VERTICAL-LIFT GATE

VM SERIES

06/06/2014

UNIDIRECTIONAL OR BIDIRECTIONAL VERTICAL-LIFT GATE

- Penstock designed for large sections with high volumes of water.
- Design of the stopboard with side wheels, to facilitate the manoeuvres of the penstock under high volumes of water.
- Design of square or rectangular penstock.
- Option of unidirectional or bidirectional.
- Various seal materials available.
- Designed to install embedded in concrete or mounted on walls with chemical or expansion anchors.

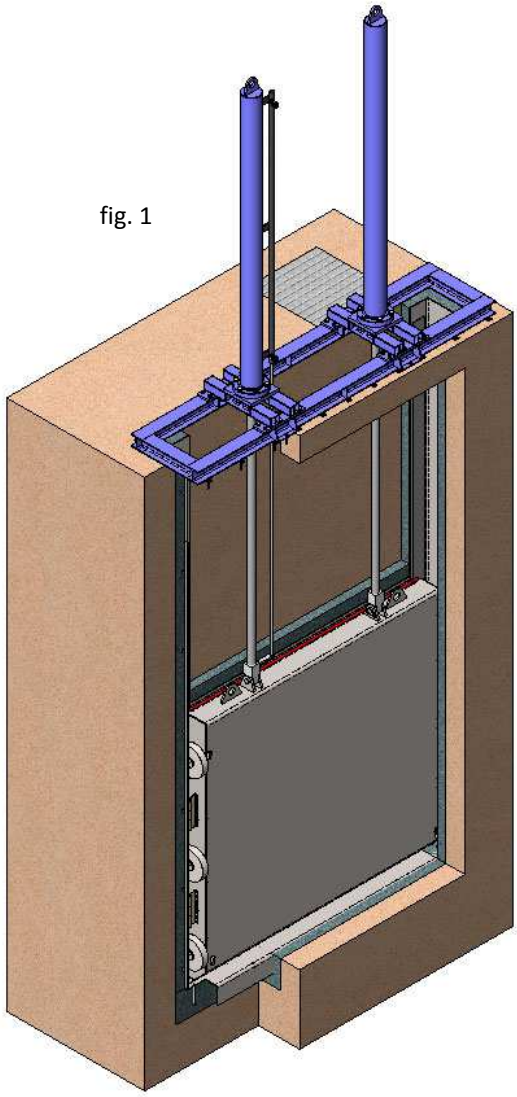

fig. 1

General applications:

- This vertical-lift gate is designed to be installed in channels or on orifices in walls. The channel or orifice can be rectangular, round or square, and this penstock can have a 3-side or 4-side seal.
  It is suitable to work with clean liquids or loaded with solids. Used mainly in:
  - Wastewater treatment plants
  - Hydroelectric power stations
  - Irrigation
  - Conduits

Sizes:

- From 500 x 500 up to 5000 x 5000 (larger sizes to order). Check with CMO for the general dimensions of a specific vertical-lift gate.

Working (ΔP):

- The maximum working pressure adapts to the needs of the customer in every project. These penstocks are designed to comply with working conditions in the place of installation.

Civil engineering work:

- Given the large dimensions of **VM** vertical-lift gates and the large volumes of water they have to withstand, the most common assembly system (recommended by CMO) is embedded in concrete. This type of assembly requires a series of gaps in the civil engineering work for the installation of the penstock.
  There is also the possibility of securing it to the wall with expansion or chemical anchors. In this case it is essential that the wall where the penstock is to be installed is completely smooth and level.

Sealtight integrity.

- The sealtightness of **VM** vertical-lift gates complies with that set out in regulation DIN 19569, class 5 of leaks.

Design regulations and directives:

- **DIN 19704** Hydraulic Steel Structures. Criteria for Design and Calculation.
- **DIN 19705** Hydraulic Steel Structures. Recommendation for Design, Construction and Erection.
- 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.

Advantages of CMO "VM Model"

VM vertical-lift gates are designed to handle liquids. The main elements are the body or frame, in which a mechanically welded stopboard which moves up and down and has a 3- or 4-sided sealing system to prevent leakages of liquid is fitted. The stoppers are bolted onto the upper part of the body (only when manual actuator is fitted).
CMO's **VM**s can be of different sizes, in one of the options (recommended by CMO) the body is designed to be embedded in the concrete. Another option is for the body to be secured to the wall using expansion or chemical anchors. There is also the option of combining both types of design in the same penstock, i.e., some parts of the body embedded in concrete and other parts secured by expansion or chemical anchors. These penstocks are designed in accordance with the requirements of each project, taking into account dimensions, pressures, type of civil engineering work, etc.
The dimensions of the body passage usually coincide with the dimensions of the wall or channel orifice, thereby ensuring that there is no obstruction in the passage of the fluid, allowing entirely continuous passage whenever the penstock is completely open and avoiding any build-up of residue.
One of the main characteristics of self-lift gates is that the stopboard is fitted with side wheels for easier operation of the gate under high volumes of water, even in large-sized gates. In CMO's **VM**s the bushing of the wheels is often self-lubricating material, thus avoiding having to lubricate the axles.
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 carried out, such as lubricating the stem, etc.
The CMO penstock stem is made from stainless steel 18/8.
The operating wheel is manufactured in nodular cast GJS-500. This material is highly resistant to bangs, making it more resistant than commonly used cast iron wheels.
The yoke has a compact design with the bronze actuator nut protected in a sealed box, lubricated. 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 aluminium or nodular cast iron GJS-400, making them highly shock resistant. This characteristic is essential in pneumatic actuators.
The pneumatic cylinder sealing joints are commercial products and can be purchased worldwide. This means it is not necessary to contact CMO every time a seal is required.

