


Pipe-Seal-Fix® Pipe-Seal-Flex® Installation Manual



Quick. Cost-Effective. Permanent.

PIPE 
ROBOTEC
USA

For internal pipe sleeves with a nominal diameter of
8 - 24" (DN 200 - 610 mm)

- Information on Sealings
- Preparation of the Installation Points
- Mounting of the Internal Pipe Sealing
- Technical Data

Caution:

- Please carefully read all the instructions!
- The pipeline system must be depressurised and completely emptied before starting the mounting and dismantling!
- Personal protective equipment, protective glasses, helmet and safety boots must be worn.

The non-observance of instructions and advice in the installation manual could result in malfunctions / defects on the product and / or the system which could result in personal injury and material damage.

If you need additional installation instructions or if you have questions concerning the product, please contact:

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November 2015

Dear Users,

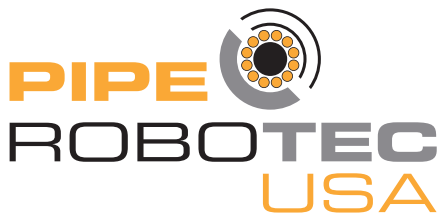
This manual has been written for installation contractors and engineering firms. We can assure you that the manufacturing of our products is based on many years of experience.

The parent company, Pipe-Robo-Tec GmbH, is a pioneer in the manufacturing of sleeve systems and has produced high quality, high performing products for more than a decade. As a result, the Pipe-Seal® system is one of the most reliable systems for the partial rehabilitation of sanitary sewer pipe systems.

This manual is meant to be a guide and only experienced installation contractors should be installing this product.

Sincerely,

The Pipe-Robo-Tec USA Team



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1. Pipe-Seal® Product Description

1.1 Mode of Operation

The Pipe-Seal® system is a continuous mechanical spanning system for the partial repair of damaged spots in sewage systems, industrial pipelines and drinking water systems.

The system is based on the mode of operation of a compression sealing in which the produced contact pressure is maintained by the locking system, so that the sealing behind is form-fit with the pipe system. The stainless steel sleeve serves as a carrier for the sealing and is always rolled up with a smaller diameter than the nominal diameter of the pipe to be repaired.

In our Pipe-Seal® system two rows of teeth are punched into each sleeve so that the interlocking pinions can nearly continuously expand and thus a conical expansion of the stainless steel sleeve can be realized.

1.2 Principles and Rules for the Layout of the System

Sewage Water

- DIN EN 681-1 "Elastomer sealing – Material requirements on a pipeline sealing for the application in the water supply and drainage"
- Data sheet DWA-M 143-5 "Rehabilitation of drainage systems outside buildings"

Drinking Water

- DIN DVGW W270
- Elastomer directive of the German Federal Environment Agency ("UBA")

1.3 Tests and Licences

The Pipe-Seal® system for the nominal diameter range 8" - 24" (200 - 610 mm) was tested according to the test criteria of the German Institute for Civil Engineering (DIBT). This test includes the following checkups:

- Testing the material identity of the elastomer sealants according to ASTM D5576
- Proving the steel quality as to resistance to sewage water according to DIN 1986-3
- Testing the high pressure flushing resistance according to DIN 19523 (practical test and material test)
- Testing the water tightness for external pressure of 7.23 PSI (0.5 bar)
- Testing the water tightness under heavy load, deformation and bending according to DIN 4060
- Drinking water test according to DIN DVGW W270
- Elastomer directive of the German Federal Environment Agency

1.4 Use / Fields of Application (Features and Benefits)

The Pipe-Seal® systems Fix and Flex can be applied for the rehabilitation of the following types of damage:

- Crack formation (longitudinal, radial and transverse cracks, in- and exfiltration)
- Shard formation
- Leaky sleeves / Sockets
- Position deviation (axial bending and / or socket misalignment)
- Close and / or seal blind inlets
- Corrosion / Flaking / Abrasion (reinforced concrete pipes with exposed concrete reinforcement)
- Improvement of pipe statics (crack and shard formation, deformation)
- Root penetration

Installation options:

A single installation allows the rehabilitation of damage with the following length:

- DN 8 - 16" (200 - 400 maximum 300 mm)
- DN 18 - 24" (450 - 610 maximum 390 mm)

When using the Pipe-Seal-Flex® sleeve, only a single sleeve is necessary for the rehabilitation of socket misalignments up to 1" (25 mm) and / or an axial bending of 8°.

