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## WATER SOLUTIONS



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WATER SOLUTIONS



**"Apollo"®**

# Flow Controls

"Apollo" Valves

Elkhart Products Corporation



LASCO  
FITTINGS, INC.

SHURJOINT®

**"Apollo" ACTUATION**  
www.apollovalves.com

Year: 2014  
Type: A0040U  
Serial no.: 361025002  
PED group: 2  
PS max: 8 Bar (120 PSI)  
Temp range: -20°C (-5°F) to +75°C (+165°F) @ T8  
                  -20°C (-5°F) to +80°C (+175°F) @ T5  
For surface temp. "TX" see the Safety Guide (DOC. SG EF 1, Table 5.1)  
Tech. File Ref. RPGE-CED002, Emerson, Hengelo 7556BR, NL



**"Apollo" ACTUATOR**

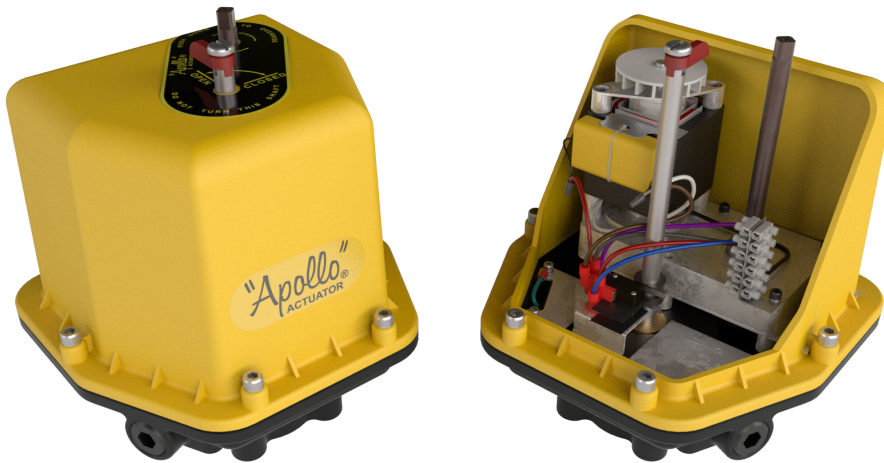
**ACTUATION CATALOG**  
ACCA9000

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Found in part 1 of 2

Found in part 2 of 2



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

### FIVE OUTPUT TORQUES, ONE HOUSING

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

### EASY TO USE

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

### MANY STANDARD FEATURES

#### 4-20MA POSITIONER FEATURES (P - OPTION)

Advanced Protection Features

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

Performance Features

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

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

### BROAD TEMPERATURE RANGE

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

### AVAILABLE OPTIONS

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

#### 4-20MA POSITION TRANSMITTER FEATURES (T - OPTION)

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

# AE SERIES ACTUATORS GENERAL SPECIFICATIONS & DIMENSIONS

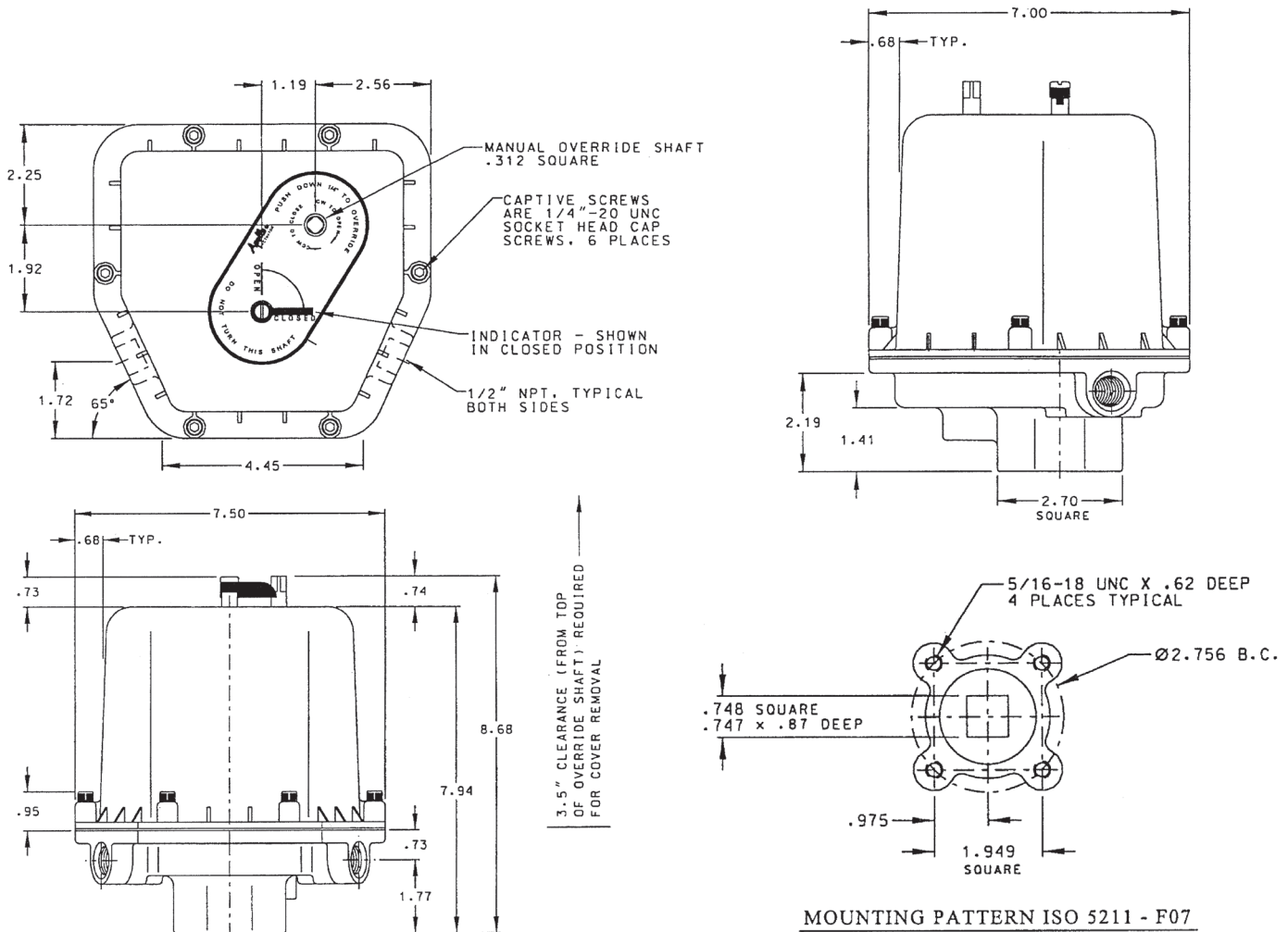
ACTUATOR MODEL	BREAKAWAY TORQUE OUTPUT (IN.-LBS.)	CYCLE TIME 90° TRAVEL (50% LOAD)	DUTY CYCLE	AMPERAGE DRAW (MAX.)			
				STARTING OR LOCKED ROTOR CURRENT VOLTAGE			
				115 VAC	230 VAC	12 VDC	24 VDC
AE200	200 in-lbs	5.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE400	400 in-lbs	10.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE600	600 in-lbs	15.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE800	800 in-lbs	20.0 sec.	25%	.74 amp	.44 amp	1.6 amp	1.7 amp
AE1000	1000 in-lbs	25.0 sec	25%	.74 amp	.44 amp	1.6 amp	1.7 amp

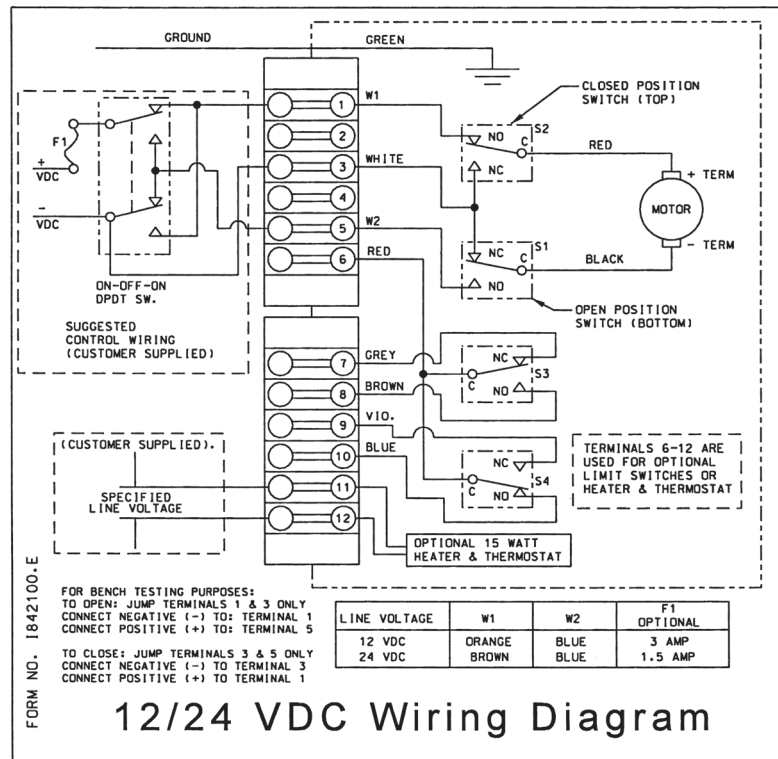
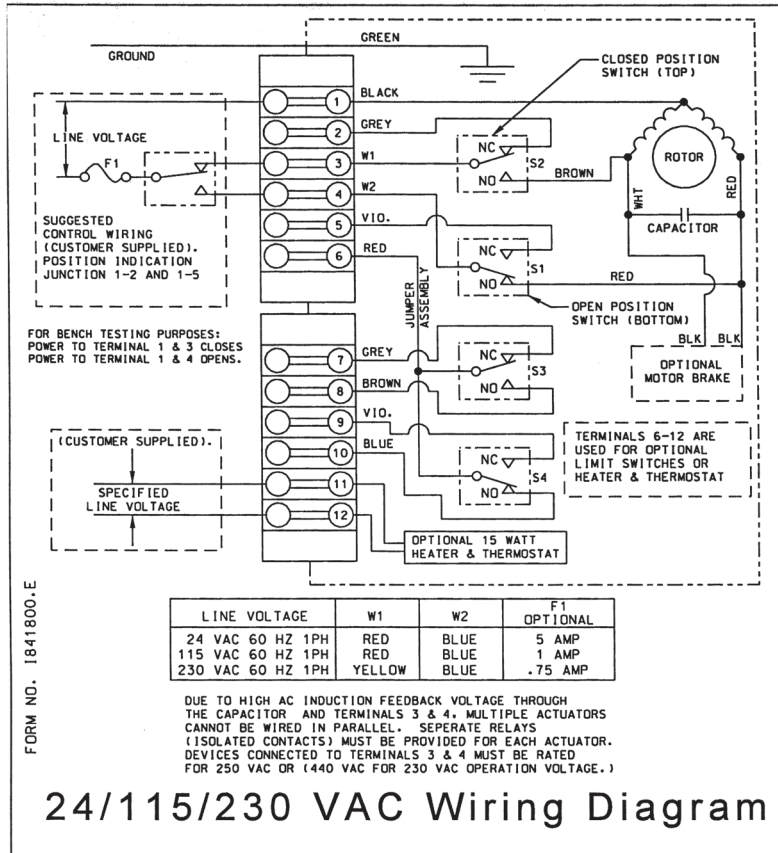
Note: 90° travel = travel from closed position to open position or vice versa.

