FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

SI-1 & SI-2.1 Skilmatic Linear Actuators

manufactured by

Rotork (UK) Ltd.
9 Brown Lane West
Leeds
LS12 6BH
United Kingdom

have been assessed by Sira Certification Service with reference to the CASS methodologies and found to meet the requirements of

IEC 61508-2:2010
Routes 1_H & 1_S
Systematic Capability (SC3)

as an element/subsystem suitable for use in safety related systems performing safety functions up to and including

SIL 2 capable with HFT=0 (1oo1)*

when used in accordance with the scope and conditions of this certificate.

* This certificate does not waive the need for further functional safety verification to establish the achieved Safety Integrity Level (SIL) of the safety related system

Certification Decision:

James Lynskey

Initial Certification : 06/07/2020
This certificate re-issued : 06/07/2020
Renewal date : 05/07/2025

UKAS PRODUCT CERTIFICATION 0011

Product description and scope of certification

The SI-1 and SI-2.1 Linear Actuator Range are compact and robust electrically operated failsafe spring-return actuators, designed for use in safety critical shutdown applications. The actuators are watertight and dust-tight to IP67, certified for use in hazardous locations for both gas groups IIB and IIC.

The SI-1 and SI-2.1 Linear Actuator Range consists of a self-contained electro-hydraulic control module and spring-return drive. The spring return mechanism provides a reliable means of positioning a valve to its safe condition in either failsafe close, open or stay put in power loss / signal failure fault conditions.

The actuators can be operated from either standard single-phase, three phase or 24 VDC supplies, operating in temperature ranges from -35 to +65^{O}C (SI-1) and -40 to +65^{O}C (SI-2.1).

Figure 1: Typical Assembly of the SI-1 (left) and SI-2.1 (right) Linear Actuators

Element Safety Function

The safety function of the certified equipment is:

'To move the actuator to the end position by means of a spring when ESD signal is removed'.

* The safety function is applicable for low demand applications.

Note: The end position depends on the actuator configuration (closed or open)

Certified Data in support of use in safety functions

The assessment has been carried out with reference to the *Conformity Assessment of Safety-related Systems* (CASS) methodology[1] using the Route 1_H[2] approach.

A Failure Mode and Effect Analysis (FMEA) has established the failure modes and failure rates for the products assessed as shown in Tables 1 and 2 below. Failure sources have been taken from RIAC NPRD-2011/FMD, Item Software and Faradip version 6.5.

The following results in Tables 1 and 2 for the Skilmatic SI-1 and SI-2.1 (respectively) are based on; the best configuration, the worst configuration and the average value of all the configurations, based on PFD value. These results are produced from the 56 possible configurations, further details on which can be found in the annex of this certificate.

Table 1: Summary of assessment for the SI-1 Linear Actuator

Safety Function: *To return the actuator to its safe position (de-energised) by means of spring return.*					
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		Best Config Value	Worst Config Value	Average Config Value	Verdict
Architectural constraints & Type of product A/B		**HFT = 0**			**Type A**
Safe Failure Fraction (SFF)		**73%**	**82%**	**80%**	**SIL 2**
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 1.84E-07	0.00E-00 3.41E-07	0.00E-00 2.63E-07	
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 4.94E-07	0.00E-00 1.54E-06	0.00-00 1.02E-06	
Diagnostic coverage (DC)		0%	0%	0%	
PFD @ PTI = 8760 Hrs. MTTR = 8 Hrs.		**8.08E-04**	**1.50E-03**	**1.16E-03**	**SIL 2**
Probability of Dangerous failure (High Demand - PFH) [h^{-1}]		**1.84E-07**	**3.41E-07**	**2.63E-07**	**SIL 2**
Hardware safety integrity compliance		Route 1_H			
Systematic safety integrity compliance		Route 1_S **See report R80020392B**			
Systematic Capability (SC1, SC2, SC3, SC4)		**SC 3**			
Hardware safety integrity achieved		**SIL 2 due to architectural constraints (SFF)**			

[1] www.cass.uk.net
[2] Refer to IEC 61508-2, 7.4.4, for a definition of this term

