



CONSTRUCCIONES
METÁLICAS
DE OBTURACIÓN, S.L.

CMO



GESTION DE
LA CALIDAD
CERTIFICADA

QUALITY
MANAGEMENT
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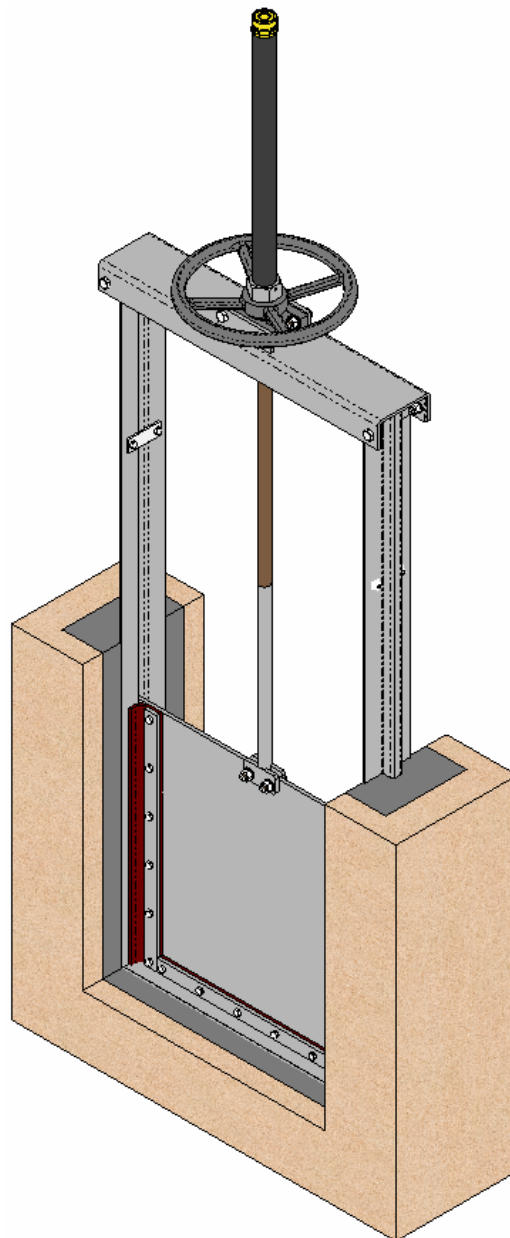
CHANNEL PENSTOCK

CA SERIES

09/11/2011

INSTRUCTIONS AND MAINTENANCE MANUAL

SERIES: CA



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ASSEMBLY

THE CA 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 **CA** 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 channel 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 channel.
- Drain all the fluid from the channel 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 channel holes for the installation of the penstock, ensuring they are of sufficient size and clean.

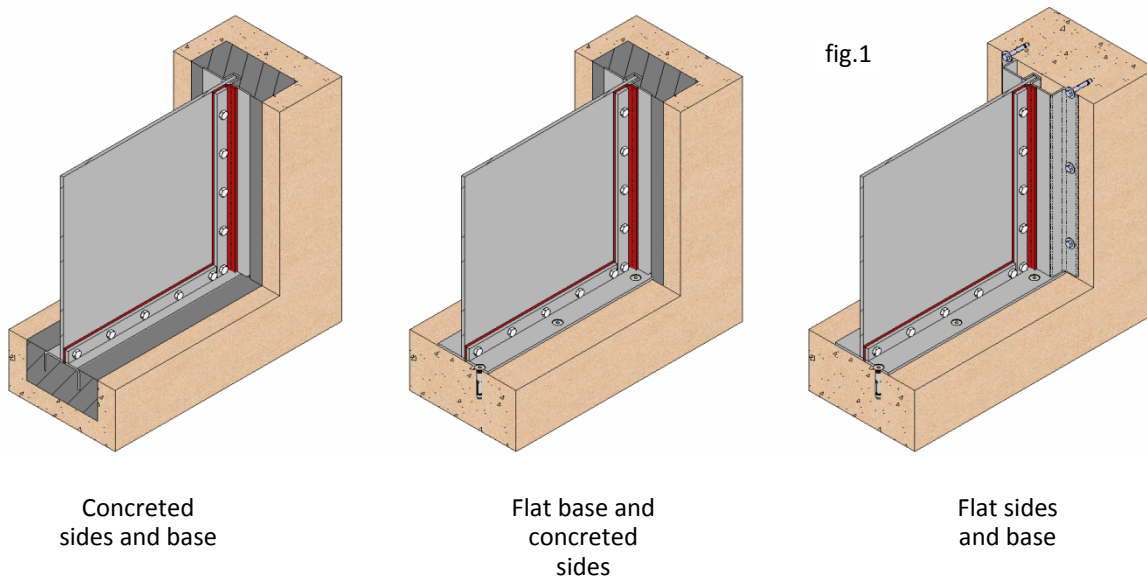
The **CA** penstock can be unidirectional or bidirectional:

- When **bidirectional**, in other words the fluid may come in one direction or another, the installation direction does not matter.

