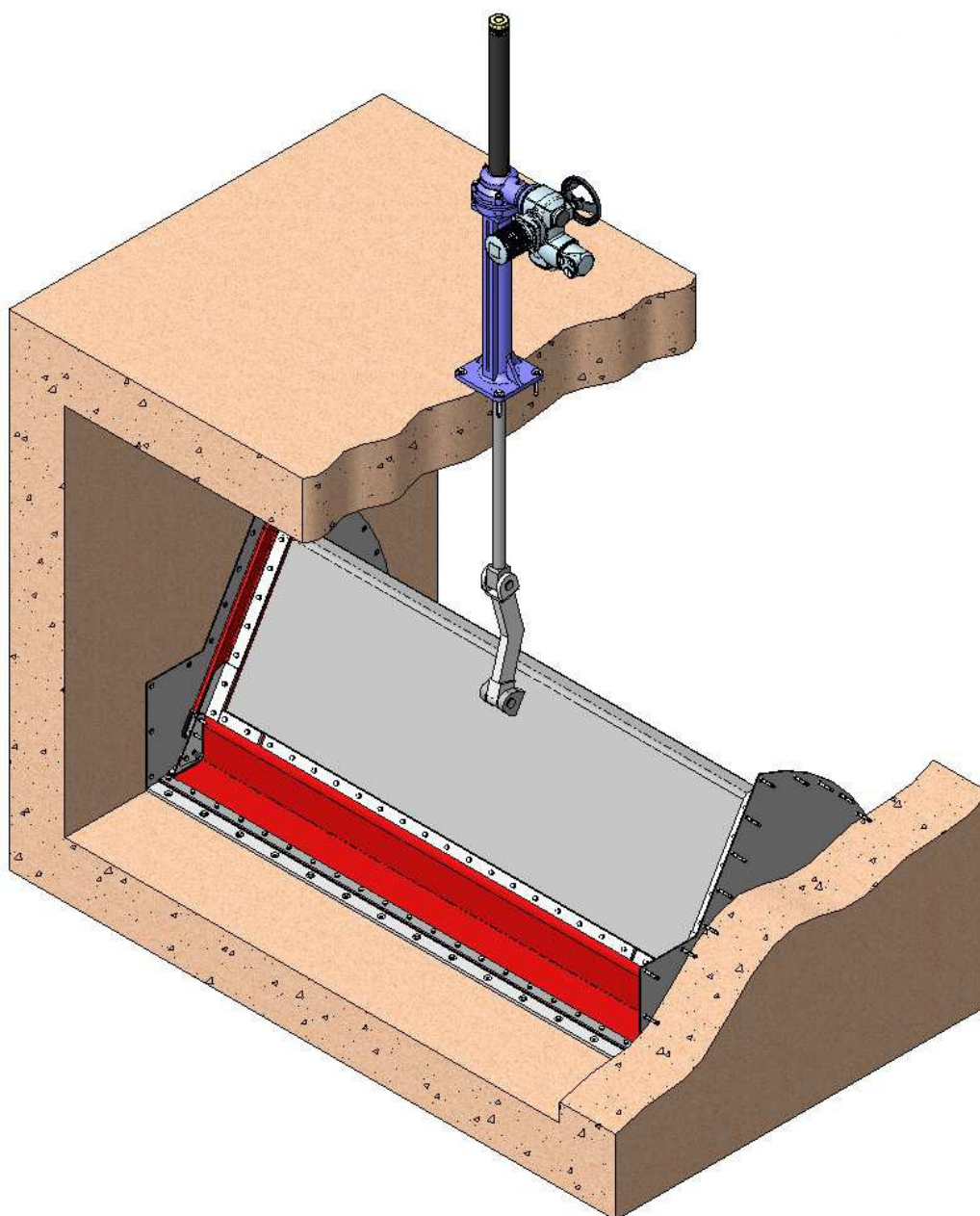


05/12/2014

INSTRUCTIONS AND MAINTENANCE MANUAL

SERIES: GI



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page 1

DESCENDING GATE

GI SERIES

ASSEMBLY

APPLICATION OF EUROPEAN DIRECTIVES

See document of European Directives applicable to **CMO Valves**.

The **GI** 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 seals, as this may lead to penstock operation problems.
- To prevent damage, especially to the anticorrosive protection, it is recommended to use soft straps to lift CMO descending gates. The stopboard is fitted with vertical ribs with orifices to make it easier to lift.
- 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 channel.
- Drain all the fluid from the channel 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. Ensure that the side guides of the penstock body and, in particular, the sealing area, are clean. Inspect the walls intended for installation of the penstock, making sure they are clean and flat.

