SIM GMS 0009 GLO

FLUROFLEX® BELLOWS

Instruction Manual

SGL GROUP
THE CARBON COMPANY

Service Partner

In this manual, the service partners listed below are included under the term "SGL Group".If you have any technical questions, please contact either your regional SGL Graphite Materials and Systems contact or:

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Subsidiaries of SGL CARBON SE in the area of Graphite Materials and Systems (GMS) can also provide information.

This instruction manual is subject to content-related and technical changes.

This instruction manual is replacing the former manual no. TO2853, Rev. 01

Table of content

1. About this instruction manual

All personnel who are assigned to install, operate or maintain the bellows, must have read and understood the instruction manual. Always keep it at hand in the vicinity of the bellows.

1.1 Warnings on the bellow

Ensure that the warnings on the bellow or on the packaging are always legible. Renew warnings if not legible anymore.

2. Safety

2.1 Introduction

In addition to these safety instructions, the general national statutory regulations and any other applicable standards and directions on accident prevention and environmental protection are to be observed. Consult your Service Partner in case of questions.

2.2 Correct use

The bellow may only be used and operated if in proper working condition and if the limits specified in the drawing, the nameplate, the technical documentation and this instruction manual are respected.

The admissible minimum/maximum operating pressures and temperatures and the admissible compensatory movements can be determined by means of the temperature/pressure diagrams in the product catalogue and must be adhered to.

Bellows can compensate or transmit forces of the line / plant to a limited extent. They are, however, not designed to transmit torsional forces.

Supporting rings made of stainless steel 1.4571 are not suitable for media containing chloride (e.g. HCl). In such a case consult the manufacturer which bellow is suitable.

PTFE is not resistant to chlorine trifluoride, butadiene monomers and styrene monomers.

In case of doubt the operating organisation must consult the manufacturer which bellow suits the specific application conditions and is resistant to the used operating media.

Any deviations especially with respect to the minimum/maximum permissible pressure set point (PS) or temperature set point (TS) can result in a failure of the component and represents a serious risk to personnel or equipment and therefore require the written approval of your Service Partner. This is also applicable if you intend to use non-approved operating media.

2.3 Prohibited activities

The following activities can provoke serious accidents and are therefore prohibited:

- To work on bellows which are under pressure or in operation. Shut down, depressurise, cool down and decontaminate the bellow before starting these works.
- To change specified operating conditions
- To modify the bellow, to remove or add components or to process them mechanically or by welding.

2.4 Customer service and repairs

Have all maintenance and repair works in the warranty period performed only by SGL GROUP personnel or by personnel who are trained by SGL GROUP.

2.5 Claims under warranty and liability

Claims under warranty and liability for injuries and damage are excluded if arising from:

- Incorrect use
- Failure to observe the transport and storage instructions
- Incorrect installation/dismantling or incorrect operation
- Failure to observe the operating conditions/limits
- Bellow operation with defective safety devices or incorrectly or not executed maintenance works
- Works performed during the warranty period, changes or modifications without written approval of the service partner

2.6 Residual risks

Bellows are designed in line with the technological standards currently available and the generally recognised safety regulations. To prevent safety risks to operators or damaging of the bellows, bellows may only be used for purposes described under correct use and when in proper working order ensuring safe operation. Safety precautions against external fires are not part of the design and must be put into force by the operating organisation itself.

Safety precautions in ATEX plants

The operating organisation must assess if operating states may occur which may cause electrostatic charging in the bellow and if spark discharging is a security issue in this case. If applicable, use a bellow made of conductive PTFE in terms of DIN 2874 and a suitable earthling element.

2.7 Personnel qualification and obligations

Only personnel authorised, trained, instructed and qualified for the relevant activities or SGL Group specialists are allowed to work on the bellows.

2.8 General safety instructions

- Observe and adhere to the applicable accident prevention regulations.
- Always wear your personal safety equipment.
- Malfunctions or inadmissible operating states of bellows under pressure or of corrosive or toxic substances in bellows can cause serious injuries or even death.
- Only remove protective covers of the flanges immediately before assembly. They are a protection against contamination by water and dirt and prevent that PTFE flares retract (internal restoring forces) which would make assembly difficult or even impossible.
- Since bellows are sensitive with respect to impacts, avoid heavy impacts, e.g. due to falling or setting it down with excessive force.
- Do not use sharp objects or inappropriate tools since this can damage the bellow.

