P series (Starflow™)

TABLE OF CONTENTS

SAFETY SIGNS AND LABELS

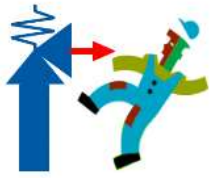
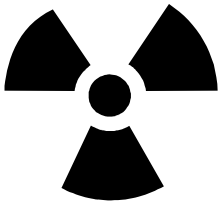
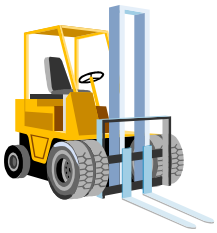
Signs or labels are included throughout this document.
These signs or labels communicate the following messages:

- The level of hazard seriousness
- The nature of the hazard
- The consequence of human or product interaction with the hazard
- The instructions if necessary on how to avoid the hazard

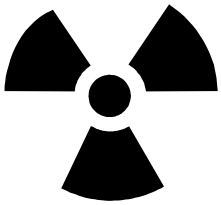
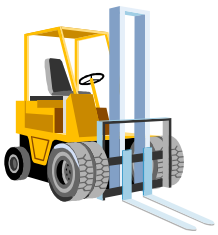
The format is characterised by vertical panels. The panels include a signal word shown below which advises the level of hazard seriousness

- DANGER
- WARNING
- CAUTION
- ATTENTION

DANGER	**WARNING**	**CAUTION**	**ATTENTION**
Immediate danger which WILL cause serious personal injury or death.	Risk or dangerous practice which COULD cause serious personal injury or death.	Risk or dangerous practice which COULD cause minor injuries.	Risk or dangerous practice which COULD cause damage to equipment.

DANGER	WARNING	CAUTION	ATTENTION
			
Never face the outlet of a valve when it is discharging as this may result in serious personal injury or death	Be aware of all site safety procedures to prevent the risk of serious injury or death.	Protect yourself by wearing the necessary protective equipment to prevent possible injury.	Use the proper lifting equipment to avoid personal injury or damage to equipment.

1. SAFETY INSTRUCTIONS

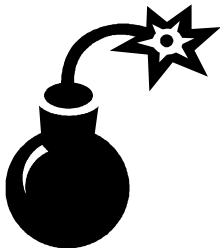
WARNING	CAUTION	ATTENTION
		
Be aware of all site safety procedures to prevent the risk of serious injury or death.	Protect yourself by wearing the necessary protective equipment to prevent possible injury	Use the proper lifting equipment to avoid personal injury or damage to equipment.

- In order that the product may work as expected, ensure that it has been correctly installed, it is being correctly used and it is correctly maintained and serviced.
- This document describes the main procedures which are necessary to satisfy to the essential safety requirements in order to operate the product correctly and to comply with the International rules and regulations for the specified pressure equipment.
- This document describes each essential step from the receipt of valves through the stages of installation, operation and service. It is mandatory to ensure that anyone intervening with the product, directly or indirectly, is fully aware of these steps. Pictograms are used to clearly advise of the potential dangers associated with the use of the product.
- Whilst this document is intended to be informative, it is important to understand that the safety messages provided are not exhaustive.
- Trillium Flow Technologies cannot possibly be aware of, evaluate or advise, all of the conceivable methods by which tasks might be performed, or of the possible hazardous consequences of each of those methods.
- Consequently, anyone who uses a procedure and/or tool, which is not recommended by Trillium Flow Technologies, or deviates from Trillium recommendations must be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the method and/or tools which have been selected.

The installation, operation and maintenance of safety valves could be dangerous. During these activities personnel might be exposed to direct or indirect injury risks from fluids which are at various high pressures and/or temperatures. Therefore, every precaution should be taken to prevent injury to personnel during the performance of any procedure.

Any person who uses a safety valve shall be trained in all aspects of handling, installation, operation and service.

2. SAFETY PRECAUTIONS

DANGER	WARNING	CAUTION
		
Never face the outlet of a valve when it is discharging as this may result in serious personal injury or death	Never dismantle a valve in line without making absolutely sure there is no remaining or residual pressure	Protect yourself by wearing the necessary protective equipment to prevent possible injury

A safety valve is a self-acting product. Always consider the potential dangers associated with the product and never minimise them. Each plant or installation has its own safety rules. Be aware of them and follow them carefully.

- Never stand in front of the discharge side of a safety valve if the valve is operating or being tested.
- Always wear personal protective equipment (PPE): PPE should consist of but not be limited to ear protection, eye protection, and the use of protective clothing (gloves, headgear, etc). Noise can be extremely high and can occur suddenly. Steam and hot water can burn. Superheated steam is NOT visible.
- Always lower the operating pressure before making any adjustment to the valve. Always gag the valve before making any ring setting adjustments.
- Before removing a valve for disassembly, ensure that there is no remaining pressure upstream the valve and that the valve is isolated from the system pressure.
- Before performing each pop test on the safety valve, ensure that no personnel are close to the valve. The steam which could escape during the operation could cause serious personal injury.
- When a lift test is performed using the lifting lever, be sure to use a rope or a chain whilst standing at a safe distance away from the valve and any potential steam escapes.
- Valves under the operating pressure may relieve at any time. Never strike the body or tamper with the valve as such practice could cause premature relief.
- Never modify or change the valves, especially when they are under pressure. It is essential that you inform Trillium in ALL instances if any machining of parts is to be considered. Deviation from critical dimensions can adversely affect the performance of a safety valve.

3. WARRANTY INFORMATION

Trillium warrants that its products (including performance) and work will meet the specifications of the customer's Purchase Order. If any issue arises whilst operating the product, the customer should inform Trillium as quickly as possible. A return to the original plant should then be considered in order for Trilium to inspect the product.

Trillium cannot be held responsible for any incorrect sizing and selection of a valve if the original specification supplied by the customer was incomplete or inaccurate.

Trillium does not authorise any third parties (eg, non-Trillium service centres) to repair a product of Trillium's manufacture. Any customer allowing or sub-contracting the repair of a Trillium product which is still within its warranty period will do so entirely it at their own risk.

4. TERMINOLOGY

For the purpose of this manual, the following abbreviations, definitions and terms apply.

ACCUMULATION
The pressure increase over the maximum allowable working pressure of the vessel, expressed in pressure units or as a percentage of maximum allowable working pressure (MAWP) or design pressure.

BACK PRESSURE
Back pressure is the static pressure existing at the outlet of a safety valve device due to pressure in the discharge system.

BLOWDOWN
The difference between actual popping pressure of a safety valve and actual reseating pressure expressed as a percentage of set pressure, or in pressure units.

CDTP (COLD DIFFERENTIAL TEST PRESSURE)
The pressure at which a safety valve is adjusted to open on the factory test bench.
The cold differential test pressure includes corrections for the service conditions of backpressure or temperature or both.

CHATTER
Rapid and erratic motion of the disc from closed to open position. This phenomenon can create damage to the valve internals, the main effect being on the disc and the nozzle components.

CLOSING PRESSURE
The value of decreasing inlet static pressure at which the valve disc re-establishes contact with the seat or nozzle, or at which the lift becomes zero.

LIFT
The actual travel of the disc away from closed position when a valve is relieving.

LEAK TEST PRESSURE
Leak test pressure is the specified inlet static pressure at which a quantitative seat leakage test is performed in accordance with a standard procedure.

MAWP (maximum allowable working pressure)
The maximum gauge pressure permissible at the top of a vessel in its normal operating position at the designated coincident temperature specified for that pressure.

OPERATING PRESSURE
The pressure at which protected unit is working and at which the safety valve should be tight.

OVERPRESSURE
The pressure increase over the set pressure of a safety valve, usually expressed as a percentage of the set pressure.

POPPING PRESSURE
The value of increasing inlet static pressure at which the disc moves in the opening direction at a faster rate as compared with corresponding movement at higher or lower pressures. It applies only to valves in compressible fluid service.

SET PRESSURE
Inlet gauge pressure at which the safety valve is set to open under relief conditions

SIMMER
The audible or visible escape of fluid between the seat and disc at an inlet static pressure below the popping pressure and at no measurable capacity.

5. GENERAL ADVICE

5.1 RESPONSIBILITIES

The recommended practices indicated within this manual must be respected to prevent any potential damage to goods. It is important that all points of advice are followed closely and are implemented by suitably qualified personnel. Trillium disclaims all responsibility for maintenance operations which may be performed by persons who are either not suitably qualified or are not considered to be an accepted part the Trillium organisation.

5.2 IDENTIFICATION PLATE

The data shown on the identification plate (figure 1) should be referenced with all requests for work, or for the supply of spare parts.

The identification plate bears the following information fields fulfilled according code and regulation requirements:

- Serial number (also stamped on the edge of the outlet flange)
- Safety valve type (model number)
- Inlet dimension - pressure class (rating)
- Outlet dimension - pressure class (rating)
- Orifice
- Set pressure
- Backpressure
- Identification number

- Spring identification number

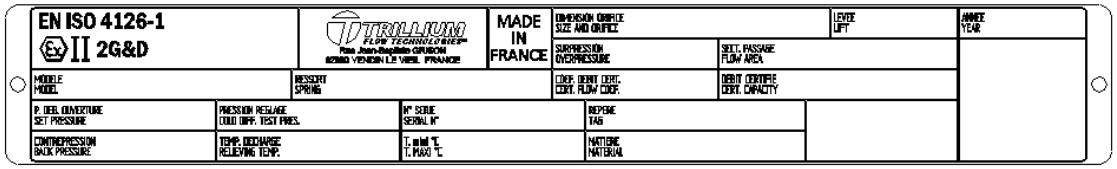


FIGURE 1

5.3 SPRING

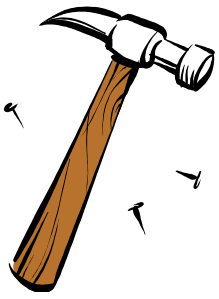
The correct operation of a pressure relief valve depends upon its spring characteristics, resilience, and compression. Good pressure relief valve operation requires:

- Effective and accurate lift
- Sufficient flow rating
- Quick closing (no damping effect when reseating)

The adjustment range of the spring must be within ± 5 % of the nominal value

Spring data should be obtained from Trillium's Sarasin-RSBD Aftersales Department. When requesting information, please quote the serial number which is shown on the valve identification plate. Without this number, it may not be possible to identify the original valve.

