

Asahi / America Actuation Basics



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Electric Actuators

Principal of Operation

An electric actuator is basically a geared motor. The motor can be of various voltages and is the primary torque-generating component. To prevent heat damage from overwork or excessive current draw, electric actuator motors are usually equipped with a thermal overload sensor embedded in the motor windings. This sensor is wired in series with the power source; and opens the circuit should the motor be overheated, then closes the circuit when the motor reaches a safe operating temperature.

An electric motor consists of an armature, electrical windings, and a gear train. When power is supplied to the windings, a magnetic field is generated causing the armature to rotate. The armature will rotate as long as there is power to the windings; when the power is cut, the motor stops. Standard end of travel limit switches, which are a necessity for an electric actuator, handle this task.

Electric actuators rely on a gear train, which is coupled directly from the motor to enhance the motor torque and dictate the output speed of the actuator. The only way to change the output speed is to install a cycle length control module. This module allows an *increase* in cycle time only. If a decrease in cycle time is required, an alternate actuator with the desired cycle time must be used.

Electric Actuator Motors

There are two (2) types of motors used for electric actuators; uni-directional and bi-directional (commonly known as reversing motors).

- Uni-directional motors are motors in which the armature rotates in one (1) direction, causing the valve to rotate in one direction. These actuators are typically used with a ball valve and rotate in 90 or 180-degree increments strictly for an on/off type of service.
- Bi-directional motors or, reversing motors, are motors in which there are two (2) sets of windings allowing the armature to rotate in either direction depending on which set of windings is powered. One (1) set of windings controls the clockwise direction for closing a valve, while the other set of winding controls the counter-clockwise direction for opening the valve. A major benefit of a bi-directional actuator is precise flow control, as the actuator is not required to travel the full stroke to begin the reverse stroke.

Switches

Principal of Operation

Electric current can flow only if the circuit is complete. An open circuit – one that has a gap within it – prevents an electrical device from operating. by creating a gap intentionally, we can turn the device on and off. That is what a switch does.

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Inside of a switch are two or more terminals. When the switch is turned off, nothing connects the two terminals, and the circuit is interrupted just as if a wire were removed from the device. When the switch is turned on, the two terminals are connected, the circuit is closed, and the current can flow again.

This opening and closing action occurs very quickly to prevent electrical sparking between the contacts. The current tries to bridge the gap between the contacts as the gap narrows; the heavier the current flowing in the circuit, the more electrical sparking can occur. Some switches operate with a tube of mercury, which conducts electricity. When the switch is on, the tube tilts, and mercury flows down between the two contacts. When the switch is off, the mercury flows away from the contacts, and the circuit is open. This design reduces the possibility of sparking and also makes operation quiet.

Types of Switches

Electrical switches are usually expressed in terms of the number of “poles” and “throws” that they contain. A “pole” is a component of the switch that is moved by the switch action to make or break electrical contact. The possible electrical connections that can be made by a given pole are called “throws”.

Single Pole Single Throw (SPST) – This switch has one moveable component, or a single pole. It also has only one possible connection, or a single throw, for that pole. The configuration of a single pole single throw is often abbreviated “SPST”. It is usually used as an on/off switch.

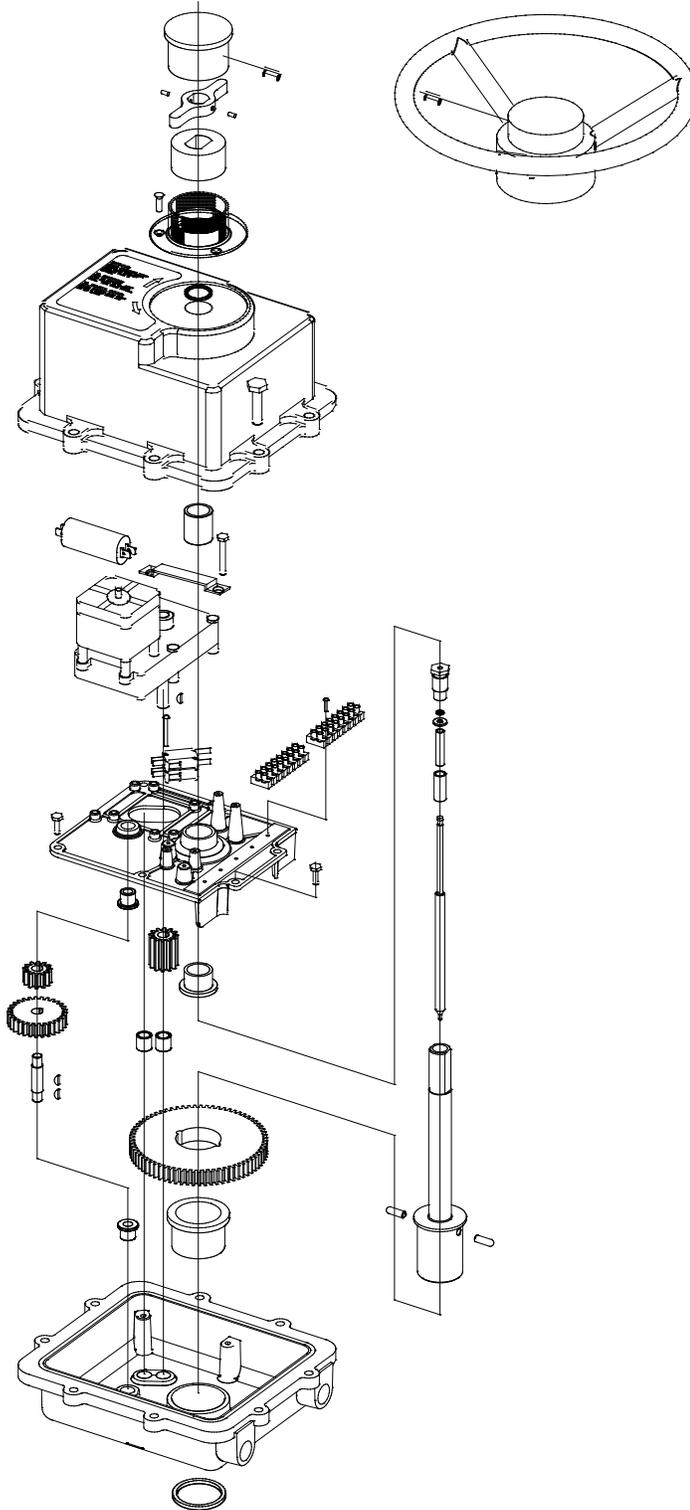
Single Pole Double Throw (SPDT) – This switch still has only one moveable component, but two possible connections, or throws. It is often found in a switchbox where the user may select between “normally open” or “normally closed” contacts. “Normally open” contacts provide an open circuit when the switch is in a free position, while “normally closed” contacts provide a closed circuit when the switch is in a free position.

