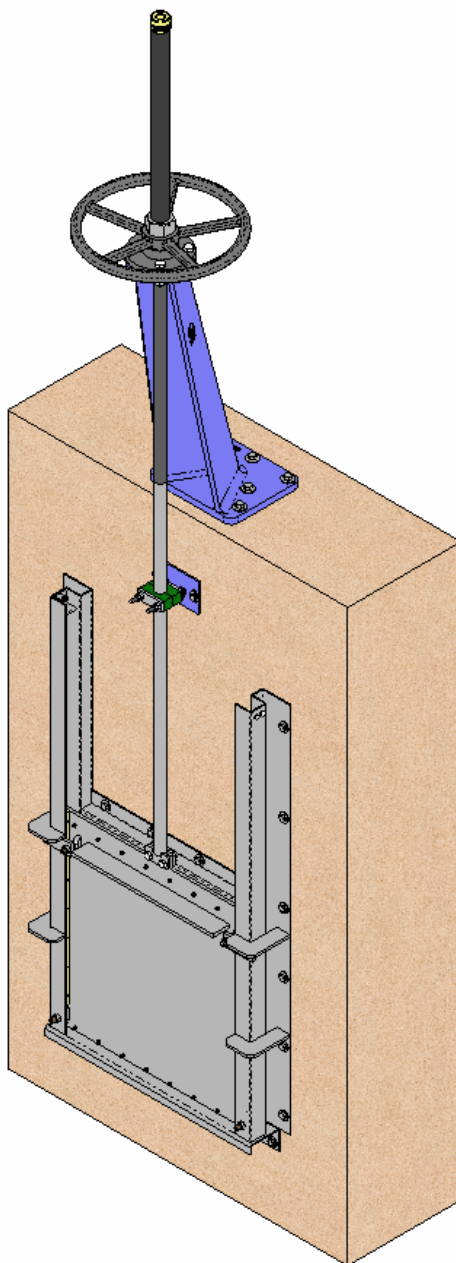




16/11/2011

INSTRUCTIONS AND MAINTENANCE MANUAL

SERIES: MC



ASSEMBLY

THE MC PENSTOCK COMPLIES WITH THE FOLLOWING:

Machinery Directive: **DIR 2006/42/EC (MACHINERY)**.

Pressure Equipment Directive: **DIR 97/23/EC (PED) ART.3, P.3.**

Potentially Explosive Atmospheres Directive (optional): **DIR 94/9/EC (ATEX) CAT.3 ZONE 2 and 22 GD.**

The **MC** penstock complies with the Directive on Equipment and Protective Systems for Potentially Explosive Atmospheres. In these cases the logo will appear on the identification label. This label shows the exact classification of the zone in which the penstock can be used. The user is responsible for its use in any other zone.



HANDLING

When handling the equipment please pay special attention to the following points:

- **SAFETY WARNING:** Before handling the penstock, check that the crane to be used is capable of bearing its weight.
- Do not lift the penstock or hold it by the actuator. Lifting the penstock by the actuator can lead to operating problems as it is not designed to withstand the penstock's weight.
- When lifting the penstock, take care not to damage the sealing joints, as this may lead to leakage during the operation of the penstock.
- To prevent damage, especially to the anticorrosive protection, it is recommended to use soft straps to lift the CMO wall penstocks. These straps must be secured around the side profiles in the upper part of the body.
- If the equipment is packed in wooden boxes, these must be provided with clearly marked holding areas where the slings will be placed when securing them. In the event that two or more penstocks are packed together, separation and securing elements must be provided between them to prevent possible movements, knocks and friction during transport. When storing two or more penstocks in the same box you must ensure they are correctly supported to prevent deformations. In the case of dispatches by sea we recommend the use of vacuum bags inside the boxes to protect the equipment from contact with sea water.
- Pay special attention to maintaining the correct levelling of the penstocks during loading and unloading as well as during transport to prevent deformations in the equipment. For this purpose we recommend the use of mounts or trestles.



INSTALLATION

In order to avoid personal harm and other type of damage (to the facilities, the penstock, etc.) please follow these instructions:

- The staff responsible for the installation or operation of the equipment must be qualified and trained.
- Use suitable Personal Protective Equipment (PPE) (gloves, safety boots, goggles...).
- Shut off all lines that affect the penstock and put up a warning sign to inform about the work being performed.
- Completely isolate the penstock from the whole process. Empty the duct.
- Drain all the fluid from the duct through the penstock.
- Use manual rather than electric tools during the installation and maintenance, in accordance with **EN13463-1(15)**.





