INSTALLATION & MAINTENANCE INSTRUCTIONS - ORIGINAL VERSION

AVK WALL PENSTOCKS

SERIES 772/61

TABLE OF CONTENTS

1. INTRODUCTION

This manual describes the recommended procedures for installation, operation, maintenance and safety precautions for AVK wall penstocks.

Please read thoroughly all the instructions in the manual prior to installation, and contact an AVK representative in case of any questions.

The manual makes reference to the “General Arrangement Drawing” (GAD). The GAD is the drawing that is sent to and approved by the customer prior to the production of the penstock.

AVK assumes no responsibility or liability if the penstock is not installed, operated and maintained in strict accordance to the procedures described in this manual.

Expect...

2. SAFETY PRECAUTIONS

Standard safety procedures should be followed to prevent personal injury or equipment damage during installation and maintenance.

- Penstocks are usually of large dimensions and heavy. Appropriate lifting devices must therefore be used for secure handling.
- Penstocks shall be lifted from the main frame or from the yoke if applicable. Holes are available for lifting eyes. Slings can also be used.
- Never lift the penstocks in inverted positions. Do not use stems, slides or actuators as lifting points.
- Passing through the penstocks' openings must never be attempted unless slides have been properly secured. In any case, this type of work should be avoided unless it is absolutely necessary.
- Penstocks must never be operated when the system is under pressure.

Personnel handling penstocks must be correctly trained to avoid accidents. The correct observation of installation and maintenance instructions will not relieve the personnel from being adequately trained. AVK will not be held responsible for any accidents arising from incorrect handling or installation.

3. MARKING

Label

- Manufacturer
- AVK item number
- Internal number
- Material
- Pressure
- Dimension
- Actuator
- Actuator type

4. HANDLING AND STORAGE

Standard safety procedures should be followed to prevent personal injury or equipment damage.

Additionally, the following instructions shall be followed during handling and storage to prevent any damage of the product:

- Stems have precision surfaces and should never be used as a mean to lift the penstock.
- Special care shall be taken on any machined surface when lifting the penstock.
- Equipment shall be stored in a dry, clean and even area on a raised even wood surface to prevent distortion of the frame. Do not stack penstocks.
- Stems and extensions that are shipped separately shall be supported over their entire length to prevent any bending or distortion while in storage.

5. INSTALLATION

5.1 Penstock installation

5.1.1 Concrete wall mounted

Required materials:

AVK wall penstocks are installed by means of anchor bolts. Depending on the size and working conditions they shall be either of the mechanical or chemical type.

Note that as standard, anchor bolts and construction sealant are not supplied with the penstock.

Note: for penstocks larger than 2000 x 2000 and un-seating water head conditions, anchor bolts are not sufficient to hold the slide in place. A second phase of concrete will be required around the penstock frame, and will be indicated on the GAD.

In order to get the expected performance of the anchor bolts, the minimum concrete strength shall be 3,000 PSI (20.7 MPa).

In order to avoid leakage between the concrete wall and the frame construction sealant shall be used.
(Sikabond construction sealant or equivalent, 200ml per meter of opening perimeter).

The following table gives a general description of the required anchor bolt types for the different penstock sizes and pressure conditions. For detailed information about the type, size and quantity of the required anchor bolts, or any other specific installation notes or materials, please refer to the notes on the 'General Arrangement Drawing'.

MU size	Water pressure	Anchor bolt type	Recommended (Hilti og equivalent)
MU bi-directional 6" x 6" - 48" x 48" (150mm x 150 mm - 1000 mm x 1000 mm)	Seating and unseating (Bi-directional)	Stud type mechanical anchor bolts and bolt type mechanical anchor bolts	Hilti 'Kwik 3' and Hilti 'HSL'
MU bi-directional 52" x 52" - 80" x 80" (1100 mm x 1100 mm - 2000 mm x 2000 mm	Seating and unseating (Bi-directional)	Chemical anchor bolts	Hilti 'HVU'
MU uni-directional 52" x 52" - 80" x 80" (1300 mm x 1300 mm - 2000 mm x 2000 mm)	Seating (Uni-directional)	Stud type mechanical anchor bolts	Hilti 'Kwik 3'

AVK WALL PENSTOCKS

SERIES 772/61

Step 1: Concrete wall surface check:

Concrete wall surface shall be inspected before starting the installation of the penstock:

- The concrete construction shall be flat, level and plumb, and shall be in accordance with the ACI 117-06 standard. If necessary, use non-shrink grout in order to meet the specified standard.
- Concrete wall surface shall be dry (so the construction sealant sets effectively). If it is necessary, the wall can be dried with the help of a blowtorch or a hot air fan.

Step 2: Reference lines:

Reference lines shall be marked on the wall in order to assure a proper alignment between the penstock and the opening during the installation:

- Measure the top width of the frame (“d”) and mark a horizontal line on the wall (RL-1), parallel to the opening and to the measured distance.
- Mark a vertical line on the vertical symmetry axis of the opening (RL-2).

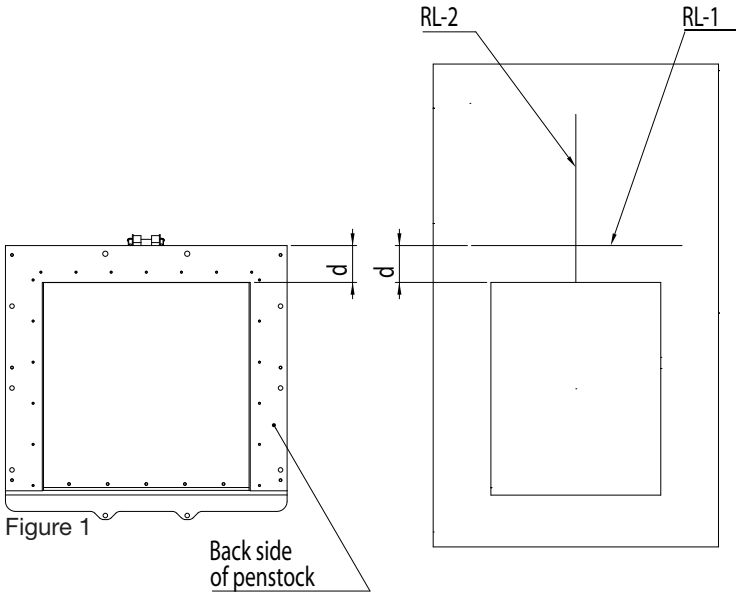


Figure 1

Step 3: Pre-installation of the penstock

- Place the slide gate against the wall and line up with the opening. Use previously marked reference lines for proper alignment. The slide shall be in the closed position.
- Drill and install an anchor bolt on each side of the slide. After installing the first anchor bolt, and prior to drilling the hole on the other side, make sure the frame is perfectly levelled.

