



CONSTRUCCIONES
METÁLICAS
DE OBTURACIÓN, S.L.

CMO



GESTION DE
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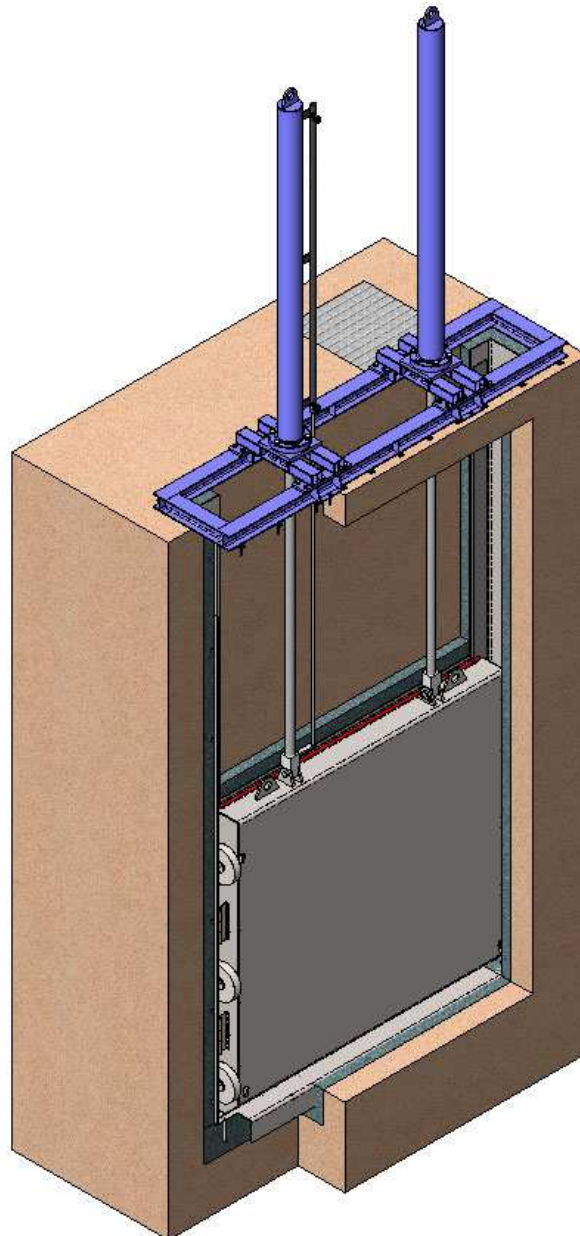
VERTICAL-LIFT GATE

VM SERIES

03/06/2014

INSTRUCTIONS AND MAINTENANCE MANUAL

SERIES: VM



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ASSEMBLY

THE VM 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 **VM** penstock complies with the Directive on Equipment and Protective Systems for Potentially Explosive Atmospheres. In these cases the logo will appear in 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

Pay special attention to the following points when handling the equipment:

- **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 CMO vertical-lift gates. 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 of two or more penstocks being 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 injury and other types of damage (to the facilities, the penstock, etc.), we recommend following 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, etc).
- Shut off all lines which affect the penstock and put up a warning sign to inform about the work being carried out.
- Completely isolate the penstock from the whole process. Empty the conduit.
- Drain all the fluid from the conduit through the penstock.
- Use non-electrical hand tools during 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 side profiles 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 **VM** penstock can be unidirectional or bidirectional:

- When **bidirectional**, the fluid may come in either direction.
- 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

Channel assembly

Since these **VM** penstocks are often large-sized and designed for high volumes of water, the most common system (recommended by CMO) is concreted assembly (fig. 1). In this assembly option, a series of gaps in the civil engineering work are used to insert the body of the **VM** penstock, with the housings then being filled with a second layer of concrete.

As these penstocks usually work under large volumes of water, they generate significant force and the best option to transmit these forces to the civil engineering work and therefore ensure attachment is by concreting, although other assembly options can be seen in fig. 2 and fig. 3.

