INSTALLATION & MAINTENANCE INSTRUCTIONS - ORIGINAL VERSION

AVK CHANNEL PENSTOCKS

SERIES 772/71

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1. INTRODUCTION

This manual describes the recommended procedures for installation, operation, maintenance and safety precautions for AVK channel 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 channel penstock is not installed, operated and maintained in strict accordance with the procedures described in this manual.

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 manipulated when the system is under pressure.

Personnel that is 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

Expect... AVK

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 to the product:

- Stems have precision surfaces and should never be used as a means 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 Embedded in concrete

Required Materials:
As a standard, AVK channel penstocks are mounted embedded in concrete (EC). Field adjustment hex bolts are required to center the penstock in the appropriate recess prior to embedding in concrete.

For detailed information about the type, 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”.

5.1.1 INSTALLATION PROCEDURE

Step 1: Concrete construction inspection

- 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. The minimum concrete strength shall be 3,000 PSI (20.7 MPa).

Step 2: Align the channel penstock in the wall recess

- Position and center the channel penstock in the recess of the wall, using the field adjustment bolts screwed in the “side centering fittings” and “bottom levelling brackets” (see Figure 1). Make sure that the channel penstock is centered in the channel.

NOTE: the smaller channel penstocks do not come with “bottom levelling brackets”.
If this is the case, follow Step 2B (page 6) prior to starting with “Step 2” in order to be able to align the penstock vertically.

- Align the penstock vertically adjusting the bolts on the “bottom levelling brackets” (see Figure 2). Make sure that the frame invert is flush with the invert of the channel.

- Align the penstock horizontally adjusting the bolts on the “lateral centering fittings” (see Figure 3). Make sure that the frame guide is flush with the channel side wall. Additionally, make sure that the penstock is perpendicular to the side walls of the channel.

Step 3: Embed the channel penstock in the wall recess

- Pour the second phase of concrete. Take special care not to damage the seals.