DC current draw is at max. torque

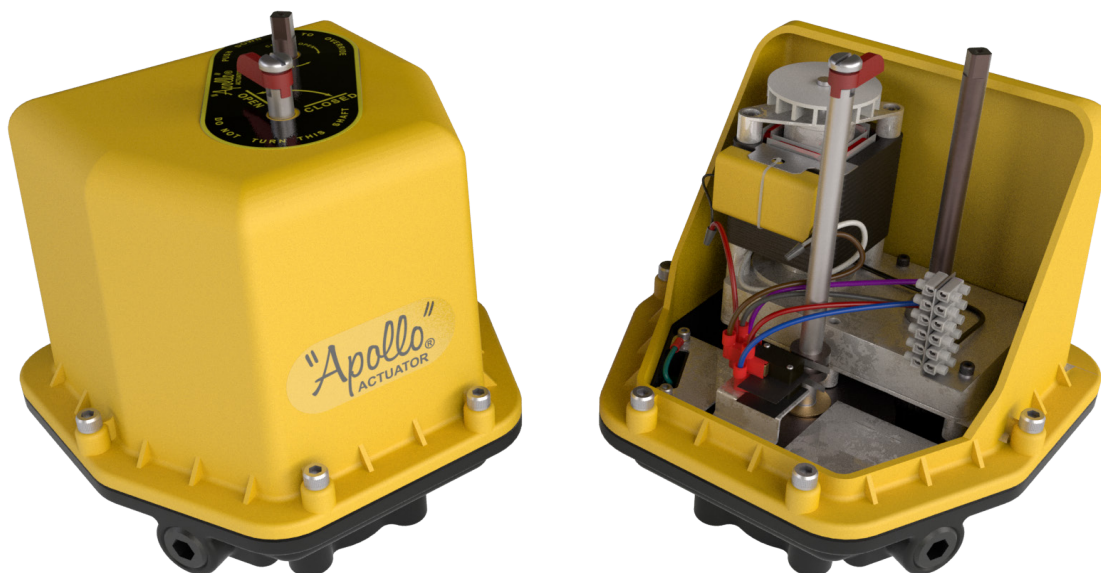
24 VAC current draw at locked rotor 4.6 amp

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





# AE SERIES ACTUATORS HOW TO ORDER



AE - PREFIX	400 - TORQUE (LB - IN)	3 VOLTAGE	BF OPTIONS
AE	200 400 600 800 1000 Enter all digits of Torque Value	1 - 115 vac 2 - 24 vac 3 - 220 vac  4 - 12 vdc 5 - 24 vdc	0 - Standard A - One extra switch & cam* B - Two extra switches & cams* C - Three extra switches and cams* D - Heater and Thermostat (15 watt) F - Motor Brake (115 VAC & 24 VAC Only) H - Tropical Heater (15 watts) P - Positioner 4-20 mA T - Transmitter 4-20 mA

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

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

**Example:**  
**AE-400-2BF :**  
 400 lb. in.; 24 VAC; 2 extra switches and cams, motor brake  
**AE-1000-ID :**  
 1000 lb. in.; 115 VAC; Heater and thermostat



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

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

## HAZARDOUS LOCATION ENCLOSURES

The standard enclosures (CS and CL) are rated for NEMA 4/4X (weather tight and corrosion resistant). The Hazardous Location enclosures are rated for NEMA 4/4X/7 & 9, Class I, Div 1, Groups C&D; Class II, Div. 2, Groups E, F, & G; Class III.

## (CSA) CERTIFICATIONS

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

## FEATURES

- Plug-in connectors for the motor, the brake option and the heater/thermostat option
- All connectors are coded to prevent mis-wiring.
- Limit switch wires are soldered to the board - no more loose connections.
- A six position terminal strip clearly labeled so it can be wired up in the field without an instruction manual.
- Thermal overload protection (AC motors)
- Dual conduit openings; 3/4" (1/2" with supplied bushings)
- Visual position indication
- All aluminum enclosure
- Captive cover bolts on CS Series
- Manual override shaft (optional handwheel override with declutchable shaft)



# CS & CL SERIES ACTUATORS DIMENSIONS

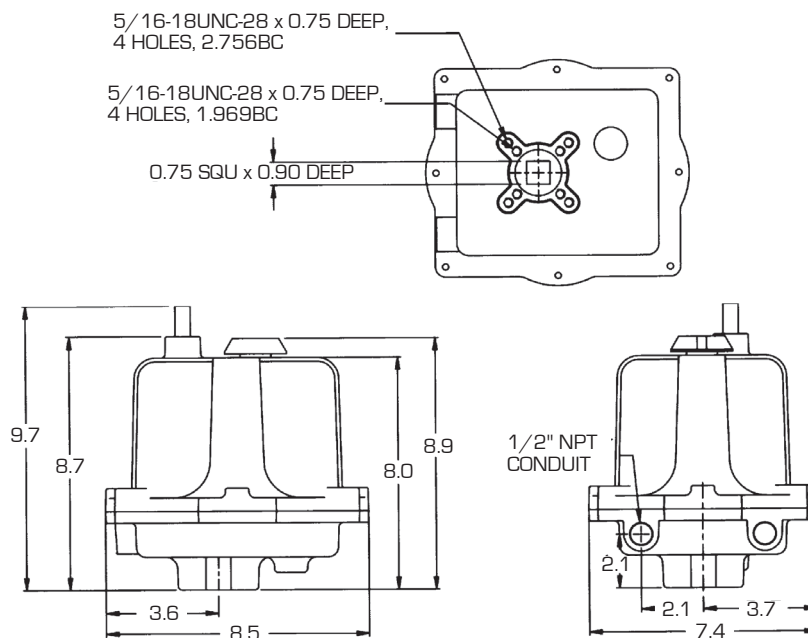
## INTRODUCING SIMPLICITY FOR CALIBRATING MODULATING ACTUATORS

The control board brings a whole new level of simplicity to the field. It will work with either of the motor boards (115VAC or 230VAC).

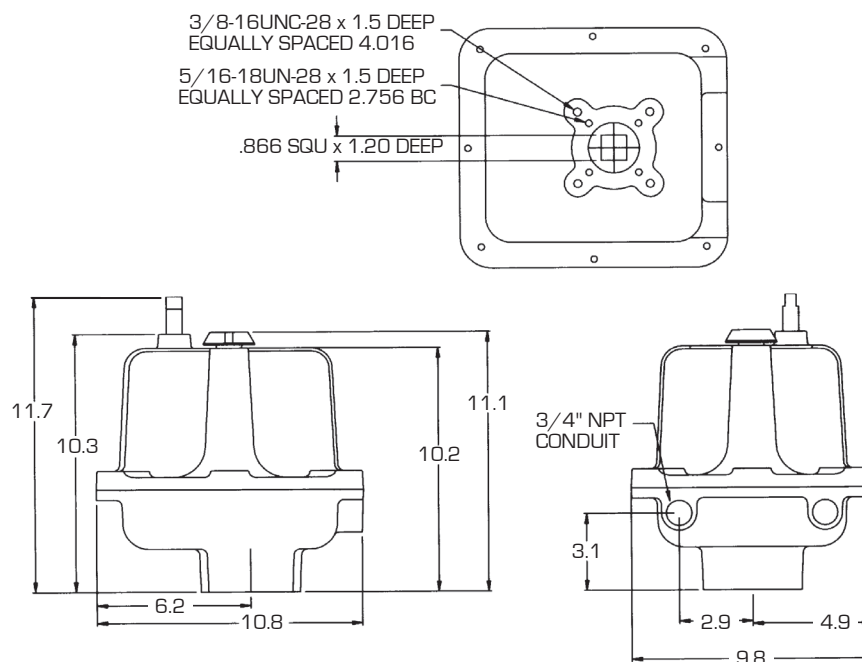
Features include:

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

## CS DIMENSIONS



## CL DIMENSIONS



# CS & CL SERIES ACTUATORS SPECIFICATIONS & OPTIONS

## CS & CL EXTENDED DUTY DATA TECHNICAL DATA—115VAC AND 230VAC MODELS\*

SERIES	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)	
				115 VAC	230 VAC	115 VAC	230 VAC	115 VAC	230 VAC
CS	150 in lb	8	75%	70vA	115vA	0.6 amps	0.5 amps	1.25 amps	0.924 amps
	300 in lb	15	75%	70vA	115vA	0.6 amps	0.5 amps	1.25 amps	0.924 amps
	600 in lb	30	75%	70vA	115vA	0.6 amps	0.5 amps	1.25 amps	0.924 amps
CL	1000 in lb	25	75%	92vA	161vA	0.8 amps	0.7 amps	1.66 amps	1.29 amps
	1500 in lb	40	75%	92vA	161vA	0.8 amps	0.7 amps	1.66 amps	1.29 amps
	2000 in lb	55	75%	92vA	161vA	0.8 amps	0.7 amps	1.66 amps	1.29 amps
	2500 in lb	70	75%	92vA	161vA	0.8 amps	0.7 amps	1.66 amps	1.29 amps
	3000 in lb	75	55%	92vA	161vA	0.8 amps	0.7 amps	1.66 amps	1.29 amps

## CS & CL CONTINUOUS DUTY DATA

SERIES	TORQUE (IN-LB)	DUTY CYCLE	12 VDC		24 VDC		24 VAC		115 VAC		230 VAC	
			CYCLE TIME (SEC/90°)	CURRENT DRAW AMPS	CYCLE TIME (SEC/90°)	CURRENT DRAW AMPS	CYCLE TIME (SEC/90°)	CURRENT DRAW AMPS	CYCLE TIME (SEC/90°)	CURRENT DRAW AMPS	CYCLE TIME (SEC/90°)	CURRENT DRAW AMPS
CS	150	100%	11	2.2	13	1.2	8	1.8	9	0.4	9	0.4
	300	100%	17	2.5	13	1.4	12	2.1	13	0.5	13	0.4
	600	100%	17	2.8	13	1.7	13	2.5	14	0.6	14	0.5
CL	1000	100%	21	4	14	2.4	15	3.5	15	0.9	15	0.6
	1500	100%	40	4	24	2.4	27	3.5	29	0.9	29	0.6
	2000	100%	40	4.3	33	2.4	28	3.5	29	0.9	29	0.6
	2500	100%	55	3.3	40	2	38	3.1	39	0.8	39	0.6
	3000	100%	60	3.7	42	2.2	40	3.5	42	0.8	43	0.6

\*Notes:

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

### ACTUATOR MODEL#s/DESCRIPTION

- 115 115 VAC Motor (Standard or Continuous)
- 230 VAC 230 VAC Motor (Standard or Continuous)
- J Speed Control/Timer Board
- X NEMA 4,4X,7, & 9
- W NEMA 4 & 4X
- H Tropical Heater
- S2 Two Auxiliary Switches SPDT
- T Heater and Thermostat
- K Motor Brake<sup>2</sup>
- Z Declutchable Handwheel Override
- P Feedback Potentiometer (0-1000 Ohm)

• CSA certification with (C US) marking is standard on all standard (extended) duty models.