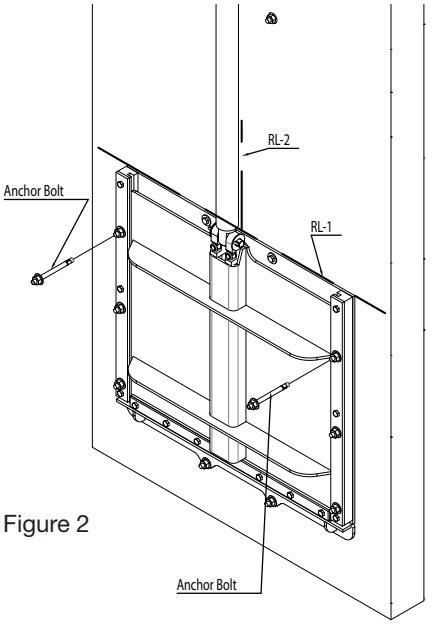
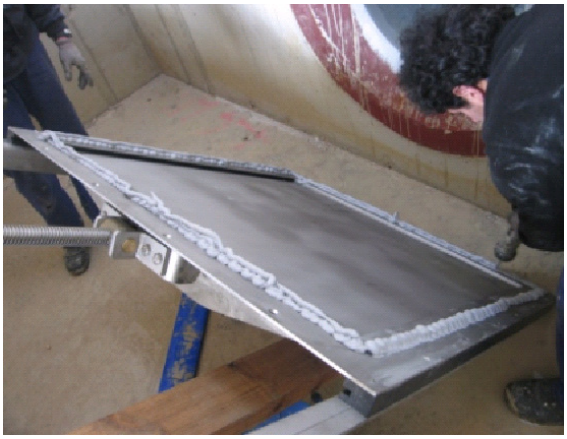


Figure 2

Step 4: Construction sealant application (Sikabond or equivalent)

In order to avoid leakage between the frame and the wall, construction sealant shall be applied on the frame:

- Remove the penstock from the wall (first remove the nuts of the anchor bolts).
- Apply construction sealant all around the perimeter of the frame. Sikabond (200 ml/m) or equivalent construction sealant shall be used. Be sure not to get sealant on the seals, guides, and/or stem, as this may cause leakage or damage.
- Re-install the penstock on the wall and tighten both anchor bolts.



Step 5: Final installation of the penstock

- Drill and install the rest of the anchor bolts (see Figure 4).

CAUTION!: If the penstock is not completely in contact with the wall, do not over-tighten the anchor bolts. Over tightening may bend or distort the frame. If the wall flatness and levelness is according to the specified standards, the construction sealant will fill in the remaining void (see Figure 5).

- Apply construction sealant around the frame in order to fill in any existing gap between the wall and the frame (this step is only for esthetics). Wipe away the excess sealant to leave a smooth finish.

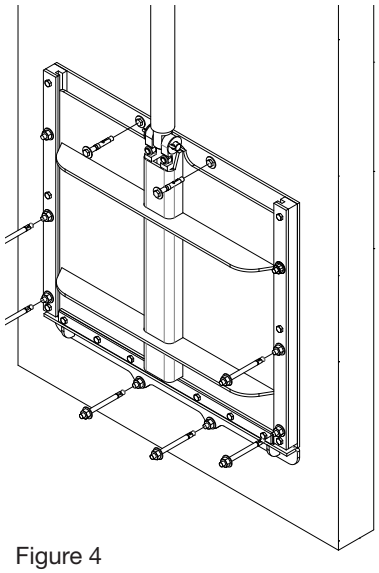


Figure 4

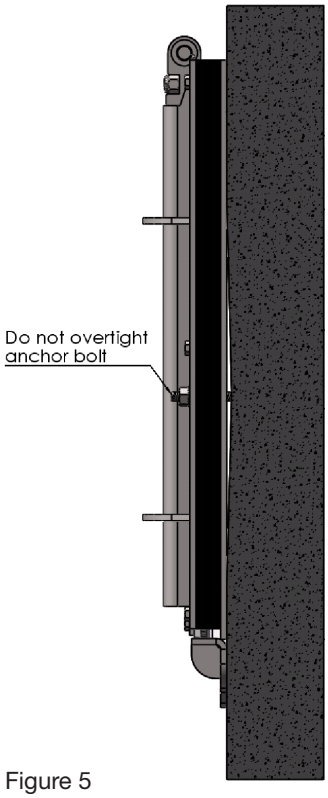


Figure 5

5.1.2 Concrete round manole wall mounted

Follow the instructions of “Concrete wall mounted” installation. Anchor bolts shall be installed perpendicular to the surface.

5.1.3 Wall thimble mounted

Required materials:

AVK wall thimble mounted penstocks are installed by means of hex bolts. In order to avoid leakage between the wall thimble and the frame, construction sealant shall be used. (Sikabond construction sealant or equivalent, 200 ml per meter of opening perimeter). For detailed information about the size and quantity of the required bolts, or any other specific installation notes or materials, please refer to the notes on the ‘General Arrangement Drawing’. Note that as standard, bolts and construction sealant are not supplied with the penstock.

Installation:

- The concrete construction shall be flat, level and plumb, and shall be in accordance with the ACI 117-06 standard. If necessary, use non-shrink grout in order to meet the specified standard.
- Apply construction sealant all around the perimeter of the frame. Sikabond (200 ml/m) or equivalent construction sealant shall be used.
- Partially tighten the four corner bolts, and check that the penstock is perfectly lined up with the wall thimble opening.
- Install the rest of the bolts, and evenly tighten all of them.

5.2 Installation of stem extension, stem guides and floor stand

5.2.1 Procedure for open-frame and rising-stem configurations

Once the penstock has been installed, the stem extension, stem guide(s) and the floor stand shall be installed (when applicable). The following procedure shall be followed:

1. Connect the stem extension to the penstock (Figure 6 and Detail A). Connect the stem extension (item 1) using the pin (item 4). In order to be able to do so, the washer (item 2) and the cotter-pin (item 3) shall be removed and re-installed.

