Back to BASICS: HOW TO SELECT AN ELECTRIC ACTUATOR

WHEN YOU'RE SEARCHING FOR AN ELECTRIC MOTOR ACTUATOR TO AUTOMATE A NEW OR EXISTING VALVE YOU HAVE A WIDE SELECTION FROM WHICH TO CHOOSE. IN FACT, JUST ABOUT ANY TYPE OF VALVE CAN BE AUTOMATED WITH THE RIGHT ACTUATOR. HERE IS A LIST OF QUESTIONS TO ASK AND POINTS TO CONSIDER THAT CAN HELP YOU WITH THE SELECTION PROCESS. **BY HOWARD WILLIAMS**

How do I choose the right manufacturer as my automation partner?

As with the actuators themselves, today's choice of manufacturer is broad. There are many well-established actuator manufacturers in North America. The best manufacturers, however, offer not only a full range of products, but also the technical advice, local field support, and readily available spare parts that go with those products. While purchase price is always a consideration, you should also analyze the "cost of ownership." In other words, you need to look at factors such as the life expectancy of the actuator, its history of reliability, the cost of routine maintenance, and the ease of installation.

Keep in mind that the amount of support you get from a manufacturer after the sale is made significantly affects the cost of ownership. Because of this, you should make sure your actuator manufacturer has experience in your particular industry and is familiar with the application you have in mind. Ask potential actuator manufacturers if they have conducted similar installations at other plants in your area, then ask for a customer reference list you can use for an independent review.

What is the leading cause of premature actuator failure?

All electric actuators contain electrical and some electronic equipment that is susceptible to catastrophic failure if that equipment comes into contact with moisture. Moisture can enter the actuator in a number of ways—through a poor cover seal ingress when covers are removed during maintenance, condensation from enclosure breathing, or flooding through the conduit that connects the power and control wiring to the actuator.

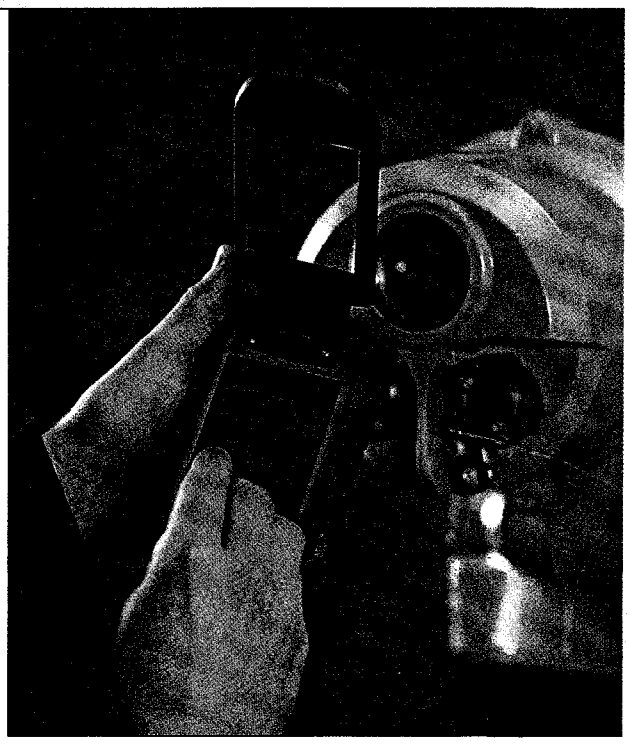


Figure 1. An actuator being set with a setting tool

The best method of preventing simple cover leaks is to use O-rings to seal covers attached to the actuator. This is because some actuator enclosures have natural breathing and space heaters for moisture that can collect inside the actuator enclosure. In those cases, ambient temperatures will vary, causing the air mass inside the actuator to expand and contract, which in turn causes internal condensation. The O-ring seals the environment so the enclosure will not breathe, condensation problems are eliminated, and a space heater is not needed to control the humidity. Another source of water ingress issues is local integral con-

trols, such as open/stop/ close and local/remote selector switches, when they are the older mechanical controls that penetrate the enclosure cover. Today several newer designs use non-intrusive local controls with magnets and reed switches, which eradicate the need for through-holes in the covers.

Another common area where there might be ingress of moisture is through the conduit. In these cases, a separately sealed terminal compartment can prevent moisture from getting into the motor and controls compartment.

