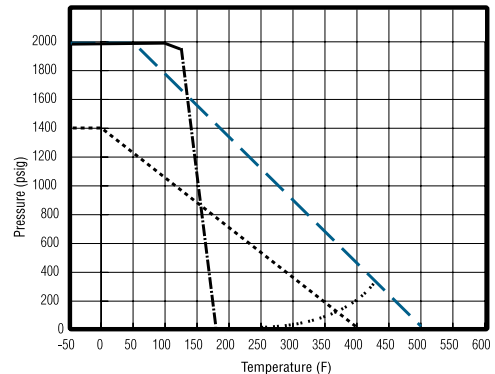
| 71-ARX-64, 76-ARX-64, 89-ARX-64 |        |      |      |      |     |        |        |     |        |     |     |  |
|---------------------------------|--------|------|------|------|-----|--------|--------|-----|--------|-----|-----|--|
| SIZE                            | 1/4"   | 3/8" | 1/2" | 3/4" | 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   |  |

## 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.

# APOLLO<sup>®</sup>

## Actuator Ready Ball Valves

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

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

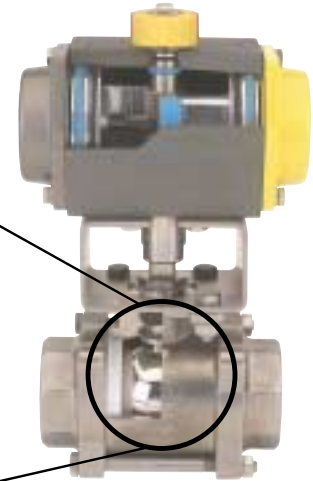
For actuation, the lever is removed, and Belleville spring washers are added as standard making the Apollo<sup>®</sup> three piece ball valve ideal for high cycle and thermal cycle applications. With Belleville washers the V-ring packing is self-adjusting. This packing arrangement has been tested well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

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

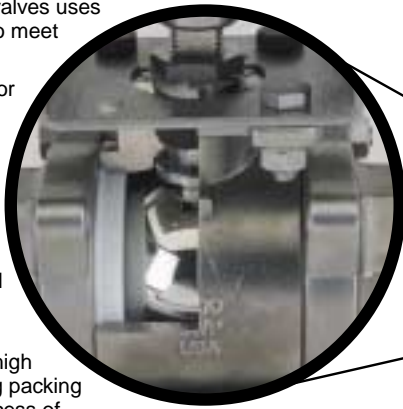
A Perfect-Fit Replacement For Current Apollo<sup>®</sup> Installations

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

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

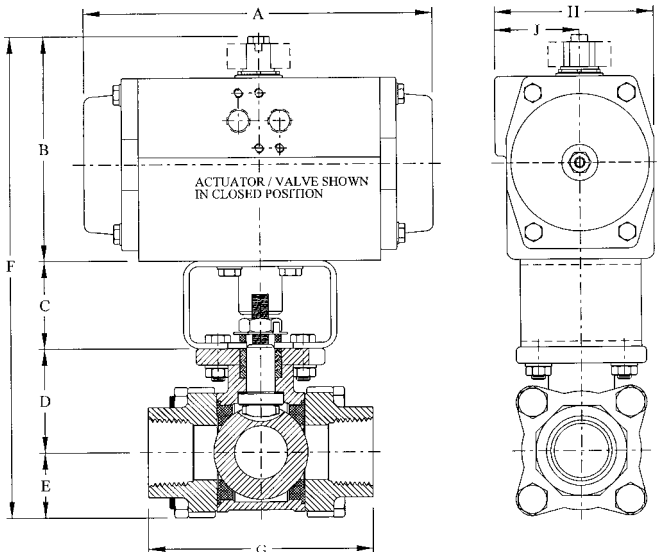


**New Design!**



| Construction Materials |   |                                |
|------------------------|---|--------------------------------|
| ITEM DESCRIPTION       | CARBON STEEL<br>(83R)                           | STAINLESS STEEL<br>(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")<br>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.

