

SAFETY MANUAL

RC200 ACTUATOR



Rev.	Date	Description	Total pag.	Issued by	Approved by
A	2025-06-05	First issue	20	S. Holm	J. Larsson
B	2025-09-11	Updated section 2 and section 8 removing spelling errors and updating information on route 2 _H	20	S. Holm	J. Larsson

Summary

1	SPECIFICATION OF THE SAFETY FUNCTION	3
2	CONFIGURATION OF THE PRODUCT	3
3	SERVICE CONDITION LIMITATIONS (LIMITATION OF USE)	7
4	EXPECTED LIFETIME	7
5	FAILURE MODES AND ESTIMATED FAILURE RATES	8
6	PERIODIC TEST AND MAINTENANCE REQUIREMENTS	9
7	CLASSIFICATION	17
8	ARCHITECTURAL CONSTRAINTS	18
9	MEAN REPAIR TIME	18
10	COMMON CAUSE FACTOR	19
11	SYSTEMATIC CAPABILITY	20
12	OPERATION AND MAINTENANCE MANUAL	20

1 SPECIFICATION OF THE SAFETY FUNCTION

The safety function used in Actuators Series RC 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.
- 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.

In both case a) or b) the safety function is performed by one or more spring.

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.
- 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 Rotork RC series are pneumatic/hydraulic actuators featuring a modern scotch-yoke mechanism that provides high start- and end-torque output in a very compact package. It is available in both double-acting and single acting configurations. Single acting actuators feature springs that are safely contained within an epoxy-coated cartridge. Pistons are guided in two places by high-performance bearings which ensure proper alignment and long seal life.

Actuator design characteristic are shown on the data plate attached to the actuator

These actuators can be fitted with an emergency manual override suitable to operate the actuator in the event of fluid supply failure. This device is of mechanical jackscrew type, operated by means of a handwheel.

In the RC range, the substantial differences between the actuators, in terms of functional safety is given from:

- Single and Double Acting;
- Single/Double Pistons;

When it is not expressly written, the prescriptions inside the present document will be valid for each model of the RC actuator range.

For more information about specific products of the RC range, please consult the Instructional Manuals downloadable at www.rotork.com.

Below are reported drawings of some of the RC Actuator configurations:

- Figure 1 RC Spring Return, Single Piston;
- Figure 2 RC Double Acting, Single Piston;
- Figure 3 RC Spring Return, Double Piston;
- Figure 4 RC Double Acting, Double Piston.

The RC88 actuator, part of the RC range actuators, shall be treated in different way respect to the other actuators of the series, since it presents a special configuration composed of two standard actuator. The side view of the RC 88 actuator is reported in Figure 5: also the RC88 actuator is available in Single Acting/Double Acting configuration.

