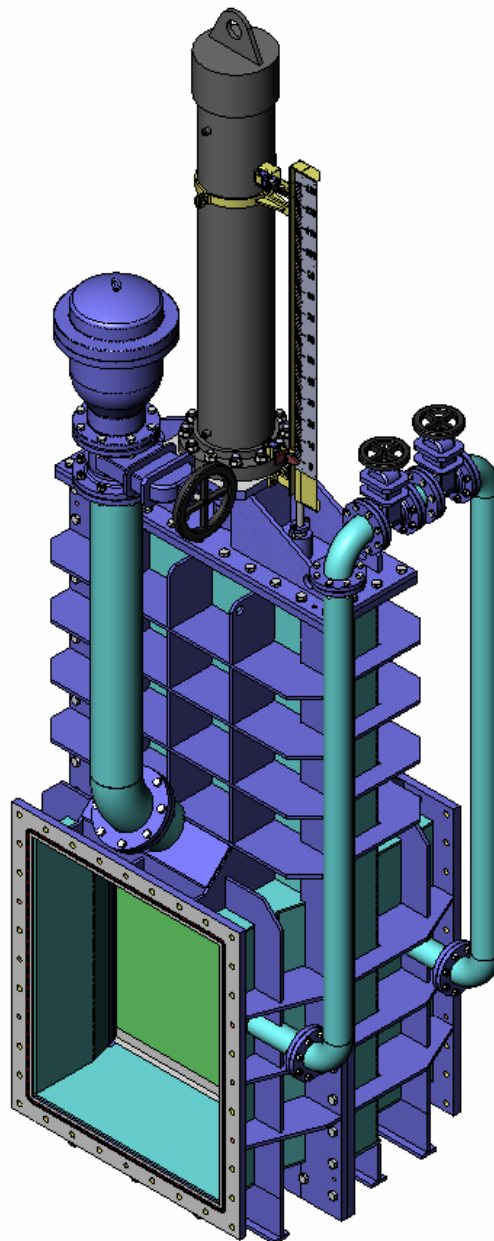




INSTRUCTIONS AND MAINTENANCE MANUAL

SERIES: CB





SLIDING PENSTOCK

SERIES CB

ASSEMBLY

THE CB VALVE COMPLIES WITH THE FOLLOWING:

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

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.
- To prevent damage, especially to the anticorrosive protection, it is recommended to use soft straps to lift the CMO penstocks. These belts must be secured in the holes fitted for this purpose in the ribs of the body.
- Do not lift the penstock or hold it by the actuator. The cylinder attachment lug is not designed to support the entire weight of the penstock, but rather to only support the weight of the hydraulic cylinder.
- Do not lift the penstock by holding it in the flow passage area. The penstock sealing system is located in this area. If the valve is secured and lifted in this area, the sealing surface may become damaged, resulting in leakage during the operation of the penstock.
- Packing in wooden boxes: 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 types 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. Depressurise the process.
- Drain all the line fluid through the penstock.
- Use manual rather than electric tools during installation and maintenance, in accordance with **EN13463-1(15)**.



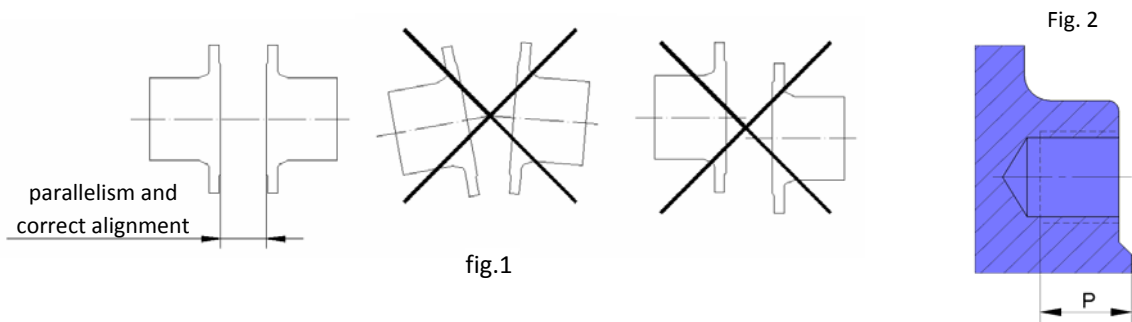
Before installation, inspect the penstock to ensure no damage has occurred during transport or storage. Make sure that the inside of the penstock body and, in particular, the seal area are clean. Inspect all pipes and the flanges to make sure they are clean.

