Axiom™ Valve Position Indicator / Controller for applications up to SIL 2
Rev. 1.0

Safety Manual

4/2016

StoneL®
Valve Communication Solutions

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1. General information

The Axiom series valve position indicator / controller is used to indicate the position of a valve assembly and control the position of the valve. The safety function is controlling the position of the valve by switching air to the pnumatic actuator by operation of the integral pneumatic valve. This device is also provides a signal outputs of valve position that can be used for diagnostics. The end user can use this information in different ways depending on the SIF or sensory input that is being instrumented.

Axiom series valve position indicator / controller can be used in a multitude configurations and any sub classification depending on the model and SIF being implemented for the desired Safety Function and SIL level.

The valve position can be indicated using one of the defined outputs (SST solid state sensors or Namur sensors). It provides input feedback of the valve to the safety system. The Axiom unit also controls the position of the valve.

End user must follow all guidance identified in the Installation, Maintenance and Operating Instructions (later referred as IMO) with this safety manual to verify the products proper installation and operation of the product product.

2. Structure of valve position indicator

2.1. System components and description of use

See the IMO for the detailed technical description of the device and the system architecture.

2.2. Permitted device types

The information in this manual pertaining to functional safety applies to all device variants mentioned in the device type coding below. It is up to the end-user to verify that the correct model is selected for the intended function and the SIF.

2.3. Supplementary device documentation

Related AMI / AX Installation, Maintenance and Operating Instructions listing

IMO	Applicable models	Description
105155	AMI33_H_____	Axiom AMI with SST sensors
105157	AMI44_E_____	Axiom AMI with SST sensors
105328	AX33S_H_S_____	Axiom AX with SST sensors
105329	AX44S_E_S_____	Axiom AX with SST sensors

Table 1

These are available from StoneL or for download from
http://www.stonel.com/en/installation-manuals/

3. Description of safety requirements

3.1. Safety function

Valve Position Control: The function of this device is to control the position of the attached actuator / valve. This can be performed by energizing / de-energizing the solenoid in single coil model. In case of dual solenoid models the valve is actuated by energizing either solenoid valve. For complete safety and reliability the Actuator / Valve that are being operated should also be considered.

3.2. Restrictions for use in safety-related applications

Please ensure that the valve monitor / controller is used correctly for the application in question and that the ambient conditions are taken into account. The instructions for installation conditions, as detailed in the IMO, shall be observed. Input air quality is a very important consideration with any pneumatic valve. Dirty air can contribute to numerous failure conditions. The specifications in the IMO shall not be exceeded.

3.3. Functional safety indicators

The functional safety assessment is based on route 2h/2s according to IEC61508.
Only Type A components are used.

Low Demand mode: < 1 operation per year

In Low Demand mode a Proof Test for diagnostic verification purposes has to be performed at least 1 time per year. (see chapter 3.4 “Proof test”)

The table below shows the specific values for functional safety for SIL 2 in low demand applications.

Model Series	Function	Demand Mode	SIL	HFT	PFD_{avg} (1 year)
AMI33xHxxxxxx	Valve control	low	2	0	4.1E-3
AMI44xExxxxxx	Valve control	low	2	0	3.0E-3
AX33SxHxSxxxxxx	Valve control	low	2	0	4.1E-3
AX44SxExSxxxxxx	Valve control	low	2	0	3.0E-3

High Demand mode: > 1 operation per year

In High Demand mode, Axiom is capable up to SIL 1 in normal simplex operation. However SIL2 is possible if the user can utilize redundant valve controllers

The table below shows the specific values for functional safety for SIL 1 in high demand applications.

Model Series	Function	Demand Mode	SIL	λ [1/h]	λs [1/h]	λd [1/h]	λdd [1/h]	λdu [1/h]
AMI33xHxxxxxx	Valve control	high	1/SC2	9.4E-7	0	9.4E-7	0	9.4E-7
AMI44xExxxxxx	Valve control	high	1/SC2	7.0E-7	0	7.0E-7	0	7.0E-7
AX33SxHxSxxxxxx	Valve control	high	1/SC2	9.4E-7	0	9.4E-7	0	9.4E-7
AX44SxExSxxxxxx	Valve control	high	1/SC2	7.0E-7	0	7.0E-7	0	7.0E-7

λ = Total Failure Rate (λ = λs + λd)
λs = Safe Failure Rate
λd = Dangerous Failure Rate
λdd = Dangerous Detected Failure Rate
λdu = Dangerous Undetected Failure Rate
SC2 = Systematic Capability: SIL 2 can be achieved in high demand mode only if redundant valve controllers can be used

Note:
If the system / application requires a higher degree of safety it’s recommended to compare the solenoid status with the valve position indicator. If there is a discrepancy, the appropriated steps to achieve a safe state must be performed.

