PARTIAL STROKE ACTUATORS

Assurance Against Sticking Valves

WHITE PAPER **XRCISER-01 041810**

Valves, in certain services, are subject to **sticking** if they are left inactive for periods of time.

Ideally, using a valve on a regular basis keeps the valve exercised and free of deposits that might otherwise accumulate in sufficient volume to prevent valve movement. Of course, use of a valve is dependent upon the process requirements.

Emergency Safety shutdown valves are critically important to plant safety. They absolutely must be able to perform given an emergency condition, yet their use in non-emergency situations simply to assure their operability would shut down the process, leading to costly outages. Again, in an ideal world, plant maintenance shutdowns would occur with sufficient frequency to permit exercising ESVs to assure their operability. In the real world, maintenance shutdowns are becoming less frequent, thereby necessitating another means to confirm ESV operability.

Other **less critical** applications exist, where a valve may not be employed in an emergency safety shut down application, but where infrequent use yet leads to sticking and inconvenient failure to respond when called upon.

Fortunately, suppliers have developed means by which valves can at least be partially operated in a manner that confirms operability but to an extent that does not disrupt the controlled process. Several approaches are now available. It is the intent of this paper to describe these and to discuss their **merit and deficiencies**.

Our discussion will center on **pneumatically** actuated valves that are to normally remain in the fully open position but it applies equally as well for normally closed valves. Also, we will focus on **1/4 turn rotary motion**, but again will be applicable to linear motion valves. Finally, we will consider actuators that employ **springs** to cause valve closure as springs assure against inoperability due to loss of the plant air supply.

Consider - a valve is being held in the fully open position by air pressure that has compressed the actuator springs and overcome whatever torsional resistance exhibited by the valve. The valve has not been called upon to operate for some period of time. Contaminants, corrosion or other factors accumulate to the extent that they will restrict rotation of the valve. If we regularly cause the valve to rotate a small amount, we will likely not disrupt the process, and the more frequently we cause this small amount of rotation, the more confident we will be that the valve will operate when called upon whether for an emergency shut down or simply to control the process.

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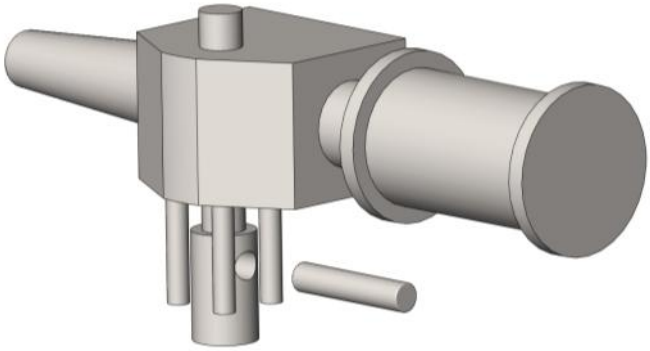
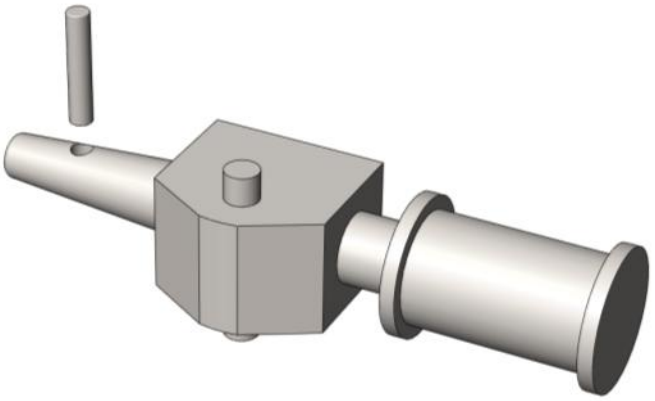
The easiest, most straight forward approach would be to exhaust pressure from the actuator until the actuator moves the valve a small amount and then reapply full pressure the actuator to again fully open the valve. This is simple, it is low cost and it usually will result in excessive valve closure and interruption of the process.