VERTICAL-LIFT GATE

VM SERIES

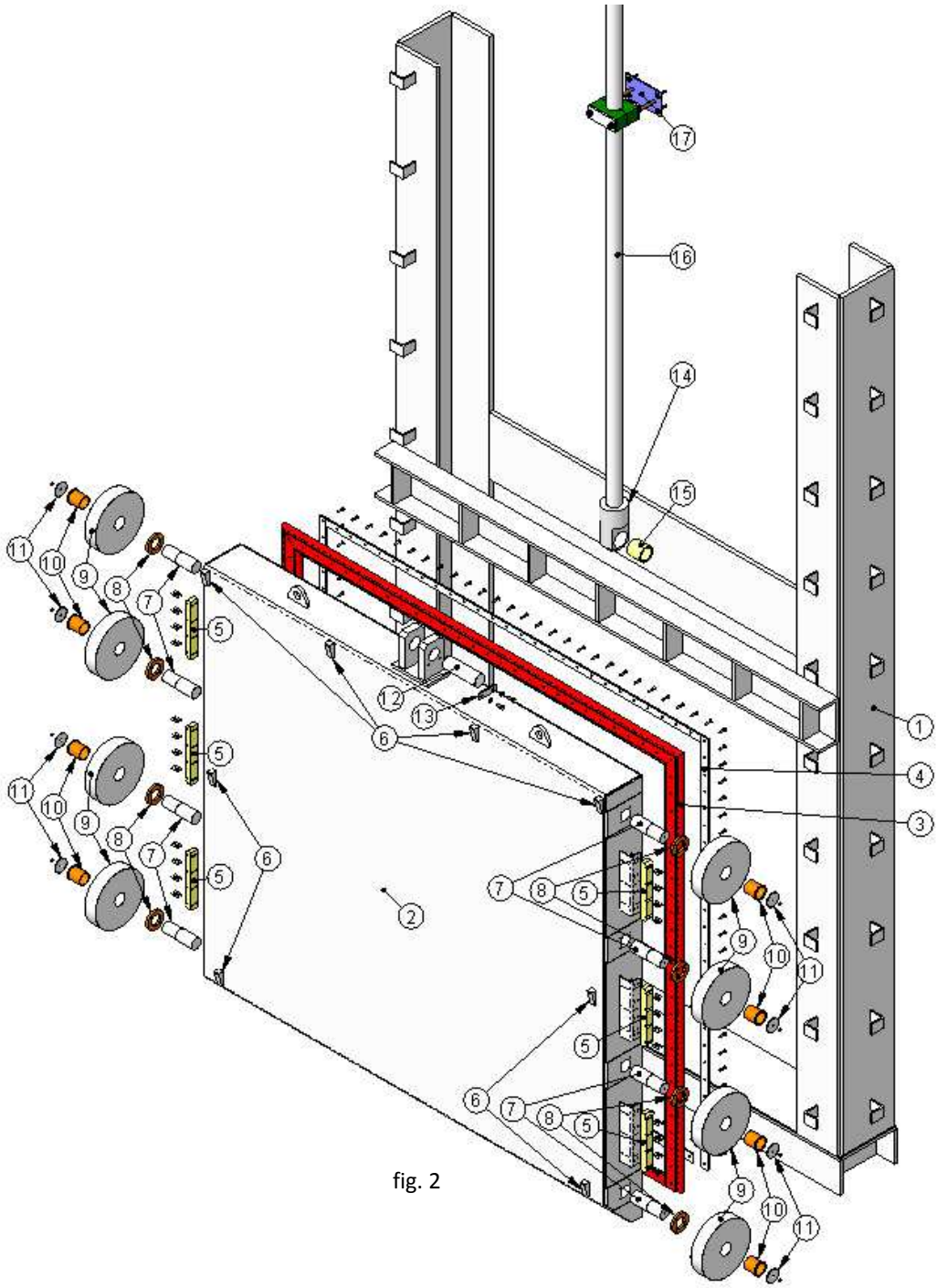

fig. 2

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 1

DESIGN CHARACTERISTICS

1- BODY

The body or frame is mechanically welded, manufactured in one single piece. Constructed with foldable profiles to prevent any loss of shape and also increase robustness. The side profiles have a gap throughout the length (in order to slide the stopboard), obtained by way of several folds (without welding), thus ensuring the body does not have any leakage.

The body has at least an approximate height of twice the stopboard, in order to house it when the penstock is completely open. The upper part is fitted with end stoppers (when manual actuator is fitted) in order to delimit the longitudinal movement of the stopboard.

The body can be designed in different ways, although the most common is to install the body embedded in the civil engineering work gaps. There is also the option of designing a body to mount supported on the wall using chemical or expansion anchors, meaning no type of civil engineering work is required for the housing. As the body is designed in line with the dimensions of the wall or channel orifice, there are no protrusions and passage is complete and continuous. If the orifice of the wall is level with the floor, the penstock can be mounted with the base embedded in the concrete (fig. 26 and fig. 31) or bolted using chemical or expansion anchors (fig. 27, fig. 28 and fig. 30), when the last option is chosen, it should be remembered that the passage of the channel or orifice is slightly reduced.

The bodies can be square or rectangular.

The materials commonly used are stainless steel AISI304 or AISI316 and carbon steel S275JR. In any case, an elastomer seal which closes against the stainless steel is used to achieve the sealtight integrity of the penstock, meaning that, if the option of S275JR carbon steel body is chosen, a stainless steel rim is welded at the torque of the seal joint in order to ensure sealtight integrity at all times.

In accordance with the conditions the penstock 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.