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Before installation, inspect the penstock to ensure no damage has occurred during transport or storage. Make sure that the inside of the penstock body and, in particular, the seal area are clean. Inspect the wall intended for installation of the penstock, making sure it is clean and flat.

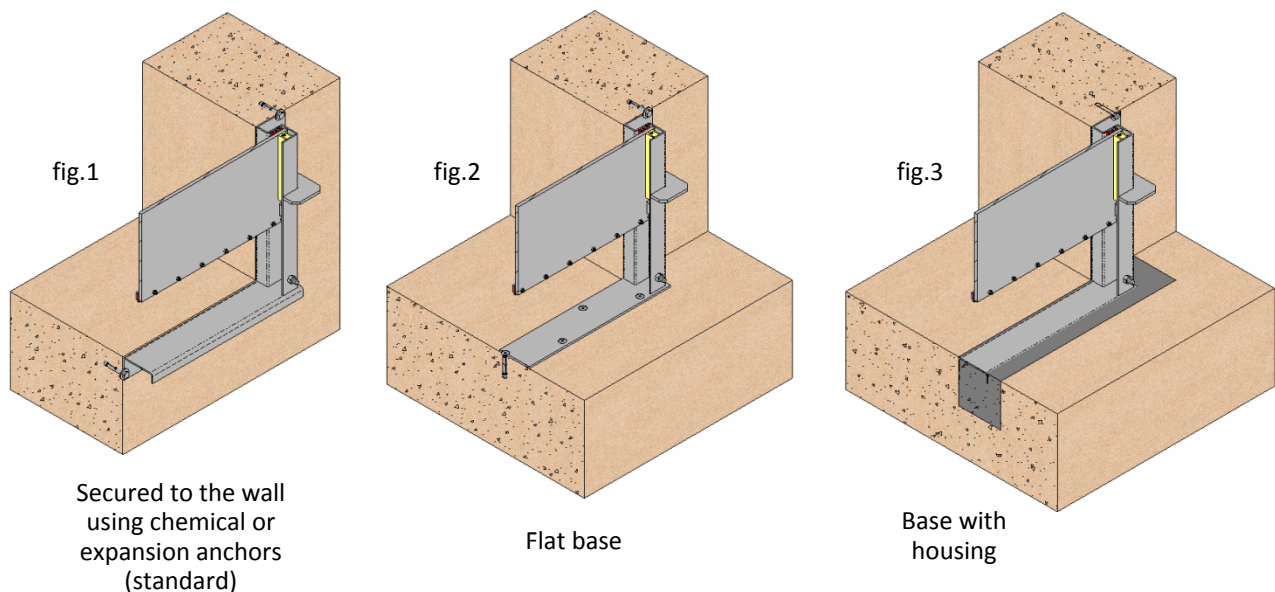
The **MC** penstock can be unidirectional or bidirectional:

- When **bidirectional**, the fluid may come in one direction or another.
- When **unidirectional**, the fluid always comes in the same direction. It is necessary to define whether it is favourable or unfavourable:
 - If it is favourable, the flow direction presses the penstock against the wall.
 - If it is unfavourable, the fluid direction tends to separate the penstock from the wall, in this case the design of the penstock is identical to bidirectional.

ASPECTS TO BE CONSIDERED DURING ASSEMBLY

The most common system to mount these penstocks is supported on the wall and secured with chemical or expansion anchors (fig. 1), although, as can be seen in fig. 2 and fig. 3, there are other assembly options.

Whatever the fastening option, the upper and side profiles are always secured with chemical or expansion anchors; for this reason it is very important that the wall is completely flat, otherwise the body could become deformed and suffer irreparable damage when starting to tighten the anchors. It is therefore recommended to use a flat rule when screwing down the body. Support the rule on the body and begin to tighten the chemical or expansion anchors, and stop tightening as soon as the body begins to deform.



- Proceed as follows to mount the penstock using chemical or expansion anchors (the most common way, fig. 1):
 - Start by placing the penstock completely open on the wall, ensuring the passage of the penstock coincides with the wall orifice.
 - Using the holes of the body of the penstock as a guide, make the boreholes necessary in the wall for the chemical or expansion anchors.