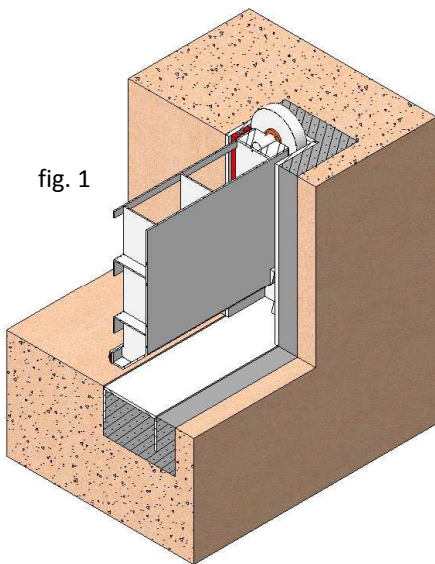


fig. 1

Concreted sides and base

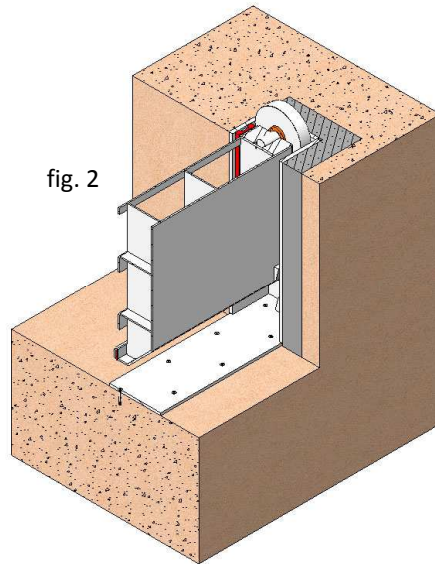


fig. 2

Flat base and concreted sides

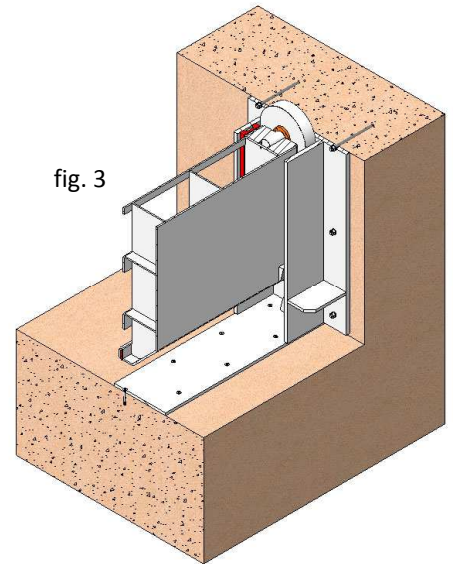


fig. 3

Flat sides and base

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- To mount the penstock concreted (fig. 1) follow these steps:
 - After checking that the gaps of the channel are clean and of sufficient size, position the penstock in these gaps. In this process (in the case of unidirectional penstocks) it is very important that the stopboard sealing joint is downstream.
 - Once the penstock is positioned in the gaps, align it horizontally relative 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 gaps, ensuring there is no protrusion in the channel.
- In order to mount the penstock using chemical or expansion anchors (fig. 3), follow these steps:
 - It is very important that the walls of the channel where the penstock is to be located are completely smooth and level, otherwise the body may come deformed and suffer irreparable damage when tightening the anchors.
 - After checking the correct state of the channel walls, position the penstock in the channel at the required point. In this process (in the case of unidirectional penstock) it is also vitally important that the sealing joints of the stopboard are downstream.
 - 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.
 - Remove the penstock from the wall and apply sealing paste such as SIKAFLEX-11FC or similar in order to prevent leakages between the body and the channel.
 - Return the penstock to its position 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 be 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; we recommend using a flat rule to carry out this task. 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 lose shape. The final torque must be correct in accordance with the applicable standard.

Wall assembly

Another option is to assemble these penstocks on the wall, secured with expansion or chemical anchors (fig. 4), although there are other assembly options, as shown in figures fig. 5 and fig. 6.

Whatever the attachment 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 bolting the body.



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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 lose shape.

