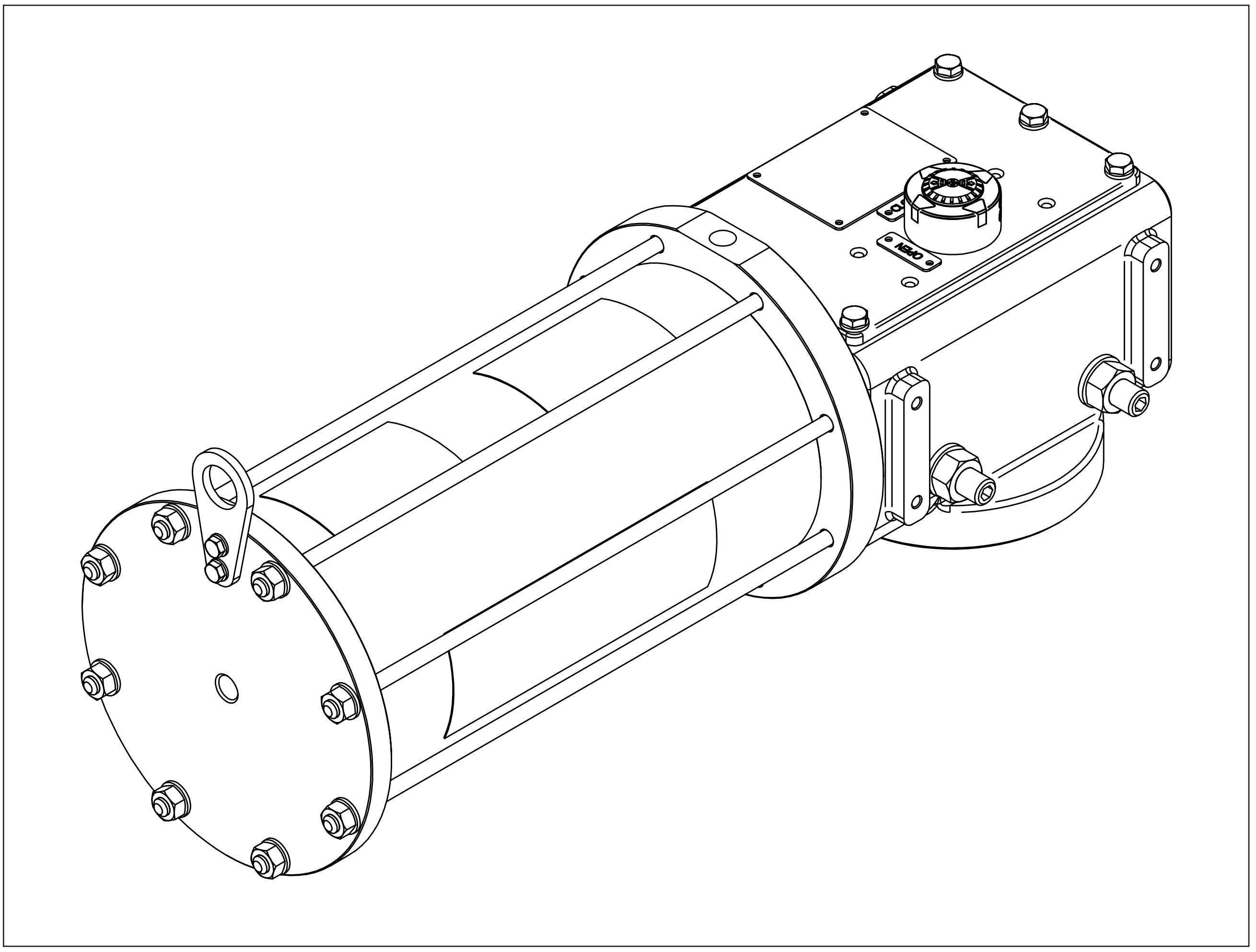
SAFETY MANUAL

SH AT-HDC EN

Original instructions



AT-HDC series

Compact scotch yoke pneumatic actuators

Edition September 2022

Definition of signal words

DANGER

Hazardous situations which, if not avoided, will result in death or serious injury

WARNING

Hazardous situations which, if not avoided, could result in death or serious injury

NOTICE

Property damage message or malfunction

Note

Additional information

Tip

Recommended action

Content

1 Introduction

1.1 Scope

This safety manual contains information, safety-related characteristics and warnings concerning the functional safety in accordance with IEC 61508-2 Annex D and concerning the application in the process industry in accordance with IEC 61511. It does not contain any particular details on other safety requirements, such as explosion protection or electrical safety.