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Figure 1

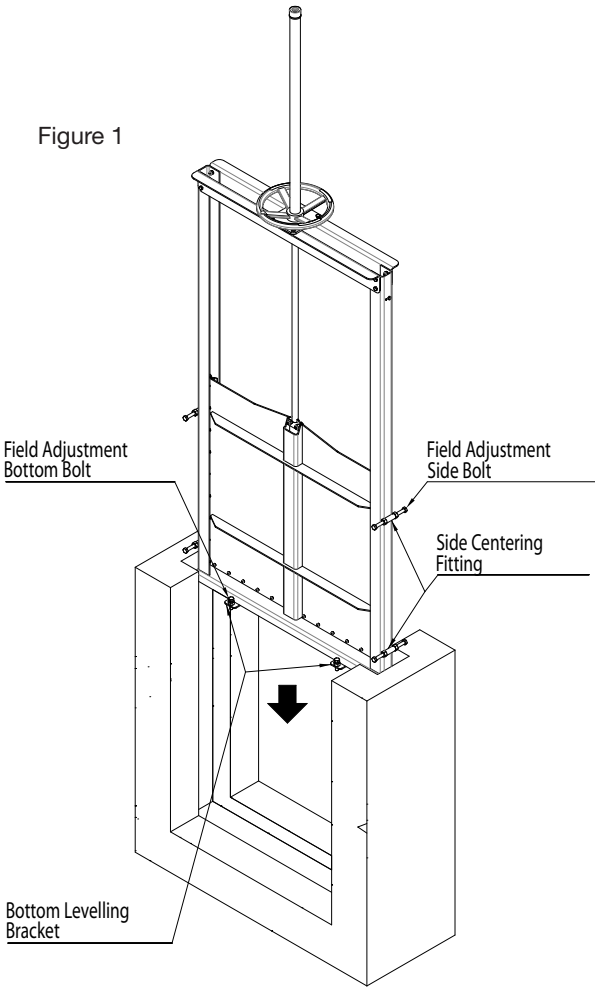


Figure 2