Another approach would be to incorporate a manually operated mechanical stop that, when in place, allows total pressure exhaust without worry about over closure. Often users design and install such a mechanical system of their own. Alternatively there are manufacturers who specialize in such devices. These are normally designed to fit between the actuator and the valve, and once engaged, will resist the actuator torque sufficiently to prevent excessive valve closure. Of course the limitations of this approach is that personnel are required to perform the manual engagement prior to the partial stroke exercise and most importantly, to then disengage the mechanism following the exercise.

Some actuator suppliers offer the ability to engage a **mechanical stroke limiting device** that is integral to the actuator. Personnel are also required to engage and disengage the travel limit stop.



Recognizing that many users do not prefer having to use their personnel to manually engage stops some suppliers of non-integral mechanical stops have designed means for **remote engagement** and disengagement.

Other supplier have expanded on the concept of exhausting the pressure via use of a 'smart' **positioner or switchbox**. These devices are designed to recognize the valve position and to allow pressure the exhaust only until the actuator has stroked the valve to the desired, non-disruptive, position. Once properly stroked, the smart device then reapplies pressure to again fully open the valve.

<u>But there are issues to be considered with each of the mentioned concepts:</u>

User exhaust of pressure:

- + Simple, inexpensive, convenient and requires no special equipment
- - Not likely to achieve the desired stroke limitation as it is extremely difficult to regulate the pressure to the actuator so that it strokes but not too much.

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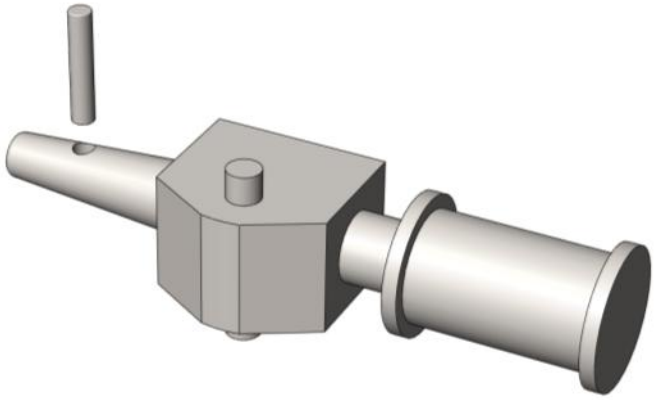
- - Exhausting only the proper amount of pressure (whatever this may actually be) limits actuator output torque as spring force is yet being countered by the remaining air pressure.

Mechanical stop - not integral to actuator:

- + Avoids need for user to design similar mechanism
- + Applies 100% of the actuator torque to break the valve free if it has become slightly stuck
- + Allows numerous close/open cycles with no concern for over closure
- + Lockable to prevent unauthorized use
- - Requires manual engagement and disengagement and verification of its disengagement following use
- - Presents severe problem if not disengaged following the exercising of the valve
- - Increased lost motion due to one or more additional coupling connections between the actuator and the valve
- - Does not permit valve closure when engaged, thus emergency situation requires both manual and remote execution of override/ disengagement procedure
- - Must withstand maximum possible actuator output torque in both direction of rotation. It may be difficult to obtain this information from the actuator supplier



- - Typically does not provide comparative or diagnostic information regarding actuator or valve operational requirements and changes that occur with time.
- Multi-source responsibility

Mechanical stop - integral to actuator:

- Generally the same positives and negatives as with non-integral mechanical stops except
- + Stop is incorporated into the actuator and while manual may be more readily lockable
- + No concern regarding compatibility with maximum actuator torques
- Single source responsibility

Smart Positioner:

- This would appear initially to be the answer everyone is looking for in that it allows remote or local operation, no field operators are required and it provides the option for diagnostic