Rehabilitation of major damage can take place with several sleeves installed in series (Pipe-Seal-Fix® and Pipe-Seal-End® can be combined). All the sleeves can be delivered with a flanging on one side, on two sides or without flanging.

1.5 Material Definition of the Pipe-Seal® Elements

Stainless Steel

For the sleeve, stainless steel is used with the quality 1.4571 or 1.4404 according to DIN EN 10088-1 and DIN EN 10222. This is a corrosion-resistant stainless steel meeting the requirements of municipal sewage waters (V4A). In case of an application in non-municipal sectors the resistance of the stainless steel must be verified.

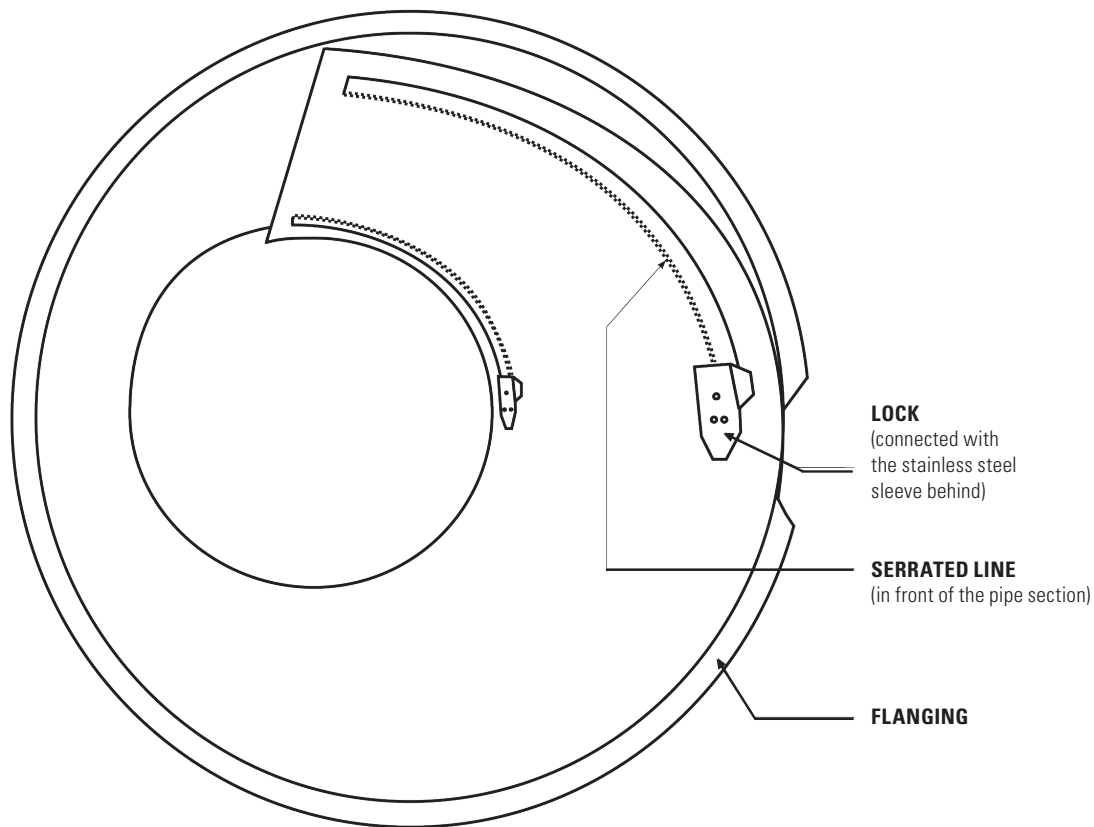
Elastomer sealing EPDM

EPDM has a high resistance to municipal sewage water. The material has temperature stability up to 266°F (130°C). EPDM provides a high resistance to acids and bases. In case of an application in non-municipal sectors the resistance must be verified.

Elastomer sealing NBR

As EPDM has no durable resistance to mineral oils and greases, the sealing must be made of NBR material. This material is characterised by its high resistance to oils and greases (carbon hydrides) and its favorable ageing behavior in these media.