Double Pole Single Throw (DPST) – This switch has two moveable components, so it has a “double pole”. There is only one connection for each pole, and therefore is a “single throw”.

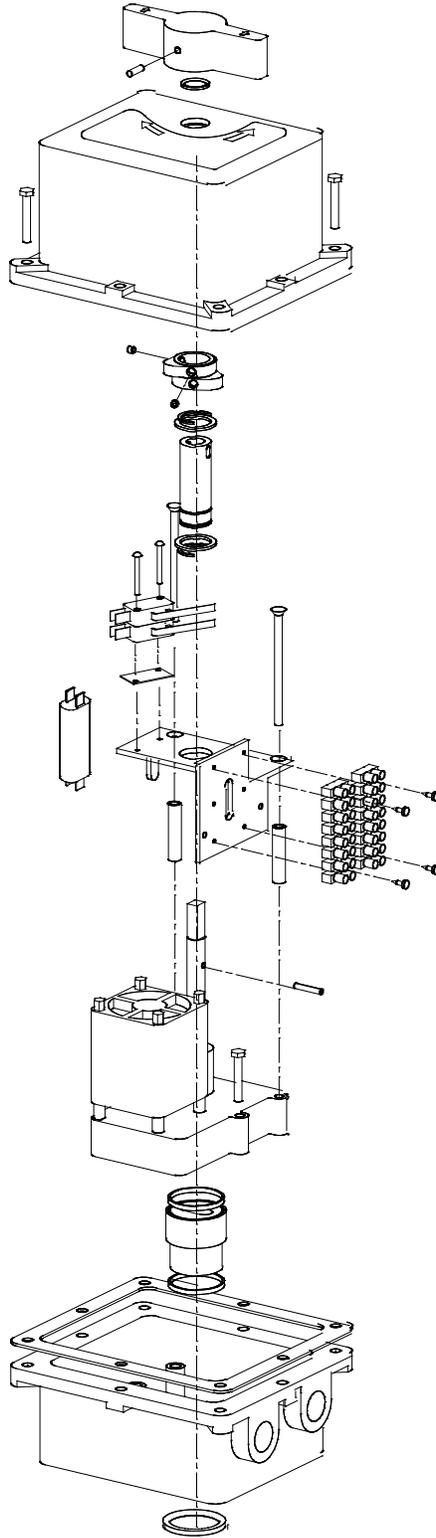
Double Pole Double Throw (DPDT) – This switch has two moveable components, and therefore is a “double pole”. It also has two connections for each pole, so it’s a “double throw”. This type of switch is often used in a switchbox to give the user an extra set of contacts to wire indicator lights or relays.

Almost any switch configuration can be identified by applying these outlined principles.