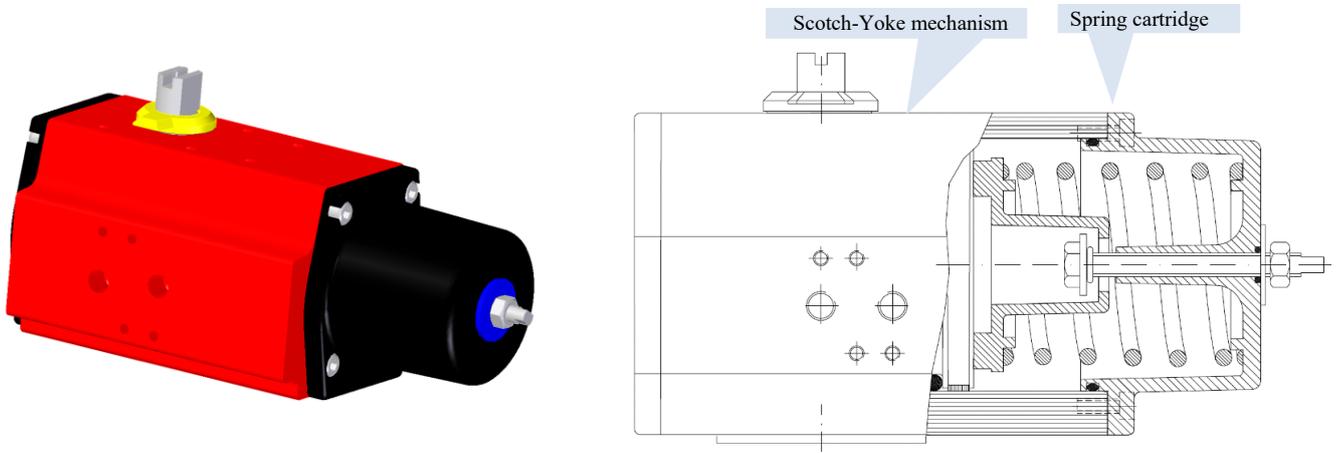


Figure 1 RC Spring Return, Single Piston

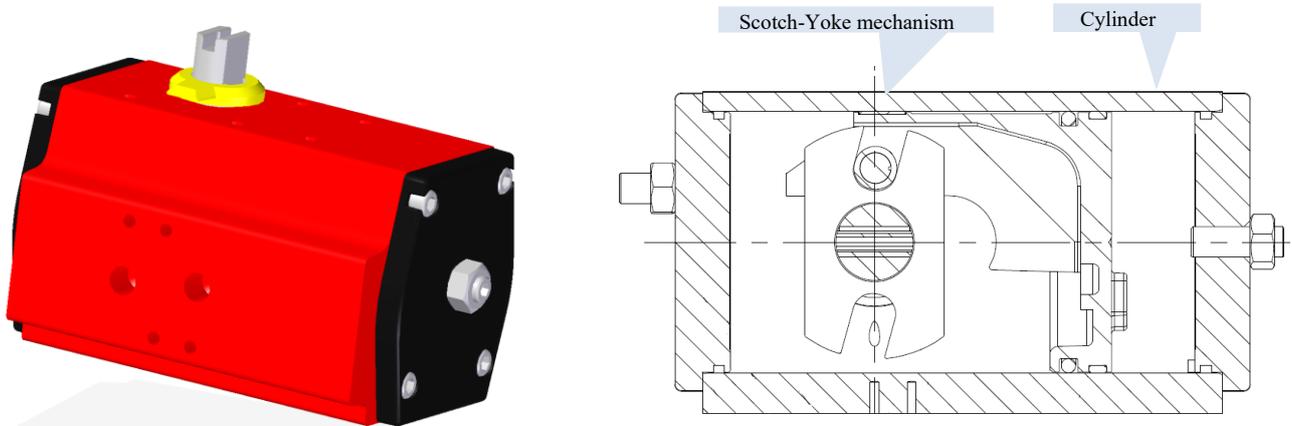


Figure 2 RC Double Acting, Single Piston

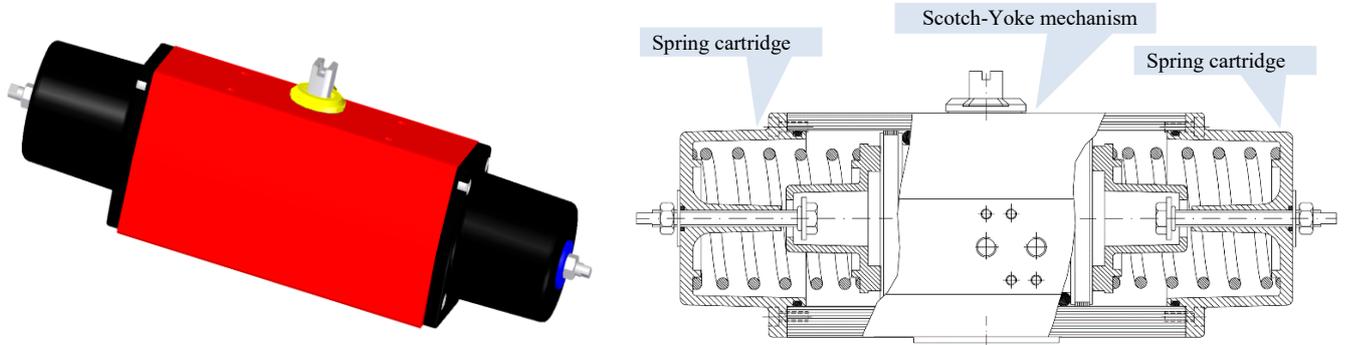