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- Remove the penstock and apply sealing paste such as SIKAFLEX-11FC or similar where the penstock is to be located, in order to prevent leakages between the body and the wall.
- Return the penstock to its location above the sealing paste and introduce the chemical or expansion anchors. These anchorings must also be suitable for the operating conditions and their measurements must in accordance with the approved plans.
- Once all the chemical or expansion anchors are in place, carry out the initial tightening with low torque and then, once all the anchors have been slightly tightened, carry out the final crosswise tightening. Tighten using a flat ruler, avoiding overtightening which may cause deformation of the penstock. The final torque must be correct in accordance with the applicable standard.

This procedure can be used both for flat base (fig. 2) and standard penstocks (fig. 1).

- Proceed as follows to mount the penstock with the base embedded in the concrete (fig. 3):
 - The civil work must include housing in the ground, which must be checked to be of sufficient size and clean.
 - Position the penstock in the housing and align it with regards to the wall orifice, ensuring that the base of the penstock is level with the civil work, thus ensuring there is no protrusion in the base, guaranteeing entirely continuous passage.
 - Keeping the penstock in this position, make the boreholes necessary for the upper and side profiles, using the holes of the body of the penstock as a guide.
 - Remove the penstock and apply sealing paste such as SIKAFLEX-11FC or similar where the penstock is to be located on the wall, in order to prevent leakages between the body and the wall.
 - Return the penstock to its location above the sealing paste and screw down with chemical or expansion anchors using the usual procedure, namely with the help of a flat rule, screwing crosswise and without excessive force.
 - After correctly securing the upper and side profiles, proceed with the second layer of cementing. This involves filling the base housing with concrete, ensuring there is no protrusion in the passage of the fluid.

The penstock can be installed completely with chemical or expansion anchors or with the base embedded in the concrete. In either case, the following points must be taken into account:

- The equipment must be firmly secured to the wall.
- As regards scaffolding, ladders and other auxiliary elements to be used during the assembly, follow the safety recommendations indicated in this dossier.
- Once the equipment has been assembled, make sure that there are no elements which can interfere with the through conduit movement.
- Make the relevant connections (electrical, pneumatic, hydraulic) in the equipment's actuator system following the instructions and wiring diagrams supplied with it.
- The assembly of the equipment must be coordinated with the site's control and safety staff and no modifications are permitted in the equipment's external indication elements (limit switches, positioners, etc.).
- When operating the equipment follow the safety recommendations indicated in this dossier.



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ASSEMBLY POSITIONS

This type of penstock is mounted on vertical walls, in which there is a square, round or rectangular orifice; this orifice may be at a certain height (fig. 5) or at ground level (fig. 4). The position of the penstock is always vertical.

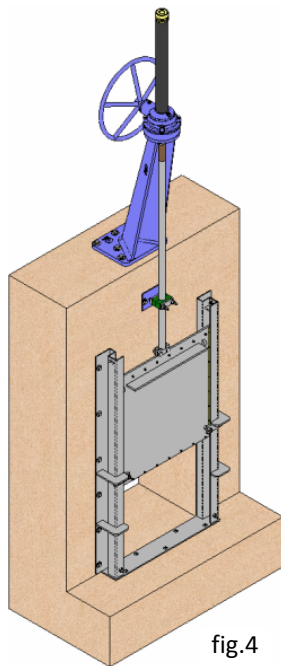


fig.4

Once the penstock has been installed, check that all the screws and nuts have been correctly tightened and that the whole penstock operation system has been correctly adjusted (electrical connections, pneumatic connections, instruments,...).

All CMO penstocks are tested at its facilities, although the penstock may have become damaged during handling or transport. Once the penstock is installed, it is therefore very important to check that there is no leakage when fluid load is applied to the penstock.

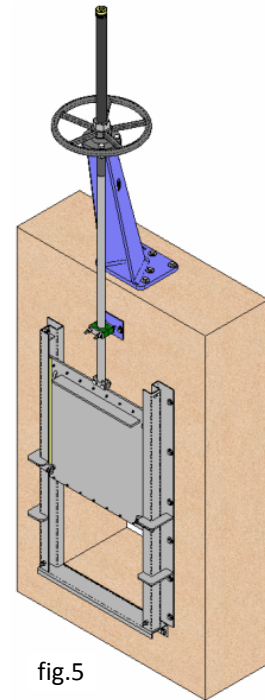


fig.5

Once the penstock is installed in its place, check the electrical or pneumatic connections. If the penstock has electrical accessories or you are in an ATEX zone, earth connections must be made before operating it.