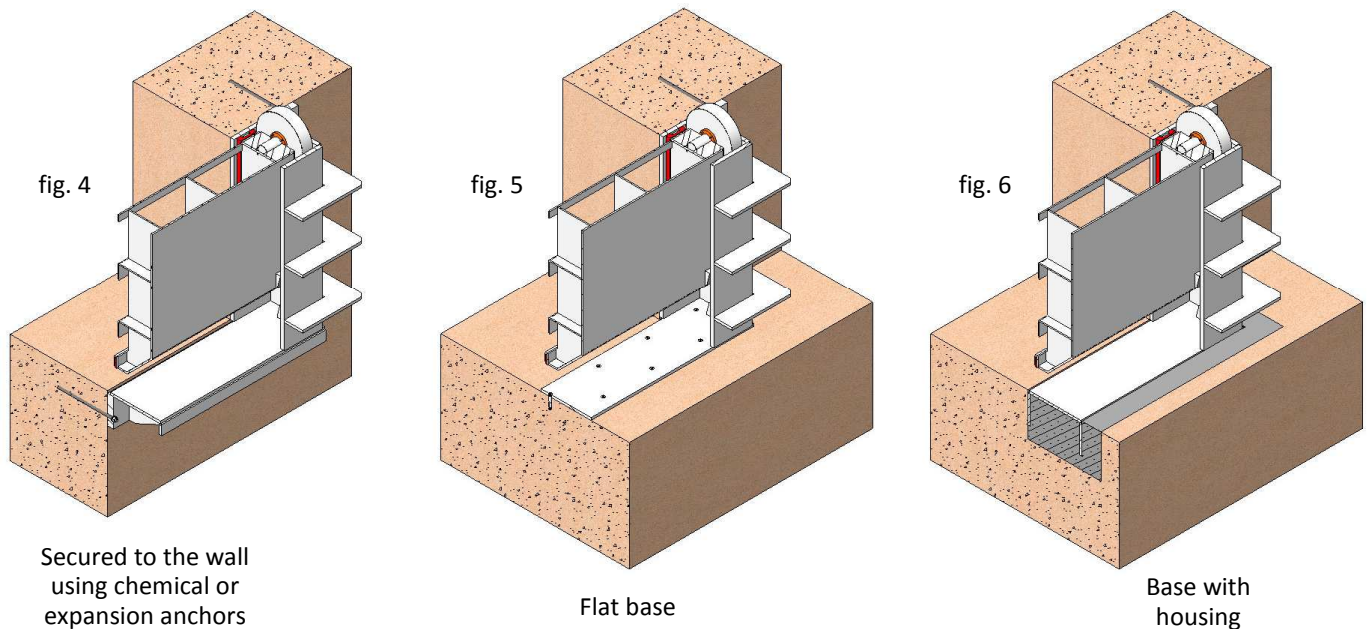


fig. 4
Secured to the wall
using chemical or
expansion anchors

fig. 5
Flat base

fig. 6
Base with
housing

- In order to mount the penstock using chemical or expansion anchors (fig. 4), follow these steps:
 - The concrete surface where the body is mounted must be smooth and level.
 - Start by positioning the body 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.
 - Remove the body from the wall and, in its location, apply sealing paste such as SIKAFLEX-11FC or similar in order to prevent leakages between the body and the wall.
 - Return the body 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 be in accordance with the approved plans.
 - Once all the chemical or expansion anchors are in place, carry out the initial tightening with low torque. Once all the anchors are slightly tightened, carry out the final torque in crosswise mode. For correct torque, we recommend using a flat ruler, avoiding overtightening which may cause loss of shape of the penstock. The final torque must be correct in accordance with the applicable standard.

This procedure can also be used for flat base penstocks (fig. 5).

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- In order to mount the penstock with the base embedded in the concrete (fig. 6), follow these steps:
 - The civil engineering work must include housing in the base, 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 engineering work, thus meaning there is no protrusion in the base and guaranteeing complete and 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 from the wall and, in its location, apply sealing paste such as SIKAFLEX-11FC or similar in order to prevent leakages between the body and the wall.
 - Return the penstock to its location above the sealing paste and bolt 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 stage of concreting. This involves filling the gaps in the base housing with concrete, ensuring there is no protrusion in the passage of the fluid.

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

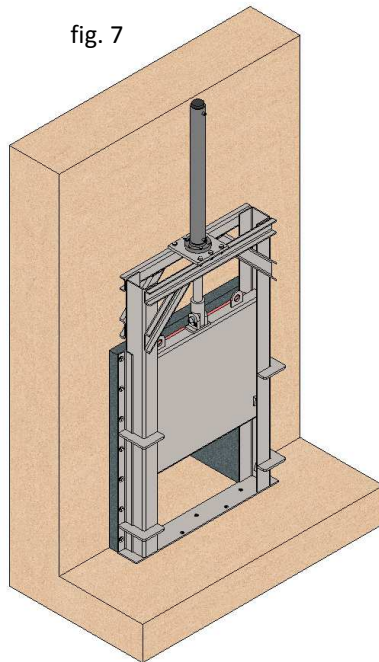
- The equipment must be firmly secured to the wall or channel.
- As regards scaffolding, ladders and other auxiliary elements to be used during assembly, follow the safety recommendations indicated in this dossier.
- Once the equipment has been assembled, make sure that there are no elements which can interfere with the stopboard 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.).
- Follow the safety recommendations indicated in this dossier when operating the equipment.