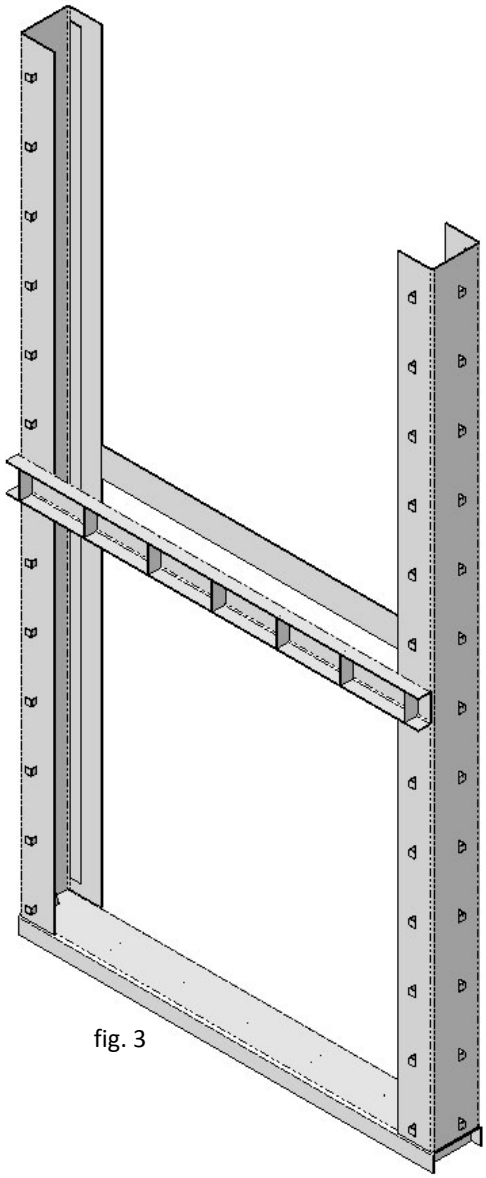

fig. 3

2 - STOPBOARD

The stopboard is mechanically welded, manufactured in one single piece. Made with folded metal plate reinforced with horizontal and vertical ribs for rigidity. The stopboard is fitted with housings for the axles on both sides. The amount and size of the wheels is defined in line with the size of the penstock and the pressure worked with. The slides for side guiding are located on the side faces.

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.

The stem or rod is connected to the upper part of the stopboard, with its longitudinal movement making the penstock open or close. The stopboard is fitted with lifting lugs for easier assembly and disassembly of the penstock and in order to facilitate maintenance and assembly work.

The seal joint goes on the stopboard, secured with bolted stainless steel flanges.

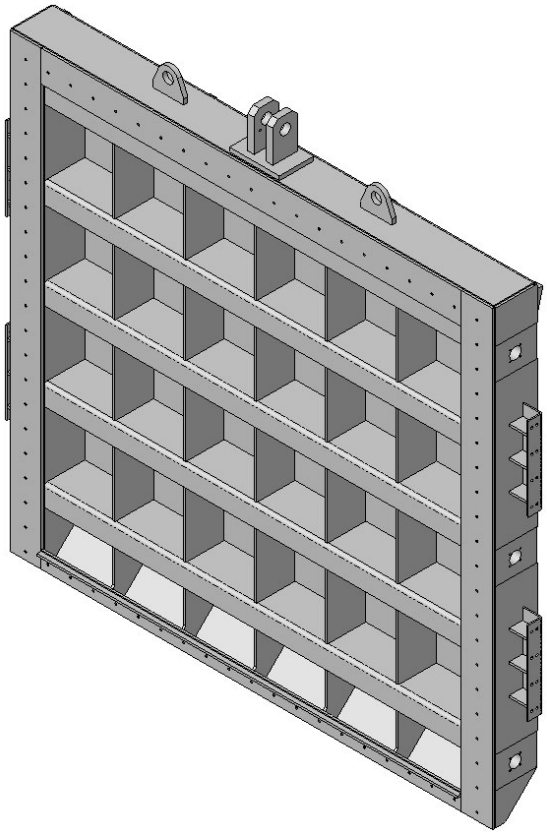

fig. 4

3- SEAT

This type of penstock is sealed with rubber profiles secured to the stopboard with bolted flanges, which close against the stainless steel seat of the body. The seal can be 3-sided or 4-sided; if it is 3-sided, the rubber profiles go in the bottom section on both sides of the stopboard, whilst if it is 4-sided another one is added in the top section. The rubber profiles vary in line with the dimensions of the penstock, the volume of water and the direction of fluid, although sealtight integrity complies with the requirements of regulation DIN 19569, class 5 of leaks in all cases.

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

- **FAVOURABLE UNIDIRECTIONAL:** (fig. 5 and fig. 6)

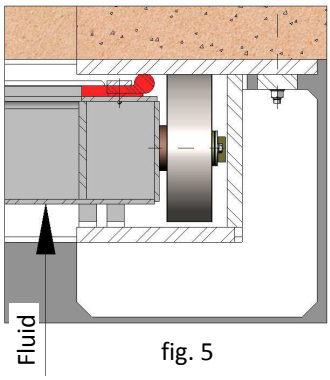

fig. 5

This type of valve is used when the fluid direction always presses the penstock against the wall. The seals used in this type of penstocks are of musical note type.

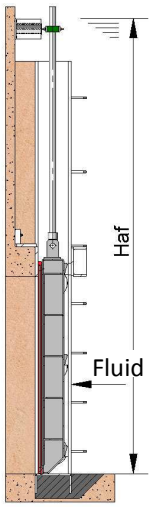

fig. 6

- **UNFAVOURABLE UNIDIRECTIONAL:** (fig. 7 and fig. 8)

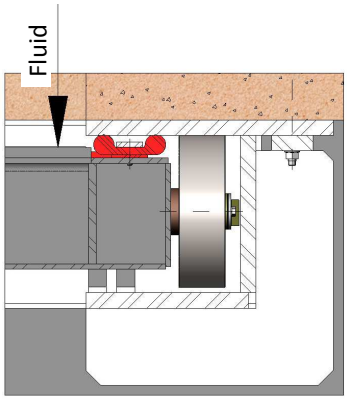

fig. 7

This type of valve is used when the fluid direction always tends to separate the penstock from the wall. In this case the design of the penstock is identical to bidirectional.
The seals used in this type of penstocks are of dual musical note type.