2.8.1 Safety instructions for transport

- Only place bellow on a level base.
- Do not set down heavy loads on flanges.

With heavy bellows pay particular attention to the following

- Use suitable lifting and transport equipment with sufficient lifting capacity (weights see drawing, delivery note and/or brochure).
- Fix lifting accessories only to points which are suitable for transport. If necessary consult your service partner.
- If you intend to transport the bellow with fork lift truck, use a pallet.
- Never walk or stand under suspended loads.

2.8.2 Safety instructions for installation

- Secure bellows against tilting or slipping.
- When lifting, putting down and securing the bellow pay attention to its own weight (see drawing and/or brochure).

2.8.3 Safety instruction for start-up, operation, shutting down, malfunctions

- Never “steam out” the line with the bellows in place without approval from service partner.
- The surfaces of the bellow can be hot and cause severe burns.
- Never (re-)tighten or loosen screws on flanges during operation and if they are under pressure or temperature.
- Increase the pressure continuously during start-up.
- Very hot/cold media must be fed slowly.

2.8.4 Safety instructions for maintenance

Before you start working on the bellow, shut it down and allow it to cool down; depressurise it and maintain it depressurised, then vent, empty, decontaminate and rinse it thoroughly.

2.9 Personal safety equipment

When working on the bellow, wear always:

- Hard helmet
- Safety shoes
- Gloves
- Safety glasses
- Safety clothing
- If necessary respirator mask

3. Description of bellows

Bellows absorb vibrations and movements on pipe line systems, which are due to thermal length changes, thus protecting stress-sensitive components (e.g. made of glass, plastics reinforced by glass-fibre, graphite, enamelled parts etc.) from damage.

Note!
Risk of damage to the bellow.
Bellows can compensate or transmit forces of the line / plant to a limited extent. They are, however, not designed to transmit torsional forces.

A bellow consists mainly of two flanges [1/1], a PTFE bellow liner [1/2], external ring stiffeners [1/3] and limiting bolts [1/4-7]. The limiting bolts prevent that bellows are damaged due to excessive movements by thermal and mechanical reaction forces in the pipe line if the pipe supports are not sufficient. The external ring stiffeners increase the resistance to pressure and temperature. Internal ring stiffeners increase the resistance to vacuum.
Refer to the nameplate, the product catalogue or the drawing for the resistance to vacuum.
Bellows, which are designed for high vacuum (see section 3.2), have a PTFE bellow liner which is divided into two parts [2/2]. The two bellow halves are tightly clamped to each other by means of metal rings.

Universal bellows
Standard designs of bellows can compensate axial, lateral and angular movements.

Lateral or angular bellows
Bellows can be supplied in a design allowing only lateral or angular movements.

3.1 FLUROFLEX®-N 1 to 6 bellows

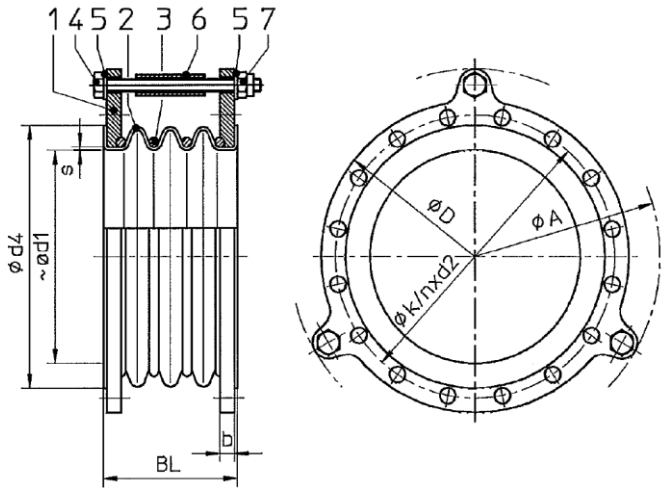

Fig. 1 FLUROFLEX®-N 1 to 6

1	Bellow flange	4	Hexagon head screw	7	Lock nut
2	PTFE bellow	5	Washer	[4, 5, 6, 7] Limiting bolts	
3	External ring stiffener	6	Spacer sleeve		