NOTICE

Risk of malfunction due to incorrect installation or start-up of the pneumatic actuators.

➔ Refer to the mounting and operating instructions on how to install and start-up the pneumatic actuators.
➔ Follow the warnings and safety instructions written in the mounting and operating instructions.

1.2 Premises

This safety manual provides the necessary information to design, install, verify and maintain a Safety Instrumented Function (SIF) when using the AIR TORQUE AT-HDC series. The AT-HDC series pneumatic actuators are to be intended as a pneumatic device for remote operation of industrial valves when is pneumatically energized and or de-energized, and in any case the AT-HDC series pneumatic actuators are to be intended to be part of a final element subsystem where the final element subsystem (consisting of a valve, positioner, actuator etc.) is connected to the safety rated logic solver which is actively performing the Safety Function as well as any automatic diagnostics designed to diagnose potentially dangerous failures of the actuator and any other final element components, (i.e. Partial Valve Stroke Test).

Anyway, the subject of this safety manual are just AT-HDC series pneumatic actuators. Not subject of the safety manual are the driven valves, power and compressed air supply or the control of the actuators from the system as well as the control valves. Unambiguous assignments in a SIL can be only given to complete safety-related systems. Herein the AT-HDC series pneumatic actuators are only one component.

1.3 Safety Responsibilities

The safety of design and operation of a safety-related system, in which the AT-HDC series pneumatic actuators are implemented, must be ensured by manufacturer and operator as following:

1.3.1 Device Manufacturer Responsibility

- Safe design of the AT-HDC series pneumatic actuators
- Guarantee product performance by monitoring the production process
- Providing of all safety-related information to the operator of the overall system
- Compliance with all regulations and guidelines that allow a safe commissioning

1.3.2 Operator's Responsibility (planners, constructors, system integrators, end users and operators of safety-instrumented system)

- Training of the personnel working on the overall system
- Maintaining the safe operation of the overall system
- Compliance with all regulations and guidelines regarding occupational safety
- Ensuring of periodic test of the overall system by qualified employees
- Observe instructions in the use and maintenance manual

1.4 Terms, abbreviation and definition

Term	Definition
Safety	Freedom from unacceptable risk of harm.
Functional Safety	The ability of a system to carry out the actions necessary to achieve or to maintain a defined safe state for the equipment / machinery / plant / apparatus under control of the system.
Basic Safety	The equipment must be designed and manufactured such that it protects against risk of damage to persons by electrical shock and other hazards and against resulting fire and explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition.
Safety Assessment	The investigation to arrive at a judgment - based on evidence - of the safety achieved by safety-related systems.
Fail-Safe State	Where solenoid valve is de-energized, supply pressure to the actuator is discontinued and spring are extended.
Fail Safe	Failure that causes the valve to go to the defined fail-safe state without a demand from the process
Fail Dangerous	Failure that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state).
Fail Dangerous Undetected	Failure that is dangerous and that is not being diagnosed by automatic stroke testing.
Safe failure Fraction	Safe failure fraction. $SFF \stackrel{def}{=} \left(1 - \frac{\lambda_{DU}}{\lambda_{SD} + \lambda_{SU} + \lambda_{DD} + \lambda_{DU}}\right)$
Failures in Time (FIT)	Number of failures in time. 1 FIT = (1 Failures/10^9 hr)
Partial Stroke Test (PST) Period	Minimum one PST per year. Failures can be uncovered during PST.
Mission Time (T mission)	Expected operating lifetime expressed in hours for device to provide safety function.
Fail Annunciation Undetected	Failure that does not cause a false trip or prevent the safety function but does cause loss of an automatic diagnostic and is not detected by another diagnostic.
Fail Annunciation Detected	Failure that does not cause a false trip or prevent the safety function but does cause loss of an automatic diagnostic or false diagnostic indication.
Fail No Effect	Failure of a component that is part of the safety function but that has no effect on the safety function
Low demand Mode ref. IEC 61508-4 § 3.5.16	Where the safety function is only performed on demand, in order to transfer the EUC into a specified safe state, and where the frequency of demands is no greater than one per year
High demand mode ref. IEC 61508-4 § 3.5.16	Where the safety function is only performed on demand, in order to transfer the EUC into a specified safe state, and where the frequency of demands is greater than one per year
Dangerous failure	Failure with the potential to set the safety-related system to a dangerous or inoperative state.
Safety-related system	A safety-related system carries out the safety functions needed to establish or maintain a safe state, e.g. in a plant. Example: Pressure measuring instrument, logic unit (e.g. limit switch) and valve form a safety-related system.
Safety function	A defined function carried out by a safety-related system in order to establish or maintain a safe state of the plant, under consideration of a specified dangerous incident. Example: Pressure limit monitoring