2. Insert all stem guides from the top of the stem extension. Align stem extension, and especially make sure it is aligned with the vertical axis of the opening (see Figure 7). The maximum misalignment shall be 1/8” (3 mm).

3. Next, install (drill and tighten anchor bolts) all stem guides except the first one (See Figure 7 and 8, “Stem Guide-1”) . Refer to General Arrangement Drawing for dimensions (“Dist 1”, “Dist 2”, in Figure 7).

4. Thoroughly clean and grease the threaded part of the stem and the nut in the operator.

5. Position the floor stand and the operator. Engage the stem in the stem nut and turn the pedestal and the operator to bring it to the operating floor level. Make sure that the stem extension is perfectly aligned and parallel to the wall surface, adjusting the offset if necessary of the stem guides’ HMWPE inserts (see Figure 8). Once the stem extension is perfectly aligned, install the floor stand (drill and tighten anchor bolts) .

6. Operate the penstock and bring it to the open position. Install “stem guide-1”, so the top of the slide hits on the stem guide. Note that “stem guide-1” is installed in the orientation shown in Figures 7 and 8 (HMWPE insert down).

7. Install the stem protector and the position indication label (if applicable)

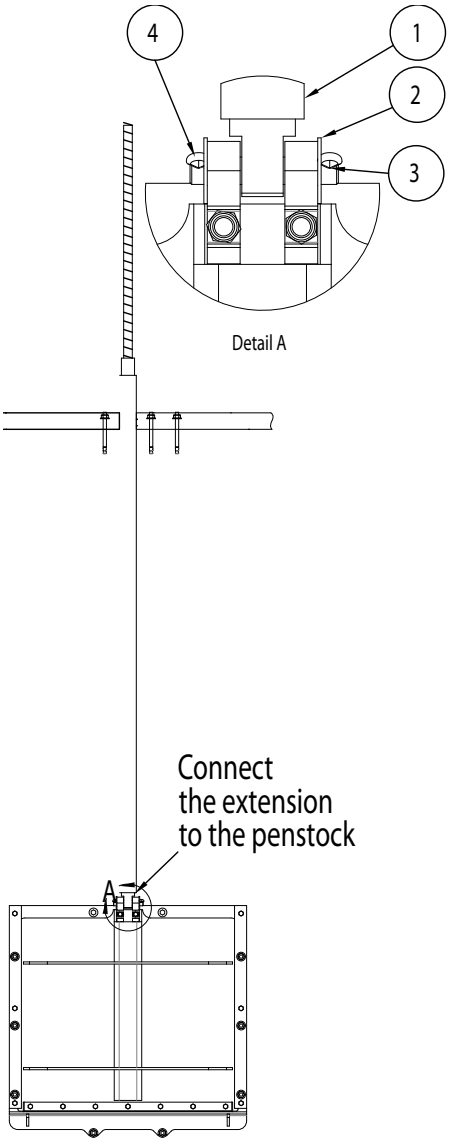


Figure 6

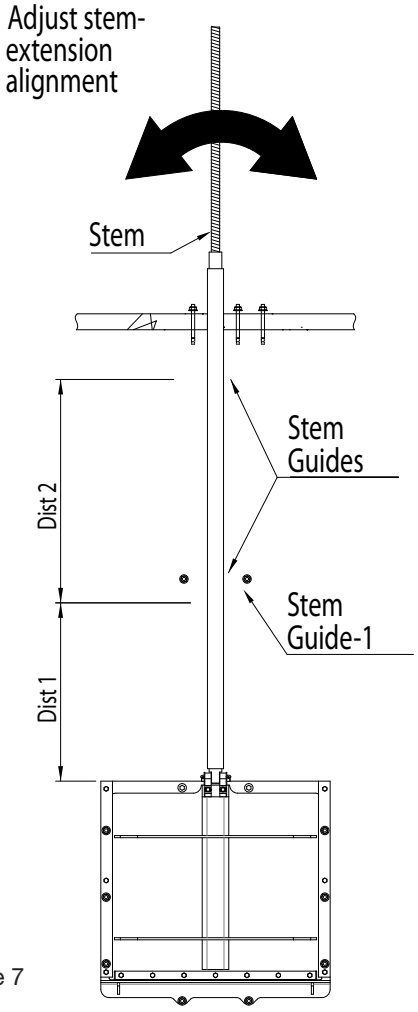


Figure 7

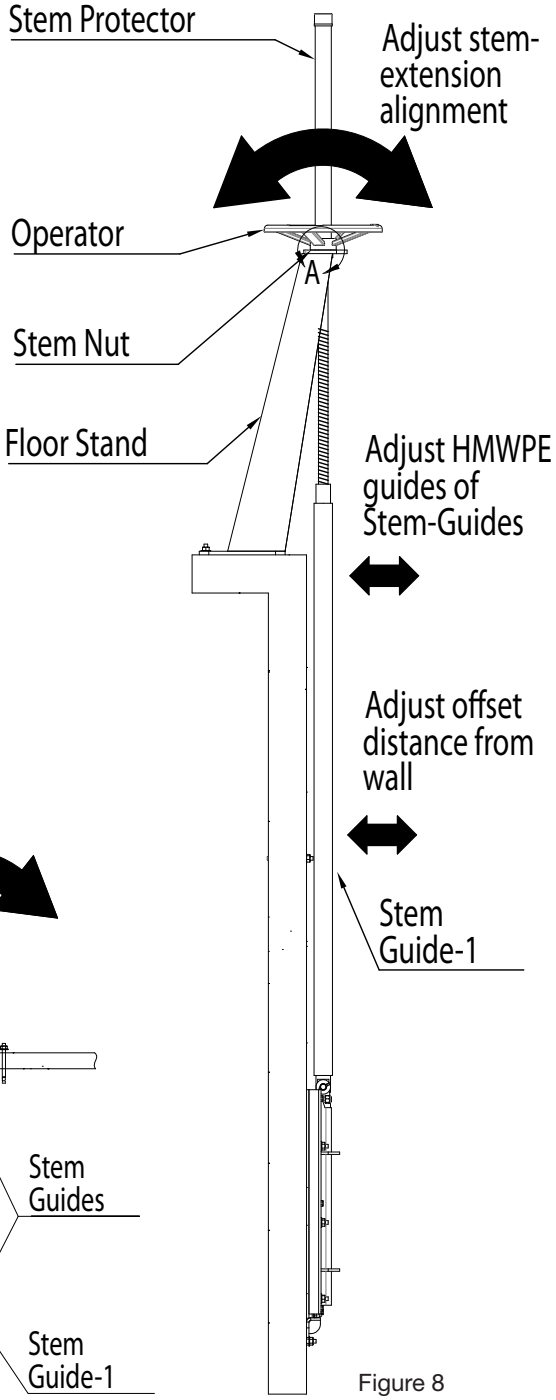


Figure 8

5.2.2 Procedure for self contained frame and non-rising stem configurations

Once the penstock has been installed, the stem extension, stem guide(s) and the floor stand shall be installed (when applicable).