Typical Series 92 Electric Actuator



Typical Series 94 Electric Actuator



Specifications

Electric actuators will usually have the following specifications:

1. HOUSING MATERIAL – (such as Aluminum Alloy) This the material of the actuator housing. Asahi America utilizes a specially treated aluminum alloy for the Series 92 and Series 10, and Zytel FR50 for the Series 94.
2. HOUSING COATING MATERIAL – (such as powder coat) This is the protective coating of the actuator housing (if any). Asahi America Series 92 and Series 10 have a thermally bonded powder coat finish.
3. ELECTRICAL PROTECTION: – (such as NEMA 4X) A general guideline for enclosures is located on page 10.
 - a. NEMA 4x - This is the rating for the enclosure as defined by the National Electrical Manufacturers Association (NEMA). The “4” designation that follows NEMA is a specific “code” that states that the enclosure is rated for indoor or outdoor use, and the “X” designates that the enclosure is non corrosive. Asahi America’s Series 92, Series 10 and Series 94 have been designed with a NEMA 4x rated enclosure.
 - b. NEMA 6 - This is the rating for the enclosure as defined by the National Electrical Manufacturers Association (NEMA). The “6” designation that follows NEMA is a specific “code” that states that the enclosure is rated for temporary submersion at a limited depth. Asahi America’s Series 10 has been designed with a combination enclosure rating of NEMA 4x & NEMA 6.
 - c. NEMA 7 - This is the rating for the enclosure as defined by the National Electrical Manufacturers Association (NEMA). The “7” designation that follows NEMA is a specific “code” that states that the enclosure is rated for use in Hazardous Locations. Asahi America’s Series 92 has been designed with a NEMA 7 rated enclosure.
 - d. ATEX Exd IIB T4 - This is the rating for the enclosure as defined by the National Electrical Manufacturers Association (NEMA). This designation is representative of an enclosure that is rated for use in Hazardous Locations. Asahi America’s Series 92 and Series 10 have been designed with an ATEX rated enclosure.

***PLEASE NOTE THAT THE ABOVE SECTION DOES NOT IMPLY
CERTIFICATION BY A THIRD PARTY, IT ONLY SUGGESTS THE PROTECTION
LEVEL OF THE DESIGN REQUIREMENTS***

Actuation Basics

4. **OUTPUT TORQUE** – (such as 400 in/lbs) This the amount of torque (typically in in/lbs) that the actuator produces at the rated voltage and phase. Asahi America provides actuators that produce from 150 in/lbs to 48,000 in/lbs.
5. **MOTOR TYPE** – (such as capacitor run) This details the motor type such as brushless, permanent capacitor (or capacitor run), etc. Asahi/America, Inc. provides brushless permanent capacitor motors in the Series 92, Series 10 and Series 94 electric actuator.
6. **SWITCHES** – (such as SPDT) This details the type and rating for switches used in electric actuators (reference page 4). Asahi America’s Series 92 and 94 use 2-SPDT 15Amp switches for end of travel, and 2-SPDT 8Amp switches for dry auxiliary contacts. These four switches are standard in the Series 92 & 94. The Series 10 uses 4-SPDT 10 Amp switches; two are end of travel, and two are dry auxiliary contacts.
7. **MOTOR VOLTAGE AND PHASE** – (such as 120/1/60) This is the rated voltage, phase, and cycles (also known as hertz, Hz) for proper and safe operation of the motor. Optional voltages are also available.
8. **GEAR TRAIN** – (such as heat treated) This is the detail of the gearing. Some manufacturers use a powdered/sintered metal or plastic gear train, which will often wear out or break prematurely. Asahi America provides electric actuators with solid alloy steel, Rockwell Hardened gears.
9. **MANUAL OVERRIDE** – (such as declutching) This is a means of cycling the actuator without power. Some manufacturer’s offer this and some do not. Also, for those who do offer, there is declutching and non-declutching. The difference is that a declutching manual override disengages the motor from the output gearing and output shaft, whereas non-declutching does not. So when the non-declutching manual override is used, the motor is winding backwards; often times damaging the windings and armature. Asahi America’s electric actuators are of the declutching manual override design.
10. **CONDUIT ENTRY** – (such as ½” FNPT) This is the pipe size and thread for electrical conduit connections. Asahi America Series 92 and Series 94 actuators are provided with two (2) ½” FNPT conduit entries. Series 10 actuators are provided with two (2) ¾” FNPT conduit entries.
11. **DUTY CYCLE** – (such as 75%) This is a ratio of “on time” vs “off time” shown as a percentage. A higher percentage equals a higher “on time” rating. This rating is important in selecting an actuator. If you have a high cycle application and a low duty cycle, the motor is going to be overworked and burn out.

Let’s assume that an electric actuator will run for 10 seconds (“on time”) and then rest for 5 seconds (“off time”). We can compute the duty cycle as follows:

Actuation Basics

$$\text{Duty cycle} = \frac{\text{Maximum "on time"}}{\text{Minimum "off time"}}$$

$$\text{Duty cycle} = \frac{10 \text{ seconds}}{5 \text{ seconds}} \quad \text{or,} \quad \frac{10}{5}$$

$$\text{Duty cycle} = 50\%$$

For this application example, an electric actuator with a minimum duty cycle of 50% is required. An actuator with a higher duty cycle would be a better choice, such as a more common 75% duty cycle.

