

## CHANNEL PENSTOCK

## CA SERIES

01/03/2012

### UNIDIRECTIONAL or BIDIRECTIONAL Channel Penstock

- Penstock for clean liquids or loaded with solids.
- Design of square or rectangular penstock.
- Possibility of unidirectional or bidirectional.
- Various seal materials available.
- Common design to embed in the walls of the channel.

#### General applications:

- This channel penstock is designed to work in open channels, and has a 3-side seal (base and sides). It is suitable to work with clean liquids or loaded with solids. Used mainly in:
  - Water treatment plants
  - Irrigation
  - Hydroelectric power stations
  - Conduits

#### Sizes:

- From 150 x 150 up to 3000 x 3000 (larger sizes on request). Check with CMO for the general dimensions of a specific penstock.

#### Working ( $\Delta P$ ):

- The maximum working pressure is the height of the through conduit of the penstock; since these penstocks have a 3-side seal, the fluid would overflow above the through conduit whenever the fluid were higher than the through conduit.

#### Civil works:

- The standard in CMO CA channel penstocks is to leave holes in the channel in order to introduce the penstock and mount concreted in the channel; however, penstocks can also be built to order in line with the customer's requirements.

#### Sealtightness.

- The sealtightness of the CA channel complies with that set out in regulation DIN 19569, class 5 of leaks.

#### Directives:

- 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**, for information on categories and zones please contact CMO Technical-Sales Department.

#### Quality dossier:

- The sealtightness of the seat area is measured with gauges.
- Material and testing certificates can be supplied on request.

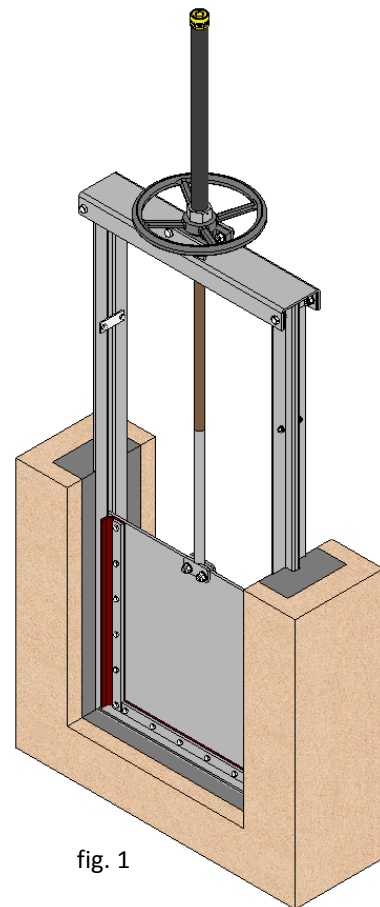


fig. 1

## CHANNEL PENSTOCK

## CA SERIES

### Advantages of CMO "CA Model"

The **CA** channel penstocks are designed to work with liquids. The main elements of the **CAs** are the body or frame, in which a through conduit or board which moves up and down and has a 3-side sealing system (lower and sides) to prevent leakages of liquid is embedded. The yoke is screwed onto the upper part of the body, where the actuator is located.

CMO standard **CAs** are designed for the body to be embedded in the channel, thus ensuring there is no obstruction in the passage of the channel. Whenever the penstock is open, it therefore provides entirely continuous passage and avoids accumulations of residue.

The stem protection hood is independent from the handwheel securing nut, this means the hood can be disassembled without the need to release the handwheel. This advantage allows regular maintenance operations to be performed, such as lubricating the stem, etc.

The stem on the CMO penstock is made of 18/8 stainless steel. This is another added advantage, as some manufacturers produce it with 13% chrome and it gets rusty very quickly.

The operating wheel is manufactured in nodular cast GGG50. Some manufacturers supply it in common cast-iron, which can lead to breakage in the event of very high operation torque or a bang.

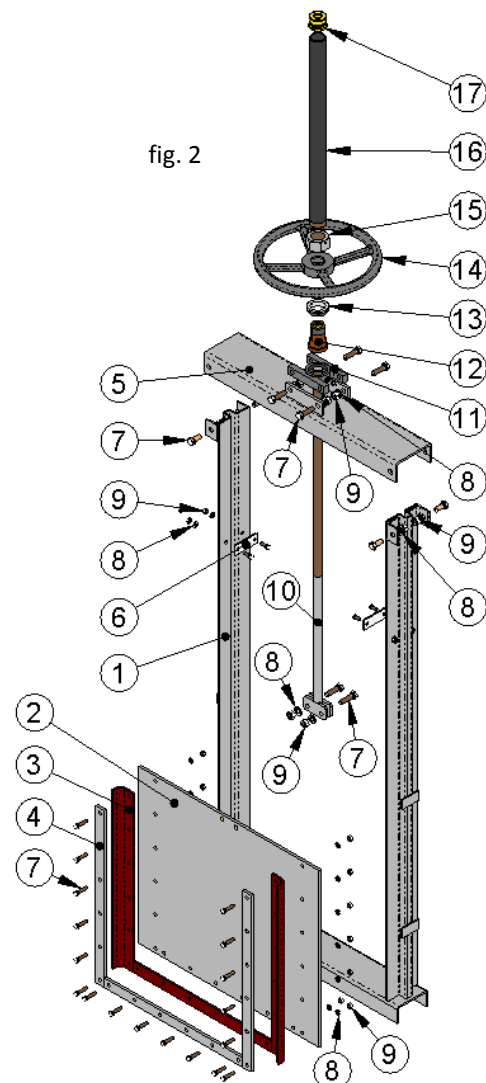
The yoke is has a compact design with the bronze actuator nut protected in a sealed and lubricated box. This makes it possible to move the penstock with a key, even without the handwheel (in other manufacturers' products this is not possible).