The following procedure shall be followed:

1. Connect the stem extension (item 3) to the shaft (item 1) on top of the yoke (see Figure 9 and Detail B).
2. Insert all stem guides from the top of the stem extension. Align stem extension, and especially make sure that it is aligned with the vertical axis of the opening (see Figure 10). For 2" square nut operated penstock, the stem guides shall be inserted onto the stem extension from the bottom.
3. Next, install all stem guides (drill and tighten anchor bolts). Refer to General Arrangement Drawing for dimensions ("Dist 1" in Figure 10).
4. Position the floor stand and the operator. Engage the shaft of the stem extension with the operator. Make sure that the stem extension is perfectly aligned and parallel to the wall surface, adjusting the offset if necessary of the stem-guides' HMWPE inserts (see Figure 11). Once, the stem extension is perfectly aligned, install the floor stand (drill and tighten anchor bolts).

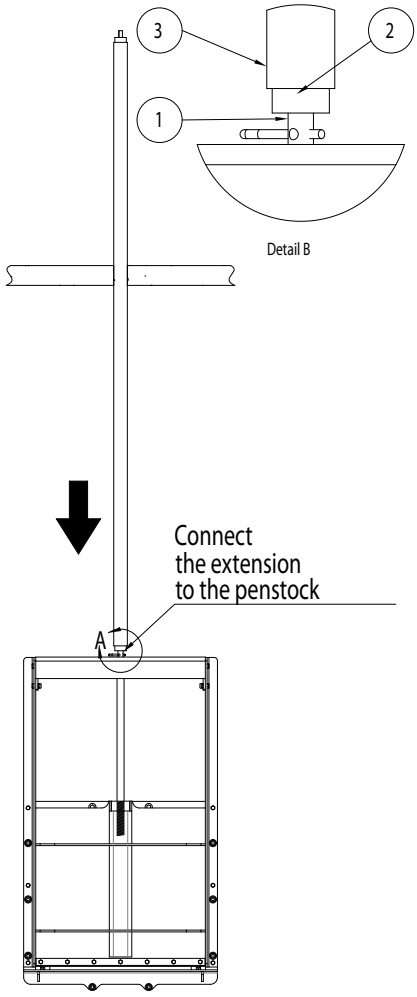


Figure 9

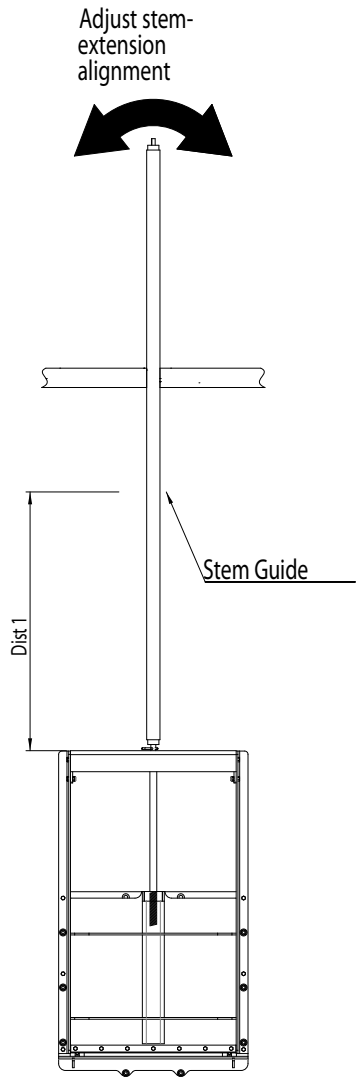


Figure 10

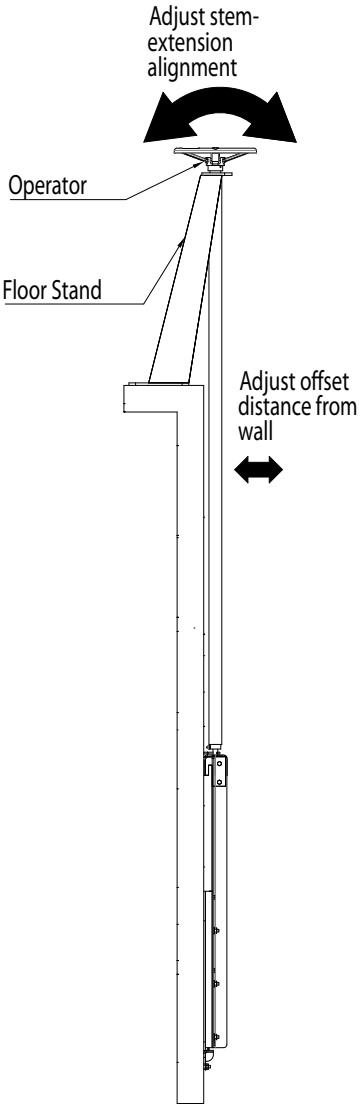


Figure 11

6. OPERATION

6.1 Initial operation

Before cycling the penstock, make sure there are no foreign deposits or materials on the seals, guides or sealing area. Slide seals could be damaged if the area is not cleaned and coated with a light grease. Please refer to section “Materials needed for maintenance and seal replacement” on page 14 for detailed information about the grease type.