Moisture ingress also might occur during commissioning (when the terminal cover is removed). Whenever the covers of conventional, mechanical actuators are removed for torque and limit switch adjustment, the actuators are exposed to moisture. This occurs not only during initial commissioning but at other points throughout the life of the actuator as valve wear calls for torque and limit-switch adjustments. Electronic-designed actuators now have electronic sensors that can be calibrated without removing any enclosure covers instead of the conventional torque and limit switches. This newer calibration procedure involves steps through a menu that allow you to set closing direction, limit switches, and torque switches, as well as adjust many secondary settings, such as auxiliary contacts for position feedback to the control room. These procedures are not only simpler to handle than calibrating a conventional switch mechanism with the covers off, they also are significantly faster.

Sealing an actuator is extremely important if that actuator is to survive in the field for the long term. Before purchasing an electric actuator, look closely at the enclosure to ensure it has O rings with a NEMA rating of at least 6 (temporary submergence) to tightly seal the enclosure.

When reviewing the actuator enclosure type, consider these points:

1) Does the actuator have a separately sealed terminal compartment?
2) Does the actuator require special storage requirements that would void the warranty between leaving the factory and field commissioning?
3) Will you ever have to break the enclosure seal to calibrate the actuator?
4) Are there any elements physically penetrating the actuator enclosure, such as local control switches, that could become potential leak paths?

How can I make sure the actuator is suitable for the duty cycle of my process?

The facts and myths that surround the topic of suitability can be confusing for those not living and breathing actuators on a daily basis.

Many electric actuators are used in on/off applications or in cases where minimal positioning service is required. To do this, the electric motor must spin in one direction for seconds or minutes to open the valve. It then reverses in direction and repeats the process to close the valve. By nature of this type of operation, the motor is never required to run in one direction continuously.

Because of this, a common myth exists that electric actuators should have continuous duty-rated motors. However, consider that most electric actuator manufacturers, depending on the application, use a three-phase, AC-powered, 15- or 30-minute-rated motor. A typical definition for a 15-minute-rated motor is 15 minutes continuous operation in one direction at a steady one-third of its rated torque. Most valves need higher torque at the beginning and end of the stroke to unseat and reseat the valve, and they run fairly light during mid stroke. Some manufacturers are using specially designed high-torque/low-inertia motors for optimum performance in this service. Although significant amounts of information are available on this topic, you should be sure to have a knowledgeable person size an actuator for its given application.

As the motor temperature increases, the motor efficiency decreases. Therefore, the motor torque output must be rated accordingly. In addition, specifications for the motor need to be written in a way that includes safety as a factor when sizing an actuator for a given valve.

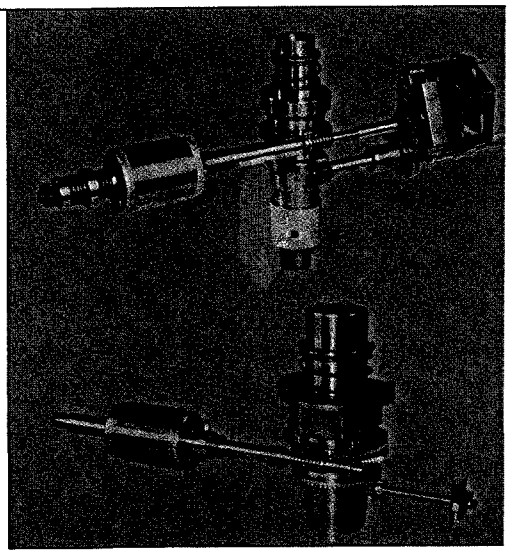


Figure 2. A switch mechanism (top) versus a hall affect sensor (bottom)

For modulating duty, the focus is on how many times you stop and start the motor rather than the length of time the motor is running. Standard electric actuators use a pair of electromechanical contactors to connect electricity to the motor windings, which operate the motor in the forward or reverse direction. These contactors typically are rated for 60 operations per hour at a maximum rate of 10 operations per minute. If the number of operations is exceeded, the contactors will overheat and may weld themselves shut. For higher duty cycles, substitute a solid-state motor starter for the mechanical contactors. This will increase the number of motor operations to as many as 1,200 per hour. Since modulating actuators move partial strokes frequently, it is important to make sure the actuator mechanics are also rated for the service, and no loss of motion is experienced.

Is the available power supply adequate?

Your selection of an actuator will also be influenced by the available power supply. As plant automation expands, more remote applications with limited power availability are used. An industrial three-phase AC power supply is the best option

because the motors are robust and suited to actuator service and duty cycles.