The pneumatic actuator's upper and lower covers are made of GGG40 nodular cast iron, making them highly shock resistant. This characteristic is essential in pneumatic actuators.

The pneumatic cylinder's seals are commercial products and can be purchased worldwide. This means it is not necessary to contact CMO every time a seal is required.

COMPONENTS LIST			
COMPONENT	VERSION S275JR	VERSION AISI304	VERSION AISI316
1- Body	S275JR	AISI304	AISI316
2- Through conduit	S275JR	AISI304	AISI316
3- Seal	EPDM	EPDM	EPDM
4 - Flange	AISI304	AISI304	AISI316
5- Yoke	S275JR	AISI304	AISI316
6 - Stopper	S275JR	AISI304	AISI316
7- Screw	A2	A2	A4
8 - Washer	A2	A2	A4
9- Nut	A2	A2	A4
10- Stem	AISI303	AISI303	AISI303
11 - Actuator Yoke	GGG50	GGG50	GGG50
12- Stem nut	BRONZE	BRONZE	BRONZE
13- Stopper Nut	STEEL	STEEL	STEEL
14- Handwheel	GGG50	GGG50	GGG50
15- Hood nut	5.6 ZINC	5.6 ZINC	5.6 ZINC
16- Hood	STEEL	STEEL	STEEL
17- Protection cap	PLASTIC	PLASTIC	PLASTIC

table 1





## CHANNEL PENSTOCK

## CA SERIES

### DESIGN CHARACTERISTICS

#### 1- BODY

The standard body or frame is mechanically welded, manufactured in one single piece. Constructed with foldable profiles to prevent any deformation and to increase robustness. The side profiles have a gap throughout the length (in order to slide the through conduit), obtained by way of several folds (without welding), thus ensuring the body will not have any leaks.

The body has at least an approximate height of twice the through conduit, in order to house it when the penstock is completely open. The upper section includes fasteners to secure the yoke.

The standard body is designed to be mounted concreted inside the channel holes, meaning no screws are required to secure the body in the channel, ensuring there is no protrusion and passage is entirely continuous. When the channel is constructed and does not have the necessary holes to mount already concreted, the body can be secured using chemical or expansion anchors, in which case it must be remembered that the channel passage is slightly narrower.

The bodies can be square or rectangular.

The material used is usually stainless steel AISI304 or AISI316, although carbon steel S275JR can also be used. In accordance with the conditions the through conduit will be subject to, there are other special materials available to order, such as AISI316Ti, Duplex, 254SMO, Uranus B6, Aluminium, etc. As a rule, iron or carbon steel penstocks are painted with an anti-corrosive protection of 80 microns of EPOXY (colour RAL 5015), although other types of anti-corrosive protections are also available.

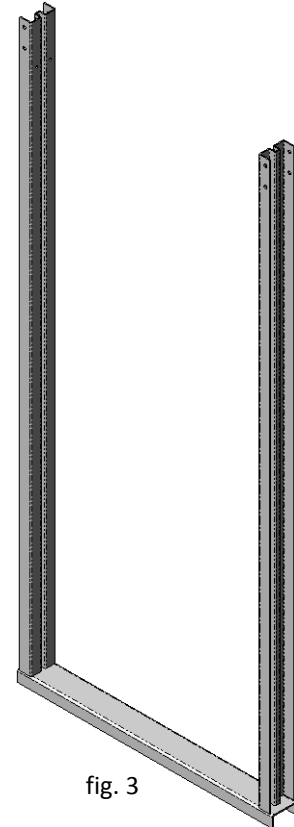


fig. 3

#### 2- THROUGH CONDUIT

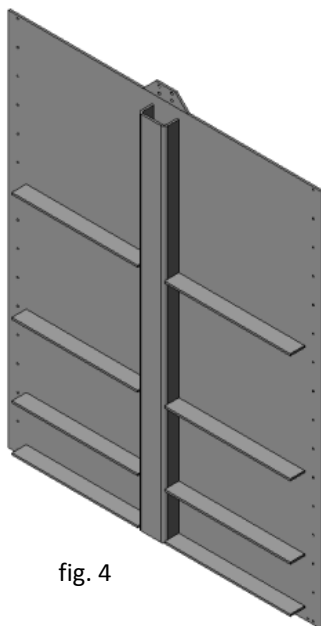


fig. 4

The through conduit manufacture material is usually the same as that used for the body, although it can also be supplied to order with other materials or combinations.

Depending on the dimensions of the penstock, some reinforcements are often welded on to the through conduit (as shown in fig. 4) in order to achieve the necessary rigidity. The stem is connected to the upper part of the through conduit, with its longitudinal movement making the penstock open or close. The three seals can be found on the through conduit, two on the sides and one in the lower section.

## CHANNEL PENSTOCK

## CA SERIES

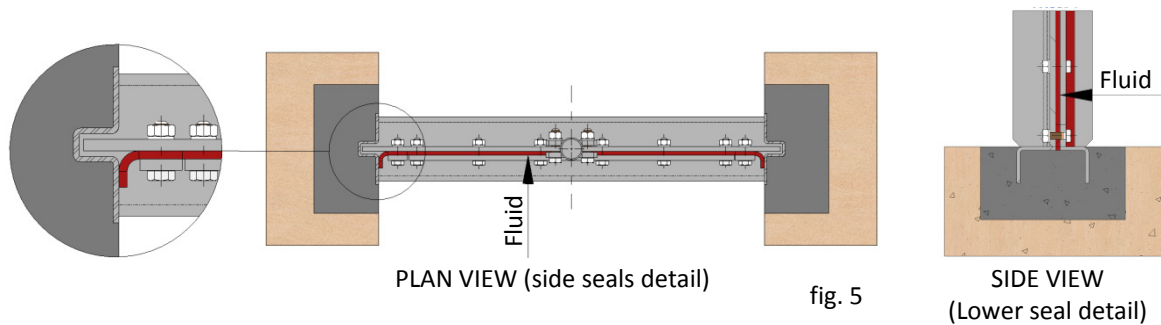
### 3- SEAT

The standard seal in this type of penstock comprises flat rubber rims which are secured to the through conduit using stainless steel flanges. The sealtightness complies with that set out in regulation DIN 19569, class 5 of leaks.