ASPECTS TO BE CONSIDERED DURING ASSEMBLY

There are different types of assembly, since these **GI** penstocks are usually designed for each specific project. In this section we describe a specific penstock design, namely a penstock supported on the civil engineering work and secured with expansion or chemical anchors. The assembly process we are going to focus on is for a descending gate with a 3-side sealing. This type of penstock has been chosen since it is the most common, and therefore the most significant.

- Proceed as follows to assemble:
 - First inspect it to ensure the base and the walls are completely flat. As the side guide plates are attached directly on the concrete, any irregularities in the concrete may be transmitted to the body when tightening the expansion anchors if the cement is not smooth, possibly leading to irreparable damage and harming the operation of the penstock. Using a rule is recommended to check the flatness of the concrete. Also check that the base is completely horizontal and the walls are level.
 - Any civil engineering work which is not flat or level must be repaired.
 - Once it has been checked that everything is correct and the width of the channel is in line with the dimensions, position the side guide plates of the body in their location (fig. 1). Position each plate on each face of the channel, ensuring that they are perfectly aligned with each other.
 - Mark the layout of the boreholes for the anchors, using the body as a template.
 - Make boreholes for the anchors.
 - Remove the side guide plates from the channel walls.
 - Apply beads of Sikaflex-11FC or similar, of between 2 and 5 mm, on the surface supported on the walls of the channel.
 - Return the side guide plates in their location, position the countersunk expansion anchors and tighten. Carry out initial crosswise tightening with reduced torque. Once all the anchors have been slightly tightened, carry out a second tightening. It is very important not to tighten excessively, especially in the plate areas not directly supported on the concrete.

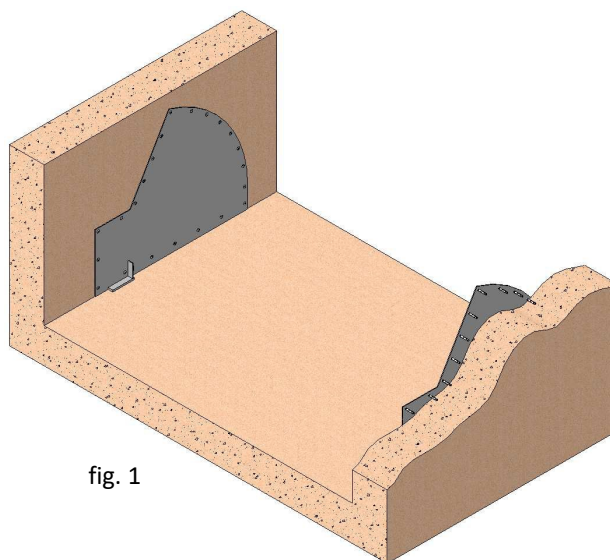
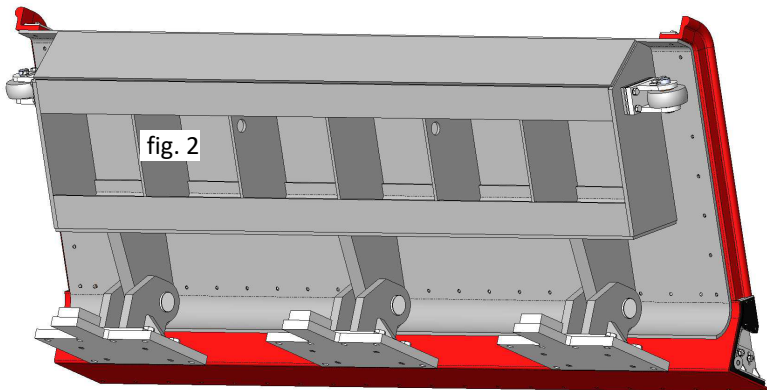


fig. 1

DESCENDING GATE

GISERIES

- Tightening the anchors with the help of a flat rule is recommended, since the side guide plates must remain completely vertical in order to prevent any deformation and ensure that the side seals fit correctly. Support the rule on the side guide plate and start to tighten the anchors, and stop tightening as soon as a minimum deformation is apparent. Carry out the same operation with the other side guide plate.



- Tightening the expansion anchors may cause excess Sikaflex-11FC to appear, which should be removed to achieve a suitable finish.