3.4. Proof Test

One complete open/closed cycle of the process valve along with confirmation of a successful cycle via the position feedback has to be performed.

4. Installation

4.4.1. Hardware fault tolerance

Valve Control function: The hardware fault tolerance of the standalone installation is HFT=0 . If hardware fault tolerance of >= 1 is required, then a redundant configuration of the valve controller shall be used.

4.4.2. Installation and commissioning

The installation and commissioning/calibration of the device must be done by qualified technician, according to the IMO. It is important that the mechanical connection to the valve/actuator is installed correctly and securely by a qualified technician. Every parameter related to the device type in question and mentioned in the IMO needs to be checked and compared against the device settings. If any deviations exist the safety of the installation cannot be guaranteed.

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4.4.3. Orientation

Orientation of the device is described in the IMO.

4.5. Operation

See IMO for the operation of the device.

Valve control function:
Single coil models: The solenoid pilot valve receives a signal from the controller. The pilot valve directs air to the drive the spool valve into the other position. This in turn switches the air to the other size of the piston in the attached pneumatic actuator.

Dual coil models: The solenoid pilot valve receive signals from the controller. Each pilot valve directs air to the drive the spool valve into the other position. This in turn switches the air to the other size of the piston in the attached pneumatic actuator.

4.6. Maintenance

See the IMO for maintenance instructions.

During maintenance work on the device, alternative safety function methods shall be taken to ensure process safety. This device should be considered in all SIF proof tests.

5. Repair

Any repair to the device shall be carried out under guidance by the manufacturer. Device failures must be reported to the manufacturer. The user shall provide a detailed report to the manufacturer describing the failure and any possible effects.

6. Certificate

Certificate

No.: 968/FSP 1252.00/16

Product tested	Valve Position Controllers AMI/AX33 and AMI/AX44 according Route 2H/2S	**Certificate holder**	StoneL 26271 US Highway 59 Fergus Falls, MN 56537 USA
Type designation	AMI33xHxxxxxx, AX33SxHxSxxxxxx, AMI44xExxxxxx, AX44SxExSxxxxxx		
Codes and standards	IEC 61508 Parts 1-7:2010		IEC 61511-1:2003 + Corr. 1:2004
Intended application	The valve controller can be used in applications - up to SIL 2 in low demand mode of operation with a HFT=0 - up to SIL 2 in high demand mode of operation with a HFT=1		
Specific requirements	The instructions of the associated installation and safety manual shall be considered. The position indication monitor uses Type B components and is not part of this certification. Nevertheless it's strongly recommended to use it for diagnostic purpose within safety-related applications. This certificate does not waive the need for further functional safety verification to establish the achieved Safety Integrity Level (SIL) of the safety-related system.		

Valid until 2021-04-06

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1252.00/16 dated 2016-04-06.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

Köln, 2016-04-06

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7. Certificate page 2

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Safety function: Control of the position of the attached actuator / valve.

Model Series	Type	Demand Mode	SIL	HFT	PFD_{avg}	
AMI33xHxxxxxx	A	low	2	0	4,1 E-3	41 % of SIL 2
AX33SxHxSxxxxxx	A	low	2	0	4,1 E-3	41 % of SIL 2
AMI44xExxxxxx	A	low	2	0	3,0 E-3	30 % of SIL 2
AX44SxExSxxxxxx	A	low	2	0	3,0 E-3	30 % of SIL 2

The calculation of PFD_{avg} is based on a route 2h assessment according to IEC 61508 with a confidence interval of 95%.

A proof test has to be performed at least 1 time per year.

Model Series	Type	Demand Mode	SIL	λ / 1/h	λs / 1/h	λd / 1/h
AMI33xHxxxxxx	A	high	1 / SC 2	9,4 E-7	0	9,4 E-7
AX33SxHxSxxxxxx	A	high	1 / SC 2	9,4 E-7	0	9,4 E-7
AMI44xExxxxxx	A	high	1 / SC 2	7,0 E-7	0	7,0 E-7
AX44SxExSxxxxxx	A	high	1 / SC 2	7,0 E-7	0	7,0 E-7

The calculation of PFH is based on a route 2h assessment according to IEC 61508 with a confidence interval of 95%.

λ Total Failure Rate (λ = λs + λd)
λs Safe Failure Rate
λd Dangerous Failure Rate
SC 2 Systematic Capability: SIL 2 can be achieved in high demand mode only if redundant valve controllers are used.

Note:
The position indication monitor of the AMI/AX33 and AMI/AX44 series was not considered, as it uses type B components without the required diagnostic measures. Nevertheless it's strongly recommended to use the position indication monitor for diagnostic purpose in safety-related applications.

For complete safety and reliability the actuator / valve that are being operated should also be considered.