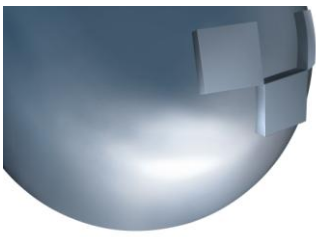




FAST COMMUTATOR CF

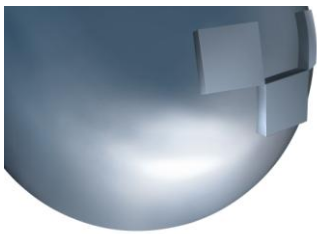
SAFETY MANUAL 9020





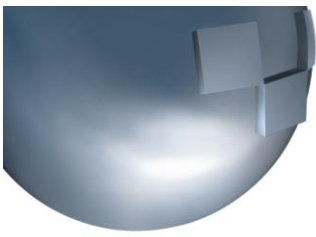
Date	Revision	Description	Compiled	Approved
<i>04/04/2014</i>	<i>0</i>	<i>Issue</i>	<i>N.Zenoni</i>	<i>F.Tondolo</i>

STI S.r.l has taken every care in collecting and verifying the documentation contained in this Safety Manual. The information herein contained are reserved property of STI S.r.l.

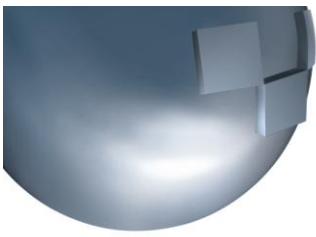


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CF - SAFETY MANUAL 9020



1 MANUFACTURER

With respect to Machinery Directive 2006/42/EC, the Manufacturer of the described CF Fast Commutator is STI S.r.l. as specified on the machinery label.

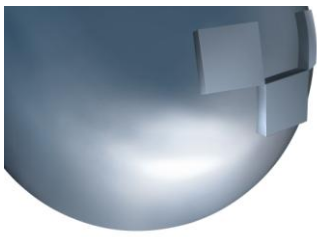
STI S.r.l. Via Pascoli 10 a/b
24020 Gorle (BG) Italy
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Fax +39 035 2928.247
info@stistrumentazione.com

2 GENERAL INFORMATIONS

The Safety Manual is only valid for identified CF configurations that have been verified to be SIL capable. All instructions have to be followed for failure rates to be valid. If any points according to list below are deviating from the specifications in this manual and related documents, a new assessment for the CF has to be made:

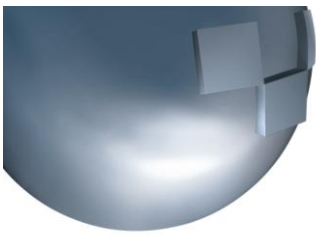
- actuator design and configuration;
- instruction manual;
- maintenance and proof testing intervals.

It is customer responsibility to follow given instructions and pay attention to specified constraints regarding operation and maintenance. It is customer responsibility to have qualified personnel to conduct maintenance. All STI guidelines and instructions must be followed. Failure rates are present in the SIL certificate.



3 TERMINOLOGY

Abbreviation	Full expression
DC	Diagnostic coverage
SFF	Safe Failure Fraction
λ_{Du}	Dangerous undetected Failure rate
λ_{Su}	Safe undetected Failure rate
λ_{Sd}	Safe detected Failure rate
λ_{Dd}	Dangerous detected Failure rate
PFD_{avg}	Average Probability of Failure on demand
MTTR	Mean Time to Restoration
MRT	Mean Repair Time
SC	Systematic Capability
FMEDA	Failure Mode and Effect and Diagnostic Analysis
PST	Partial Stroke Test
SIL	Safety Integrity Level
TI	Test interval
SIS	Safety Instrumented System
SIF	Safety Instrumented Function



4 PRODUCT DESCRIPTION

The CF is constituted by two 3-way valves having the pilot conduit in common. This accessory is designed to operate with a pilot pressure greater than 2 bar, still maintaining a perfect seal on the seats up to 8 bar. Since the pilot fluid goes to work on moving a single membrane, the switching will be also very fast.

