Self-operated Pressure Regulators
Type 42-10 RS Check Valve (backflow protection)

Translation of original instructions

Safety Manual

SH 3009 EN

Edition June 2016

The mounting and operating instructions for all supplied devices are included in the delivery. The latest versions of the documents are available on our website at www.samson.de > Product documentation. You can enter the document number or type number in the [Find:] field to look for a document.

Definition of signal words

⚠ DANGER

Hazardous situations which, if not avoided, will result in death or serious injury

⚠ WARNING

Hazardous situations which, if not avoided, could result in death or serious injury

NOTICE

Property damage message or malfunction

Note

Additional information

Tip

Recommended action

Purpose of this manual

The Safety Manual SH 3009 contains information relevant for the use of the Type 42-10 RS Check Valve in safety-instrumented systems according to IEC 61508 and IEC 61511. The safety manual is intended for planners, constructors, and operators of safety-instrumented systems.

NOTICE

Risk of malfunction due to incorrect mounting, connection or start-up of the device.

– Refer to the Mounting and Operating Instructions EB 3009 on how to mount and start-up the device as well as perform any necessary maintenance work.

– Observe the warnings and safety instructions written in the Mounting and Operating Instructions EB 3009.

Further documentation

The documents listed below contain descriptions of the start-up, functioning, and operation of the check valve. You can download these documents from the SAMSON website. The documents marked with an asterisk (*) are supplied with the check valve in printed form.

Type 42-10 RS Check Valve (backflow protection)

- T 3009: Data sheet for DIN version
- T 3010: Data sheet for ANSI version
- EB 3009*: Mounting and operating instructions

Contents

1 Scope

General

The check valve is designed to protect nitrogen and compressed air networks against backflow from directly connected systems. It basically consists of a valve and an opening actuator with two diaphragms. Mounted control lines transmit the upstream and downstream pressures to the actuator. This actuator opens or closes the valve depending on the differential pressure.

Use in safety-instrumented systems

The check valve can be used in safety-instrumented systems according to IEC 61508 and IEC 61511.

The safety-instrumented function of the check valve is to be regarded as a Type A element in accordance with IEC 61508-2.

Versions and ordering data

All versions of the Type 42-10 RS Check Valve (backflow protection) are suitable for use in safety-instrumented systems.

Mounting

The check valve is delivered as a ready-to-install unit without additional devices. It can be mounted into the pipeline without the need for any additional installation work.

2 Technical data

Type 2421 RS Valve														
Valve size	**NPS**	**½**	**¾**	**1**	**–**	**1½**	**2**	**2½**	**3**	**4**	**–**	**6**	**8**	**10**
	DN	**15**	**20**	**25**	**32**	**40**	**50**	**65**	**80**	**100**	**125**	**150**	**200**	**250**
C_V and K_{VS} coefficient	C_V	4.5	7.5	9.4	–	37	37	60	94	145	–	330	490	585
	K_{VS}	4	6.3	8	16	20	32	50	80	125	190	280	420	500
Pressure rating		Class 150/300|PN 16/25/40												
Max. constant operating pressure		360 psi|25 bar												
Max. perm. pressure acting on one side		650 psi|45 bar												
Leakage class[1] according to IEC 60534-4 or ANSI/FCI 70-2		Leakage class VI												
Max. perm. temperature														
With EPDM diaphragm in actuator		175 °F|80 °C for air and gases · 300 °F|150 °C for water 430 °F|220 °C for steam with compensation chamber												
With FPM diaphragm in actuator		300 °F|150 °C												
Compliance		CE · EAC												
Type 2420 RS Actuator														
Actuator area		50 in²|320 cm²										100 in²|640 cm²		
Fixed differential pressure set point Δp														
NPS ½ to 6 DN 15 to 150		3 psi|0.2 bar												
NPS 8 and 10 DN 200 and 250		5 psi|0.3 bar												
Max. perm. temperature														
With EPDM diaphragm		175 °F|80 °C for air and gases · 300 °F|150 °C for water 430 °F|220 °C for steam with compensation chamber												
With FPM diaphragm		300 °F|150 °C												
Compliance		EAC												