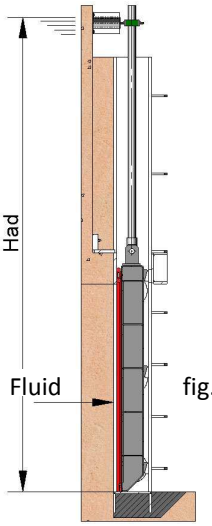

fig. 8

- **BIDIRECTIONAL:** (Fig. 9 and fig. 10)

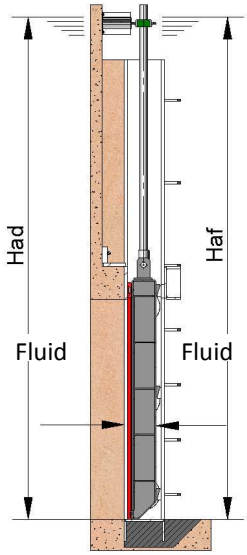

fig. 10

This type of valve is used when the fluid can come from one direction or another, in other words the fluid tends to separate the penstock from the wall or press against the wall. In this case the design of the penstock is identical to unfavourable unidirectional.
The seals used in this type of penstocks are of dual musical note type.

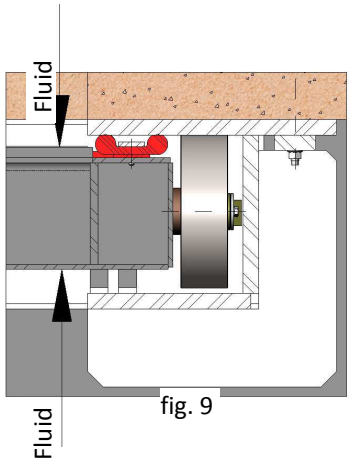

fig. 9

Although the standard sealtight joint is EPDM, there are other types of materials in order to choose the most suitable, in accordance with the working applications for the penstock (work temperature, fluid type, etc). The characteristics described below are the most common ones, and they are also summarised in table 2:

Sealtight joint materials

EPDM

Recommended for temperatures below 90°C*, providing the penstock with 100% sealtight integrity. Application: Water and acids.

NITRILE

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

VITON

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

SILICONE

Used mainly in the food industry and for pharmaceutical products with temperatures no higher than 200°C. It provides the penstock with 100% sealtight integrity.

PTFE

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

NATURAL RUBBER

This can be used in multiple applications at temperatures below 90°C, with abrasive products, and it provides the penstock with 100% sealtight integrity. Application: fluids in general.

Note: In some applications, other types of rubber are used, such as: hypalon, butyl, etc. Please contact CMO if you require one of these materials.

SEAT/SEALS		
Material	**Max.Temp. (ºC)**	**Applications**
EPDM (E)	90*	Non-mineral oils, water and acids
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 to order.

*** EPDM and Nitrile: possible up to max temp: 120°C to order.**

4- STEM

The CMO penstock stem is made from stainless steel 18/8. This characteristic makes it highly resistant and provides excellent properties against corrosion.

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 greased.

5- ACTUATORS

In these **VM** vertical-lift gates, when the height of the penstock needs to be kept to a minimum, a yoke can be used in the upper part of the body where the actuator will be housed (fig. 11). The yoke will delimit the longitudinal movement of the through-conduit.

If this is not the case, when positioning the actuator at considerable distance from the location of the penstock, an extension can be coupled to the stem or rod, with the actuator secured in a floor stand (fig 13) or a square bracket (fig. 14). In this case the body will have a stopper system to delimit the longitudinal movement of the through-conduit (only in the case of manual actuators).

When starting up the actuator, it exercises the torque or draw necessary in the stem or rod, which in turn is transmitted to the stopboard and starts the opening or closing movement.

Our vertical-lift gates are supplied with several types of actuator, bringing the advantage that, thanks to the CMO design, they can be interchanged.

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

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

Manual:
Wheel with rising stem
Wheel with non-rising stem
Chainwheel
Gearbox
Others (square stem, etc.)