2. General Layout Drawings with the Method Statements and the Mode of Operation of the Pipe-Seal® Systems



The basic principle of the Pipe-Seal® system consists in a defined rolled stainless steel sleeve, provided with an elastomer sealing, is spanned over a damaged spot. The sleeve is manufactured in a way that a permanent interlocking seal with the defected pipe wall is guaranteed.

The compression of the sealing must be maintained during the whole service life. For the single installation, the area where rehabilitation is possible is located between the sealing lips. In order to bring the whole sealing without difficulty to the rehabilitation area, it is necessary to roll the stainless steel sleeve to a defined minus allowance compared to the diameter of the pipe to be rehabilitated.

The locking mechanism mounted in the sleeve guarantees that the provided tension forces will be maintained during the whole service life. The locking mechanism (lock) of Pipe-Seal® is able to lock the slightest movement or advance due to the special layout of the row of teeth. The advance is only possible in one direction. The locking pinion blocks any attempt of a backward movement.

The individual components are described in the following sections.

2.1 Pipe-Seal-Fix® and Pipe-Seal-Flex®

Stainless Steel Sleeve

The stainless steel sleeve is the carrier of the locking system – consisting of the locking mechanism and the hold-down plate. Its function is to forward the initiated radial forces (produced by a packer balloon) to the elastomer sealing behind. It is also the support of the statics in the pipe.

Row of Teeth

The function of the row of teeth is to guide the locking pinions of the locking mechanism (lock). As soon as the sleeve has been tightened, the forces are transmitted via the row of teeth to prevent contracting or backward running of the stainless steel sleeve. Blocking forces must be transmitted from the row of teeth via the pinion to the sleeve.

Slide Strip

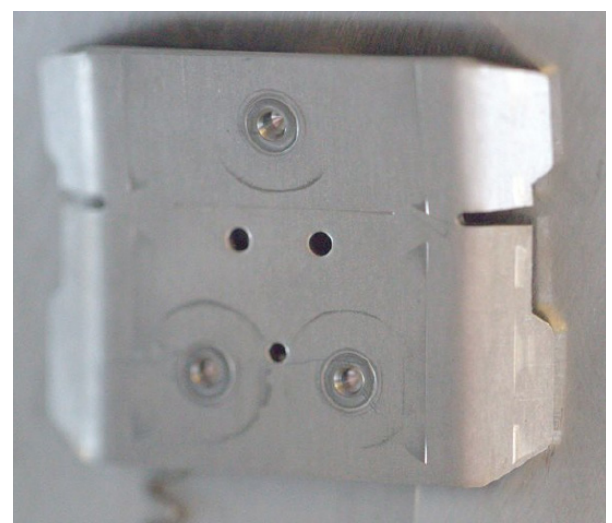
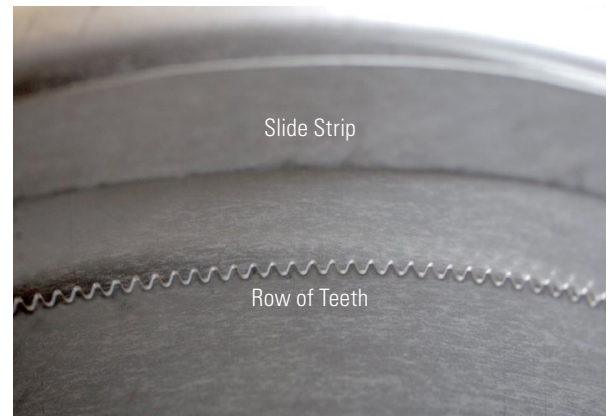
The slide strip serves as a counter bearing for the hold-down clamp and thus guarantees that the opposite locking pinions can freely move. Hence a conical expansion of the stainless steel sleeve is possible. It provides the locking mechanism guidance for the translatory motion and allows the pinion to be fixated in the row of teeth.

Hold-down Plate

The hold-down plate is there to uniformly press the expanding sleeve sheet and fixes the unchanging space for the pinions. It is the basic unit for fixing the locking mechanism.



