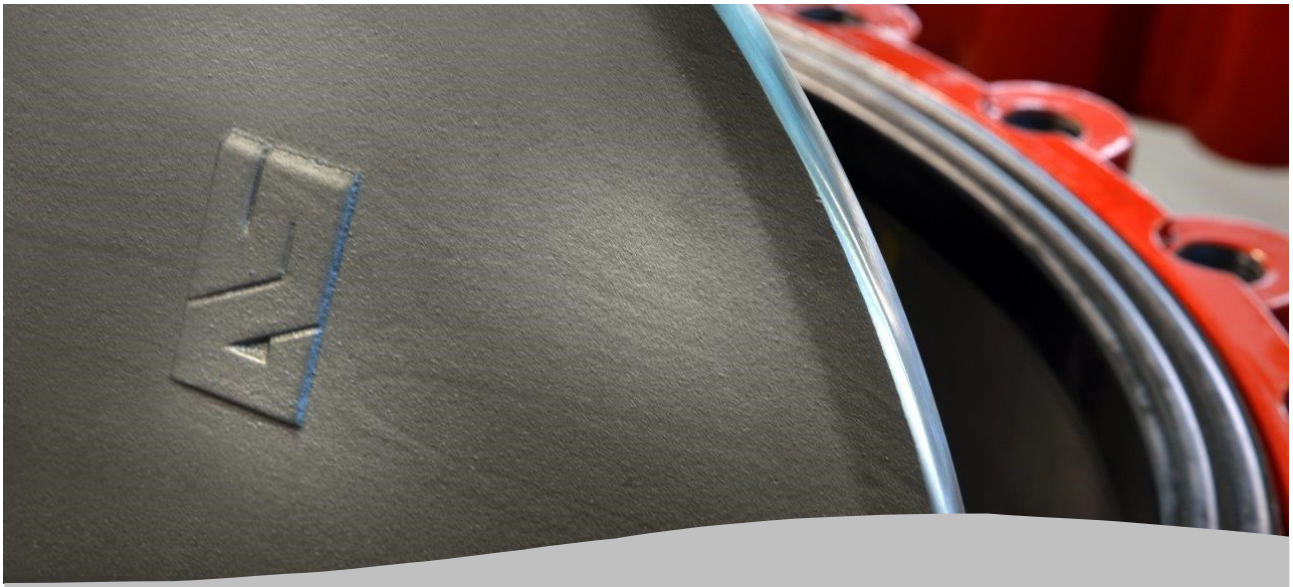
Manual de Seguridad
Safety Manual

SIGEVAL

ABSPERRKLAPPEN
VANNES PAPILLON
BUTTERFLY VALVES
VÁLVULAS DE MARIPOSA



GUARANTEE - SERVICE - EXPERIENCE - QUALITY

Safety manual for SIGEVAL butterfly valves (Edition 1, date 01/04/2024) (SIL-Manual-001)
according to IEC 61508-2 Annex D

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1.1. Scope

This manual provides necessary information for meeting the IEC 61508 or IEC 61511 functional safety standards and to design, install, verify and maintain a Safety Instrumented Function (SIF).

1.2. Responsibilities for safety

The safety of design and operation of a safety-related system, in which the device is implemented, must be ensured by manufacturer and operator.

1.2.1. Responsibility of manufacturer

- Safe design of the device.
- Providing of all safety-related information to the operator of the overall system.
- Compliance to all regulations and guidelines that allow a safe commissioning.
- Inform to the end user that this manual must be mandatory supply to the operator that do the installation and commissioning.
- Select the right valve according to the information provided during the inquiry and offer process.
- In case of ATEX required Supply the additional safety-related information to the operator of the overall system.

1.2.2. Responsibility of operator

- Instructing of personnel working on the overall system.
- Maintaining the safe operation of the overall system.
- Compliance to all regulations and guidelines regarding occupational safety.
- Ensuring of periodic test of the overall system by qualified employees.
- Follow carefully all instructions depicted in the safety manual and, in case of ATEX required, in the specific ATEX installation manual.
- In case of food grade valves following the good practices for installation of valves in such type of installation avoiding contamination of the valves.
- In case of labs free (silicon free) valves following the good practices for installation of valves in such type of installations avoiding contamination of the valves.