Depending on the work application, the following options can be chosen from:

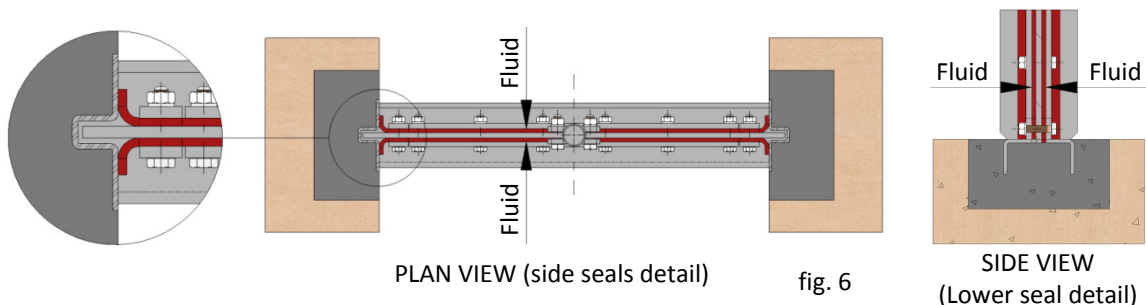
#### - UNIDIRECTIONAL:

This is the most common, and is used when the fluid always comes in the same direction. The sealing joints are located on the upwater face of the through conduit, thus ensuring that the thrust of the fluid pressures the seal against the body and guarantees sealtightness (fig. 5).



#### - BIDIRECTIONAL:

This type of seal is used when the fluid can come in one direction or the other. The sealing joints are located on both sides of the through conduit, thus ensuring that, even though the fluid comes in one direction or another, the thrust of the fluid always pressures the seal against the body and therefore guarantees sealtightness (fig.6).



Although the standard sealtight joint is EPDM, there are other types of materials in order to choose the most suitable, in accordance with the work applications for the penstock (work temperature, fluid type, etc). Described here are the characteristics of the most common, which are summarised below in Table2:

#### Sealtight materials

##### EPDM

Recommended for temperatures no higher than 90°C\*, it provides the penstock with 100% watertight integrity. Application: Water and acids.

##### NITRILE

It is used in fluids containing fats or oils at temperatures no higher than 90°C\*. It provides the penstock with 100% watertight integrity.



## CHANNEL PENSTOCK

## CA SERIES

### VITON

Suitable for corrosive applications and high temperatures up to 190°C continuously and peaks of 210°C. It provides the penstock with 100% watertight integrity.

### SILICONE


Mainly used in the food industry and for pharmaceutical products with temperatures no higher than 200°C. It provides the penstock with 100% watertight integrity.

### PTFE

Suitable for corrosive applications and pH between 2 and 12. Does not provide the penstock with 100% watertight integrity. Estimated leakage: 0.5% of the channel flow.

### NATURAL RUBBER

It can be used in multiple applications at temperatures no higher than 90°C with abrasive products and it provides the penstock with 100% watertight integrity. Application: fluids in general.

 **Note:** In some applications other types of resilient materials are used, such as hypalon, butile, etc. . Please contact us if you require one of these materials.

SEAT/SEALS		
Material	Max. T. (°C)	Applications
EPDM (E)	90 *	Non-mineral oils, acids and water.
Nitrile (N)	90 *	Hydrocarbons, oils and greases
Viton (V)	200	Hydrocarbons and solvents
Silicone (S)	200	Food Products
PTFE (T)	250	Resistant to corrosion
Natural Rubber	90	Abrasive products

table 2

NOTE: More details and other materials available on request.

\* → EPDM and nitrile: is possible until serving temperature Max.: 120°C under request.

## 4- STEM

The stem on the CMO penstocks is made of 18/8 stainless steel. This characteristic provides high resistance and excellent corrosion-resistant properties.

The penstock design can be rising stem or non-rising stem. When a rising stem is required for the penstock, a stem hood is supplied to protect the stem from contact with dust and dirt, besides keeping it lubricated.

## 5- ACTUATORS

These CA channel penstocks usually have a yoke in the upper section of the body where the actuator is housed. When the height of the penstock must be minimum, the yoke will delimit the longitudinal movement of the through conduit. When starting up the actuator, it exercises the torque or draw necessary in the stem or rod, which in turn is transmitted to the through conduit to start movement.

Our channel penstocks are supplied with several types of actuator, bringing the advantage that, thanks to the design of CMO, they can be interchanged.

This design allows customers to change the actuators themselves and no extra assembly accessories are required.

The total dimensions of the penstock may vary in accordance with the type of actuator chosen.

## CHANNEL PENSTOCK

## CA SERIES

### Manual:

Handwheel with rising stem  
Handwheel with non-rising stem  
Chainwheel  
Handle  
Gears  
Others (square nut,...)