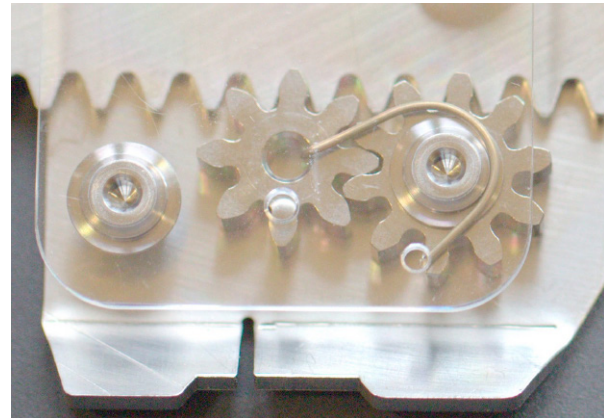
Stainless Steel Sleeve



Hold-down Plate

Locking Mechanism

The locking mechanism consists of a pinion for running, guiding and power transmitting and of a spring-loaded locking pinion. The result of the arrangement of both interlocking pinions is that the sheet sleeve can only move in one direction and that the movement in the opposite direction is blocked. The pinion is fixed on a bearing shaft. It is adjusted in its position by means of a spring element. After the expansion of the sealing, the spring element loses its function.



Locking Mechanism

Transport Lock

There are two different types of transport locks for the Pipe-Seal® elements in order to prevent an unwanted expansion of the sleeve: adhesive strips or a plastic rivet (new).

Flanging

The flange is processed on one or both sides of the outer edge of the sleeve depending on the customer's request. The flanging guarantees a better hydraulic flow of the medium and a reduction of the resistance to flow.



Stainless Steel Sleeve

2.2 Pipe-Seal-Flex®

Stainless Steel Sleeve

The stainless steel sleeve is characterised by cut-out's in the middle area. Lamellar openings are worked in off-center. Due to the arrangement of the cut-out's and the lamellar openings, the normally rigid sleeve body can be formed; and so three-dimensional movements can also be realized as well:

- A tilting for curves in case of axial bending
- A buckling in case of misalignments
- A stretching, upsetting for the compensation in the curves
- A torsional movement in case of an overlapping of misalignment and axial bending



Guide Plate

Guide Plate

The guide plate of stainless steel 1.4404 and 1.4571 serves as a cover of the cut-outs and the elongated slots and protects the elastomer sealing against infiltration. It is avoided that the sealing is pressed into the cut-outs and hence destroyed.

2.3 Elastomer Sealing

The elastomer sealing for Pipe-Seal-Fix® and Pipe-Seal-Flex® is a cylindrical sealing with superimposed tapered sealing lips. This sealing is made with an excess length – with an overlapping resp. a projecting end longer than the stainless steel sleeve. This projecting end is necessary for the sealing in case of an installation in series. In case of a single installation the projecting end is cut.

Sealing Lips

The elastomer sealing is provided with sealing lips in a defined spacing. When repairing a damaged pipe with a single sleeve installation, it is important to note that the damage is no bigger than the space between the pair of sealing lips. (The space between the pairs of lips is the actual width of rehabilitation being at the disposal.)

Rubber Projecting End

Should it be necessary to place several seals together in order to cover the damage, the rubber end projecting over the stainless steel sleeve is the sealing. The rubber is only cut at the end sealing or in case of a single installation.



Sealing Lips



Rubber Projecting End

3. Overview of the Application of Pipe-Seal-Fix® and Pipe-Seal-Flex®

Pipe-Seal-Fix®

- Non-flanged: preferential for the installation in series
- Flanged on one side: appropriate for the single installation or as a last sleeve for the installation in series
- Flanged on both sides: most appropriate for single installation with flushing safety on both sides

Pipe-Seal-Flex®

- Non-flanged: for the installation in series in case of socket misalignments up to 1" (25 mm) and / or of an axial bending 8° in combination with Pipe-Seal-Fix®
- Flanged on both sides: for single installation in case of socket misalignments up to 1" (25 mm) and / or an axial bending up to 8° including a flushing safety on both sides

On request a Pipe-Seal-Flex® flanged on one side can also be delivered.

3.1 Specification of the Application (installation begins here)

A) Inspection / Deciding on the Type of Rehabilitation

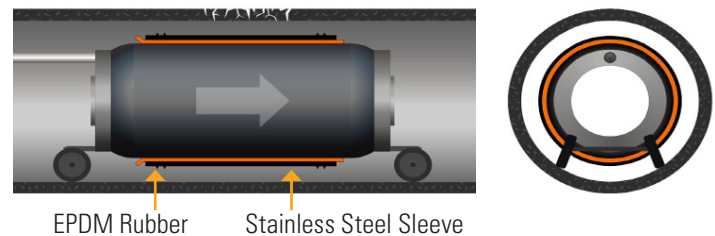
- A thorough inspection when assessing the rehabilitation option and selecting the method of repair for the stainless steel sleeve.
- Possible options:
 - Single installation Pipe-Seal-Fix® or Pipe-Seal-Flex®
 - Installation in series with Pipe-Seal-Fix® or in combination Pipe-Seal-Flex®
- It must be guaranteed that at least one access via the inspection opening or the shaft / manhole.
- The size of the shaft should allow for packer, sleeve, and the camera together.