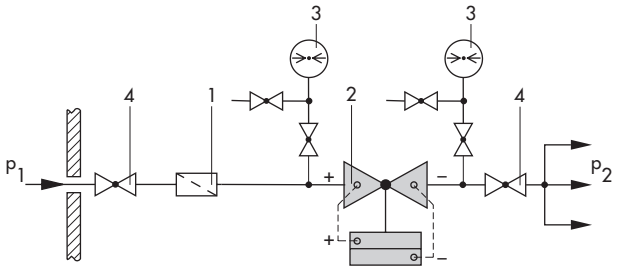
[1] Terms for control valve sizing according to IEC 60534 (ANSI/FCI 70-2): $F_L = 0.95$, $X_T = 0.75$

3 Safety-related functions

Preventing the medium from flowing back in the opposite direction than the specified flow direction

The check valve monitors the differential pressure across the valve. The valve is open provided the upstream pressure is greater than the downstream pressure by at least the differential pressure set point. It closes when the downstream pressure rises and reaches or exceeds the upstream pressure (event of emergency).

Fixed differential pressure set point Δp	
NPS ½ to 6|DN 15 to 150	3 psi|0.2 bar
NPS 8 and 10|DN 200 and 250	5 psi|0.3 bar



1 Strainer
2 Type 42-10 RS Check Valve (backflow protection)
3 Pressure gauge
4 Shut-off valve

p_1 Upstream pressure
p_2 Downstream pressure

Fig. 1: *Sample application*

Behavior in the event of emergency

In the event of emergency, the valve closes reliably to prevent backflow from the plant into the compressed air or nitrogen network.

Protection against unauthorized changes to the configuration

The differential pressure set point decisive for the functioning is fixed and cannot be changed by the user.

i ***Note concerning increased functional safety***

The actuator with two diaphragms is fitted with a mechanical diaphragm rupture indicator. In the event of a diaphragm rupture, the pin in the diaphragm rupture indicator is pushed outwards and a red ring appears indicating the diaphragm rupture. The intact operating diaphragm takes on the control task of the ruptured diaphragm.
A pressure switch can be optionally mounted to the actuator to trigger an alarm.
If a diaphragm rupture is indicated, we recommend replacing both diaphragms.

4 Installation and start-up

The check valve is installed and started up according to the mounting and operating instructions ▶ EB 3009.

5 Required conditions

⚠ WARNING

Risk of malfunction due to incorrect selection or wrong installation and operating conditions. Only use check valves in safety-instrumented systems after the necessary conditions in the plant have been fulfilled.

Selection

➔ In continuous operation, the maximum permissible constant operating pressure of 360 psi | 25 bar is not exceeded.

➔ The maximum permissible pressure of 650 psi|45 bar acting on one side is not exceeded.

➔ The maximum permissible temperature is observed:

– Actuator with EPDM diaphragm:
175 °F|80 °C for air and gases · 300 °F|150 °C for water
430 °F|220 °C for steam with compensation chamber

– Actuator with FPM diaphragm: 300 °F|150 °C

Mechanical installation

➔ The check valve is installed correctly in a horizontal pipeline.

➔ The direction of flow corresponds to the direction indicated by the arrow on the body.

➔ The mounting position of the check valve meets the requirements:

– NPS ½ to 6|DN 15 to 150: actuator facing downward

– NPS 8 and 10|DN 200 and 250: actuator facing upward

➔ A strainer installed upstream in the flow pipe holds back any dirt or other foreign particles carried along by the medium.

➔ The two pressure gauges with sampling connection required for function testing are installed upstream and downstream of the check valve in the pipeline. See section 6.

Operation

➔ The check valve is only used in applications that meet the specifications used for sizing at the ordering stage.

6 Proof testing

The proof test interval and the extent of testing lie within the operator's responsibility. The operator must draw up a test plan, in which the proof tests and the interval between them are specified. We recommend summarizing the requirements of the proof test in a checklist.