12. AMP DRAW – (such as 1.0A) This is the amount of current required to cycle the actuator. Some manufacturers show this figure as a “running current”, while others show it as a “locked rotor current”, or “stall current”. Running current is just that, the current required to run or cycle the unit. Locked rotor current, or stall current, is the maximum current that the actuator will draw, even if something were to become lodged in the valve limiting its travel, thus locking the rotor, or stalling the motor. Asahi America publishes ALL amp draws as locked rotor, and believes that this aids electrical designers to properly design their system.
13. MAXIMUM AMBIENT TEMPERATURE – (such as 150°F) This is the maximum ambient temperature for safe and proper operation. Asahi America electric actuators have a maximum temperature of 150°F.
14. MOUNTING CONFIGURATION – (such as ISO 5211) This is a standard for the bolt circle and output shaft for the mounting of valves. Asahi America electric actuators meet ISO 5211 standards.
15. CERTIFICATION:
 - a. UL APPROVAL/CERTIFICATION – (SUCH AS UL508) This is a third party approval that certifies that the actuator has undergone and passed third party testing to a specific standard. Asahi America actuators have been certified to UL508, which is the standard for Industrial Control Equipment. (AKA: NEMA 4)
 - b. UL APPROVAL/CERTIFICATION – (SUCH AS UL1203) This is a third party approval that certifies that the actuator has undergone and passed third party testing to a specific standard. Asahi America Series 92 actuators can be certified to UL1203 (Class 1, DIV 1 & 2), which is the standard for Process Control Equipment for use in Hazardous Locations (AKA: NEMA 7, or Explosion Proof).

Actuation Basics

- c. **ATEX CERTIFICATION (SUCH AS Exd IIB T4)** This is a third party approval that certifies that the actuator has undergone and passed third party testing to a specific standard. Asahi America Series 92 and Series 10 actuators can be certified to ATEX Exd IIB T4 (Equal to Class 1, DIV 1 & 2), which is the standard for Equipment use in Hazardous Locations (AKA: NEMA 7, or Explosion Proof).

Enclosure Types According to NEMA

The following is from NEMA Standard #250

An enclosure is a surrounding case constructed to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection to the enclosed equipment against specified environmental conditions

Type 1 Enclosures

are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment.

Type 2 Enclosures

are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.

Type 3 Enclosures

are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and external ice formation.

Type 3S Enclosures

are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and to provide for operation of external mechanisms when ice laden.

Type 4 Enclosures

are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water and hose directed water.

Type 4X Enclosures

are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose directed water.

Type 5 Enclosures

are intended for indoor use primarily to provide a degree of protection against settling airborne dust, falling dirt, and dripping non-corrosive liquids.

Type 6 Enclosures

are intended for indoor use primarily to provide a degree of protection against the entry of

water during occasional temporary submersion at a limited depth.

Type 6P Enclosures

are intended for indoor use primarily to provide a degree of protection against the entry of water during prolonged submersion at a limited depth.

Type 7 Enclosures

are for use in indoor locations classified as Class I, Groups A, B, C, or D, as defined in the National Electric Code.

Type 8 Enclosures

are for indoor or outdoor locations classified as Class I, Groups A, B, C, or D, as defined in the National Electric Code.

Type 9 Enclosures

are for use in indoor locations classified as Class II, Groups E, F, and G, as defined in the National Electric Code.

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Type 10 Enclosures are constructed to meet the applicable requirements of the Mine Safety and Health Administration.

degree of protection to enclosed equipment against the corrosive effects of liquids and gasses.

against dust, falling dirt, and dripping non-corrosive liquids.

Type 11 Enclosures are intended for indoor use primarily to provide, by oil immersion, a

Type 12 Enclosures are intended for indoor use primarily to provide a degree of protection

Type 13 Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying water, oil, and non-corrosive coolant.

Actuator sizing

Actuator sizing is an important step to ensure the actuator can overcome the required valve torque. If the actuator does not produce enough output torque, it can not successfully cycle the valve to which it is coupled to. Most manufacturers use a safety factor when sizing an electric actuator. Asahi America's safety factor is 25%.

Minimum actuator output torque is the product of the maximum valve torque and the safety factor, and can be computed using the following formula:

Minimum actuator output torque = maximum valve torque (in/lbs) X 1.25

So:

Maximum valve torque = (450 in/lbs)(1.25)

Minimum actuator output torque = 562 in/lbs

For a valve that requires 450 in/lbs of torque to operate, the actuator must produce a minimum of 562 in/lbs to properly cycle the valve. An A92XWJ produces 700 in/lbs and would be the actuator of choice for this application.

Electric Actuator Options

Feedback Potentiometer

A 1000-ohm, 1 watt feedback potentiometer with 5% linearity can be installed for position feedback. The feedback potentiometer provides a varying degree opening percentage from 0-1000 ohms. This option is not used very often.

Positioner

A solid state PCB is installed inside of the actuator for precise modulating control. The standard positioner accepts 120vac supply voltage and a user selectable control signal of current or voltage. This positioner has 450 points of resolution in a 90 degree quadrant, is

pushbutton calibrated without the use of tools, and accept a transmitter via plug and socket.

Transmitter

A solid state PCB installed in the positioner via plug and socket will provide precise valve position to a PLC, DCS, etc. via a current or voltage signal. This is an output signal *from* the actuator NOT a control signal *to* the actuator. This is for reporting the precise valve position to the appropriate piece of equipment. Transmitter is also provided with 3 SPST relays; one for open position, one for closed position, and one for a fault condition.