- When **unidirectional**, in other words the fluid always comes in the same direction, it is necessary to install the penstock in such a manner as the through conduit seals are on the upwater side, meaning that, thanks to the pressure of the fluid, the seals are pressurised against the side profiles of the body, thus ensuring sealtightness.

ASPECTS TO BE CONSIDERED DURING ASSEMBLY

The most common system to mount these penstocks is by concreting, although, as can be seen in fig. 1, there are other assembly options.



- Proceed as follows to mount the penstock concreted (the most common way):
 - After ensuring that the holes of the channel are clean and of sufficient size, proceed to position the penstock in these holes. In this process it is particularly important that the through conduit sealing joints are upwater side (only in the case of unidirectional).
 - Once the penstock is positioned in the holes, align it horizontally with regards to the channel and vertically make sure that the base of the penstock is level with the channel. In this manner, there are no protrusions in the channel, achieving entirely continuous passage.
 - After correctly levelling the penstock, carry out the second stage of concreting, which involves filling in the channel holes, ensuring there is no protrusion in the channel.
- Proceed as follows to mount the penstock using chemical or expansion anchors:
 - Begin by placing the penstock in the channel in the required location. Similarly, in this case it is particularly important that the through conduit sealing joints are upwater side (only in the case of unidirectional).
 - Using the holes of the body of the penstock as a guide, make the boreholes necessary in the channel 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 channel.
- 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. The final torque must be correct in accordance with the applicable standard.

The penstock can be concreted with chemical or expansion anchors; in both cases the following must be taken into account:

- The equipment must be firmly secured in the channel.
- 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.

ASSEMBLY POSITIONS

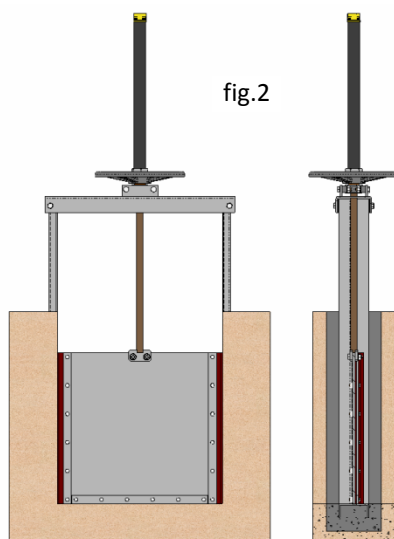


fig.2

This type of penstock is mounted in open horizontal channels (fig. 2), and the penstock position must always be vertical. As detailed above, in unidirectional penstocks it is particularly important that the sealing joint is upwater side (fig. 3, the seal is the red item).

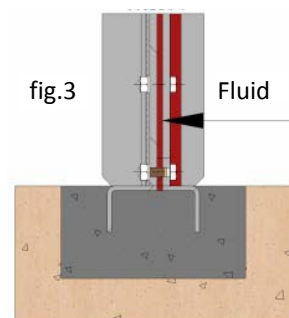


fig.3

Fluid

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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.

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.

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.



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MOTORISED (Rising or non-rising stem)