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ASPECTS TO BE CONSIDERED DURING ASSEMBLY

- The **CB** valve is unidirectional, making it vitally important to take into account the fluid direction. To know how to position the penstock, check any of the following details:
 - The fluid will enter the face of the board through the bevel in the lower section.
 - If the penstock has an aeration system, this aeration system must remain on downwater side, taking the actuator as the reference axis.
 - The fluid direction must press the board against the body's sealing frame, for which reason the sealing frame must be on the downwater side.
- Special care must be taken to respect the correct distance between the flanges and ensure they are correctly aligned and parallel (fig. 1).
The incorrect position or installation of the flanges can cause deformations on the penstock's body and this could lead to operating problems.




It is very important to make sure that the penstock is correctly aligned and parallel to the flanges to prevent leakages and avoid deformations. Try to assemble the penstock in closed position.

- The screws in the tapped blind holes will have a maximum depth (fig. 2) and will never reach the bottom of the hole. The following table (Table 1) specifies the torque to be applied to the flange screws:

Metric	M12	M16	M20	M24	M27	M30	M33	M36	M39
TORQUE (Nm)	18	45	88	152	223	303	412	529	685

table 1

 **Note:** Check torque values for screws with other dimensions.

- The equipment must be firmly installed in the duct. It will be joined to the duct with a screw joint.
- The screws and nuts to be fitted must also be suitable for the operating conditions and their measurements must be in accordance with the approved plans. The screws and nuts must be fitted crosswise.
The torque to apply to the fastening screws and nuts must be correct according to the applicable standard; we recommend the initial assembly be carried out with a low tightening torque and after all the screws are in place, the final torque applied.
- 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, whether interior or exterior, which can interfere with the movement of the penstock.

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- Make the relevant connections (electrical, hydraulic, etc) in the equipment's actuator system following the instructions and wiring diagrams supplied with it.
- The operation 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 POSITION

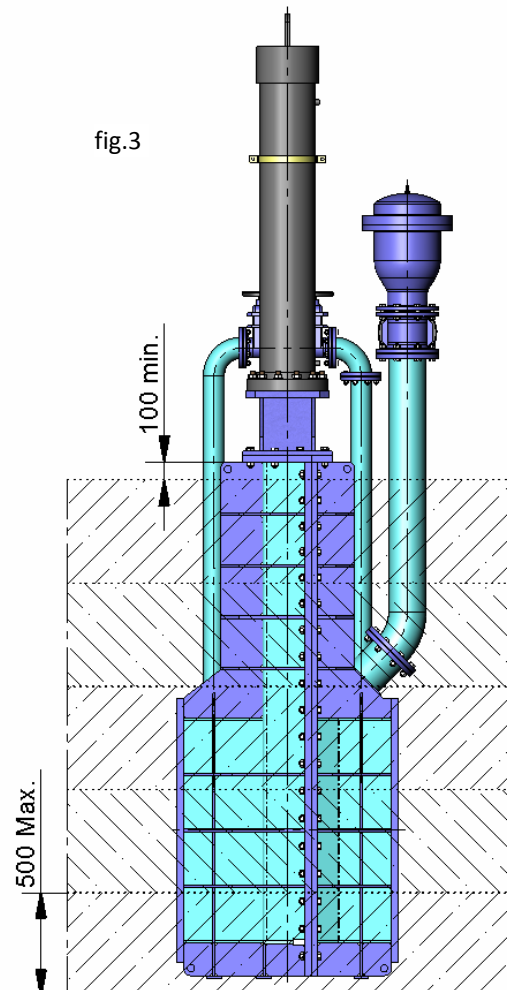
This type of penstock is installed in horizontal pipelines and the position of the penstock is always vertical (other positions can be studied).

INSTALLING THE CONCRETED PENSTOCK

In most facilities this type of penstock is placed in concrete.

The assembly process starts by correctly levelling the penstock, then screwing down the pipe and finally concreting. To carry out the concreting of these penstocks, follow the procedure below (Fig. 3):

- It is extremely important that the penstock is placed in closed position.
- Position the penstock, fit and screw to the pipe.
- Check the correct levelling of the penstock.
- Proceed to firmly anchor the penstock.
- Start pouring concrete in layers no more than 500 mm high. It is very important to respect this measurement, since larger layers would place excessive pressure on the penstock and possibly produce deformation, leading to operating problems.
- Pour as many layers of concrete as necessary to cover the body of the penstock, taking into account that the concrete must not be less than 100 mm from the lower part of the cover. In this manner, the cover can be released in the future without any problem in order to carry out inspection and



Once the valve is installed in its place, check that the flanges and electrical and hydraulic connections are secure. If the valve has electrical accessories, earth connections must be made before operating it.