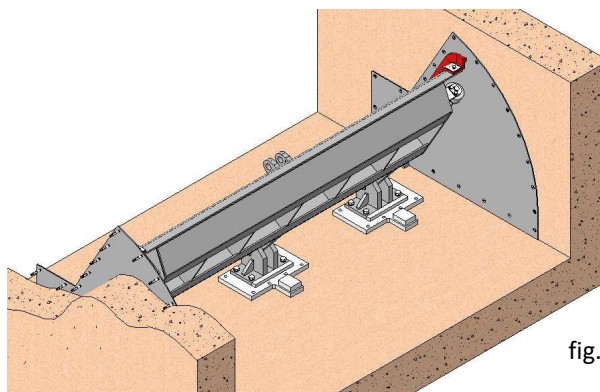
- Continue the assembly process with the stopboard unit (fig. 2). This requires the seals to be mounted along with all the rotation mounts on the stopboard.

- Apply petroleum jelly in abundance to the side sealings of the stopboard.

- Secure the stopboard unit and accessories with slings, using the lifting lugs fitted in the vertical reinforcements of the stopboard.

- Using the lifting equipment, position this unit in the location in accordance with the assembly drawing (fig. 3).

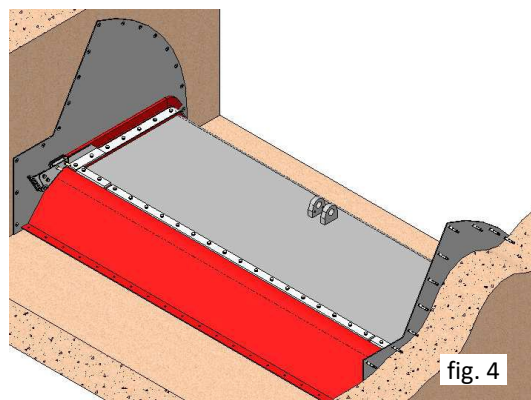
- After aligning the stopboard relative to the side guide plates and correctly levelling, mark the layout of the boreholes for the anchors on the channel base, using the rotation mount baseplates as a template.



- Bolt down the rotation mounts. Carry out initial crosswise tightening with reduced torque. Once all the anchors have been slightly tightened, carry out a second, crosswise tightening. It is very important not to tighten excessively, especially in the plate areas not directly supported on the concrete.

- Once all the rotation mounts have been attached to the base of the civil engineering work, bring down the lifting equipment, making the stopboard turn until it is supported on the open position stoppers (fig. 4).

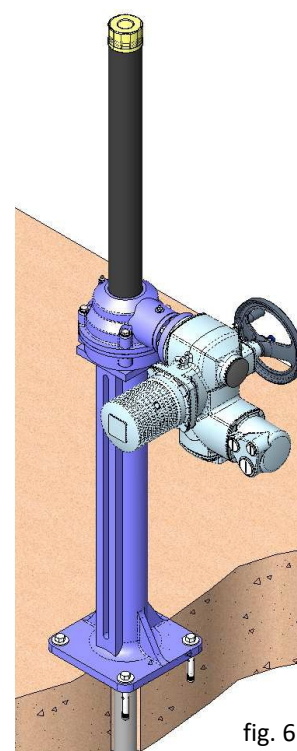
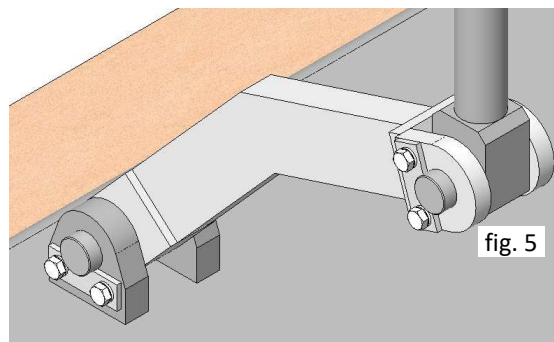
- Extend the bottom seal of the stopboard as far as it will go, and mark the position on the base of the civil engineering work.