Figure 3 RC Spring Return, Double Piston

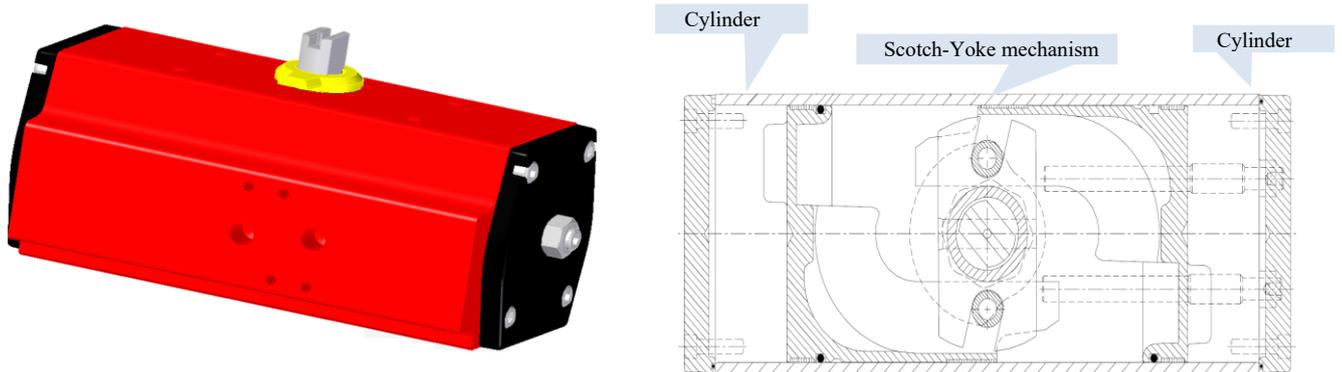


Figure 4 RC Double Acting, Double Piston

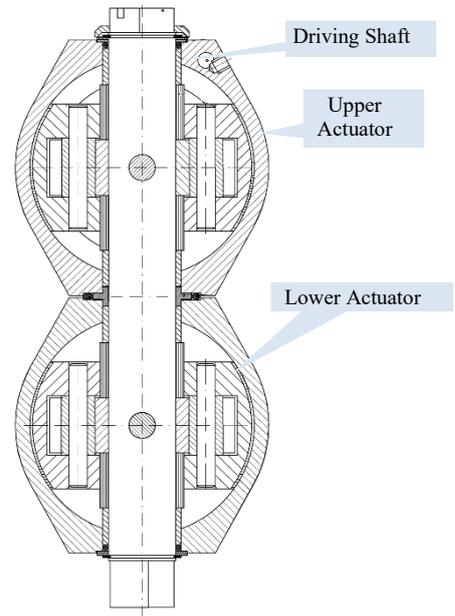
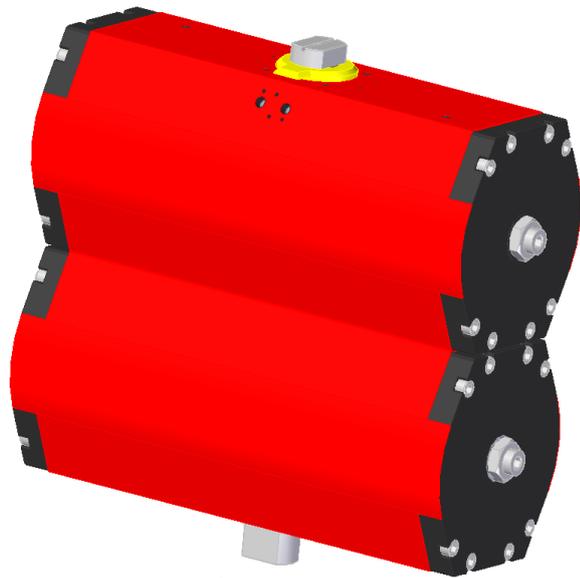