Cycle Length Controller (CLC)

The CLC allows the field adjustment of the actuator cycle time up. This adjustment is for lengthening the cycle time, is accomplished by pulsing power to the motor. The CLC is configured at the factory for the combination of open and close cycles, and mounted inside of the actuator housing.

Mechanical Brake

This prevents oscillation typically found with rubber seated Butterfly Valves. The brake is installed on top of the motor armature and is electro-mechanical. When power is applied to the actuator, it is also applied to the brake, which releases the armature and allows the unit to cycle. When the power is lost the springs within the brake lock the armature so that it can no longer rotate, thus eliminating oscillation.

Center-Off

This option is used when a 90-degree “off” position is required while using a three-way ball valve. Two additional limit switches and two additional cams are installed in the unit (not to be confused with auxiliary limit switches) and allow three positions for a three way valve; 0 degrees or left port open, 180 degrees or right port open, and 90 degrees or “off” position.

2-Wire Control

The two-wire control option is a relay installed inside of the actuator for direct wiring to timers, level switches, etc. A constant power supply and a SPST switch of some sort are required for cycling of the actuator. When the SPDT switch is closed, the valve opens, and vice versa.

Failsafe Battery Back-up

A solid state PCB along with a rechargeable battery pack is installed inside of the actuator. When power is lost, the unit will then travel to a pre-determined “fail position”. It is imperative that there be constant power to the unit to ensure that the battery pack maintain a full charge.

Voltages

Asahi/America, Inc. offers five voltage options to meet a variety of customer needs: 220vac, 12vdc, 24vdc, 12vac, 24vac

Local Remote Station

The Local Remote Station is also known as a *Control Station*, and is used to electrically cycle the actuator independent of the control system. These stations typically have pushbutton and/or selector switches, and two position indication lights. Asahi/America, Inc. provides a 3-position selector switch, and a 2-position selector switch. The 3-position selector switch is for Hand-Off Auto selection. The hand mode is for controlling the actuator independent of the control system, the auto mode is for controlling the actuator via the control system, and the off mode disconnects power to the actuator. The 2-position selector switch is for Open or Close. By selecting the open or close switch, in hand mode, you can drive the actuator to either the open or close position.

Asahi/America, Inc. supplies these stations with Green/Open and Red Close position indication lights as a standard.

Why Specify Electric Actuators?

Lack of an air supply, cold climate, PLC controlled process, etc. are all reasons to specify an electric actuator over a pneumatic actuator.

In many remote locations, such as the Oil & Gas Industry, it may not be possible to provide an air compressor. In the Oil & Gas Industry, automated valves are located in an oilfield, literally in the middle of nowhere. That means no power supply for the air compressors, which typically run on 120vac or 240vac. This is overcome by using a low voltage electric actuator (12vdc) which is powered by a PLC, which is powered by a 12 volt battery, which is kept at full charge by a solar battery charger. So the required wattage would be 24 watts. On the other hand, if you were to try and use a similar solar system for a pneumatic system, the wattage required would be approximately 2400 watts.

A cold climate is not a good choice for a pneumatic system. Water is found in all air systems, which is a component of the atmosphere. When lower temperatures are considered with pneumatics, there is always the possibility of freezing air lines. This could be potentially dangerous depending on the process and the process media. There could also be partial freezing within the actuator. If this happens, the cylinder walls become scored, providing an air leak by the pistons, which dramatically reduces output torque from the actuator. One might consider heat tracing the air lines and actuator. If there is low voltage available for heat tracing, that same power source could be used to power an electric actuator without the concerns of a freezing air system.

Computer control systems (PLC, DCS, PID, PAC, etc.) are controlling more and more automated processes. These controllers can be wired directly to the electric actuators, streamlining the system. A pneumatic actuator would require a solenoid valve or a current to pneumatic, or I/P, converter that would wire to the controller, thus complicating the system. Along with the controller and components, an air compressor system would also be required. When all of the required components are factored in, the electric actuator is the best monetary choice.

Pneumatic Actuators

Pneumatic actuators are available in many different styles such as rack and pinion, scotch yoke, vane, etc. These actuators are available as single acting (spring return) or double acting (air open/air close). ALL pneumatic actuators have the same principle of operation.

Principal of Operation

Pressurized air enters the actuator and pushes against the inside of the housing and a piston or a vane. This pressure forces the piston(s) or vane to move, thus rotating the output shaft in one direction and typically opening the actuator (CCW rotation).