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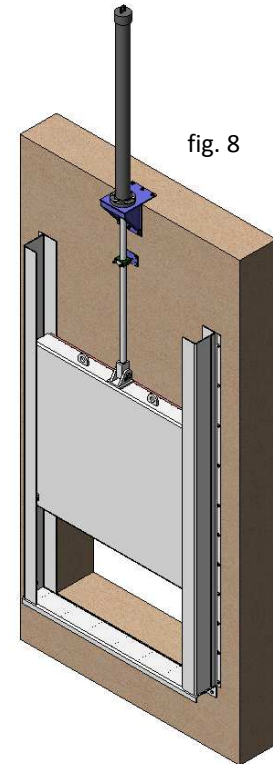
ASSEMBLY POSITIONS

This type of penstock is mounted on vertical walls in which there is a square, round or rectangular orifice; this orifice may be at ground level (fig. 7) or at a certain height (fig. 8). The penstock position is always vertical.



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

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



Once the penstock is in 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 gearbox)

In order to operate the penstock: turn the handwheel clockwise to close or anticlockwise to open. It is possible to stop the handwheel from turning 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 wheel turns clockwise. It is possible to 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.

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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.

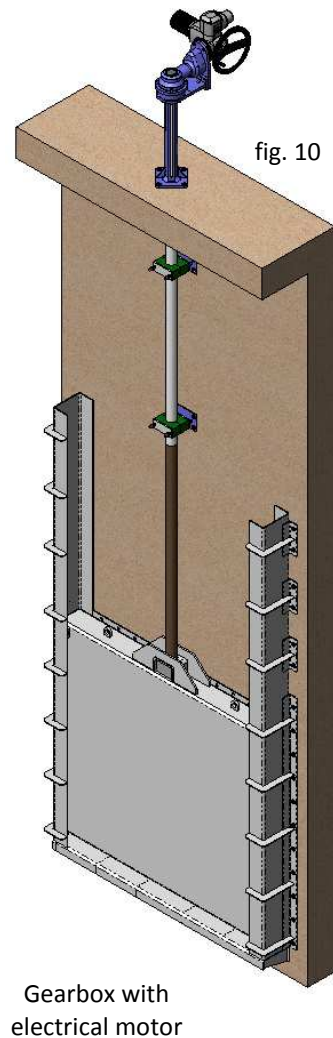
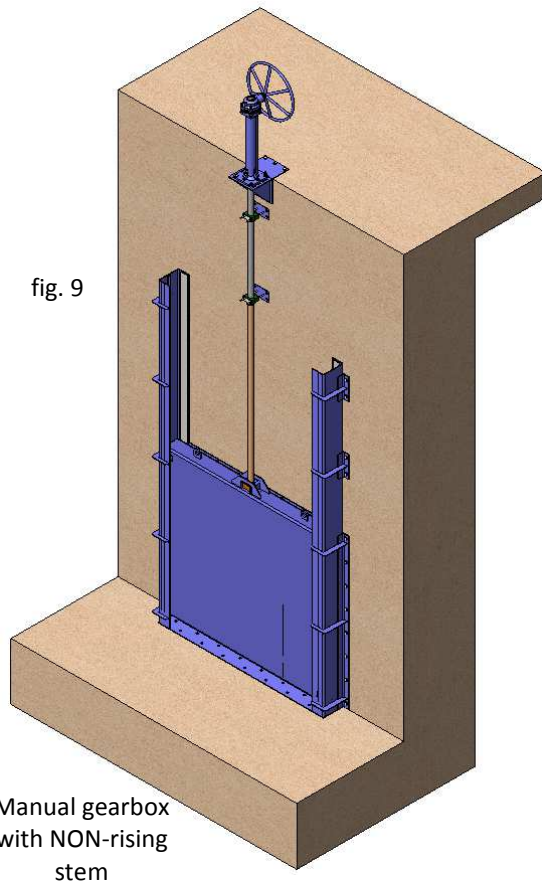
MOTORISED (rising, non-rising stem)

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



In manual actuators (handwheel, gearbox, etc), it is not necessary to exercise excessive force for the lower seal to close correctly (max. 25 Kg). 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.