Figure 5 RC 88 Double Acting, Double Pistons ¹

¹ It is available also the Spring Return configuration

3 SERVICE CONDITION LIMITATIONS (LIMITATION OF USE)

The operating conditions limits strongly depends on the Actuator type and on materials of construction used (refer to the specific manuals Instructional Manuals downloadable at www.rotork.com for further details); operating limits of temperature and pressure are indicated in the following table:

TEMPERATURE AND PRESSURE OPERATING LIMITS						
Actuator Type	Pressure range	Max Operating Pressure	Temperature range			
			Standard	High Temp	Low Temp	Low Temp Arctic
RC200,RCI200*	up to 10 Barg	10 Barg	-20° up to +75°C	0° up to +150°C	-40° up to +55°C	-47° up to +55°C
RCO200, RCIO200*	Up to 8 Barg	8 Barg	-20° up to +75°C	0° up to +150°C	-40° up to +55°C	-47° up to +55°C
RC265*	Up to 8 Barg	8 Barg	-20° up to +75°C	0° up to +105°C	-25° up to +55°C	N/A
RC88-DA*	up to 7 Barg	7 Barg	-20° up to +75°C	0° up to +150°C	-40° up to +55°C	-47° up to +55°C
RC88-SR*	Up to 6 Barg	6 Barg	-20° up to +75°C	0° up to +150°C	-40° up to +55°C	-47° up to +55°C

*Includes actuators with Tough corrosion protection (example RCT).

A warning on the Installation and Maintenance Manual is reported to verify that, after each manual override operation, and before returning to remote operation, the Auto position must take place.

In case of use of double effect actuators in Safety Instrumented Systems, the integrator must follow all requirements reported in par. 11.2.11 of IEC 61511-1.

4 EXPECTED LIFETIME

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

For normal service conditions RC Actuators can be in good conditions also after more than 25 years with planned maintenance, according to Par. 6.5.

5 FAILURE MODES AND ESTIMATED FAILURE RATES

Please refer to the values included in the latest valid version of SIL Certificate(s) available upon request or on Rotork.com.

Notes:

- 1) No internal diagnostic is included in the device.
- 2) The failure rates are guaranteed:
 - a. For service conditions listed in par. 3;
 - b. For the expected lifetime declared in par. 4;
 - c. Considering the periodic test and maintenance included in par. 6.
- 3) The failure rates are determined performing a FMEDA based on failure rates of components taken from industrial database (NPRD-2016/FMD97/2016, EXIDA E&MCRH and NSWC-2011), integrated with field feedback using the Bayesian statistical approach mentioned in IEC 61508-2 Par. 7.4.4.3.3. The system for reporting failures is based on field feedback end users, with:
 - Identification of the claim/failure.
 - Root cause analysis to identify cause and responsibility of the failure.
 - Identification of the possible effect of the failure on the Safety Function.
 - Classification of the failure considering the failure categories of IEC 61508-2 (Safe, Dangerous, No Effect).
- 4) Rotork uses a worldwide data management system, used in all manufacturing sites, where are recorded for each actuator model the relevant NCRs and retrofit activities done, with failures classification (Dangerous, Safe, No Effect) related to each specific application and actuator safety function.
- 5) Customer Service, Quality and Technical Department are responsible for the procedure, according to the respective role.
- 6) The requirements in IEC 61508-2 paragraphs 7.4.10.1 – 7.4.10.7 are fulfilled and assessed by Third Party.
- 7) The HDM failure rates has been obtained from the FMEDA of the LDM application, using the following procedure:
 - To identify the components where the high demand could be increased the wearing effect or minor ageing (blocking).
 - For these components, to identify specific failure modes that could be affected by major wearing or minor ageing.
 - For these failures modes, to estimate the increasing of failure rates for wearing, or, respectively, the decreasing for ageing.
 - The estimation of the changing of the failure modes, is done considering:
 - The difference between the LDM and HMD application indicated in the international database, as NSWC and EXIDA EMRCH.
 - Technical analysis of experts.
 - Combination of the two techniques give above.
 - With the λ_{BB} , value, to obtaining the λ_{SS} has been used the same corrective factor originated from the Bayesian analysis for LDM application.
- 8) In case of High Demand Mode, the “On-Line Monitoring” failure rates can be used if:
 - The safety function is performed in Low Demand Mode, and the actuator operates in high utilization rate, OR

- The safety function is performed in High Demand Mode, and the utilization rate of the actuator is at least 10 times higher than the safety function demand rate.