Table 2: Summary of assessment for the SI-2.1 Linear Actuator

Safety Function: *To return the actuator to its safe position (de-energised) by means of spring return.*					
Summary of IEC 61508-2 Clauses 7.4.2 and 7.4.4		Best Config Value	Worst Config Value	Average Config Value	Verdict
Architectural constraints & Type of product A/B		**HFT = 0**			**Type A**
Safe Failure Fraction (SFF)		**76%**	**82%**	**80%**	**SIL 2**
Random hardware failures: [h^{-1}]	λ_{DD} λ_{DU}	0.00E-00 1.77E-07	0.00E-00 2.59E-07	0.00E-00 2.34E-07	
Random hardware failures: [h^{-1}]	λ_{SD} λ_{SU}	0.00E-00 5.60E-07	0.00E-00 1.16E-06	0.00-00 9.56E-06	
Diagnostic coverage (DC)		0%	0%	0%	
PFD @ PTI = 8760 Hrs. MTTR = 8 Hrs.		**7.78E-04**	**1.41E-03**	**1.04E-03**	**SIL 2**
Probability of Dangerous failure (High Demand - PFH) [h^{-1}]		**1.77E-07**	**2.59E-07**	**2.34E-07**	**SIL 2**
Hardware safety integrity compliance		Route 1_H			
Systematic safety integrity compliance		Route 1_S **See report R80020392B**			
Systematic Capability (SC1, SC2, SC3, SC4)		**SC 3**			
Hardware safety integrity achieved		**SIL 2 due to architectural constraints (SFF)**			

Note 1: The failure data:

1) The PFD_{AVG} figure shown is for illustration only assuming a proof test interval of 8760 hours and MTTR of 8 hours. Refer to IEC 61508-6 for guidance on PFD_{AVG} calculations from the failure data.

2) The verified failure rates used in the safe failure fraction and diagnostic coverage do not include (λ no parts or no effect) failures in the calculation.

The failure data above is supported by the base information given in Table 3 below.

Table 3: Base information for the SI-1 & SI-2.1 Linear Actuators

1	Product identification:	SI-1 & SI-2.1 Linear Actuators
2	Functional specification:	'To move the actuator to the end position by means of a spring when ESD signal is removed'.
3-5	Random hardware failure rates:	Refer to tables 1 & 2 of this certificate
6	Environment limits:	Operating temperature: 35 to +65^{O}C (SI-1) and -40 to +65^{O}C (SI-2.1).
7	Lifetime/replacement limits:	25 years
8	Proof Test requirements:	Refer to safety manual
9	Maintenance requirements:	Refer to safety manual
10	Diagnostic coverage:	0% diagnostic coverage.

11	Diagnostic test interval:	Refer to safety manual
12	Repair constraints:	Refer to safety manual
13	Safe Failure Fraction:	Refer to tables 1 & 2 of this certificate
14	Hardware fault tolerance (HFT):	Refer to tables 1 & 2 of this certificate
15	Highest SIL (architecture/type A/B):	Type A, SIL2
16	Systematic failure constraints:	The hardware safety integrity assessment was based on a proof test interval of 1 year
17	Evidence of similar conditions in previous use:	Not applicable.
18	Evidence supporting the application under different conditions of use:	Not applicable.
19	Evidence of period of operational use:	Not applicable.
20	Statement of restrictions on functionality:	See systematic report R80020392B
21	Systematic capability (SC1, SC2, SC3)	SC3 - See systematic report R80020392B
22	Systematic fault avoidance measures:	Compliance with techniques and measures from IEC 61508-2 Annex B to SIL 2 - See systematic report R80020392B
23	Systematic fault tolerance measures:	Compliance with techniques and measures from IEC 61508-2 Annex A to support the SFF achieved – see hardware safety integrity report R80020392A
24	Validation records:	All documents that have been used in support of the hardware have been documented in section 5.24 of report R80020392A; this includes the FMEA document

Management of functional safety

The assessment has demonstrated that the product is supported by an appropriate functional safety management system that meets the relevant requirements of IEC 61508-1:2010 clause 6, see report R80020392B.

Identification of certified equipment

The certified equipment and it's safe use is defined in the manufacturer's documentation listed in Table 4 below.

Table 4: Certified documents

Document no.	Pages	Rev	Date	Document description
2041387	1	0	13/11/2019	Hydraulic schematic, SIL, SI-2.1, Linear actuator, hand pump, hardwired ESD.
2014389	1	0	13/11/2019	Hydraulic schematic, SIL, SI-2.1, Linear actuator, fail safe.
2041390	1	0	13/11/2019	Hydraulic schematic, SIL, SI-2.1, Linear actuator, fail safe.
2041388	1	0	13/11/2019	Hydraulic schematic, SIL, SI-2.1, Linear actuator, hand pump, fail safe, hardwired ESD.
2322001000	1	B	28/01/2015	Spring down pneumatic linear actuator
2332001000	1	B	28/01/2015	Spring up pneumatic linear actuator
STR-317	20	1	09/12/2019	Skilmatic SI Linear range SIL approval document