5.4 STORAGE

ATTENTION	ATTENTION
	
Never lift the valve horizontally, or hook to the lifting lever or the spring. Always lift by using the lifting eyes or sling.	Make sure the valve is not dropped and does not receive strikes.

Safety valves may be received several months before an actual plant start-up date. In order that the valve performance is not adversely affected, it is important to follow some clear rules concerning storage and handling prior to installation.

- It is recommended that the safety valves are stored in a clean and dry environment, protected from weather conditions, the ingress of sand, dust, or any other solid particles or foreign matter.
- Wherever possible, the valves should be stored in their original packaging.
- Blanking plugs, thread protectors and plastic covers should only be removed at the point of installation of the valve.
- Special attention should be given to flange gasket contact surfaces and machined threads. Impact on these areas should be avoided.

5.5 HANDLING

According to procedure 20.02, the safety valve should be handled very carefully at all times whether they are in the packed or unpacked condition. The valves should never be subjected to any impact or striking, either directly or indirectly through the packaging.

Never lift or handle a safety valve by its lifting lever.

The valve should be moved and transported in the upright position at all times to maintain performance accuracy.

6. STARFLOW BASICS

6.1 DESCRIPTION

Description STARFLOW RANGE

- Certified ASME Section VIII Div. 1 (stamp UV)
- Sizes: 1" x 2" to 12" x 12" x 12" (dual outlet)
- API STD 526 orifices from D to T

STARFLOW Inlet x Outlet Size Combinations (in.) Orifice Area (sq. in)					Inlet	Outlet
Actuel	0.134	0.273	0.373	0.589	Flange	Flange
API	0.110	0.196	0.307	0.503	Rating	Rating
ORIFICE	D	E	F	G	ASME B16.5	ASME B16.5
	1 x 2	1 x 2	1 ½ x 2	1 ½ x 3	150	
	1 x 2	1 x 2	1 ½ x 2	1 ½ x 3	300	150
	1 x 2	1 x 2	1 ½ x 2	1 ½ x 3	300	
	1 x 2	1 x 2	1 ½ x 2	1 ½ x 3	600	
	1 ½ x 2	1 ½ x 2	1 ½ x 3	1 ½ x 3	900	
	1 ½ x 2	1 ½ x 2	1 ½ x 3	2 x 3	1500	300
	1 ½ x 3	1 ½ x 3	1 ½ x 3	2 x 3	2500	

- Effective orifice areas from D (0.865 cm^2) to W (452 cm^2)

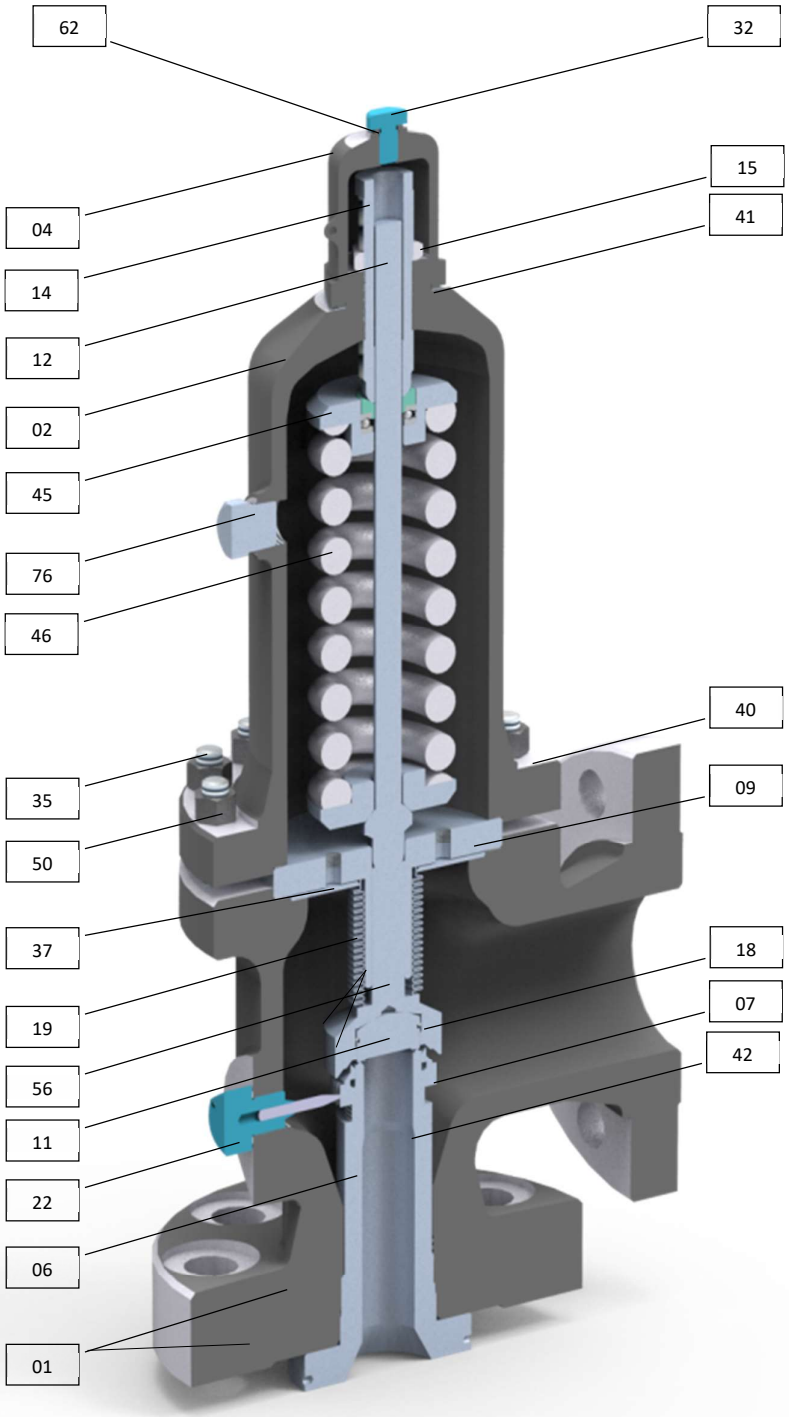
STARFLOW Inlet x Outlet Size Combinations (in.) Orifice Area (sq. in)													Inlet	Outlet
Actual	0.881	1.457	2.097	3.284	4.093	4.987	7.215	12.91	17.81	28.87	46.75	70.10	Flange	Flange
API	0.785	1.287	1.838	2.853	3.6	4.34	6.38	11.05	16	26	N/A	N/A	Evaluation	Rating
ORIFICE	H	J	K	L	M	N	P	Q	R	T	V	W	ASME B16.5	ASME B16.5
	1 ½ x 3	2 x 3	3 x 4	3 x 4	4 x 6	4 x 6	4 x 6	6 x 8	6 x 8	8 x 10	10 x 14	12x12x12	150	150
	1 ½ x 3	2 x 3	3 x 4	3 x 4	4 x 6	4 x 6	4 x 6	6 x 8	6 x 8	8 x 10	10 x 14	12x12x12	300	
	2 x 3	3 x 4	3 x 4	4 x 6	4 x 6	4 x 6	4 x 6	6 x 8	6 x 10	8 x 10	10 x 14	12x12x12	300	
	2 x 3	3 x 4	3 x 4	4 x 6	4 x 6	4 x 6	4 x 6	6 x 8	6 x 10	-	-	-	600	
	2 x 3	3 x 4	3 x 6	4 x 6	4 x 6	4 x 6	4 x 6	-	-	-	-	-	900	
	2 x 3	3 x 4	3 x 6	4 x 6	-	-	-	-	-	-	-	-	1500	300
	-	-	-	-	-	-	-	-	-	-	-	-	2500	

Note: Inlet and outlet size combinations as well as Orifice sizes shown in the table above are compliant with API standard 526 – Latest edition.

6.2 FEATURES AND NOMENCLATURES

Body design in accordance with ASME B16.34

- ASME B&PV Code section VIII div I design 10%
  - 10% overpressure
  - Adjustable blowdown in between 7% (gas) and 20% (liquid)
- Full nozzle design
- Body inlet connection : Flanged
- Pressure rating : from class 150 to class 2500



Part N°	Part Name	SPARE PARTS
01	Body	E
02	Bonnet	E
04	Cap	E
06	Nozzle	E
07	Adjusting ring	B
09	Guide	C
11	Disc	A
12	Spindle	B
14	Adjusting screw	B
15	Adjusting screw locknut	D
18	Retaining ring	A
19	Balanced Bellows	C
22	Adjusting ring screw	B
35	Bonnet stud	D
37	Bellows plate	C
40	Body/bonnet gasket	A
41	Bonnet/cap gasket	A
42	Adjusting ring screw gasket	A
45	Spring washers (upper & lower)	C
46	Spring	C
50	Nut	D
56	Disc holder	C

Note: Spare parts chapter 12

FIGURE 2

7. INSTALLATION

7.1 GENERAL

DANGER	WARNING	CAUTION	CAUTION
			
Never face the outlet of a valve when it is discharging as this may result in serious personal injury or death	Be aware that the environment might be extremely hot. Care should be taken if there is any potential steam leakage. Superheated steam is invisible.	Protect against high noise levels which occur during popping tests. Keep a safe distance when the test is being performed.	Helmets and gloves must be worn to prevent any injures while operating or working on the valve.

Piping systems and equipment through which the fluid flows must be thoroughly cleaned. Dust, deposits and metal particles must be removed using controlled blasts of compressed air or steam.

The presence of any solid particles between the safety valve and its seat faces will have damaging effects. Any leak will lead to improper functioning and erosion of the seating surfaces. Such erosion develops quickly, due to the high pressure. The system should always be purged before safety valve is installed.

Prior to installation of the safety valves, all protective covers must be removed. It is recommended that any surfaces in contact with gaskets are checked. Dimensions of gaskets should be checked: gaskets must not obstruct inlet or outlet orifices.

A pressure relief valve will only operate correctly if all installation procedures are observed.

7.2 INLET PIPING

If the inlet pressure drop is excessive, it may generate chattering effect during operation of the valve. Chattering may in turn be the cause of seat damage, or spindle deformation.