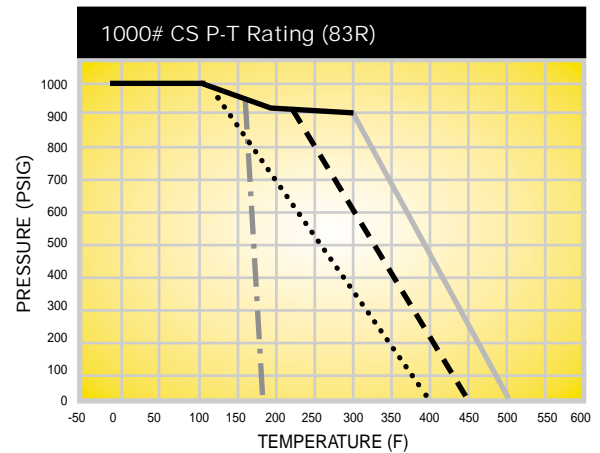
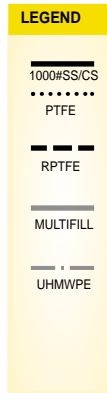
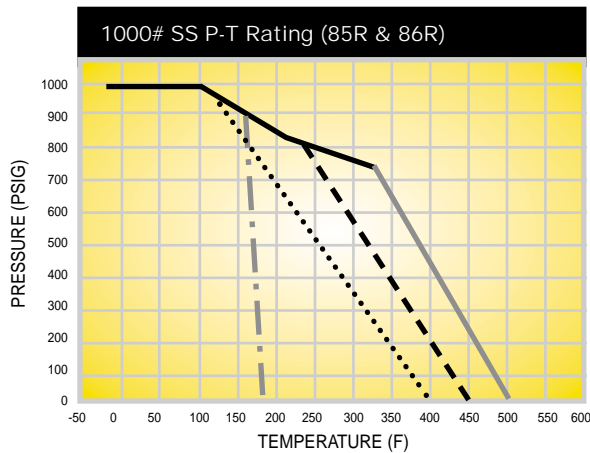
# Apollo® Actuator Ready 3-Piece Ball Valve

## CV Factors

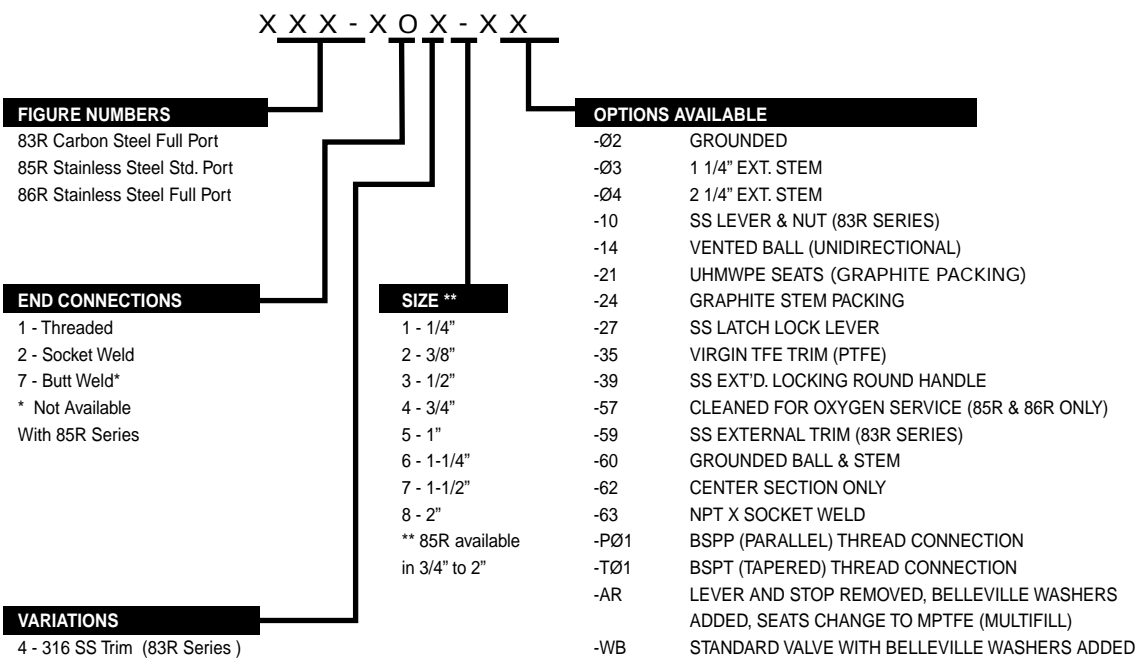
| 83R-100, 83R-200, 83R-700, 86R-100, 86R-200 & 86R-700 Series |     |      |      |      |      |     |        |        |     |
|--|-----|------|------|------|------|-----|--------|--------|-----|
| SIZE   |     | 1/4" | 3/8" | 1/2" | 3/4" | 1"  | 1-1/4" | 1-1/2" | 2"  |
| OPEN   | 90° | 8.1  | 14   | 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      |     |