DESCENDING GATE

GISERIES

- Position the bottom seal anchor plate in its location, making sure that the bottom seal reaches with sufficient margin when extended.
- Mark the layout of the boreholes for the expansion anchors, using the bottom sealing anchor plate as a template.
- Make boreholes for the anchors.
- Remove the bottom sealing anchor plate from the channel.
- Apply beads of Sikaflex-11FC or similar, of between 2 and 5 mm, on the surface supported on the base of the channel.
- Return the bottom sealing anchor plate to its location, position the expansion anchors and proceed with tightening. Carry out initial tightening with reduced torque. Once all the anchors have been slightly tightened, carry out a second tightening.
- Tightening the expansion anchors may cause excess Sikaflex-11FC to appear, which should be removed to achieve a suitable finish.
- Extend the bottom seal and secure it to the bottom sealing anchor plate, securing it with the bottom seal flange.
- Once the penstock is in place, position the actuator system.
- Mount the actuator lever on the stopboard (fig. 5).
- Insert the stem through the orifice fitted in the floor for this purpose, and secure it to the actuator lever.
- Position the floor stand in its location (fig. 6), make boreholes for the anchors, using it as a template.
- Secure the floor stand to the floor using the anchors.
- Position the actuator system on the floor stand and bolt it down (fig. 6).
- Make the corresponding electrical connections in the equipment's actuator system.
- Carry out several operations without fluid load to check that the gate opens and closes without any problems, and to adjust the seals of the bottom corners, side guide wheels, limit switches, etc.



The following points must be taken into account in all cases when installing the penstock in concrete or using expansion or chemical anchors:

- The equipment must be firmly secured in the channel.
- The surfaces where the seals fit must be completely clean of any residue.
- As regards scaffolding, ladders and other auxiliary elements to be used during assembly, follow the safety recommendations indicated by the manufacturers or suppliers.

DESCENDING GATE

GISERIES

- Once the equipment has been assembled, make sure that there are no elements which can interfere with the movement of the stopboard.
- 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.

ASSEMBLY POSITIONS

This type of penstock is mounted in channels, which may be rectangular or square in section. The position of the penstock is always with the rotation shaft horizontal in the bottom part of the stopboard.

Once the penstock has been installed, check that all the nuts and bolts have been correctly tightened and that the whole penstock actuator 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 this works correctly and that there is no leak when fluid load is applied.



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

The most common actuator system in **GI** descending gates is electrical or hydraulic. As mentioned several times throughout this document, these penstocks are designed for each specific project; if you require any type of specific actuator not envisaged in this manual, check with CMO's technical and sales department.

Some possible types of actuator and their most significant characteristics are detailed below:

HANDWHEEL (direct or geared)

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 stopboard will maintain its position since the actuator is self-locking.

PNEUMATIC

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 gate.

DESCENDING GATE

GISERIES

HYDRAULIC

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 gate.

MOTORISED

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



Manual actuators (wheel, gears, etc.) should not be subjected to excessive force (Maximum 25 Kg). Exerting excessive force may result in irreparable damage to the equipment.
Motorised actuators must have torque limiters and limit switches in order to prevent damage to the equipment.

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 channel.
- Drain all the fluid from the channel through the penstock.
- Use non-electrical hand tools during maintenance, in accordance with **EN13463-1(15)**.



The only maintenance required in this type of penstock is to change the seals and the self-lubricating bushing of the rotation points and 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 seal attachment flanges are stainless steel and can, as with the nuts and 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.

DESCENDING GATE

GISERIES

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.

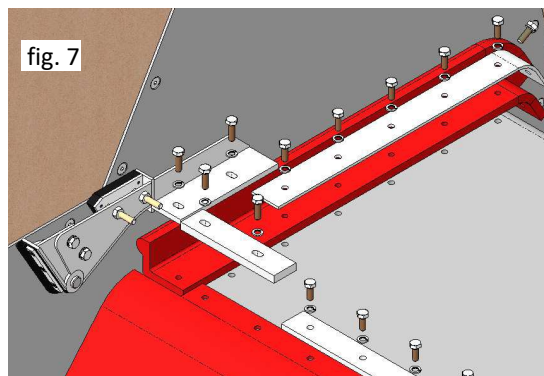
IMPORTANT SAFETY ASPECTS

- In order to work under ideal safety conditions, the magnetic and electrical elements must be in idle mode and the air tanks depressurised. Moreover, 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 stopboard.
- 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 rotation 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 SEALS

1. The complete absence of fluid and water load in the channel is preferable.
2. Place the penstock in completely open position.
3. Completely isolate the penstock from the electrical or hydraulic supply, as appropriate.
4. Release and extract the bolts which attach the side seal flanges with the side seals to the stopboard (fig. 7).
5. Release and extract the bolts which secure the side sealing foot pieces with their seals to the stopboard (fig. 7).
6. Remove the side sealing foot pieces, then remove and extract the bolts which secure the bottom corner seal flanges with the bottom corner seals.
7. Remove the bottom corner seal flanges and finally the bottom corner seals (fig. 8).
8. Replace the seal plugs in the side sealing foot pieces (fig. 8).
9. Position new bottom corner seals with the same dimensions as the ones removed. Make boreholes in the new seals using the seal flanges as a template. It is recommended to impregnate new seals with petroleum jelly to facilitate assembly. Return the seal flanges, securing the seals; then check that they are correctly assembled.