Manual:

- Apply a light grease on the stem before initial operation after the installation. If the operation is difficult due to high torque, stop operation of the penstock and check stem alignment

Electric motor:

- Refer to the electric motor instruction manual section before cycling the penstock. Manually open the slide approximately 10 cm before the initial electric motor operation. Check the motor rotation to assure proper direction of the slide travel according to the motor operation switch (open/close).
- Special attention should be taken when the slide is almost fully open or fully closed. If the actuator does not stop once the fully open or fully closed position is reached, stop immediately and adjust the limit and torque switches (Refer to motor manual).

6.2 Operation:

- CAUTION! Do not force the operator to close the slide, as it may cause damage to the stem and it does not improve the sealing system.
- The wall penstock is closed by a clockwise rotation, and opened by a counter-clockwise rotation of the operator.
- For self-contained frame configurations, the slide is stopped by the yoke when it is fully opened. For open frame configurations, the stem guide (wall bracket) stops the slide.
- The wall penstock is designed to be self-locking, so that the slide maintains its position in open, close or intermediate positions.

7. MAINTENANCE

7.1 Cleaning and lubrication

AVK wall penstocks need practically no maintenance. In order to assure maximum performance of the penstock, the following maintenance inspections shall be carried out periodically every 6 months:

- Stem and stem nut shall be cleaned and greased. For non-rising stem configurations, the stem may be in contact with water and dirt. Under these conditions, the threads of the stem and/or stem nut may wear, and they shall be checked every 3 months.
- Clean the slide with clear water and remove any deposits, especially on the seals and in the guides.
- Check the seals and make sure they are not damaged. Seals shall be replaced if damaged.
- See section ‘Maintenance: Seal replacement’ for detailed procedures about seal replacement.
- Seals shall be wet while operating. If the penstock has not been used for a long period of time under dry conditions, the seals shall be wetted with clear water before operating the penstock. Operating the slide with dry seals may damage the seals. Additionally, more torque may be required to operate the penstock.

7.1.1 Spare parts

AVK does not recommend stocking any spare parts by the owner of the equipment as the penstocks are designed for a very long life cycle. If a repair part is required, please contact an AVK representative and provide the following information:

- AVK order number.
- AVK "General Arrangement Drawing" number.
- Project name (if applicable).
- Vendor's company name.

Materials needed for maintenance and seal replacement:

Material	Type	Recommended or equivalent
Silikone	Silicone rubber	Dow Coming RTV 732
Grease	Silica-gel silicone grease	Verkosil G-2
Glue	Instant adhesive	Loctite 495

7.2 Seal replacement

7.2.1 Open-frame and rising stem configuration penstocks (up to 1200 x 1200)

Step 1: From the closed position, raise the slide around 1,3 cm.

Step 2: Unscrew the nuts of the lateral anchor bolts (item 10).

Step 3: Remove stem extension coupling pin (item 1).
NOTE: the stem extension will not fall down as it is a rising-stem configuration penstock.

Step 4: Unscrew bolts (item 2) with caution, as major components of the slide are no longer secured.

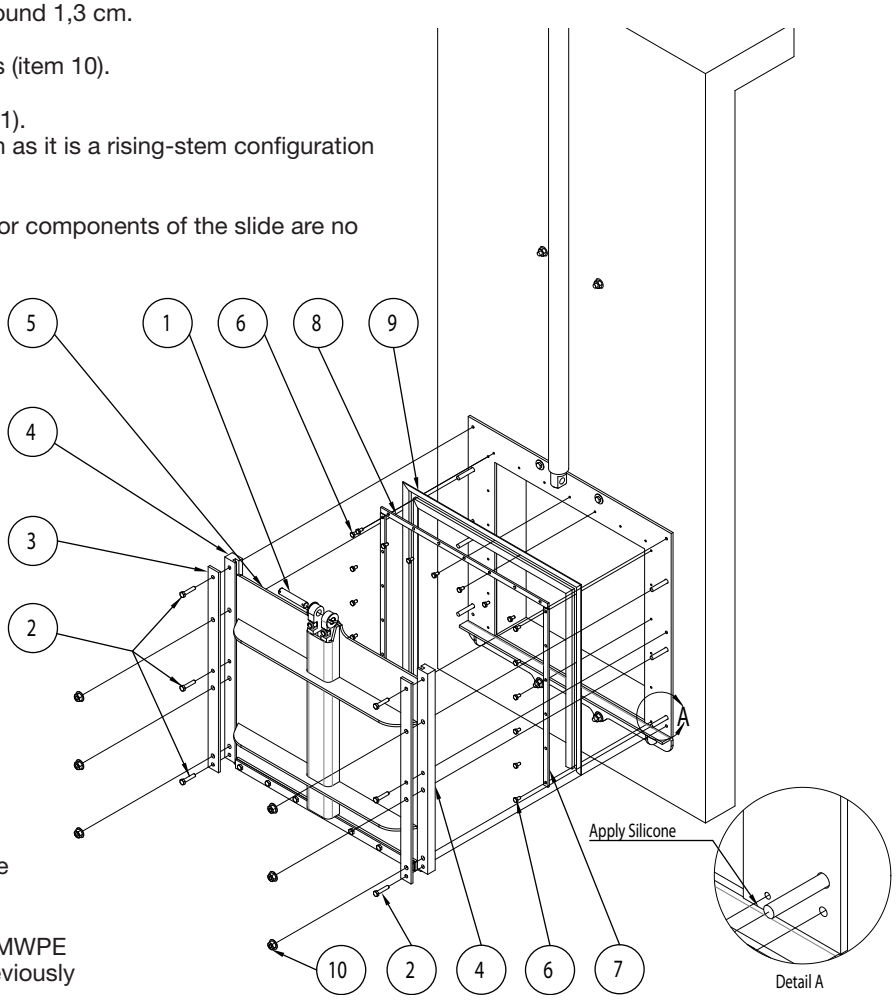
Step 5: Remove frame guides (item 3), HMWPE guides (item 4) and slide (item 5).

Step 6: Unscrew bolts (items 6) and remove retainers (items 7 and 8).

Step 7: Remove seal (item 9) and replace it by the new seal.

Note 1: Before installing the new seal, apply silicone on the frame invert, where the seal will be in contact with it (see detail A).

Note 2: After installing the new seal, apply grease on it to ease operation.



Reassembly:

Follow Steps 6 to 1.

Note: To reassemble in Step 5, first place one of the HMWPE guides (item 6) on the anchor bolt rods.