If you are in an ATEX zone, check the continuity between the different elements of the penstock (EN 12266-2, annex B, points B.2.2.2. and B.2.3.1.). Check the earth connection of the penstock.

ACTUATOR

HANDWHEEL (rising stem, non-rising stem and with gear box)

To operate the penstock: Turn the handwheel clockwise to close or anticlockwise to open. We can stop turning the handwheel at any degree of opening of the penstock; the through conduit will maintain its position since the actuator is self-locking.

CHAINWHEEL

To operate the penstock pull one of the chain's vertical drops, taking into account that sealing is carried out when the chainwheel turns clockwise. We can stop pulling the chain at any degree of opening of the penstock; the through conduit will maintain its position since the actuator is self-locking.

LEVER

First loosen the position locking clamp located on the yoke. Once it is unlocked, raise the lever to open it or lower to close it. To complete the operation lock the lever again. This actuator also allows the possibility of locking the through conduit at any degree of opening.



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PNEUMATIC (double and single acting)

CMO pneumatic actuators are designed to be connected to a pneumatic grid of between 6 kg/cm² and 10 kg/cm².

The pressurised air used for the pneumatic actuator must be correctly dried, filtered and lubricated. This type of actuator does not require any adjustment, due to the fact that the pneumatic cylinder is designed for the exact stroke required by the penstock.

HYDRAULIC (double and single acting)

CMO hydraulic actuators are designed to work at a standard pressure of 135 kg/cm² (other pressures can be used in accordance with needs).

This type of actuator does not require any adjustment, due to the fact that the hydraulic cylinder is designed for the exact stroke required by the penstock.

MOTORISED (Rising or non-rising stem)

If the penstock incorporates a motorised actuator it will be accompanied with the electric actuator supplier's instructions.

In manual actuators (handwheel, gears, lever, etc), it is not necessary to exercise excessive force (max. 25 Kg/m) for the lower seal to close correctly. If excessive force is used, the lower seal is not improved and there is a risk of causing irreparable damage in the equipment.



Motorised actuators must have torque limiters and limit switches in order to prevent damage to the equipment.