Single-phase AC and DC motors also are available but they have some limitations, especially if you are looking at a positioning or modulating valve application. Be sure to explore these issues when specifying your plant automation. DC motors offer variable output speeds and are easily adaptable to a failsafe backup power supply. Electric spring failsafe actuators are another option for failsafe applications. These actuators use self-contained electro-hydraulics to drive a piston with a spring failsafe stroke, and they can be operated by different power supplies with non-intrusive features similar to the modern electric motor actuators.

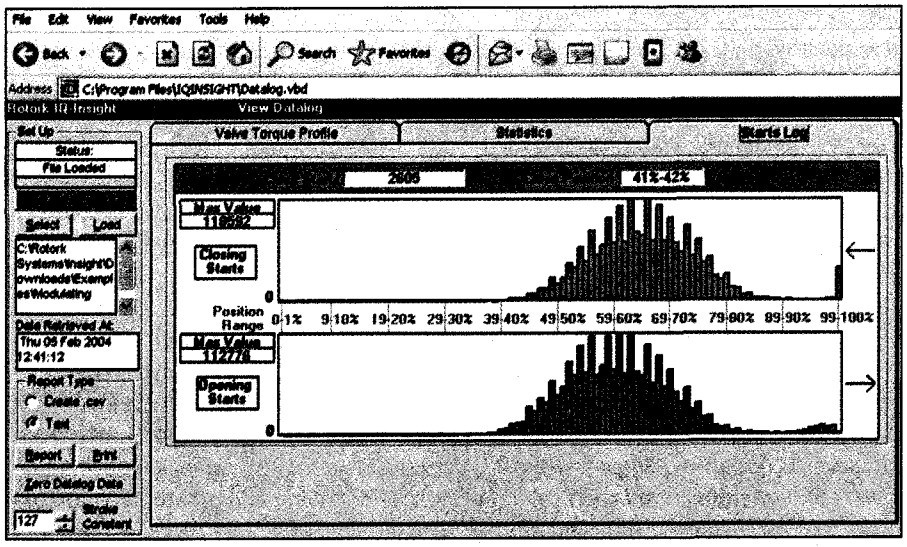


Figure 3. Diagnostic information is shown on this computer screen.

Is there a way to manually override my motor-operated valve?

Electric actuators come with a manual override that allows you to hand crank the valve open or closed after loss of electricity or actuator motor failure.

Consider the ways you will use your actuator once it is installed. It is important that your manual override drive mechanism is totally independent of the motor gearing, thus guaranteeing the valve will operate regardless of electrical problems with the actuator (such as a seized motor).

Most actuator designs include integral (open/stop/close) local controls and a display showing actual valve position. A local/remote selector switch should isolate input signals from the local integral controls instead of relying on remote input from the control room. Without this ability to operate independently, you might have two opposing input signals that fight to position the valve.

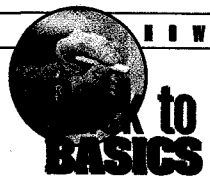
Should I choose a basic actuator or one of the new "intelligent" electronic types?

Smart electronic actuators were introduced in the early 1990s. Although some customers embraced the technology immediately, it took a few years before design engineering firms modified their core equipment specifications to include the advanced features.

Some would say that electronically controlled actuators are overkill for simple on/off applications. However,

POINTS TO REMEMBER

- ✔ Define your individual needs and plant requirements such as environmental conditions, available power, local and remote control needs, duty cycle, and desirable actuator features.
- ✔ Do your research of actuator manufacturers to find a company with a full range of products that has the experience in your market and application.
- ✔ Narrow your search to manufacturers that will provide good service for long-term reliability and low cost of ownership.
- ✔ Ask the manufacturer to bring in working demo actuators so you can review the mechanical and electronic features. The diagnostic software needs to be demonstrated to ensure it works as advertised.
- ✔ If you require the actuator be added to an existing network, ask if you can run an interoperability test. Today's modern actuators can run on Modbus, Devicenet, Profibus, Foundation Fieldbus, and now Ethernet.
- ✔ Write your equipment specifications around the product that meets your needs. To do so, request stringent performance parameters and experience clauses. Also important in your research is prior experience with your application and user reference lists of existing working sites.
- ✔ Expect technical resource manuals to be included in your purchase so your systems integrator feels comfortable making the device talk on the network. You should also expect a reasonable manufacturer's warranty.
- ✔ The actuator often comes to site as part of the valve package, and the procurement method in such cases can be complicated; be sure to maintain direct factory contact with the actuator manufacturer so that issues can be addressed quickly once the actuator is ready for commissioning.
- ✔ Remember that long-term cost of ownership and satisfaction is more important than initial purchase price. An inefficient plant costs your company money.



solid arguments exist for using today's technology for all applications including the moisture ingress issues mentioned above.