5 SAFETY FUNCTION

The “Safety Function” is a function to be implemented by an E/E/EP safety-related system, other technology safety-related system or external risk reduction facilities, which is intended to achieve or maintain a safe state for the Equipment Under Control [EUC] in respect of a specific hazardous event. According to the above mentioned definition we can classify 3 safety functions:

- a) *“The CF performs the safety function on demand if it allows the double acting pneumatic cylinder to discharge and to charge in the required time”* (figure 1: one 3-way valve charges the pneumatic cylinder, the other one discharges the pneumatic cylinder).
- b) *“The CF performs the safety function on demand if it allows the single acting pneumatic cylinder to discharge in the required time”* (figure 2: one 3-way valve discharges the pneumatic cylinder, the other one is not utilized).
- c) *“The CF performs the safety function on demand if it allows the double acting pneumatic cylinder with spring to discharge in the required time”* (figure 3: 3-way valves discharge the pneumatic cylinder).

The Safety Function and safety integrity level are given by safety-related system in which the CF is mounted.

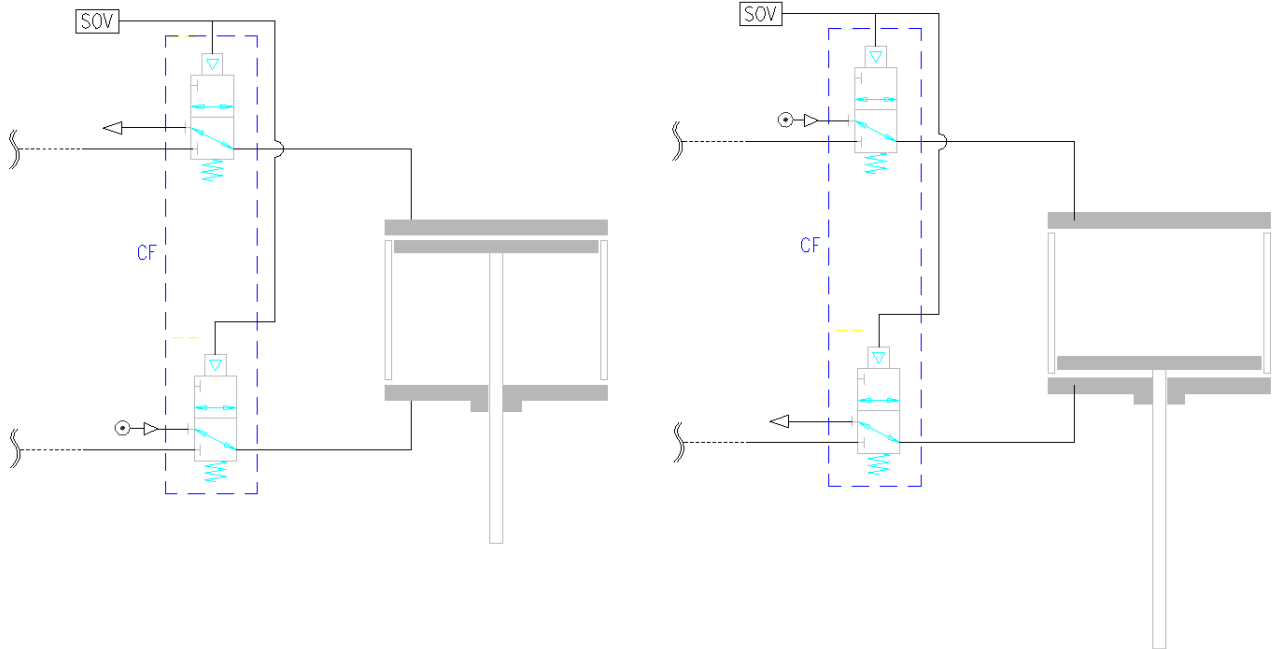
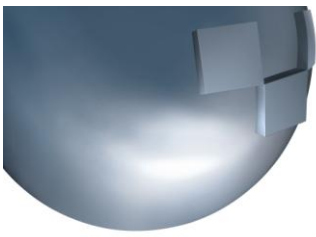