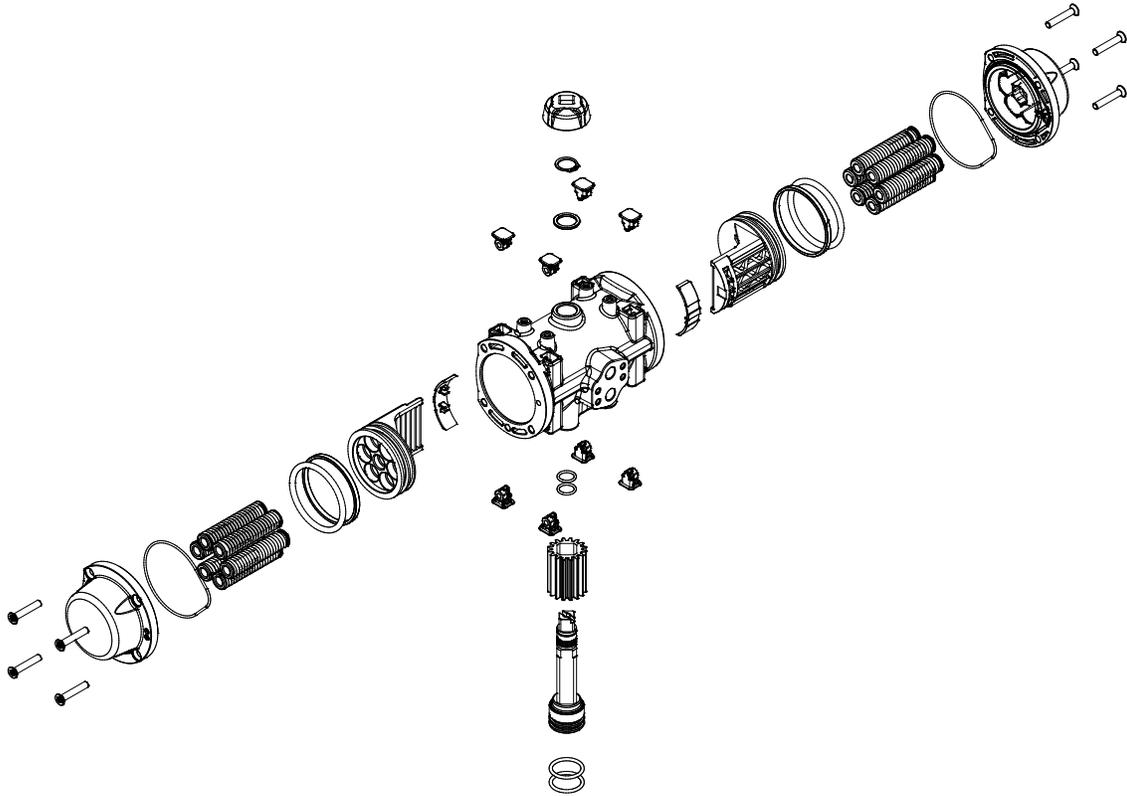
If the actuator is double acting, then the air is removed from the open port and introduced through the close port. This channels the air to the opposite side of the piston(s) to rotate the output shaft in the opposite direction; thus closing the actuator (CW rotation).

If the actuator is single acting, there are a set of springs that are on the opposite side of the piston(s) or vane that compress during the open stroke. When the air supply is removed, the stored energy in the compressed springs forces the piston(s) or vane back to its original position (typically closed – CW rotation).

Spring return actuators are also known as failsafe actuators. This is due to the spring action upon the loss of supply air. Most of the time spring return actuators a setup for a “failsafe closed” position; meaning that the actuator will close upon loss of air supply. These actuators can also be setup for a “failsafe open” position; meaning that the actuator will open upon loss of air supply. Since the actuator works “backwards” in a failsafe open application, the actuator will need to be reconfigured for this operation. Therefore, it is imperative that a failsafe open application be specified to the manufacturer prior to shipment, as many actuators can not be reconfigured in the field.

Some pneumatic actuators can be powered by other means, such as nitrogen gas, water, oil, etc. One must make sure that the “power source” is compatible with the actuator materials, so that there are no potential corrosion issues to hamper the operation of the actuator. One should also work with the manufacturer for proper material selection of actuator and actuator components.

Typical Series 79P PAG Pneumatic Actuator



Specifications

Pneumatic actuators usually have the following specifications:

1. **BODY MATERIAL** – (such as Aluminum Alloy) This the material of the actuator body. Asahi America has three body materials available: Rilsan coated aluminum alloy, Glass-filled Polyamide, and 316SS.
2. **BODY COATING MATERIAL** – (such as being Anodized) This is the protective coating of the aluminum alloy actuator body. Asahi America utilizes a combination of cataphoresis and Rilsan coating inside and outside.
3. **END CAP MATERIAL** – (such as Aluminum Alloy) This is the material of the actuator end caps. Asahi America uses the same material for the end caps as for the body.
4. **END CAP COATING MATERIAL** – (such as being Anodized) This is the protective coating of the aluminum alloy actuator end caps. Asahi America utilizes a combination of cataphoresis and Rilsan coating inside and outside.

