

EL-O-Matic F-Series Pneumatic Actuator

SIL Safety Manual



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Section 1: Functional Specification

The safety function for El-O-Matic F-Series pneumatic actuator is defined as follows:

Double-Acting Scenario:

- a. When an unsafe condition is detected in a plant by a process sensor, the controller, via actuator control system, drives the Actuator to **close** the shut-down valve, depressurizing (if under pressure) the Opening side of the actuator and pressurizing the Closing side of the actuator.
- b. When an unsafe condition is detected in a plant by a process sensor, the controller, via actuator control system drives the Actuator to **open** the blow-down valve, depressurizing (if under pressure) the Closing side of the pneumatic actuator and pressurizing the Opening side of the pneumatic actuator.

Single-Acting Scenario:

- a. When an unsafe condition is detected in a plant by a process sensor, the controller, via actuator control system drives the Actuator to rotate with sufficient torque to move a valve to its fail-safe state when hold-position air pressure is released.

The El-O-Matic brand Actuator Selection Procedure provides functional definition with specifics on input variables and performance.

In any case, the choice of the safety function to be implemented is responsibility of the system integrator.

Section 2: Configuration of the Product

The El-O-Matic F-Series are pneumatically operated actuators designed to operate Ball / Plug / Butterfly valves, automation of louvers and dampers & automation of any quarter-turn mechanism. Both the double-acting and single-acting (spring-return) versions of the El-O-Matic F-Series pneumatic actuators are designed in such a way that there are no moving parts on the outside (with the exception of the position indicator). This makes them safe, easy to install and virtually maintenance free.

For further details about actuator configurations, please refer to the El-O-Matic F-Series product data sheets, Safety guide and Installation, Operation and Maintenance manual.

Section 3: Service Condition Limitations (Limitation of Use)

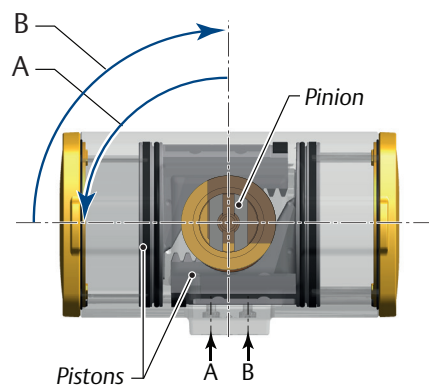
The operating capabilities are listed below:

- Maximum Operating Pressure:
 - Pneumatic Service
 - Up to 120 psig (8.3 barg)
- Ambient Temperature:
Temperature extremes require different solutions to maintain actuator operational integrity and reliability. For each El-O-Matic F-Series actuator is available in three different temperature executions.
 - -20°C to +80°C (-4°F to +176°F) Standard temperature
 - -20°C to +120°C (-4°F to +250°F) High Temperature
 - -40°C to +80°C (-40°F to +176°F) Low Temperature
- Torque Output Range:
 - Double-Acting El-O-Matic F-Series actuators, requiring pressure to rotate in either direction, are available with a torque range between 4.8 Nm (44 lbf.in) and 6,490 Nm (59000 lbf.in)
 - The El-O-Matic F-Series spring-return models require pressure in only one direction of travel and are suitable for air-fail close and air-fail to open applications without modification. These models are available with a spring end torque between 2 Nm (20 lbf.in) and 2394 Nm (21000 lbf.in)
- Safety Function:
For spring-return models, the safety function is self-evident performed by the springs. The safety function of double-acting models should be performed by the A-chamber for safety related systems.

Figure 1 Use the A-Chamber for Safety Related Systems on Double-Acting Actuators

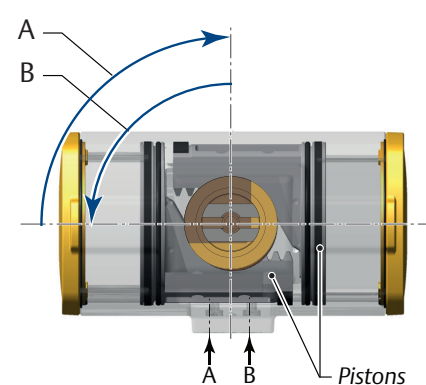
Assembly Code: CW

= Safety Function is
Counterclockwise Rotation



Assembly Code: CC

= Safety Function is
Clockwise Rotation



Section 4: Expected Lifetime

Actuator lifetime (for which failure rates indicated in Par. 5 are ensured) strongly depends on operating conditions.

For normal service conditions, EL-O-Matic F-Series actuators can be in good conditions also after more than 10 years with planned minimum maintenance. Normal working life is 500.000 cycles. EL-O-Matic F-Series carry a warranty period of:

- 18 months after delivery if properly stored in conditions that we declare or
- 12 months after installation on site.

Section 5: Failure Modes and Estimated Failure Rates

Table 1. Failure Modes and Estimated Failure Rates – El-O-Matic F-Series Actuator

Failure Mode	Estimated Failure Rate [1/h]
Failure on demand to Close/Open (FTC/FTO) - El-O-Matic F-Series Double-Acting	5.24E-08
Failure on demand to Close/Open (FTC/FTO) - El-O-Matic F-Series Single-Acting	4.63E-08

 **NOTICE**

No internal diagnostics is included in the device. These numbers are valid when taken in account the maintenance interval and procedure described in Section 7.

Section 6: Installation and Site Acceptance Procedure

Any necessary installation and site acceptance procedures are discussed in the EL-O-Matic F-Series actuators Installation, Operation and Maintenance manual. The Installation, Operation and Maintenance manual defines exercising of the actuator after installation and defines testing after maintenance.