Figure 1 - not energized setup: supply/exhaust mode for double acting pneumatic cylinder

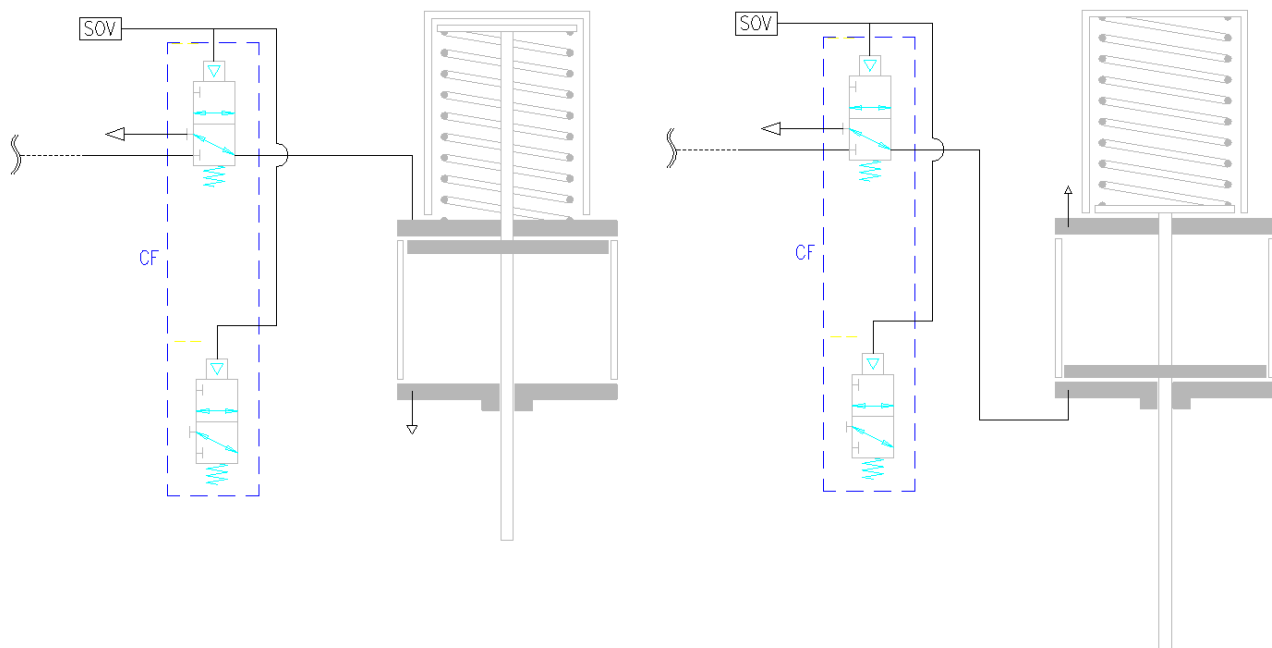


Figure 2 - not energized setup: exhaust mode for single acting pneumatic cylinder