### Automatic:

Electric actuator  
Pneumatic cylinder  
Hydraulic cylinder

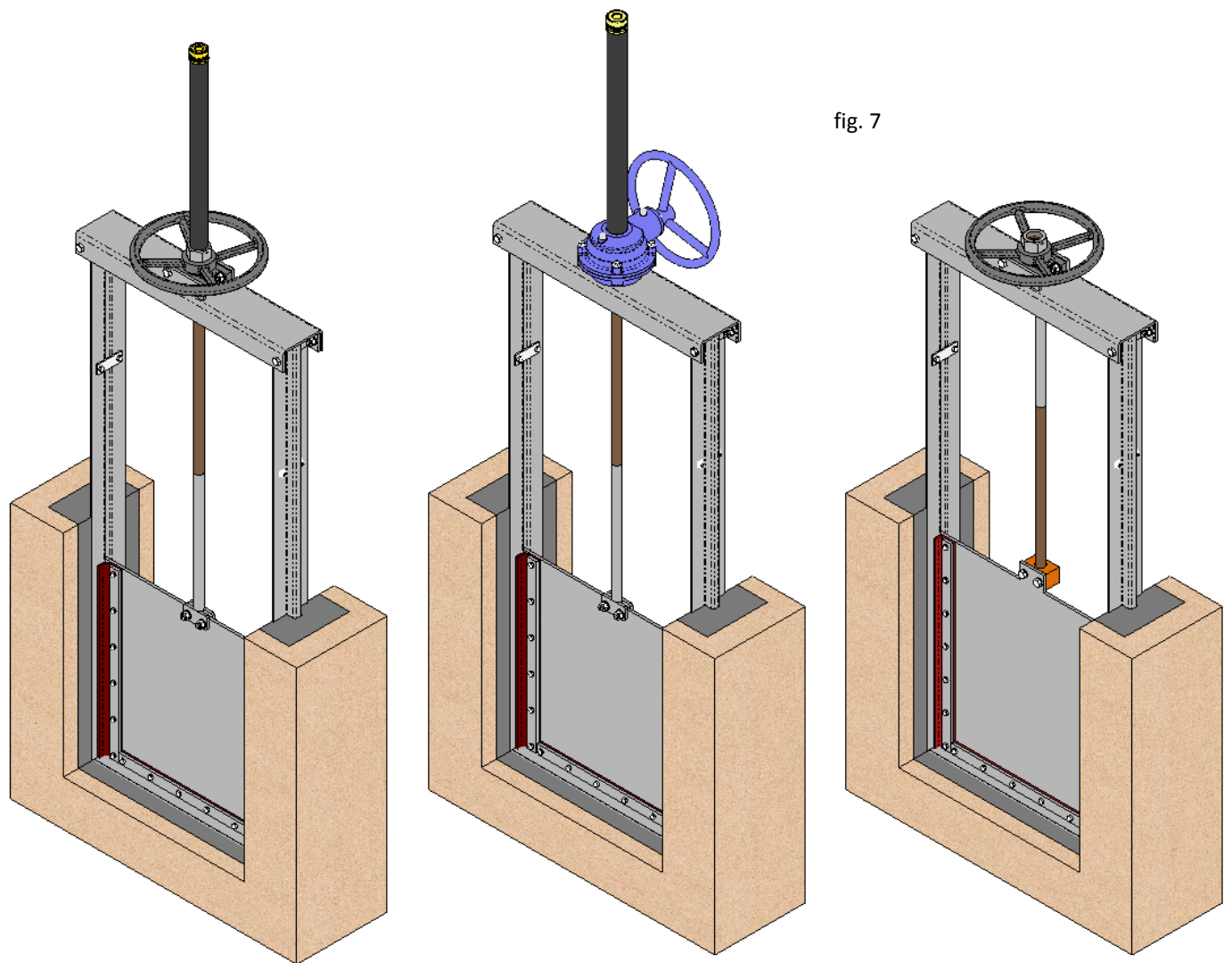


fig. 7

Handwheel rising  
stem

Handwheel  
gear box

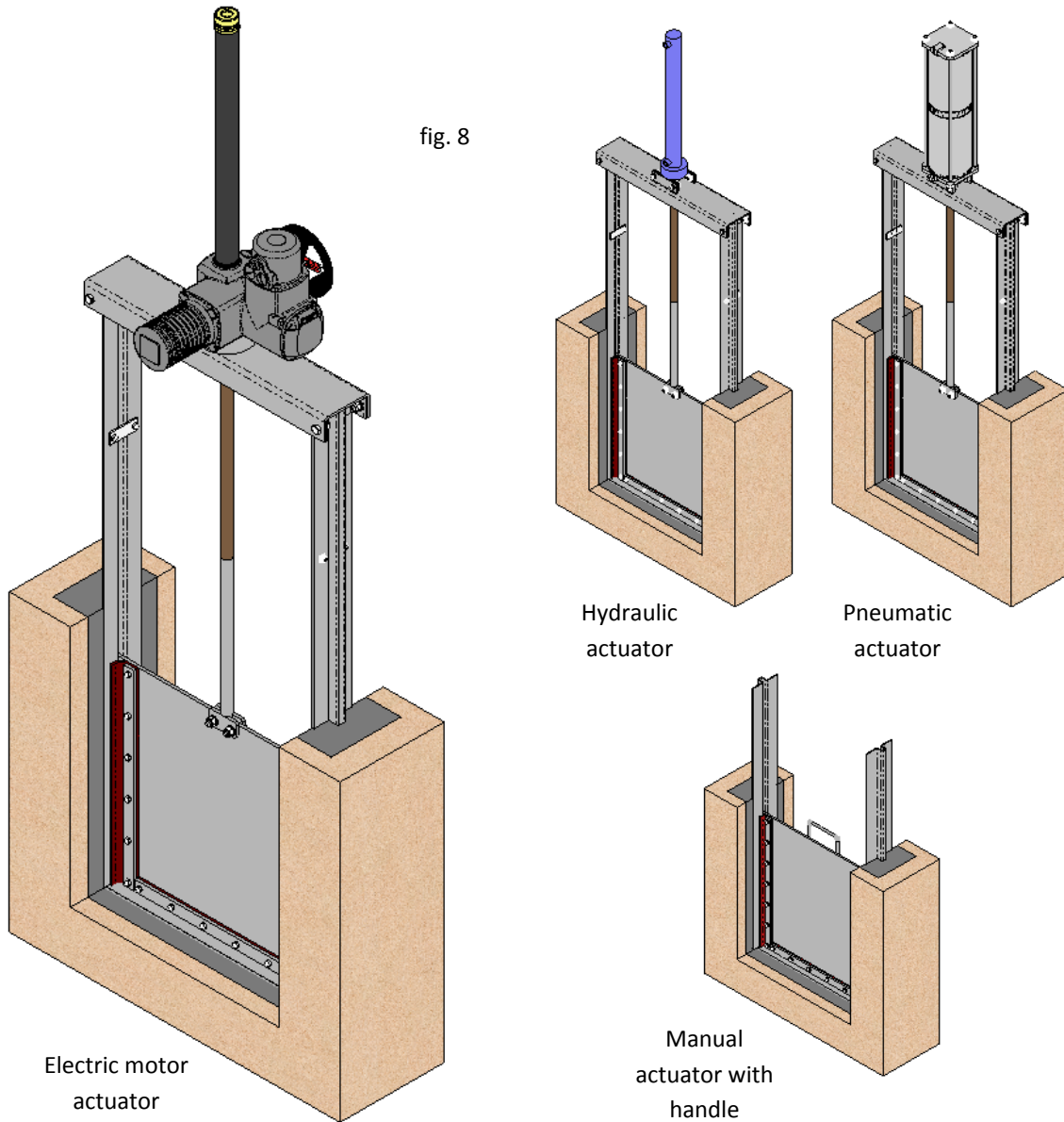
Handwheel with  
NON-rising stem

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



## CHANNEL PENSTOCK

## CA SERIES



Stem extensions have also been developed, allowing the actuator to be located far away from the penstock, to suit all needs. Please consult our technicians beforehand.

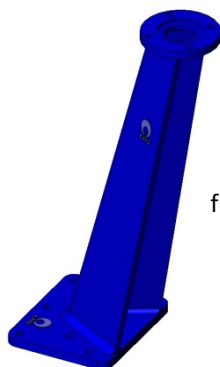


fig. 9

### Wide range of accessories available:

- Mechanical stoppers
- Locking devices
- Emergency manual actuators
- Electrovalves
- Positioners
- Limit switches
- Proximity switches
- Straight floor stands (fig. 10)
- Leaning floor stand (fig. 9)
- ...

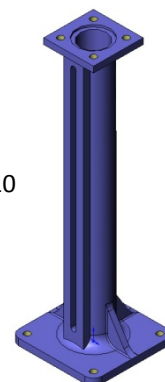


fig. 10



## CHANNEL PENSTOCK

## CA SERIES

### ACCESSORIES AND OPTIONS

Different accessories are available to adapt the penstock to specific working conditions such as:

**-Mechanical limit switches, inductive switches and positioners (fig. 11):**

Limit switches or inductive switches are installed to indicate precise penstock position, as well as positioners to indicate continuous position.