DESCENDING GATE

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10. Release and extract the bolts which attach the base and bottom seal flanges with the bottom seal to the stopboard and to the bottom sealing anchor plate (fig. 9).
11. Remove the side, bottom and base seal flanges. Finally, remove the deteriorated side and bottom seals.
12. Clean the seal housing.
13. Position new seals with the same dimensions as the ones removed.
14. Make boreholes in the new seals using the seal flanges as a template.
15. It is recommended to impregnate new seals with petroleum jelly to facilitate assembly.
16. Return the side seal flanges and the bottom seal flange, securing the side seals and the bottom seal respectively.
17. Extend the bottom seal and position it above the bottom sealing anchor plate.
18. Make boreholes in the new bottom seal using the base seal flange as a template.
19. Bolt down the base seal flange, securing the bottom seal to the bottom sealing anchor plate.
20. Bolt down the side sealing foot pieces with their new seals in their locations.
21. Adjust the position of the side sealing foot pieces in order to achieve maximal watertight integrity.
22. Reconnect the penstock to the electricity or hydraulic supply, as appropriate.
23. Carry out an opening and closing operation without load to check that all elements work correctly.
24. Apply fluid load to the penstock and check that it closes correctly.

fig. 8

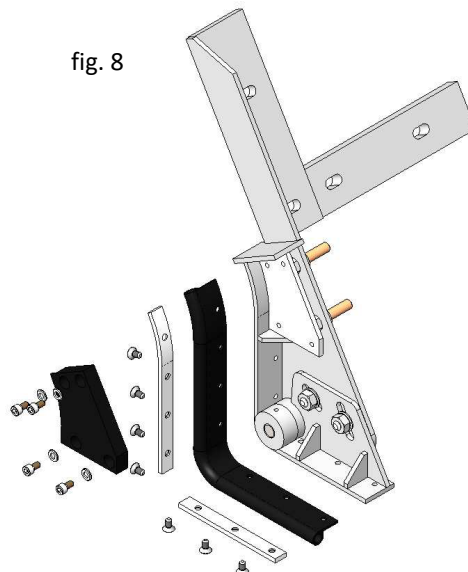
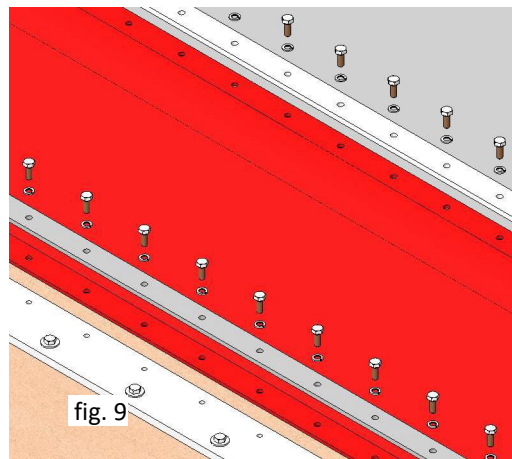


fig. 9



REPLACING THE STOPBOARD ROTATION POINTS BUSHING

The best time to replace the stopboard rotation points bushing is whilst replacing the seals, since, at a given moment (step 11), the stopboard will be without the bottom seal which attaches it to the civil engineering work.