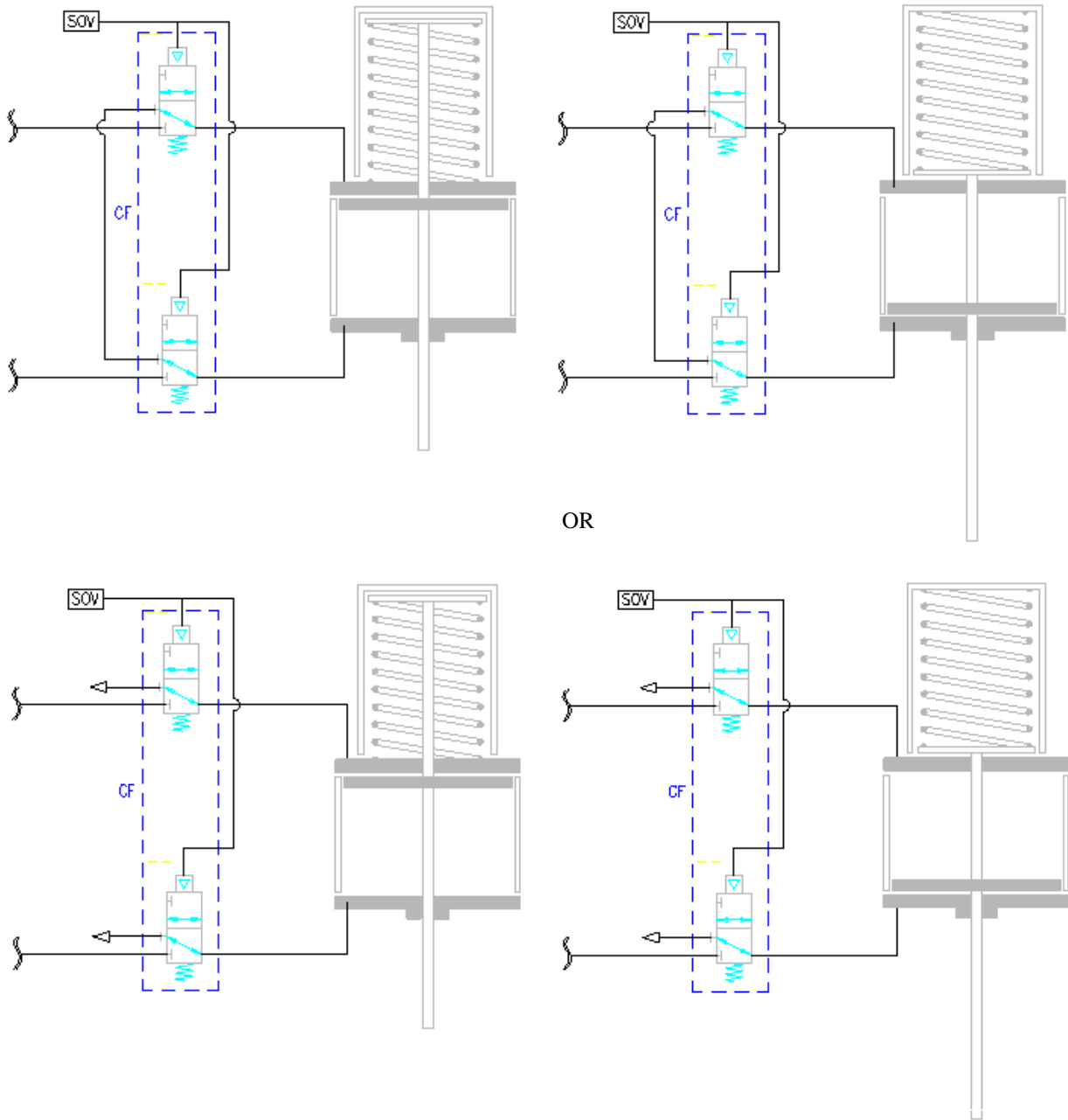
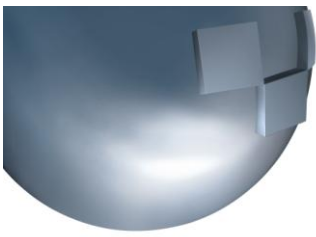
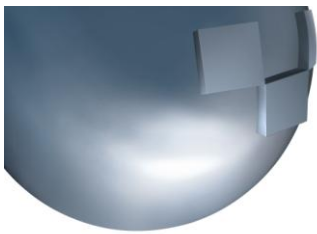


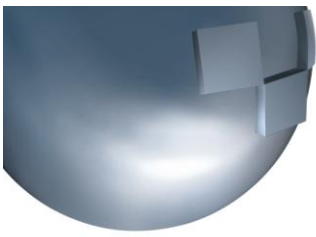
Figure 3 - not energized setup: exhaust mode for double acting pneumatic cylinder with spring



