FLOWSERVE

SAFETY MANUAL

LPS Series Heavy-Duty Actuators

FCD LPS-SM-00 – 1/14

Experience In Motion

Summary

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n°	**DESCRIPTION**	**DATE**	**ISSUED EMESSO**	**APPROVED APPROVATO**

1 Safety Function Specification

The safety function used in LPS Actuator Series is defined as follows:

Single acting actuator:

a. When an unsafe condition is detected in a plant by a process sensor, the controller, via the control panel, drives the Actuator to close the shut-down valve, normally de-energizing a solenoid valve, and venting air via the control system, OR

b. When an unsafe condition is detected in a plant by a process sensor, the controller, via the control panel, drives the Actuator to open the shut-down valve, normally de-energizing a solenoid valve, and venting air via the control system.

Double acting actuator:

a. When an unsafe condition is detected in a plant by a process sensor, the controller, via the control panel, drives the Actuator to close the shut-down valve, depressurizing the OPEN chamber of the cylinder and pressurizing the CLOSE chamber, OR

b. When an unsafe condition is detected in a plant by a process sensor, the controller, via the control panel, drives the Actuator to open the shut-down valve, depressurizing the CLOSE chamber of the cylinder and pressurizing the OPEN chamber.

The choice of the safety function to be implemented is responsibility of the system integrator.

2 Configuration of the Product

The LPS Actuator Series is composed by pneumatic, single acting (spring return) LPS-SA or double acting LPS-DA actuators designed to operate several types of quarter-turn valves.

The LPS-SA actuators can be assembled in the 'fail to open' or 'fail to close' configurations.

Actuator design characteristics are shown on the data plate attached to the actuator.

The LPS-SA actuator series is available in a wide torque range. The torque ratings of this actuator series are specified in the document: "PRESSURE-TORQUE CHARTS LPS SINGLE ACTING ACTUATORS" (doc. n° DUT008-LPS-SA", Draft Document).

The overall dimensions of the LPS-SA actuator series, their weight, the number of available models and all the available constructive options are listed in the documents: "dim-data_LPS_SA_FC", "dim-data_LPS_SA_FO", "Weight SA" and "Selection table" (Draft Documents).

3 Service Condition Limitations

(Limitation of Use)

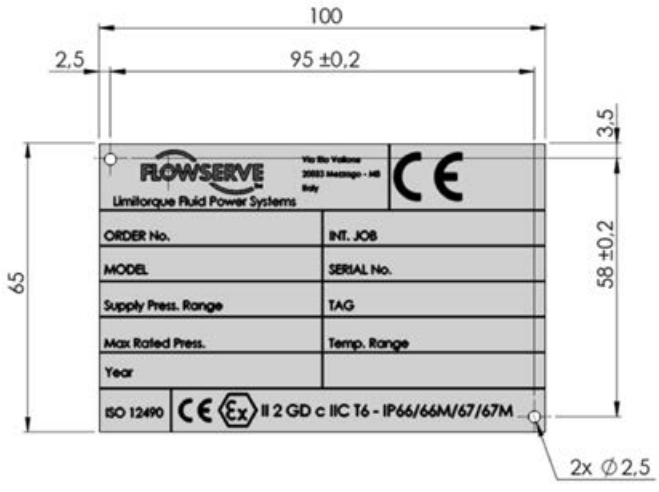
The limits of operating conditions strongly depend on the Actuator type and on materials of construction; operating limits of temperature and pressure are indicated in the following table:

Operating Condition	Range
Pressure	Design pressure = 12 barg (MOP* depending on actuator size)
Tmin	- 29°C (-60°C with special seals)
Tmax	100°C (160°C with special seals)

*MOP = Maximum Operating Pressure, as per ISO12490.

The service condition limitations (Max Rated Pressure, Temperature range, ...) are included on actuator label (see below).

Figure 1: LPS Actuator Nameplate



4 Expected Lifetime

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

For normal service conditions, LPS Actuators can be in good conditions also after 25 years, with planned maintenance, according to Par. 6.4.

5 Failure Modes and Estimated Failure Rates

Failure Mode	**Estimated Dangerous Failure Rate** λ_D [1/h]
Failure on demand	6,39 E-08

Failure Modes and estimated Failure rates – Actuators Series LPS/SA

Failure Mode	**Estimated Dangerous Failure Rate** λ_D [1/h]
Failure on demand	7,68 E-08

Failure Modes and estimated Failure rates – Actuators Series LPS/DA

NOTE: no internal diagnostics is included in the device.

6 Periodic Test and Maintenance Requirements

6.1 General

Please consider that the information in this paragraph are relevant only in regards of Reliability Tests; please refer to the Document "IOM MANUAL" ("Installation, Operation and Maintenance Manual", doc. n° LFENIM0001) 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, before Valve usage.

6.2 Full Stroke Test

The "Full Stroke Test" ("On-line") must be performed to satisfy the PFDAVG (average probability of failure on demand) value.

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

Procedure:

- Operate the Actuator/Valve assembly for an open/close complete cycle, with complete opening - closing of the valve.
- Verify the Correct performing of open – close manoeuvre (e.g. 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%.

6.3 Partial Stroke Test

The "Partial Stroke Test" ("On-line") can be performed to improve the PFDAVG value.

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

The "Partial Stroke Test" ("On line") can be performed to satisfy PFDAVG (average probability of failure on demand) value.

Recommended Test Interval = **1 – 3 months**.

Procedure:

- Operate the Actuator/Valve assembly for in an open/close cycle, with 15% of the stroke;
- Verify the Correct performing of partial stroke manoeuvre (e.g. check locally, or automatically via Logic solver, or via the PST system, the correct movement of the actuator/ valve till 15% of the stroke).

The above parameters will depend on the available partial stroke test system.

Considering the application of the described Partial Stroke Test procedure, the "Diagnostic Coverage" is >90 %.

6.4 Proof Test and Periodic Maintenance

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

- Visually check the entire actuator as well as the control groups, if any.
- Ensure there are no leaks on the actuator parts under pressure.
- Check pneumatic connections for leaks. Tighten pipe fittings, as required.
- Check if the quick exhaust valves (if any) have been cleaned properly.
- Check if the (hydraulic) manual override is regular.
- Check if the suction and exhaust cylinder filters have been cleaned properly.
- Check the setting of the relief valves.
- 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 an open/close complete cycle with complete closing of the valve.
- Verify the correct performing of open – close manoeuvre (e.g. check locally, or automatically via Logic solver, the correct movement of the actuator/valve).

We advise to perform the following periodic maintenance:

- Replace the seals on the parts under pressure every five years.
- Check all components subject to wear (bushings, coupling mechanisms).

7 Hardware Fault Tolerance

The HFT (Hardware Fault Tolerance) of the device is 0.

According to Tab.6 of IEC 61511-1, the requirements of minimum hardware fault tolerance (HFT) have to be observed, but, as long as an assessment report, fully in compliance with IEC 61508 part 1 to7, has been performed, 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.

8 Classification

The device is classified as Type A, according to IEC 61508-2.

9 Safe Failure Fraction

SFF (Safe Failure Fraction) = 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.

10 Mean Repair Time

The MRT (Mean Repair Time) of the device is 24 hours.

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

11 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 according to the present Manual.
2. Use the device in the appropriate environment (limitation of use).

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