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5. **EXTERNAL HARDWARE MATERIAL** – (such as SS) These are the “nuts and bolts” used to assemble the actuator. Asahi America uses 303SS for actuators constructed of aluminum alloy and glass-filled Polyamide, and 316SS for the actuators constructed of 316 SS.
6. **OUTPUT SHAFT MATERIAL** – (such as 304 SS) This is the material of the actuator’s output shaft. Asahi America uses 304SS, 316SS or cathodization coated carbon steel; depending on actuator body materials and actuator size.
7. **O-RING MATERIAL** – (such as Self-lubricating BUNA-N) This is the material of the O-Rings found within the pneumatic actuator. Asahi America uses a self-lubrication Buna N material.
8. **PISTON MATERIAL** – (such as Polyarylamine) This is the material that the pistons are constructed of. In some actuators, steel pistons are used. This can be a problem if “powered” with water, and also if powered from a “moist” air supply. Asahi America uses polyarylamine or aluminum alloy; depending on actuator size.
9. **PISTON GUIDE MATERIAL** – (such as Polyacetal) This is the material of the piston guides. Piston guides prevent the pistons from side-loading which robs output torque. Asahi America uses polyacetal or PTFE/Bronze; depending on actuator size.
10. **TEMPERATURE RANGE** – (such as -25°F to 195°F) This is the ambient temperature range for safe and proper operation. Asahi America’s standard actuators have a temperature range of -25°F to 195°F. For temperatures higher than 195°F, Asahi America offers a HT actuator (which is 316SS with High temperature o-rings installed) that has an upper temperature limit of 450°F.
11. **OUTPUT TORQUE** – (such as 576 in/lbs) This the amount of torque (typically in in/lbs) that the actuator produces at a specific air supply pressure. Asahi America provides actuators that produce from 60 in/lbs to 40,441 in/lbs based on an 80 psi air supply.
12. **AIR CONNECTIONS** – (such as ¼” FNPT) This is the pipe size and thread for air inlet ports. Asahi America actuators are provided with ¼” FNPT air inlets.
13. **AIR SUPPLY PRESSURE** – (such as 80 psi) This is a specified air inlet pressure to obtain a certain amount of output torque. As pressure increases, so does the output torque; and vice versa.
14. **MOUNTING DIMENSIONS** – (such as ISO 5211, NAMUR) These are standards for the mounting of accessories such as solenoid valves or positioners. Asahi America actuators meet both of these standards.

Actuator sizing

Actuator sizing is an important step to insure the actuator can overcome the required valve torque. If the actuator does not produce enough output torque, it can not successfully cycle the valve to which it is coupled to. Most manufacturers use a safety factor when sizing a pneumatic actuator. Asahi America's safety factor is 25%.

Minimum actuator output torque is a product of the maximum valve torque and the safety factor, and can be computed using the following formula:

Minimum actuator output torque = maximum valve torque (in/lbs) X 1.25

So:

Maximum valve torque = (450 in/lbs)(1.25)

Minimum actuator output torque = 562 in/lbs

For a valve that requires 450 in/lbs of torque to operate, the actuator must produce a minimum of 562 in/lbs , based on the proper air supply, to properly cycle the valve.

The CP79PN air to air actuator produces 575 in/lbs at 80 psi and would be the actuator of choice for this application.

The DP79PSN air to spring actuator produces 582 in/lbs at 80 psi and would be the actuator of choice for this application.

Pneumatic Actuator Options

Solenoid Valves

Solenoid valves are a necessity for cycling pneumatic actuators. These electric valves allow air to enter specific ports of the actuator based on their design type. Solenoid valves are available as 2-way, 3-way, 4-way, etc. So you must be cautious when selecting solenoid valves.

Design Styles

2-way solenoid valves operate as open or closed.

3-way solenoid valves operate as a multi-port valve with one port being an inlet, one port being an outlet, and the third port being exhaust. 3-way solenoid valves are used with single acting actuators.

4-way solenoid valves also operate as a multi-port valve with one port being an inlet, two ports being outlets, and two ports being exhaust. 4-way solenoid valves are used with double acting actuators.

Specifications

Solenoid valves usually have the following specifications:

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1. **DIRECT OR REMOTE MOUNT** – This specifies the location of the solenoid. Direct mount is mounted directly to the actuator, while Remote Mount is mounted on a manifold and piped to the actuator ports. The standard solenoid for Asahi America, Inc. is Direct Mount.
2. **PIPE SIZE** – (such as ¼” FNPT) This is the pipe size and thread for the inlet and outlet ports for a remote mount solenoid, or the pipe size and thread for the inlet port of a direct mount solenoid. The standard inlet/outlet pipe size for Asahi America, Inc. is ¼” FNPT.
3. **ELECTRICAL PROTECTION** – (such as NEMA 4X) This is the rating for the enclosure as defined by the National Electrical Manufacturers Association (NEMA). A general guideline for enclosures is available on page 7. The standard Electrical Protection level for Asahi America, Inc. is NEMA 4X.
4. **COIL VOLTAGE** – (such as 120vac) This is the voltage that will energize the coil and have the solenoid change states and allow air to enter the actuator, thus cycling the unit. 120vac is the standard voltage for Asahi America, Inc.
5. **MAXIMUM INLET PRESSURE** – (such as 125 psig) This is the maximum allowable inlet pressure allowed without causing damage and also to operate safely. It is very important that the maximum inlet pressure of the solenoid be equal or higher than the actuator.
6. **TEMPERATURE RANGE** – (such as 32°F to 125°F) This is the recommended temperature range for safe and proper operation.

Limit Switches

Auxiliary limit switches, are used for interlocking with other equipment or valves. They are also widely used as valve position confirmation (end of travel) with a PLC, DCS, etc. 2-SPDT switches with a 15 amp rating are mounted inside of a NEMA 4X enclosure. This enclosure has SS trim, is mounted on top of the actuator, and direct coupled with the actuator output shaft.

