Axiom™ Valve Position Indicator / Controller for applications up to SIL 2
Rev. 2.0

Safety Manual

11/2021

StoneL™

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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 position feedback is not part of the safety function.

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
105408.pdf	AMI33_H_____	Axiom AMI with SST sensors
105408.pdf	AMI44_E_____	Axiom AMI with SST sensors
7AX70EN.pdf	AX33S_H_S_____	Axiom AX with SST sensors
7AX70EN.pdf	AX44S_E_S_____	Axiom AX with SST sensors

Table 1

These are available from StoneL or for download from
https://www.stonel.com/products/axiom-ami/
https://www.stonel.com/products/axiom-ax-explosionproof/

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/1s according to IEC61508.
Only Type A components are used.
Systematic Capability = SC3 Use in SIL 3 applications is possible considering the minimum hardware fault tolerance HFT=1 of the SIF (Safety instrumented function)

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”)

High Demand mode: > 1 operation per year, up to 10^6 cycles

The table below shows the specific values for functional safety in high and low demand applications.

Model Series	Function	Demand Mode	SIL	HFT	λd [1/h]	FIT	PFD_{avg} (1 year)	PFH
AMI33/44, AX33/44	Single acting	low	2	0	1.73E-7	173 FIT	7.70E-4	1.73E-7
AMI33/44, AX33/44	Double acting	low	2	0	1.89E-7	189 FIT	8.41E-4	1.89E-7
AMI33/44, AX33/44	Single acting	high	2	0	1.73E-7	173 FIT	7.70E-4	1.73E-7
AMI33/44, AX33/44	Double acting	high	2	0	1.89E-7	189 FIT	8.41E-4	1.89E-7

λd = Dangerous Failure Rate
PFD_{avg} = Average probability of failure on demand 1oo1
PFH = Probability of failure per hour
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. Recommended interval is 1 year.

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, or the requirement has to be fulfilled on system level (SIF).

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/V 1266.00/21

Product tested	Pneumatic valve positioner	**Certificate holder**	Neles USA Inc. dba StoneL 26271 US Highway 59 Fergus Falls, MN 56537 USA
Type designation	AMI/AX33 and AMI/AX44 Versions		
Codes and standards	EN 61508 Parts 1-2 and 4-7:2010		
Intended application	Safety Function: Initiate movement of attached actuator and valve into safe state The valve controllers are suitable for use in a safety instrumented system up to SIL 2 (low demand mode) and SIL 1 (high demand mode of operation). Under consideration of the minimum required hardware fault tolerance HFT = 1 the test items may be used in a redundant architecture up to SIL 3 (low and high demand mode).		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual shall be considered.		

Summary of test results see back side of this certificate.

Valid until 2026-10-28

The issue of this certificate is based upon an evaluation in accordance with the Certification Program CERT FSP1 V1.0:2017 in its actual version, whose results are documented in Report No. 968/V 1266.00/21 dated 2021-10-11. This certificate is valid only for products, which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit

Köln, 2021-10-28

Certification Body Safety & Security for Automation & Grid

Dipl.-Ing. (FH) Wolf Rückwart

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7. Certificate page 2

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Holder: **Neles USA Inc. dba StoneL**
26271 US Highway 59
Fergus Falls, MN 56537
United States of America

Product tested: **pneumatic valve positioner**
AMI/AX33 and AMI/AX44 Versions

Results of Assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode High Demand Mode (up to 10^6 cycles)
Hardware Fault Tolerance	HFT	0
Systematic Capability		**SC 3**

Single acting

Dangerous Failure Rate	λ_D	1.73 E-07 / h	**173 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	7.70 E-04	
Probability of Failure per Hour	PFH	1.73 E-07	

Double acting

Dangerous Failure Rate	λ_D	1.89 E-07 / h	**189 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	8.41 E-04	
Probability of Failure per Hour	PFH	1.89 E-07	

Assumptions for the calculations above: DC = 0 %, T_1 = 1 year, MRT = 72 h, β_{1oo2} = 10 %

Origin of failure rates
The stated failure rates are the result of an FMEDA with tailored failure rates for the design and manufacturing process.

The results have been verified by field-feedback data.
Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing.
The stated failure rates do not release the end-user from collecting and evaluating application-specific reliability data.

Periodic Tests and Maintenance
The given values require periodic tests and maintenance as described in the Safety Manual.
The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.