Next, take the slide (item 5) and attach the other HMWPE guide onto it. Finally, mate the whole unit to the previously positioned HMWPE guide.

7.2.2 Self-contained and non-rising-stem configuration penstocks (up to 1200 x 1200)

Step 1: From the closed position, raise the slide around 1,3 cm.

Step 2: Detach the stem extension (if applicable).

Note: The stem extension needs to be held in place, otherwise it will fall.
Clamp the extension and lean it on the stem guide (if applicable) or on the operating floor.

Step 3: Unscrew nuts and washers of lateral anchor bolts (items 1 and 2).

Step 4: Unscrew bolts (item 3) with caution, as major components of the slide are no longer secured.

Step 5: Remove the 'yoke (item 7), stem (item 9), slide (item 8), and frame guides (item 5) as one unit.

Step 6: Unscrew bolts (item 10) and remove the seal retainer (items 11 and 12).

Step 7: Remove seal (item 13) and replace it by the new seal.

Note 1: Before installing the new seal, apply silicone on the frame invert, where the seal is in contact with it (see detail A).

Note 2: After installing the new seal, apply grease on it to ease operation.

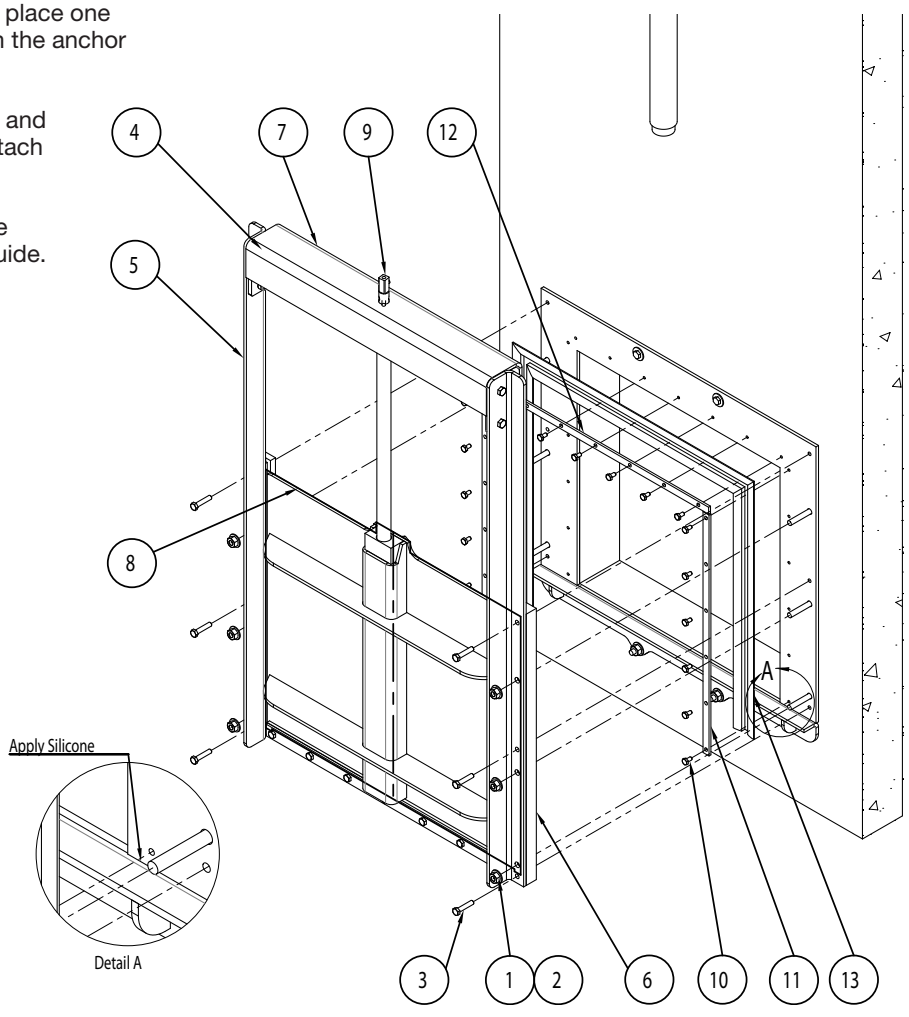
Reassembly:

Follow steps 6 to 1.

Note: To reassemble Step 5, first place one of the HMWPE guides (item 6) on the anchor bolt rods.

Next, take the yoke, stem, slide, and frame-guides as one unit, and attach the other HMWPE guide onto it.

Finally, mate the whole unit to the previously positioned HMWPE guide.



7.2.3 Open-frame and rising-stem configuration penstocks (above 1200 x 1200)

Step 1: Start from closed position.

Step 2: Remove the stem extension pin (item 2) and uncouple the stem extension (item 3) from the slide (item 1). See “Detail A”.

Note: The stem extension will not fall down as it is a rising-stem configuration penstock.

Step 3: Unscrew the nuts and washers (items 8 and 9) of stem guide (item 7).

Step 4: Unscrew the nuts and washers (item 5 and 6) of floor stand (item 4).

Step 5: Move the set floor stand and stem extension (items 3 and 4) in order to be able to remove the slide (item 1).

Step 6: Remove the slide (item 1) from the frame.

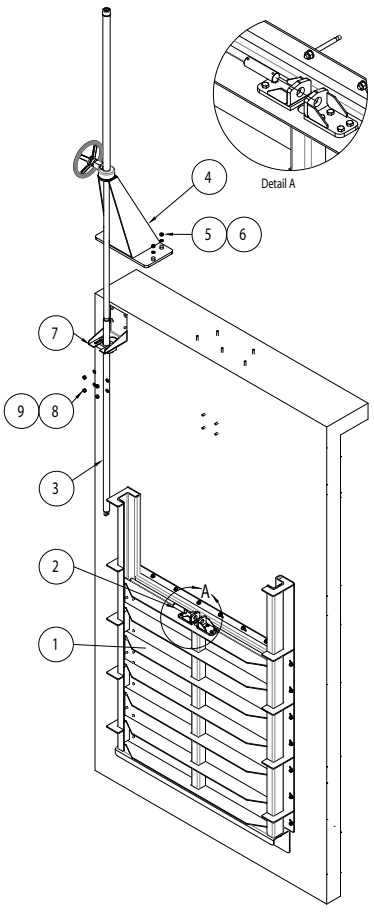
Step 7: Unscrew bolts and nuts (items 12 and 13) from the retainers (items 10 and 11).