Pneumatic Positioners

The pneumatic positioner accepts variable pneumatic instrumentation signals (typically between 3 and 15 psig) and regulates the 80-psi air supply to the actuator via a characterized cam, diaphragm, and spool.

The diaphragm receives an input pressure signal from the controller, which applies force to the spool valve spring causing the spool valve to move. This movement modifies the air pressure to the actuator, permitting the actuator to respond accordingly. The characterized cam transmits the actuator movement to the spool valve.

Electro-Pneumatic Positioners

The electro-pneumatic positioner accepts variable electrical instrumentation signals (between 4 and 20 milliamps) from a PLC, DCS, set point controller, etc. and regulates

the 80-psi air supply to and from the actuator via an on-board I/P converter. This process regulates the actuator position within its quadrant for precise modulation.

Transmitter

A transmitter installed in the positioner will provide precise valve position to a PLC, DCS, etc. via a current signal (typically between 4 and 20 milliamps). This is an output signal *from* the actuator NOT a control signal *to* the actuator. This is for reporting the precise valve position to the appropriate piece of equipment. The transmitter is standard piece of equipment within an Asahi America, Inc. positioner.

AS-I Bus Networks

AS-I (Actuator-Sensor Interface) offers many of the benefits of more complex and costly bus systems, but does it at a substantially lower cost and with greater simplicity. The Actuator-Sensor Interface is ideally suited for controlling valves, actuators and many other field devices in a processing application.

This interface can be used for stand-alone process control, or it can be used together with a higher-level bus control system. AS-Interface does not compete with higher-level bus systems; it should be seen as a complimentary system that offers low cost, reliable device control for binary and analog devices.

Reliability, simplicity and interoperability make AS-Interface a cost effective connection/control solution, particularly where low installation costs is imperative. A single pair of wires, which handles power and communications, is used to control the network by means of “chaining” the actuators with the PLC. Each actuator (or device) will then have its own unique address within the system and only that device with the proper address will respond to system commands. ASI is best known for its yellow flat cable, which is pierced by insulation displacement connectors so that the expense of tees and complex connectors is avoided. Devices are simply clamped onto the cable.

Digital signals are encoded on this cable in a sinusoidal signal, which has a very narrow frequency bandwidth. Filtering which is distributed through the network rejects all extraneous frequencies, and in this way ASI can be operated in electrically noisy environments without experiencing transmission errors.

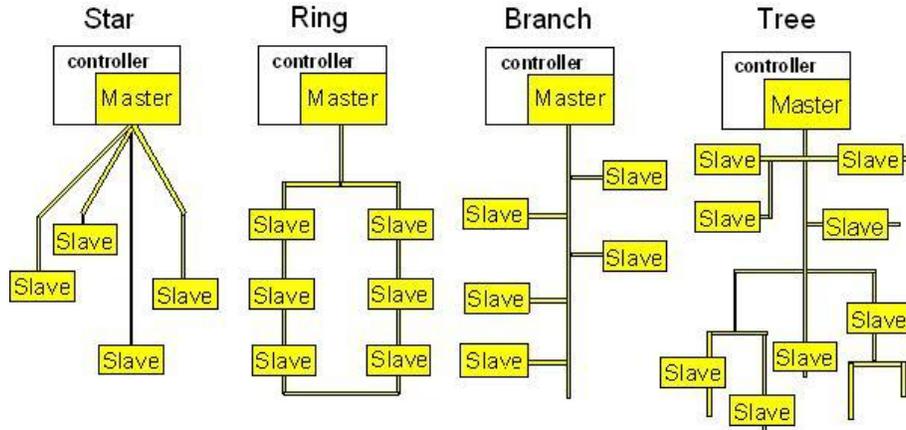
The yellow flat cable carries low current (30 VDC) for input devices as well as the AS-I signal. If power for outputs (such as energizing relays) is required, an additional BLACK flat cable is available. Standard networking is capable of 62 units with a distance up to 100 meters, and a cycle time of 5ms. A maximum of 300 meters is achieved by installing repeaters.

This system also responds well with products from other manufacturers, by installing a gateway to “translate” the commands of higher-level networks. This allows an existing system to be expanded simply by using the AS-I networking system.

Actuation Basics

There are various wiring structures which can be used with this system such as the “star”, “ring”, “branch”, “tree”, etc. All are practiced and acceptable, but the loop has a distinguished property; if there were a “break” in the network cable the units **would still cycle** and the master would detect the loss of a node, and set off an alarm. This feature is unique to the ring structure.

These wiring structures can be reviewed below.



Declutching Manual Override

A declutching manual override is a gear operator that has an offset input handwheel shaft assembly that either engages or disengages with the internal worm gear. When the shaft assembly is disengaged, the actuator cycles normal and the handwheel will rotate freely. When the shaft assembly is engaged, the handwheel must be rotated to manually open or close the actuator. This should only be done when there is no air pressure to the actuator. It is imperative that the valve torque and the actuator torque be used in the sizing equation for air to spring actuators, as the manual override gear box must overcome to valve torque as well as the spring torque.



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www.asahi-america.com
asahi@asahi-america.com