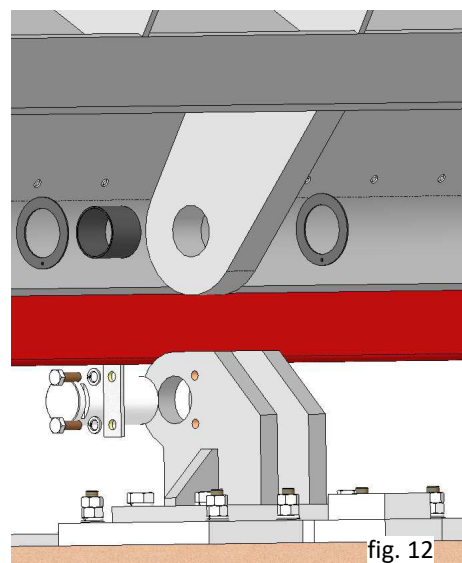
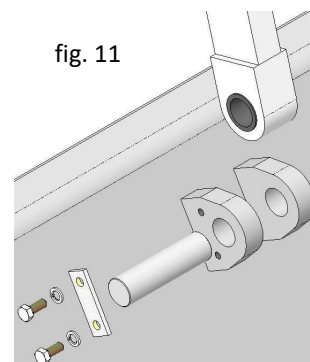
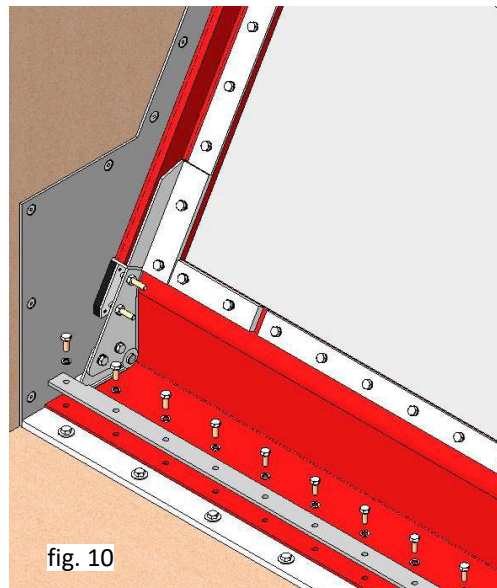
If this maintenance work is carried out independently, follow these instructions:

1. The complete absence of fluid and water load in the channel is preferable.
2. Place the penstock in completely closed position.
3. Completely isolate the penstock from the electrical or hydraulic supply, as appropriate.

DESCENDING GATE

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4. Release and extract the bolts which attach the base seal flange with the bottom seal to the bottom sealing anchor plate (fig. 10).
5. Remove the seal flange from the base (fig. 10).
6. Secure the stopboard with slings, using the lifting lugs fitted in the vertical reinforcements.
7. Using the lifting equipment, secure the stopboard in this position.
8. Release the stopboard joint actuator system (fig. 11).
9. Release the rotation mount non-turn plates fastening bolts (fig. 12).
10. Remove the rotation mount pins (fig. 12); at this moment the stopboard is suspended from the lifting equipment.
11. Using the lifting equipment, lift the stopboard in order to have sufficient space to replace the sliding bearings.
12. Remove both the stopper washers and the displacement bearings of all rotation points and clean their housing (fig. 12).
13. Position the new sliding bearings and the new stopper washers in their corresponding locations.
14. Bring down the stopboard to its usual location.
15. Insert the pins in all the rotation mounts.
16. Reassemble the penstock actuator system.
17. Release the slings which hold the stopboard.
18. Extend the bottom seal and position it above the bottom sealing anchor plate.
19. Bolt down the base seal flange, securing the bottom seal to the bottom sealing anchor plate.
20. Reconnect the actuator system to the electricity or hydraulic supply, as appropriate.
21. Carry out several operations without fluid load to check that the gate opens and closes without any problems. Make use of these operations to adjust the limit switches.
22. Apply fluid load to the penstock and check that it closes correctly.



DESCENDING GATE

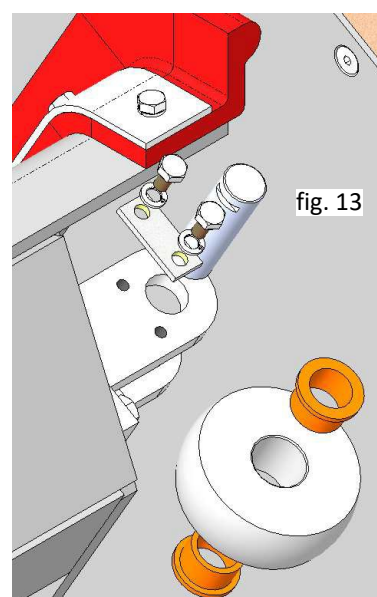
GISERIES

REPLACING THE WHEEL SELF-LUBRICATING BUSHING

No special condition is required to replace the wheel bushing, although, for safety reasons, it is best done without any water and fluid load, since this operation must be carried out downstream from the stopboard.