Conditions of Certification

The validity of the certified base data is conditional on the manufacturer complying with the following conditions:

1. The manufacturer shall analyse failure data from returned products on an on-going basis. Sira Certification Service shall be informed in the event of any indication that the actual failure rates are worse than the certified failure rates. (A process to rate the validity of field data should be used. To this end, the manufacturer should co-operate with users to operate a formal field-experience feedback programme).
2. Sira shall be notified in advance (with an impact analysis report) before any modifications to the certified equipment or the functional safety information in the user documentation is carried out. Sira may need to perform a re-assessment if modifications are judged to affect the product's functional safety certified herein.
3. On-going lifecycle activities associated with this product (e.g., modifications, corrective actions, field failure analysis) shall be subject to surveillance by Sira in accordance with 'Regulations Applicable to the Holders of Sira Certificates'.

Conditions of Safe Use

The validity of the certified base data in any specific user application is conditional on the user complying with the following conditions:

1. The user shall comply with the requirements given in the manufacturer's user documentation in regard to all relevant functional safety aspects such as application of use, installation, operation, maintenance, proof tests, maximum ratings, environmental conditions, and repair.
2. Selection of this product for use in safety function and the installation, configuration, overall validation, maintenance and repair shall only be carried out by competent personnel, observing all the manufacturer's conditions and recommendations in the user documentation.
3. All information associated with any field failures of this product should be collected under a dependability management process (e.g., IEC 60300-3-2) and reported to the manufacturer.
4. CSA-Sira suggests that the safety device is to have an independent power supply, it must not share the same power supply as non-safety devices that may cause a fault to the safety device. This is in Accordance with IEC61508-1, cl. 7.6.2.7 and IEC61508-2 cl. 7.4.2.3.
5. A proof test interval of 1 year.

General Conditions and Notes

1. This certificate is based upon a functional safety assessment of the product described in Sira Test & Certification Assessment Report R80020392A and R80020392B.
2. If the certified product or system is found not to comply, Sira Certification Service should be notified immediately at the address shown on this certificate.
3. The use of this Certificate and the Sira Certification Mark that can be applied to the product or used in publicity material are subject to the 'Regulations Applicable to the Holders of Sira Certificates' and 'Supplementary Regulations Specific to Functional Safety Certification'.
4. This document remains the property of Sira and shall be returned when requested by the issuer.
5. No part of the Functional safety related aspects stated in the instruction manual shall be changed without approval of the certification body.

6. This certificate will remain valid subject to completion of two surveillance audits within the five year certification cycle, and upon receipt of acceptable response to any findings raised during this period. This certificate can be withdrawn if the manufacturer no longer satisfies scheme requirements.

Certificate History

Issue	Date	Report no.	Comment
0	06/07/2020	R80020392A R80020392B	The release of prime certificate.