1.3. Terms and abbreviations

Table 1: Terms and abbreviations

FMEDA	Failure Modes, Effects and Diagnostic Analysis	Failure Modes, Effects and Diagnostic Analysis
HFT	Hardware Fehler Toleranz	Hardware Fault Tolerance
PFD AWG	Mittlere Wahrscheinlichkeit eines gefahrbringenden Ausfalls bei Anforderung	Average Probability of Failure on Demand
SFF	Anteil sicherer Fehler	Safe Failure Fraction
SIL	Sicherheits-Integritätslevel Eine von vier diskreten Stufen, die einem Wertebereich der Sicherheitsintegrität entsprechen, wobei der Sicherheits-Integritätslevel 4 die höchste Stufe der Sicherheitsintegrität und der Sicherheits-Integritätslevel 1 die niedrigste darstellt	Safety Integrity Level Discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems where Safety Integrity Level 4 has the highest level of safety integrity and Safety Integrity Level 1 has the lowest
SIF	Sicherheitsgerichtete Funktion Ein Zusammenwirken von Komponenten mit dem Ziel ein spezielles Risiko zu minimieren	Safety Instrumented Function A set of equipment intended to reduce the risk due to a specific hazard (a safety loop), Safety instrumented control/protection function
SIS	Sicherheitsgerichtetes System Konstellation einer oder mehrerer SIFs. Es besteht aus Sensor(en), Logik Einheit (en) und Aktor(en)	Safety Instrumented System Implementation system of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s)
DC	Diagnosedeckungsgrad (insofern Diagnosemöglichkeiten bestehen)	Diagnostic Coverage Factor (if diagnostic measures exist)
PTC	Proof Test Coverage Factor Deckungsgrad der Aufdeckungswahrscheinlichkeit gefahrbringender Fehler durch den Proof Test	Proof Test Coverage Factor Names how many dangerous undetected failures can be detected during Proof Test
PFH	Mittlere Häufigkeit eines gefahrbringenden Ausfalls je Stunde	Average Frequency of a dangerous failure per hour
MTBF (D)	Mean Time between (dangerous) Failures, mittlere Zeit zwischen (gefahrbringenden) Fehlern	Mean Time between (dangerous) Failures

1.4. Reference documents

- Assembling and maintenance manual.
- ATEX manual.
- Technical catalogue.
- Guarantee.
- TÜV Report and Certificate.
- FMEDA.

1.5. Related standards

- IEC 61508 Parts 1-2 and 4-7:2010 Functional safety of electrical/electronic/ programmable electronic safety-related systems.
- IEC 61511 Parts 1-3:2004 Functional safety - Safety instrumented systems for the process industry sector.
- EN 593, Industrial valves. Metallic butterfly valves.
- EN 558-1 Industrial valves. Face to Face dimension.
- ISO 5752 Metallic valves for use in pipe lines with flanges.
- API 609 Butterfly valves. Double flange, lug and wafer.
- BS 5155 Butterfly valve.
- EN 12266-1 Industrial valves. Valve pressure tests.
- ISO 5208 Industrial valves. Valve pressure tests.
- ISO 5211 Industrial valves. Part-turn actuator to valve attachment.
- EN 19 General Purpose industrial valves. Marking.
- EN 10204 Metallic products. Type documents of inspection.

General description

Butterfly valve is a critical component in most of industrial installations. The advantages that have made butterfly valve so popular are the technological improvements of materials and adaptability that are required when a simple and reliable solution is demanded. The butterfly valve is basically composed of a body, shafts, disc and an elastomeric sleeve also called seat.

Body Metal it is made from metal and several alloys according to the requested work conditions. It is not in contact with the flow medium.

Disc/Shaft They work as unique piece to produce a movement and are made from metal suitable to each fluid (coated ductile iron, stainless steel, special alloy, etc.). Disc is **spherically machined** for reduced the valve torque and increase the life time of the seat rubber.