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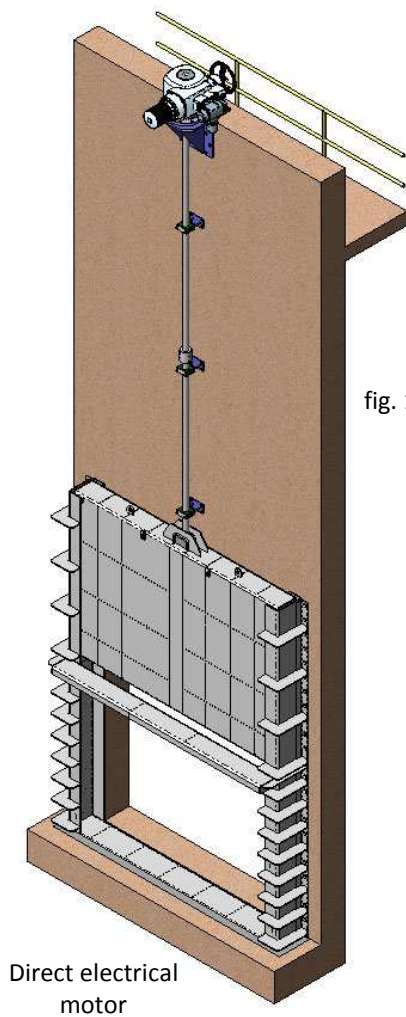


fig. 11

Direct electrical
motor

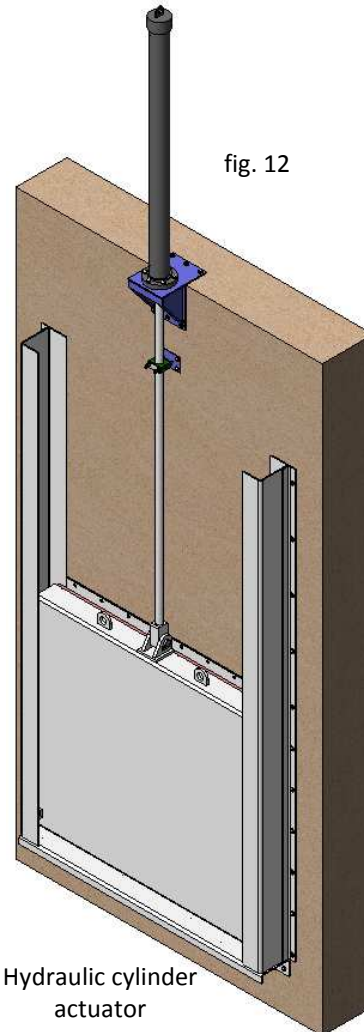


fig. 12

Hydraulic cylinder
actuator

The handwheel, chainwheel, gearbox and motor actuators are available with both rising stem and 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. The following instructions should be followed in order to avoid personal injury or material damage when carrying out maintenance tasks:

- 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, etc. ..).
- Shut off all lines which affect the penstock and put up a warning sign to inform about the work being carried out.
- Completely isolate the penstock from the whole process. Empty the conduit.
- Drain all the fluid from the conduit through the penstock.
- Use non-electrical hand tools during maintenance, in accordance with EN13463-1(15).



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The only maintenance required in this type of penstocks is to change the rubber sealing joint, the slides and the self-lubricating bushing of the wheels. It is recommended to check these elements every 6 months, although their working life will depend on the operating conditions of the penstock, such as: pressure, temperature, number of operations, type of fluid and others. The bolts used to secure these elements are stainless steel, meaning they can be reused several times. The rubber seal attachment flange is stainless steel, meaning it can, as with the bolts, 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.

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 from the site's safety staff.
- The safety areas must be clearly marked, avoiding the use of auxiliary equipment (ladders, scaffolding, etc.) in levers or moving parts, in order to produce the movement of the through-conduit.
- In units fitted with an 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's shaft has no load before disassembling the actuator system.

Taking into account the recommendations indicated, the maintenance operations recommended for this type of equipment are shown below:

REPLACING THE SEALING JOINT

1. Make sure there is absolutely no pressure or fluid in the conduit. Release the actuator system and withdraw the complete stopboard from the body, lifting it using the lugs fitted for this purpose.
2. Support the complete stopboard on a flat surface or on trestles, ensuring the rubber seals are upwards.
3. Loosen and extract the screws (18) which secure the flanges (4) and the seal (3) to the stopboard (2).
4. Remove the flanges (4) and finally the deteriorated sealing joint (3), then clean the housing.
5. Fit a new seal (3) in the stopboard (2), impregnated with petroleum jelly, with the same dimensions as the one removed.

