IEC 61508 Functional Safety Certification

This is to certify that the undernoted products have been assessed against the relevant requirements of the applicable standard

Office: **Houston**
Date: **25 September, 2019**

This Certificate is issued to:	Mecànica Prisma, S.L., C/ Telègraf 1-7 - Polig. Ind. Sota el Molí 08160 Montmeló, Barcelona, Spain
Product Description:	Spring Return Rotary Rack and Pinion Pneumatic Actuators • PAS Series (PAWS, PA00S, PA05S, PA10S, PA15S, PA20S, PA25S, PA30S, PA50S, PA60S, PA70S), 0-90° rotation, Air Pressure up to 8bar, Temp -32°C to + 80°C, For Low Temp Services from – 55°C to + 80° C, For High Temperature Services from – 20°C to + 120°C • PS Series (P40S, PAVS), 0-90° rotation, Air Pressure up to 8bar, Temp -32°C to 80°C, For Low Temp Services from – 55°C to + 80° C, For High Temperature Services from – 20°C to + 120°C

Description and Results

- Lloyd´s Register has assessed the product to the relevant requirements of the applicable standard and verifies it meets the requirements providing a level of integrity of:
  - Systematic Safety Integrity SIL 3 (Route 1S)
  - Random Safety Integrity (Type A, Route 2H Device) SIL 2 (HFT=0) and SIL 3 (HFT=1)

Applicable Standard

- IEC61508-2010 Parts 1 and 2, Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Safety Functions Included

- Rotate 90° the stem with the required torque on demand. Upon activation of the SIS, the source of pressure is removed from the actuator by a solenoid valve, the fluid inside is vented, the springs expand rotating the stem 90° with the required torque. It should be noted that in order to fulfil this safety function in a specific time, a correctly designed solenoid valve must be installed. Furthermore, it should be noted that the design of the actuator is the same regardless of the safe state of the actuator i.e. open or closed. This configuration depends only on the way the components are assembled.

IEC 61508 Failure Rates (based on FMEDA)

Failure Classification and Models	Failure Rate (1/h)				
	Note 1	PA60S	PA70S	P40S	PAVS
Dangerous failure rate λ_D (1/h)	5.77E-07	8.59E-07	1.14E-06	5.67E-07	4.48E-07
Safe failure rate λ_S (1/h)	1.24E-06	1.26E-06	1.26E-06	8.89E-07	7.94E-07
Critical failure rate (DU + S) λ_C (1/h)	1.82E-06	2.12E-06	2.40E-06	1.46E-06	1.24E-06
Diagnostic Coverage (DC) (%)	0%	0%	0%	0%	0%
Safe Failure Fraction (SFF) (%)	68%	59%	53%	61%	64%

Note 1: PAWS, PA00S, PA05S, PA10S, PA15S, PA20S, PA25S, PA30S and PA50S.

Supporting Documents

- LR SIL Capability Assessment to IEC61508, Report no PRJ1110017872 Rev.00 dated 25 September 2019.

Notes and Conditions

- The products are installed in low demand applications i.e. expected demand rate of less than once per year.
- Random hardware failure rates have been determined based on a Failure Modes Diagnostic and Effects Analysis (FMEDA).
- Random Safety Integrity (PFDavg and Architectural Constraints) must be assessed for the entire function for each application.
- Other elements such as valves, solenoids, etc. are not included in the assessment.
- The product must be installed, operated and maintained according to vendor instructions by competent personnel.

- The design specifications supplied with the products and useful life will be observed by end users to ensure the validity of the assumptions and calculations made on this report.
- A valid ISO 9001 certification is a requirement for the duration of this certificate.

Date of Issue: **25th September, 2019**
Expiry date **25th September, 2024**

Chinaka R. Okoroafor / Angel Casal

Lloyds Register North America Inc.
Americas TSO, Houston.
a member of the Lloyd's Register group.

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Product Description:	Spring Return Rotary Rack and Pinion Pneumatic Actuators, PIS 12,5 Series (PI00S 12,5, PI10S 12,5, PI20S 12,5, PI30S 12,5, PI40S 12,5), 0-90° rotation, Air Pressure up to 12.5bar, Temp -32°C to 80°C, For Low Temp Services from – 55°C to + 80° C, For High Temperature Services from – 20°C to + 150°C

Description and Results

- Lloyd´s Register has assessed the product to the relevant requirements of the applicable standard and verifies it meets the requirements providing a level of integrity of:
  - Systematic Safety Integrity SIL 3 (Route 1S)
  - Random Safety Integrity (Type A, Route 2H Device) SIL 2 (HFT=0) and SIL 3 (HFT=1)

Applicable Standard

- IEC61508-2010 Parts 1 and 2, Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Safety Functions Included

- Rotate 90° the stem with the required torque on demand. Upon activation of the SIS, the source of pressure is removed from the actuator by a solenoid valve, the fluid inside is vented, the springs expand rotating the stem 90° with the required torque. It should be noted that in order to fulfil this safety function in a specific time, a correctly designed solenoid valve must be installed. Furthermore, it should be noted that the design of the actuator is the same regardless of the safe state of the actuator i.e. open or closed. This configuration depends only on the way the components are assembled.