Automatic:
Electrical actuator
Pneumatic cylinder
Hydraulic cylinder

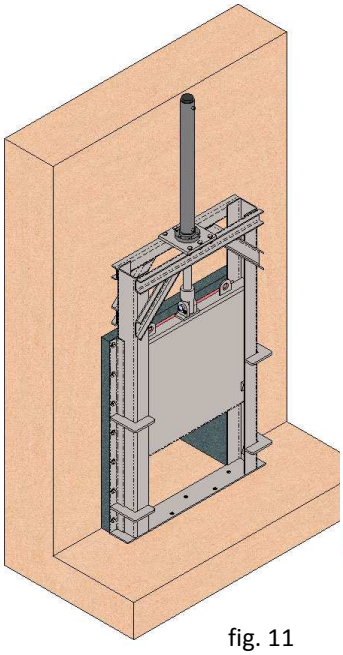

fig. 11

Hydraulic actuator on yoke

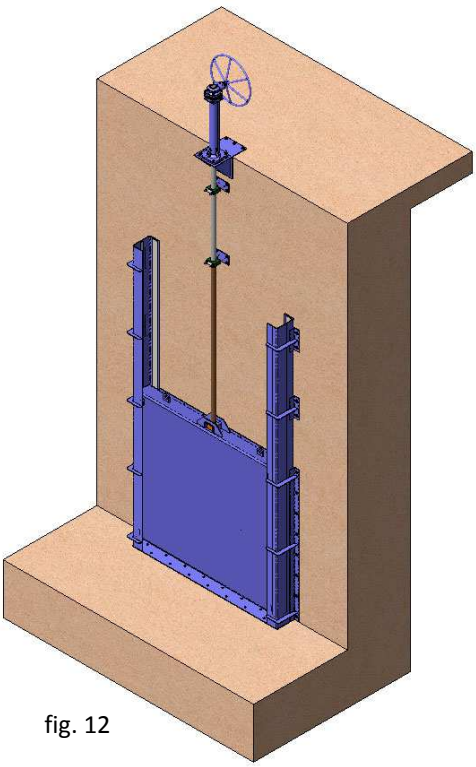

fig. 12

Gearbox actuator on stand + square bracket

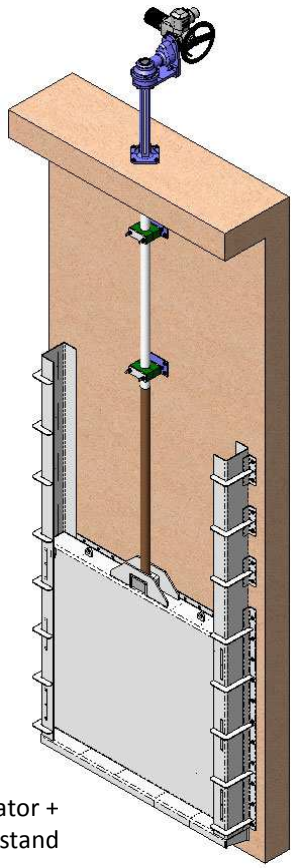

fig. 13

Motor actuator + gearbox on stand

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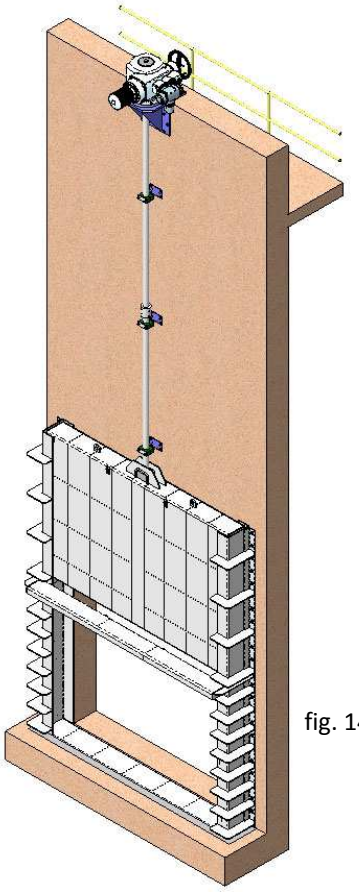


fig. 14

Direct motor actuator on square bracket

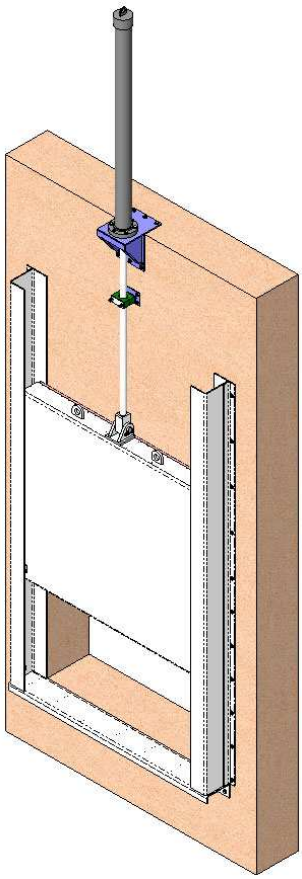


fig. 15

Hydraulic actuator on square bracket

The handwheel, chainwheel, gearbox and motor actuators are available with both rising stem and non-rising stem.

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

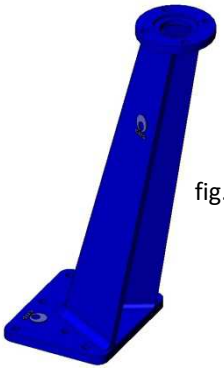


fig. 16

Wide range of accessories available:
Mechanical stoppers
Locking devices
Manual emergency actuators
Electrovalves
Positioners
Limit switches
Proximity detectors
Straight floor stands (fig. 17)
Leaning floor stand (fig. 16)

fig. 17

ACCESSORIES AND OPTIONS

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

- Mechanical limit switches, inductive detectors and positioners (fig. 18):
Limit switches or inductive detectors are installed to indicate precise penstock position, as well as positioners to indicate continuous position.

- Electrovalves (fig. 18):
For air distribution to pneumatic actuators.

- Junction boxes, cabling and pneumatic piping: Units supplied with all the required accessories.

-Mechanical stroke limiters (mechanical stops): Allow the stroke to be mechanically adjusted, limiting the penstock run.

- Mechanical locking system:
Allows the penstock to be mechanically locked in a set position for long periods.

- Emergency manual actuator (handwheel/gearbox): Allows manual operation of the penstock in the event of power or air failure (fig. 18).

- 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.