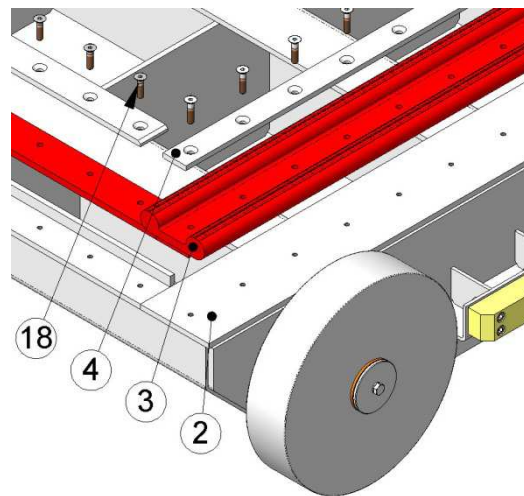



fig. 13

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6. Replace the flanges (4), securing the sealing joint (3). It is important that the side and lower seals protrude around five millimetres from the lower part of the stopboard (2) in order to make the lower seal correctly. Bolt them down after checking they are correctly assembled.
7. Lift the complete stopboard using the lifting lugs fitted for this purpose.
8. Introduce the complete stopboard in the body.
9. Reassemble the actuator system.
10. Before starting up the installation, carry out various operations to open and close the penstock while empty.

 **Note:** The numbers in brackets refer to fig. 13.

REPLACING THE SLIDES

1. Make sure there is absolutely no pressure or fluid in the conduit. Release the actuator system and withdraw the complete stopboard from the body, lifting it using the lugs fitted for this purpose.
2. Support the complete stopboard on a flat surface or on trestles, ensuring the rubber seals are upwards.
3. Loosen and extract the screws (18) which secure the slides (5) to the stopboard (2).
4. Remove the deteriorated slides (5) and clean their housing.
5. Position the new slides (5) of the same dimensions as the ones removed.
6. Return the screws (18), securing the slides (5) to the stopboard (2).
7. Lift the complete stopboard using the lifting lugs fitted for this purpose.
8. Introduce the complete stopboard in the body.
9. Reassemble the actuator system.
10. Before starting up the installation, carry out various operations to open and close the penstock while empty.

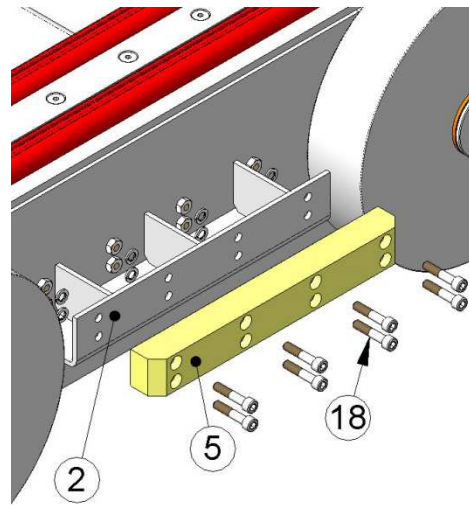



fig. 14

 **Note:** The numbers in brackets refer to fig. 14.

REPLACING THE WHEEL SELF-LUBRICATING BUSHING

1. Make sure there is absolutely no pressure or fluid in the conduit. Release the actuator system and withdraw the complete stopboard from the body, lifting it using the lugs fitted for this purpose.
2. Support the complete stopboard on a flat surface or on trestles, ensuring the rubber seals are upwards.
3. Loosen and extract the screws (18) which secure the stopper washers (11) to the wheel axles (7).
4. Remove the stopper washers (11) and the wheels (9) from the axles (7) with their bushing (10).
5. Remove the bushing (10) from the wheels (9), taking care not to damage the inside housing of the wheel.
6. Position the new bushing (10) in the wheels (9).
7. Use this moment to check the state of the stopper flanges (8); even though these elements have a long life, checking their state is recommended. Ensure, at all times, that the heads of the screws (18) which secure them to the stopboard (2) are never level with the exterior surface of the stopper flange (8). If they are, replace them.

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8. Loosen and extract the screws (18) which secure the stopper flanges (8) to the stopboard (2).
9. Remove the deteriorated stopper flanges (8) and clean their housing.
10. Position the new stopper flanges (8) of the same dimensions as the ones removed.
11. Return the screws (18), securing the stopper flanges (8) to the stopboard (2).
12. Insert the wheels (9) on the axles (7) with their bushing (10).
13. Position the stopper washers (11) on the wheel axles (7) and bolt them down.
14. Turn each wheel a few times to check it turns freely.
15. Lift the complete stopboard using the lifting lugs fitted for this purpose.
16. Introduce the complete stopboard in the body.
17. Reassemble the actuator system.
18. Before starting up the installation, carry out various operations to open and close the penstock while empty.