6 CONFIGURATION OF THE PRODUCT

Model	Technical features			
	Type A	Type B	Type C	Type D
Housing material	Aluminum	Aluminum	Stainless steel	Stainless steel
Feeding	With pilot	Without pilot	With pilot	Without pilot
Feeding connections	See the following table	See the following table	See the following table	See the following table
Outlet connections	See the following table	See the following table	See the following table	See the following table
Signal connections	1/4" NPTF	1/4" NPTF	1/4" NPTF	1/4" NPTF
Operating temperature range	-60/+100 °C	-60/+100 °C	-60/+100 °C	-60/+100 °C
Design pressure	10 bar	10 bar	10 bar	10 bar
Operating pressure range	See machinery label	See machinery label	See machinery label	See machinery label
Expected lifetime	20 years	20 years	20 years	20 years

Model	To actuator			To positioner		
	A/B/C/D	1/2" NPTF	1/2" NPTF	3/4" NPTF	PLUG-IN	PLUG-IN
A/B/C/D	3/4" NPTF	3/4" NPTF	3/4" NPTF	PLUG-IN	PLUG-IN	PLUG-IN
A/B/C/D	3/4" NPTF	3/4" NPTF	3/4" NPTF	3/4" NPT	3/4" NPT	3/4" NPT



7 OPERATING CONDITIONS AND INTENDED USE

7.1 Operation description

The CF has 2 main setups: energized and not energized.

Figure 4 shows the energized setup: for each 3-way valve, the working fluid (instrument air or natural gas) passes through the diaphragm plunger and pushes down the piston. The shutter stem blocks the connection between the CF supply/exhaust chamber and the actuator chamber and allows the connection between the positioner and the actuator chamber.