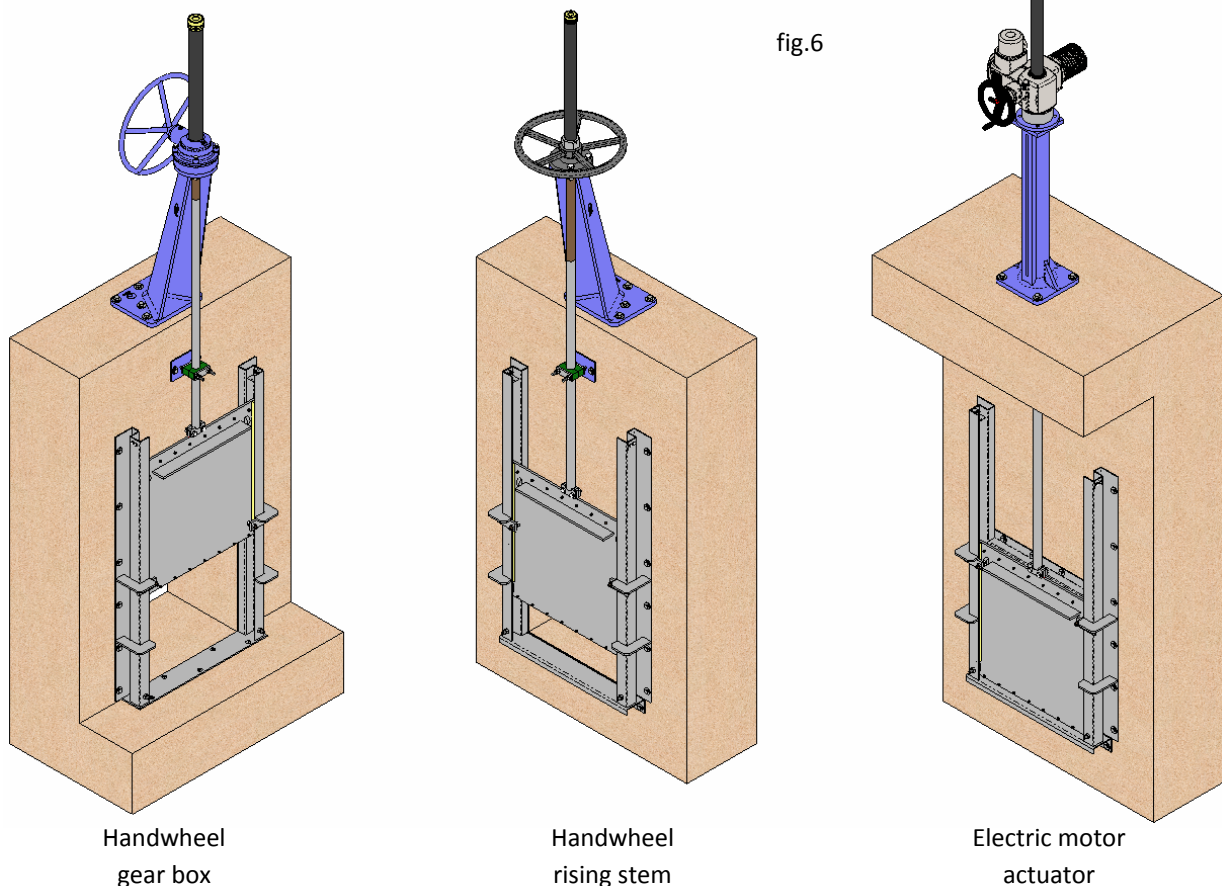


fig.6

Handwheel
gear box

Handwheel
rising stem

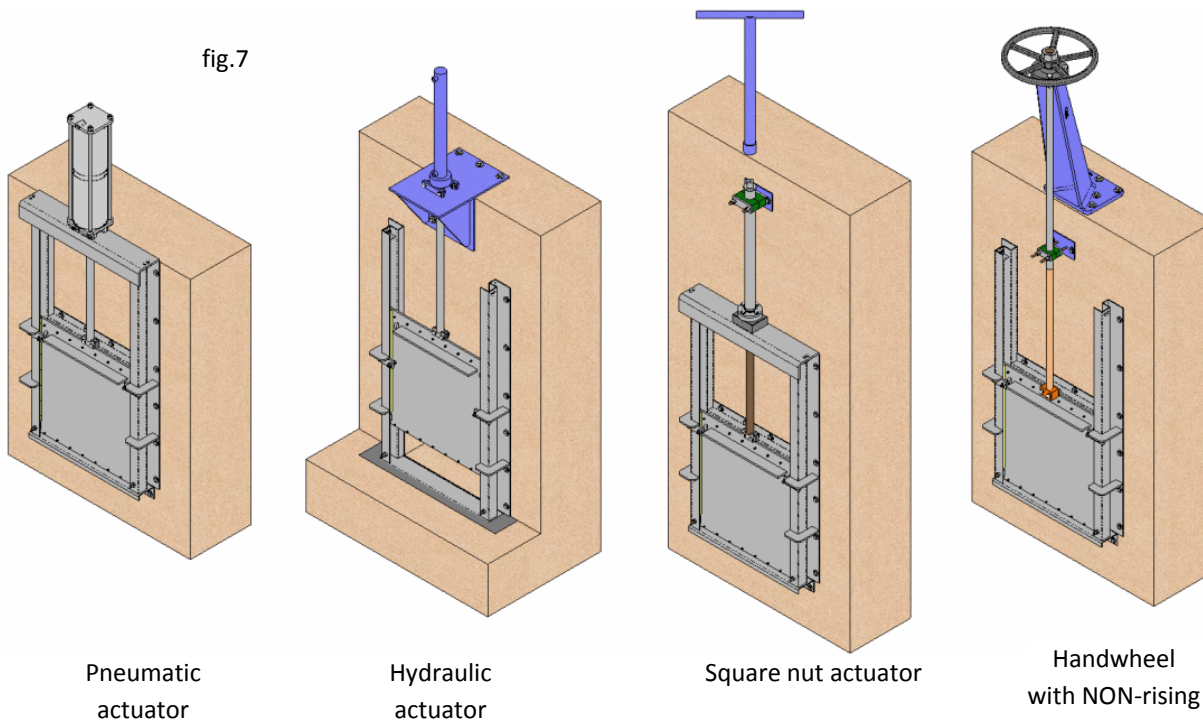
Electric motor
actuator



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fig.7



Pneumatic
actuator

Hydraulic
actuator

Square nut actuator

Handwheel
with NON-rising

The handwheel, chainwheel, gear box and motor actuators are also available with non-rising stem.