**-Electrovalves (fig. 11):**

For air distribution to pneumatic actuators.

**-Connection boxes, wiring and pneumatic piping:** Units supplied fully assembled with all the necessary accessories.

**- Stroke limiting mechanical stops:** Allow the stroke to be mechanically adjusted, limiting the penstock run.

**-Mechanical locking device:**

Allows the penstock to be mechanically locked in a set position for long periods.

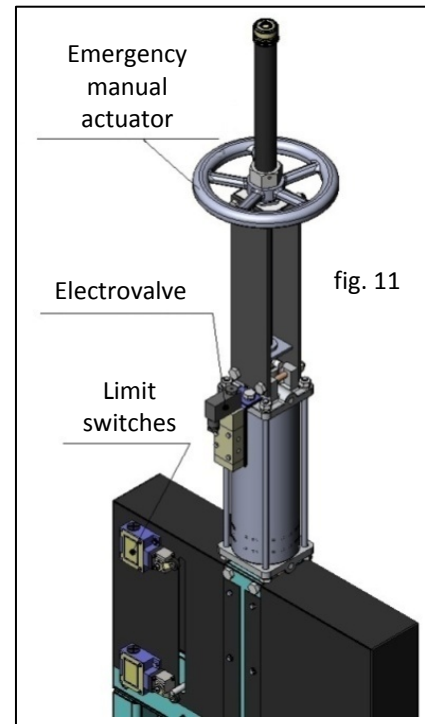
**-Emergency manual actuator (hand wheel / gear box):** Allows manual operation of the penstock in the event of power or air failure (fig. 11).

**-Interchangeable actuators:**

All actuators are easily interchangeable.

**-Epoxy coating:**

All carbon steel components and bodies of CMO penstocks are EPOXY coated, giving them great resistance to corrosion and an excellent surface finish. CMO's standard colour is blue RAL-5015.







# CHANNEL PENSTOCK

# CA SERIES

## TYPES OF EXTENSION

When the penstock needs to be operated from a distance, the following different types of actuators can be fitted:

### 1 - Extension: Floor Stand.

This extension is performed by coupling a spindle to the stem. By defining the length of the spindle, the desired extension is achieved. A floor stand is normally installed to support the actuator.