• CSA certification with (C US) marking is standard on continuous duty models ordered with enclosure option "E".

<sup>2</sup> Standard on continuous duty cycle units

# CS & CL SERIES ACTUATORS HOW TO ORDER

## HOW TO ORDER CS & CL EXTENDED DUTY CYCLE ACTUATOR

### PART NUMBER MATRIX

SERIES	TORQUE	ENCLOSURE	GENERAL OPTIONS	DUTY CYCLE	VOLTAGE
CS	600	W	S2	E - STANDARD	115 VAC
CL	1500	X	S2	E - STANDARD	230 VAC

## HOW TO ORDER CS CONTINUOUS DUTY CYCLE ACTUATOR

### PART NUMBER MATRIX

3RA	CS	600	W	UL2	Z
PREFIX	SERIES	TORQUE	ENCLOSURE	OPTIONS <sup>2</sup>	ADDITIONAL OPTIONS
3RA	CS	150 IN-LB, 12 FT-LB, 17 NM 300 IN-LB, 25 FT-LB, 34 NM 600 IN-LB, 50 FT-LB, 68 NM	W - NEMA 4/4X X - NEMA 4/4X/7&9	U2 - ON/OFF/POSITION BOARD UL2 - ON/OFF/POSITION BOARD W/ BATTERY BACKUP	-- NO ENTRY IF STANDARD Z - HANDWHEEL

## HOW TO ORDER CL CONTINUOUS DUTY CYCLE ACTUATOR

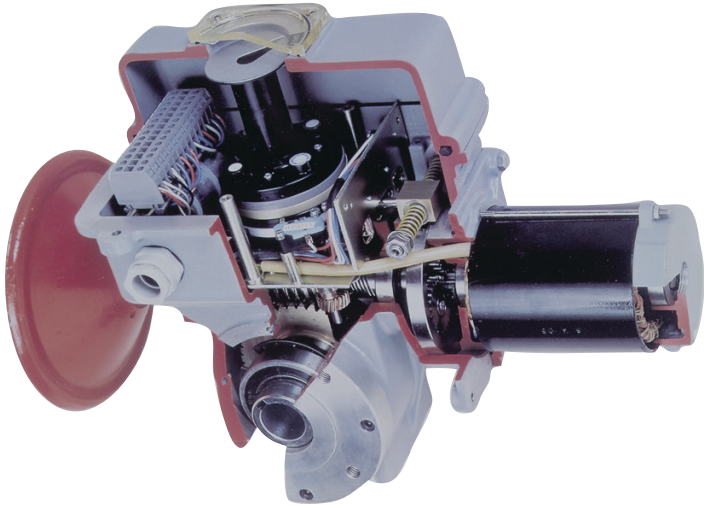
### PART NUMBER MATRIX

3RA	CL	2500	X	UL3	-
PREFIX	SERIES	TORQUE	ENCLOSURE	OPTIONS <sup>2</sup>	ADDITIONAL OPTIONS
3RA	CL	1000 IN-LB, 83 FT-LB, 113 NM 1500 IN-LB, 125 FT-LB, 169 NM 2000 IN-LB, 167 FT-LB, 226 NM 2500 IN-LB, 208 FT-LB, 282 NM 3000 IN-LB, 250 FT-LB, 339 NM	W - NEMA 4/4X X - NEMA 4/4X/7&9	U2 - ON/OFF/POSITION BOARD UL3 - ON/OFF/POSITION BOARD W/ BATTERY BACKUP	-- NO ENTRY IF STANDARD Z - HANDWHEEL

1. All Continuous Duty Cycle CS/CL actuators accept any of the following input voltage (12VDC, 24VDC, 24VAC, 115VAC, & 230VAC), are rated for continuous duty cycle, include a holding brake, two auxiliary limit switches, 4-20mA or 0-10VDC position feedback, wrench-operated manual override, CSA "C US" certification, CE compliance, and a heater/thermostat that can be user-enabled on the option board.

2. Only one board option can (and must) be selected. All board options can be configured for On/Off or modulating operation.

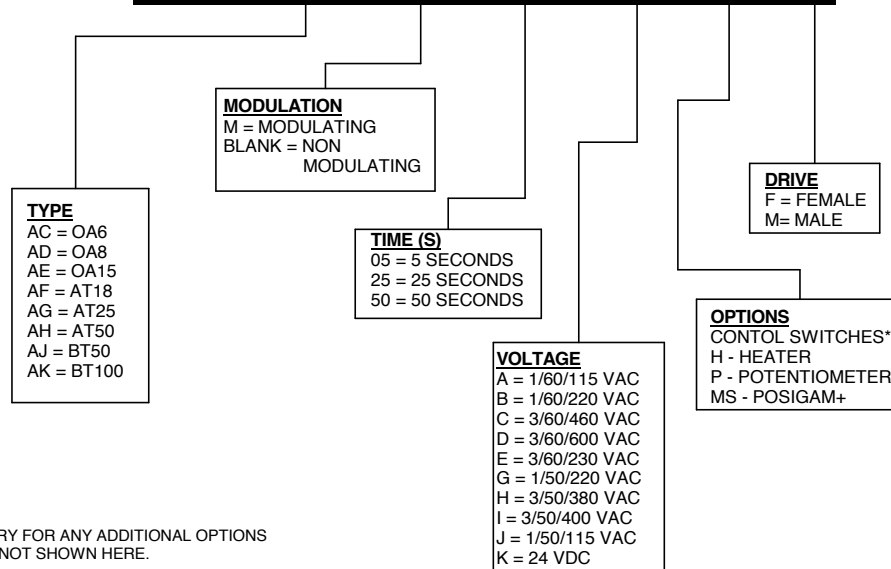
# LB SERIES ACTUATORS SPECIFICATIONS & OPTIONS



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

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

## 3R - AD - M - 05 - B - X - F



### LB SERIES ELECTRIC ACTUATOR PERFORMANCE DATA

L-B SERIES MODEL NUMBER	TORQUE OUTPUT LB-IN	ROTATING SPEED (SEC/90 DEGREE)		POWER REQUIREMENTS 30% DUTY CYCLE			
		STD	OPT	115VAC 1 PH 60HZ		460 VAC 3 PH 60 HZ	
				RATED	START	RATED	START
OA8	885	5		1.95	3.3	0.63	1.15
OA8	885	25		1.25	2	0.39	0.78
OA15	1350	15	25	1.95	3.3	0.39	0.78
AT25	2250	15		1.95	3.3	0.63	1.15
AT25	2250	25	50	1.95	3.3	0.39	0.78
AT50	4500	25		4.6	12	0.63	1.15
AT100	8850	24	12	4	17	0.6	1.2

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

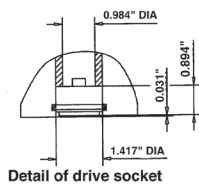
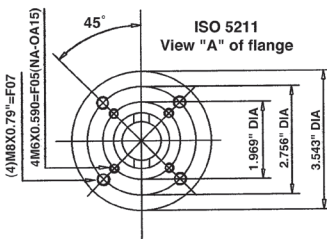
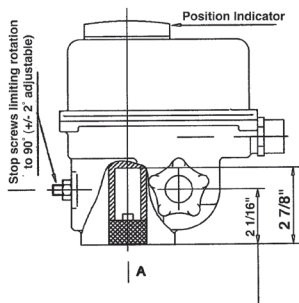
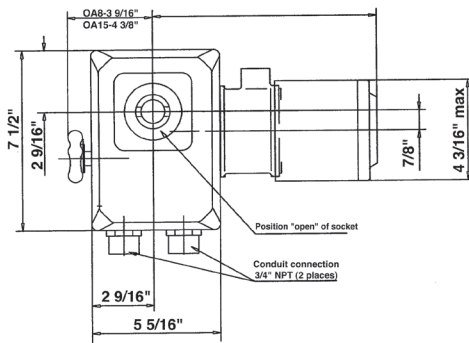
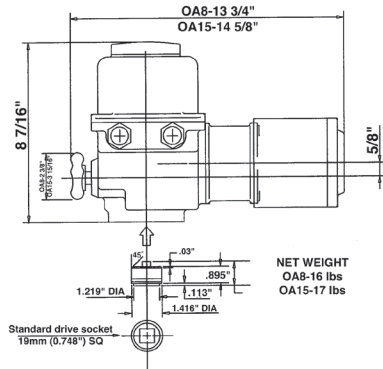
Notes:

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

# LB SERIES ACTUATORS DIMENSIONS

## TYPES OA08 AND OA15

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



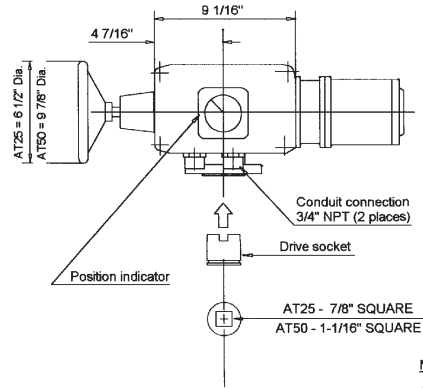
## TYPES AT25 AND AT50

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

Duty rating 30%. Net weight: 40 lbs.

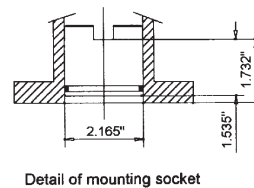
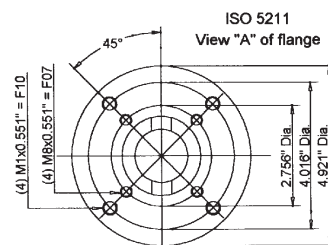
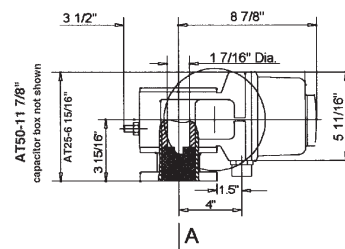
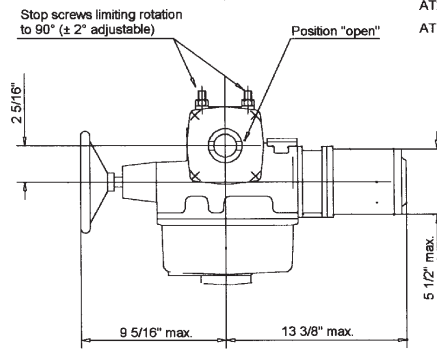
AT25 female socket dimension = .866 square