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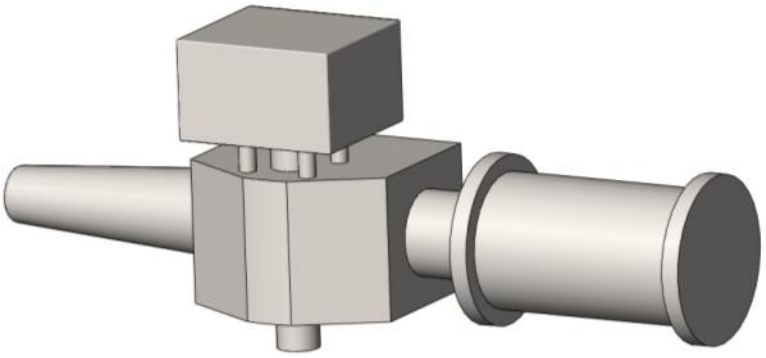
feedback to enable the user to recognize if the valve / actuator performance has changed with time. Maybe not…



- + Remote and or local engagement
- + Diagnostic feedback
- + Can be activated should an emergency, or need to operate, occur in the midst of testing
- - Fails to positively assure that the valve will not over close
    - Is it likely to over close? Perhaps not, but it is also not predictable as to when or if over closure will occur
    - Consider, while designed to exhaust only the correct amount of pressure there is no mechanical stop to absolutely assure that over closure cannot occur.
    - Many operators express fear of initiating the partial stroke sequence as they lack confidence in the devices' capabilities and over closure would be disastrous to their process.
    - If the valve does stick and then breaks free, will over closure result? Likely.
- - Discourages frequent usage as well as multiple cycles during test
    - If the operator fears failure, reluctance to test will extend the time between testing.
    - This also discourages multiple cycling during testing despite such additional exercising perhaps offering additional assurance of operational readiness
- - Performs poorly on larger actuators / overly expensive on smaller actuators
    - Consider, in order to function properly the device must allow pressure to escape gradually from the actuator or risk allowing over closure of the valve. Thus the speed of response is very slow.
    - Cost - on smaller actuators, the device likely costs more than the actuator.
- - Does not permit full actuator torque to be applied to the valve
    - Consider, by design the device does not allow full exhaust of the supply pressure as to do so would fully close the valve.
    - As most of the pressure is maintained, this prevents the actuator springs from developing their full force output

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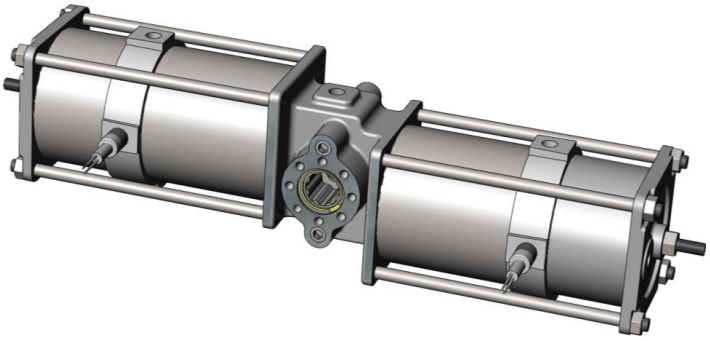
  - A valve that may be just slightly stuck, may be reported as in need of repair, when all that was needed was a bit more torque to break it loose, followed of course by numerous additional operations to assure operability
- - It is a POSITIONER on what is normally an ON/OFF valve application
- - Normally, multi-source responsibility

Smart Switchbox:

- Basically the same features, capabilities and limitations of the positioner based device except that discrete travel positions are sensed rather than continuous travel feedback. And low flow solenoid valves replace the positioner relays (may also be solenoid valves in newer digital versions)
- + May cost less than a smart positioner
- - Inherits the same slow response speed as the smart positioner
- - Same potential for over closure
- Normally, multi-source responsibility

QTRCO XRCISER:

- + Built into the actuator to assure force compatibility
- + Works equally well with small, medium or large actuators
- + Fully automated for remote or local engagement initiation
- + 100% assurance against over closure
  - Built in hard travel stop
  - Instilled confidence encourages multiple cycle testing to assure valve operability
  - Same confidence allows more frequent testing
- + 100% of the actuator torque is applied to the valve
  - By design all of the pressure is exhausted for the testing, therefore full spring force is applied
  - No false failures
- + Very fast time of response as pressure can be exhausted from small, medium or large diameter ports without worry about over closure occurring.
- + Redundancies are inherent



