SVM Range

rotork®
Fluid Systems

Smart Valve Monitor

Rotork Fluid Systems' patented, Smart Valve Monitor (SVM) is the most versatile and comprehensive partial stroke valve testing system for hydraulically or pneumatically actuated on/off valves available. It tests every element of the valve/actuator/control system and has several unique features that set it apart from the solutions offered by many competing products. SVM facilitates strategic preventive maintenance and extended shutdown intervals.

Typical applications include ESD, blow-down, subsea, HIPPS and process shutdown valves.

Benefits:

- Comprehensive valve performance monitoring system.
- Partial stroke testing in real time.
- Test all final elements as required by IEC 61508.
- Compatible with virtually any fluid power actuator.
- Assists with SIL compliance—extends shutdown intervals.
- Completely transparent to normal valve operation.
- Facilitates strategic maintenance.

Comparison of Test Techniques

SVM	Conventional
✓ Achieves partial stroke speeds of t_c < 1 second	X Limit switch control causes valve overshoot due to high inertia
✓ Solenoid Operated Valve (SOV) performance analysis	X No diagnostics or by-pass of SOV testing
✓ Speed Of Valve operation tested	X Does not operate the valve in real time
✓ Intelligent pressure compensation	X Possible over-stroking caused by instrument pressure fluctuation
✓ Quick exhaust valve diagnostics	X Conventional techniques do not test all final elements

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SVM Range

Simple, Non-intrusive System

SVM is unique among partial stroke testing techniques in that it does not infer valve position via direct drive from the actuator. Consequently, it cannot interfere with normal valve operation.

The SVM system is comprised of the equipment indicated in red in Fig 1 below: A control unit that connects the power supply to the solenoid valve and also a pressure transmitter to provide feedback for the analysis of valve performance.

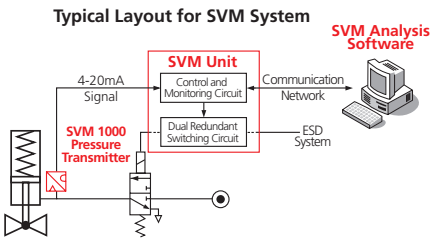

Fig 1 – Basic SVM Configuration

Due to its simple yet complete system, the SVM can be used with a complex control mechanism without the need for any additional equipment. An example is shown in Fig 2 below: a HIPPS valve with dual redundant solenoid valves and three quick exhaust valves.

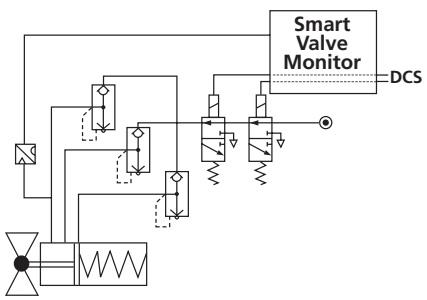

Fig 2 – HIPPS Configuration

Valve Testing in Real Time

In a typical use test, the SVM will de-energise the solenoid valve and monitor the pressure transmitter for a fixed time. The fixed time is set during the SVM commissioning process and relates to the percentage of valve test movement required. Once the required time is reached the solenoid valve will be re-energised and the valve will return to its original position.

Upon completion of the test the SVM will analyse the pressure data and return a Pass/Fail result to the operator. Fig 3 is an example of typical pneumatic spring-return actuator and valve test data. The partial stroke is indicated in red and, for reference only, the full stroke is shown in blue.

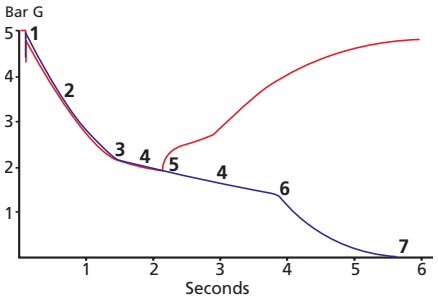

Fig 3 – SVM Pressure vs. Time Graph

The following events are identified on the red partial stroke curve.

1. The solenoid switches state.
2. Venting of the actuator.
3. The valve begins to move.
4. Valve movement.
5. End of the partial stroke, the valve starts to re-open.

The blue curve shows historic full closure data not seen during the test.

6. The valve reaches the end of stroke.
7. The actuator is completely vented.

Fault Identification

Through analysis of the historic operational data gathered by the SVM, it is possible to accurately identify a variety of faults in the valve, actuator and control system. An abridged list appears below.

- Valves
  - ✓ Stuck valve
  - ✓ Stem shear
  - ✓ Excessive valve torque
- Actuators
  - ✓ Spring failure
  - ✓ Internal corrosion
  - ✓ Damaged cylinder
- Solenoid valves
  - ✓ Exhaust blockage
  - ✓ Sticking solenoid valve

Versatility and Compatibility

The SVM system is an extremely versatile partial stroke testing system compatible with both quarter-turn and linear valves in virtually any fluid power actuator control configuration. A representative sample appears below.

- Valves
  - ✓ Ball
  - ✓ Butterfly
  - ✓ Gate
  - ✓ Globe
  - ✓ HIPPS
  - ✓ SSIV
- Actuators
  - ✓ Pneumatic
  - ✓ Hydraulic
  - ✓ Electro-hydraulic
  - ✓ Spring-return
  - ✓ Double-acting
  - ✓ Linear
  - ✓ Quarter-turn
- Valve control systems
  - ✓ Single or twin solenoids
  - ✓ Normally energised and/or de-energised solenoids
  - ✓ Quick exhaust valves
  - ✓ Pilot valves

Unique System Features

The SVM system has several unique features that make it superior to other approaches to partial stroke valve testing.