1.5 Acronymus

Acronyms	Designation	Description
SIS	Safety Instrumented System	Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).
SIF	Safety Instrumented Function	A set of equipment intended to reduce the risk due to a specific hazard (a safety loop).
SIL	Safety Integrity Level	One of four discrete levels for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/ PE safety-related systems, where SIL 4 has the highest level of safety integrity and SIL 1 has the lowest.
MTBF(D)	Mean Time Between Dangerous Failures	Mean time between two consecutive (dangerous) failures.
MTTR	Mean Time To Restoration ref. IEC 61508-4 § 3.6.21	Expected time to achieve restoration. This includes the time needed to detect the failure, initiate the repair and fully complete the repair.
MRT	Mean Repair Time ref. IEC 61508-4 § 3.6.22	Expected overall repair time. This includes the time needed to initiate the repair and fully complete the repair. This does not include the time needed to detect the failure.
MTTF(D)	Mean Time to Dangerous Failure	Mean Time to Dangerous Failure is the average amount of time until a system fails or its expected failure time.
HFT	Hardware Fault Tolerance	Capability of a functional unit to continue executing the demanded function in case of faults or deviations.
λ_{SD}	Failure rate for all safe detected failures	
λ_{SU}	Failure rate for all safe undetected failures	
λ_{DD}	Failure rate for all dangerous detected failures	
λ_{DU}	Failure rate for all dangerous undetected failures	
SFF	Safe Failure Fraction	Fraction of non-hazardous failures, i.e. the fraction of failures without the potential to set the safety-related system to a dangerous or impermissible state.
PFDavg	Average Probability of dangerous Failure on Demand	Mean unavailability of an E/E/PE safety-related system to perform the specified safety function when a demand occurs.
PFH	Average frequency of dangerous failure per hour [h-1] ref. IEC 61508-4 § 3.6.19	Average frequency of a dangerous failure of a E/E/PE safety related system to perform the specified safety function over a given period of time
TI	Test interval between life testing of the safety function	Time interval between functional tests of the safety function
FMEDA	Failure Modes, Effects and Diagnostic Analysis.	
MOC	Management of Change. These are specific procedures often done when performing any work activities in compliance with government regulatory authorities.	

1.6 Related Documents

- Pneumatic Actuator product catalogue and technical data sheets,
- Installation, maintenance and operating instruction manual for AT-HDC series actuators
- SIL Certificate

1.7 Relevant Standards

- EC 61508 Parts 1-2 and 4-7: Functional safety of electrical/electronic/ programmable electronic safety-related systems
- IEC 61511 Parts 1: Functional safety - Safety instrumented systems for the process industry sector

2 Device description

The AT-HDC series actuators are available in double acting (D) and spring return (S) configuration with or without manual emergency override. The Series can be powered with pneumatic or hydraulic fluids. When fast acting maneuver is required, quick and damper system (Q&D) can be mounted on the pneumatic cylinder.

For output torque values see technical data sheets. The AT-HDC series actuators are designed in compliance to ISO 5211, EN 15714/3 and EN 15714/4.