MAINTENANCE

CMO will not be liable if the penstocks suffer any damage due to improper handling or without proper authorisation. The penstocks must not be modified except under express authorisation from CMO. In order to avoid personal or material damage when performing the maintenance tasks, it is recommended to follow these instructions:

- The staff responsible for the maintenance or operation of the equipment must be qualified and trained.
- Use suitable Personal Protective Equipment (PPE) (gloves, safety boots, goggles...).
- Shut off all lines that affect the penstock and put up a warning sign to inform about the work being performed.
- Completely isolate the penstock from the whole process. Empty the duct.
- Drain all the fluid from the duct through the penstock.
- Use manual rather than electric tools during the maintenance, in accordance with **EN13463-1(15)**.



The only maintenance required in this type of penstocks is to change the rubber sealing joint. It is recommended to check the sealing joint every 6 months, however its working life will depend on the working conditions of the penstock, such as: pressure, temperature, number of operations, type of fluid and others. These sealing joints are screwed on with flanges; both the flanges and the screws are made of stainless steel, and can be reused several times.



In an ATEX zone, electrostatic charges may be present inside the penstock, which can cause a risk of explosion. The user will be responsible for carrying out the appropriate actions in order to minimise the risks.

The maintenance staff must be informed about the risks of explosion and ATEX training is recommended.

C.M.O.



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Regular cleaning of the penstock to prevent accumulation of dust.

Avoid re-painting the products supplied.

IMPORTANT SAFETY ASPECTS

- In order to work under ideal safety conditions, the magnetic and electrical elements must be in idle mode and the air tanks depressurised. The electrical control cabinets must also be out of service. The maintenance staff must be up to date with the safety regulations and work can only start under orders the site's safety staff.
- The safety areas must be clearly marked and you must avoid placing auxiliary equipment (ladders, scaffolding, etc.) on levers or moving parts which will lead to the movement of the through conduit.
- In equipment with spring return actuators, the through conduit must be mechanically locked and only unlocked when the actuator is pressurised.
- In equipment with electrical actuator, it is recommended to disconnect it from the mains in order to access the moving parts without any risk.
- Due to its great importance, you must check that the penstock shaft has no load before disassembling the actuator system.

Taking into account the recommendations indicated, below we indicate the maintenance operations carried out in this type of equipment:

REPLACING THE SEALING JOINT

1. Make sure there is absolutely no pressure and fluid in the duct.
2. Release the yoke and the stoppers (when fitted) and remove the complete through conduit from the body in order to facilitate the change of sealing joint.
3. Loosen and extract the screws (9, 3 and 11) which secure the flanges (4) and the sealing joint (3).
4. Remove the flanges (4) and finally the deteriorated joint (3), clean the housing.
5. Fit a new sealing joint (3) with the same dimensions as the old one.
6. Replace the flanges (4), securing the seal (3). It is important that the side seals and the lower seal protrude around five millimetres from the lower part of the through conduit (2) in order to make the lower seal. Having checked that they are correctly assembled, screw them down.
7. Introduce the through conduit in the body, bearing in mind that if the penstock is unfavourable unidirectional or bidirectional, the sealing joint will have two peaks and its position must be with the peaks open (Fig. 9).