9) The failure rates indicated in the certificates are conservative and are referred to the worst configuration.

6 PERIODIC TEST AND MAINTENANCE REQUIREMENTS

6.1 General

Please consider that the information in this paragraph is relevant only in regards of Reliability Tests; please refer to Doc. INSTRUCTION MANUAL for detailed information about product maintenance, handling and storage.

Diagnostic tests may be made to increase the system reliability.

“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 PFD_{AVG} (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 No. 2 open/close complete cycles with complete closing of the valve.
- Verify the Correct performing of open – close manoeuvre (eg. check locally, or automatically via Logic solver, the correct movement of the actuator/valve).

The procedure can be manually or automatically performed. In the following, for both cases, are reported:

- Parameters to be measured.
- Instruments to be used.
- Failure modes detected.
- Diagnostic coverage/proof test coverage.

6.2.1 Parameters to be measured:

The following parameters have to be measured for an effective Full Stroke Test:

- Angular position of the shaft.
- Time necessary to reach the final position.
- Output torque (as indirect measure, by means of the measure of pressure within the cylinder).

Note. Parameters may not all be needed, but the following combinations can be used:

1. Measure of angular position as function of the time (pressure measure optional).
2. Measure of Cylinder Pressure as function of the time.
3. Verification of final position achievement in the established maximum time.

6.2.2 Instruments / equipment to be used for the test:

Quantity	Instruments / equipment	
	Automatic Procedure	Manual Procedure
Angular position of the shaft	<p>Case A: use of a Logic Solver:</p> <ol style="list-style-type: none"> 1. Limit switches box, or 4-20 mA position transmitter 2. Digital Input Module / Analog Input Module included in the Logic Solver 3. Application SW function <p>Case B: use of a PST device:</p> <ol style="list-style-type: none"> 1. Limit switches box, or 4-20 mA position transmitter 2. PST device with integrated SW function 	<ol style="list-style-type: none"> 1. Limit switch box, with visual indication 2. Skilled and trained personnel
Time necessary to reach to final position	As above	<ol style="list-style-type: none"> 1. Chronometer 2. Skilled and trained personnel
Output torque (Pressure in the cylinder)	<p>Case A: use of a Logic Solver:</p> <ol style="list-style-type: none"> 1. Pressure transmitter connected to the cylinder chamber 2. Analog Input Module included in the Logic Solver 3. Application SW function (to compare the actual trend with the one stored during SAT) <p>Case B: use of a PST device:</p> <ol style="list-style-type: none"> 1. Pressure transmitter connected to the cylinder chamber 2. PST device with integrated SW function 	Skilled and trained personnel (to check audible partial sticking)

6.2.3 Failure mode detectable by the test:

The following table reports the major failure modes of main components.

Component	Detectable failure modes	
	Automatic Procedure	Manual Procedure
<u>Spring Cartridge</u>		
Spring	Scored in Spring Section Weakened Sticking Worn	As per automatic
Spring Flange	Breakage	As per automatic
<u>Scotch-Yoke mechanism</u>		
Driving Shaft	Breakage	As per automatic
Double Roll Pin	Breakage	As per automatic
Yoke	Breakage	As per automatic
Piston Pin	Breakage	As per automatic
<u>Cylinder</u>		
Piston	Broken/Sticking	As per automatic
Cylinder	Broken	As per automatic
<u>Only for RC88²</u>		
Guide Pin	Broken Deformation	As per automatic

In case of Manual procedure, detectable failure modes are the same as per automatic modes. On the contrary, the proof test coverage is less than in automatic mode because of the presence of the human factor.