B) Preparing the Line

The gravity line is to be prepared in a way that the camera-packer system including the sleeve can pass through without any restriction, i.e.

- The installation packer must be able to pass through without hindrance. Deposits and obstacles must be completely removed.
- The gravity line must be cleaned by flushing. Make sure all solids and other obstructions, such as discharge nozzles and root penetration, are also removed.
- It is recommended that work be performed with no sewer water running through the pipe.

Space Requirement Packer Including Sleeve



The installation packers pass with their center line approximately .2" (0.5 cm) below the center line of the pipe.

Example Calculation for the Space Requirement:

Ø Pipe: 300 mm
 Ø Rolled Including EPDM Rubber: 263 mm (see technical data sheet)

$300 \text{ mm} - 263 \text{ mm} = 37 \text{ mm}$ above and below in total

Above: $37 \text{ mm} / 2 = 18.5 \text{ mm} + 5 \text{ mm}$ (axial bending pipe / packer) = 23.5 mm
Below: $37 \text{ mm} / 2 = 18.5 \text{ mm} - 5 \text{ mm}$ (axial bending pipe / packer) = 13.5 mm

A single sleeve with a Pipe-Seal-Flex® sleeve has to be applied for the rehabilitation of socket misalignments bigger than .4" (1.0 cm)!

C) Equipment Technology – Material and Sleeve Preparation

In order to work economically, the following materials should be available:

- Sewer CC/TV camera or robot system – always adjusted to the nominal diameter of the reach (ideally the camera has a swivelling and zooming function)
- Installation packer depending on the nominal diameter
- The installation packer, track expansion and wheel sets are adapted to the respective nominal diameters of the reach
- Coupling rod for the connection to CC/TV camera and packer
- Compressed-air unit or compressor with an output of at least 72.5 PSI (5.0 bar)
- Compressed-air hose with a hose length of at least 3,937" (100 m)
- Quick release valve
- Milling robot for preparation work
- Sharp knife or scissors used in industry
- Talcum powder
- Current superglue
- Mineral Flex glue (root penetration, corrosion, armouring, reinforced concrete pipes)



Equipment needed

D) Preparation of the Stainless Steel Collar

Before the installation the product has to be checked for possible damage during transportation. It is essential to cut and / or remove all the adhesive strips. On the Pipe-Seal-Flex® the security tape is to be cut at the guide plate.



E) Prepare EPDM rubber

The EPDM rubber is powdered with talcum, so that it can be easily drawn over the sleeve. Friction between sleeve and rubber is reduced.



The EPDM rubber has to be shortened afterwards, so that the rubber is on either side about .2" - .4" (0.5 - 1.0 cm) shorter than the sleeve.



As to Pipe-Seal® products flanged on one side, the rubber can be drawn more easily over the non-flanged side. Place the EPDM rubber in a centered position on the seal, in a way that the rubber end is on either side always about .2" - .4" (0.5 - 1.0 cm) shorter than the sleeve.

It is absolutely necessary to use a sharp cutter knife or industrial scissors order to obtain a clean cut!

In the case of a single installation the sealing effect is always between the two pairs of sealing lips and the rubber-projecting end is on principle cut. In the case of an installation in series, it is absolutely necessary to preserve the rubber-projecting end.

F) Fixing the EPDM Rubber

Fixing is necessary to prevent the rubber from being pushed off the sleeve or folded during the transport to the damaged spot. The superglue is to be evenly applied on maximum 4 points at the sides opposite to one another. The glue must not contact the area of the sliding and moving sheet metal parts and locking components.



G) Positioning of the Sleeve on the Installation Packer

The Pipe-Seal® sleeve must be positioned in such a way that the locking mechanism is always at the crown during a later expansion process.

In the case a Pipe-Seal® seal flanged on one side is used; the flanged side must principally be mounted in the opposite direction to the flow direction. Therefore it is important to watch the way that the sleeve is drawn on the packer.