Follow these instructions to carry out this maintenance work:

1. The complete absence of fluid and water load in the channel is preferable.
2. Place the penstock in completely closed position.
3. Completely isolate the penstock from the electrical or hydraulic supply, as appropriate.
4. Secure the stopboard with slings, using the lifting lugs fitted in the vertical reinforcements.
5. Using the lifting equipment, secure the stopboard in this position (for safety reasons).
6. Release the fastening bolts from the guide wheel mount non-turn plates (fig. 13).
7. Extract the guide wheel mount pins and remove the guide wheels with their bearings (fig. 13).
8. Remove the self-lubricating bearings with flanges from the guide wheels and clean the housing (fig. 13).
9. Position the new bearings in the guide wheels (the same size as those removed).
10. Return the guide wheels to their usual locations and introduce the pins.
11. Position the non-turn plates in their positions and bolt them to the guide wheel mounts.
12. Release the slings which hold the stopboard.
13. Reconnect the actuator system to the electricity or hydraulic supply, as appropriate.
14. Carry out several operations without fluid load to check that the gate opens and closes without any problems. Make use of these operations to adjust the limit switches.
15. Apply fluid load to the penstock and check that it closes correctly.



Note: When carrying out any of the maintenance work described above, it is recommended to apply petroleum jelly to the seals 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

DESCENDING GATE

GISERIES

LUBRICATION

It is recommended to lubricate the stem twice a year by removing the protection hood 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.)

PNEUMATIC ACTUATOR MAINTENANCE

The pneumatic cylinders in our penstocks are manufactured and assembled at our premises. Maintenance for these cylinders is straightforward; 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 Ø200 mm are made of cast iron GJS-400.

The maintenance kit normally includes: the bushing and its seals 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. Place the penstock in open position and shut off the pneumatic circuit pressure.
2. Release the cylinder air input connections.
3. Release and remove the top cover (5), the casing (4) and the tie rods (16).
4. Release the nut (14) which connects the piston (3) to the spindle (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 mount 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	SPINDLE	AISI-304
2	MOUNT COVER	ALUMINIUM
3	PISTON	S275JR + EPDM
4	CASING	ALUMINIUM
5	TOP 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

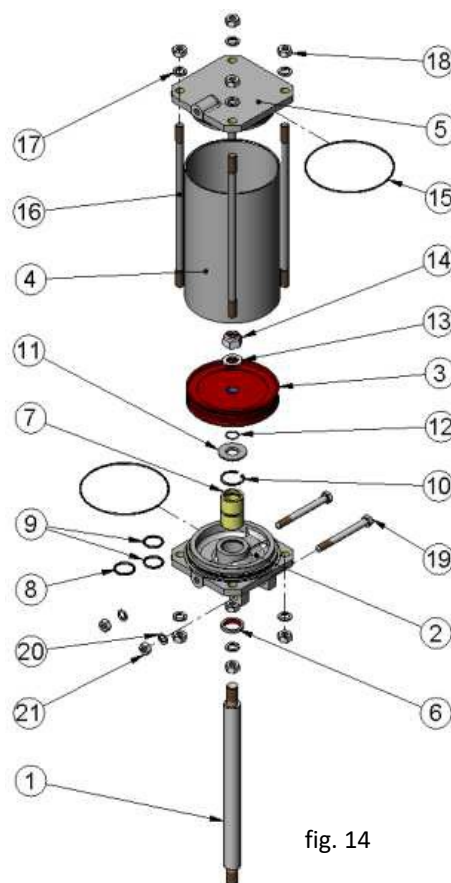


fig. 14

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DESCENDING GATE

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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 undercover.
- 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 packing 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.

COMPONENTS LIST

POS	DESCRIPTION	POS	DESCRIPTION	POS	DESCRIPTION
01	STOPBOARD	12	BOTTOM SEAL	23	NON-TURN PLATE
02	SIDE GUIDE PLATE	13	BOTTOM SEAL FLANGE	24	GUIDE WHEEL BUSHING
03	BOTTOM SEALING ANCHOR PLATE	14	BASE SEAL FLANGE	25	ACTUATOR LEVER
04	ROTATION MOUNT PIECE	15	SIDE SEALING FOOT PIECE	26	PULL STOPBOARD PIN
05	TURN MOUNT BASEPLATE	16	BOTTOM CORNER SEAL	27	NON-TURN PLATE
06	ROTATION PIN	17	BOTTOM CORNER SEAL FLANGE	28	LEVER BUSHING
07	NON-TURN PLATE	18	SEAL PLUG MOUNT	29	STEM/SPINDLE
08	ROTATION BUSHING	19	SEAL PLUG	30	PULL LEVER PIN
09	ROTATION STOPPER WASHER	20	GUIDE WHEEL MOUNT	31	NON-TURN PLATE
10	SIDE SEAL	21	GUIDE WHEEL	32	SPINDLE BUSHING
11	SIDE SEAL FLANGE	22	GUIDE WHEEL PIN	33	SCREWS AND BOLTS