In order to avoid chattering, the following recommendations should be followed to reduce pressure drop: Une réduction concentrique arrondie de l'installation créera un minimum de turbulence.

- A rounded concentric reducer from the installation will create a minimum of turbulence.
- The inlet piping must be as short as possible and direct.
- A safety valve must not be installed on piping which has a nominal diameter of less than the nominal inlet diameter of the safety valve.
- The safety valve must not be subjected to excessive vibration which might be transmitted by the installation.

7.3 OUTLET PIPING

The safety valve must not support either the weight or the installation stresses of the outlet piping.

The backpressure should be reduced by using outlet piping with a nominal diameter at least equal to the nominal diameter of the safety valve outlet flange, together with large radius elbow.

Recommendations for steam applications

- The inside diameter of the exhausting piping must not be less than that of the safety valve outlet.
- Release should be in the upwards direction and, a means of draining must be available in the lower angle to prevent any accumulation in the body.
- The connection curve to the vertical piping must be as close as possible to the safety valve outlet flange. The easiest solution is for the elbow to be bolted directly to the safety valve flange.
- The radius of the elbow must be as great as possible, ie, at least $R \geq 2.5$ d.

7.4 INSTALLATION ON THE PROTECTED EQUIPMENT

- Installation on a pressure vessel

The opening in the vessel wall to accept the safety relief valve must be designed to give direct flow and there must be no obstruction between the vessel and the safety relief valve.

- Installation on equipment to be protected

The safety relief valve must be mounted on the upper part of the equipment protected, especially if the safety relief valve is releasing gas or steam.

When releasing liquid, the safety relief valve must be installed on the lower part of the equipment.

7.5 OUTLET MANIFOLD DESIGN

In the case of an installation with several safety relief valves, outlet manifold dimensions must be such that the sum of the backpressures generated is less than the value accepted by the safety relief valve which accepts the least backpressure.

Separate manifolds must be installed for operation with both low and high pressures.

If the safety relief valves only operate consecutively, the relevant manifold dimensions must be at least equal to those of the safety relief valve with the greatest flow rate. Great care must be taken with the calculations determining interdependent operation between the safety relief valves, and the possibility of their being open at the same time.

7.6 RECOMMANDATIONS

- The safety relief valve must always be installed in the vertical position.
- The safety relief valve must be subjected to no stress whatsoever from piping..
- The outlet reaction force requires the use of reinforcement on the inlet piping connections, to support dynamic loading due to the outlet.
- The lifting lugs are destined for the handling of the valve. They must not be used to lift the apparatus upstream or downstream of the valve. They should be dismantled once the valve is put into operation.

7.7 OUTDOOR INSTALLATION

A safety valve which is installed outdoors must be protected against any inclement environmental conditions to ensure that it will provide the highest level of safety and will operate in the most effective & responsive manner.

If the safety valve is exposed to hazardous weather conditions, ingress of dirt or other foreign matter or any extremes of temperature conditions, please ensure that:

- The body is insulated from the inlet neck to the top of the body. Excessive variations in temperature may affect the set pressure or the body structure (thermal stress).

7.8 INDOOR INSTALLATION

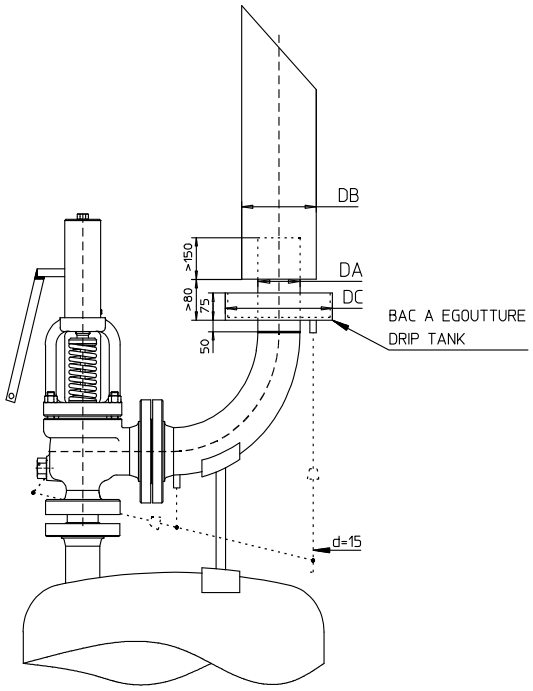
In case of an open bonnet, the outlet of the safety valve should not be connected to any equipment which might allow steam to be ejected though the top cover and might in turn add risk of injury to personnel working close to the valve.

The opening of the valve can cause the projection of undirected fluid. The installation should be designed so that access to the area around the valve is limited or we advise you to connect the outlet flange.

7.9 SPECIAL CASE OF STEAM

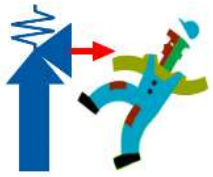
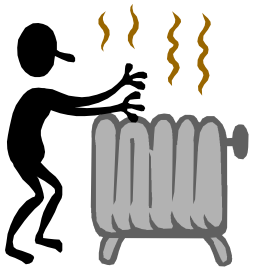
When the fluid to be relieved is steam, and in the case of long outlet piping, in order to achieve full safety requirements, the piping should be in two parts. This arrangement considerably reduces the stresses between the piping and its support.

The safety relief valve body must be permanently drained, by connecting the drain orifice, on the lower part of the body, to that on the drip tank, as shown in the diagram below.



DA (mm)	DB (mm)	DC (mm)
25	50	150
40	80	200
30	80	200
66	100	220
80	150	270
100	150	270
150	200	320
200	250	370
250	300	420

8. MAINTENANCE

DANGER	CAUTION	CAUTION
		
Never face the outlet of a valve when it is discharging as this may result in serious personal injury or death. There should be zero pressure at the valve inlet prior to commencement of any work which is to be performed.	Any person who is working on the valve should be aware of any potential dangers such as retained heat)	Helmets and gloves must be worn to prevent any injures while operating or working on the valve.

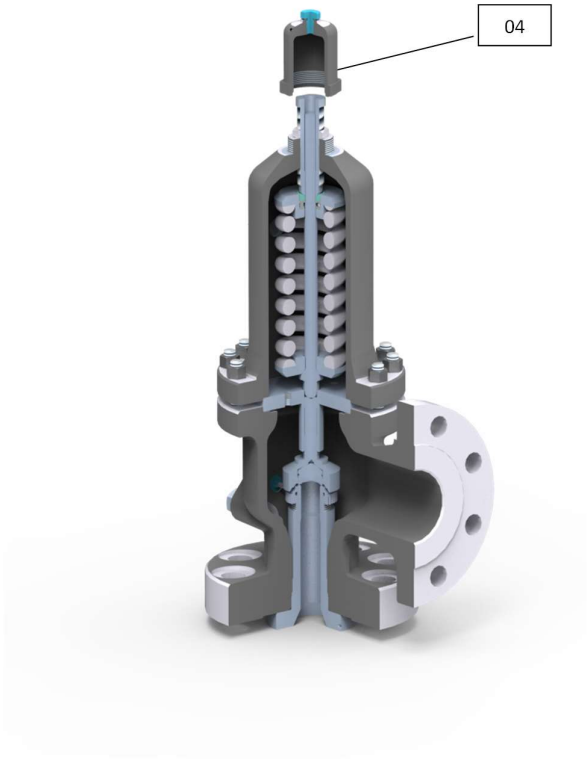
A regular visual inspection is recommended to make sure about the good visible condition of the safety relief valve.

- If the safety relief valve includes a relieving device, it can be necessary to plan periodic tests of manoeuvrability according the inspection department recommendation. At least one test a year is recommended.
- If the safety valve is installed on a compressible fluid, a simmer would warn about a leakage.
- If the safety valve is closed, with an open bonnet (or yoke) and installed on a steam line, a steam escape by the top of the valve body will warn about a leakage.

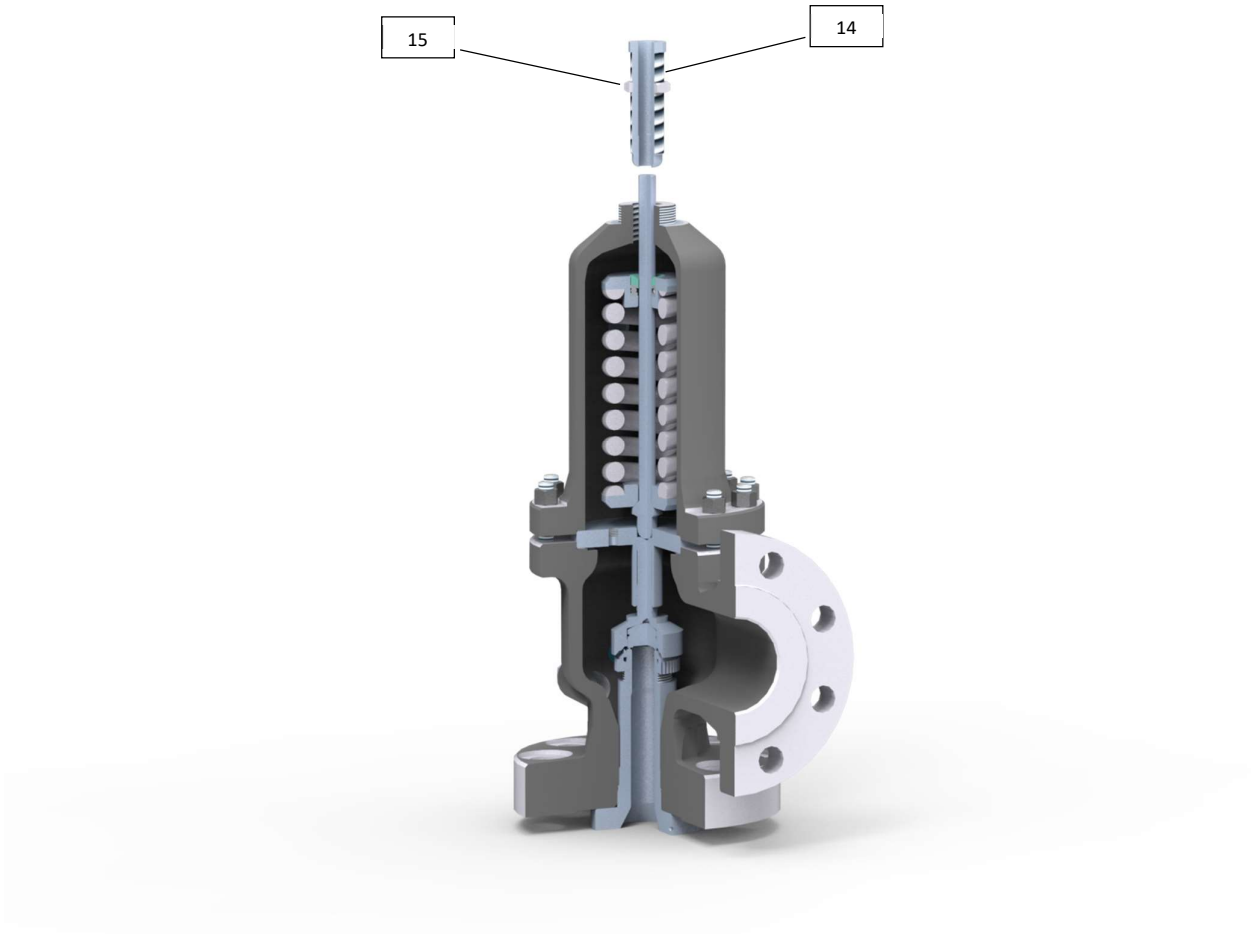
The whole maintenance operations should be achieved by qualified technicians. This is the responsibility of the end-user to make sure about the functioning of the valve as well as the safety of the operator.