The Pipe-Seal® sleeve has to be fixed onto the installation packer such that a continuous camera inspection of the installation procedure is possible at any time. A uniform overall picture is absolutely necessary!

Preferably, the locking system should always expand at the same crown height and in the same direction. This is why it is absolutely necessary that the lock on the installation packer is skid-proof and positioned with 7.25 PSI (0.5 bar) between 11 or 1 o'clock.



12 o'clock Position

Important criteria for the exact positioning of the lock:

- Improvement for passing through
- Free moving space
- The installation process can be better documented
- Prevention of obstructions in the outflow

3.2 Single Installation – Installation of a Flanged Sleeve

The Pipe-Seal® sleeve flanged on one side must always be installed with the flanging in the opposite direction to the flow direction.

The sleeve with the EPDM rubber should be adjusted in the center of the damage. Then a pressure of about 21.8 - 29 PSI (1.5 - 2.0 bar) is built-up.

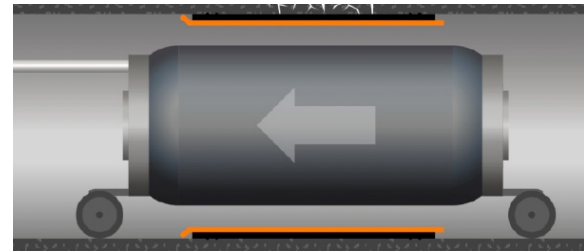
A correction of the position is still possible now!

After having fixed the exact position of the Pipe-Seal® sleeve, the final installation pressure can be built-up (annex). The flanging is about .12" - .2" (3 - 5 mm) depending on the nominal width of the sleeve and hence covers the EPDM rubber. As soon as the installation procedure has been finished, a control by means of a CC/TV camera is required. Thus it can be checked whether a retightening of the sleeve is necessary.

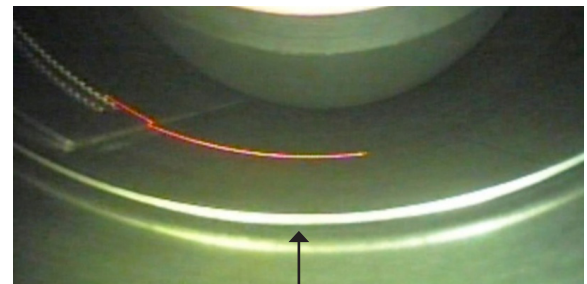
Please watch that the flanging does not butt against the pipe wall!

Note to the Reflection

In a vitrified clay pipe or in case of an installation in series in a steel pipe, reflections may occur after the installation procedure due to the light of the CC/TV camera. This can be avoided by changing the camera perspective.



Flanging in opposite direction to the flow

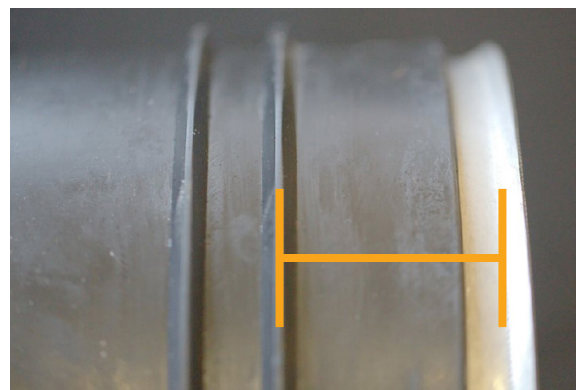


Reflection

3.3 Installation in Series

When the damage is bigger than approximately 11.8" (30 cm) (space between the sealing lips), several non-flanged sleeves must be set:

- Basically, the installation in series is carried out from the low point (direction opposite to flow).
- In case of an installation in series it is absolutely important that the first and the last sealing lip is applied at least 5.9" (15 cm) outside the damaged spot.
- It is imperative to use the rubber projecting end!



Distance sealing lip to sleeve

The last sleeve (flanged on one side) is installed without a rubber-projecting end in the opposite direction of the flow direction (see description single installation). Like in the single installation, one must care for the installation pressures in the installation in series as well.

During the installation in series, small misalignments result from the sleeve overlapping (but they are not an obstacle to the outflow). Therefore it makes sense that the installation takes place in the opposite direction of the flow direction.