The definition variables are as follows:

**H1:** Distance from the base of the channel to the base of the floor stand.

#### Characteristics:

- It can be coupled to any type of actuator.
- A stem support-guide is recommended (fig. 13) every 1.5 m.
- The standard floor stand is 800 mm high (fig. 12). Other floor stand measurements available to order.
- A position indicator can be fitted to determine the degree of opening of the penstock.
- Possibility of leaning floor stand (fig. 14).

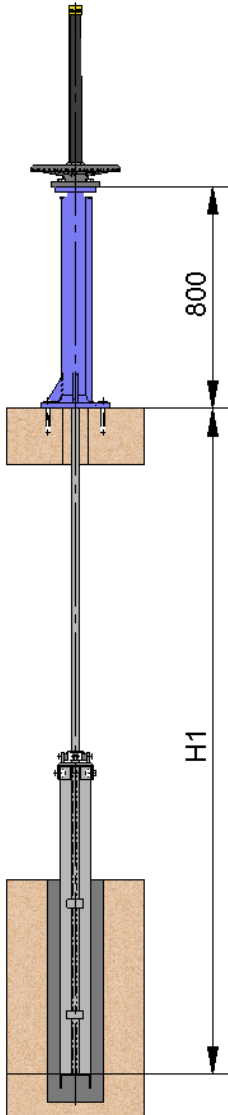


fig. 12

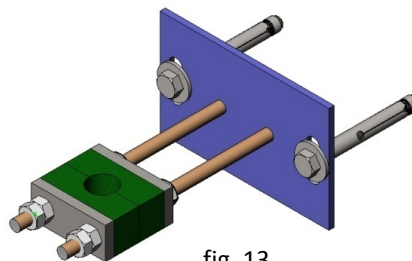


fig. 13

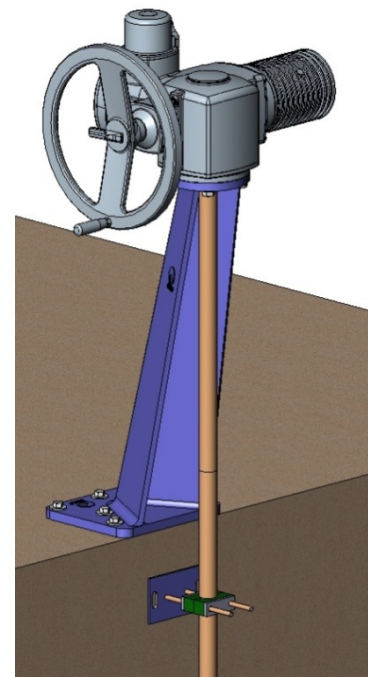


fig. 14

COMPONENTS LIST	
Component	Standard Version
Stem	AISI 303
Stem	AISI 304
Guide-support	Carbon steel with EPOXI coating
Slide	Nylon
Floor Stand	GGG 50 with EPOXY coating

table 3



# CHANNEL PENSTOCK

# CA SERIES

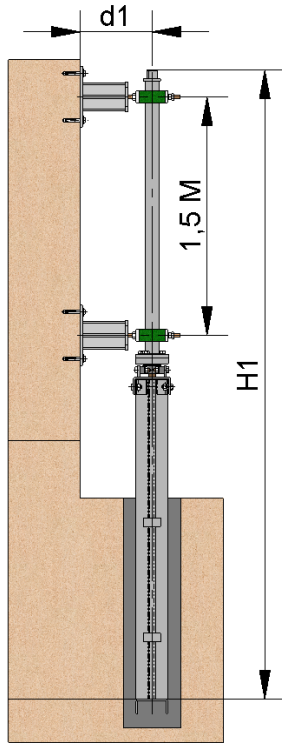


fig. 15

### 2 - Extension: Pipe (fig. 15)

Consists of raising the actuator. The pipe will rotate with the wheel or key when the penstock is operated, although this will always remain at the same height.

The definition variables are as follows:

**H1:** Distance from the base of the channel to the required height of the actuator.

**d1:** Separation from the wall to the spindle shaft.

#### Characteristics:

- Standard actuators: Handwheel and "Square Nut".
- A pipe support-guide is recommended every 1.5m.
- The standard materials are: EPOXY coated carbon steel or stainless steel.

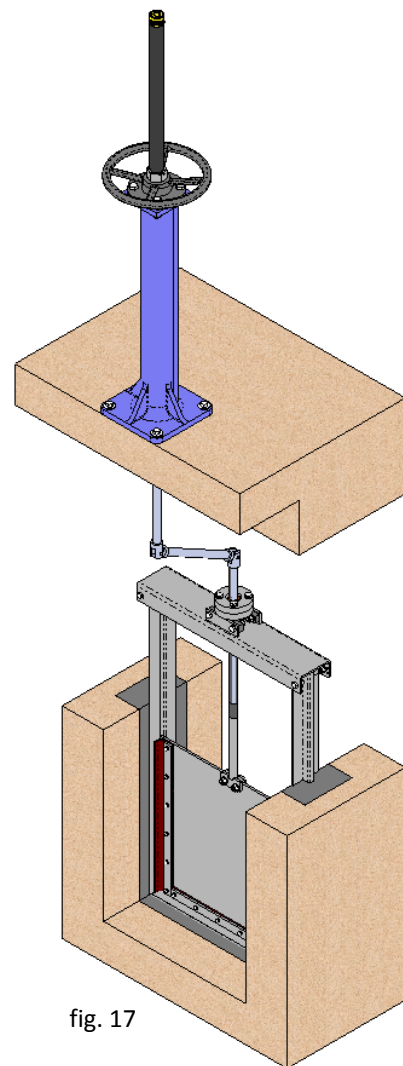


fig. 17

### 3 - Extension: Extended body guides (fig. 16)

When an extension is required, it can be achieved by extending the guides of the body. An intermediate yoke can be fitted to reinforce the body guides structure.