Smart electronic actuators also come with a standard package of additional features that protect the actuator electrically during operation. These extra "bells and whistles" are part of the main electronic assembly and add negligible cost to the actuator. Some standard features included in the modern electronic actuators are: monitor relay, automatic phase rotation correction, single phasing protection, motor protection in situations in which a valve jams, motor thermostat protection, instant reversal protection, and auto self-test diagnostics.

Many on/off actuators are infrequently used so they are not exercised regularly. This can be as tough on an actuator as if it was operated regularly. The question then becomes, "Will the actuator be ready for operation when it is called upon to move the valve?" Also, the ability of an electronic actuator to report its status to the control room at all times is important because the infrequently used actuators are networked with other, frequently used actuators. The control room needs a complete plant view to see the status of all motor-operated valves in one format. Electronic actuators are best suited to the network environment.

Finally, by using modern torque and limit-sensing mechanisms, manufacturers are greatly reducing the number of mechanical moving parts in the actuator, thereby increasing its reliability.

Is diagnostic software a useful tool—or simply a sales gimmick?

Another significant feature of today's smart actuators is an onboard data logger that tracks the actuator's activity. This activity information can be downloaded at any time to a laptop or a PDA loaded with the actuator manufacturer's diagnostic software.

The software can provide critical information about the actuator's operation and can give torque profiles detailing the valve's performance. This is important because as valves age, their wear causes increased torque demand on the actuator. Most actuators are sized using a safety factor that allows for this extra demand, but at some point, the valve actuator will eventually run out of torque. A continuous torque data report allows a technician to view the exact torque demand across the stroke of the valve in opening and closing directions. Because open/close service valves often remain in one position for long periods of time, electronic torque protection features are important as a means of monitoring the valve torque demand when the valve is stroked or exercised.

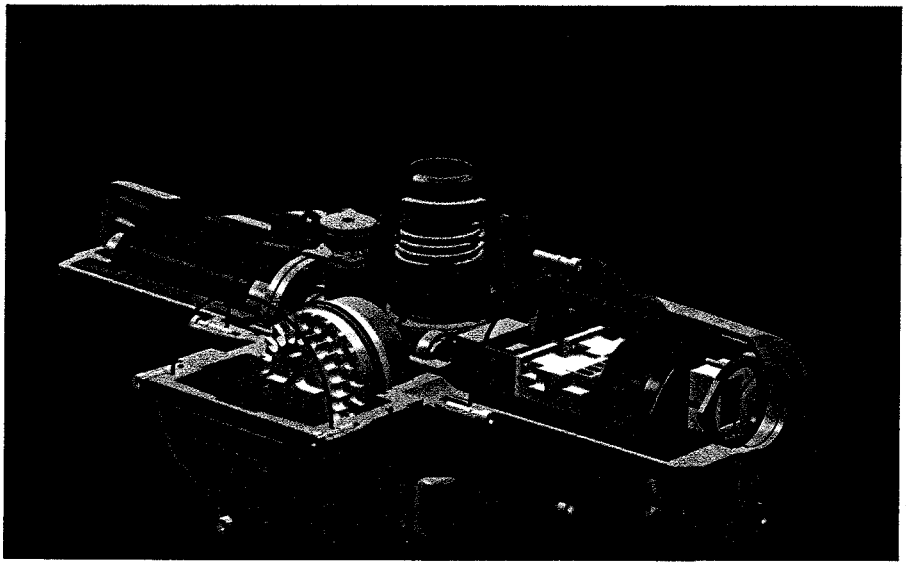


Figure 4. An actuator showing O-rings in a sealed terminal compartment

Many plants today operate with minimal staffing so analyzing what happened is difficult and often takes place after an event occurs. Software keeps track of all movements that occur and can give time and date stamping. As a result, all operations can be reviewed quickly to catch the source of a problem.

This review process includes monitoring input signals from both local and remote controls as well as the local manual override. This can be important today because many industries are tightening safety procedures and fine tuning maintenance programs. The on-board data logger and diagnostic software not only reports on a valve's condition, it also provides a permanent record that mandatory valve cycling and safety checks have been performed following plant safety procedures.