The manual procedure cannot be considered as diagnostic.

6.2.4 Diagnostic Coverage / Proof Test Coverage

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

In case of manual procedure the test coverage can be considered as 90-95 %, taking into account the test imperfection and the reliability/competence of the operator.

² To add to the other failure modes

6.3 Partial Stroke Test

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

A typical partial stroke value is 15 degrees.

- Recommended Test Interval = 1 – 6 months

- Procedure:
 - Operate the Actuator/Valve assembly for 1 open/close cycles till 15 degrees

 - Verify the Correct performing of partial stroke manoeuvre (eg. check locally, or automatically via Logic solver, or via the PST system the correct movement of the actuator/valve till 15 degrees).

The procedure can be manually or automatically performed. In the following, for both cases, are reported:

- Parameters to be measured.
- Instruments to be used.
- Failure modes detected.
- Diagnostic coverage/partial stroke test coverage.

NOTE:

1. PST is relevant for LDM applications, while is considered not relevant in HDM applications

6.3.1 Parameters to be measured:

The following parameters have to be measured for an effective Full Stroke Test:

- Angular position of the shaft.
- Time necessary to reach the final position.
- Output torque (as indirect measure, by means of the measure of pressure within the cylinder).

NOTE: Parameters may not all be needed, but the following combinations can be used:

1. Measure of angular position as function of the time (pressure measure optional).
2. Measure of Pressure within the Cylinder as function of the time.
3. Verification of final position achievement in the established maximum time.

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

6.3.2 Instruments / equipment to be used for the test:

The Partial Stroke Test can be executed in the following way:

1. Using commercial PST device measuring/verifying:
 - a) Measure of angular position as function of the time (pressure measure optional).
 - b) Measure of Pressure within the Cylinder as function of the time.
 - c) Final position achievement in the established maximum time.

2. By means of Logic Solver device measuring/verifying:
 - a) Measure of angular position as function of the time (pressure measure optional).
 - b) Measure of Pressure within the Cylinder as function of the time.
 - c) Final position achievement in the established maximum time.

3. By means of PST manual devices manufactured by Rotork Sweden:
Regarding the manual devices for PST, different possibilities are available.

A mechanical partial stroke device is composed of a blocking dowel that has to be inserted in the actuator spool piece. The dowel insertion limits the actuator scotch yoke rotation to a predefined angle during the manoeuvre, thus allowing to verify that the actuator/valve assembly correctly start moving without, however, interfering with normal valve operation.

The spool piece is equipped with a Limit switch that signal the Mechanical block insertion.

Another mechanical partial stroke test device is composed by a cam valve that acts on the actuator stroke, limiting to a predefined angle and a manual operated spring return valve that, when engaged by the spring, actuates the cam valve. The partial stroke device disengagement is automatic trough the cam valve action and spring release of the key operated valve.

Quantity	Instruments / equipment	
	Automatic Procedure	Manual Procedure
Angular position of the shaft	Case A: use of a Logic Solver: 1. Limit switches box, or 4-20 mA position transmitter 2. Digital Input Module / Analog Input Module included in the Logic Solver 3. Application SW function Case B: use of a PST device: 1. Limit switches box, or 4-20 mA position transmitter 2. PST device with integrated SW function	1. Mechanical cam of PST device connected to shaft 2. Skilled and trained personnel (to activate PST and verify the successful operation)
Time necessary to reach to final position	As above	1. Chronometer 2. Skilled and trained personnel
Output torque (Pressure in the cylinder)	Case A: use of a Logic Solver: 1. Pressure transmitter connected to the cylinder chamber 2. Analog Input Module included in the Logic Solver 3. Application SW function (to compare the actual trend with the one stored during SAT) Case B: use of a PST device: 1. Pressure transmitter connected to the cylinder chamber 2. PST device with integrated SW function	Skilled and trained personnel (to check audible partial sticking)

6.3.3 Failure mode detectable by the test:

The following table reports the major failure modes of main components.