3.2 FLUROFLEX®-0 bellows (for high vacuum)

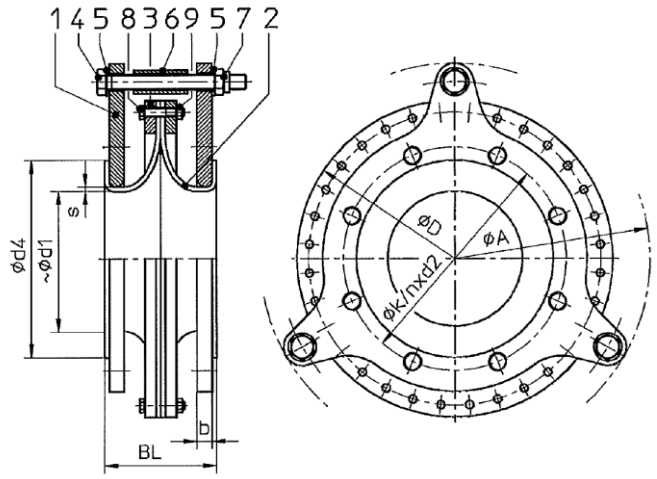

Fig. 2 FLUROFLEX®-0

1	Bellow flange	4	Hexagon head screw	7	Lock nut
2	PTFE bellow liner (2-piece)	5	Washer	8	Internal Hexagon head screw
3	Ring stiffener (vacuum support ring)	6	Spacer sleeve	9	Internal hexagon nut
[4, 5, 6, 7] Limiting bolts					

Note!
Risk of damage to the bellow.
The two bellow parts are connected by the manufacturer [2/2, 3, 8, 9] and must not be disconnected afterwards.

3.3 Nameplate

Nameplates of the bellow must not be removed or modified. In case of loss or damage they are to be replaced with the original data.

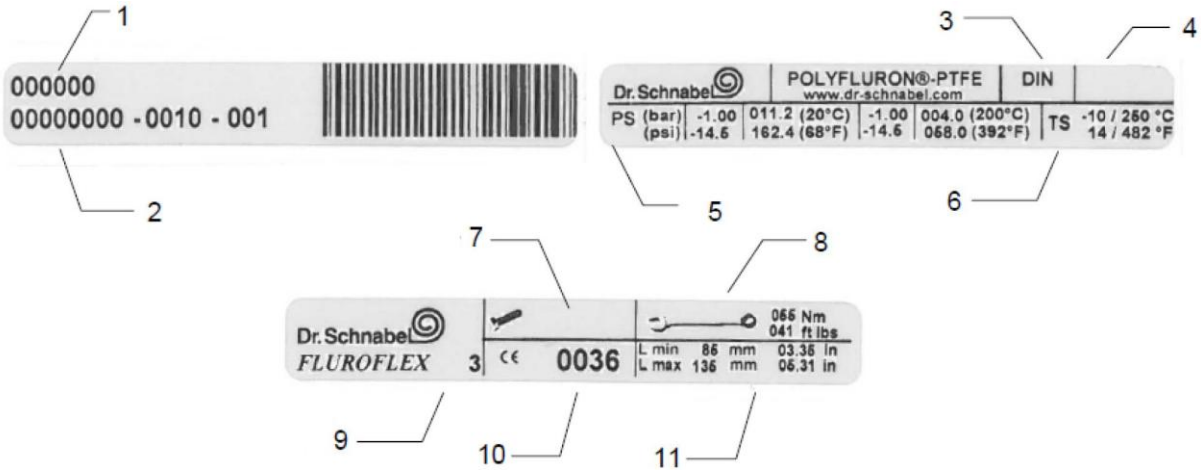

Fig. 3 Nameplates

1	Internal type number	5	Pressure setpoint (PS)	9	Bellow type
2	Serial number	6	Temperature setpoint (TS)	10	CE mark
3	Flange standard	7	Flange screws	11	Admissible axial movement compensation
4	Width setpoint	8	Tightening torque		

3.4 Pressure/temperature limits, resistance to vacuum

The values for admissible operating pressure and temperature as well as resistance to vacuum can be found on the nameplate, the catalogue or the drawing. It is imperative to adhere to the state values.

3.5 Compensation of movements and limiting bolts

See drawing in sections 3.1 and 3.2.