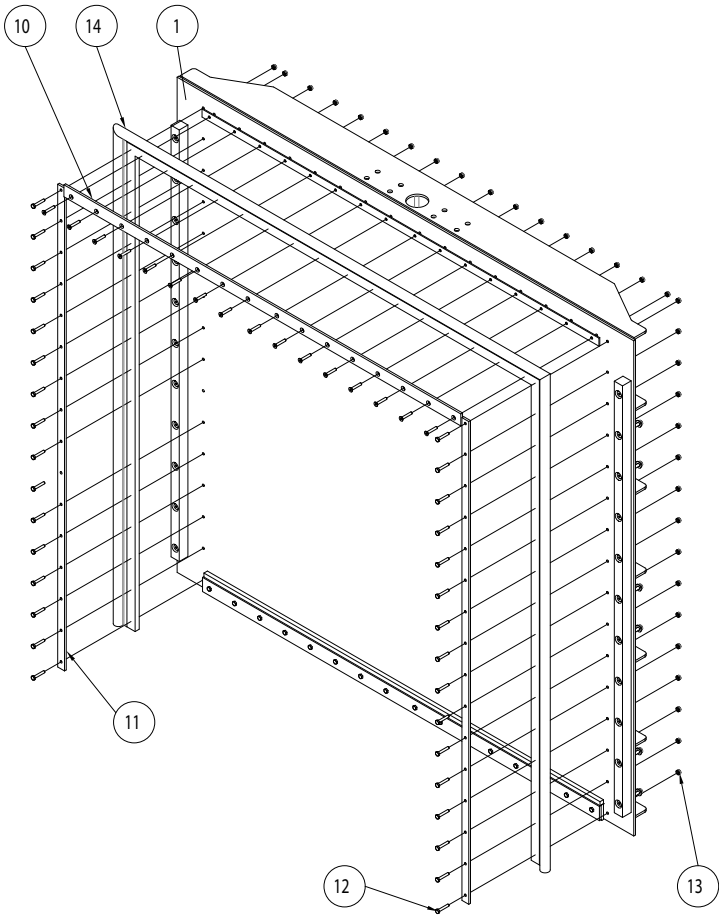
Step 8: Remove seal (item 14) and replace it by the new seal.

Note 1: Apply glue where the bottom seal and side seals join.

Note 2: After installing the new seal, apply grease on it to ease operation.

Reassembly: Follow steps 8 to 1.





7.2.4 Self-contained and non-rising-stem configuration penstocks (above 1200 x 1200)

Step 1: Start from closed position.

Step 2: Unscrew bolts and nuts (items 3 and 4) that hold the couplings (item 2) in place. See “Detail A”.

Step 3: Unscrew the bolts and nuts (items 6 and 7) from the yoke (item 5).

Step 4: Remove the yoke and stem (items 5 and 8) as one unit.

Step 5: Remove the stem extension (item 9).

Step 6: Remove the slide (item 1) from the frame.

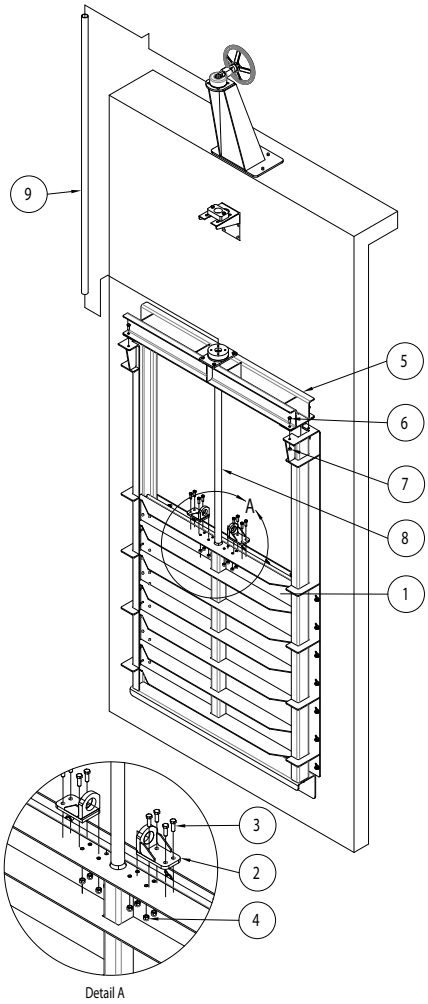
Step 7: Unscrew bolts and nuts (items 12 and 13) from the retainers (items 10 and 11).

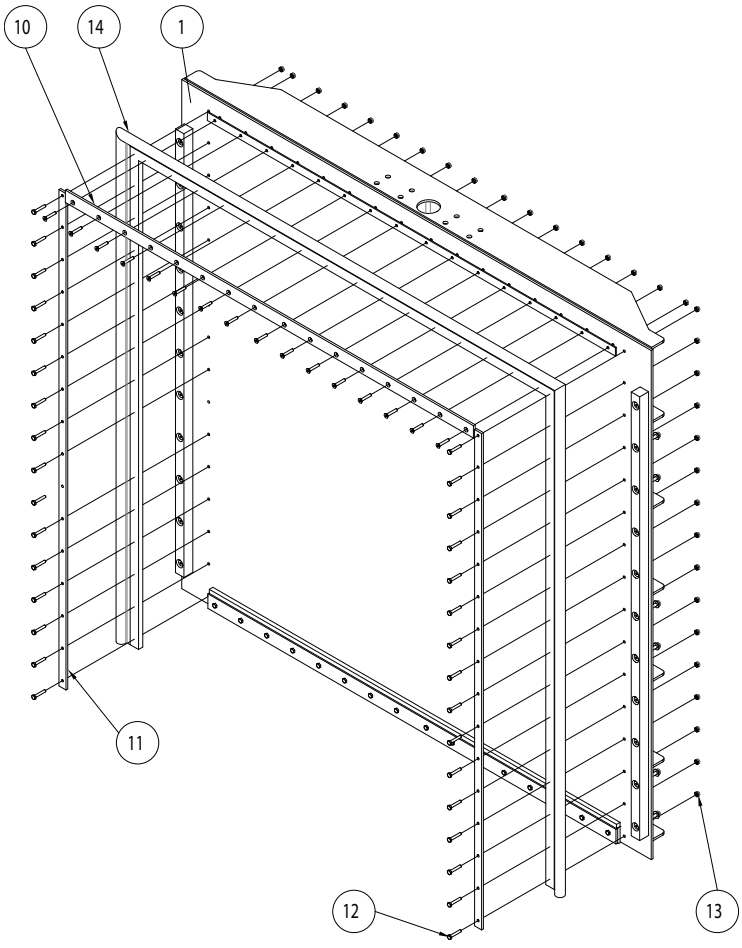
Step 8: Remove seal (item 14) and replace it by the new seal.