8.1 DISASSEMBLY

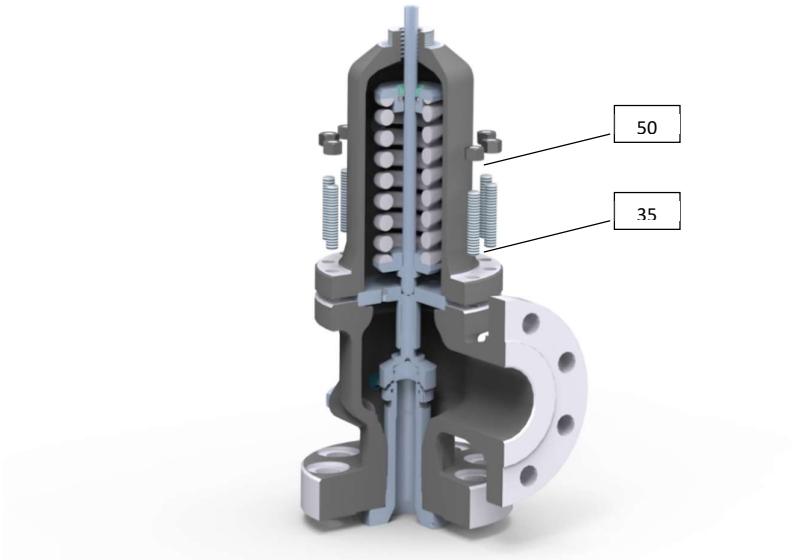
- Remove the lifting device, where applicable.
- Remove the cap (4).



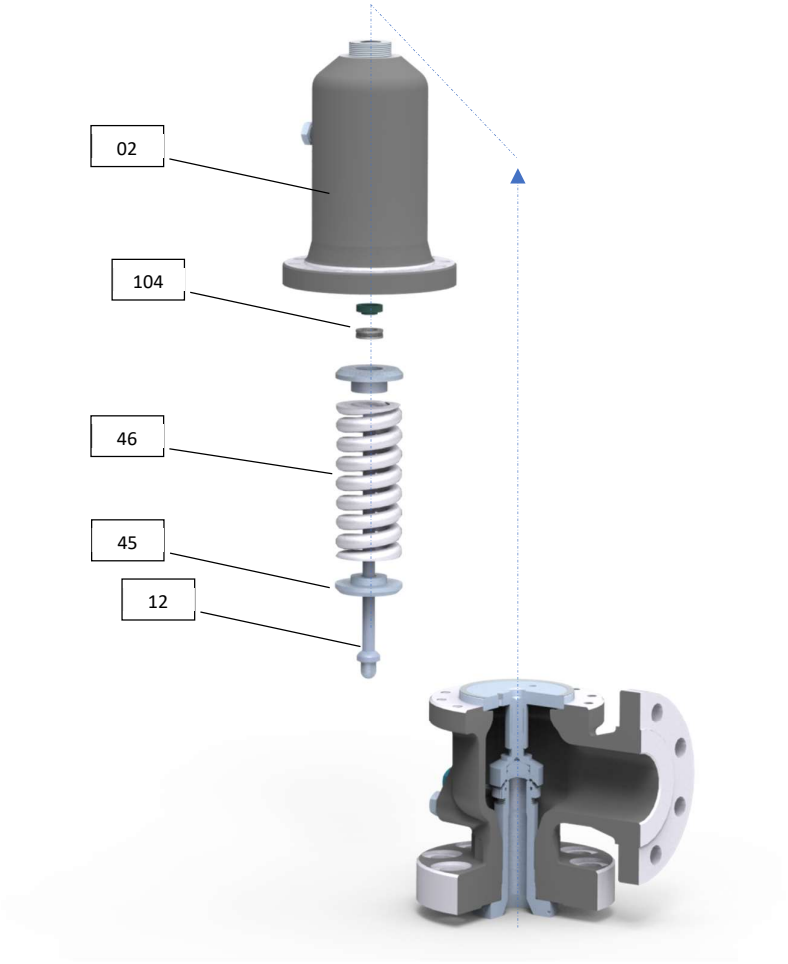
Unscrew the locknut (15) and then unscrew the adjustment screw (14) until it is no longer compressing the spring. To facilitate subsequent pre-adjustment of the safety relief valve, mark the position of the adjustment screw (14).



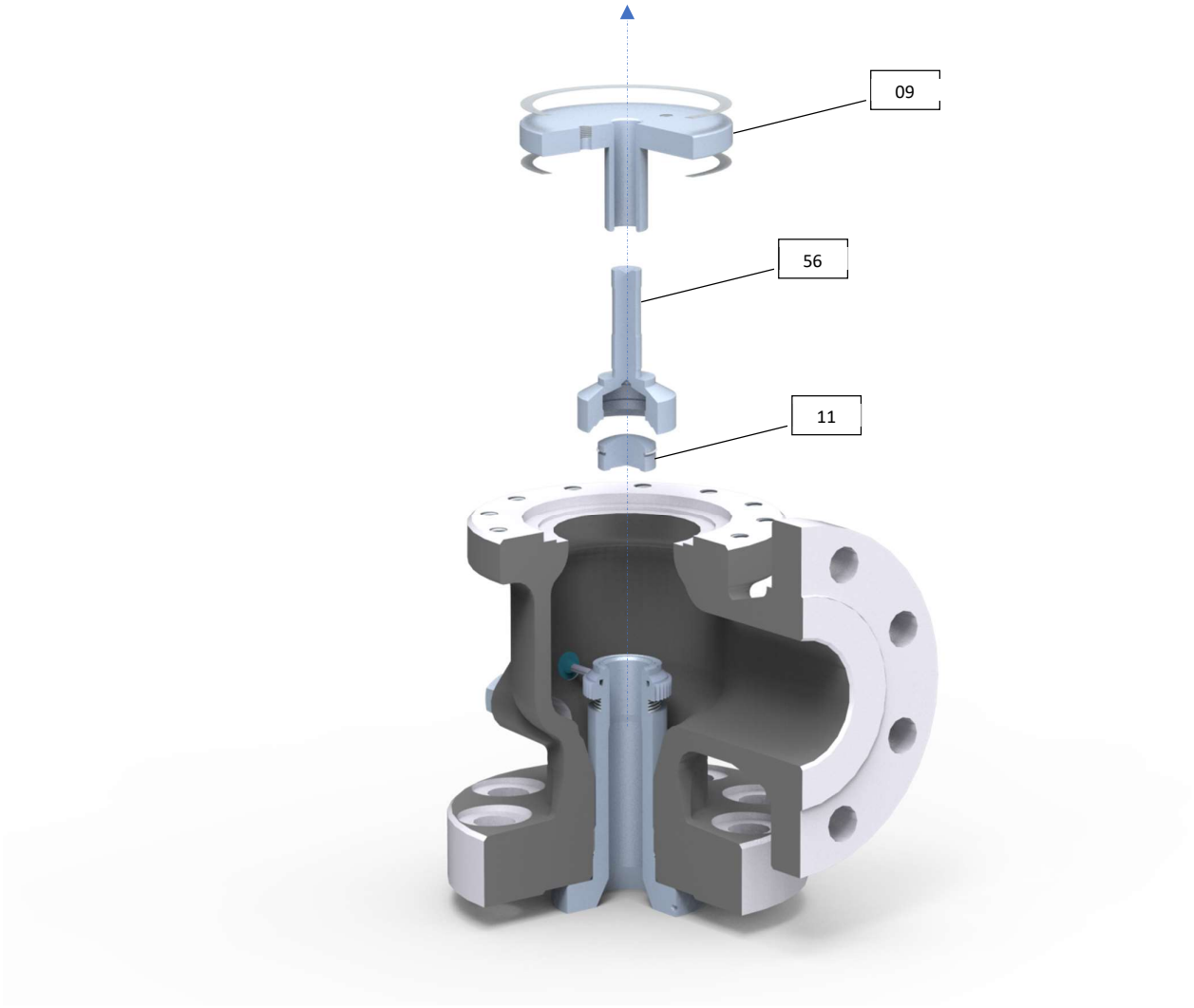
- Unscrew nut (50) and take off bonnet stud (35)



