

FSM-002 - AQ, DQ, IQ, SLR, SRA, SRX and VSD – VALVE POSITION MONITOR FUNCTIONAL SAFETY MANUAL

1. Scope

The product is a valve position monitor comprising at least one switch, sensor or transmitter in an enclosure that is activated by a shaft/cam assembly when a defined valve position is achieved by tracking the movement of the valve via a mechanical linkage system. Number 2 to 6 x mechanical switches, hermetically sealed reed switches or inductive proximity sensors or Number 1 to 2 continuous position transmitter can be utilised to provide feedback.

Hazardous events will include failure of a switch/sensor/transmitter connected to the plant SIS to report valve position such that the SIS is compromised.

2. Safety-related Functions

2.1 Reporting valve position to Plant SIS in situations where the limit switch or transmitter feedback loop is integral to SIS.

2.2 The electrical product life is 200,000 operations for Mechanical switches, 1,000,000 operations for Reed Switches or Potentiometer based transmitters, and at least 2,000,000 operations for Solid State sensors and Transmitters. The electrical life of a Mechanical switch can seriously deteriorate if installed in a demanding environment.

The mechanical life of the product will depend on the installed environment and the maintenance strategy employed. The maintenance frequency should be determined by the product operator based on the application into which the product is installed.

Special Note on Reed Switches: Where reed switches (particularly low power, rhodium contact type) are installed at the end of long cable runs (typically above 50m), precautions should be taken to ensure cable capacitance does not induce premature switch failure. Consult Imtex for further information.

3. Interfaces

Valve Position Monitor is mounted to the host valve/actuator using an interface kit. Field wiring is brought into the monitor via a suitable cable gland and terminated in a terminal block within the monitor.

Interfaces should be fitted using recognised industrial practices and be in accordance with the Installation, Operation and Maintenance Instructions for the individual Valve Position Monitor.

3.1 Inputs/Outputs

- Drive shaft, with cam(s) as required, connected directly or via a coupler to the valve/actuator to be monitored.
- Field wiring connected to SIS

4. General

The monitor should be fitted using a suitable mounting interface that ensure proper alignment of the monitor drive shaft.

Monitors are intended for fitting to assemblies operating with a frequency of no greater than 15 cycles per minute.

The Switches/Sensors/Transmitter within the Valve Position Monitor should respond to a change of status within 0.3sec. Transmitters utilising the PR Transmitter should respond within 1s.

5. Environment

Operating Environment should be in accordance the Installation, Operation and Maintenance Instructions for the individual Valve Position Monitor.

6. Internal Diagnostics and Proof Testing

A proportion of 'Failures to Signal' by a given switch will be communicated to the SIS by reference to the secondary switch/sensor within the monitor. A 'Failure to Signal' by a transmitter will be communicated to the SIS by loss of signal or the transmitter moving to a fixed, out of normal range signal.

Where the Monitor has not operated for a period of one year or longer, it is recommended that a test be run to verify operability.

7. Start-Up Requirements

Following a failure to report, the failed component should be replaced by a qualified operator.

8. Failure Rates

The details below are taken from Technis Report T319.

In respect of the perceived failure modes:

Following a valid host valve movement, either of the output signalling devices failing to achieve a specified condition.

Following a valid host valve movement, one of the output signalling devices failing to achieve a specified condition.

(Potentiometer) Following a host valve movement >10% of current position, failing to reflect the change in a 4-20mA signal (noting that <4mA and >20mA outputs are utilised as revealed failure scenarios).

(Non-contact sensor) Failure to report actual valve position to within 5% accuracy to the 4-20mA transmitter output.

The specific output failure mode conditions are identified in the following table.

VERSION	FAILURE	FAILURE RATE per million hrs TOTAL	FAILURE RATE per million hrs HAZARDOUS
Microswitch Output	Any one o/p Normally open - fail to close	0.12	0.04
	Any one o/p Normally closed - fail to open	0.12	0.02
	Either of 2 o/ps Normally open - fail to close	0.43	0.13
	Either of 2 o/ps Normally closed - fail to open	0.42	0.05
Reed Switch	Any one o/p Normally open - fail to close	0.32	0.10
	Any one o/p Normally closed - fail to open	0.32	0.04
	Either of 2 o/ps Normally open - fail to close	0.63	0.19
	Either of 2 o/ps Normally closed - fail to open	0.63	0.07
Inductive Sensor	Any one o/p Fails to change state	0.07	0.016
	Either of 2 o/ps Fails to change state	0.12	0.023
Potentiometer and 4-20mA o/p	Fail to indicate >10% valve movement	1.2	0.95
Potentiometer and 4-20mA o/p with 1oo2 duplicated potentiometer	Fail to indicate >10% valve movement	1.8	0.47
Non-contact Transmitter	Fail to indicate >5% position error	0.23	0.19
Non-contact Transmitter 1oo2 duplicated	Fail to indicate >5% position error	0.47	0.019

These failure rates are for inclusion in a wider calculation of a safety function. They could be, however, sufficiently small as to allow suitability for the use of these items in up to SIL 3 applications.