In double acting version (air/oil requested for both opening and closing operations), the safety function is determined by specific plant measures (e.g. by providing an auxiliary circuit equipped with compressed air/oil reservoir), the actuator is controlled by 5/2 way valve.

In single acting (spring return) version, the safety function is provided by the springs force action when actuator is deenergized in case of loss of supply pressure (when power supply fails), the actuator is controlled by 3/2 way valve.

3 Designing a SIF using the AIR TORQUE line AT-HDC series actuators

3.1 Safety Function

In case of dangerous situation, a safety-related system will perform defined safety function. In this situation the actuator will be activated so that the actuator and the operated valve shall move to its fail-safe position.

For example, for spring return actuator when the actuator is de-energized, the actuator and valve shall move to its fail- safe position (depending on Fail direction specified fail-closed or fail-open).

⚠ WARNING

Risk of failure of the safety function

– *It is user responsibility to verify if the actuator is equipped with device or accessories (e.g., lock-out sys- tem, gear-boxes, 100% travel stop adjustment etc.) that cannot permit to perform the requested safety function.*
– *The actuator SIL capability may be invalidated.*

3.2 Environmental and Application Limits

The designer of a SIF must verify that the product is rated and selected for the usage within the expected environmental and application limits. For usage in safety-related applications, it is important the designer to check the material suitability considering working and on-site conditions. However, the compatibility of the operating medium with the materials of construction must be verified.

⚠ WARNING

Risk of malfunction due to incorrect selection or wrong installation and operating conditions.

➔ Only use valves in safety-instrumented systems if the necessary conditions in the plant are fulfilled.

The AT-HDC series actuators are:

– intended for use in Indoor, Outdoor and/or Hazardous Area (ATEX directive 2014/34/EU),
– available in different temperature configurations:
    – S, suitable for a temperature range from –40°C (-40°F) up to +80°C (+176°F),
    – H, suitable for a temperature range from –15°C (+5°F) up to +150°C (+302°F),
    – L, suitable for a temperature range from –60°C (-76°F) up to +80°C (+176°F),
– suitable for operating pressure up to 12 bar (174 psi),
– IP tested, rated up to IP68,

Refer to installation, maintenance and operating instruction manual, brochure and technical datasheets for service data and relevant information, of the AT-HDC series actuators.

The use outside the application limits or with incompatible material of the AT-HDC series actuators, may compromise the safety functions and the reliability of the provided data becomes invalid.

3.3 Design Verification

A FMEA was conducted to evaluate the fault avoidance and fault controlling measures in the relevant steps of the actuator life cycle. Possible failures in the design phase as well as during the manufacturing and assembling were contemplated herein. Failures that do not affect the safety function (no effect) were not considered.

Furthermore, the suitability of the design is proven by the positive result of a type examination as well as an endurance test and the adequate field feedback of the product.

3.4 SIL Capability

3.4.1 Systematic Safety Integrity IEC 61508-4 § 3.5.6

For standard and special version/type of AT-HDC pneumatic actuators, the achievable failure rates when used in a redundant structure (multi-channel architecture) allow the usage up to and including a Safety Integrity Level SIL 3 (for SIL 3 application HFT = 1 is required).

Standard and special version/type of AT-HDC pneumatic actuators, fulfills the safety relevant constrains for usage in single channel system up to and including Safety Integrity Level SIL 2. **See the product related certificates.**

These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer. A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than the statement without prior use justification by end user or diverse technology redundancy in the design.

The development and manufacturing process and the functional safety management applied by the manufacturer in the relevant lifecycle phases of the product has been inspected and assessed as suitable for the use in applications with a maximum Hardware Safety Integrity Level of 3 (SC 3), IEC 61508-4 § 3.6.22.

A complete report for the achieved Safety Integrity Level (SIL) of the AT-HDC series pneumatic actuators is available at AIR TORQUE S.p.a..

The achieved Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) design must be verified by the designer (constructors or system integrators of safety-instrumented system) via a calculation of PFDavg considering architecture, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and the specific failure rates of all products included in the SIF. Each subsystem must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

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i ***Note***

The architecture and the interval between proof tests must be considered concerning the safety integrity level.