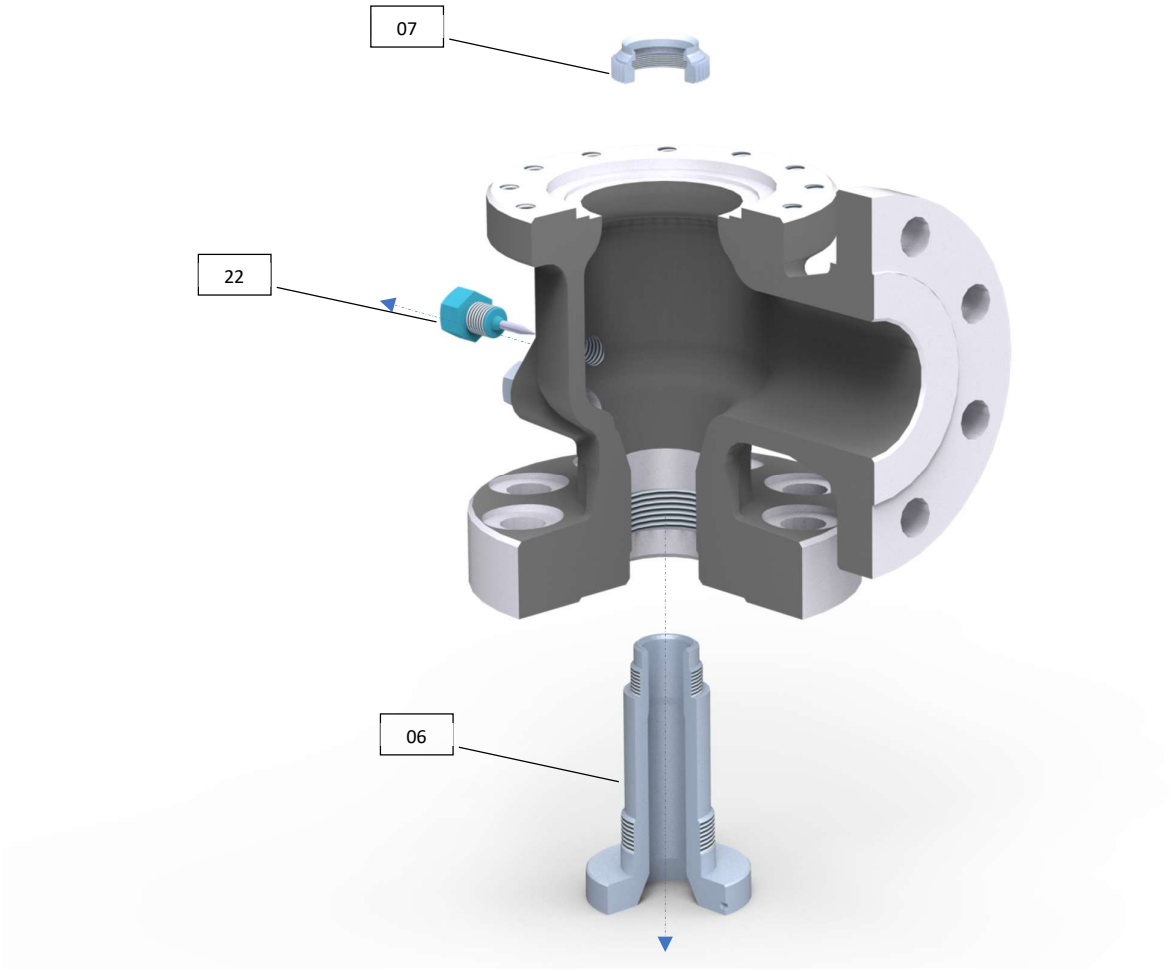
- Remove the bonnet (2), the bearing (104) (if there's one) the spring and washers (46-45) and the stem (12)



- Check that the spring remains cylindrical by rolling it on a flat surface. If the spring is distorted or shows signs of corrosion, it should be replaced.
- For safety relief valves without bellows, remove the guide (9) and the assembly disc / disc-holder (11-56).
- For safety relief valves with bellows, remove the assembly formed by the guide (9), the bellows (19) and the assembly disc / disc-holder (11-56).



- Check the seat surface of the disc (11) and nozzle (6).
- If the nozzle needs to be disassembled (6), unscrew the locking screw (22) and remove the adjusting ring (7), followed by the nozzle (6), for sizes above 4”, the use of a special tool can be required which may be ordered from Trillium Flow Technologies.



- Inspect the parts, especially the disc (11) and nozzle (6) contact surfaces, and the guide surfaces of the disc-holder (56) and the guide (9).

Safety relief valve tightness and correct operation are only assured if the seat surfaces are in perfect condition. If they are damaged, then they must be relapped or remachined. Any machining must be subject to the tolerances defined by Trillium Flow Technologies. Any machining subsequently outside tolerances will not give correct operation or performance. The Trillium Flow Technologies Sales Department remains at your disposal for any other information you may require concerning tolerances.

- Parts should be cleaned, degreased and dried, before reassembly.

It is practical to have spare parts available, so that a safety relief valve can be immediately reassembled, using new parts. This ensures optimum safety relief valve availability.

8.2 LAPPING

After a period of operation, when at which point relief safety valve might naturally start to leak, it should be reconditioned by performing lapping operations on the seat surfaces of the nozzle and the disc, either by hand or by using a lapping machine, to ensure that good tightness, plus opening and closing phases are restored.

This operation requires specific skills and experience and may be carried out only by qualified personnel.

If such essential skills are not available, the valve should be returned to Trillium Sarasin-RSBD or one of its identified accredited partners to be reconditioned (Your nearest Trillium representative should be contacted in such an occurrence).

8.2.1 DISC AND NOZZLE

- Nozzle
  - A slight coat of lapping paste should cover entirely the bottom face of the block.
  - Place the lapping block on the nozzle seat.
  - Then lap in clockwise motion applying an uniform pressure to the block.
  - If damage is important, change the lapping paste frequently after having wipped the block. Increase the pressure to improve the paste action.
  - To check plane remove completely the paste from both the nozzle seat and the block, with ARDROX 9PR5 PMUC CHEMETALL or equivalent.
  - If the lapping is not perfect, the defective zones will appear as shaded, compared to the brightness of the other zones.

If such is the case, an additional lapping is then necessary.

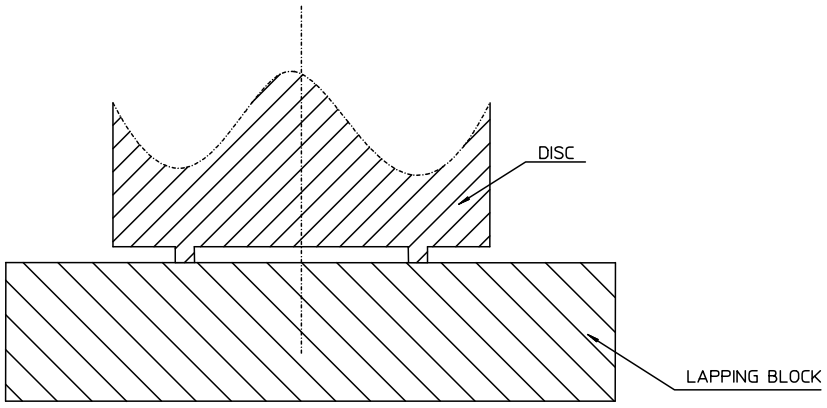
When good, the nozzle seat should be cleaned with ARDROX 9PR5 PMUC CHEMETALL or equivalent, using either a clean rap or cleaning paper.

AVOID ANY CONTACT OF THE SEAT WITH FINGERS

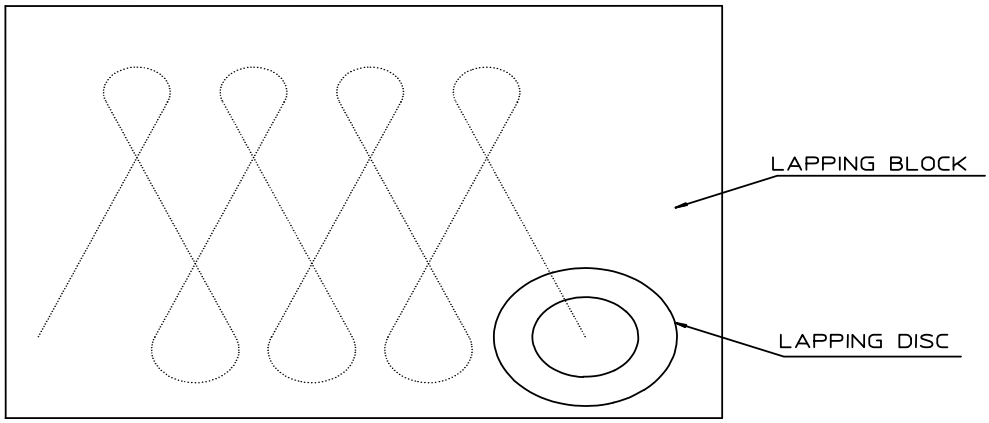
COMMERCIAL DESIGNATION	SUPPLIER	UTILISATION
ABRASIF SERIE 17 900	AQUA LAM	LAPPING
FLUIDE MM 781	LAM PLAN	LAPPING
LESSIVE 742	LAM PLAN	DEGREASING
BIO DIAMANT MM 330-340	LAM PLAN	LAPPING
LUBRIFIANT 716	AQUA LAM	LUBRIFICANT