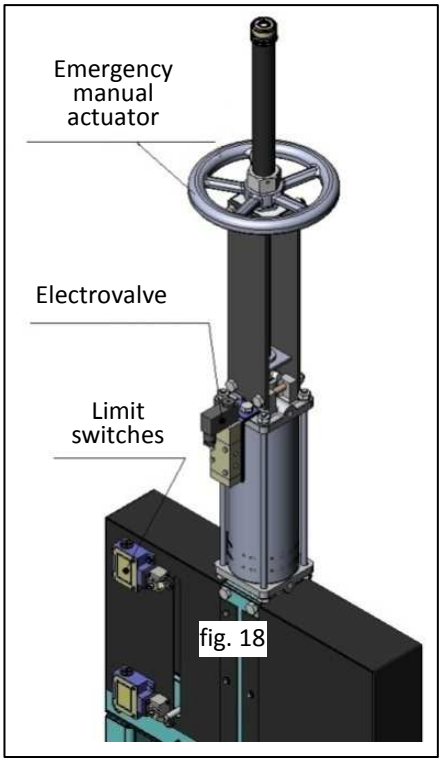


fig. 18

- Bypass system:
These vertical-lifting valves can be supplied with a bypass system. As these penstocks are usually very large and are used to stop large volumes of water, the opening force necessary when the penstock is completely closed and under maximum pressure is usually very significant; in consequence, the actuator required needs to be very powerful. The advantage of the bypass system is that the pressures on both sides of the penstock can be balanced by opening the bypass before opening the penstock, meaning the pressure differential drops and the actuator force necessary is considerably reduced.

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.

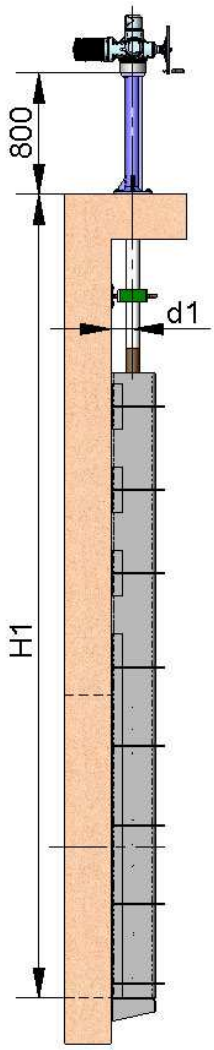


fig. 19

This extension is done by coupling an extension to the stem or rod. The desired extension is achieved by defining the length of the elongation. A floor stand is normally installed to support the actuator.

The definition variables are as follows:
H1: Distance from the base of the wall or channel orifice to the base of the floor stand.
d1: Separation from the wall to the extension shaft.

Characteristics:
- It can be coupled to any type of actuator.
- A stem support-guide is recommended (fig. 20) every 1.5 m.
-The standard floor stand is 800 mm high (fig. 19).
Other floor stand measurements available to order.
- Option of fitting an indicator rule in order to display the degree of opening of the penstock.
- Option of leaning floor stand (fig. 21).

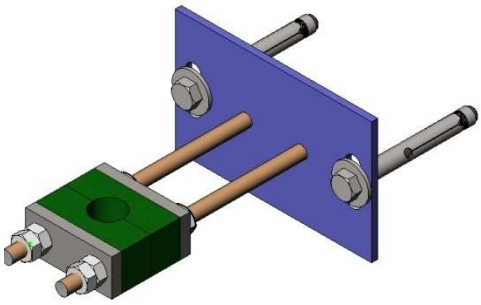


fig. 20

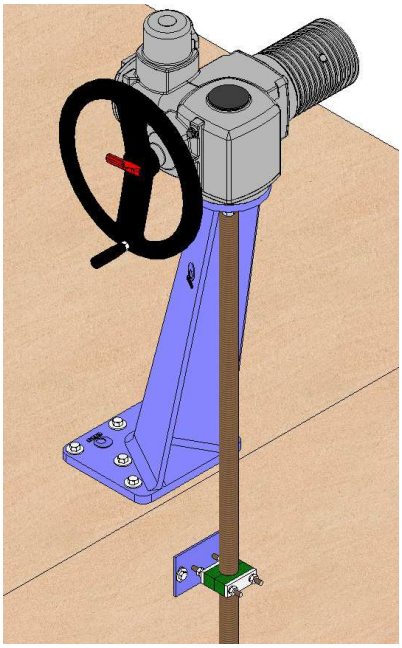


fig. 21

COMPONENTS LIST	
Component	**Standard Version**
stem	AISI 303
Rod	AISI 304
Guide-support	Carbon steel with EPOXI coating
Slide	Nylon
Floor Stand	GJS-500 with EPOXY coating

Table 3

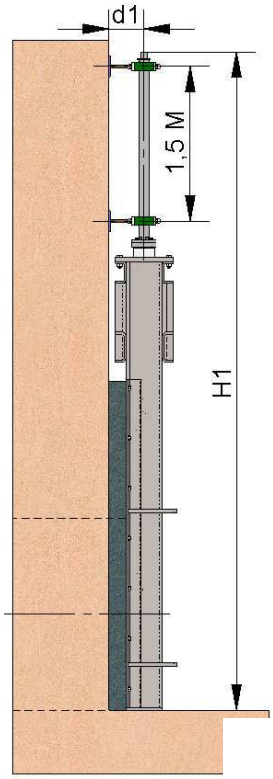


fig. 22

2 - Extension: Pipe (fig. 22)

Consists of raising the actuator. Whenever the penstock is operated, the pipe turns with the wheel or key, always remaining at the same height.

The definition variables are as follows:
H1: Distance from the base of the wall or channel orifice to the required height of the actuator.
d1: Separation from the wall to the pipe shaft.

Characteristics:
- Standard actuators: Handwheel and square stem.
- A pipe support-guide is recommended every 1.5m.
- The standard materials are: Stainless steel or EPOXY coated carbon steel.

3 - Extension: Extended body guides (fig. 23)

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.