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PACKING GLAND CHECK

All CMO **CB** penstocks are checked on site, although it is possible that the gasket may come loose during handling and transport, in which case the packing nuts should be retightened to prevent any leakage.

Once the penstock is installed in the pipe and has been pressurised, it is important to check whether there is any leakage in the gasket area (where the spindles are introduced in the cover).

In case of leakage, retighten the packing gland nuts until the leak stops. It is important to uniformly retighten the nuts crosswise, checking at all times that there is no contact between the packing flange and the spindle.

A very high tightening torque on the packing gland's screws can lead to problems, such as a reduction of the working life of the gasket or the deforming of the packing flange. To do this, define the torque that must be applied in each gland (Table 2).

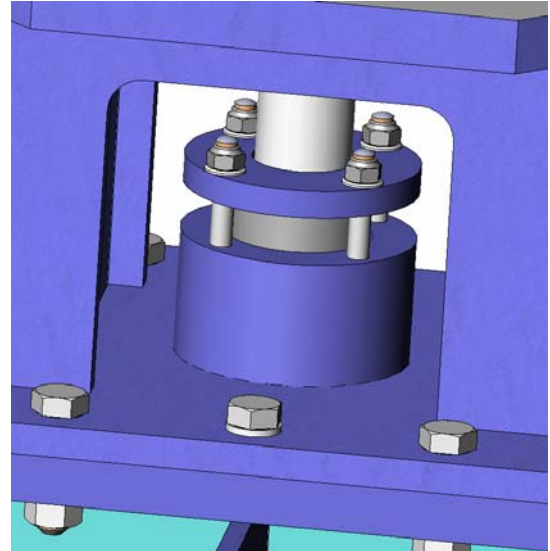


fig.4

Tightening torques for packing gland nuts	
M10	17.5 Nm
M12	21 Nm
M16	30 Nm
M20	35 Nm

table 2

ACTUATOR

HYDRAULIC

The drive system of these penstocks is usually a hydraulic cylinder.

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.

When it is envisaged that any penstock is to remain open for long periods, there is the possibility of supplying the hydraulic cylinder with interlocking. The interlocking system we supply is usually mechanical, and works by way of springs on the outside of the cylinder. However, there is also the option of hydraulic interlocking, which consists of a smaller hydraulic cylinder coupled to the hydraulic drive cylinder.

These penstocks have two open positions: open and gasket change. When the cylinder is interlocked, the penstock remains in open position. In order to carry out the release process, it is necessary to take the penstock to the gasket change position, then release the cylinder and freely operate the penstock.



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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. Depressurise the process.
- Drain all the line fluid through the penstock.
- Use manual rather than electric tools during the maintenance, in accordance with **EN13463-1(15)**.

The maintenance required in this type of penstocks is the change of gasket. It is recommended to check the gasket 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, etc. This maintenance task can even be carried out when the penstock is working under pressure, as detailed below in the section "*REPLACING THE GASKET*".

Regularly clean the valve 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 hydraulic oil circuits 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 and you must avoid placing auxiliary equipment (ladders, scaffolding, etc.) on moving parts which may lead damage.
- 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 cylinder spindle 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 GLAND

As mentioned previously, it is not necessary to depressurise the line in order to carry out maintenance work, which can be done even when the penstock is under pressure, provided the instructions below are followed:



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1. Place the penstock in maximum opening position, namely packing change. In this manner the board's elastomer seals (10) carry out the seal against the cover's bronze scrapers (18), thus preventing any leakage.
2. Shut off the two valves on the hydraulic cylinder connections, in order to immobilise the actuator.
3. Loosen the packing gland nuts and raise the spindle (9 and 14), the packing flange (15) and the gland bushing (16).
4. Remove the old gasket strips (17) with a pointed tool, taking care not to damage the surface of the spindles (9 and 14).
5. Carefully clean the gasket housing, making sure there are no residues anywhere in order to allow the new gasket strips (17) to fit correctly.
6. Insert the new gasket strips (17) in the housing. During this operation it is very important for both ends of each ring to be perfectly joined.
7. Place the gland bushing (16) and the packing gland (15) in the original position, making sure not to touch the spindle (9 and 14). Carefully tighten all the nuts crosswise, ensuring the same distance between the packing flange (15) and the entire spindle (9 and 14).
8. Open both hydraulic cylinder inlet valves in order to operate the penstock again.
9. If there is any leakage through the gasket after carrying out several manoeuvres with the penstock, retighten the packing nuts crosswise enough to halt the leakage (see tightening torques in table 2).