Tableau 1 – Recommended lapping products

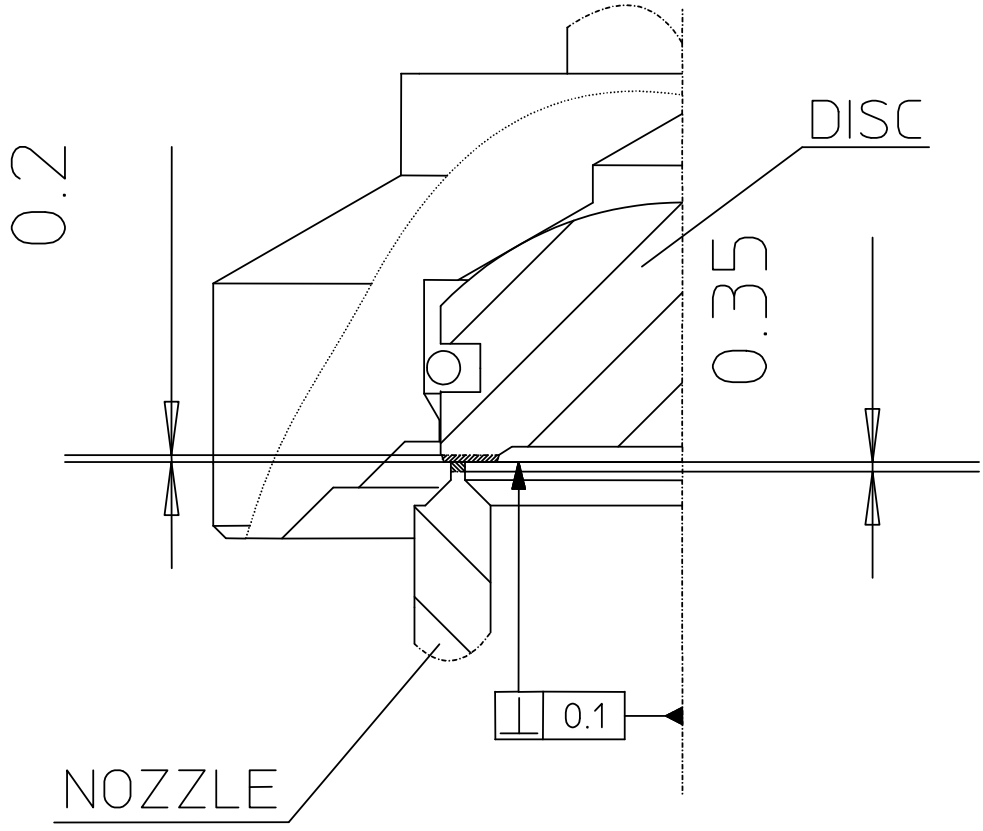
- Disc
  - Use the disc lapping block
    Laid down flat on the work table



- Cover it with a slight coat of lapping paste
- Hold firmly then apply the bottom face of the valve disc (seat)
- Proceed on the same way than for the nozzle.
- After every lapping we strongly suggest to recondition the lapping tools, in lapping themselves on a tray perfectly flat. Use the same pastes than for the nozzle. Move the pieces in tracing the eight figures on tray surfaces.



NOZZLES AND DISCS MAXIMUM REPAIR DIMENSIONS



The maximum repair dimension must not go below 0.1 mm for all orifices. If the repair dimension is out of the tolerance, the disc or nozzle must be replaced.

8.3 ASSEMBLY

8.3.1 RECOMMANDATIONS

The safety relief valve should be reassembled with a set of new gaskets.

Parts must be absolutely clean before assembly. Trim parts: nozzle, disc, disc-holder, guide and adjusting ring must be thoroughly degreased and dried before reassembly. Check that there are no burrs on these parts.

Safety relief valve assembly and adjustment is easier if the parts listed below are lubricated, before assembly, when operating conditions allow:

- Nozzle / body threads
- Nozzle / adjusting ring threads
- Disc / disc-holder contact
- Stem / disc-holder contact
- Adjusting screw threads
- Studs

ssThe lubricant used must be compatible with operating conditions. A molybdenum bisulphide (MOS2) lubricant is recommended, in powder spray form for standards applications. For cryogenic conditions, we recommend lubricant CT1240 (ORAPI trade brand).

8.3.2 PROCEDURE

- Screw and tighten the nozzle (6) in the body (1) to the nominal tightening torque (Table p26).
- Place the adjusting ring (7) on the nozzle (6).
- For safety relief valves without bellows, install the disc assembly (11-56) on the nozzle (6). Then adjust the guide (9) and the gaskets (40).
- For safety relief valves with bellows, install the assembly formed by the disc-holder / disc (11-56), the guide (9), and bellows (19), don't forget to put in place the gaskets (40).
- Position the stem (12), spring and washers (46-45) and bonnet (2). Tighten the bonnet studs.
- Using the adjustment screw (14), compress the spring (46), up to the mark made before disassembly. Screw the lock-nut to a medium setting.
- Check that the adjusting ring (7) can rotate freely on the nozzle (6).Raise the ring (7) until it is in contact with the assembly disc-holder / disc (11-56). Then lower the ring 2 to 5 notches to check set pressure, and lock using the screw (22).

Orifice	Outlet size	Thread types	Diameter (mm)	Thread pitch (mm)	Length of engagement (mm)	Nominal torque (m.daN)
All	All	M18x1.5	18	1.5	10	5.3
All	All	M34x2	34	2	10	18.7
All	All	M52x2	52	2	10	43.0
All	All	M60x2	60	2	10	50.0

All	All	M92x2	92	2	15	50.0
All	All	M92x3	92	3	15	50.0
All	All	M118x2	118	2	15	50.0
All	All	M165x2	165	2	15	50.0
All	All	M205x2	205	2	15	50.0

9. TESTING

9.1 RECOMMENDATIONS

Safety valve setting and adjustment must be executed on the appropriate test bench (valves on liquid service should be adjusted on a liquid bench).

Flanging must be homogeneous and have at least 3 tightening points.

- Precautions during adjustment on test bench or on installation

The opening of the valve can create a very high noise level. Persons exposed should be adequately protected.

The opening of the valve can cause the projection of undirected fluid through the bonnet item 2 or valves with no connection on the outlet flange. The installation should be designed so that access to the area around the valve is limited.

- Composition of test installation :
  - Pressure tank, which can be pressurised through a valve (e.g. needle valve) and a source of pressure.
  - A connection on the reservoir, on which the valve to be adjusted must be flange-mounted.

The connection between the reservoir and safety relief valve must be sufficiently wide to minimise pressure drops during the safety relief valve test.

The pressure tank volume is a compromise between economic considerations and technical necessity. The greater the tank volume, in relation to the safety relief valve, the more accurate the adjustment.

If the volume is small, the set pressure can be adjusted, but the blowdown adjustment will be empirical.

If the volume is large, both the set pressure and the closing pressure drop can be accurately adjusted.

9.1.1 OPERATION USING GAS

The safety relief valve must be adjusted using clean, dry air on nitrogen.

9.1.2 OPERATION USING LIQUID

The safety relief valve is adjusted using clean water with a corrosion inhibitor. Do not use oil or similar fluids.

9.1.3 OPERATION USING STEAM

If the safety valve is "UV" stamped (ASME BPVC Section VIII div I), it must be adjusted on a steam test bench according boiler capacity or using air or directly on the final equipment.

If the safety valve is adjusted in cold condition, the cold test pressure will be the set pressure multiplied by the correction factor of table 2 p30.

NOTE: For these tests, it is recommended that the fluid used be the same as that used by Trillium Flow Technologies. The specification of this fluid is shown on the test certificate supplied with all equipment.

9.2 SET PRESSURE AND ADJUSTMENT ON LINES

DANGER	WARNING	CAUTION	CAUTION
			
Never face the outlet of a valve when it is discharging as this may result in serious personal injury or death.	Always take off the test gag before performing the pop test. Replace the gag before adjusting the screw and the rings to prevent any unexpected valve opening.	Protect against high noise levels which occur during popping tests. Keep a safe distance when the test is being performed.	Helmets and gloves must be worn to prevent any injures while operating or working on the valve.

The safety valve set pressure may be checked by using either of the following procedures

1. The system pressure increase
2. An online testing device.

- Using the first method, the system pressure is increased until the popping point of the safety valves is reached. This method allows both verification of the set pressure and clarification of the blowdown.
- For the second method, the Trillium online testing device is used to determine the valve's opening pressure at the normal system operating pressure. The difference between set pressure and operating pressure which is necessary to test the valve is compensated by the online testing device.

This online testing device is made up of a hydraulic cylinder and pressure, temperature and force transducers which are able to open the valve and to give precise values of the force needed to perform this procedure (see also section 9.3)

Before the set pressure test is performed, the following procedures must be followed:

- Please follow the recommendations for installation which are provided in section 7,
- The pressure gauge which is used to check the opening pressure shall be as close as possible of the valve inlet.
-

9.2.1 SET PRESSURE ADJUSTMENT

NOTE: For insitu intervention, make sure the operating pressure is decreased as such to prevent the valve top open during the adjusments.

In order to change or adjust the set pressure, cap should be removed as per the instructions which are provided within section 8.1.

To adjust the set pressure, note number of complete turns and do a mark on the screw to quickly locate the correct zone of spring compression.

To change or adjust the set pressure, unscrew the set screw locknut (15).

- To increase the set pressure, screw the set screw downwards.
- To decrease the set pressure, screw the set screw upwards.

The set pressure adjustment must not be above ± 5 % of the original nameplate set pressure. Any adjustment beyond this limit, please consult Trillium so that we may check the possibility.

Once the adjustment is acceptable, screw the locknut (15) into place.

Seat tightness area (mm2) - To be used for set pressure						
	Inlet class					
Orifice	150	300	600	900	1500	2500
D	117,86	117,86	117,86	241,90	241,90	241,90
E	241,90	241,90	241,90	241,90	241,90	241,90
F	330,06	330,06	330,06	339,79	339,79	339,79
G	510,71	510,71	510,71	510,71	510,71	510,71
H	779,31	779,31	779,31	779,31	779,31	
J	1240,98	1240,98	1240,98	1240,98	1240,98	
K	1809,56	1809,56	1809,56	1809,56	1809,56	
L	2733,97	2733,97	2733,97	2733,97	2733,97	
M	3525,65	3525,65	3525,65	3525,65		
N	4185,39	4185,39	4185,39	4185,39		
P	6013,20	6013,20	6013,20	6013,20		
Q	10751,32	10751,32	10751,32			
R	13273,23	13273,23	13273,23			
T	19980,73	19980,73	19980,73			
V	33653,53	33653,53				
W	51070,52	51070,52				

9.2.2 ADJUSTING RING SETTING

On a test bench without enough flow capacity, the adjusting ring (7) must be preset in the up position (about 2 notches), to enable the set pressure to be checked using a small capacity test set. The notches are counted from the very upper position (when the adjusting ring is raised up to be in contact with the disc holder)

For in-situ operation, to adjust the ring, unscrew the screw (22) first, after adjustement, **position the set screw 22 back between two notches. It must prevent the ring 7 from turning without blocking it.**

Using the table 4 here-below, the ring is then lowered a number of notches, as shown for the nozzle concerned. Lock using the screw (22).

The safety relief valve can then be lead sealed before going into use.