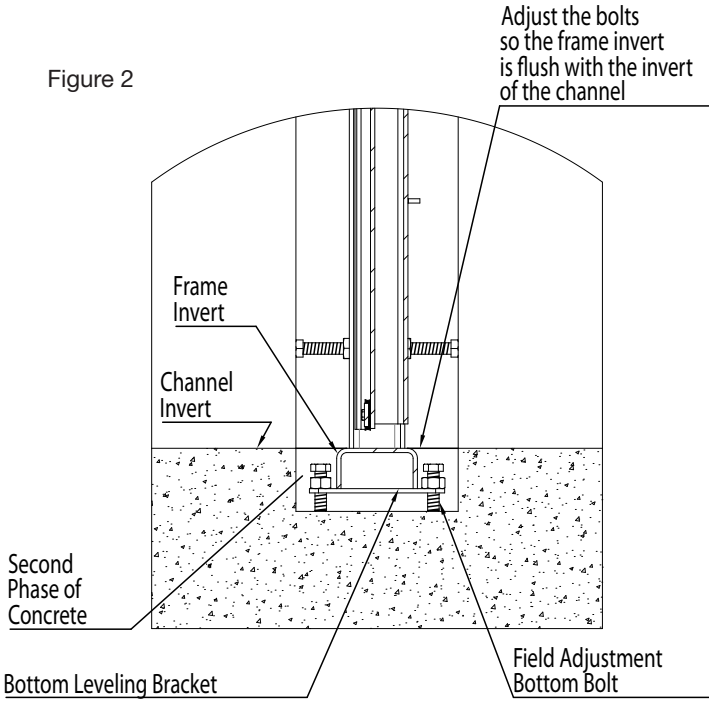
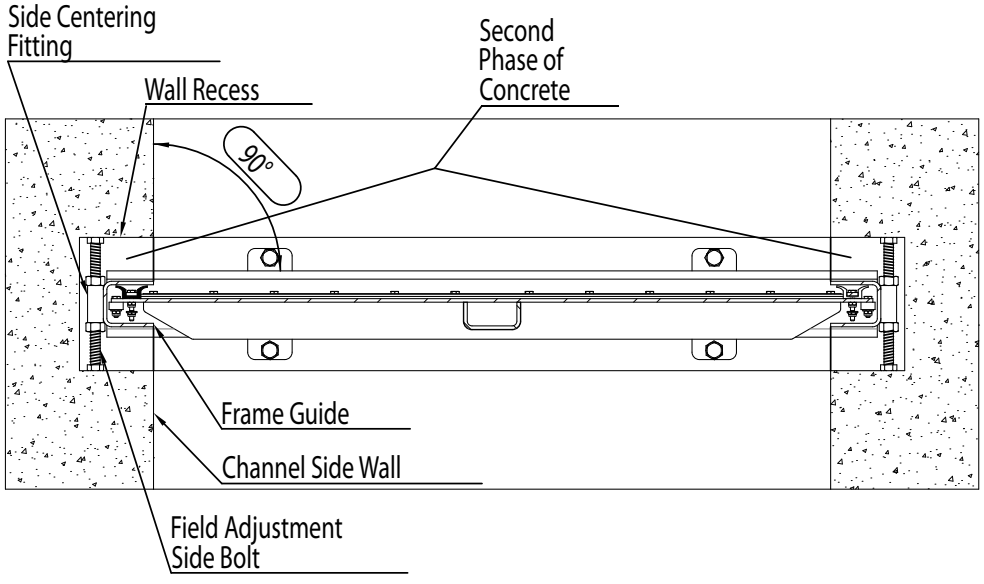
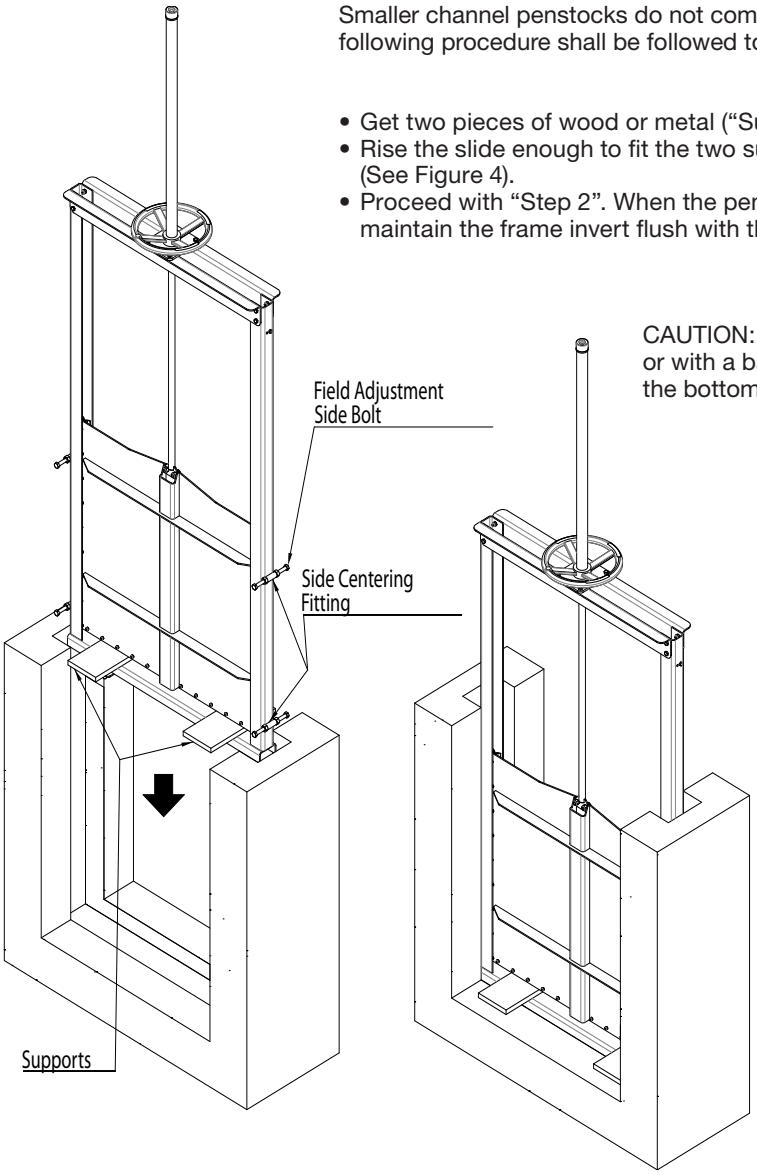