AT50 female socket dimension = 1.063 square



### NET WEIGHT

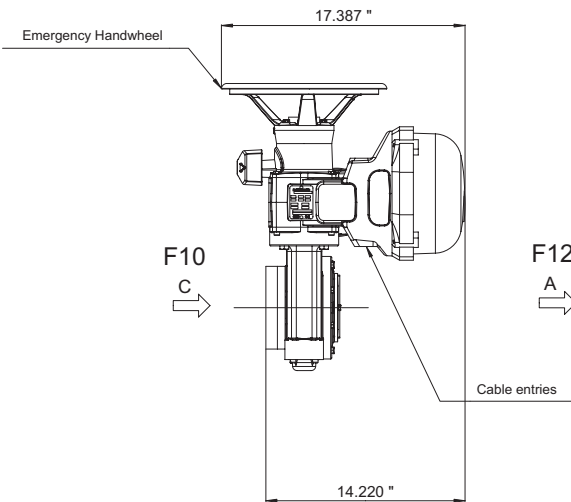
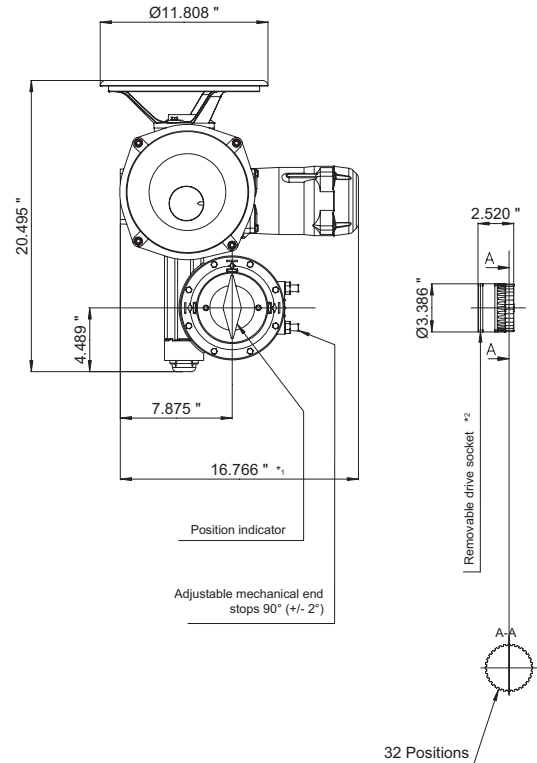
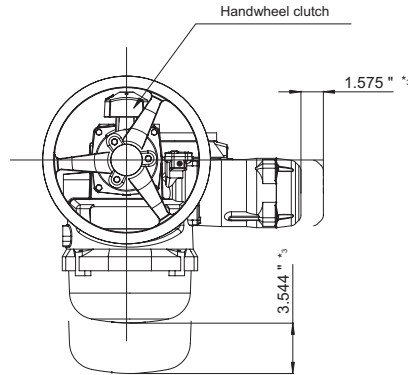
AT25 - 35 lbs  
AT50 - 40 lbs



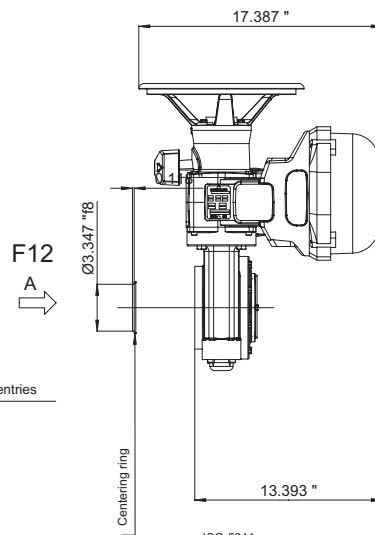
# LB SERIES ACTUATORS DIMENSIONS

## TYPE AT100

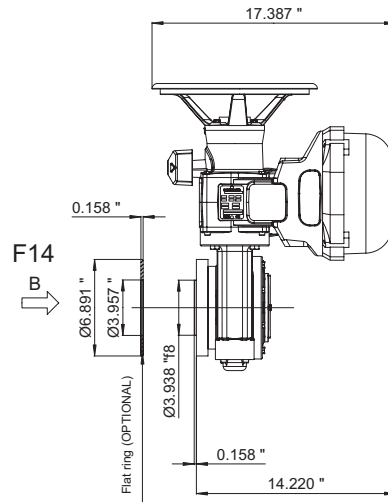
Standard specification: Weatherproof to NEMA 4, fitted with two adjustable SPDT travel limit switches (one for each extreme position); two SPDT torque limit switches (one for each direction of rotation) and with handwheel for manual operation. Duty rating 30%.



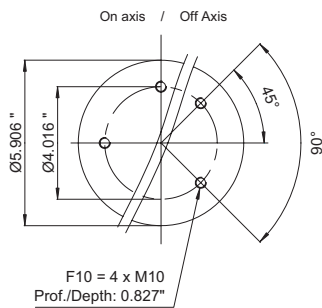
ISO 5211  
F10  
View C of the flange



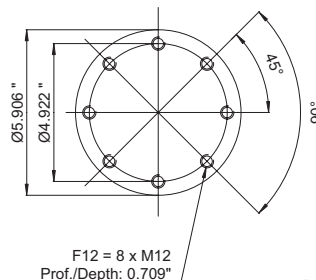
ISO 5211  
F12  
View A of the flange



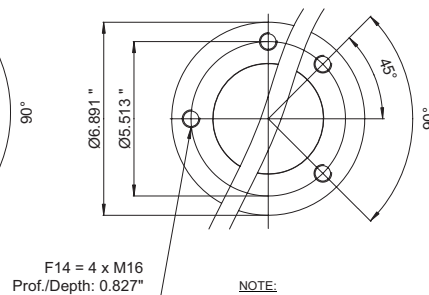
ISO 5211  
F14  
View B of the flange



F10 = 4 x M10  
Prof./Depth: 0.827"



F12 = 8 x M12  
Prof./Depth: 0.709"



F14 = 4 x M16  
Prof./Depth: 0.827"

**NOTE:**

- \*1: The actuator is represented in its maximum size.
- \*2: Representation of the socket in closed position.
- \*3: Dimension to allow for disassembly

32 Positions

# SOLENOIDS GENERAL SPECIFICATIONS

## DIRECT MOUNTED NAMUR SOLENOID VALVES

### TEMPERATURE LIMITS:

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

### COIL RATINGS:

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

### COIL VOLTAGES AVAILABLE:

- Coil Voltage Variation: +/-10% of Nominal  
120 VAC-60 Hz/110 VAC-50 Hz.  
240 VAC-60 Hz/220 VAC-50 Hz/120 VDC.  
48 VAC-60 Hz/44 VAC-50 Hz/24 VDC.  
24 VAC-60 Hz/22 VAC-50 Hz/12 VDC.

### POWER CONSUMPTION:

- 6 Watts

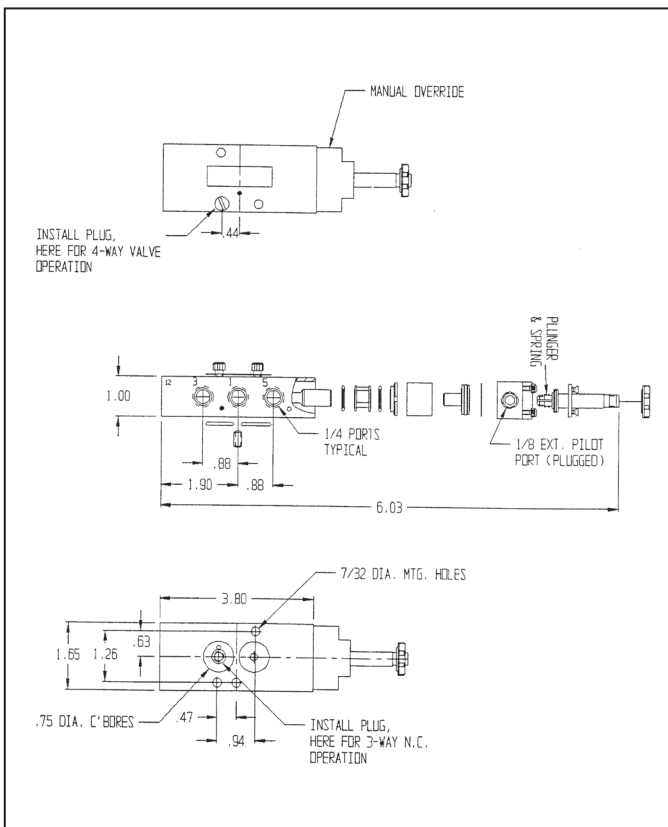
### MATERIALS:

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

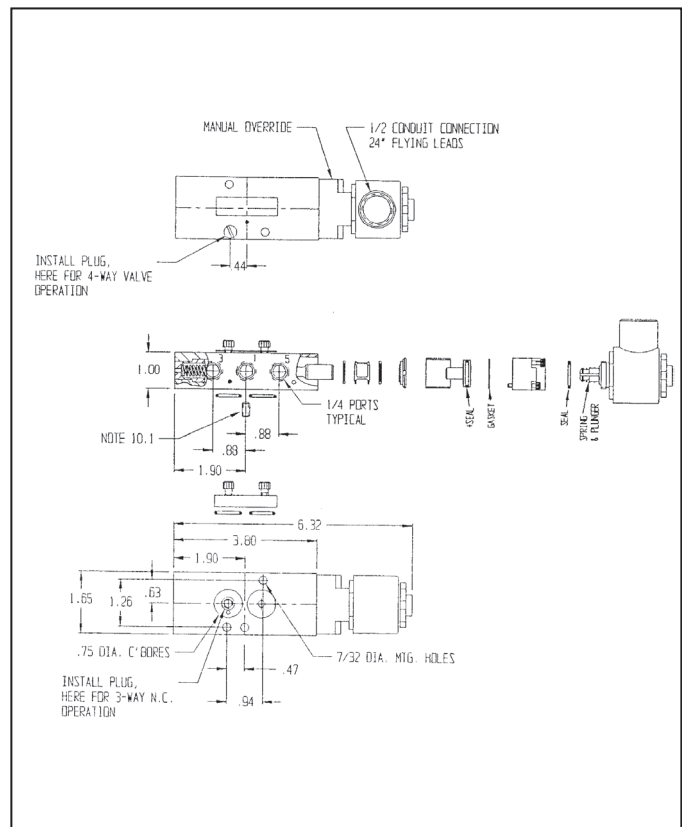
### CV FLOW RATE:

- 1.8

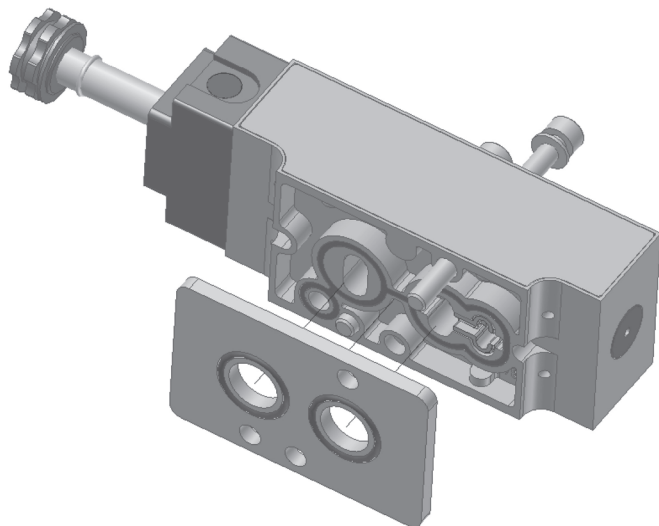
NEMA 4-4X UL, CSA, PTB&CE



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



## NAMUR SOLENOID VALVE WITH TRANSITION PLATE



## SOLENOID VALVES

AVC NAMUR \*Three & Four-way, end mounted coil

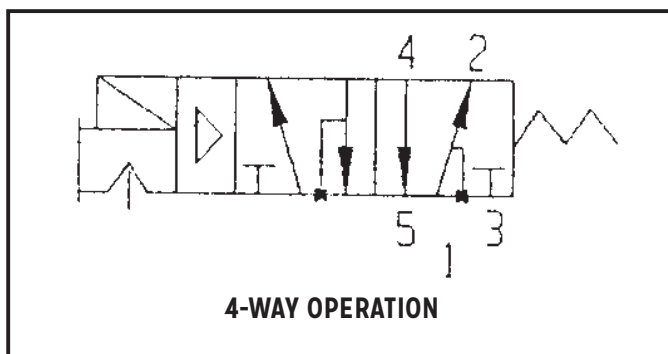
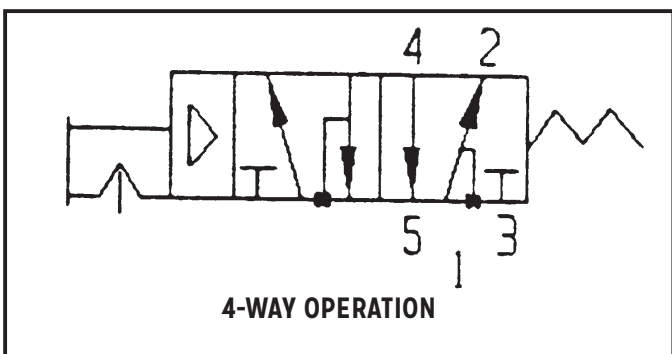
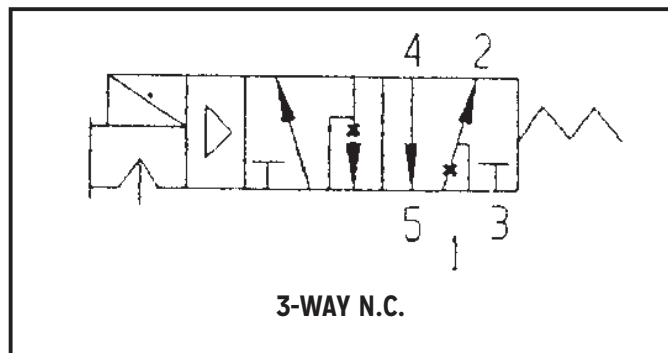
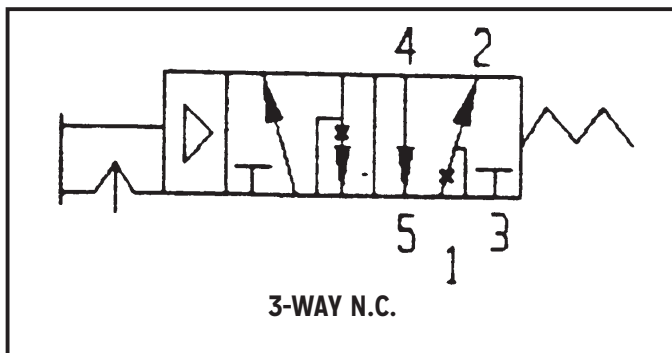
Solenoids: Cv=1.8

For NAMUR Direct Mount

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

All above include adapters to turn "NAMUR 90°"

PART NO.		
3T8-000-32A	Adapter	0025-4000





# LIMIT SWITCHES STONEL QUARTZ & MONITEUR

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

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

## ENCLOSURES OPTIMIZED FOR ENVIRONMENT

- QX: Explosion proof, water tight and corrosion-proof enclosure is approved for use in div. 1/zone 1 hazardous areas.
- QN: Nonincendive is approved for all div. 2/zone 2 hazardous environments with proximity sensors using a clear cover. Intrinsically safe Namur sensors or passive switches are available for div. 1/zone 0 applications.
- QG: General purpose features a clear Lexan cover with mechanical switches. All enclosures are rated NEMA 4, 4x, and 6.



## RAPID ENCLOSURE ACCESS

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

## FASTER WIRING

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

## WIDE VARIETY OF SWITCHING & COMMUNICATION

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

## QUICK SET CAMS ARE EASY TO ADJUST

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

## DUAL SHAFT O-RING SEALS ELIMINATE CORROSION

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

## SPECIAL DRIVE BUSHING ASSURES LONG CYCLE LIFE

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

## SPACE SAVING VISUAL INDICATION

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

Moniteur Limit Switches have been designed to provide the most visible and reliable valve position indication in general purpose, difficult process, and explosion-proof environments. With a wide variety of switches and sensors available to match your application.

## FEATURES

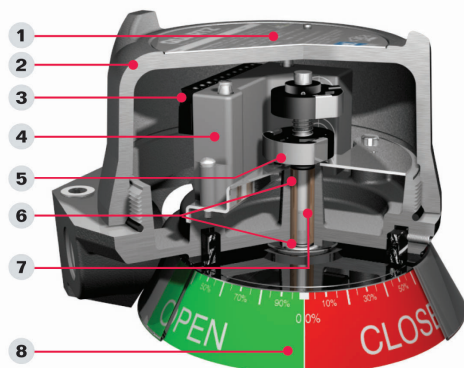
- The industry's only "true" visual valve position indicator available for multi-port valves, adjustable to match the actual physical flow pattern of the valve.
- Patented engineered Loc-Ring Cam and Shaft Retention System provides unsurpassed sensing accuracy over the multi-million cycle life of the physical platform.
- Clear Ektar cover offers optimum chemical resistance and strength and is environmentally sealed to prevent fogging and entry of contaminants.
- Indicator is fully adjustable to any valve or actuator.
- Internal switches and terminal block are labeled for easier installation.
- Careful material selection provides a rated life of minimum 1,000,000 cycles.
- Materials of construction selected to excel in high vibration, corrosive, and dirty environments, either indoors or outdoors.
- "Flat cover" version is available without an indicator for areas with tight space requirements.

PART NUMBER	MODEL NO.	DESCRIPTION
3T-LS3-02	FMYB-5120	NEMA 4/Indicator/2 SPDT Mech.
3T-LS3-06	FFNB-5120	NEMA 4/Flat Cover/2 SPDT Mech.
3T-LS3-01	AMYB-5120	NEMA 7/Indicator/2 SPDT Mech.
3T-LS3-05	AFNB-5120	NEMA 7/Flat Cover/2 SPDT Mech.
3T-LS3-03	AMYB-5220	NEMA 7/Indicator/2 SPDT Prox.
3T-LS3-07	AFNB-5220	NEMA 7/Flat Cover/2 SPDT Prox.
3T-LS3-04	FMYB-5220	NEMA 4/Indicator/2 SPDT Prox.

PART NUMBER	ACTUATOR SIZE
63-002-12	0012
63-002-13	0025-0350
63-002-14	0600-4000

\*Short shaft NAMUR must use kits above.

See Page 42 for Part Numbering Matrix



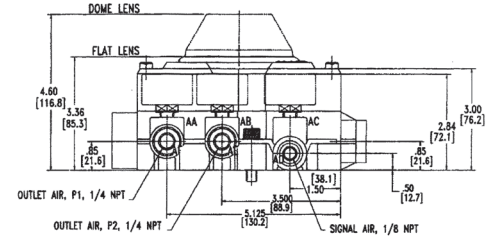
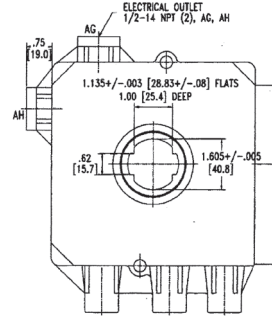
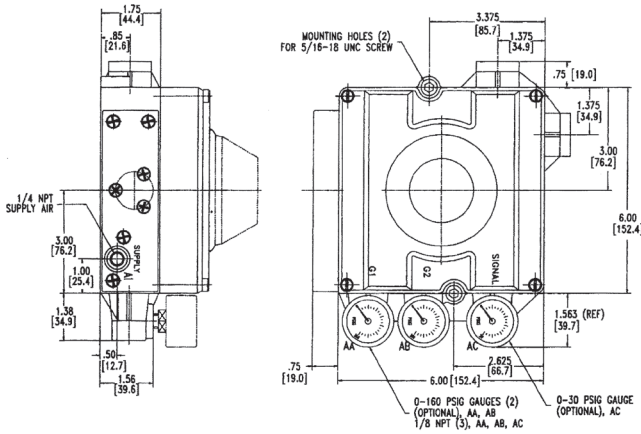
# LIMIT SWITCHES HOW TO ORDER - STONEL QUARTZ

Explosion proof Quartz Models (Aluminum Cover)						
Series	Sensors/Switches	Enclosure	Indicator			
QX	<b>Sensor Modules</b>					
	33	SST N.O. Switching Sensor Dual Module	E North American (NEC/CEC) R International (IEC/ATEX) F INMETRO	02 (1) 3/4" NPT & (1) 1/2" NPT 03 (1) 3/4" NPT & (2) 1/2" NPT	SRA Red-Closed / Green-Open SGA Green-Closed / Red-Open S1A T1 3-way S2A T2 3-way S3A T3 3-way S4A T4 3-way S5A T5 3-Way S0A No Indication SXA Special SCA Continuous	
	<b>Valve Communication Terminals (VCTs)</b>		S* Stainless Steel North American (NEC/CEC) T* Stainless Steel International (IEC/ATEX) M* Stainless Steel INMETRO	05 (2) M20 06 (3) M20		
	<b>Mechanical Switches</b>		* Available w/ 03 or 06 conduit entry only			
	2V	(2) SPDT Mechanical Switches				
	2W	(2) SPDT Gold Contact Mechanical Switches				
	4V	(4) SPDT Mechanical Switches				
	4W	(4) SPDT Gold Contact Mechanical Switches				
	14	(2) DPDT Mechanical Switches				
	5V	Position Transmitter w/ (2) SPDT Mechanical Switches				
	5W	Position Transmitter w/ (2) SPDT Mechanical Switches				
	<b>Expeditors (Proximity Type)</b>					
	82	DeviceNet				
	86	AS-Interface				
	<b>Sensors/Switches</b>					
	Function		Switch/Sensor Type			
	2	(2) Switches	P	SPST Maxx-Guard		
	4	(4) Switches	L	SPST Maxx-Guard (LED)		
	5	Position Transmitter w/ (2) or No Switches	G	SPDT Maxx-Guard		
	7	High Performance Position Transmitter w/ (2) or No Switches	H	SPDT Maxx-Guard		
	8	Expeditor, Y or H switches only	S	SPDT Maxx-Guard (LED)		
			Y	Expeditor Only (3)		
			F	PNP Solid State 3-Wire P&F		
			X	SST Sensor (LED)		
			O	No Switches		