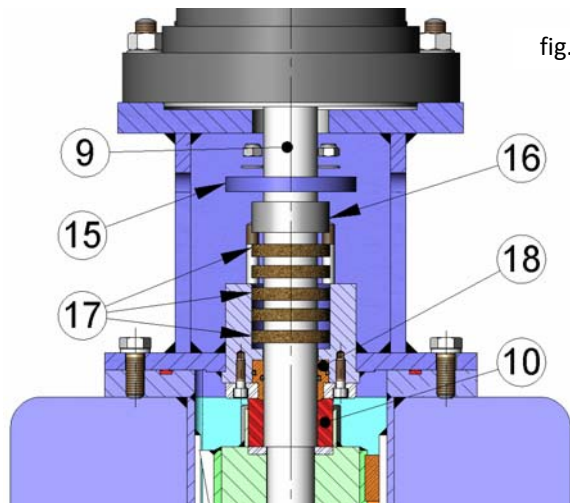


fig.5

Note: The numbers in brackets refer to Figure 5 and to the components list in Table 3.

Whenever the gasket is to be changed with the penstock depressurised, carry out the process as described above, following all the steps, although step nº 1 can be missed out.

INSPECTING THE BOARD

Although it is not a common maintenance task, there is the possibility of checking the state of the board and the inside of the body without having to dismantle the penstock from the line.

Detailed below are the instructions to be followed in order to carry out this operation without any risk to the operators or to the equipment:

1. Make sure there is absolutely no pressure or fluid in the facility.
2. Place the penstock in open or packing change position.
3. Shut off the two valves on the hydraulic cylinder connections, in order to immobilise the actuator.
4. Release the hydraulic cylinder connection hoses.



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5. Loosen the limit switch or inductive sensor connections.
6. Loosen the screws which join the cover to the body.
7. In order to lift the board, cover and actuator unit, it is necessary to first fasten the straps through the holes fitted for this purpose in the cover. Never use the hydraulic cylinder lug, since this is not designed to support the weight of the unit.
8. As soon as the cover begins to separate from the penstock, take care not to lose the two guide pins. These cylindrical pins guide the cover with the body, and are located diagonally on each end.
9. Continue to remove the unit vertically until the board is completely outside of the body.
10. Once the unit is completely outside the penstock, it is possible to carry out cover maintenance work, check the state of the board with its sealing frame and even inspect the inside of the body.
11. Once the envisaged maintenance work has been completed, assemble the unit in reverse order to that described for dismounting. Check the state of the elastomer seal in the upper part of the body and replace if deteriorated. Care should be taken to properly position the guide pins between the cover and body, ensuring they fit perfectly and can be screwed.
12. After mounting the cover, cylinder and board unit inside the penstock body, it is very important to check that the limit switches or sensors and the hydraulic cylinder sleeves have been connected correctly. Do not forget to open the two valves in the hydraulic cylinder connections.

Although the whole cylinder, cover and board unit is extracted when extracting the board, this series of elements can be dismantled later on. To explain how to carry out this disassembly, we assume that the unit is outside the penstock body:

- Release the cover (7) from the face of the board (3) at the bronze seal frame (5). This cover (7) is located in the top centre of the board (3) and is attached by countersunk Allen screws.
- Remove the cover (7) and the seal (6).
- Fasten the cylinder nut (12) and release the cylinder conternut (13).
- Secure to prevent turning on the square stem of the cylinder spindle (9) and release the cylinder nut (12).
- Release the ring (20) from the indication spindle (14) in order to completely remove the board from the cover.
- In order to remove the hydraulic cylinder (8) from the cover, simply release the attachment nuts of the cylinder flange and the indicator supports (25 and 26).
- To release the indicator system, release the indicator stopper (21) and the brackets (25 and 26).

Maintenance tasks can be carried out once everything has been dismantled. The most important are the checking and replacement (whenever deteriorated) of the following elements:


- Gasket change seal (10) for the indicator and hydraulic cylinder.
- O-rings (19) of the bronze scraper guides (18).
- Gasket (17) for the indicator and the hydraulic cylinder.



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As described above, the gasket (17) can be inspected and replaced in a more straightforward manner, without having to extract the board from the penstock body, even when the penstock is under pressure.

 **Note:** The numbers in brackets refer to the components list in Table 3.

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 valve'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 valve'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.