Bellows can compensate relative movements of pipe lines and equipment. Refer to the nameplate, the catalogue or the drawing for the admissible movement compensation value.

To protect the bellows from inadmissible movements, they are provided with limiting bolts which prevent inadmissible compensatory movements.

Note!

Risk of damage to the bellow.

Unlike bellow joints, limiting bolts do not transmit forces.

3.6 Flange connections/connecting elements

Bellows are usually supplied without connecting elements (screws, nuts) for flanges. In such a case, the operating organization has to provide the necessary connecting elements. Select and dimension the connecting elements according to the operation requirements and in line with the flange standard and the generally recognized technologies.

Further indications for the correct choice of connecting components can be extracted from the product catalogue or the technical drawing.

3.7 Gaskets

The use of gaskets with FLUROFLEX®-Bellows between POLYFLURON® sealing faces is not necessary and not recommended since gaskets may damage the PTFE lining. However, a gasket is required for connections to glass, ceramics, enamel or other materials.

Information!

In case of doubt whether gaskets have to be used and of which type, please contact your service provider.

3.8 Tightening torques at 23°C

Use only impeccable, lightly oiled screws.

Note!

Refer to the nameplate, the drawing or the table for the tightening torques.

DN	Number x thread	Md Nm	DN	Number x thread	Md Nm
25	4x M12	25	250	12x M20	85
32	4x M16	30	300	12x M20	120
40	4x M16	35	350	16x M20	135
50	4x M16	45	400	16x M24	170
65	4x M16	45	500	20x M24	205
80	8x M16	46	600	20x M27	240
100	8x M16	55	700	24x M27	290
125	8x M16	60	800	24x M30	350
150	8x M20	80	900	28x M30	440
200	8x M20	100	1000	28x M33	510

Instructions on tightening flange connections

- Use a torque wrench and NEVER use an impact wrench
- Tighten screws in increments until the final tightening torque value is achieved. In doing so, tighten the screws in cross diagonal pattern.
- The following applies in general when handling PTFE sealing surfaces: Tighten the screws as much as necessary, never as much as possible!

3.9 Accessories

3.9.1 Internal smoothbore sleeves

FXS smoothbore sleeves installed in flow direction can be used for protection from abrasive media and to avoid formation of deposits in the bellow folds.

Note!

Risk of damage to the bellow.

Internal flow liners reduce angular and lateral movements of the bellow. This must be taken into consideration by the operating organisation in the design process.

Do never install internal flow liners in vertical flow direction leading from bottom to top, otherwise deposits may form between bellow and internal flow liner.

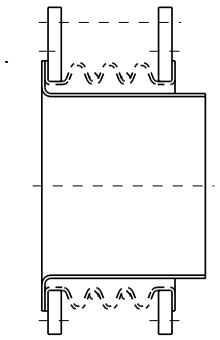

Fig. 4 FLUROFLEX® "FXS internal smoothbore sleeve"

3.9.2 Splash guard

We strongly recommend to use spray guards for all flange connections and bellows if hot, corrosive and/or perilous media are used.

Note!

We strongly recommend the use of our Tayson KLETT® resp. RAMCO® spray guarding collars.

In case of leakages they can prevent or minimize equipment damage and injuries of personnel.

4. Packaging/transport/storage

Warning!

Inappropriate packaging/transport/storage can result in serious accidents. Adhere to the safety instructions.

4.1 Items supplied

The bellows are supplied as complete assembly and in neutral installation length.

4.2 Packaging

The bellow is supplied in cardboard or wooden boxes.

- Check bellows and packaging for damage in transit.
- Do not remove the protective covers before you have installed the bellow.
- If supplied in wooden boxes, open them and check them for completeness.
- Check the tilt and shock indicators whether they show an incident.

Signs on the packaging

This side up | *Protect against direct exposure to sun* | *Fragile, handle with care* | *Keep dry* | *Anchorage point for lifting equipment*

Fig. 5 Signs on the wooden box

4.3 Transport

Adhere to the safety instructions in section 2.8.1.

4.4 Storage and preservation

Store the bellows in the original packaging until they are used.
The following provisions are to be observed:

- Store on level base.
- Do not stack bellows on top of each other.
- Store bellows only when completely empty and dry. Protect them from frost since this can destroy the bellows.
- Prevent the bellow from being contaminated by water or dirt. Protect it from damage.
- Protect the bellow from direct exposure to the sun and high temperatures.
- Only remove protective covers immediately before assembly.