Nonincendive & Intrinsically Safe Quartz Models (Clear Cover)					
Series	Sensors/Switches	Enclosure	Indicator		
QN	<b>Sensor Modules</b>				
	33	SST N.O. Switching Sensor Dual Module	C North American (NEC/CEC) D International (IEC/ATEX)	02 (1) 3/4" NPT & (1) 1/2" NPT 03 (1) 3/4" NPT & (2) 1/2" NPT 05 (2) M20 06 (3) M20	SRA Red-Closed / Green-Open SGA Green-Closed / Red-Open S1A T1 3-way S2A T2 3-way S3A T3 3-way S4A T4 3-way S5A T5 3-Way S0A No Indication SXA Special SCA Continuous
	44	Namur Sensors Dual Module I.S.; DIN 19234			
	<b>Valve Communication Terminals (VCTs)</b>				
	92	DeviceNet VCT			
	93	Foundation Fieldbus			
	96	AS-Interface			
	97	AS-Interface (w/ extended addressing)			
	<b>Expeditors (Proximity Type)</b>				
	82	DeviceNet			
	86	AS-Interface			
	<b>Sensors/Switches</b>				
	Function		Switch/Sensor Type		
	2	(2) Switches	P	SPST Maxx-Guard	
	4	(4) Switches	L	SPST Maxx-Guard (LED)	
	5	Position Transmitter w/ (2) or No Switches	G	SPDT Maxx-Guard	
	7	High Performance Position Transmitter w/ (2) or No Switches	H	SPDT Maxx-Guard	
	8	Expeditor, Y or H switches only	S	SPDT Maxx-Guard (LED)	
			Y	Expeditor Only (3)	
			F	PNP Solid State 3-Wire P&F	
			X	SST Sensor (LED)	
			O	No Switches	
	<b>Intrinsically Safe Type</b>				
			J	SPST (Passive)	
			M	SPDT (Passive)	
			N	P + F Namur Sensors	

General Purpose Quartz Models (Clear Cover)					
Series	Function	Enclosure	Indicator		
QG	<b>Mechanical Switches</b>				
	2V	(2) SPDT Mechanical Switches	C General Purpose	02 (1) 3/4" NPT & (1) 1/2" NPT 03 (1) 3/4" NPT & (2) 1/2" NPT 05 (2) M20 06 (3) M20	SRA Red-Closed / Green-Open SGA Green-Closed / Red-Open S1A T1 3-way S2A T2 3-way S3A T3 3-way S4A T4 3-way S5A T5 3-Way S0A No Indication SXA Special SCA Continuous
	2W	(2) SPDT Gold Contact Mechanical Switches			
	4V	(4) SPDT Mechanical Switches			
	4W	(4) SPDT Gold Contact Mechanical Switches			
	14	(2) DPDT Mechanical Switches			

# VRC POSITIONERS



## STANDARD MATERIALS LIST

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

## PERFORMANCE

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

## HOW TO ORDER VRC POSITIONERS

### PART NUMBER MATRIX

3PV -	0	7	3	0	0
PREFIX	POSITION INDICATOR & TYPE	SPOOL VALVE	PORT GAUGES	POSITION TRANSMITTER	LIMIT SWITCH
3PV	0 - Flat Pneumatic	7 - Standard Flow	3 - No Gauges	0 - No Transmitter	0 - No Switch
	1 - Flat Electro-Pneumatic	8 - Max Flow	4 - Brass Gauges	F - 4-20MA Current	K - Mechanical Switch
	5 - Dome Pneumatic		5 - SS Gauges	Output 2-Wire	M - Proximity Switch
	6 - Dome Electro-Pneumatic				



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

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

## PRODUCT SPECIFICATIONS

	P2000/20	P5/EP5*
Connections:	1/4"	1/4"
Supply Pressure:	120 psig	145 psig
Hysteresis:	0.5%	0.5%
Linearity:	2.0%	0.5%
Repeatability:	0.5%	0.5%
Sensitivity:	0.5%	0.25%
Input Signal:	4-20 mA	3-15, 4-20mA
Temperature - Standard:	+5 - 175°F	+5 - 185°F
Temperature - Optional:	+5 - 230°F	+5 - 230°F
Weight:	5.9 lbs.	2.9/4.1 lbs.
Air Consumption @ 85 psig:	35/71 scfm-----	75 scfm
Air Delivery @ 57 psig:	12/15.7 scfm	12.6 scfm
Gain Factor:	50/400	10,000

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

## PMV MOUNTING KITS FOR APOLLO ACTUATORS

ACTUATOR SIZE	MOUNTING KIT	MATERIAL
AD/AS 0012	63-002-01	Stainless Steel
AD/AS 0025-0350	63-001-89	Stainless Steel
AD/AS 0600-4000	63-001-91	Stainless Steel

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.

## PART NUMBERS

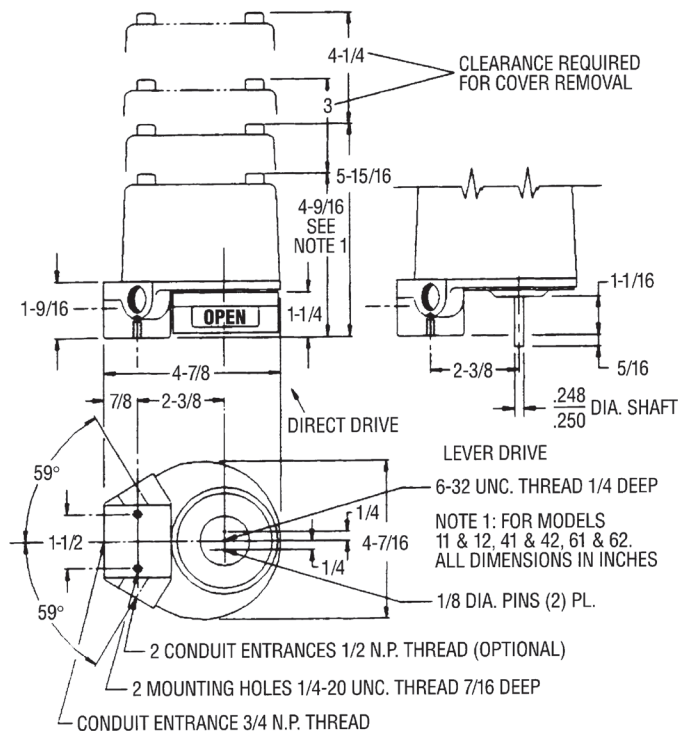
APOLLO PART #'S	PMV MODEL #'S	DESCRIPTION
3T-200-01	P-2000	Double Acting, Electro-Pneumatic, 1
3T-202-01	P-2020	Double Acting, Electro-Pneumatic, 2
3T-500-01	P5	Double Acting, Hi Capacity & Gain
3T-250-01	EP5	Electro Pneumatic, Hi Capacity & Gain
3T-250-02	EP5-EX	Double Acting, Hi Capacity & Gain, Explosion Proof

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

# 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
42RD0	4,4X,7,9	2 SPDT PROX, Herm Sealed Reed, Anodized Al.	3 amps ac, 2 amps dc
42VDOJ1	4,4X,7,9	2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al.	10 amps ac, 10 amps dc
42RDOJ1	4,4X,7,9	2 SPDT PROX, 3/4" & 1/2" NPT Entry, Anodized Al.	3 amps ac, 2 amps dc
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
62PDO	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
12VDOJ1	Mag Coupling	2 SPDT MECH, 3/4" & 1/2" NPT Entry, Anodized Al.	10 amps ac, 10 amps dc
12AD6	Mag Coupling - ST STL	2 SPDT MECH, 304 Stainless Steel Housing	15 amps ac, 5 amps dc
15VD6	Mag Coupling - ST STL	2 SPDT MECH, & Transmitter, 304 Stainless Steel	10 amps / 4-20 mA out

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

\*\* Conbraco maintains the 12ADO in stock, Conbraco part number with indicator M116100 and without indicator M105900.

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.



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

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

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

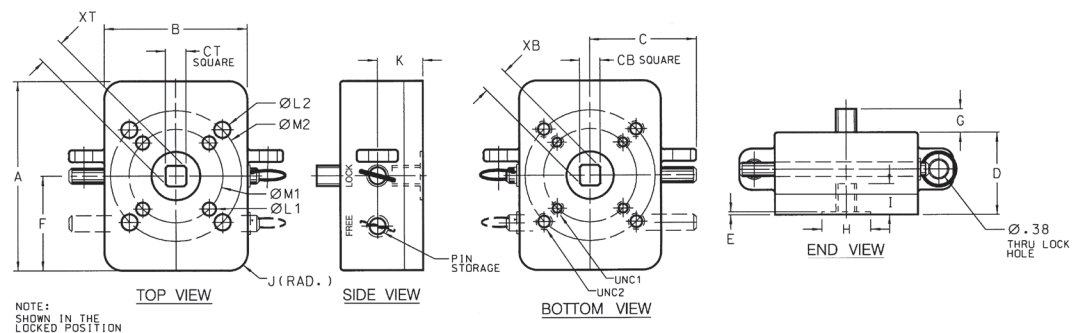
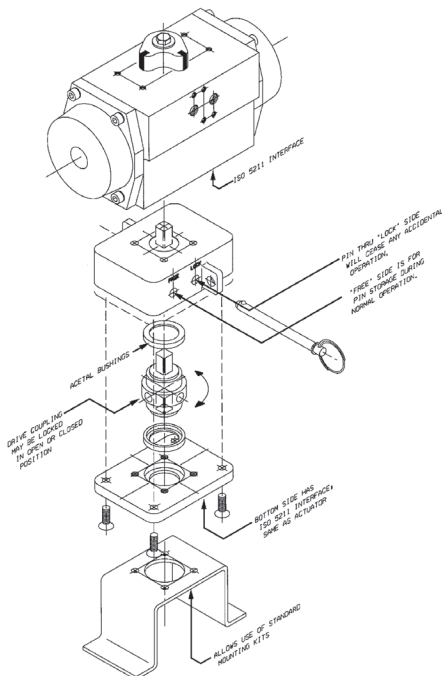
Available in six sizes, it is the perfect compliment to the Apollo® Rack and Pinion Actuator and Apollo® Ball Valve. The design results in a safe automated package that will satisfy the concerns of the most discriminating safety engineer.

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

## DIMENSIONS

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 (F14)
M2 B.C.	NA	NA	4.016 (F10)	4.016 (F10)*	NA	NA
XT (MAX.)	0.540	0.690	0.955	1.080	1.325	1.780
XB (MIN.)	0.551	0.710	0.985	1.105	1.420	1.890
CT	.430/.432	.547/.550	.744/.747	.862/.865	1.056/1.059	1.413/1.416
CB	.433/.435	.551/.553	.748/.750	.866/.868	1.060/1.063	1.419/1.422
WEIGHT	3.65	3.75	9.90	10.40	28.90	29.50

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



## VALVE MOUNTING

Mounting of Apollo® actuators to quarter turn valves is a 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.

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

## CAUTION

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

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

## BALL VALVE TORQUE

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

## LONG STAND STILL TORQUE (LSST)

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

## BALL & SEAT

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

## STEM & PACKING

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

## -24/-29 GRAPHITE STEM PACKING ADDER

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

## BREAKWAY TORQUE

Torque required to initiate the opening of a valve from the fully closed position. This is the highest torque requirement anywhere within the Apollo® Ball Valve's rotation. The Torque Constants Chart lists breakaway torques for Apollo® valves under defined operation conditions. Note: For double acting actuators, the torque output at the given air supply pressure must exceed the breakaway torque of the valve.