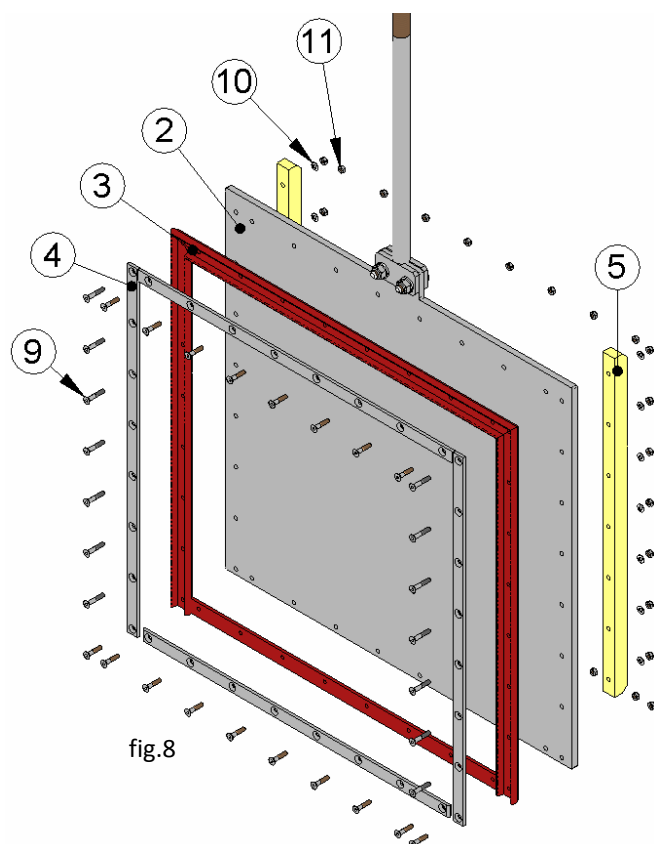


fig.8



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8. Screw down the yoke and the stoppers.
9. Before starting up the installation, perform various operations to open and close the penstock while empty.

Note: The numbers in brackets refer to fig. 8.

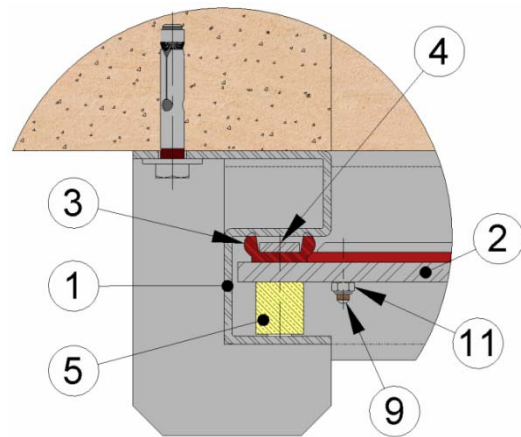


fig.9

Note: During the assembly of the new sealing joint it is recommended to apply petroleum jelly to the seal to facilitate the assembly process and the correct operation of the penstock (do not use oil or grease); table 1 below shows details of the petroleum jelly used by CMO:

PETROLEUM JELLY		
Saybolt colour	ASTM D-156	15
Melting point (°C)	ASTM D-127	60
Viscosity at 100°C	ASTM D-445	5
Penetration 25°C mm./10	ASTM D-937	165
Silicone content	None	
Pharmacopeia BP	OK	

table 1

LUBRICATION

It is recommended to lubricate the stem twice a year by removing the protection cap and filling it with grease up to half its volume.

After the maintenance and in an ATEX zone, you must check the electrical continuity between the different components of the penstock, such as the body, through conduit, stem... EN 12266-2 Standard, annex B, points B.2.2.2. and B.2.3.1.).





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MAINTAINING THE PNEUMATIC ACTUATOR

The pneumatic cylinders in our penstocks are manufactured and assembled at our premises. The maintenance of these cylinders is simple, if you need to replace any elements or have any questions please consult CMO. Below is an exploded diagram of the pneumatic actuator and a list of the cylinder's components. The top cover and the support cover are usually made of aluminium, although pneumatic cylinders greater than $\varnothing 200$ mm are made of cast iron GGG40.

The maintenance kit normally includes: the bushing and its joints and the scraper, and, if the customer wishes, the piston is also supplied. Below we show the steps to follow to replace these parts.

1. Position the penstock in closed position and shut off the pneumatic circuit pressure.
2. Loosen the cylinder air input connections.
3. Release and remove the cylinder cap (5), the cylinder tube (4) and the tie rods (16).
4. Loosen the nut (14) which connects the piston (3) to the rod (1), remove the parts. Disassemble the cir-clip (10) and remove the bushing (7) with its o-rings (8,9).
5. Release and remove the cylinder head (2), in order to remove the scraper (6).
6. Replace the deteriorated parts with new ones and assemble the actuator in the reverse order to that described for disassembly.