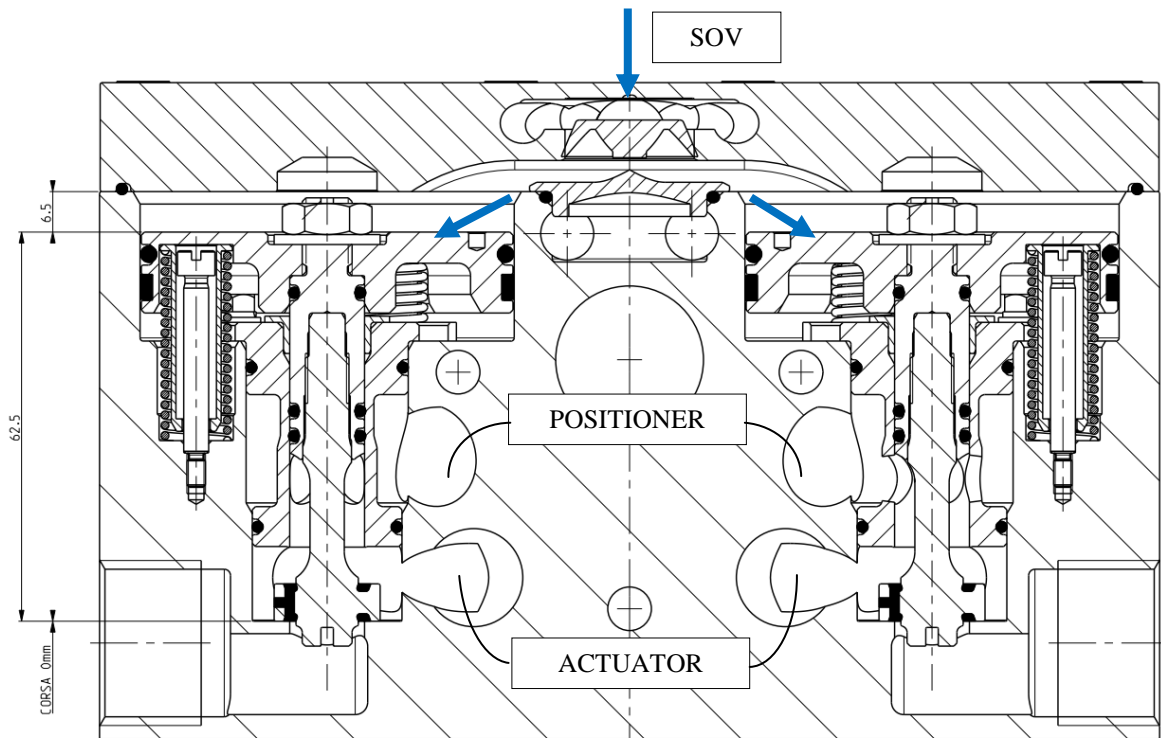


Figure 4 - energized setup

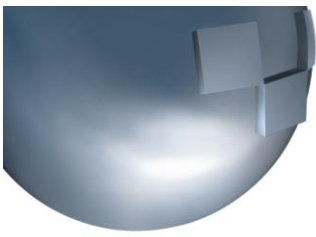


Figure 5 shows the not energized setup: for each 3-way valve, the springs push up the piston and the working fluid (instrument air or natural gas) passes from the chamber above the piston to the environment. In this position the shutter stem allows the connection between the CF supply/exhaust chamber and the actuator chamber (supply mode or exhaust mode). This setup is the Safety Function.

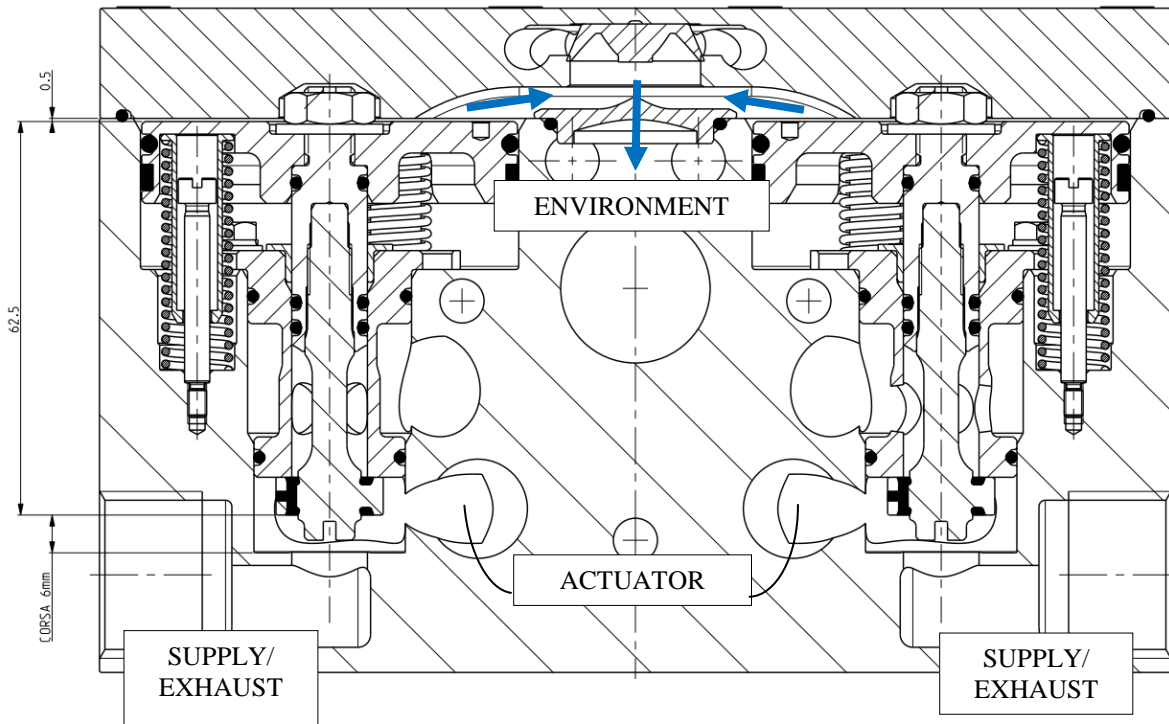


Figure 5 - not energized setup

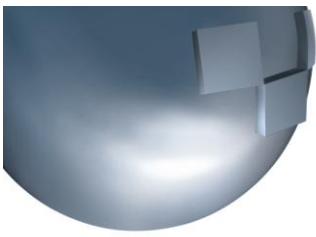
7.2 Intended use

Warning



It is severely forbidden to use the CF for purpose or application other than those for which it was designed and here above specified.