## CLOSING TORQUE

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

## GUIDELINES FOR DETERMINING IN-SERVICE VALVE TORQUE

Actual service conditions must be considered when determining a valve's required torque. Torque Adjustment Factors have been established to convert the Torque Constant value to an in-service torque. Multiple Torque Adjustment Factors may be required to establish the proper in-service torque requirement. All valve torque determinations begin with the Torque Constant value at the appropriate differential pressure. Adjustment factors must be used to determine the in-service valve torque requirement (see page 52, Torque Adjustment Factors Chart). Each applicable adjustment factor is applied to the value from the Torque Constants chart. The sum of all appropriate adjustments of the valve's torque are added to the original value from the Torque Constants chart. The result is the in-service torque requirement. This torque value is to be used in actuator selection.

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



# BALL VALVES TORQUE CONSTANTS

## TORQUE CONSTANTS FOR APOLLO END ENTRY VALVE (1), (2)

		TORQUE CONSTANT (LB-IN) AT DIFFERENTIAL PRESSURE INDICATED (PSIG)							
DIFFERENTIAL PRESSURE (PSIG)		200	400	600	800	1000	1500	LSST***	-24 ADDER
VALVE MODEL	SIZE							(IN.-LBS)	(IN.-LBS)
STANDARD PORT 70-64x 71-14x 76-10x 76-60x 89-14x 399-10x	1/4 - 1/2	35	35	40	43	46	48	70	45
	3/4	50	50	54	59	62	64	100	45
	1	101	101	103	106	116	130	202	56
	1-1/4	171	171	205	216	246	286	342	96
	1-1/2	192	192	216	265	280	311	384	96
	2	271	271	276	300	309	354	542	96
	2-1/2 & 3	540	700	820	920	1030		1000	96
FULL PORT BRONZE 77-14x	1/4 - 1/2	35	35	40				70	45
	3/4	74	74	84				148	56
	1	234	234	250				468	56
	1-1/4	286	286	321				552	56
	1-1/2	357	357	398				714	96
	2	650	650	722				1300	96
	2-1/2 & 3	715	715	790				1430	111
FULL PORT BRONZE 77D-14X	1/2	25	25	25	25			50	
	3/4	55	55	55	55			110	
	1	87	87	87	87			174	
	1-1/2	120	120	120	120			240	
	2	280	280	280	280			560	
**STANDARD PORT **71-ARX-64 89-ARX-64 76-ARX-64	1/4 - 1/2	26	27	28	30	32	35	50	45
	3/4	50	52	54	57	60	64	100	45
	1	86	88	90	94	97	110	170	56
	1-1/4	140	145	156	160	172	194	280	96
	1-1/2	164	173	186	195	201	235	320	96
	2	230	258	270	310	350	460	440	96
	2-1/2	495	576	680	790	900		900	96
	3	540	700	820	920	1030		1000	96
*FULL PORT **77-ARX-64	1/4 - 1/2	50	52	54				100	45
	3/4	86	88	90				170	56
	1	148	160	180				280	56
	1-1/2	300	310	340				580	96
	2	355	420	563				680	96
FULL PORT 3-PIECE 82-14X & 24X	1/4 - 1/2	78	78	90				156	56
	3/4	156	156	178				312	56
	1	208	208	230				416	96
	1-1/4	234	234	276				468	96
	1-1/2	350	350	390				700	96
	2	715	715	755				1430	96
	3	710						1100	292
	4	1052						1540	292
FULL PORT 3-PIECE 83A-14X & 24X 83B-14X & 24X 86A-10X & 20X 86B-10X & 20X	1/4 - 1/2	38	39	41	42	43	49	75	45
	3/4	61	62	63	63	67	79	121	68
	1	97	104	110	117	124	141	180	68
	1-1/4	182	198	213	228	243	281	335	96
	1-1/2	182	198	213	228	243	281	335	96
	2	275	388	402	466	529	688	422	127
	3	715	715	755	800	912	1024	1430	96
FULL PORT 3-PIECE 83R-108-01 & 83R-100-01 86R-108-01 & 86R-100-01	2	715	715	755	800	912	1024	1430	96
	3	1030	1030	1087	1148	1212		2060	201

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

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

\*\*\* LSST - Long Stand Still Torque

**Note 1:**

Constants are used to determine the in-service torque requirements of Apollo Valves.

**Note 2:**

Constants are based on RPTFE seats, and clean dry air at the stated differential pressure.

## TORQUE CONSTANTS FOR APOLLO PEEK SEATED 83B/86B WITH GRAPHITE STEM PACKING

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

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

## TORQUE CONSTANTS FOR APOLLO FLANGED BALL VALVES

VALVE SERIES	SIZE	WORKING PRESSURE (PSIG)									LSST	-24 ADDER	-EF ADDER	
		0	100	200	300	400	500	600	700	740	(IN.-LB)	(IN.-LB)	(IN.-LB)	
87A-100s 88A-140s 87B-100s 88B-100s	1-1/2" SP 150	132	144	155	167							264	68	68
	2" SP 150	176	193	211	228							352	96	96
	2-1/2" SP 150	231	254	277	300							462	127	127
	3" SP 150	253	327	402	476							506	127	127
	4" SP 150	850	860	875	890							1700	292	292
	6" SP 150	1325	1345	1370	1400							2650	292	292
	8" SP 150	2200	2494	2788	3081							4400	661	895
87A-200s 88A-240s	10" SP 150	3300	3580	3860	4140							6600	661	895
	1/2" FP 150	22	22	22	22							44	45	45
	3/4" FP 150	39	43	47	51							77	68	68
	1" FP 150	132	144	155	167							264	68	68
	1-1/2" FP 150	176	193	211	228							352	96	96
	2" FP 150	231	254	277	300							462	127	127
	2-1/2" FP 150	253	327	402	476							506	127	127
	3" FP 150	850	860	875	890							1700	292	292
	4" FP 150	1325	1345	1370	1400							2650	292	292
	6" FP 150	2200	2494	2788	3081							4400	661	895
87A-700s 88A-740s	8" FP 150	3300	3580	3860	4140							6600	661	895
	10" FP 150	4400	5059	5718	6377							8800	988	1625
	12" FP 150	4950	8300	11650	15000							9900	988	1625
	1-1/2" SP 300	132	144	155	167	178	190	201	213	217		264	68	68
	2" SP 300	176	193	211	228	245	262	280	297	304		352	96	96
	2-1/2" SP 300	231	254	277	300	323	346	369	392	401		462	127	127
	3" SP 300	253	327	402	476	551	625	700	774	804		506	127	127
	4" SP 300	850	860	875	890	910	950	1030	1110	1142		1700	292	292
87A-900s 88A-940s	6" SP 300	1325	1345	1370	1400	1430	1474	1615	1756	1812		2650	292	292
	8" SP 300	2200	2494	2788	3081	3375	3669	3963	4257	4374		4400	661	895
	10" SP 300	3300	3580	3860	4140	4420	4700	4980	5260	5372		6600	661	895
	1/2" FP 300	22	22	22	22	23	23	23	23	23		44	45	45
	3/4" FP 300	39	43	47	51	55	59	63	67	69		77	68	68
	1" FP 300	132	144	155	167	178	190	201	213	217		264	68	68
	1-1/2" FP 300	176	193	211	228	245	262	280	297	304		352	96	96
	2" FP 300	231	254	277	300	323	346	369	392	401		462	127	127
	2-1/2" FP 300	253	327	402	476	551	625	700	774	804		506	127	127
	3" FP 300	850	860	875	890	910	950	1030	1110	1142		1700	292	292
	4" FP 300	1325	1345	1370	1400	1430	1474	1615	1756	1812		2650	292	292
	6" FP 300	2200	2494	2788	3081	3375	3669	3963	4257	4374		4400	661	895
8" FP 300	3300	3580	3860	4140	4420	4700	4980	5260	5372		6600	661	895	
10" FP 300	4400	5059	5718	6377	7036	7696	8355	9014	9277		8800	988	1625	
12" FP 300	4950	8300	11650	15000	18349	21699	25049	28399	29739		9900	988	1625	

# FLANGED VALVES TORQUE CONSTANTS

## TORQUE CONSTANTS FOR APOLLO CLASS 600 FULL PORT FLANGED VALVES

SEAT MATERIAL	SIZE	WORKING PRESSURE (PSIG)								LSST*	-24 ADDER	-EF ADDER
		200	400	600	800	1000	1200	1400	1500			
Devlon V-API (-95)	1"	166	189	211	233	256	275	292	300	288	N/A	N/A
	1.5"	253	273	292	312	331	351	370	380	468	N/A	N/A
	2"	686	698	710	721	732	744	755	761	1350	N/A	N/A
	2.5"	1150	1190	1231	1272	1313	1353	1395	1415	2256	N/A	N/A
	3"	1893	2030	2167	2304	2440	2577	2714	2782	3512	N/A	N/A
	4"	2406	2681	2957	3232	3508	3784	4060	4197	4260	N/A	N/A
	6"	7935	8280	8625	8970	9135	9660	10005	10178	13638	N/A	N/A
	8"	8282	8868	9454	10041	10627	11213	11799	12092	15978	N/A	N/A
PEEK (-38)	1"	184	204	224	245	264	283	304	314	328	N/A	N/A
	1.5"	379	399	420	439	460	479	500	509	468	N/A	N/A
	2"	882	968	1054	1140	1225	1313	1399	1481	1323	N/A	N/A
	2.5"	1256	1320	1384	1448	1512	1576	1640	1672	2384	N/A	N/A
	3"	2378	2588	2797	3007	3217	3427	3637	3741	4336	N/A	N/A
	4"	5771	6832	7892	8952	10012	11073	12133	12663	9422	N/A	N/A
	6"	6983	8675	10368	12061	13753	15446	17139	17985	10580	N/A	N/A
	8"	8586	12822	17058	21294	25531	29767	34003	36121	12936	N/A	N/A
UHMWPE (-21)	1"	155	178	201	219	222	224	228	228	264	N/A	N/A
	1.5"	211	245	280	305	310	315	318	318	352	N/A	N/A
	2"	428	454	479	505	531	556	582	594	806	N/A	N/A
	2.5"	447	467	486	506	525				875	N/A	N/A
	3"	1139	1224	1310	1396	1482				2106	N/A	N/A
	4"	1506	1638	1820	2002	2184				2600	N/A	N/A
	6"	3133	3487	3842						5558	N/A	N/A
	8"	3814	4354	4894						7088	N/A	N/A
MULTISEAL (-80)	1"	155	180	205	222	227	231	233	234	264	102	102
	1.5"	213	245	280	308	316	322	326	326	354	144	144
	2"	313	356	400	444	487	531	575	597	538	191	191
	2.5"	410	437	465	493	520				791	191	191
	3"	875	890	1030	1151	1228				1112	292	292
	4"	1506	1584	1683	1781	1880				2776	292	292
	6"	2788	3375	3963						4824	661	895
	8"	4836	5175	5514						8993	988	1625

Caution: For torque constants in the highlighted areas, manual valve operation is not suggested. Automated and gear operated assembly options are available. All values are stated in (in-lb)

## BALL VALVE TORQUE ADJUSTMENT FACTORS

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

### 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.

\*Do not consider when calculating Top Entry Valve Torques. Apply all applicable torque adjustment factors to the valve

\*\* If accounting for LSST, disregard frequency of operation.