SOUPAPE TYPE STARFLOW			
ORIFICES / OPENINGS	NOMBRE DE CRANS / NUMBER OF NOTCHES		
	GAZ *GAS*	VAPEUR * *STEAM* *	LIQUIDE *LIQUID*
D	20	25	**
E	20	25	
F	20	25	
G	25	25	
H	25	25	
J	27	30	
K	30	45	
L	30	45	
M	35	48	
N	35	50	
P	30	45	
Q	20	25	
R	20	25	
T	18	23	
V	16	23	
W	14	20	

* : May be adjusted in-situ.

** :

- For set pressure higher than 5 bar, the ring down to maximum.
- For set pressure lower than 5 bar, get the ring down to 5 notches.

Reminder

To increase the blowdown, raise the adjusting ring.

To decrease the blowdown, lower the adjusting ring.

9.2.3 TEST PRESSURE CORRECTION ACCORDING TEMPERATURE (COLD ADJUSTMENT)

To compensate for low strength drop in the safety relief valve spring designed to operate at high temperatures, the set pressure is adjusted cold, and the pressure is then increased by a percentage given in the table 2 below.

TABLE 2							
Operating temperature °C (°F)		Vapeur				Gaz ou liquide	
From	To	Yoke + cooling extension	Open Bonnet	Closed B.+ Bellows	Closed Bonnet	Bonnet + cooling spool	Closed Bonnet
-196 (-320)	66(150)						
67(151)	315(600)		1.5%	1.5%	2%		
316(601)	430(800)	2%	3%	3%	4%	2.5%	2.5%
431(801)	540(1000)	4%	5%	5%	6.5%	5%	5%

9.2.4 TIGHTNESS CHECK USING GAS

Safety relief valve tightness is checked in compliance with the requirements of API Standard 527.

The safety relief valve is connected to a reservoir with sufficient volume to enable clean safety relief valve opening. The proper pressure gauge is before hand controlled, and selected so that the graduation area used is between ¼ and ¾ FSD.

When the set pressure has been adjusted, the outlet orifice is blanked off and reservoir pressure is increased to 90 % of set pressure.

For safety relief valves set at 3,45 bar or less, the tightness test pressure will be the pressure setting, less 0,350 bar.

A measuring device is mounted on the safety relief valve outlet blanking plate. Leak rate is then measured by counting the number of air bubbles escaping through a pipe, i.e. 6 mm, under 12 mm of water.

Counting starts after application of test pressure for 1 minute for inlet diameters up to 2", 2 minutes for diameters from 2 ½ to 4" and 5 minutes for orifices above or equal to 6".

The safety relief valve is only acceptable if the leak rate is less than the allowed bubble rate, shown in table 3, below API STD 527).

TABLE 3						
Set pressure			Set pressure		Orifices > F	
Bar	Psi	MPa	Bubbles/min	$Nm^3/24h$	Bubbles/min	$Nm^3/24h$
1,03-68.96	15-1000	0.103-6.896	40	0.017	20	0.0085
103	1500	10.3	60	0.026	30	0.013
130	2000	13.0	80	0.034	40	0.017
172	2500	17.2	100	0.043	50	0.021
207	3000	20.7	100	0.043	60	0.026
276	4000	27.6	100	0.043	80	0.034
385	5000	38.5	100	0.043	100	0.043
414	6000	41.4	100	0.043	100	0.043

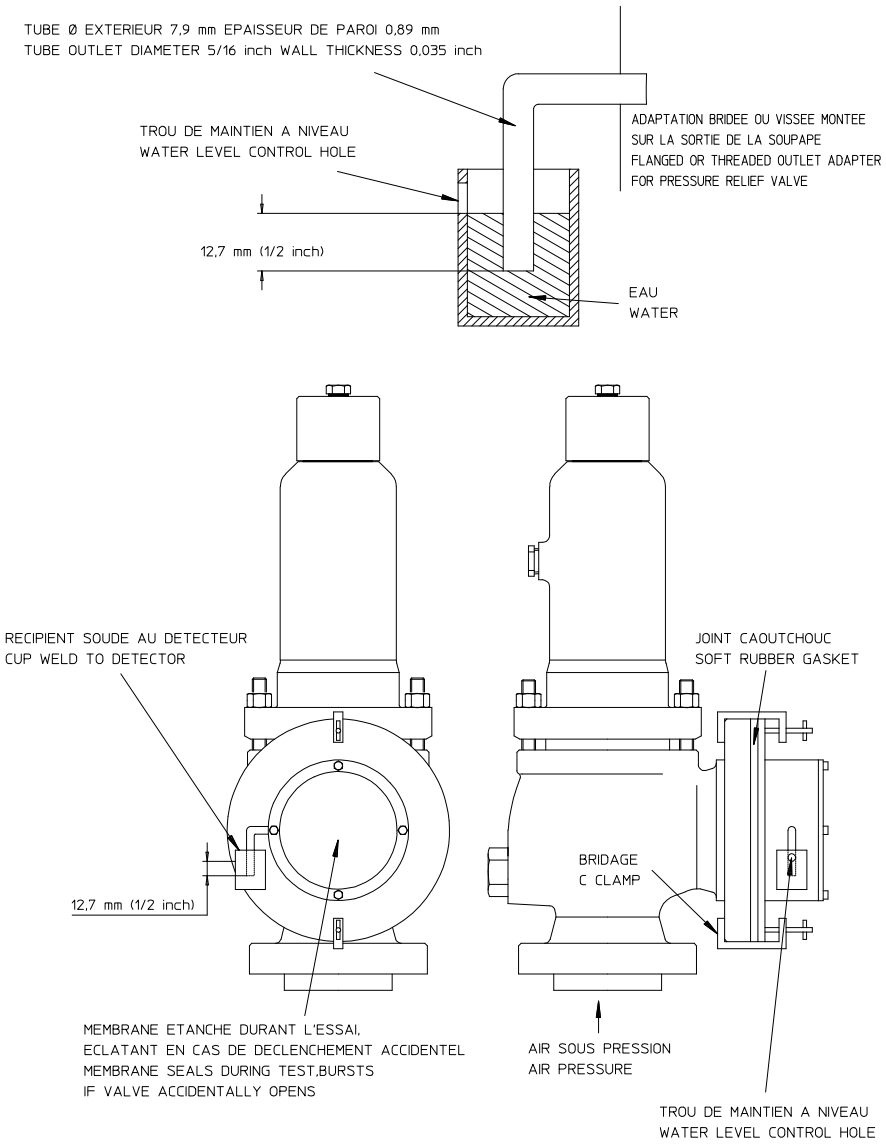
N.B.:

For steam valves with yoke (P5), test criteria is as follows:

a) on an air test bench : acceptable bubble rate according to above table 3 divided by 2 (outlet flange sealed
and body filled with water).
b) on a steam test bench : no visible or audible leak at test pressure.

For valves with soft seat, test criteria is:

a) On gas: 0 bubbles per minute at test pressure
b) On liquid: no leak at test pressure.


TUBE Ø EXTERIEUR 7,9 mm EPAISSEUR DE PAROI 0,89 mm
TUBE OUTLET DIAMETER 5/16 inch WALL THICKNESS 0,035 inch
TROU DE MAINTIEN A NIVEAU
WATER LEVEL CONTROL HOLE
ADAPTATION BRIDEE OU VISSEE MONTEE
SUR LA SORTIE DE LA SOUPAPE
FLANGED OR THREADED OUTLET ADAPTER
FOR PRESSURE RELIEF VALVE
12,7 mm (1/2 inch)
EAU
WATER
RECIPIENT SOUDE AU DETECTEUR
CUP WELD TO DETECTOR
JOINT CAOUTCHOUC
SOFT RUBBER GASKET
BRIDAGE
C CLAMP
12,7 mm (1/2 inch)
MEMBRANE ETANCHE DURANT L'ESSAI,
ECLATANT EN CAS DE DECLENCHEMENT ACCIDENTEL
MEMBRANE SEALS DURING TEST,BURSTS
IF VALVE ACCIDENTALLY OPENS
AIR SOUS PRESSION
AIR PRESSURE
TROU DE MAINTIEN A NIVEAU
WATER LEVEL CONTROL HOLE

9.2.5 TIGHTNESS CHECK USING LIQUID

For liquid, valve whose inlet has a nominal pipe size of 1 in. or larger, the leakage rate shall not exceed 10 cm^3/h/in of nominal inlet size. For valve whose inlet has a nominal pipe size of less than 1 in, the leakage rate shall not exceed 10 cm^3/h. For soft-seated valves, there shall be no leakage for one minute.

9.2.6 RESETTING SET PRESSURE

It is sometimes necessary to modify the set pressure of a Sarasin-RSBD safety relief valve.

In this case, Trillium Flow Technologies Sales Department should be consulted in order to find out whether or not the spring needs to be changed and whether the new setting is compatible with the characteristics of the valve concerned.

If the valve cannot be sent back to Trillium Flow Technologies for modification, the following rules should be respected:

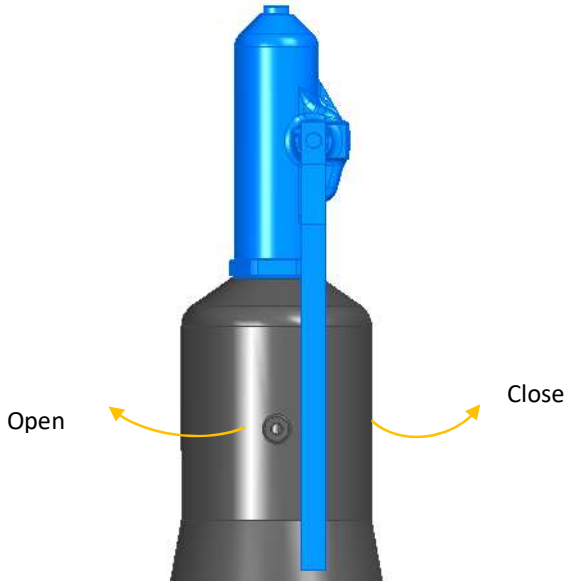
- Decrease the inlet valve pressure down to 50 % of the set pressure before proceeding with the new setting.
- If the ring setting also needs to be corrected, it is advisable to wait until the temperature has dropped before carrying out the modification in order to avoid seizing.