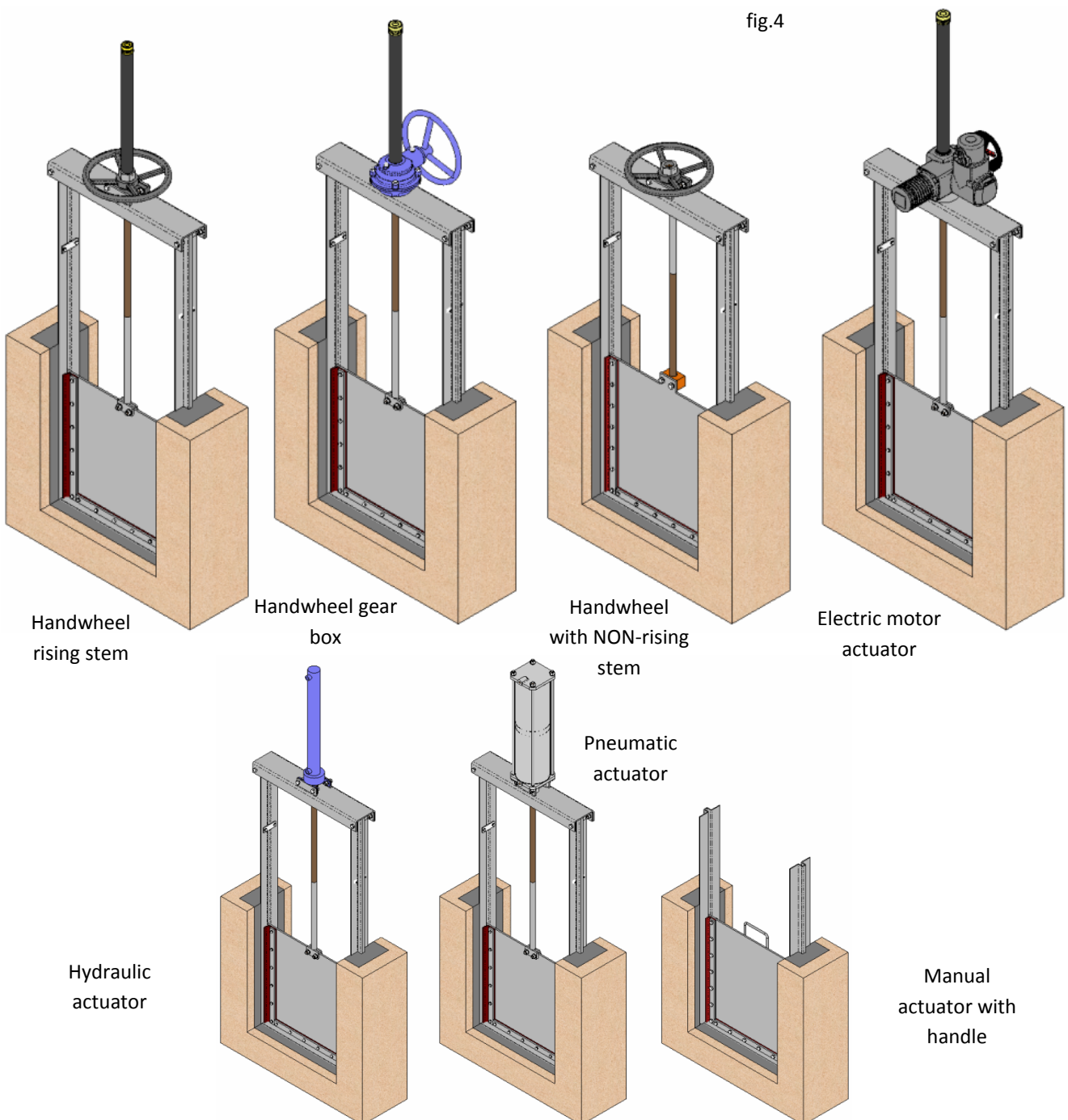
If the penstock incorporates a motorised actuator it will be accompanied with the electric actuator supplier's instructions.



In manual actuators (handwheel, gears, lever, etc), it is not necessary to exercise excessive force (max. 25 Kg/mt) for the lower seal to close correctly. If excessive force is used, the lower seal will not be 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.4





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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 channel.
- Drain all the fluid from the channel 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 penstock is to change the rubber seal. It is recommended to check the seal 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 seals 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.

Regular cleaning of the penstock to prevent accumulation of dust.

Assemblies are not permitted at the end of the line.

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:

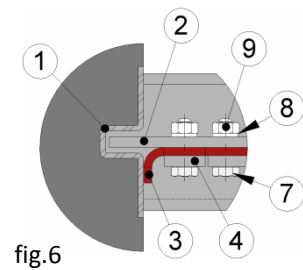
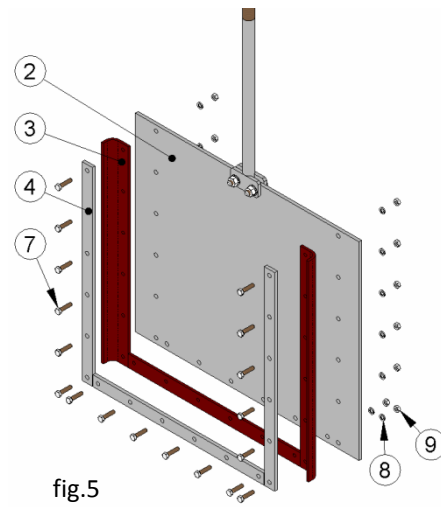