| 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



**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<br>**71-ARX-64<br>89-ARX-64<br>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   |       |       |  |
| *FULL PORT<br>**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<br>70-64X<br>71-14X<br>76-10X<br>76-60X<br>89-14X<br>399-10X   | 1/4 - 1/2 | 35    | 35    | 40    | 43    | 46    | 48    |
|   | 3/4       | 50    | 50    | 54    | 59    | 62    | 64    |
|   | 1         | 101   | 101   | 103   | 106   | 116   | 130   |
|   | 1-1/4     | 171   | 171   | 205   | 216   | 246   | 286   |
|   | 1-1/2     | 192   | 192   | 216   | 265   | 280   | 311   |
|   | 2         | 271   | 271   | 276   | 300   | 309   | 354   |
|   | 2-1/2 & 3 | 715   | 715   | 790   |       | 1,200 |       |
| FULL PORT<br>BRONZE<br>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<br>3-PIECE<br>83-34X & 44X<br>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<br>3-PIECE<br>82-14X & 24X<br>83R-14X, 24X & 74X<br>83-54X & 64X<br>86R-10X, 20X & 70X<br>86-50X & 60X<br>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   |        |        |        |        |
| 88A-140's               | 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     |
| 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)

|              |            | Differential Pressure (psig) |        |        |        |        |
|--------------|------------|------------------------------|--------|--------|--------|--------|
| Seat Options | Valve Size | 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<br>U     | 8          | 11,000                       | 14,000 | 18,500 | 25,000 | 36,000 |
|              | 10         | 18,500                       | 22,000 | 30,000 | 40,000 | 62,000 |
| **6 Z**      | 1/2 thru 1 | 115                          | 160    | 210    | 260    | 450    |
| 4            | 1-1/2      | 270                          | 370    | 480    | 590    | 1,000  |
|              | 2          | 475                          | 650    | 860    | 1,050  | 1,750  |
| 8<br>****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<br>OF OPERATION         | ON/OFF SERVICE                      | 0          |
|                              | MODULATING SERVICE                  | 0.25       |
| PROCESS<br>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   |
| FREQUENCY<br>OF<br>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<br>TEMPERATURE       | APPLICATIONS ABOVE 400 DEG F        | 0.25       |
|                              | APPLICATIONS BELOW -20 DEG F        | 0.25       |
| VALVE<br>SEATING<br>MATERIAL | PTFE                                | -0.3       |
|                              | *MULTIFILL                          | -0.2       |
|                              | *PEEK                               | 0.4        |
|                              | *UHMWPE                             | 0.3        |
| CUSTOMER<br>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<br>SIZE   | SERVICE FACTOR I |      |       |       | SERVICE FACTOR 1+ |       |       |       | SERVICE FACTOR II |       |       |       | SERVICE FACTOR III |       |       |       |
|   | 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  | 6525  | 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:**

- Above figures are applicable to 130/132 & 140/142 Series Apollo® Resilient Seated Butterfly Valves.
- The charted torque values above are the total of all internal frictional resistances for opening or closing against indicated pressure.
- The effect of Dynamic Torsion is not considered in this chart.
- Pressure capacity (rating) of valves is not considered in this chart.
- Torsional capacity of valve shafts is not considered in this chart.
- 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.
- For Elastomer covered discs, do not use less than service Factor II Values.
- 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<br>Bushings PTFE           | 100 PSIΔP<br>Bushings PTFE | 150 PSIΔP<br>Bushings PTFE | 200 PSIΔP<br>Bushings 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.

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