Annex A: List of possible product configurations & Results

SIRA FMEA FIGURES FOR SI-1 LINEAR SERIES																			
ACTUATOR - SPRING UP CYLINDER SIZE RANGE L80 – L200	Config No	SOV Config	ESD Circuit	FCV	Dang	Safe	SFF	PFDavg	SIL	ACTUATOR - SPRING DOWN CYLINDER SIZE RANGE L80 – L200	Config No	SOV Config	ESD Circuit	FCV	Dang	Safe	SFF	PFDavg	SIL
	1	0	Y	N	1.85E-07	4.65E-07	71.54%	8.12E-04	SIL 2		**33**	0	Y	N	1.84E-07	4.94E-07	72.86%	8.08E-04	SIL 2
	2	0	Y	Y	2.21E-07	6.75E-07	75.33%	9.70E-04	SIL 2		**34**	0	Y	Y	2.20E-07	7.04E-07	76.19%	9.66E-04	SIL 2
	3	1 or 3	Y	N	2.27E-07	7.04E-07	75.62%	9.97E-04	SIL 2		**35**	1 or 3	Y	N	2.26E-07	7.33E-07	6.43%	9.92E-04	SIL 2
	4	1 or 3	Y	Y	2.63E-07	9.14E-07	77.66%	1.15E-03	SIL 2		**36**	1 or 3	Y	Y	2.62E-07	9.43E-07	78.26%	1.15E-03	SIL 2
	5	2	Y	N	2.21E-07	7.53E-07	77.31%	9.69E-04	SIL 2		**37**	2	Y	N	1.78E-07	5.43E-07	75.31%	7.80E-04	SIL 2
	6	2	Y	Y	2.57E-07	9.63E-07	79.93%	1.13E-03	SIL 2		**38**	2	Y	Y	2.14E-07	7.53E-07	77.87%	9.37E-04	SIL 2
	7	2	Y	N	2.99E-07	1.31E-06	81.42%	1.31E-03	SIL 2		**39**	2	Y	N	2.23E-07	8.89E-07	79.95%	9.78E-04	SIL 2
	8	2	Y	Y	3.35E-07	1.52E-06	81.94%	1.47E-03	SIL 2		**40**	2	Y	Y	2.59E-07	1.10E-06	80.94%	1.14E-03	SIL 2
	9	6	N	N	2.24E-07	7.00E-07	75.76%	9.48E-04	SIL 2		**41**	6	N	N	2.23E-07	7.29E-07	76.58%	9.79E-04	SIL 2
	10	6	N	Y	2.60E-07	9.10E-07	77.78%	1.14E-03	SIL 2		**42**	6	N	Y	2.59E-07	9.39E-07	78.38%	1.14E-03	SIL 2
	11	7	N	N	2.60E-07	9.88E-07	79.17%	1.14E-03	SIL 2		**43**	7	N	N	2.59E-07	1.02E-06	79.75%	1.14E-03	SIL 2
	12	7	N	Y	2.96E-07	1.20E-06	80.21%	1.30E-03	SIL 2		**44**	7	N	Y	2.95E-07	1.23E-06	80.66%	1.29E-03	SIL 2
	13	7	N	N	3.05E-07	1.33E-06	81.35%	1.34E-03	SIL 2		**45**	7	N	N	3.04E-07	1.36E-06	81.73%	1.33E-03	SIL 2
	14	7	N	Y	3.41E-07	1.54E-06	81.87%	1.50E-03	SIL 2		**46**	7	N	Y	3.40E-07	1.57E-06	82.20%	1.49E-03	SIL 2
	15	7	N	N	3.05E-07	1.33E-06	81.355	1.34E-03	SIL 2		**47**	7	N	N	3.04E-07	1.36E-06	81.73%	1.33E-03	SIL 2
	16	7	N	Y	3.41E-07	1.54E-06	81.87%	1.50E-03	SIL 2		**48**	7	N	Y	3.40E-07	1.57E-06	82.20%	1.49E-03	SIL 2

SIRA FMEA FIGURES FOR SI-2.1 LINEAR SERIES

ACTUATOR SPRING UP CYLINDER SIZE RANGE – L200 – L320										ACTUATOR SPRING DOWN CYLINDER SIZE RANGE – L200 – L320									
	Config No	SOV Config	ESD Circuit	FCV	Dang	Safe	SFF	PFDavg	SIL		Config No	SOV Config	ESD Circuit	FCV	Dang	Safe	SFF	PFDavg	SIL
	17	0	Y	N	1.78E-07	5.31E-07	74.89%	7.82E-04	SIL 2		**49**	0	Y	N	1.77E-07	5.60E-07	75.98%	7.78E-04	SIL 2
	18	0	Y	Y	2.14E-07	7.41E-07	77.59%	9.40E-04	SIL 2		**50**	0	Y	Y	2.13E-07	7.70E-07	78.33%	9.36E-04	SIL 2
	19	1 or 3	Y	N	2.13E-07	8.36E-07	79.62%	9.37E-04	SIL 2		**51**	1 or 3	Y	N	2.13E-07	8.65E-07	80.24%	9.33E-04	SIL 2
	20	1 or 3	Y	Y	2.50E-07	1.05E-06	80.77%	1.10E-03	SIL 2		**52**	1 or 3	Y	Y	2.49E-07	1.07E-06	81.12%	1.09E-03	SIL 2
	21	2	Y	N	2.14E-07	8.19E-07	79.28%	9.39E-04	SIL 2		**53**	2	Y	N	2.13E-07	8.48E-07	79.92%	9.34E-04	SIL 2
	22	2	Y	Y	2.50E-07	1.03E-06	80.47%	1.10E-03	SIL 2		**54**	2	Y	Y	2.49E-07	1.06E-06	80398%	1.09E-03	SIL 2
	23	2	Y	N	2.59E-07	1.16E-06	81.75%	1.41E-03	SIL 2		**55**	2	Y	N	2.58E-07	1.19E-06	82.18%	1.13E-03	SIL 2
	24	2	Y	Y	2.95E-07	1.37E-06	82.28%	1.30E-03	SIL 2		**56**	2	Y	Y	2.94E-07	1.40E-06	82.64%	1.29E-03	SIL 2

UKAS PRODUCT CERTIFICATION
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