- Fail Safe

The SVM unit cannot, under any circumstance, prevent the valve from operating on demand. Operators can be confident that their testing regime cannot compromise operational performance. Many competing systems use valve positioners that directly affect the operation of the valve and thus can potentially leave the valve in a state where it may fail to operate on demand.

- Tests All Final Elements

The SVM system tests all final elements required to operate the valve including the solenoid valve and any associated quick exhaust or pilot valves. The most comprehensive test of the system possible is assured.

According to independent studies, solenoid valves are responsible for approximately 50% of all shutdown system failures yet many rival systems do not test them.

- No Direct Drive From The Actuator

The fact that the SVM system does not attach directly to either the valve or the actuator brings many benefits. No special mounting kits are required so remote mounting or retrofit to an existing install is simple and straightforward. As an example, the SVM has been used in subsea valve applications where the SVM equipment is located topside.

- Testing In Real Time

The SVM system performs a partial stroke test in real time. Unlike many competing designs, tests are conducted in the same manner and at the same speed as in normal operation. Pressure is monitored and the data is stored to generate a signature graph that reflects the collective performance of all system components.

Operational Benefits

The SVM system provides the most comprehensive and highest level of testing possible. Cost savings are facilitated by strategic preventive maintenance and extended shutdown intervals.

Strategic Preventive Maintenance
The SVM stores performance data after each test. The comparison of data gathered from multiple tests shows any changes or degradation of system performance. Further signature analysis can identify the cause of any changes. Operators can then predict and therefore prevent potential critical failure of the valve/actuator/control system through strategically scheduled preventive maintenance.

For example, in Fig 4 the red graph shows the valve in proper working order and the black curve shows a valve that did not properly leave the seat.

There is a deviation at the point where the valve should have begun to move and then, after approximately 2 seconds, the valve abruptly jumped forward.

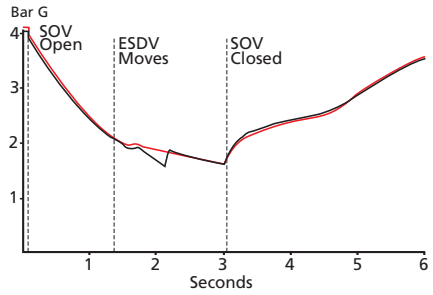

Fig 4 – Increasing Breakout Torque

Over time, as shown in Fig 5, this problem may worsen to a point where the valve will fail to move at all. The black curve indicates that depressurisation continued from the point where the valve should have begun to move. This indicates that the valve is seized and will not close.

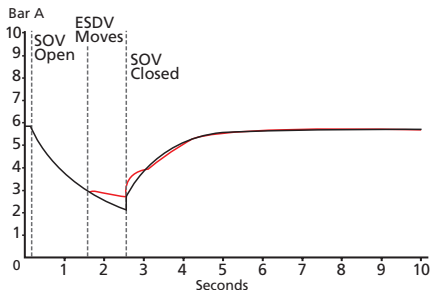

Fig 5 – A Completely Seized Valve

SIL & Extended Shutdown Intervals
SIL (Safety Integrity Level) is an IEC standard to define Safety Instrumented Systems and their reliability as a means of improving both safety and system availability. SIL levels range from 1 to 4 with more rigorous requirements as the numbers increase.

The level of risk is quantified by assessing the Probability of Failure on Demand (PFD) of the safety system. All equipment has a PFD and the likelihood of failure increases over time.

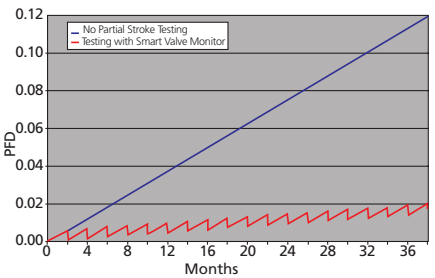

Fig. 6 – PFD Graph

The blue line in Fig 6 shows the increasing PFD for a generic solenoid valve, actuator and ball valve with no partial stroke testing. The y-axis shows the PFD with zero being no chance of failure and 0.1 being a 10% chance of failure. The red line shows the effect on PFD of partial stroke testing every 2 months. The PFD is greatly reduced.

Fig 7 shows the relationship between SIL rating and PFD avg and also how they relate to the actual chance that the safety system will fail to operate.

SIL	Max PFD_{avg}	Chance of Failure
1	0.1	10%
2	0.01	1%
3	0.001	0.1%
4	0.0001	0.01%

Fig 7 – SIL Ratings

Once this maximum level of PFD avg has been reached the system must be shutdown and fully tested.

Fig 8 shows the same data as Fig 6 but on a logarithmic scale with the SIL levels shown on the y-axis. The blue curve shows that, if this plant was required to operate at SIL 2, without partial stroke testing, the plant would need to shutdown for testing every 6 months.

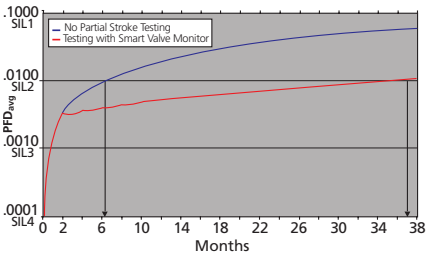

Fig 8 - PFD avg

However, the red curve shows that by testing every two months with SVM, the shutdown test interval is extended to 3-years — a 500% increase!

SVM – The Market Leader

The SVM is the market leading valve test system because it offers unequalled performance that, used properly, greatly reduces the chance of a system failure while at the same time, maximising the return on the invested effort and expense of system maintenance.

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All Rotork Fluid Systems actuators are manufactured under a third party accredited ISO9001:2000 quality assurance programme.

As we are continually developing our products, their design is subject to change without notice. POWTG0908

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