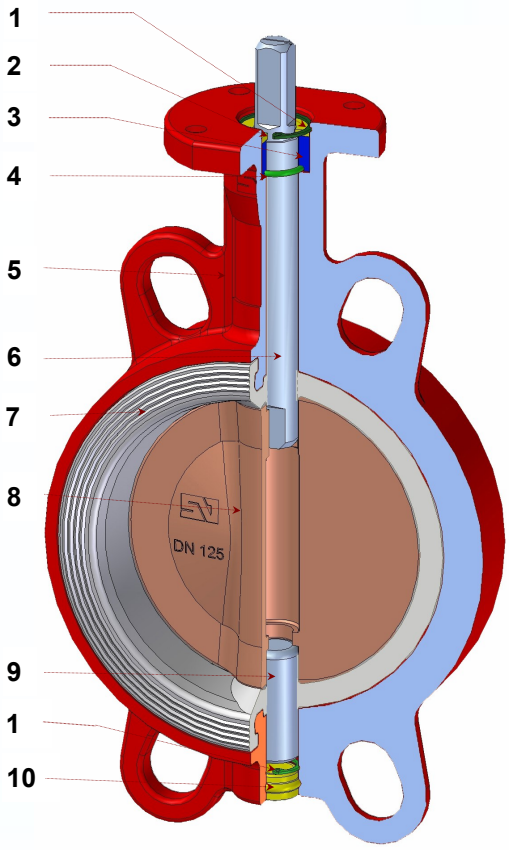
Seat: Isolate the body and assure the internal and external tightness of the valve. The seat rubber is chosen according to the fluid (temperature, pressure, chemical attack, etc.).

Assembling: It is done between standard flat flanges, **without any joint ring**, as the seat rubber produces a complete tightness, not only internally but also externally.

Testing: Valves are tested for bubble tight shut off at full pressure rating, assuring tightness and resistance. Under request we can issue certificate and manage testing of product by international classification agency, official laboratories, etc

Adventages of Sigeval valves

- *Minimum pressure drop.*
- *Low operation torque.*
- *Bi-directional bubble-tight shutoff.*
- *Interchangeable components.*
- *Easy assembling and disassembling.*
- *Hardly any maintenance.*
- *Assembling lugs for flanged installation.*



Particular characteristics

Disc Position Indicator
Marking the upper shaft.

Shaft acc. ISO 5211
For all type of actuators.

Blow out Proof Spindle (Zegi ring)
Avoid driving shaft can be displaced outwards.

Bushing
Guarantees perfect alignement of the shaft, reducing the torque.

"O" sealing ring.
Offering an additional safety factor to the shaft avoiding leakages and prevents any external contamination.

High precision fit disc and shaft squares.
Easy to dismantle and avoid looseness between shaft-disc.

Spherical disc with polished edges
Ensures low torque and extends life of elastomer seat.

High warranty coating
Epoxy powder coating, thickness up to 400 microns.

Great elastomer thickness
Gives long lasting resilience and prevents external leakage via the shafts.

Static lower shaft
Seat not damaged in operation and not leakages.

Machined surfaces
Accurate dimensions between faces gives the seat a well balanced tigtness and an identical torque in every valve.

1	*Zegi ring*	*5*	*Body*	*9*	*Lower shaft*
2	*Washer*	*6*	*Upper shaft*	*10*	*Plug*
3	*Bushing*	*7*	*Seat*		
4	*O ring*	*8*	*Disc*		

3.1. Safety function

Description of the safety functions of the device with all limits:

The safety function is to maintain the internal and external tightness and to open or shut off a flow rate, depending on the actuator's configuration.

The Sigeval valves are designed to seal internally and externally the fluid inside the body, in order the fluid is in contact with the disc and the rubber seat exclusively.

Additional o rings in the area between the shaft and the rubber, and on the rubber seat side in contact to the flanges will increase the safety.

Safety device to avoid expulsion of the shaft in case of abnormal increase of pressure is implemented.

Thickness of the body wall is oversized to keep the pressure of the fluid.

Limits:

- Rating of the valve.
- Maximum open and close cycles.
- Right selection of the components in contact to the fluid "seat and disc". Type of fluid, concentration, temperature must be checked.
- Right assembling must be done according to the manual of assembling.
- Corrosive grade resistance of the valve.
- Right installation of the full system where the valve is working.
- Shockwave and water hammer.
- Control function is not allowed.

3.2. Application and environmental limits

When designing a SIF, it must be ensured that the product is suitable for use within the expected application limits. The compatibility of the operating medium with the materials used must be agreed with the manufacturer when used in safety-relevant applications.

The product is intended for use with gaseous, liquid and powder media. The fluids used must be compatible chemically with the components in contact to the fluid (rubber seat and disc). The product is designed for use up to 10, 16 and 25 bar depending on the rating and between -50 to 200 °C depending on the combination of the components in contact to the fluid (rubber seat and disc). Detailed information on the materials of the product can be found in the technical data sheets and advised combination is specifically agreed with the technical and commercial department.