CF is produced by STI srl (Manufacturer) and identified by a label. STI srl will not be liable for any possible damage or physical injury resulting from use in other than the designated applications or by lack of care during installation, operation, adjustment and maintenance of the machine. Such risks lie entirely with the user. Depending on the specific working conditions, additional precautions may be requested. Considering that STI srl has no direct control over particular applications, operation or maintenance conditions, it is the operator's responsibility to comply with all applicable safety rules. Please inform STI srl urgently if you face unsafe situations not described in this Instruction Manual. It is the sole responsibility of the operator to ensure that the local health and safety regulations are adhered to.



CF is designed in accordance with the applicable International Rules and Specifications, but the following Regulations must be observed in any case:

- the general and safety regulations;
- the plant specific regulations and requirements;
- the proper use of personal and protective devices (glasses, clothing, gloves, etc);
- the proper use of tools and transport equipment.

7.3 Operating conditions

Warning	It is severely forbidden to use the CF under conditions other than those provided on the machinery label.
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The machinery label fastened on the CF contains the main CF operating conditions for the specified application.

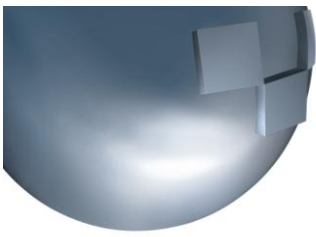


Figure 6 - Label


7.4 Reasonably foreseeable misuse

A short list of reasonably foreseeable misuse:

- installation in ambient with not planned conditions: i.e. climatic conditions different from the specified conditions;
- Insert incorrect fluid into the system;
- supply pressure out of required range.



7.5 Field activities

Warning 	It is assumed that the installation, setting and commissioning are carried out by qualified personnel and checked by responsible specialists complying with the rules and regulations of the Country of installation. User must consider and take all precautions to avoid that pressurized parts are not used out of specified range and to avoid exposure to fire. Any repair work other than the operations outlines in the Instruction Manual will be strictly reserved to qualified STI srl personnel or to personnel directly authorised by the Company itself.
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8 EXPECTED LIFETIME

CF lifetime (for which failure rates indicated in the next paragraph 9 are ensured) strongly depends on operating conditions and on materials of construction. For normal service conditions CF can be in good conditions also after more than 20 years.

9 FAILURE MODES AND EXTIMATED FAILURE RATES

Safety Action	λ_D [1/h]
Application for Single Acting Actuator	1,57E-08
Application for Double Acting Actuator	3,25E-08
Application for Double Acting Actuator with spring	3,15E-08

10 PERIODIC TEST AND MAINTENANCE REQUIREMENTS

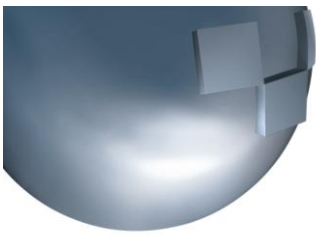
Diagnostic tests (proof tests) may be made “on site” to increase the system reliability in the form of Full Stroke or Partial Stroke Test. “On site” tests depend on Project/Plant facilities/requirements; however a functional test must be executed on site before valve usage.

10.1 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. Recommended Full Stroke Test procedure:

- Starting from the valve in fully open (closed) position operate the Actuator/Valve assembly in closing (opening) direction to reach the complete closing (opening) of the valve.
- Verify the correct performing of full stroke operation (i.e.: check locally, or automatically via Logic solver, the correct movement of the actuator/valve).
- Go back to the fully open (closed) position.

Taking into the account the application of the above described Full Stroke Test procedure, the “Test Coverage” can be considered 99%.