Component	Detectable failure modes	
	Automatic Procedure	Manual Procedure
<u>Spring Cartridge</u>		
Spring	Scored in Spring Section Weakened Sticking Worn	As per automatic
Spring Flange	Breakage	As per automatic
<u>Scotch-Yoke mechanism</u>		
Driving Shaft	Breakage	As per automatic
Double Roll Pin	Breakage	As per automatic
Yoke	Breakage	As per automatic
Piston Pin	Breakage	As per automatic
<u>Cylinder</u>		
Piston	Broken/Sticking	As per automatic
Cylinder	Broken	As per automatic
<u>Only for RC88³</u>		
Guide Pin	Broken Deformation	As per automatic

In case of Manual procedure, detectable failure modes are the same as per automatic modes.

In case of manual PST the Test is considered as a “non-perfect Proof Test”. It is considered valid as a test for the calculation of PFDAVG, while it is not considered in the estimation of SFF. On the contrary, the proof test coverage is less than in automatic mode because of the presence of the human factor.

The manual procedure cannot be considered as diagnostic.

6.3.4 Diagnostic Coverage / Test Coverage

Considering the application of the above described Partial Stroke Test procedure, the “Diagnostic Coverage” is 95 %.

In case of manual procedure, the test coverage can be considered as 90-95 %, taking into account the test imperfection and the reliability/competence of the operator.

³ To add to the other failure modes

6.4 “On-line monitoring” by the process

The “On-line monitoring” by the process can be performed to satisfy PFH value.

➤ Procedure:

- To monitor the correct functioning of the actuator during the normal process operation.

The procedure shall be automatically performed. In the following are reported:

- Parameters to be measured.
- Instruments to be used.
- Failure modes detected.
- Diagnostic coverage.

NOTES:

- “On-line monitoring” by the process is relevant for HDM applications, but can be relevant also in LDM applications, where the safety function is performed in Low Demand Mode, and the actuator operates in high utilization rate.

6.4.1 Parameters to be measured:

The following parameters have to be measured for an effective “On-line monitoring”:

- Angular position of the shaft.
- Time necessary to reach the final position.
- Output torque (as indirect measure, by means of the measure of pressure within the cylinder).

NOTES:

Parameters may not all be needed, but the following combinations can be used:

1. Measure of angular position as function of the time (pressure measure optional).
2. Measure of Pressure within the Cylinder as function of the time.
3. Verification of final position achievement in the established maximum time.

The above parameters will depend from “On line monitoring” system available.

6.4.2 Instruments / equipment to be used for the test:

The “On-line monitoring” can be executed in the following way:

- Using e.g. a Positioner / Logic Solver / DCS to measure / verify:
 - a) angular position as function of the time (pressure measure optional).
 - b) Pressure within the Cylinder as function of the time.
 - c) Final position achievement in the established maximum time.

Quantity	Instruments / equipment Automatic Procedure
Angular position of the shaft	<ol style="list-style-type: none"> 1. Limit switches box, or 4÷20 mA position transmitter. 2. Digital Input Module / Analog Input Module included in the Logic Solver. 3. Application SW function.
Time necessary to reach to final position	As above
Output torque (Pressure in the cylinder)	<ol style="list-style-type: none"> 1. Pressure transmitter connected to the cylinder chamber. 2. Analog Input Module included in the Logic Solver. 3. Application SW function (e.g. to compare the actual trend with the one stored during SAT).

6.4.3 Failure mode detectable by the test:

The following table reports the major failure modes of main components.

Component	Detectable failure modes Automatic Procedure
Spring Cartridge	
Spring	Breakage Weakened Worn Sticking
Spring Container	Total Breakage
Scotch-Yoke mechanism	
Driving Shaft	Breakage
Double Roll Pin	Breakage
Piston Pin	Breakage
Yoke	Breakage Sticking
O-Rings	Breakage => External leakage
Pneumatic Cylinder	
Piston	Sticking

6.4.4 Diagnostic Coverage / Test Coverage

Considering the application of the above described “On-line monitoring” by the process procedure, the “Diagnostic Coverage” can be $\geq 90\%$. The “Diagnostic Coverage” value depends upon the procedure and the equipment used to perform the “On-line monitoring” by the process.