IEC 61508 Failure Rates (based on FMEDA)

Failure Classification and Models	Failure Rate (1/h)	
	PI00S 12,5, PI10S 12,5, PI30S 12,5, PI40S 12,5	PI20S 12,5
Dangerous failure rate λ_D (1/h)	4.90E-07	4.44E-07
Safe failure rate λ_S (1/h)	1.26E-06	1.26E-06
Critical failure rate (DU + S) λ_C (1/h)	1.75E-06	1.70E-06
Diagnostic Coverage (DC) (%)	0%	0%
Safe Failure Fraction (SFF)	72%	74%

Supporting Documents

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Notes and Conditions

- The products are installed in low demand applications i.e. expected demand rate of less than once per year.
- Random hardware failure rates have been determined based on a Failure Modes Diagnostic and Effects Analysis (FMEDA).
- Random Safety Integrity (PFDavg and Architectural Constraints) must be assessed for the entire function for each application.
- Other elements such as valves, solenoids, etc. are not included in the assessment.
- The product must be installed, operated and maintained according to vendor instructions by competent personnel.
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Product Description:	Spring Return Rotary Rack and Pinion Pneumatic Actuators, PIS Series (PI00S, PI10S, PI20S, PI30S, PI40S), 0-90° rotation, Air Pressure up to 8bar, Temp -32°C to 80°C, For Low Temp Services from – 55°C to + 80° C, For High Temperature Services from – 20°C to + 150°C

Description and Results

- Lloyd´s Register has assessed the product to the relevant requirements of the applicable standard and verifies it meets the requirements providing a level of integrity of:
  - Systematic Safety Integrity SIL 3 (Route 1S)
  - Random Safety Integrity (Type A, Route 2H Device) SIL 2 (HFT=0) and SIL 3 (HFT=1)

Applicable Standard

- IEC61508-2010 Parts 1 and 2, Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Safety Functions Included

- Rotate 90° the stem with the required torque on demand. Upon activation of the SIS, the source of pressure is removed from the actuator by a solenoid valve, the fluid inside is vented, the springs expand rotating the stem 90° with the required torque. It should be noted that in order to fulfil this safety function in a specific time, a correctly designed solenoid valve must be installed. Furthermore, it should be noted that the design of the actuator is the same regardless of the safe state of the actuator i.e. open or closed. This configuration depends only on the way the components are assembled.

IEC 61508 Failure Rates (based on FMEDA)

Failure Classification and Models	Failure Rate (1/h)	
	PI00S, PI10S, PI30S, PI40S	PI20S
Dangerous failure rate λ_D (1/h)	4.90E-07	4.05E-07
Safe failure rate λ_S (1/h)	1.26E-06	1.26E-06
Critical failure rate (DU + S) λ_C (1/h)	1.75E-06	1.66E-06
Diagnostic Coverage (DC) (%)	0%	0%
Safe Failure Fraction (SFF)	72%	76%

Supporting Documents

- LR SIL Capability Assessment to IEC61508, Report no PRJ1110017872 Rev.00 dated 25 September 2019.

Notes and Conditions

- The products are installed in low demand applications i.e. expected demand rate of less than once per year.
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Product Description:	Spring Return Rotary Rack and Pinion Pneumatic Actuators, PPS Series (PPWS, PP00S, PP10S, PP20S), 0-90° rotation, Air Pressure up to 8bar, Temp -32°C to + 80°C, For Low Temp Services from – 55°C to + 80° C

Description and Results

- Lloyd´s Register has assessed the product to the relevant requirements of the applicable standard and verifies it meets the requirements providing a level of integrity of:
  - Systematic Safety Integrity SIL 3 (Route 1S)
  - Random Safety Integrity (Type A, Route 2H Device) SIL 2 (HFT=0) and SIL 3 (HFT=1)

Applicable Standard

- IEC61508-2010 Parts 1 and 2, Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems

Safety Functions Included

- Rotate 90° the stem with the required torque on demand. Upon activation of the SIS, the source of pressure is removed from the actuator by a solenoid valve, the fluid inside is vented, the springs expand rotating the stem 90° with the required torque. It should be noted that in order to fulfil this safety function in a specific time, a correctly designed solenoid valve must be installed. Furthermore, it should be noted that the design of the actuator is the same regardless of the safe state of the actuator i.e. open or closed. This configuration depends only on the way the components are assembled.