## TORQUE CONSTANTS FOR TOP ENTRY BALL VALVES

SEATS	VALVE SIZE STD. PORT (INCHES)	VALVE SIZE FULL PORT (INCHES)	DIFFERENTIAL PRESSURES (PSIG)					LSST*	GRAFOIL* ADDER	-EF ADDER
			100	285	500	740	1480			
5 6** C D G L M U**	1/2 thru 1	1/2 thru 3/4	85	110	140	180	290	170	68	68
	1-1/2	1	205	260	330	415	660	410	96	96
	2	1-1/2	350	430	550	735	1,200	700	127	127
	3	2	950	1,250	1,650	2,000	3,200	1,900	292	292
	4	3	2,000	2,500	3,300	4,100	6,500	4,000	292	292
	6"	4"	5,300	6,700	8,200	11,400	18,000	10,600	661	895
	8"	6"	11,000	14,000	18,500	25,000	36,000	22,000	661	895
	10"	8"	18,500	22,000	30,000	40,000	62,000	37,000	988	1625
4 8 9 B H N	1/2 thru 1	1/2 thru 3/4	115	160	210	260	450	230	68	68
	1-1/2	1	270	370	480	590	1,000	540	96	96
	2	1-1/2	475	650	860	1,050	1,750	950	127	127
	3	2	1,250	1,850	2,400	2,950	4,900	2,500	292	292
	4"	3"	2,700	3,700	4,900	5,900	10,000	5,400	292	292
	6"	4"	7,410	10,100	13,400	16,400	25,300	14,800	661	895
	8"	6"	15,000	20,000	26,000	34,500	56,000	30,000	661	895
	10"	8"	25,000	32,000	45,000	60,000	96,000	50,000	988	1625

\*LSST - Long Stand Still Torque

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

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

\*\*Gear operator or actuation recommended

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

## FACTORS AFFECTING SEATING AND UNSEATING TORQUE AND APPLICATION GUIDELINES

### OPERATING FREQUENCY

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

### LUBRICATING CHARACTERISTICS OF FLOW MEDIA

- Judge your flow media on this basis-better than or worse than water. Examples of lubricating media are: water, lubricating oils, aqueous process flow, beverage service, etc. Examples of non-lubricating media are: air, dry gases, dry bulk services, solvents, diesel oil, etc.

### CONDITION OF DISC EDGE AND SEAT

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

### TEMPERATURE EXTREMES

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

### ELASTOMER SWELL

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

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

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

# BUTTERFLY VALVES TORQUE CONSTANTS

## RTFM & UHMWPE SEAT - TORQUE RATING (IN-LB)

SIZE	PSIG	CLASS 150				CLASS 300					CLASS 600					
		ΔP=100	ΔP=150	ΔP=200	ΔP=285	ΔP=100	ΔP=150	ΔP=200	ΔP=285	ΔP=740	ΔP=150	ΔP=500	ΔP=800	ΔP=1000	ΔP=1200	ΔP=1480
2"	in-lb	204	230	266	332	248	332	381	425	531	-	-	-	-	-	-
2.5"	in-lb	239	283	319	398	301	398	443	478	575	-	-	-	-	-	-
3"	in-lb	257	301	345	434	327	434	487	540	664	407	513	841	974	1,106	1,283
4"	in-lb	398	469	531	664	469	664	761	867	1,106	620	841	1,540	1,823	2,106	2,487
5"	in-lb	558	655	743	929	620	885	1,062	1,239	1,664	-	-	-	-	-	-
6"	in-lb	726	850	974	1,212	858	1,221	1,505	1,779	2,460	974	1,363	2,593	3,089	3,575	4,248
8"	in-lb	1,328	1,549	1,770	2,213	1,646	2,354	2,921	3,487	4,868	1,912	2,673	5,080	6,045	7,009	8,319
10"	in-lb	2,213	2,575	2,947	3,682	2,575	3,682	4,691	5,699	8,142	3,177	4,437	8,434	10,036	11,638	13,806
12"	in-lb	2,867	3,345	3,823	4,779	3,629	5,177	6,522	7,877	11,151	4,788	6,682	12,709	15,116	17,523	20,798
14"	in-lb	4,938	5,761	6,584	8,231	6,053	8,646	11,186	13,735	19,913	-	-	-	-	-	-
16"	in-lb	6,903	8,054	9,204	11,505	8,461	12,080	14,788	17,496	24,072	-	-	-	-	-	-
18"	in-lb	9,717	11,337	12,956	16,196	11,903	17,010	20,461	23,913	32,303	-	-	-	-	-	-
20"	in-lb	12,930	15,089	17,240	21,550	15,842	22,629	26,816	30,993	41,153	-	-	-	-	-	-
24"	in-lb	19,859	23,169	26,479	33,099	24,329	34,754	40,595	46,436	60,623	-	-	-	-	-	-
30"	in-lb	30,090	35,400	40,710	49,472	-	-	-	-	-	-	-	-	-	-	-
36"	in-lb	48,233	58,145	68,057	84,849	-	-	-	-	-	-	-	-	-	-	-

## FIRE SAFE SEAT - TORQUE RATING (IN-LB)

SIZE	PSIG	CLASS 150				CLASS 300					CLASS 600					
		ΔP=100	ΔP=150	ΔP=200	ΔP=285	ΔP=100	ΔP=150	ΔP=200	ΔP=285	ΔP=740	ΔP=150	ΔP=500	ΔP=800	ΔP=1000	ΔP=1200	ΔP=1480
2"	in-lb	434	504	584	726	504	726	770	814	929	-	-	-	-	-	-
2.5"	in-lb	460	540	620	770	540	770	823	885	1,018	-	-	-	-	-	-
3"	in-lb	584	681	779	974	681	974	1,035	1,097	1,257	866	1,208	1,549	1,788	2,027	2,354
4"	in-lb	708	832	947	1,186	832	1,186	1,248	1,319	1,478	1,402	1,887	2,372	2,797	3,230	3,814
5"	in-lb	965	1,124	1,283	1,602	1,133	1,620	1,894	2,177	2,850	-	-	-	-	-	-
6"	in-lb	1,345	1,566	1,788	2,239	1,584	2,257	2,531	2,805	3,478	3,758	4,485	5,213	6,204	7,186	8,531
8"	in-lb	2,089	2,443	2,788	3,487	2,513	3,584	4,160	4,735	6,133	7,077	8,455	9,832	11,691	13,558	16,089
10"	in-lb	3,283	3,832	4,381	5,478	4,027	5,753	6,673	7,602	9,841	11,400	13,616	15,833	18,833	21,833	25,913
12"	in-lb	5,168	6,036	6,894	8,620	6,230	8,894	10,470	12,045	15,877	17,542	20,949	24,355	28,975	33,595	39,869
14"	in-lb	6,912	8,062	9,213	11,514	8,363	11,948	14,426	16,904	22,913	-	-	-	-	-	-
16"	in-lb	8,770	10,231	11,700	14,620	10,655	15,222	18,682	22,152	30,559	-	-	-	-	-	-
18"	in-lb	12,567	14,664	16,762	20,948	15,178	21,683	27,541	33,409	47,640	-	-	-	-	-	-
20"	in-lb	16,859	19,674	22,479	28,099	20,196	28,851	37,993	47,126	69,322	-	-	-	-	-	-
24"	in-lb	25,072	29,249	33,426	41,781	30,046	42,923	56,622	70,331	103,607	-	-	-	-	-	-

## METAL SEAT - TORQUE RATING (IN-LB)

SIZE	PSIG	CLASS 150				CLASS 300					CLASS 600					
		ΔP=100	ΔP=150	ΔP=200	ΔP=285	ΔP=100	ΔP=150	ΔP=200	ΔP=285	ΔP=740	ΔP=150	ΔP=500	ΔP=800	ΔP=1000	ΔP=1200	ΔP=1480
2"	in-lb	478	558	637	797	558	797	850	903	1,027	-	-	-	-	-	-
2.5"	in-lb	513	593	681	850	593	850	912	974	1,124	-	-	-	-	-	-
3"	in-lb	637	743	850	1,062	743	1,062	1,133	1,204	1,381	832	1,035	1,699	1,965	2,230	2,593
4"	in-lb	797	929	1,062	1,328	929	1,328	1,398	1,460	1,628	1,496	2,018	3,708	4,381	5,053	5,965
5"	in-lb	1,062	1,239	1,416	1,770	1,248	1,788	2,089	2,398	3,133	-	-	-	-	-	-
6"	in-lb	1,487	1,735	1,982	2,478	1,770	2,522	2,814	3,106	3,823	2,947	4,106	7,815	9,301	10,788	12,797
8"	in-lb	2,257	2,637	3,009	3,761	2,726	3,894	4,540	5,177	6,744	4,443	6,204	11,797	14,036	16,275	19,311
10"	in-lb	3,797	4,434	5,052	6,328	4,646	6,638	7,584	8,531	10,824	6,558	9,151	17,417	20,718	24,019	28,506
12"	in-lb	5,947	6,938	7,930	9,912	7,558	10,797	12,302	13,815	17,470	11,001	15,364	29,223	34,772	40,321	47,843
14"	in-lb	8,655	10,098	11,540	14,426	10,841	15,488	18,196	20,904	27,488	-	-	-	-	-	-
16"	in-lb	10,965	12,797	14,620	18,275	14,249	20,355	23,691	27,037	35,143	-	-	-	-	-	-
18"	in-lb	15,718	18,337	20,957	26,196	19,514	27,878	33,949	40,029	54,782	-	-	-	-	-	-
20"	in-lb	21,081	24,594	28,108	35,135	25,709	36,728	45,648	54,578	76,252	-	-	-	-	-	-
24"	in-lb	31,382	36,612	41,843	52,304	38,595	55,136	67,251	79,367	108,793	-	-	-	-	-	-

# BUTTERFLY VALVES RESILIENT SEATED

## SEATING AND UNSEATING TORQUE APOLLO® RESILIENT SEATED BUTTERFLY VALVES WD141, LD141, WD145, LD145, LC149 SERIES

VALVE SIZE (IN.)	DIFFERENTIAL PRESSURE (PSID)			
	50 BUSHING PTFE	100 BUSHING PTFE	150 BUSHING PTFE	200 BUSHING PTFE
2	100	106	111	117
2 1/2	150	163	176	189
3	207	220	232	244
4	290	323	357	390
5	423	481	540	598
6	599	691	783	875
8	1060	1183	1307	1430
10	1671	1872	2074	2275
12	2568	2795	3023	3250
14	2640	3070	3500	-
16	4260	4880	5500	-
18	6287	7243	8200	-
20	8360	9180	10000	-
24	15427	16813	18200	-
30	31200	32550	33930	-

All torque values shown on chart are for wet (water and other non-lubricating media) on-off service. For dry (non-lubricating, dry gas media), multiply values by 1.15. For lubed service (clean, nonabrasive lubricating media), multiply values by 0.85. Under certain conditions, hydrodynamic torque can meet or exceed seating and unseating torques. When designing valve systems, hydrodynamic torque must be considered to help ensure correct selection of actuation.

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

## SECTION R - ACTUATION REVISIONS

PAGE	DATE	DESCRIPTION
R-40	31AUG17	Removed -32A Solenoids and -32B Adapter
R-49	13APR17	Changed torque values for 2.5" & 3", standard port valves shown in table's top section (70-64x... 399-10x)
R-50, R-51	04MAY17	Added -EF torque adder
R-52	04MAY17	Added -EF torque adder
		Changed 3" & larger standard port Grafoil adders



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