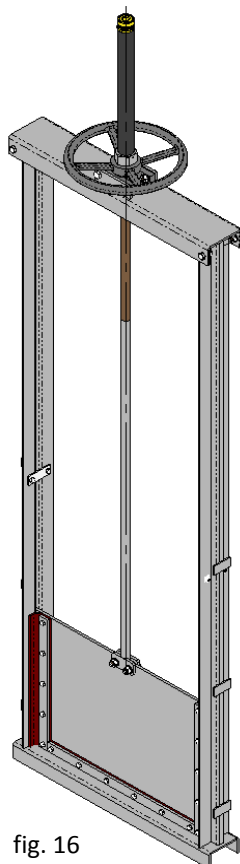


fig. 16

### 4 - Extension: Cardan joint (fig. 17)

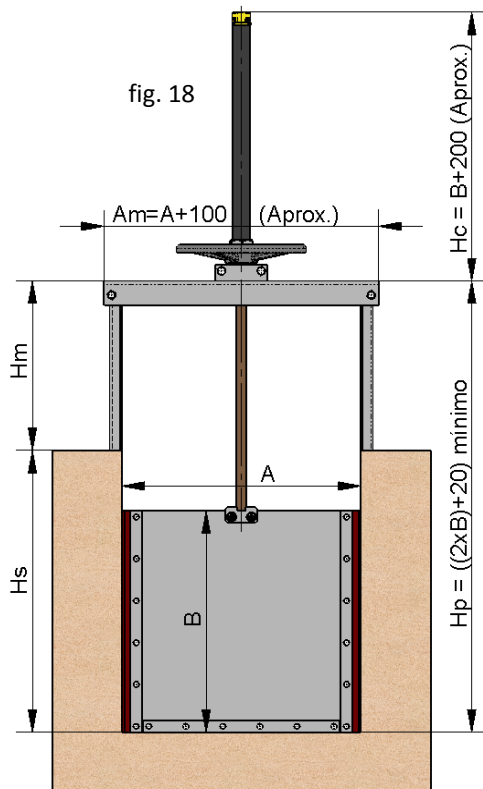
If the penstock and the actuator are not in correct alignment, the problem can be resolved by fitting a universal joint.

# CHANNEL PENSTOCK

# CA SERIES

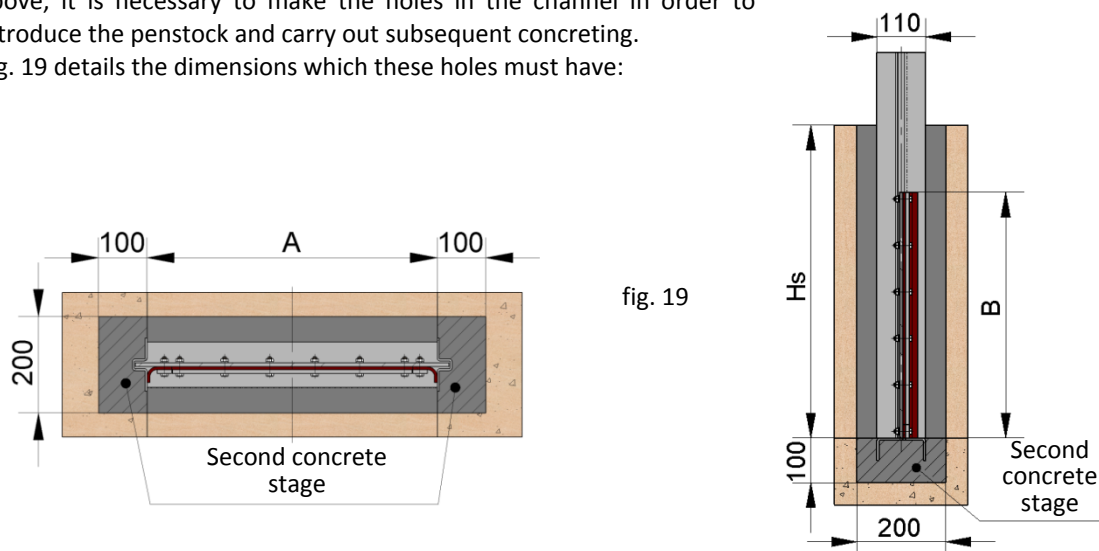
## GENERAL DIMENSIONS

In order to define a **CA** channel penstock, we need to know the width and height of the penstock. The levels **A** and **B** will be used to refer to these variables, whilst the designation mode will be **A x B** (Width x Height). The dimensions range from 150 x 150 up to 3000 x 3000 (larger dimensions upon request). These penstocks may be square or rectangular, meaning they do not need to have the same width (**A**) and height (**B**). Each level is described in fig. 18:



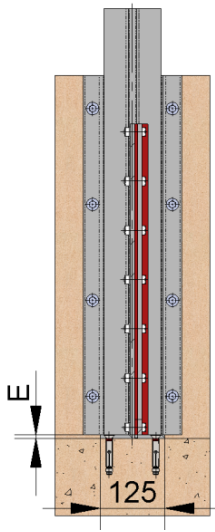
- **Level A:** This is used to define the width of the penstock.
- **Level B:** This is used to define the height of the penstock.
- **Level Hs:** This is used to define the height of the channel where the penstock is to be located. This level must be equal to or greater than the height of the penstock (**B**).
- **Level Hm:** This is used to define the distance from the floor to the yoke where the actuator is located. This level (**Hm**) is usually 800 mm, allowing a person to comfortably handle the penstock.
- **Level Hp:** This is used to define the distance from the base of the channel through to the yoke. This level must be at least twice the height of the penstock (**B**) plus 20 mm (in order for the penstock to open completely). If the penstock has a non-rising stem actuator, 80 mm must be added to achieve the **Hp**.
- **Level Hc:** This is used to define the total height of the actuator. This level (**Hc**) is usually the the height of the penstock (**B**) plus 200 mm. If the penstock has a non-rising stem actuator, the **Hc** level is reduced, and will have an approximate value of 300 mm (depending on the actuator installed).
- **Level Am:** This is used to define the maximum width covered by the penstock. This level (**Am**) is usually approximately the width of the penstock (**A**) plus 100 mm.

CA channel penstocks are usually mounted concreted in the channel and, to this end, as described above, it is necessary to make the holes in the channel in order to introduce the penstock and carry out subsequent concreting. Fig. 19 details the dimensions which these holes must have:



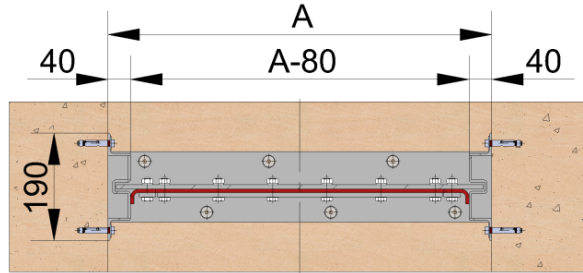
# CHANNEL PENSTOCK

# CA SERIES



When the channel is constructed and does not have the necessary holes to mount the penstock already concreted, the body can be secured using chemical or expansion anchors, in which case it must be remembered that the channel passage width is approximately 80 mm narrower (fig. 20).

fig. 20



A flat rim will be fastened in the base of the channel where the penstock can make the lower seal. The thickness of this rim (level E) varies in accordance with the width of the penstock (A), as defined in table 4.

LOWER RIM (BASE)	
Penstock width (A)	Base rim thickness (E)
150 ~ 1000 mm	6 mm
1100 ~ 2000 mm	8 mm
2000 ~ 3000 mm	10 mm

table 4

## FASTENING OPTIONS

As described above, the most common system to mount these penstocks is by concreting, although, as can be seen in fig. 21, there are other assembly options.

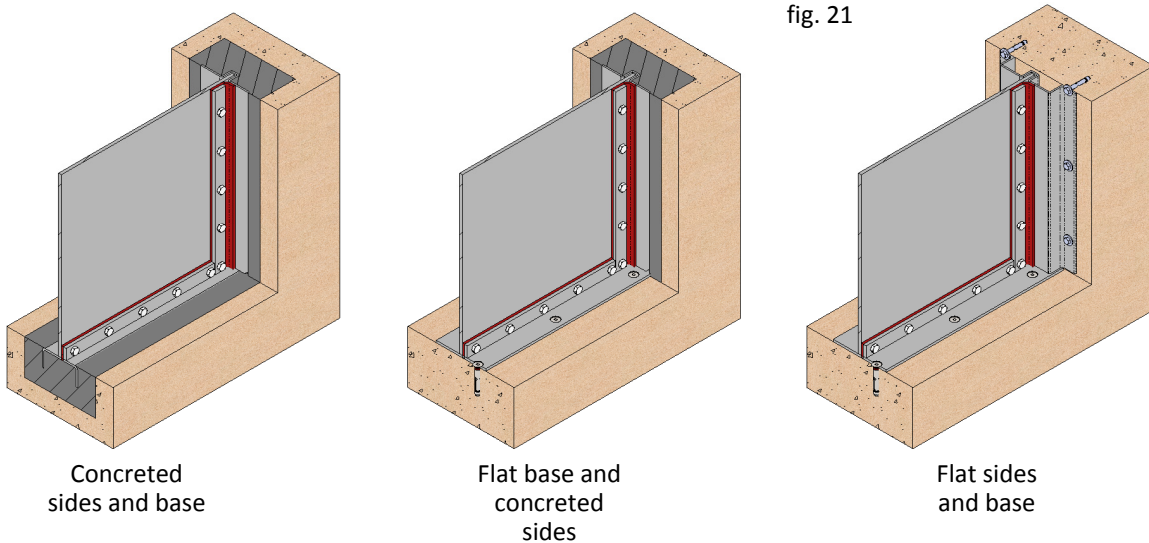


fig. 21

- Position the penstock in the channel holes in order to mount the penstock concreted (the most common way); in this process it is particularly important that the through conduit sealing joints are upwater.

## CHANNEL PENSTOCK

## CA SERIES

Once the penstock is positioned in the holes, align it horizontally with regards to the width of the channel and vertically make sure that the base of the penstock is level with the channel, thus guaranteeing that there is no protrusion in the channel, allowing entirely continuous passage.

The second stage of concreting, namely filling the holes, will take place while maintaining this position, ensuring there is no protrusion in the channel.

- In order to mount the penstock using chemical or expansion anchors, proceed to position the penstock in the channel; it is also vitally important that the sealing joints of the through conduit are upwater. Using the holes of the body of the penstock as a guide, make the boreholes in the channel for the chemical or expansion anchors. 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 and screw down using the chemical or expansion anchors. Take care to screw crosswise and without excessive force, in order to ensure the penstock does not become deformed.