IEC 61508 Failure Rates (based on FMEDA)

Failure Classification and Models	Failure Rate (1/h)
	PPWS, PP00S, PP10S, PP20S
Dangerous failure rate λ_D (1/h)	5.87E-07
Safe failure rate λ_S (1/h)	8.98E-07
Critical failure rate (DU + S) λ_C (1/h)	1.48E-06
Diagnostic Coverage (DC) (%)	0%
Safe Failure Fraction (SFF) (%)	60%

Supporting Documents

- LR SIL Capability Assessment to IEC61508, Report no PRJ1110017872 Rev.00 dated 25 September 2019.

Notes and Conditions

- The products are installed in low demand applications i.e. expected demand rate of less than once per year.
- Random hardware failure rates have been determined based on a Failure Modes Diagnostic and Effects Analysis (FMEDA).
- Random Safety Integrity (PFDavg and Architectural Constraints) must be assessed for the entire function for each application.
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EN IEC 61508:2010 CONFORMITY CERTIFICATE.

MECÁNICA PRISMA, SL Certifies on its own resources, that the following Rack and Pinion Pneumatic Actuators, are Capable to be used on Whole Safety Loops:

Actuator	Failure Rate	Dangerous Failure Rate	PFD	Capable SIL (PFD)	HFT	Type	Mode
PA00	1,00E-08	1,00E-08	4,38E-05	SIL3	0	A	Low Demand
PA05	3,00E-08	3,00E-08	1,31E-04	SIL3	0	A	Low Demand
PA10	1,10E-08	1,10E-08	4,82E-05	SIL3	0	A	Low Demand
PA15	1,40E-08	1,40E-08	6,14E-05	SIL3	0	A	Low Demand
PA20	1,80E-08	1,80E-08	7,89E-05	SIL3	0	A	Low Demand
PA25	1,80E-08	1,80E-08	7,89E-05	SIL3	0	A	Low Demand
PA30	9,72E-08	9,72E-08	4,27E-05	SIL3	0	A	Low Demand
PA50	2,26E-06	2,26E-06	1,01E-03	SIL2	0	A	Low Demand
PAW	1,20E-08	1,20E-08	5,26E-05	SIL3	0	A	Low Demand
PAV	2,26E-06	2,26E-06	1,01E-03	SIL2	0	A	Low Demand
P40	6,30E-08	6,30E-08	2,76E-04	SIL3	0	A	Low Demand
P40T	9,60E-08	9,60E-08	4,21E-04	SIL3	0	A	Low Demand
PA60	2,26E-06	2,26E-06	1,01E-03	SIL2	0	A	Low Demand
PA70	2,26E-06	2,26E-06	1,01E-03	SIL2	0	A	Low Demand
PP00	2,27E-09	2,27E-09	9,56E-06	SIL3	0	A	Low Demand
PP10	1,98E-09	1,98E-09	8,33E-06	SIL3	0	A	Low Demand
PP20	4,21E-09	4,21E-09	1,84E-05	SIL3	0	A	Low Demand
PPW	1,28E-07	1,28E-07	5,64E-04	SIL3	0	A	Low Demand
PI00	2,10E-07	2,10E-07	9,21E-04	SIL3	0	A	Low Demand
PI10	1,47E-07	1,47E-07	6,45E-04	SIL3	0	A	Low Demand
PI20	4,28E-07	4,28E-07	1,88E-03	SIL2	0	A	Low Demand
PI30	6,96E-07	6,96E-07	3,05E-03	SIL2	0	A	Low Demand
PI40	2,26E-06	2,26E-06	1,01E-03	SIL2	0	A	Low Demand

Remarks:

SSF is limited to the HFT.
The capable assessment results carried out by the CFSE trained, are based on Proven in Use, (Route 2H), obtained from MECANICA PRISMA, SL.

X. Albareda / Technical Manager. 2019/10/24

ACTUATORS ACCORDING TO:

ISO TS 29001, API Q1, PED DIRECTIVE, ATEX DIRECTIVE,
SIL IEC 61508, Low Temperature Services, EAC TR CU Certification.