When passing through the Pipe-Seal® sleeve, it is important that folding does not occur at the rubber projecting end. Should this happen, you must drive back completely, so that the projecting end can again straighten and you repeat the procedure.

3.3.1 Installation in Series Step-By-Step

A) Preparing the Pipe-Seal® sleeves

- Find out how many sleeves are necessary (e.g. three sleeves for a pipe length of 40" (1 m) – two non-flanged, one flanged on one side).
- Sheathe the Pipe-Seal® sleeve with EPDM rubber and fix it (s. single installation).
- Do not cut the projecting end of the rubber of the non-flanged sleeves!
- The last sleeve is flanged on one side. Here, the projecting end of the rubber must be cut.

B) Positioning

- Position the first sleeve on the packer in such a way that the sleeve is skid-proof (approximately 7.23 PIS [0.5 bar]) and supervision with a CC/TV camera is possible.
- The first sleeve (contrary to the flow direction) must be positioned with the first sealing lip at least 5.9" (15 cm) outside the damaged spot.
- Expand the sleeve with the installation pressures (annex).

C) Overlapping of the Sleeves

- Pass with the second sleeve through the first sleeve to about $\frac{1}{5}$ " (0.5 cm) behind the second lock. Thus about $\frac{3}{5}$ " (1.5 cm) is available for the overlapping of the sleeves.
- It is important that folding does not occur at the rubber projecting end of the first sleeve and that overlapping of the second sleeve is not placed over the lock!
- Now expand the second sleeve.
- Position the installation packer anew on the overlapping sleeves and provide the appropriate installation pressure.
- Due to the overlaps the rubber is sealed inside the overlapping and sealing lips inside the projecting end of the rubber! Should you need any more sleeves (depending on the length of damage), the procedure will be repeated.

D) Last Sleeve

The last sleeve with the flanging on one side is installed as described under B. Pay attention to that at the last sleeve the last sealing lip is positioned at least 5.9" (15 cm) outside the damage.

Caution!

In the case of overlapping of the sleeves, the sleeve must in no way be placed on the locking mechanism. The bearing surface of lock and sleeve end has enough space to guarantee an overlapping.

The last sleeve should preferably be flanged on one side. The projecting end of the rubber must be cut. The flanging shows in the opposite direction to the flow!

Please consider that in case of longitudinal cracks, rehabilitation must take place from socket to socket, as longitudinal cracks usually run over the whole pipe length. As to the rubber overlapping, be careful that folding does not occur, because then the optimal sealing effect of the sleeve can no longer be guaranteed.

4. Misalignments and Axial Bending with Pipe-Seal-Flex®

Socket misalignments which are bigger than .4" (1.0 cm) can be best rehabilitated with a Pipe-Seal-Flex® sleeve. This sleeve is flexible, it is conically expanding and it can be ideally adjusted to the pipe – appropriate for misalignments to 1" (2.5 cm) and / or an axial bending of 5°.

The installation of the sleeve must be carried out the following way:

1. Prepare the Sleeve

- Pour talcum powder on the EDPM rubber. Carefully slide the EDPM rubber to the first transport lock.
- Cut no more than 50% of the safety tape. Draw EPDM rubber to the second transport lock and repeat the procedure until the last one just as described before.
- Afix the EPDM rubber with superglue at four points opposite to one another.
- The installation packer must be positioned with approx. 7.25 PSI (0.5 bar) in such a way that CC/TV supervision is possible.

2. Installation

- Transport Pipe-Seal-Flex® to the damage and find out the exact location. The sleeve should be positioned in the center of the damage.
- Expand the installation packer with approx. 7.25 - 21.8 PSI (1 - 1.5 bar). Completely relieve pressure from the packer and do not change the position of the packer. Restart expansion of the packer to 29 - 36.3 PSI (2 - 2.5 bar). Then, completely relieve pressure from the packer.
- Now, position the installation packer in the center of the rear lock and apply the appropriate installation pressures (acc. to list). Then again completely relieve the packer.
- Move the packer to the front lock and repeat the procedure as described above.

3. Control

- With a CC/TV camera, it must now be verified once more, whether the Pipe-Seal-Flex® entirely butts against both sides of the pipe wall. If so, the installation procedure is finished. If not, repeat the last two steps.