If you are interested in this type of monitoring ability, ask a manufacturer to provide you with a demonstration of the actuator showing how the software works so you can verify its user friendliness. You should also ask yourself if the software will be an extra expense. Ask the manufacturer what you need to run the software and how you get access to software upgrades. As with shopping for software in a retail electronics store, all too often you can look at the box and drool over the contents, but once you get the software home and open the package, the reality of how it operates is not as advertised. (Unfortunately, at that point you own that software—it cannot be returned).

What do I need to know about control systems?

Electric actuators often are considered part of the valve's mechanical package. Yet these actuators require the services of an electrician to supply power and to

commission them. They also may require an instrument technician to integrate the actuator into the plant control system alongside other field instruments.

By necessity, actuator manufacturers have been drawn into the control system arena, becoming experts at knowing how their equipment can best be interfaced with the other equipment in a plant.

Today, many different protocols are used to interface with the plant's operation system or SCADA. Traditionally, however, interfacing required wires to run to each actuator to perform a specific operation. If you wanted to open a valve, you sent voltage to a specific terminal in the actuator. When the valve needed to be closed, the same signal was sent to a different terminal. The voltage used was supplied from the control room or the actuator control transformer.

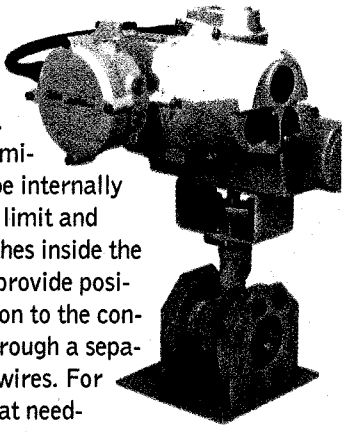


Figure 5. A failsafe actuator

Other terminals would be internally wired to the limit and torque switches inside the actuator to provide position indication to the control room through a separate pair of wires. For actuators that needed to be moved in a mid-travel position, a 4-20mA signal would be sent to the actuator. A second 4-20mA signal could be sent back to the control room to confirm actual valve position. Any other signals the control room needed would require their own separate wires run to the actuator.

Modern control systems are hungry for data from all field instrumentation. Instead of heavy investments in copper wire and large-diameter conduit, actuators are networked using a data highway. Infrequently used on/off motor-operated valves and modulating service operators are daisy-chained together and recognized by the control system through unique field addresses.

An actuator manufacturer today can supply a closed loop with a data concentrator providing the control system a single-source point to send and receive all actuator commands and feedback. This data concentrator can also act as an Ethernet bridge that has web browser features and provides direct access to the plant's local area network. Alternatively, the control system can communicate directly with all motor-operated valves using one of the many communication protocols such as Modbus, Devicenet, Foundation Fieldbus, Profibus, and most recently Ethernet.

So what should you expect from the actuator manufacturer when deciding on motor operators for your plant? Here are a few questions to ask:

1) Does the manufacturer have experience with the control sys-

tem you intend to use? Ask for a user list with references of existing sites that use your type of controls system.

2) Is the manufacturer's communication card certified by governing organizations and has it been tested with the host control system you intend to use?
3) Does the manufacturer produce the communication cards itself? What is the long-term availability of the cards?
4) Does the manufacturer have field technicians capable of starting up the actuators and commissioning the actuator control loops?
5) Does the manufacturer provide technical manuals when a system is purchased to allow a systems integrator to evaluate how that system will communicate with the actuators?
6) Do they have technical phone support in the U.S. or Canada?
7) Will the manufacturer supply a demo actuator to allow the systems' functional test to be performed before actuators are installed on site?

What happens when it's hard to gain access to the actuator?

Should an actuator be hard to reach, local controls can be replicated using a separate push-button station hardwired to the actuator. A requirement often overlooked during design is the need for a local power disconnect at the actuator to safely cut off power from the actuator before an electrician performing maintenance attempts to remove the enclosure covers. This device should be totally separated from the actuator so people have no opportunity to come into contact with a live wire. For maintenance done in an instrument shop, an electrician must physically remove the power leads from the actuator terminal compartment. An integral disconnect, although often a cheaper alternative, defeats the safety objective so it is dangerous. VM

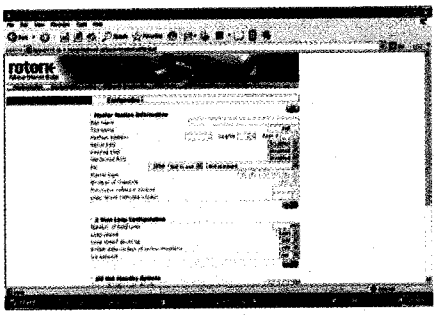


Figure 6. An Ethernet web browser

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