⚠ WARNING

Risk of dangerous failure due to malfunction in the event of emergency. A valve that does not shut off tightly indicates a malfunction when the downstream pressure rises and reaches the upstream pressure.
Only use devices in safety-instrumented systems that have passed the proof test according to the test plan drawn up by the operator.

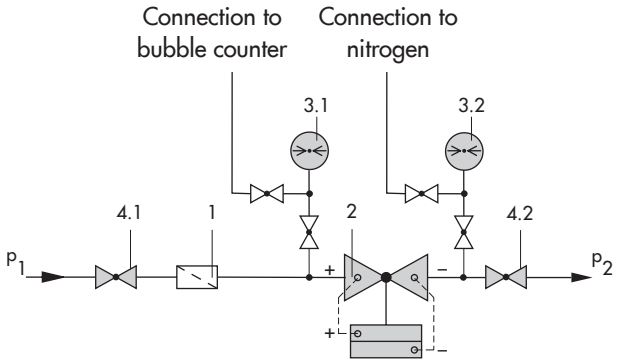
Regularly check the safety-instrumented function of the entire SIS loop. The test intervals are determined, for example on calculating each single SIS loop in a plant (PFD_{avg}).

Function testing

Regularly check the safety function according to the test plan drawn up by the operator.

Required accessories for testing:

– Nitrogen cylinder with pressure reducing valve 200 bar
– Pneumatic input unit, e.g. SAMSON order no. 9932-2262
– Bubble counter



1 Strainer
2 Type 42-10 RS Check Valve (backflow protection)
3.1 Pressure gauge 1
3.2 Pressure gauge 2
4.1 Shut-off valve 1
4.2 Shut-off valve 2

Fig. 2: *Test setup*

1. Depressurize and completely drain the plant section, in which the check valve is installed by closing shut-off valve (4.1).
2. Connect the pneumatic input unit and nitrogen cylinder with pressure reducing valve to the pressure gauge connection (3.2).
3. Apply 0.1 bar(g) test pressure to the pressure gauge connection (3.2).
4. Connect the bubble counter at pressure gauge connection (3.1).
5. Completely open the shut-off ball valve at 3.1 connection.
6. Slowly open the shut-off ball valve at 3.2 connection.
7. Watch the bubble counter. No bubbles should be visible when the 3.2 connection is completely open.

i ***Note***

The time until there are no bubbles depends on the volume of the pipeline.

8. After completing the test, disconnect the nitrogen cylinder and bubble counter. Put the check valve back into operation (see ▶ EB 3009).

Visual inspection to avoid systematic failure

To avoid systematic failure, inspect the check valve regularly. The frequency and the scope of the inspection lie within the operator's responsibility.

– Checking the diaphragm rupture indicator
– Checking the valve for external leakage of the medium, e.g. at the flanges

Take application-specific influences into account, such as:

– Corrosion (destruction primarily of metals due to chemical and physical processes)
– Material fatigue
– Aging (damage caused to organic materials, e.g. plastics or elastomer, by exposure to light and heat)
– Chemical attack (organic materials, e.g. plastics or elastomer, which swell, leach out or decompose due to exposure to chemicals)

NOTICE

Risk of malfunction due to the use of unauthorized parts.
Only use original parts to replace worn parts.

7 Repairs

Only perform the work on the check valve described in ▶ EB 3009.

NOTICE

Fail-safe action impaired due to incorrect repair.
Service and repair work must only be performed by trained staff.

SAMSON
MESS- UND REGELTECHNIK

Herstellererklärung

Hiermit bestätigt die Firma

SAMSON Aktiengesellschaft
Weismüllerstraße 3, 60314 Frankfurt am Main
Germany

für Rückströmsicherung der Bauart

Type 2421 RS / 2420 RS

dass die Geräte der o.g. Baureihen für die Verwendung in sicherheitsgerichteten Systemen nach IEC 6 1508 und IEC 6 1511 einsetzbar sind. Bei Beachtung aller Bedingungen der Norm ist entsprechend NE 79 ein Einsatz bis SIL 3 möglich. Der Nachweis erfolgte auf der Basis der Betriebsbewährtheit (proven in use) kombiniert mit einer FMEDA.