Note the cylinder separators

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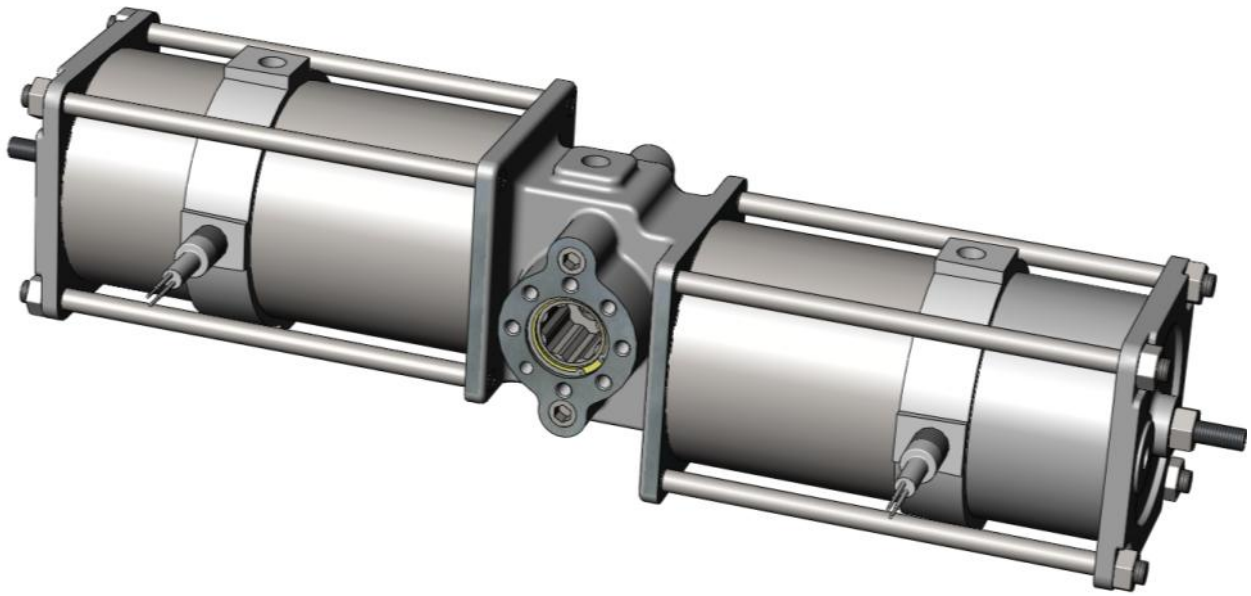
- Failure of a single component will not cause valve closure
- Feedback provides opportunity to repair failed component while process remains running
- Yet, such component failure does not limit the ability of the device to cause valve closure if needed

- + Fully programmable complete with pre-verification of test readiness prior to test initiation
- + Allows actuator to close the valve in the event of need in the midst of testing
- + No additional shaft couplings or lost motion
- + Diagnostics available+ Cost is lower for small valves and higher for larger valves but unlike other smart devices, it works equally well with all sizes of valves and actuators
- + Single source responsibility
- + Available in all stainless steel (actuator and the controls) or aluminum controls with ductile iron actuator construction.

The QTRCO PSTD XRCISER ™ - for Emergency shut down valve applications or where you just don't want a valve to stick open!