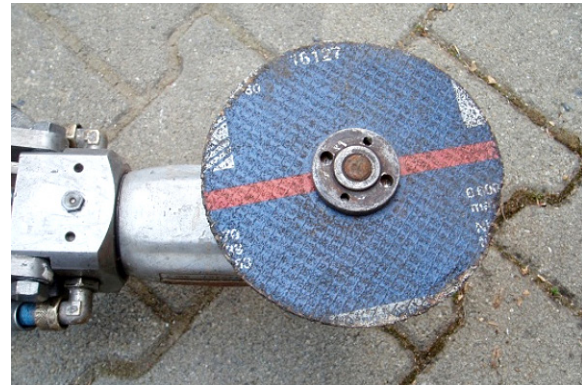
Note

Should an installation in series, usually done with Pipe-Seal-Fix®, require rehabilitation with Pipe-Seal-Flex®, the products can be combined without difficulty. Please hold out for the case when you need a flanged or a non-flanged sleeve!

5. Removal of Placed Pipe-Seal-Fix® and Pipe-Seal-Flex® Sleeves

Blind inlets or misfit dislocation are often closed with a stainless steel Pipe-Seal® sleeve. Should these sleeves be removed from the blind inlets and the misfit dislocation, the locking mechanism can be destroyed. For this purpose a milling robot is equipped with a common flex disc for metals.

In order to remove the sleeve, it is necessary to cut each lock, so that the sleeve with the EPDM rubber can contract again a bit due to the surface tension. The sleeve has loosened in the pipe and can be removed without effort.



6. Special Applications with Pipe-Seal®

6.1 Pipe-Seal-Fix® in Tight Pipe Systems

The sealing of the Pipe-Seal-Fix® sleeve is provided by the EPDM sealing rubber on a compression basis. Thus excellent sealing results are obtained. When Pipe-Seal-Fix® is used in tight pipe systems there is the risk that in the space between the pairs of sealing lips and the old pipe an overpressure is built-up. This effect arises especially in pipe systems with a smooth pipe wall and a tight pipe structure (plastic pipes, GFRP pipes and glazed vitrified clay pipes). This enclosed air cushion may have an influence on the flushing safety. The Pipe-Seal-Fix® sleeve might shift when a high-pressure jet hits on the sleeve edge or the high-pressure jet might penetrate between the sleeve and the old pipe and then further build-up the already existing overpressure. Tests have shown that the overpressure slowly decreases by diffusion.

6.2 Root Penetration

In case of pre-existing root penetration, a special procedure is required to prevent future root penetration after the rehabilitation procedure is completed. Since roots can continue to grow along the sleeve, they will seek a way into the pipe through the sealing lip. By following the special procedure below, this can help reduce the chance of this occurring.

- Remove all penetrating roots before rehabilitation.
- Apply a high alkaline mineral flex glue to the EPDM rubber sealing between the interior sealing lips to the sealing lip height.
- It is absolutely necessary to use a product with adhesive properties so that you do not lose the applied material in the reach. The flex properties provide in addition that the applied material can be overstretched with the EPD rubber and does not tear.

Annex

Survey : Contact Pressures

Type of Pipe	Damage	Nominal Diameter	Contact Pressure
PVC, concrete, asbestos cement and vitrified clay pipe	Longitudinal cracks	7.5" (188 mm)	58 - 65 PSI (4.0 - 4.5 Bar)
		7.9" (200 mm)	43.5 - 50.6 PSI (3.0 - 3.5 Bar)
		9.8 - 31.5" (250 - 800 mm)	39.1 - 43.5 PSI (2.7 - 3.0 Bar)
	Transverse cracks, leaky sockets	7.5" (188 mm)	58 - 65 PSI (4.0 - 4.5 Bar)
		7.9" (200 mm)	50.6 - 58 PSI (3.5 - 4.0 Bar)
		9.8 - 31.5" (250 - 800 mm)	43.5 - 50.6 PSI (3.0 - 3.5 Bar)
GFRP (PE, PP), reinforced concrete and grey cast iron pipes	All	7.5" (188 mm)	58 - 65 PSI (4.0 - 4.5 Bar)
		7.9" (200 mm)	43.5 - 50.6 PSI (3.0 - 3.5 Bar)
		9.8 - 31.5" (250 - 800 mm)	43.5 - 50.6 PSI (3.0 - 3.5 Bar)

The listed contact pressures are standard values.

Important: Watch dwell time and setting time of the rubber!

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