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REPLACING THE SEALING JOINT

1. Make sure there is absolutely no pressure and fluid in the channel.
2. Release the yoke and the stoppers (when fitted) and remove the through conduit from the body in order to facilitate the change of seal.
3. Loosen and extract the screws (7, 8 and 9) which secure the flanges (4) and the seal (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 we will begin to bend the side seals of the lower section (placing them perpendicular to the through conduit) and introduce the through conduit in the body. Continue to introduce the through conduit whilst bending the sealing joints. It is very important that the two sides of the sealing joint are "L" shaped throughout the length, as shown in fig. 6.
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 the components list in Table 3.

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 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

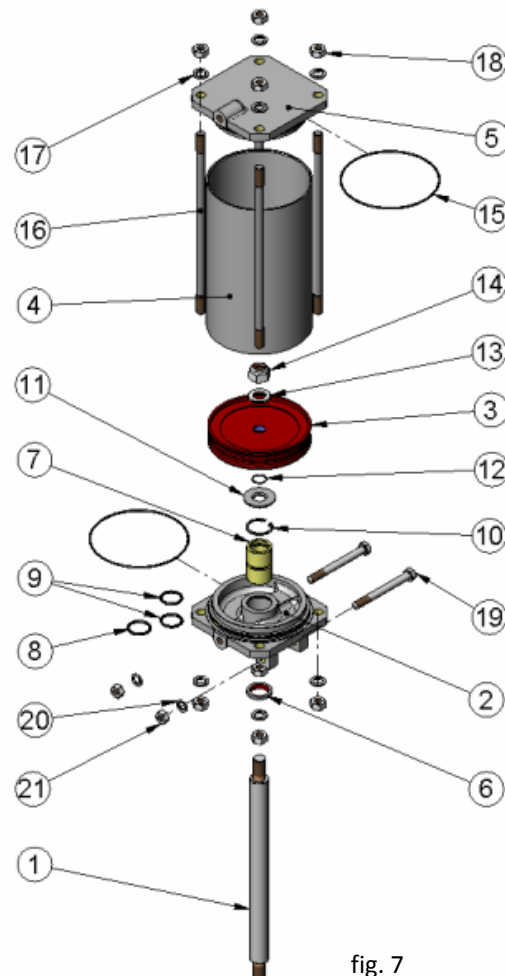


fig. 7



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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)

POS	DESCRIPTION
1	BODY
2	THROUGH CONDUIT
3	SEALING JOINT
4	FLANGE SEAL
5	YOKE
6	STOPPER
7	SCREW
8	WASHER
9	NUT
10	STEM
11	ACTUATOR YOKE
12	STEM NUT
13	STOPPER NUT
14	HANDWHEEL
15	HOOD NUT
16	HOOD
17	PROTECTION CAP

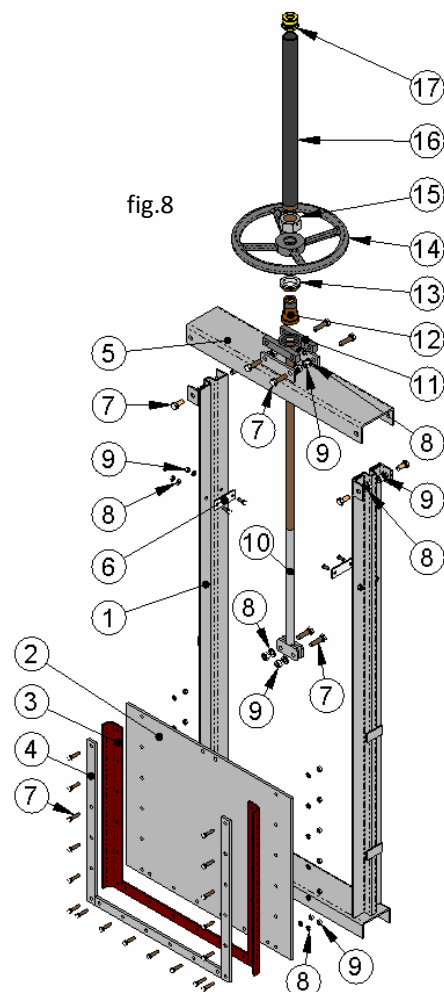


table 3