The product is not intended to be used in food industry unless specifically is declared by Sigeval as food grade use for.

The product is not intended to be used in potable water service unless specifically is considered by Sigeval as potable water approved for.

Typical fluid to be used are: (Consider in order to select the right rubber and disc, detailed information about substances, concentration and temperature is required)

- Potable water, sewage, and raw water.
- Industrial water.
- Sea water.
- Oil, gas, fuel, diesel and hydrogen.
- Powdery and abrasive products.
- Food grade products including beverages.
- Pharma products.
- Chemical products.
- etc.

When designing a SIF, it must be ensured that the product is suitable for use within the expected ambient conditions.

Which limit values for the ambient conditions must be observed?

- Wind, snow, ice, sunlight exposed, humidity, temperature, and corrosion environmental grade.
- Oscillations and/or vibrations caused by the liquid or the installation.
- Shock waves and water hammer.
- Underwater or underground service.
- Required environmental cleanliness.

The product is intended to be used indoor and outdoor depending on the combination of the components used and the level of corrosion protection. Maximum and minimum working temperature depends on the combination of the components used.

The product is not intended to be used in ATEX zones, unless specifically is labeled such ATEX grade.

The product is not intended to be used underwater, underground or in a corrosive environmental unless combination of suitable components is agreed specifically with Sigeval.

The product is not intended to be used when shockwaves and/or water hammer could occur.

The product is not intended to be used in clean environments such as "labs free" unless specifically agreed with Sigeval.

The product is not intended to be used exceeding the maximum number of cycles depicted in the guarantee.

3.3. Design verification

A FMEDA was carried out to evaluate the error-preventing and error-controlling measures. Faults in the design phase as well as during production and assembly were considered. Faults that have no influence on the safety function (no effect) were not considered.

In addition, the suitability of the design is verified by the positive result of a type examination and extensive endurance tests of the product.

These documents are referred in the 1.4 chapter.

3.4. SIL capability

The device is suitable for use in a safety-related system up to SIL 2. Taking into account the minimum required hardware fault tolerance HFT = 1, the devices can be used in a redundant configuration up to SIL 3 (see test report).

The achieved safety integrity level (SIL) of the entire safety chain must be verified by calculating the PFD_{avg} value, taking into account the architecture, the test intervals and their effectiveness, the respective automatic diagnostic devices, the average repair times and the specific failure rates of all products integrated in the safety chain. Each subsystem must be checked to ensure compliance with the minimum hardware fault tolerance (HFT) requirements.

The development and manufacturing process as well as the functional safety management applied by the manufacturer in the relevant life cycle phases of the product were tested and assessed as suitable for use in applications with a maximum safety integrity level of 3 (SC 3).

Table 2: device specific parameters

Route of Assessment		2H / 1S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode
Hardware Fault Tolerance	HFT	0
Systematic Capability		**SC 3**

Closing on demand and external tightness

Dangerous Failure Rate	λ_D	2.07 E-07 / h	207 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	9.22 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	9.31 E-05	

Closing on demand with leakage class IV acc. IEC 60534-4 and external tightness

Dangerous Failure Rate	λ_D	3.00 E-07 / h	300 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	1.34 E-03	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	1.36 E-04	

Closing on demand and external tightness

Dangerous Failure Rate	λ_D	1.97 E-07 / h	197 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	8.77 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	8.85 E-05	

Assumptions for the calculations above: DC = 0 %, T1 = 1 year, MRT = 72 h, β1oo2 = 10 %

The failure rates were determined using FMEDA. Basic failure rates of the components used were corrected depending on the manufacturer's reliability-enhancing measures.

3.5. Requirements of other components

To determine whether the product is suitable for use in a safety-related system, it is necessary to determine the PFD_{avg} value of the overall system. It is usually assumed that the final element (valve + actuator) requires up to 50 % of the total available PFD_{avg} value.

4.1. Installation

The product must be installed in accordance with the installation instructions using standard procedures. It must be ensured that the environmental conditions are within the specifications of the product.

4.2. Location and placement

The product must be accessible for physical inspection and maintenance purposes.