5. Installation

Warning!

Inappropriate handling of the PTFE component can result in serious accidents. Observe also the safety instructions in this section and in section 2.

5.1 Preparing installation

1. Check assembly clearances
2. Check bellows for damage

Note!

Check PTFE liners for grooves and notches
Any seemingly insignificant irregularity in the liner may open up during operation and cause PTFE liner failure and result in injury and damage to property!
Contact your Service Partner if PTFE liners are damaged.

3. If intended, insert FXS smoothbore sleeve. If doing so, pay attention to the flow direction (see section 3.9.1)
4. Clean sealing surfaces

5.2 Assembling the bellows

1. Use suitable lifting equipment and fix them to the correct points.
2. Place the bellows in assembly position. The holes for the screws must be aligned precisely (observe sections 2.8.1 and 2.8.2).
3. Secure against tilting, sloping and falling down.
4. If indicated, use the relevant gaskets and pay attention to the suitability of the connecting elements (screws, nuts etc.)

Note!

Connections with through holes on both sides require a screw length that allows screws to protrude the nut only by a minimum. Otherwise, the ends can crash together because of axial compression, thus obstructing the compensation of movements.

5. Tighten flange connections to the specified values (see nameplate, drawing and section 3.8).

Note!

Install bellow as supplied and free of stress. Do not force the pipelines or equipment to fit to each other by means of the bellows. Otherwise this may exceed or obstruct the compensation potential of the bellows and the forces of the lines are transmitted.
After assembly, adjust the limiting bolts to the value of the maximum expansion (see catalogue or nameplate).

6. Retighten PTFE flares several times with the specified tightening torques (see section 3.8).
7. Check if the bellow is flush with the line or nozzle and if it is free of tension. Correct it if necessary.

5.3 Pressure test

Perform a pressure test before putting the bellow into service for the first time.

Note!

Risk of damage to the bellows!

- Observe maximum test pressure values. They can deviate from those of the plant (water: see equipment drawing; air: < 0.5 bar)
- Vent bellows during emptying so that the drained liquids do not generate a vacuum.

Danger!

(Re-)Tightening or loosening screws on flanges, while the bellow is under pressure, can result in serious accidents.
Therefore, depressurize the bellow before (re-)tightening or loosening screws.

1. Retighten screws of leaking flanges with the specified tightening torque (see section 3.8).
2. Perform the pressure test again.
3. If it is still leaking, contact Service Partner.
4. If the internal connections are still leaking, contact Service Partner.

6. Start-up, operation, shutting down, malfunctions

Warning!

Inappropriate handling of the bellow can result in serious accidents. Observe also the safety instructions in this section and in section 2.

6.1 Start-up

Preparing measures

When putting the bellows into service take the plant design into account. Perform the following steps prior to putting into service:

- Perform a pressure test before putting the bellow into service for the first time (see section 5.3).
- Perform a leak test of the assembled plant or line.

Start-up procedure

- Increase pressure and temperature up to the admissible maximum values. Observe the entire plant design in this process.

Checks after putting it into service

- Check the flange connections for leaks approx. 1 to 2 hours after the intended operating conditions (pressure and temperature) have been reached. Retighten the flange connections again in case of leaks (see equipment drawing or section 3.8).

6.2 Operation

Operate bellows only:

- Within the limits to use

Check during operation:

- Temperature and pressure
- The bellow for leaks and movement compensation
- The steel parts for corrosion
- The PTFE bellow for damage and deformation
- The lock nut of the limiting bolts for correct seating.

If a malfunction occurs:

- Take appropriate measures to rectify the malfunction (see section 6.5)

6.3 Shutting down

As during start-up, take into account the plant design during the shutting down process; the operating organisation must determine the relevant instructions.
General instructions for the shutting down process of bellows:

- If the bellow design is not intended for vacuum operation, it is imperative during shutting down to maintain at least ambient pressure, e.g. by supplying nitrogen.
- It is recommended to maintain this state after shutting down during the entire standstill period of the bellow if possible.

6.4 Restart

Increase pressure and temperature up to the admissible maximum values. Observe the entire plant design in this process.