Sicherheitstechnische Kenndaten:

Lambda safe, undetected	$5.6^* 10^{-7}$ 1/hr
Lambda safe, detected	0
Lambda dangerous, undetected	$3^* 10^{-7}$ 1/hr
Lambda dangerous, detected	0
PFD (avg) bei jährlicher Prüfung	$1.3 * 10^{-3}$
HFT	0
Gerätetyp	A

Nutzbare Lebensdauer : Die getroffenen Feststellungen gelten für eine Lebensdauer von 8 Jahren bei durchschnittlicher Beanspruchung in industrieller Umgebung. Aufgrund von nachweisbaren Betriebserfahrungen des Anwenders unter definierten Bedingungen kann sich die nutzbare Lebensdauer verlängern.

Daraus ergeben sich:

SFF	65 %
$MTBF_{gesamt}$	130 Jahre
$MTBF_{dangerous}$	380 Jahre
DC (Diagnostic coverage)	0

Bestimmungsgemäße Verwendung ist zu beachten:
- Bedienungsanleitung
- Funktionsprüfung erfolgt in der Werkstatt

Sicherheitstechnische Annahme:
Die Rückstromsicherung verhindert den Produktfluss entgegen der markierten Fließrichtung.

Hinweis:
Durch Kontrolle der Berstanzeige kann ein Membranschaden im laufenden Betrieb erkannt werden.

Voraussetzungen:
Die Reparaturzeit ist klein gegenüber der mittleren Anforderungsrate. Durchschnittliche Beanspruchung in industrieller Umgebung durch Medien und Umgebungsbedingungen. Der Anwender ist für bestimmungsgemäßen Gebrauch verantwortlich.

Uwe Vogel
Head of Central Department
Technical Sales

Manufacturer´s Declaration

The manufacturer

SAMSON Aktiengesellschaft
Weismüllerstraße 3, 60314 Frankfurt am Main
Germany

certifies that the following check valves (backflow prevention)

Type 2421 RS / 2420 RS

are suitable for the use in safety-related systems according to IEC 61508 and IEC 61511. On fulfilling all requirements of these standards, the devices can be used in accordance with NE 79 in safety-related systems up to SIL 3.
The evidence is based on proven in use combined with a FMEDA.

Safety-related data:

Lambda safe, undetected	$5.6^* 10^{-7}$ 1/hr
Lambda safe, detected	0
Lambda dangerous, undetected	$3^* 10^{-7}$ 1/hr
Lambda dangerous, detected	0
PFD (avg) with annual tests	$1.3 * 10^{-3}$
HFT	0
Device type	A

Useful lifetime: The observations made apply to a lifetime of 8 years with average exposure in an industrial environment. The useful lifetime may be longer based on the experience of the user under defined conditions.

This results in:

Safe failure fraction (SFF)	65 %
$MTBF_{total}$	130 years
$MTBF_{dangerous}$	380 years
Diagnostic coverage (DC)	0

Intended use must be observed:
– Operating instructions
– Functional test performed in the workshop

Safety-related assumptions:
The backflow prevention prevents the process medium from flowing back against the specified direction of flow.

Note:
A damaged diaphragm can be detected while the process is running by checking the rupture indicator.

Preconditions:
The repair time is short compared to the average rate of demand. Average exposure to industrial environments and fluids. The user is responsible for the intended use.

Rudolf Lässler
Head of Product Department
Self-operated Regulators

SAMSON AKTIENGESELLSCHAFT
Postfach 10 19 01
60019 Frankfurt/M.,Germany

Weismüllerstraße 3
60314 Frankfurt/M.,Germany
http://www.samson.de

Phone: +49 69 4009-0
Fax: +49 69 4009-1507
E-mail: samson@samson.de

SAMSON AG · MESS- UND REGELTECHNIK
Weismüllerstraße 3 · 60314 Frankfurt am Main, Germany
Phone: +49 69 4009-0 · Fax: +49 69 4009-1507
samson@samson.de · www.samson.de

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