4.3. Pneumatic, electric, hydraulic, mechanic connections

- Requirements and recommendations for connections and supply media.
- It is recommended to use PVC hoses for pneumatic connections. The length of the pipe connections between the product and an actuator, such as a solenoid valve, must be kept as short as possible or kink-free.
- The compressed air must be dry and filtered to 50 µm. The air pressure must comply with the requirements in the IOM instructions. The compressed air capacity must be sufficient to move the valve actuator within the required time.
- Regulation of the actuator should be not modified unless agreed with Sigeval.
- Actuator cannot be disassembled unless agreed with Sigeval.
- Actuator cannot be disassembled and exchanged with other valves the same configuration as regulation is done for an specific valve.
- Manual of the producer of actuator should be followed.
- Diameter of the connection between the components should be followed according to the manual of the actuator manufacturer.
- Limits declared by the actuator manufacturer should be respected.

To operate and for the maintenance of the valve follow the "Instruction and safety manual. Assembling instructions" for standard valves and "Instruction and safety manual s/ATEX 2014/34/UE General security requirements" for the ATEX valves.

- More advice to consider are in the "Guarantee" document.
- Operator must be qualified according to the ATEX directive in case of such type of installation.
- Operator must be qualified according to pneumatic and/or electric knowledge when actuator is such way. Experience of 5 years working as maintenance and installation of this type of equipment is desirable.

5.1. Proof test interval

- Information on the test interval, scope and measures of the proof test and, if applicable, details of the PTC are required.
- General proof test consists of several open close operations with fluid inside and checking o of the coating status for repairing. Interval suggested will be annual, unless another period is specified in the guarantee.
  Just in case of not human force actuated valves, follow the interval suggested by the actuator manufacturer.
- The exact procedure for the proof test should be found in the general guarantee depicted in the technical catalogue.
  Please refer to the actuator manufacturer manual for more information.
- The competence and qualifications of the personnel are the same as in the chapter 5.
  Please refer to the actuator manufacturer manual for more information.

5.2. Maintenance

- Information on the maintenance interval, scope and measures of the maintenance and, if applicable, details of the MTC are depicted in the "Instruction and safety manual. Assembling instructions" for standard valves and "Instruction and safety manual s/ATEX 2014/34/UE General security requirements" for the ATEX valves. And also, in the "Guarantee" document.

- Expertise and qualifications of the personnel should be considered to assure an experience in assembling of soft seated butterfly valves. Minimum 5 years of experience is required and proved technical knowledge for pneumatic and electric actuators installation are required.

After the time depicted in the guarantee, complete maintenance and repair of the product must be carried out in accordance with the Manuals and guarantee. During maintenance, components that are susceptible to ageing and wear must be replaced.

The extensive maintenance measures result in a diagnostic factor of **MTC > 99 %**

5.3. Repair and replacement

"Instruction and safety manual. Assembling instructions" for standard valves and "Instruction and safety manual ATEX 2014/34/UE General security requirements" for the ATEX valves; And also, in the "Guarantee" document, must be followed when repairing the product. The SIL rating of the product may be invalidated if the repairs are not carried out with OEM parts and by unqualified personnel. For personnel the same considerations as previous chapter will be followed.

As general advise, we recommend repairing to be done in Sigeval facilities by Sigeval workers.

5.4. Useful lifetime

A period of use of more than 2 years (+ 1 year storage) respecting the maximum cycles , can only be endorsed under the responsibility of the operator, taking into account the specific conditions of use and suitable test cycles.

With regular maintenance and appropriate operation, the service life is 5 years. However, components susceptible to ageing must be replaced during periodic maintenance.

Cycles must not be higher than 2000 maximum for DN ≥ 400 and 5000 for DN < 400 in standard conditions. For other harder fluids such steam, acids, basis, solvents, abrasives and dangerous fluids cycles will be confirm by Sigeval during the guarantee issued in case.

Advice for storage and use life time are depicted in the "Instruction and safety manual. Assembling instructions" for standard valves and "Instruction and safety manual s/ATEX 2014/34/UE General security requirements" for the ATEX valves; And, in the "Guarantee" document.

5.5. Manufacturer notification

The manufacturer must be informed in the event of any type of failure. Contact should be made via the quality department at the address given. All defective products must be handed over to the manufacturer using the service/return note for further investigation and fault rectification. Information about the real working conditions such fluid, concentration, cycles, pressure and temperature and cleaning systems should be provided. Also pictures and video of the installation will be provided.