3.4.2 Hardware Safety Integrity IEC 61508-4 § 3.5.7

Standard and special version/type of AT-HDC pneumatic actuators are classified as a Type A Device, having a hardware fault tolerance HFT of 0. According to 61508-2, 7.4.4.3, route 2_H was used for the AT-HDC pneumatic actuators. See the product related Certificate.

The AT-HDC pneumatic actuators are typically one of several devices that can be used in a final element assembly. When the final element assembly consists of many components (pneumatic actuator, valve, solenoid, quick exhaust valve, etc.) the SIL must be verified for the entire assembly using failure rates from all components.

This analysis must account for any hardware fault tolerance and architecture constraints.

3.4.3 Pneumatic actuator Specific Parameters

Actuator models Tested:

– AT045..U D/S to AT1000/1/4..U D/S (90°)

Results of assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Modes of Operation		Low and High Demand Mode
Hardware Fault Tolerance	HFT	0

Low demand Mode

Lambda Dangerous confidence level of calculation 1-α = 95% □	λ_D	1.00 E-08 / h	10 FIT
Lambda Dangerous Undetected assumed Diagnostic Coverage DC = 0%	λ_{DU}	1.00 E-08 / h	10 FIT
Mean Time To Dangerous Failure	$MTTF_D$	1.00 E+08 / h	11,416 a
Average Probability of Failure on Demand 1oo1 assumed Proof Test Interval T_1 = 1 year	PFD_{avg} (T_1)	4.38 E-05	
Average Probability of Failure on Demand 1oo2 assumed Proof Test Interval T_1 = 1 year assumed β_{1oo2} = 10%	PFD_{avg}(T_1)	4.38 E-06	

High Demand Mode

Average Frequency of a Dangerous Failure per Hour	PFH	4.56 E-07 / h
Maximum number of demands	$n_{op,max}$	50 / a

Actuator models Tested:

– AT052..U D/S to AT1002..U D/S (120° rotation)
– AT053..U D/S to AT1003..U D/S (135° rotation)
– AT055..U D/S to AT1005..U D/S (145° rotation)
– AT058..U D/S to AT1008..U D/S (180° rotation)
– FA AT045..U D/S to FA AT1000/1/4..U D/S (FAST ACTING)
– HC AT051/054 D/S to HC AT1001/1004 D/S (Hydraulic Dampened)
– FM AT058 S to FM AT1008 S (FAIL MID)
– 3P/3PD AT051/054 to 3P/3PD AT1001/1004 (3Position 90°)
– 3P/3PD AT058 to 3P/3PD AT1008 (3Position 180°)

Results of assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Modes of Operation		Low and High Demand Mode
Hardware Fault Tolerance	HFT	0

Low demand Mode

Lambda Dangerous confidence level of calculation 1-α = 95%	λ_D	1.00 E-08 / h	10 FIT
Lambda Dangerous Undetected assumed Diagnostic Coverage DC = 0%	λ_{DU}	1.00 E-08 / h	10 FIT
Mean Time To Dangerous Failure	$MTTF_D$	1.00 E+08 / h	11,416 a
Average Probability of Failure on Demand 1oo1 assumed Proof Test Interval T_1 = 1 year	PFD_{avg} (T_1)	4.38 E-05	
Average Probability of Failure on Demand 1oo2 assumed Proof Test Interval T_1 = 1 year assumed β_{1oo2} = 10%	PFD_{avg}(T_1)	4.38 E-06	

Actuator models Tested:

– R50/100 AT045..U D/S to R50/100 AT1000/1/4..U D/S (R50/R100 90° Stroke ADJ.)