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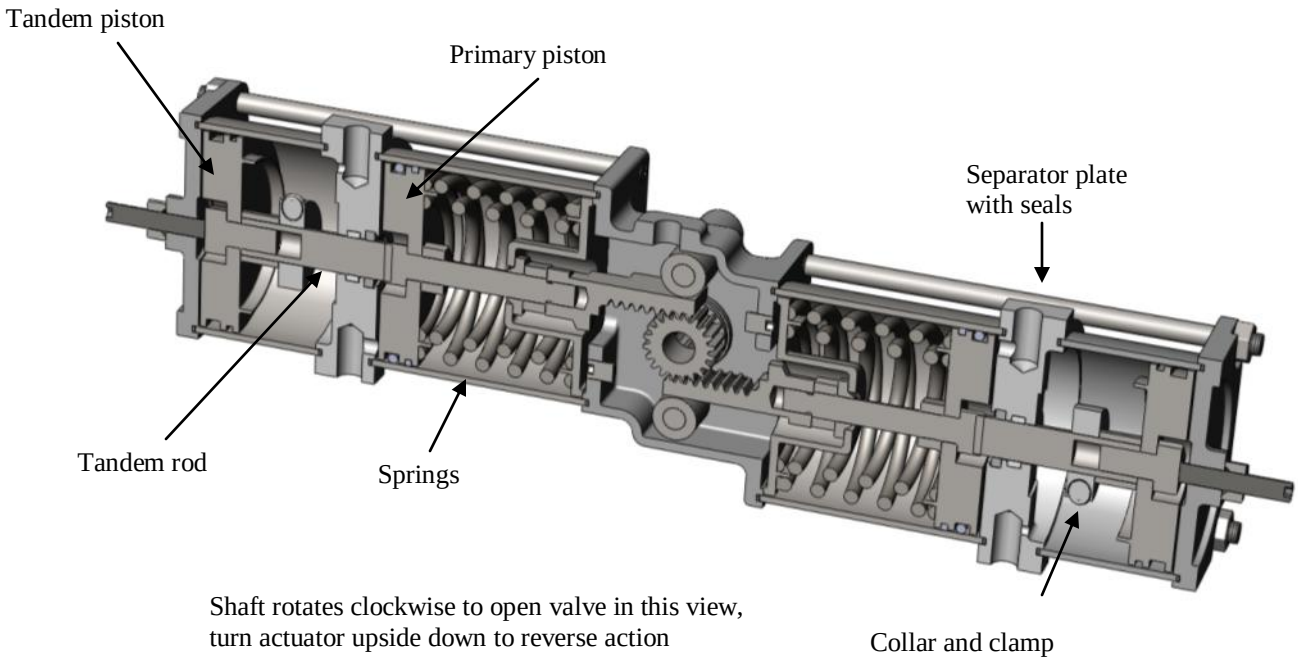

The **QTRCO XRCISER ™** Note there are two pistons (each end), one (inner) is primary and other (outer) is tandem. A separator plate prevents pressure interaction between the two pistons.

Primary pistons are pressured to compress the springs and to open the valve.

Exhausting pressure from primary pistons allows springs to fully close the valve.

Tandem piston is stroke limited by a collar and clamp. Stroke equates amount required to serve as travel stop at desired PSTD valve position. Length of collar changeable to modify PSTD position.

Tandem piston is pressured to move it inward. The tandem piston rod is not connected to the primary piston these do come in contact when both are outward and also when tandem rod is serving to prevent further outward motion of the primary piston.

Operation:

- Open valve - pressure both tandem and primary pistons via separate solenoid valves.
    - Should either SV fail, actuator, at most, will move to the PSTD position (primary fails) or will not move at all (tandem fails).
- Close valve - exhaust pressure from both primary and tandem pistons.
- PSTD - Exhaust pressure from primary but not from tandem. Springs will move primary piston outward but motion will stop when tandem rod is contacted.

Operational security (why it will NOT over close your valve)

- A pressure switch senses pressure to the tandem piston. If no pressure then no PSTD

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- A proximity switch located in the separator plate senses that the tandem piston is in the inward position. Not inward - no PSTD.

Optional:

- Switchbox with two or three travel activated switched indicates open, closed and PSTD positions.
- Position transmitter - continually relays travel position to control room
- Pressure transducer - relays pressure value to control room (may be combined with position data to serve as diagnostic data for comparison of pressure versus travel as actuator and valve age.

Programmable:

- Control logic set to define PSTD schedule
- When PSTD due to occur, asks is tandem pressurized? If yes, is tandem inward? If yes, initiate PSTD.
- Record and compare pressure and position, advise if deviant behavior.
- Cycle multiple times if desired.
- Allow predefined time to valve to arrive at PSTD position. Provide failure message.

No size limitation:

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