Section 7: Periodic Test and Maintenance Requirements

7.1 General

Please consider that the information in this paragraph are relevant only in regards of Reliability Tests; please refer to Doc. Installation, Operation and Maintenance manual for detailed information about product maintenance, handling and storage.

Diagnostic tests may be made to increase the system reliability (Full-Stroke or Partial-Stroke Test).

“On site” tests depend on Project/Plant facilities/requirements; however, a functional test must be executed on site, prior actuator operation.

7.2 Full-Stroke Test

The “Full-Stroke Test” (“On-line”) must be performed to satisfy the PFD_{AVG} (average probability of failure on demand) value.

The full-test frequencies will be defined by the final integrator in relation to the defined SIL level to achieve.

- Procedure:
 - Operate the Actuator/Valve assembly for No. 2 open/close complete cycles with complete closing of the valve.
 - Verify the Correct performing of open – close manoeuvre (for example, check locally, or automatically via Logic solver, the correct movement of the actuator/valve).

Considering the application of the above described Full-Stroke Test procedure, the “Test Coverage” can be considered 99%.

7.3 Partial-Stroke Test

The “Partial-Stroke Test” (“On-line”) can be performed to improve the PFD_{AVG} value.

A typical partial-stroke value is 15% of the stroke.

The “Partial-Stroke Test” (“On line”) can be performed to satisfy PFD_{AVG} (average probability of failure on demand) value.

- Recommended Test Interval = 1 to 3 months.
- Procedure:
 - Operate the Actuator/Valve assembly for No 1 open/close cycles 15/20% of the stroke.
 - Verify the Correct performing of partial-stroke operation (for example, check locally, or automatically via Logic solver, or via the PST system the correct movement of the actuator/valve till 15/20% of the stroke).

The above parameters to check will depend from the partial-stroke test system available. Considering the application of the above described Partial-Stroke Test procedure, the “Diagnostic Coverage” is >90 %.

7.4 Proof Test and Periodic Maintenance

We advise to perform the following checks upon each proof test interval complying with the rules and regulations of the country of final installation:

- Visually check the entire actuator as well as the control system (where foreseen).
- Ensure there are no leaks on the actuator parts under pressure.
- Check pneumatic connections for leaks. Tighten tube fittings as required.
- Check if manual override (where foreseen) is regular.
- Check if pneumatic filter cartridge (where foreseen) is sound and filter bowl (where foreseen) has been cleaned properly.
- Check the setting of the relief valves (where foreseen).
- Verify that the power fluid supply pressure value is within the required range.
- Remove built-up dust and dirt from all actuator surfaces.
- Inspect actuator paint work for damages to ensure continued corrosion protection. Touch-up as required in accordance with the applicable paint specification.
- Operate the Actuator/Valve assembly for No 2 open/close complete cycles with complete closing of the valve.
- Verify the correct performing of open – close operations (for example, check locally, or automatically via Logic solver, the correct movement of the actuator).

The Installation, Operation and Maintenance manual defines a minimum maintenance interval after 500.000 cycles for the EL-O-Matic F-Series actuators. This addresses components that may have age related degradation. When the maintenance interval has elapsed a complete overhaul of the actuator is required.

Section 8: Hardware Fault Tolerance

The HFT of the device is 0.

The requirements of minimum hardware fault tolerance (HFT) according to Tab.6 of IEC 61511-1 have to be observed but, as long as has been performed an assessment report fully in compliance with IEC 61508 part 1 to7, alternative fault tolerance requirements have to be considered applicable according to Table 2 of IEC 61508-2 as per par. 11.4.5 of IEC 61511-1.

Section 9: Classification

The equipment is classified Type A according to IEC 61508-2.

Section 10: Safe Failure Fraction

SFF=0 without external diagnostic tests.

SFF>0 with external diagnostic tests, carried out according to definition 3.8.7 of IEC 61508-4.

- SFF = 91% with Partial-Stroke Test.
- SFF = 99% with Full-Stroke Test.

The SFF shall be evaluated for the entire final element sub-system.

The diagnostic test shall be performed considerably more often than the demand of the safety function.

Section 11: Mean Repair Time

The MRT of the device is 1 hour.

NOTICE

The MRT is estimated considering availability of skilled personnel for maintenance, spare parts and adequate tools and materials on site (that is, it encompasses the effective time to repair and the time before the component is put back into operation).

Procedures to repair or replace the EL-O-Matic F-Series actuators are provided in the respective Installation, Operation and Maintenance manual. Please refer to the Installation, Operation and Maintenance manual for any tools required for repair and replacement and required competency of technicians. Maintenance and subsequent test procedures are also covered in the Installation, Operation and Maintenance manual. Any failures, identified by the end-user during maintenance, repair or proof testing, that potentially impact the functional safety of the EL-O-Matic F-Series actuators should be reported back to Actuation Technologies Customer Service Coordinator.

Section 12: Systematic Capability

The systematic capability of the device is 3.

This systematic capability is guaranteed only if the user:

1. Use the device according to the instructions for use and to the present Manual.
2. Use the device in the appropriate environment (limitation of use).

Section 13: Document Revision

Table 2. Revision Overview

ECN	DATE	REV		BY *	DATE
PRE RELEASE		00A	ORIGINATOR	J. Zorgdrager	27 January 2015
			CHECKED	R. Ouwendijk	27 January 2015
			APPROVED		

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