9.3 MANUAL LIFTING DEVICE

Our valves can be equipped with a manual lifting device. According to regulation, this device can only be activated when the pressure in the enclosure is higher than or equal to 75 % of the set pressure.

During operation, the exposed person should protect themselves from noise and possible projection of fluid.

Don’t forget to put the lever back in “close” position (until you cannot push anymore) to prevent from any leakage.



9.4 CALIBRATION CHECK WITH ONLINE TESTING DEVICE

It is sometimes required to check for the calibration of the valve at the commissioning stage or periodically. Such activity can be achieved using a specific online testing electronic device. Trillium can arrange to perform such activity.

The use of such a method instead of the lifting of the disc under operating pressure allows to prevent certain risks such a valve seat damages, superheater tube damages. It allows to eliminate high costs from feed water, fuel, and minimise the personal costs.

Only the opening pressure can be verified with this method. If required the blowdown adjustments are achieve on live flow.

9.5 VALVE SEALING

WARNING

Always seal the valve once all the adjustments are done.

Once the valve is correctly adjusted and all the tests have passed succesfully, it is necessary to seal the valve in compliance with most of the international regulations. This prevents changing the adjustments. It allows also to identify the last intervening organisation (manufacturer, service centre or end-user) that will be responsible for the last adjustments.

In case a seal is broken, please make sure to inform your inspection department and arrange a valve inspection as quick as possible.

Also, once the seal is broken, the valve will not be covered anymore by the warranty.

10. MAINTENANCE

Starflow™ parts are deburred and cleaned, in accordance with the 09.11 procedure.

11. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
The disc does not seem to move (no lift)	Test gag still in place	Remove the test gag
	Foreign material trapped in between a moving part and the fixed one.	Proceed to a maintenance operation in order to remove the part and service the potential damaged parts.
	Seizing possibly due to chattering	Change the disc-holder and the guide
The disc does not go to the rated lift	Upstream capacity lower than the rated valve capacity	Contact Trillium to find the possible alternative according your application (smaller valve, modulating POPRV, etc …)
Simmer	Adjusting ring too low.	Adjust the position of the ring.
	Equipment vibrations	Investigate the source of the vibration and strengthen the support.
Seat leakage	Damaged seat (due to none maintenance, chattering, particles (metal, sand, etc.) while reseating	Proceed to a maintenance operation in order to lap or change the disc and the nozzle.
	Part misalignment	Proceed to a maintenance operation in order to inspect the contact surfaces of each parts from the set screw to the disc. Check also the spindle righteousness.
	Disc hinge is not sufficient.	Proceed to a maintenance operation in order to inspect the disc and disc-holder hinge surface.
	Discharge piping support not sufficient and / or its weight supported by the outlet flange.	Arrange the support. Install if necessary a drip pan.
	Foreign material	Proceed to a maintenance operation in order to remove the part and service the potential damaged parts.
Long blowdown	Adjusting ring too high.	Adjust the position of the ring.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
	Built-up back pressure too high.	Identify the source of the high back pressure. If it comes from the size of the outlet line, then increase its size. If it comes from the silencer size (steam application), then change it and choose a larger one. If it comes from another instrument, please get in contact with a contractor to check the complete outlet line.
Chatter or short blowdown	Upstream pressure drop too high.	Redesign the inlet piping to reduce the pressure drop to less than the ½ blowdown value

12. SPARE PARTS

After prolonged and intensive use or in exceptional working conditions, a safety valve will need to be serviced or overhauled.

Such work must be carried out by a skilled technician. The Trillium Group offers trainings and education programmes to cover all areas of maintenance and repair. Please consult your nearest Trillium representative for more details.

To perform basic maintenance tasks within the shortest possible timeframe, it is recommended that class “A” spare parts are purchased at the same time as new valves.

Spare parts predictability	
Parts classification	Replacement frequency
A	Most frequent
B	Less frequent but critical
C	Seldom
D	Hardware
E	Practically never replaced

Parts classification can be found in section 6.2.

It is necessary to indicate the serial number which is stamped on the valve nameplate in order to guarantee the authenticity and the interchangeability of spare parts.

13. DISMANTLING

The user must make sure that the product is disposed of in an appropriate manner, according to the regulations in force in the country where the machine is installed, thus avoiding a negative impact on the environment and human health.

14. GENUINE PARTS

The use of spare parts which are not obtained from a genuine Trillium source or a Trillium accredited company exposes product, plant and personnel to high risk.Les pièces Sarasin-RSBD ™ sont conçues et fabriquées pour être utilisées uniquement dans les conceptions de soupapes Sarasin-RSBD ™.

- Sarasin-RSBD™ parts only are designed and produced to be used in Sarasin-RSBD™ valve designs.
- Sarasin-RSBD™ parts carry warranties.
- Trillium has an global aftersales network (sales offices, distributors and agents) to respond immediately to requests
- For any products which may be considered obsolete, Sarasin-RSBD™ parts may still be produced on demand.

If you are not aware of your nearest representative, please contact the manufacturing operation at the address shown below:

Trillium Flow Technologies France
Rue Jean-Baptiste Grison – ZI du Bois Rigault
62880 Vendin-le-Vieil - France
Tel: +33 3 21 79 54 50
Fax: +33 3 21 28 62 00

Aftersales department: wvcfr.aftersalessarasinrsbd@trilliumflow.com
Service : aftermarket.sarasinrsbd@trilliumflow.com
Sales : sales.sarasinrsbd@trilliumflow.com

15. CODIFICATION

- **Starflow Model Coding**

Select the correct model number and designate the applicable options or accessories when ordering STARFLOW valves.

- **Model code system**

P	3 4	J	4	4	3 0	A	—	D	/	V	—	J - M	Z

Position 1)
P: STARFLOW P3 / P4 / P5
S: STARFLOW S5

Position 2) Inlet x outlet
1. 1'' (DN 25)
2. 2'' (DN 50)
3. 3'' (DN 80)
4. 4'' (DN 100)
5. 21⁄2 '' (DN 65)
6. 6'' (DN 150)
7. 11/2'' (DN 40)
8. 8'' (DN 200)
9. 10'' (DN 250)
A. 12'' (DN 300)
B. 14'' (DN 350)

Position 3) Orifice letter
(according to API Std 526) D-E-F-G-H-J-K-L-M-N-P-Q-R-T
Additional non standard orifices : V-W

Position 4) Valve rating (ASME)
1. 150 lbs
2. 300 lbs
3. 600 lbs*
4. 900 lbs
5. 1500 lbs
6. 2500 lbs
7. 300 lbs (light - with 150 lbs maximum pressure)

Position 5) Type
3. Conventional (closed bonnet)
4. Balanced bellows
5. Steam (open bonnet)

Position 6) Configuration
10: A 351 Gr CF8M (Cryogenic)
14: A 351 Gr CF3M
15: A 351 Gr CF8C
16: A 351 Gr CF8M (Std Application)
18: A 351 Gr CF8M / A 352 Gr LCC
19: A 352 Gr LCC
30: A 216 Gr WCC
32: A 217 Gr WC6
42: A 217 Gr WC9
50: A 216 Gr WCC (Steam / Hot Water - P3 / P4)
52: A 217 Gr C12A
A201 to A206 : Alloy 20 AL1 to AL6 : Alloy 625 AY1 to AY6 : Alloy 825
AV1 to AV6 : Alloy 254 SMO CN1 to CN7 : A 351 Gr CN3MN
D1 to D6 : Duplex H1 to H6 : Alloy C M1 to M6 : Alloy 400
SD1 to SD6 : Superduplex MRA & MRB : NACE MR0103
SGA & SGB : NACE MR0175 / ISO 15156

Position 7) Flange Type
A = ASME B16.5 or EN 1759-1
P, F, G = EN 1092-1 or DIN - see table below Z = Special flanges
* Except T orifice is Class 300 flange.
** Today standard

Position 11) Special
- Nothing Nothing special
- Z Special device or requirement
(see the comments on the datasheet or consult the factory with the serial #)

Position 10) Flanges finish

- M**	Inlet or outlet smooth finish	
- J	Inlet flange finish RJ (according ASME B16.5)	
- E2	”	” Small male face
- E1	”	” Large male face
- E	”	” Male face
- F2	”	” Small female face
- F1	”	” Large female face
- F	”	” Female face
- C2	”	” Small tongue face
- C1	”	” Large tongue face
- C	”	” Tongue face
- D2	”	” Small groove face
- D1	”	” Large groove face
- D	”	” Groove face
- H	Inlet hub connectors	

Position 9) Options
- Nothing No accessories
- L Packed lever for P3/P4
- S Stellited nozzle and disc
- B Stellited nozzle
- G Stellited disc
- K Long screwed spindle for on site tests.
- V Test gag
- R Plain lever for P3/P4
- Y Soft seat disc (FKM standard)
- Y1 Soft seat disc (PTFE)
- Y2 Soft seat disc (NBR)
- Y3 Soft seat disc (EPDM)
- Y4 Soft seat disc (HNBR standard)
- Y5 Soft seat disc (FFKM standard)
- Y6 Soft seat disc (PEEK)
- Y7 Soft seat disc (PCTFE)
- Y8 Soft seat disc (VMQ)
- Y9 Soft seat disc (FFKM hot temperature)
- Y0 Soft seat disc (Special soft material and/or design)
- H Bolted cap
- N With UV Stamp : gas or steam
- W With UV Stamp : liquid (without adjusting ring))

Position 8) Spring materials
D: Chromnium alloy, aluminized coated
D1: Chromnium alloy, cadmium coated
Q: Stainless steel 316
T: 2% tungsten steel
U: 9% tungsten steel
H: Alloy 600
J: Alloy X750
M: Alloy 400
K: Stainless steel 17.4PH
X: Special material: to be defined

Pressure series according to position 3	Inlet Ø PN	1”	11/2”	2”	21/2”	3”	4”	6”	8”	10”	12”	14”
1	10								F	F	F	F
	16				P	P	P	P	G	G	G	G
2	25	P	P	P					F	F	F	F
	40				P	P	P	P	G	G	G	G
3	64			F	F	F	F	F	-	-	-	-
	100	P	P	G	G	G	G	G	-	-	-	-

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