Note 1: Apply glue where the bottom seal and side seals join.

Note 2: After installing the new seal, apply grease on it to ease operation.

Reassembly: Follow steps 8 to 1.





AVK WALL PENSTOCKS

SERIES 772/61

8. BOTTOM SEAL REPLACEMENT

8.1 Sizes up to 1200 x 1200

Bottom seal replacement procedure*:

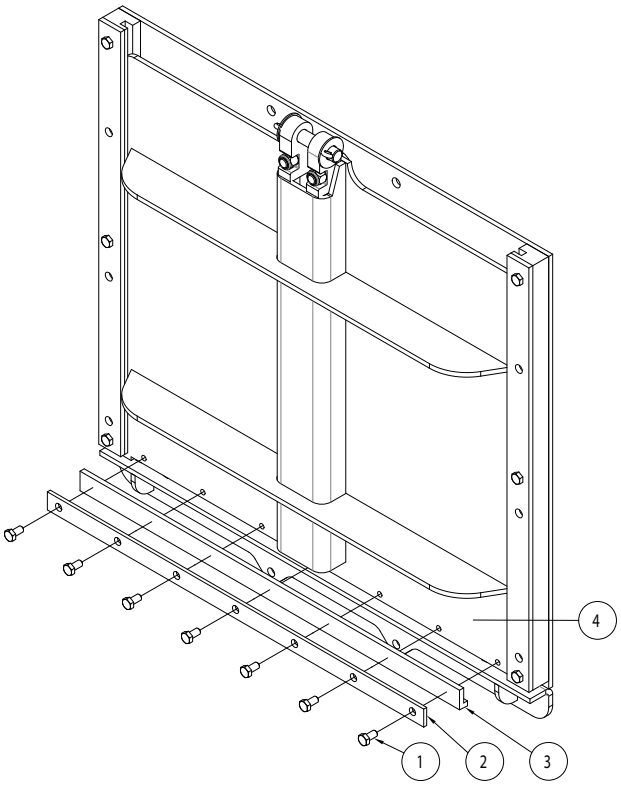
Step 1: From the closed position, raise the slide (item 4), around 5 cm.

Step 2: Unscrew bolts (item 1) and remove the bottom retainer (item 2).

Step 3: Replace the bottom seal (item 3).

Reassembly:

Follow steps 3 to 1.



* The figure shows the penstock removed from the wall in order to ease the identification of the different parts. However, there is no need to remove the frame or the slide from the wall to replace the bottom seal.

8.2 Sizes above 1200 x 1200

Bottom seal replacement procedure*:

Step 1: From the closed position, raise the slide (item 5), around 5 cm.

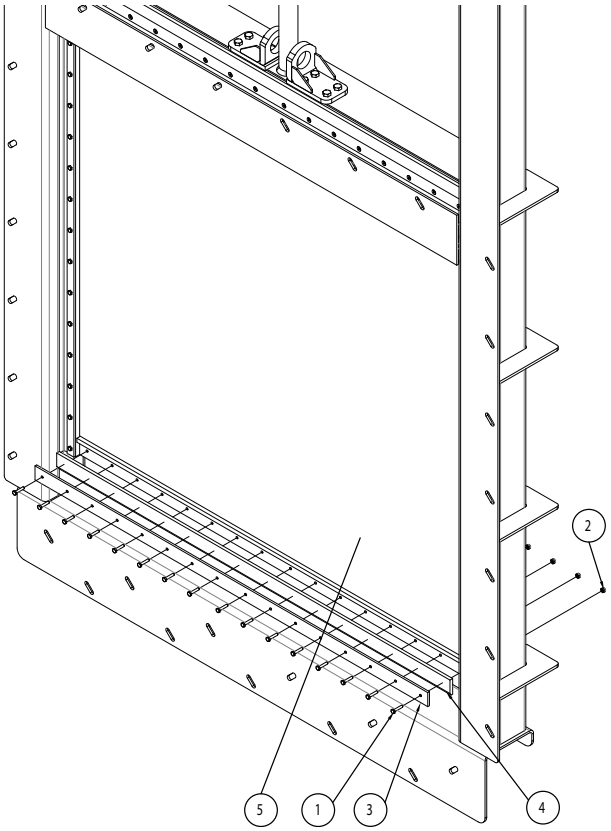
Step 2: Unscrew bolts and nuts (item 1 and 2) and remove the bottom retainer (item 3).

Step 3: Replace the bottom seal (item 4).

Note: Apply glue where the bottom seal and side seals join.

Reassembly:

Follow steps 3 to 1.



* The figure shows the penstock removed from the wall in order to ease the identification of the different parts. However, there is no need to remove the frame or the slide from the wall to replace the bottom seal.

Expect... AVK

9. TROUBLE SHOOTING

Symptom	Cause	Solution
Leakage between penstock and concrete wall	Concrete wall does not meet the required standard.	Un-install the penstock and fix the wall
	Not enough construction sealant.	Un-install the penstock, clean the wall and apply a new layer of construction sealant.
	Loose anchor bolts.	Tighten anchor bolts.
	Incorrect anchor bolts.	Check the 'General Arrangement Drawing' and make sure the right anchor bolts have been installed.
Leakage through the side seals	Damaged seal.	Replace seal.
Leakage through the bottom seal	Foreign material trapped between frame invert and slide.	Remove the foreign material. Check if there is any damage to the seal.
	Damaged seal.	Replace seal.
Excessive force required to operate the penstock.	Misaligned stem extension, stem guide, or floor stand.	Check and adjust alignment of stem extension, stem guide or floor stand.
	Dirty stem and/or stem nut.	Clean and lubricate stem and/or stem nut.