Results of assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Modes of Operation		Low and High Demand Mode
Hardware Fault Tolerance	HFT	0

Low demand Mode

Lambda Dangerous confidence level of calculation 1-α = 95%	λ_D	1.00 E-08 / h	10 FIT
Lambda Dangerous Undetected assumed Diagnostic Coverage DC = 0%	λ_{DU}	1.00 E-08 / h	10 FIT
Mean Time To Dangerous Failure	$MTTF_D$	1.00 E+08 / h	11,416 a
Average Probability of Failure on Demand 1oo1 assumed Proof Test Interval T_1 = 1 year	PFD_{avg} (T_1)	4.38 E-05	
Average Probability of Failure on Demand 1oo2 assumed Proof Test Interval T_1 = 1 year assumed β_{1oo2} = 10%	PFD_{avg}(T_1)	4.38 E-06	

High Demand Mode

Average Frequency of a Dangerous Failure per Hour	PFH	7.54 E-09 / h
Maximum number of demands	$n_{op,max}$	50 / a

3.5 Safety integrity level determination

The achievable safety integrity level (SIL) is determined by the following safety-related characteristics:

- Average probability of failure on demand (PFDavg)
- Hardware fault tolerance (HFT)
- Safe failure fraction (SFF)

The following table in accordance with IEC 61508 and IEC 61511 shows how the safety integrity level (SIL) depends on the average probability of failure on demand (PFDavg). It is based on low demand mode of operation, i.e. the frequency of demands on a safety-related system is no greater than once per year.

Safety integrity Level (SIL)	PFD_{avg} (Low Demand Mode)
4	$\geq 10^{-5}$ to $< 10^{-4}$
3	$\geq 10^{-4}$ to $< 10^{-3}$

2	**≥ 10^{-3} to < 10^{-2}**
1	**≥ 10^{-2} to < 10^{-1}**
PFD_{avg} in Low Demand Mode of operaation according to IEC 61508-1, Table 2	

The sensor, logic unit and final element form a safety-related system that performs a safety function. Example:

	SENSOR e. g. pressure measuring instrument	→	**LOGIC UNIT** e. g. PLC	→	**FINAL ELEMENT** e. g. actuator or valve
PFD_{avg}	**≤ X%**		**≤ X%**		**≤ X%**

The average probability of failure on demand (PFDavg = sum of sensor, logic unit and final element failures) must be within the range of the demanded safety integrity level (SIL) in case of demand as listed in the above table.

The failure rate data listed in the certificates and FMEA (Failure Mode and Effect Analysis) reports are only valid for the useful life time of an AT-HDC series actuator

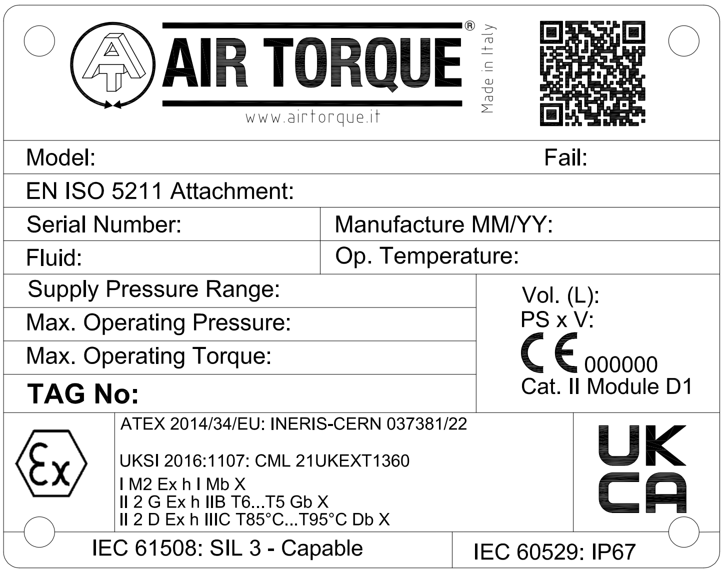
In order to determine whether pneumatic actuator is suitable for the usage in a certain safety-related system, it is necessary to define the PFDavg value of the overall system. Usually, it is presumed that a final element (valve + actuator + solenoid valve) uses up to 50% of the total available PFDavg value.

3.6 Connection of the AT-HDC series actuator to the SIS Logic-solver

The AT-HDC series pneumatic actuator may be connected to the safety rated logic-solver which may actively perform the safety function as well as automatic diagnostics designed to diagnose potentially dangerous failures within AT-HDC series actuator (i.e. partial stroke test).

3.7 General Requirements

The system's response time shall be less than process safety time. The AT-HDC series pneumatic actuator is only one part of the final element of a SIS. All elements of the SIF must be selected to meet safety response time. All SIS components including the AT-HDC actuator must be operational before process start-up. User shall verify that the AT-HDC pneumatic actuator is suitable for use in safety applications by confirming the AT-HDC actuator's label is properly marked (see below example).