PNEUMATIC ACTUATOR		
POS.	DESCRIPTION	MATERIAL
1	STEM	AISI-304
2	SUPPORT COVER	ALUMINIUM
3	PISTON	S275JR + EPDM
4	CASING	ALUMINIUM
5	UPPER COVER	ALUMINIUM
6	SCRAPER	NITRILE
7	BUSHING	NYLON
8	EXTERIOR O-RING	NITRILE
9	INTERIOR O-RING	NITRILE
10	CIR-CLIP	STEEL
11	WASHER	ST ZINC
12	O-RING	NITRILE
13	WASHER	ST ZINC
14	SELF-LOCKING NUT	5.6 ZINC
15	O-RING	NITRILE
16	TIES	F-114 ZINC
17	WASHER	ST ZINC
18	NUT	5.6 ZINC
19	SCREW	5.6 ZINC
20	WASHER	ST ZINC
21	NUT	5.6 ZINC

table 2

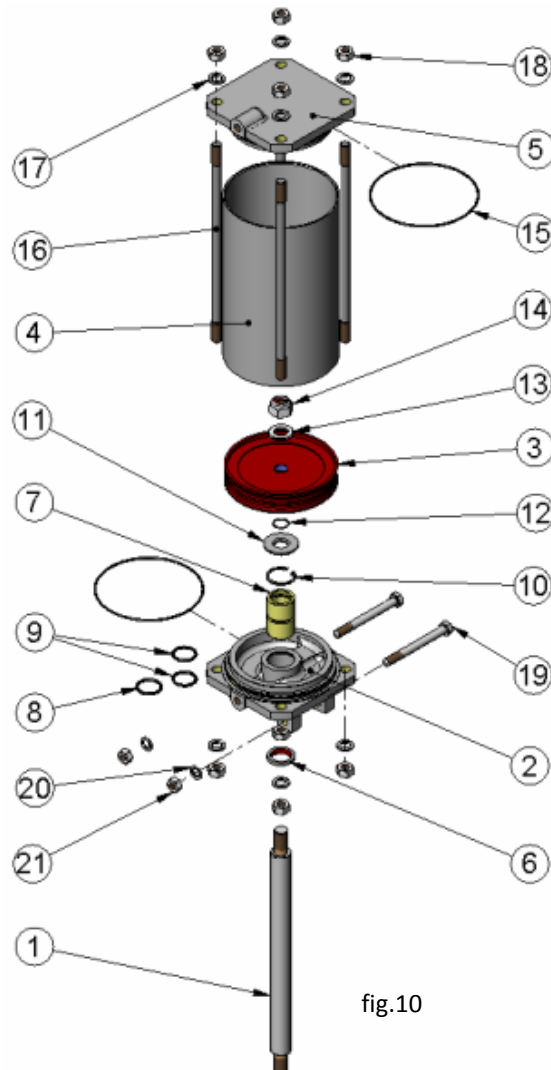


fig.10



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STORAGE

To ensure the penstock is in optimum conditions of use after long periods of storage, it should be stored in a well-ventilated place at temperatures below 30°C.

It is not advisable, but if it is stored outside, the penstock must be covered to protect it from heat and direct sunlight, with good ventilation to prevent humidity. The following aspects must be considered for storage purposes:

- The storage place must be dry and under cover.
- It is not recommended to store the equipment outdoors with direct exposure to adverse weather conditions, such as rain, wind, etc., even when the equipment is packaged.
- This recommendation is even more important in areas with high humidity and saline environments. Wind can carry dust and particles which can come into contact with the penstock's moving parts and this can lead to operating difficulties. The actuator system can also be damaged due to the introduction of particles in the different elements.
- The equipment must be stored on a flat surface to avoid deformations.
- If the equipment is stored without suitable packaging it is important to keep the penstock's moving parts lubricated, for this reason it is recommended to carry out regular checks and lubrication.
- Likewise, if there are any machined surfaces without surface protection it is important for some form of protection to be applied to prevent the appearance of corrosion.

COMPONENTS LIST (manual penstock with slanting floor stand)

POS	DESCRIPTION
1	BODY
2	THROUGH CONDUIT
3	SEALING JOINT
4	FLANGE SEAL
5*	SLIDE
6*	WEDGE
7*	COUNTERWEDGE
8*	END STOPPER
9	STEM
10*	GUIDE SUPPORT
11	FLOOR STAND
12	FRICTION WASHER
13	STEM NUT
14	YOKE FLANGE
15	HANDWHEEL
16	HOOD NUT
17	HOOD
18	PROTECTION CAP

table 3

Note: The elements with * are optional.