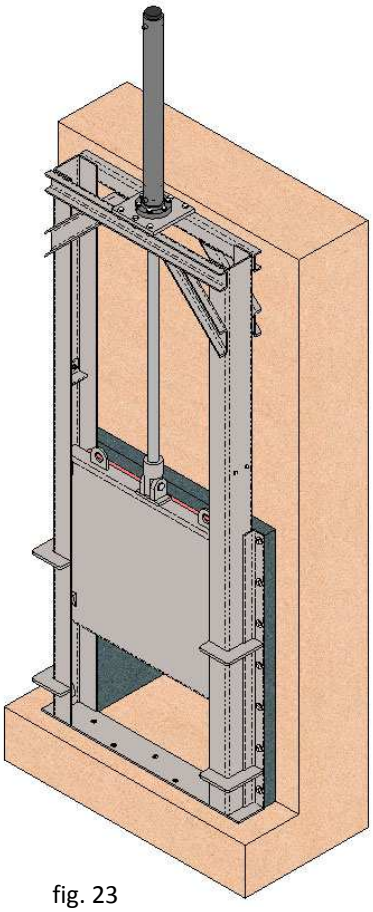


fig. 23

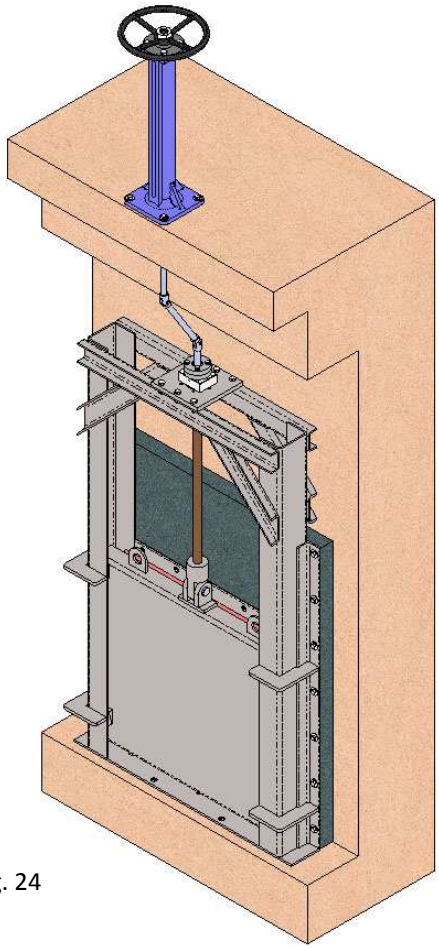


fig. 24

4 - Extension: Universal joint (fig. 24)

If the penstock and the actuator are misaligned, the problem can be resolved by fitting a universal joint.

GENERAL DIMENSIONS

In order to define a **VM** vertical-lift gate, it is necessary to know the width and height of the orifice to seal, the fluid direction and the fluid load on each side of the penstock. It is also necessary to define the height from the floor (Hs).
The levels A and B are used to refer to the width and height variables, whilst the designation mode will be A x B (Width x Height). The dimensions range from 500 x 500 up to 5000 x 5000 (larger dimensions to order). These penstocks may be square or rectangular, meaning they do not need to have the same width (A) and height (B). Below is a description of each level of fig. 25:

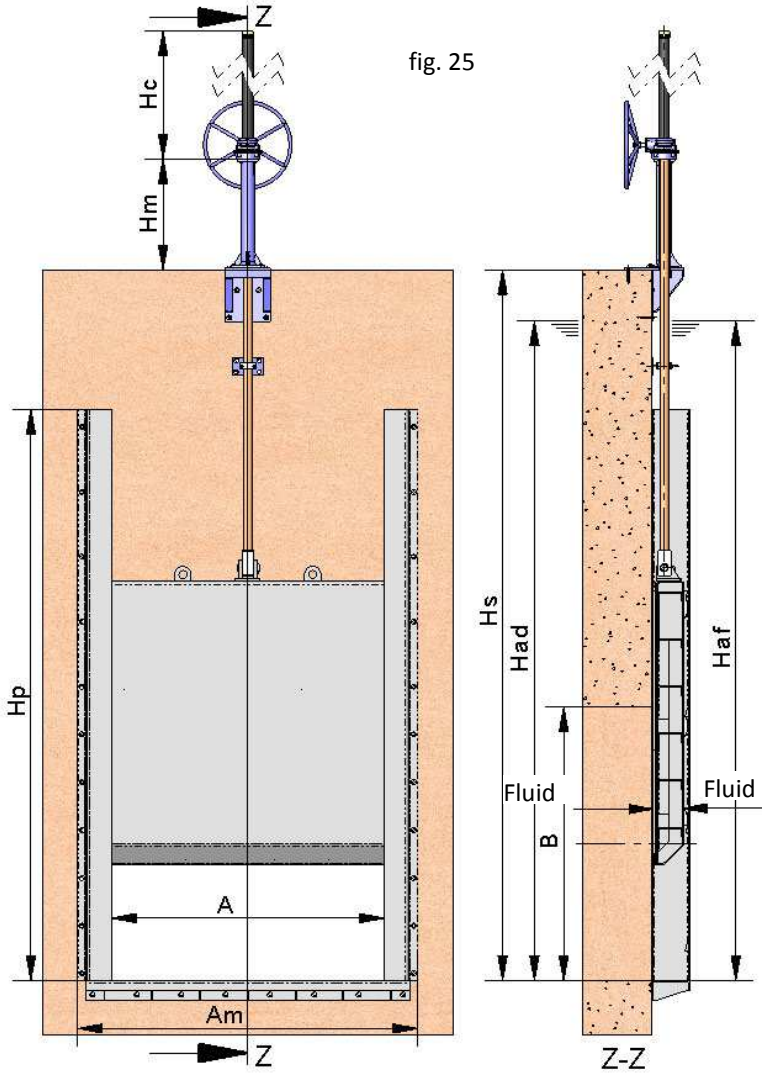


fig. 25

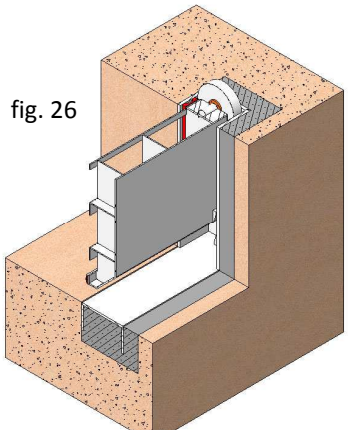
- Level **A**: This is used to define the width of the orifice to be sealed.
- Level **B**: This is used to define the height of the orifice to be sealed.
- Level **Hs**: This is used to define the height from the base of the orifice to the floor.
- Level **Hm**: This is used to define the distance from the floor to where the actuator is located. When the penstock has a manual actuator, this level (Hm) is usually 800 mm in order for one person to comfortably manage the penstock.
- Level **Hp**: This is used to define the distance from the base of the orifice through to the upper part of the body. This level will be at least twice the height of the orifice (in order for the penstock to open completely).
- Level **Hc**: This is used to define the total height of the actuator. This level varies in line with the type of actuator fitted in the penstock. Whenever the penstock has a non-rising stem actuator, the Hc level is considerably reduced.
- Level **Am**: This is used to define the maximum width covered by the penstock body.
- Cota **Haf**: This is used to define the favourable fluid load (when the fluid direction pressures the penstock against the wall), the Haf level defines the maximum fluid level measured from the base of the orifice.
- Cota **Had**: This is used to define the unfavourable fluid load (when the fluid direction tends to separate the penstock from the wall), the Had level defines the maximum fluid level measured from the base of the orifice.

ATTACHMENT OPTIONS

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. 26). 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. These penstocks work with high volumes of water and generate forces of significant strength. In consequence, concreting is the most suitable option to transmit these forces to the civil engineering work and ensure optimal attachment of the penstock. This type of assembly can have other variants, as can be seen in the assembly options of the figures fig. 27 and fig. 28.

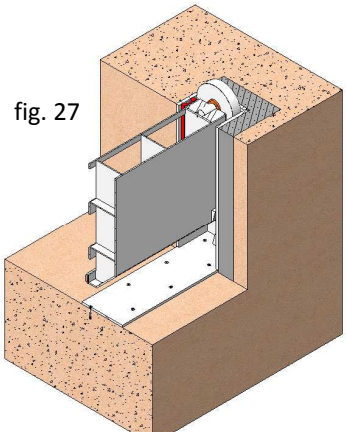
- One of the most important characteristics in order to mount the concreted penstock are the gaps to house the body in the engineering work. These gaps must have specific dimensions, meaning it is hugely important to respect the dimensions detailed in the penstock diagram.

fig. 26



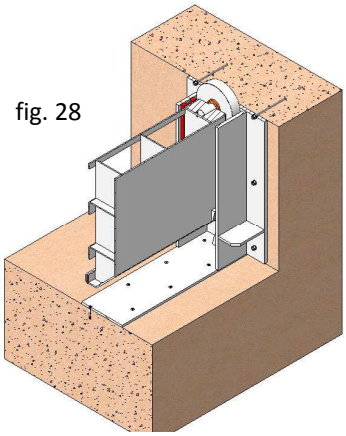
Concreted sides and base

fig. 27



Flat base and concreted sides

fig. 28



Flat sides and base

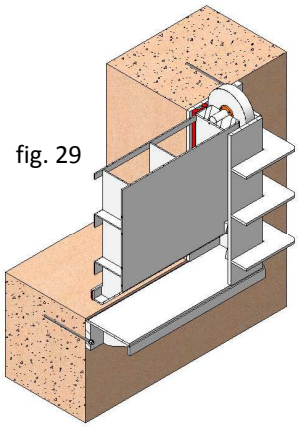
Another option is to assemble these penstocks on the wall, secured with expansion or chemical anchors (fig. 29), although this type of assembly has other options, as shown in figures fig. 30 and fig. 31.
In all options involving mounting the penstock on the wall, the side and upper profiles of the body are secured using expansion or chemical anchors.

- One of the most important aspects in order to mount the penstock on the wall is that the wall must be flat and level. As the upper and side profiles are attached directly on the wall, any irregularities in the wall may be transmitted to the body when tightening the expansion or chemical anchors if the wall is not flat, leading to irreparable damage and also harming the operation of the penstock. Before starting to install the penstock on the wall, we recommend using a rule to check that the wall is flat.

VERTICAL-LIFT GATE

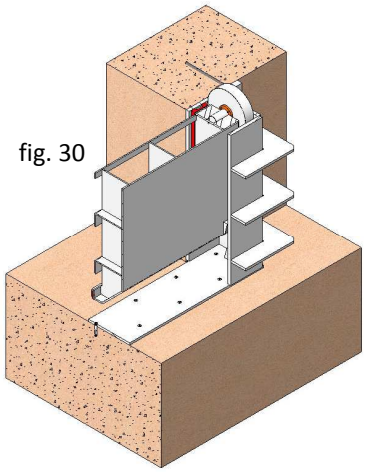
VM SERIES

fig. 29



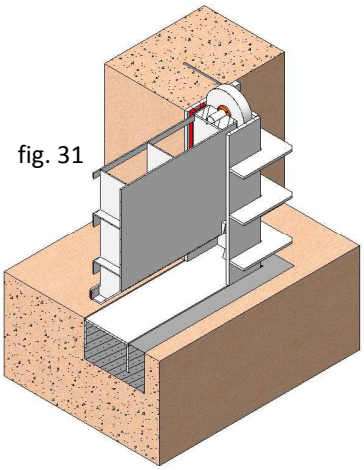
Secured to the wall using chemical or expansion anchors

fig. 30



Flat base

fig. 31



Base with housing

This document mentions the different attachment options. Check the instructions and maintenance manual for further details or to see the complete assembly process for each option.