10.2 Partial Stroke Test (PST)

The “Partial Stroke Test” (“On-line”) can be performed to improve the PFD_{avg} value. A typical partial stroke value is normally covering about 25% of the full 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 – 6 months.

Recommended PST procedure:

- Starting from the valve in fully open (closed) position operate the Actuator/Valve assembly in closing (opening) direction for a portion of stroke equal to 25% of the full stroke and then go back to the fully open (closed) position.
- Verify the correct performing of the PST operation (i.e. 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 in the foreseen time,...).

The above parameters to check will depend from the partial stroke test system available. Taking into the account the application of the above described PST procedure, the “Diagnostic Coverage” is > 99 %.

10.3 Proof Test checks

After each proof test (Full Stroke Test or PST) the following checks must be carried out:

- Visually check the entire CF.
- Check that there are no leaks on the CF parts under pressure.
- Check if the exhaust port is properly cleaned.
- Verify that the power fluid supply pressure value is within the required range.
- Remove built-up dust and dirt from all CF surfaces.
- Inspect CF paint for damages and touch-up as required in accordance with the applicable paint specification in order to ensure continued corrosion protection.

10.4 Periodic Maintenance

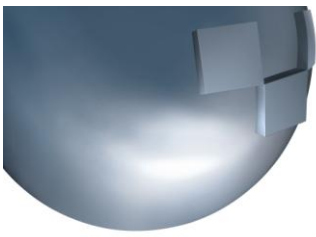
Take care that a build-up of dust or dirt on the CF can inhibit cooling and contribute to increase surface temperature. The user should plan and provide for a periodic cleaning/maintenance program that will maintain the external surface of the CF free from excessive layer of dust. Operation and maintenance shall be carried out by skilled staff.

11 CLASSIFICATION

According to paragraph 7.4.4.1.2 of IEC 61508-2 the device can be classified “type A”.

12 HARDWARE FAULT TOLERANCE (HFT)

The HFT of the device is 0. The requirements of minimum HFT according to Table 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 to 7, 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.



SFF	HARDWARE FAULT TOLERANCE		
	0	1	2
< 60%	SIL 1	SIL 2	SIL 3
≥ 60% - < 90%	SIL 2	SIL 3	SIL 4
≥ 90% - < 99%	SIL 3	SIL 4	SIL 4
≥ 99%	SIL 3	SIL 4	SIL 4

Figure 7 - Table 2 of IEC 61508-2 for a “type A” device

13 SAFE FAILURE FRACTION

Considering that no internal diagnostics is included in the device:

- without external diagnostic tests: SFF>97%
- with external diagnostic tests carried out according to definition 3.8.7 of IEC 61508-4, and according to what written in the Safety Manual, e.g.:
 - SFF >99% with Partial Stroke Test using commercially available PST systems (the exact value of SFF depends upon the system used)
 - SFF >99% with Full Stroke Test (the exact value of SFF depends upon the procedure and the equipment used for the verification)¹

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

14 MEAN REPAIR TIME (MRT)

MRT is considered conservatively 24 h.

15 SYSTEMATIC CAPABILITY (SC)

The systematic capability of the device is 3.

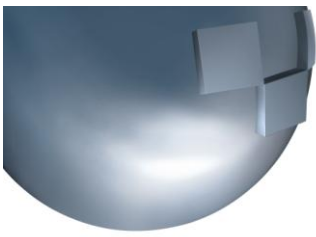
This systematic capability is guaranteed only if the User:

- utilizes the device according to the Instructions Manual and to this Safety Manual;
- utilizes the device in the appropriate environment and operating conditions.

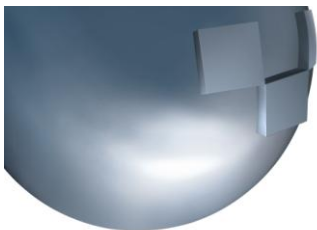
16 INSTRUCTION MANUAL

See separate document attached with the CF.

¹ The diagnostic test shall be performed considerably more often than the demand of the safety function.



CF - SAFETY MANUAL 9020



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