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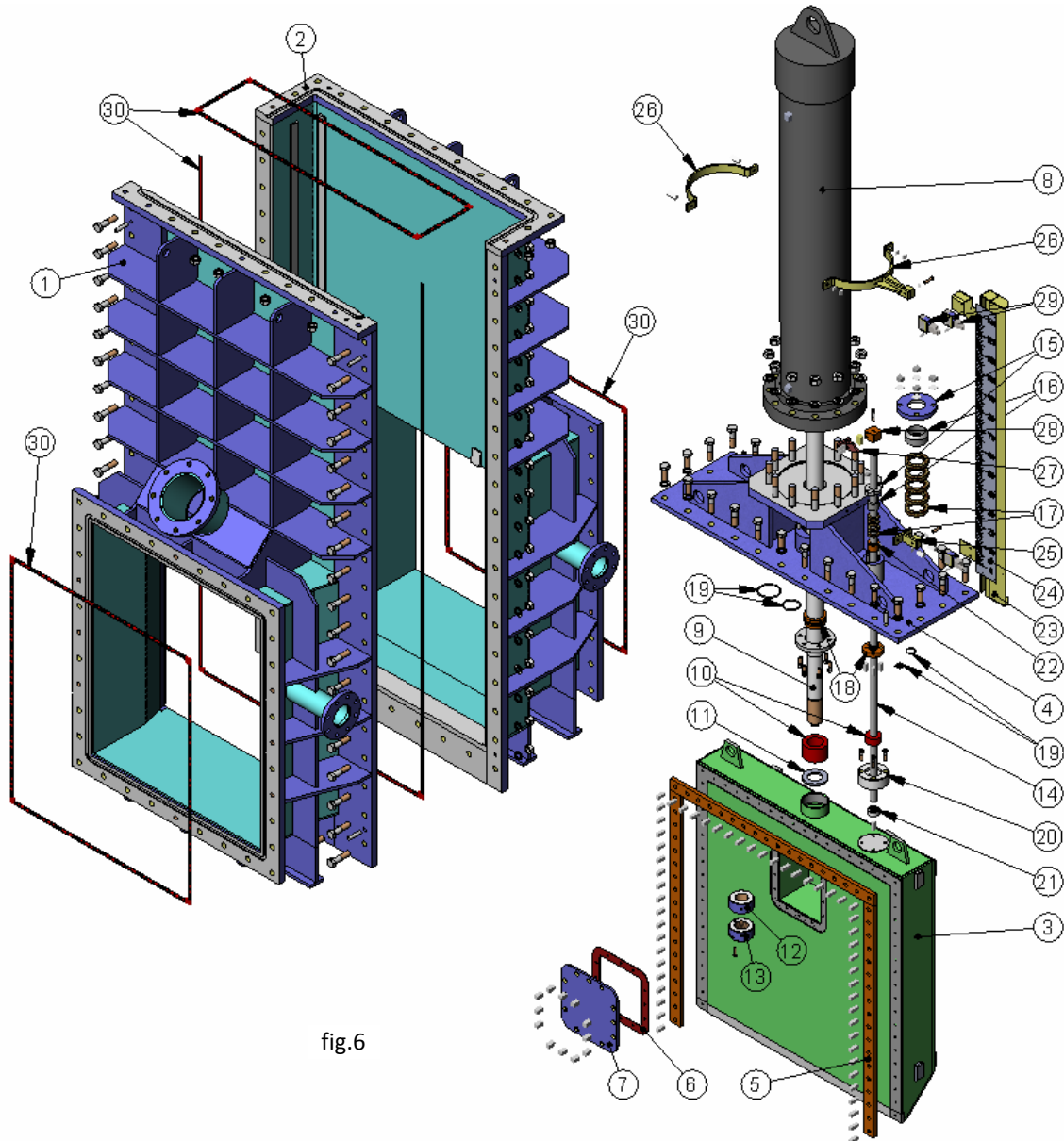


fig.6

STANDARD COMPONENTS LIST					
POSITION	COMPONENT	POSITION	COMPONENT	POSITION	COMPONENT
1	BODY	11	THRUST WASHER	21	INDICATOR STOPPER
2	COUNTERBODY	12	CYLINDER NUT	22	GUIDE BUSHING
3	BOARD	13	CYLINDER COUNTERNUT	23	RULE SUPPORT
4	COVER	14	INDICATOR SPINDLE	24	INDICATION RULE
5	SEAL	15	GLAND FLANGE	25	LOWER SUPPORT
6	BOARD COVER SEAL	16	GLAND BUSHING	26	UPPER SUPPORT
7	BOARD COVER	17	GASKET	27	INDICATOR ARROW
8	HYDRAULIC CYLINDER	18	SCRAPER GUIDE	28	SLIDE
9	CYLINDER SPINDLE	19	O-RING SEAL	29	LIMIT SWITCH
10	GASKET CHANGE SEAL	20	RING	30	SEAL

table 3

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