Personnel performing maintenance and testing on the AT-HDC series actuator shall be competent to do so. Results from the proof tests shall be recorded and reviewed periodically.

4 Installation and commissioning

4.1 Installation

The AT-HDC series pneumatic actuator must be installed as per standard practices outlined in the Installation Manual. The environment must be checked to verify that environmental conditions do not exceed the ratings.

The AT-HDC series pneumatic actuator must be accessible for physical inspection.

4.2 Physical Location and Placement

The AT-HDC series pneumatic actuator shall be accessible with sufficient room for pneumatic connections and for manual proof testing. Pneumatic piping to the valve shall be kept as short and straight as possible to minimize the air- flow restrictions and potential clogging. Long or kinked pneumatic tubes may also increase the valve closure time. The AT-HDC pneumatic actuator shall be mounted in a low vibration environment. If excessive vibration can be expected special precautions shall be taken to ensure the integrity of pneumatic connectors or the vibration should be reduced using appropriate damping mounts.

4.3 Mechanical and pneumatic installation and Connections

➔ During mechanical and pneumatic installation, the mounting and operating instructions of the corresponding device must be followed.

➔ On sizing actuators, note that the actuator must provide sufficient torque to overcome the closing torque in closed position as well as the dynamic torque in open position. The actuator sizing, include also verification of the permissible torques for the valve shaft, shaft adapter etc. as a result, the max. torque of the actuator (air or spring torque) must not exceed these torques under any circumstances. The ISO 5211 and EN 15081 requirements must be respected.

➔ Recommended piping for the inlet and outlet pneumatic connections to the AT-HDC pneumatic actuator is minimum 1/4 (depending on actuator size and air volume) stainless steel. The length of tubing between the pneumatic actuator and the control device, such as a solenoid valve, shall be kept as short as possible and free of kinks. Direct mount on actuator air connections interface of the control device is recommended.

➔ The process air capacity shall be sufficient to move the AT-HDC pneumatic actuator within the required time.

➔ The minimum requirements for the operating medium (power supply) according to ISO 8573-1 are: pressure dewpoint ≤ -20°C (or at least 10 °K below ambient temperature), maximum particle size < 30 microns.

➔ To prevent corrosion of the actuator springs, measures must be taken to prevent water or moisture entering the actuator.

➔ The process air pressure shall meet the requirements set forth in the installation manual. Important Verification: Function and operating time (open and closing time) shall be verified after installation. Effect of different operating pressure shall be considered for the verification.

5 Operation and maintenance

⚠ WARNING

Risk of dangerous failure due to malfunction in the event of emergency (pneumatic actuator does not move to the fail-safe position).

➔ Only use devices in safety-instrumented systems that have passed the proof test according to the test plan drawn up by the operator.

Tip

We recommend to perform the proof tests based on a checklist.

5.1 Proof test without automatic testing

The scope of proof testing is to detect failures within the AT-HDC pneumatic actuator that are not detected by any automatic diagnostics of the system. Of main concern are undetected failures that prevent the safety instrumented function from performing its intended function. The frequency of proof testing, or the proof test interval, is to be determined in reliability calculations for the safety instrumented functions for which the AT-HDC pneumatic actuator is applied. The proof tests must be performed more frequently than or as frequently as specified in the calculation in order to maintain the required safety integrity of the safety instrumented function. The following proof test is recommended.

The results of the proof test should be recorded and any failures that are detected and that compromise functional safety should be reported to AIR TORQUE S.p.a.. The suggested proof test consists of a full stroke of the AT-HDC pneumatic actuator The person(s) performing the proof test of an AT-HDC pneumatic actuator should be trained in SIS operations, including bypass procedures, pneumatic actuator maintenance and company Management of Change procedures. No special tools are required.