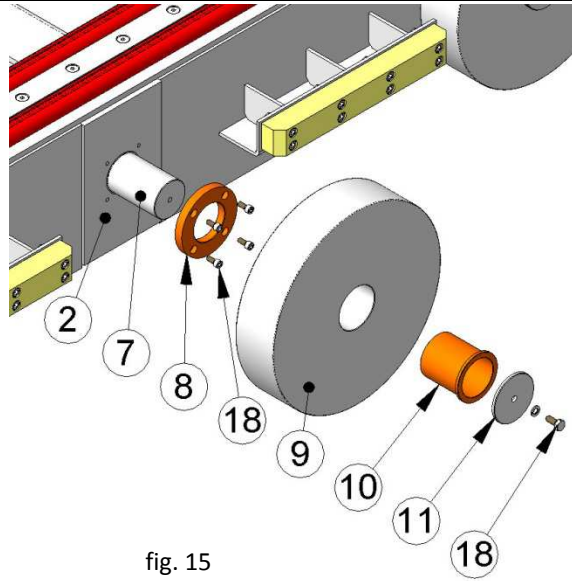


fig. 15

Note: The operations described numbered 8 to 11 are optional. We recommend carrying them out in accordance with the result of the inspection made in section number 7.

Note: The numbers in brackets refer to fig. 15.

Note: After carrying out any of the maintenance work described above, it is recommended, before introducing the stopboard in the body, to apply petroleum jelly to the sealing joint 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	
Pharmacopea 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 maintenance in an ATEX zone, it is necessary to check the electrical continuity between the different parts of the penstock, such as the body, stopboard, stem, etc. Standard EN 12266-2, Annex B, points B.2.2.2. and B.2.3.1.)

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PNEUMATIC ACTUATOR MAINTENANCE

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 ask 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 made of aluminium, although pneumatic cylinders over $\varnothing 200$ mm are made of cast iron GJS-400.

The maintenance kit normally includes: the bushing and its sealing joints and the scraper, and, if the customer wishes, the piston is also supplied. The steps to follow to replace these parts are shown below.

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 top cover (5), the casing (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 socket (7) with its O-rings (8, 9) .
5. Release and remove the support cover (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	ROD	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

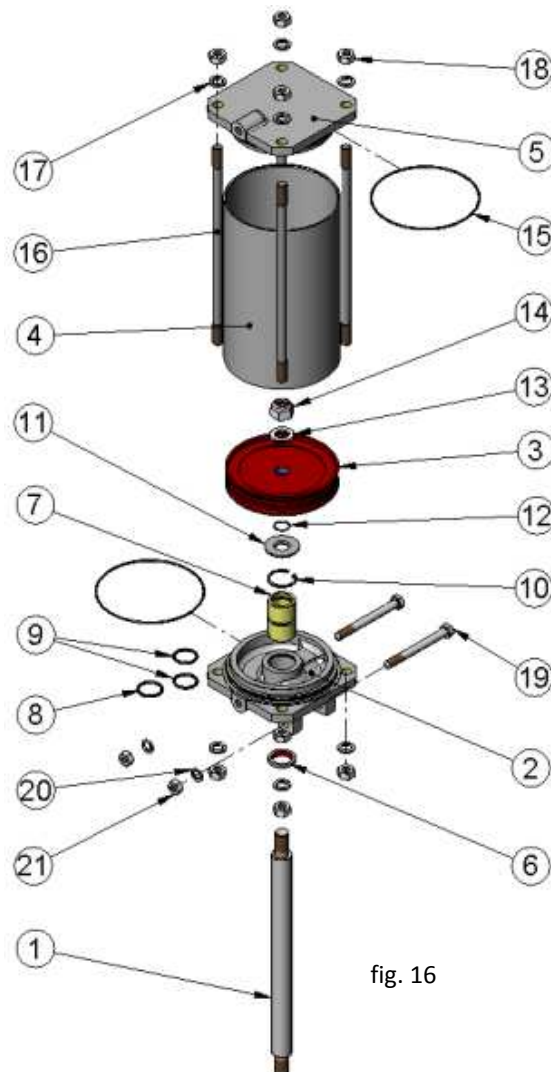


fig. 16

STORAGE

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

It is not advisable, but, if 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:

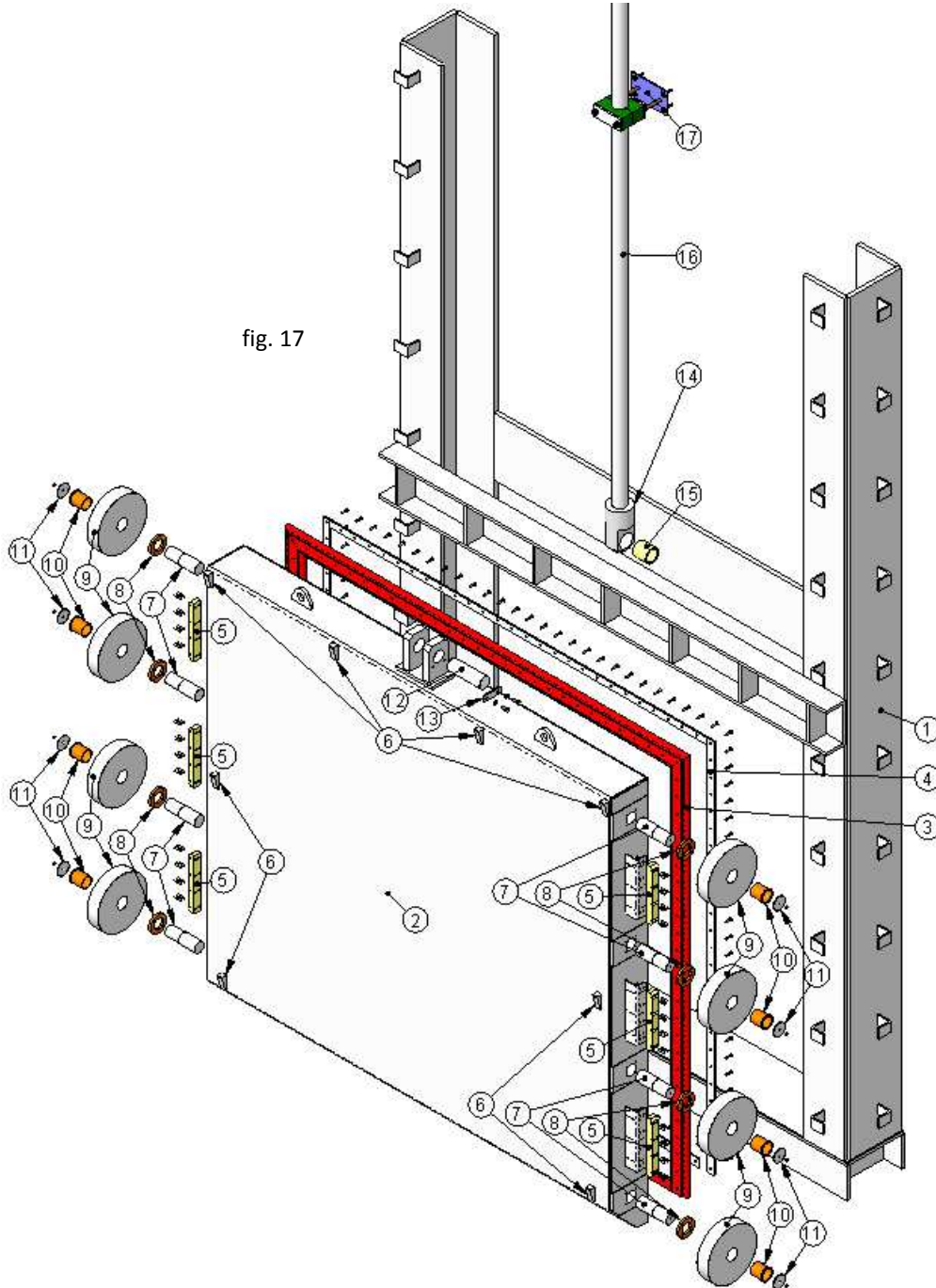
- The storage place must be dry and under cover.
- It is not recommended to store the equipment outdoors with direct exposure to adverse weather conditions, such as rain, wind, etc, even when the equipment is packaged.
- This recommendation is even more important in areas with high humidity and saline 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 loss of shape.
- If the equipment is stored without suitable packaging it is important to keep the penstock's moving parts greased, 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.



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COMPONENTS LIST



POS	DESCRIPTION	POS	DESCRIPTION	POS	DESCRIPTION
1	BODY	7	AXLE	13	NON-TURN PLATE
2	STOPBOARD	8	STOPPER FLANGE	14	HINGE
3	SEALING JOINT	9	WHEEL	15	HINGE BUSHING
4	FLANGE SEAL	10	WHEEL BUSHING	16	ROD
5	SLIDES	11	STOPPER WASHER	17	GUIDE SUPPORT
6	WEDGES	12	HINGE PIN	18	SCREWS AND BOLTS

Table 3

C.M.O.

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