6.5 Malfunctions

Malfunctions can cause inadmissible operating states damaging the bellow, e.g.:

- Mechanical shocks
- Thermal shocks
- Inadmissible composition of media flows
- Freezing of bellows
- Exceeding admissible pressure or temperature
- Inadmissible transmission of tension from the pipe to the bellow

Therefore:

- Provide features ensuring that inadmissible operating states are prevented even in cases of malfunctions on the bellow.
- Observe the following measures to prevent inadmissible operating states in case of malfunctions.

Warning!

Shut down line with installed bellow, depressurise and allow the component to cool down and decontaminate it before troubleshooting.

Information!

The faults listed below are a selection of possible faults. Further failures can occur in connection with plant design and/or the supplied PTFE component including all internals.

The operating organisation has the responsibility to check the listed faults including causes and remedy instructions for compatibility with the plant design and, if necessary, to revise and amend the information and to determine suitable remedial measures including immediate shutdown.

Malfunction	Cause	Remedy
Medium escapes from the flange connections	Screw force to low	Retighten screws in proper manner.
	Flanges are not precisely set or flange connections are under strain	Fit flange connections correctly.
	Sealing surfaces of flange connections or gaskets are damaged or soiled	Clean sealing surfaces and check them for damage. In case the liner is damaged or the steel parts corroded, replace the below. In case the gaskets are damaged only, renew the gaskets.
Medium escapes from internal flange connections	Leaking bellow connection.	Consult Service Partner.
Damaged bellow liner		Consult Service Partner.
Corrosion on steel components	Leakage.	Determine the cause of damage and eliminate it properly. Replace the bellow.

7. Maintenance/repair/disposal

Warning!

Inappropriately performed installation works can result in serious accidents.
Observe also the safety instructions in this section and in chapter 2.

Warning!

The PTFE component can be contaminated with hazardous or even fatal substances after operation.
Wear your personal safety equipment and decontaminate the PTFE component.

7.1 Service works

Check regularly:

- Flange connections for leaks
- Steel parts for corrosion
- Installation situation
- In case of vibration: the lock nut of the limiting bolts, in particular with high operating temperatures.

The operating organisation must determine intervals according to the medium and the operation.

7.2 Cleaning

Note!

The bellow can be damaged or destroyed due to mechanical cleaning.
Therefore never clean Bellow by sand blasting or similar methods.

7.2.1 Chemical treatment

Note!

The bellow can be damaged or destroyed due to abrasive cleaning agents.
Therefore use and dispose cleaning agents properly. Adhere to the applicable national regulations for disposal.

In most cases it is sufficient to rinse with water or to clean with cleansing agents which are appropriate for the operating medium.

7.2.2 High-pressure water jet

Note!

The bellow can be damaged or destroyed due to jet cleaning with high-pressure water.
Therefore never use high-pressure water jet for cleaning..

7.3 Searching for leaks and analyzing the damage

If the leak is not obvious, perform a leak test.

Damage analysis

If the bellow was damaged, replace the bellow immediately.
Determine the cause of damage and consult your Service Partner.

7.4 General instructions on dismantling/assembling of bellows

Note!
If the bellow must be removed from service, the works to be performed must be determined by the operating organisation since this depends on the plant design.

7.4.1 Dismantling

1. Shut down the line with the bellow (see 6.3), allow it to cool down, depressurise it and maintain it depressurised.
2. Empty the bellow and simultaneously vent it.
3. Rinse the bellow and decontaminate it.
4. Determine the order of dismanteling

Danger!
Suspended loads can cause serious injuries.
Adhere to the instructions in section 2.

Danger!
Risk of crushing!
When lifting, putting down and securing the PTFE component, pay attention to the PTFE component's own weight (see drawing).

5. Remove the bellow and place it on a suitable basis.
6. If internal smoothbore sleeves are used, remove them and put them on a suitable surface for potential re-use.

7.4.2 Assembly

Follow the instructions in section 5 for assembly.

7.5 Documentation of maintenance works

Document all service works thoroughly.

7.6 Repair

In general, repairs are not performed. Use always new bellows in case of faults/defects.

7.7 Disposal

Warning!
After operation, the bellows can be contaminated with substances hazardous to your health.
Decontaminate the bellow before disposal.

Adhere to the applicable national regulations.