Table 1: Recommended Proof Test (example)

Step	Action
1	**Bypass the safety function and take appropriate action to avoid a false trip.**

2	**Interrupt or change the signal/supply to the actuator to force the actuator and valve to perform a full stroke to the FailSafe state and confirm that the Safe State was achieved and within the correct time.**
3	**Restore the supply/signal to the actuator and confirm that the normal operating state was achieved.**
4	**Inspect the AT-HDC pneumatic actuator for any visible damage or contamination.**
5	**Record the test results and any failures in your company's SIF inspection database.**
6	**Remove the bypass and otherwise restore normal operation.**

5.2 Proof test with automatic partial stroke testing

An automatic partial valve stroke testing scheme that also performs a periodic full stroke of the AT-HDC pneumatic actuator and valve movement timing will detect most potentially dangerous failure modes.

It is recommended that a physical inspection (Step 2 from Table 1) is performed on a periodic basis with the time interval determined by plant conditions. A maximum inspection interval of five years is recommended.

5.3 Maintenance

The given values require periodic test and maintenance according to the mounting and operation instruction manuals:

- EB AT-HDC-F,
- EB AT-HDC-S,
- EB AT-HDC-JS,
- EB AT-HDC-JD,
- EB AT-HDC-HP,
- EB AT-HDC-DP.

The operator is responsible for establishing an appropriate maintenance interval considering of the real working conditions and adequate test cycles.

❗ *NOTICE*

Risk of malfunction due to the use of unauthorized parts.

➔ Only use original parts to replace worn parts.

Tip

Contact AIR TORQUE's After-sales Service department concerning any work not described in the section on servicing or maintenance in the associated AT-HDC pneumatic actuators documentation.

5.4 Repair and replacement

Repairing procedures for the AT-HDC pneumatic actuators are described in the Installation, Operation and Maintenance manual that must be followed. The SIL rating of the AT-HDC pneumatic actuator will be voided if the repair is not performed with AIR TORQUE S.p.a. OEM repair parts and serviced by a competent person.

NOTICE

Fail-safe action impaired due to incorrect repair.

➔ Service and repair work must only be performed by trained staff.

5.5 Useful Life

Useful lifetime is an engineering reliability term that describes the operational time interval where the failure rate of a device is relatively constant. It is not a term which covers product obsolescence, warranty, or other commercial issues. For normal service condition and planned minimum maintenance for the AT-HDC pneumatic actuator the useful lifetime can be up to 10 years and over depending by real operating conditions. When field experience indicates a shorter useful lifetime than indicated, the number based on field experience should be used.

The useful lifetime is highly dependent on the subsystem itself and its operating conditions. It is the responsibility of the end user to maintain and operate the AT-HDC pneumatic actuator per manufacturer's instructions. Furthermore, regular inspections should show that all components are clean and free from damage.

Cycle life varies by actuator size up to over 1.000.000 cycles for smaller size depending on real working conditions and maintenance intervals.

5.6 Manufacturer Notification

Any failures that are detected and that compromise functional safety should be reported to AIR TORQUE S.p.a. .

Please contact AIR TORQUE S.p.a. customer service or your local AIR TORQUE S.p.a. service representative.

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5.7 Start-Up Checklist

The following checklist may be used as a guide to employ the AIR TORQUE AT-HDC series pneumatic actuators in a safety critical SIF compliant to IEC61508.

Activity	Result	Verified	
		By	Date
Design			
Target Safety Integrity Level and PFDAVG determined			
Correct valve mode chosen (Fail closed, Fail open)			
Design decision documented			
Pneumatic compatibility and suitability verified			
SIS logic solver requirements for valve tests defined and documented			
Routing of pneumatic connections determined			
SIS logic solver requirements for partial stroke tests defined and documented			
Implementation			
Physical location appropriate			
Pneumatic connections appropriate and according to applicable codes			
SIS logic solver valve actuation test implemented			
Maintenance instructions for proof test released			
Verification and test plan released			
Implementation formally reviewed and suitability formally assessed			
Verification and Testing			
Electrical connections verified and tested			
Pneumatic connection verified and tested			

SIS logic solver valve actuation test verified			
Safety loop function verified			
Safety loop timing measured			
Bypass function tested			
Verification and test results formally reviewed and suitability formally assessed			
Maintenance			
Tubing blockage / partial blockage tested			
Safety loop function tested			

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