6.5 Periodic Maintenance

According to IEC 61508, Rotork Sweden advises to perform the following checks upon each proof test interval complying with the rules and regulations of the country of final installation:

PLEASE NOTE! that the periodic maintenance have to be permitted on site.

- Remove built-up dust and dirt from all actuator surfaces.
- Visually check if any damages on the entire actuator, as well as the control groups and control equipment.
- 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) are clean.
- Check if the mechanical manual override is functioning. NOTE! Put it back in neutral position.
- Check if the suction and exhaust cylinder filters (filter plug and silencer) are clogged.
- Check the setting of the relief valves, if any.
- Verify that the supply pressure value is within the required range.
- Inspect actuator paint work/treated surface for damages to ensure continued corrosion protection. Touch-up as required in accordance with the applicable paint/surface treatment specification.
- Operate the Actuator/Valve assembly for two times open/close complete cycles, 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).

Rotork Sweden advises to perform the following periodic maintenance:

- Replace the seals on the parts under pressure every 4 years.
- Check all components subject to wear (bushings, body mechanism).

7 CLASSIFICATION

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

8 ARCHITECTURAL CONSTRAINTS

For the evaluation of the conformity to the requirement of Hardware Safety Integrity, architectural constraints of the standard IEC 61508, Route 1H and Route 2H are used.

Route 1H

- The device has a single channel configuration, HFT=0.
- Considering that $\lambda_s=0^4$ and that no internal diagnostics is included in the device:
 - SFF=0 without external diagnostic tests.
 - SFF>0 with external diagnostic tests carried out according to definition 3.8.7 of IEC 61508-4 (i.e. carried out “on-line”).
 - SFF = 90% with:
 - Partial Stroke Test using commercially available PST systems, OR
 - “On-line monitoring” by the process(the exact value of SFF depends upon the procedure and the equipment used).
 - SFF = 95% / 99% with Full Stroke and Leak Test (the exact value of SFF depends upon the system used)

Route 2H

The application of Route 2_H (“field feedback”) is assessed. As the device is classified as “Type A”, no requirements for SFF are given for Route 2_H.

Results:

Low Demand Mode

The device can be used in single channel configuration up to:

- **SIL 2**, without external diagnostic tests.
- **SIL 3**, considering external diagnostic tests.

High Demand Mode

The device can be used in single channel configuration up to:

- **SIL 1**, without external diagnostic tests.
- **SIL 3**, considering external diagnostic tests.

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

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

9 MEAN REPAIR TIME

The MRT of the device is 24 Hours.

⁴ According to definitions 3.6.8 and 3.6.13 of IEC 61508-4, no Safe Failures are possible in a Single and Double Acting actuator: each failure mode of the actuator itself shall be classified as “Dangerous” or “No Effect” (failures which can generate the spurious operation of the safety function are only external to the actuator itself, or are related to components that “plays no part in implementing the safety function”, e.g. components of the cylinder, and so, according to definition 3.6.13 of IEC 61508-4, they cannot be used for the calculation of the SFF): hence $\lambda_s=0$ for each type of Single/Double Acting actuator.

NOTE: The MRT is estimated considering availability of skilled personnel for maintenance, spare parts and 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).

10 COMMON CAUSE FACTOR

The product has a single channel configuration, HFT=0.

The β factors can be used when performing PFD_{AVG} calculations for redundant architectures.

The Common Cause factors value, relevant when the product is used in redundant configuration, are:

$$\beta = \beta_D = 0,05.$$

NOTES:

- The above value is the value for the 1oo2 architecture. The values for other architecture shall be calculated according to IEC 61508 Part 6, Table D.5;
- The above value is calculated in the hypothesis of redundancy without diversity.

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

12 OPERATION AND MAINTENANCE MANUAL

Operation and maintenance manual describe in detail the following points:

- Storage.
- Installation and start up.
- Regulation.
- Multiple configuration.
- Dismantling and Disposal.
- Troubleshooting.
- Maintenance operation (with assembling and disassembling).