Table 2

DESCENDING GATE

GISERIES

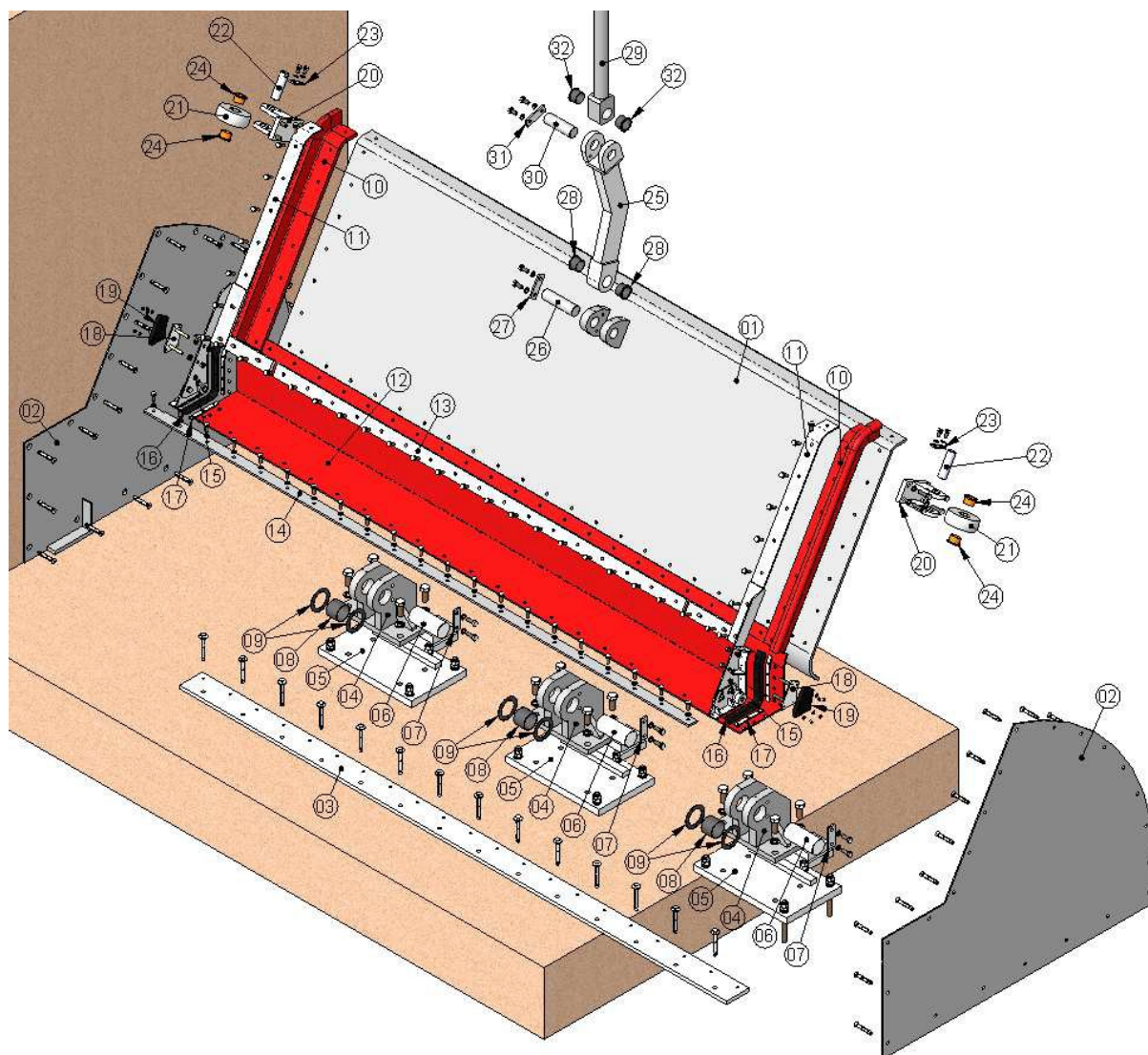


fig. 15