Figure 3



Step 2B: Align the penstock vertically (without the bottom balancing brackets)



Smaller channel penstocks do not come with “bottom balancing brackets”. Therefore, the following procedure shall be followed to align the penstock vertically (After “Step 1”).

- Get two pieces of wood or metal (“Supports”).
- Rise the slide enough to fit the two supports and secure the supports by closing the slide (See Figure 4).
- Proceed with “Step 2”. When the penstock is positioned in the recess, the supports will maintain the frame invert flush with the invert of the channel (See Figure 5).

CAUTION: Do not use pieces of wood or metal with sharp edges or with a bad surface condition in order to avoid any damage to the bottom seal.

5.2 INSTALLATION: FACE MOUNTED IN EXISTING CHANNEL

Required materials:
For the face mounted in existing channel (FM) mounting option, the channel penstock is installed by means of mechanical anchor bolts (Hilti Kwilt 3 or equivalent). All the gaps shall be grout filled afterwards and shaped in order to get a smooth transition.

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”.

5.2.1 INSTALLATION PROCEDURE

Step 1: Concrete construction inspection:

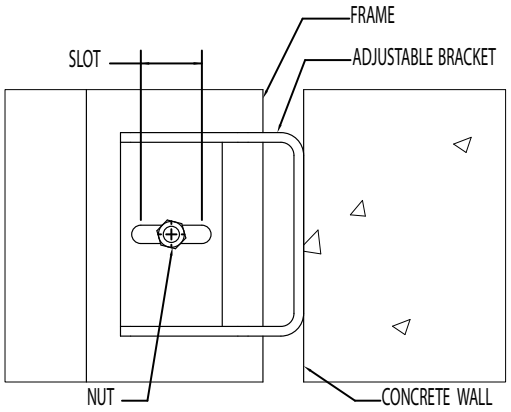
- The concrete construction shall be flat, level and plumb, and shall be in accordance to ACI 117-06 standard. If necessary, use non-shrink grout in order to meet the specified standard. The minimum concrete strength shall be 3,000 PSI (20.7 MPa).

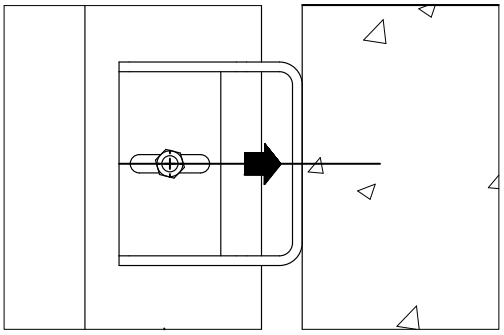
Step 2: Anchor the penstock to the channel

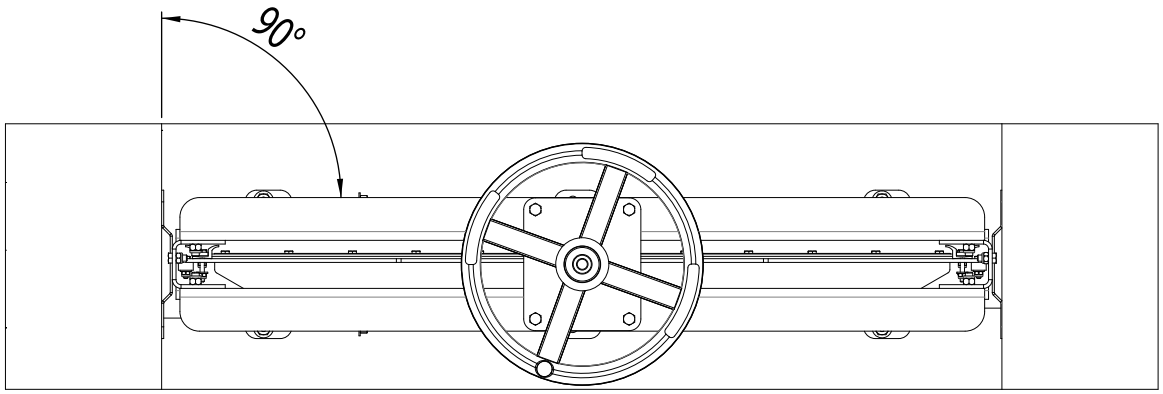
- Position the channel penstock in the existing channel. Make sure that the penstock is perfectly aligned and centered in the channel (see figure 6).
- Install the bottom anchor bolts, and then the lateral anchor bolts (see figure 8).

All face mounted channel penstocks incorporate bottom and lateral mounting brackets. For smaller sizes (typically under 60”), the channel penstock includes lateral flexible brackets (as seen in Figure 8) that require no field adjustment. For bigger sizes (typically over 64”), the channel penstock includes “field adjustment brackets”. In order to adjust the bracket, the following steps shall be followed (see Figure 7):

- Untighten the nut
- Adjust the bracket until it is completely leaning against the wall
- Tighten the nut
- Install the anchor bolt







Step 3: Grout fill

Grout fill the remaining voids (See Figure 8), both at the bottom (See Figure 9) and laterals of the penstock (See Figure 10).

Remember that the objective of the grout fill is twofold:

- Fill the voids between the frame, frame invert and the channel.
- Make a smooth transition for water flow. Therefore, the grout shall be built-up to the level of the frame as shown in Figures 9 and 10.

CAUTION! Make sure not to get grout or any other foreign material on the seals, guides or stem as this may cause leakage or damage.

Figure 8

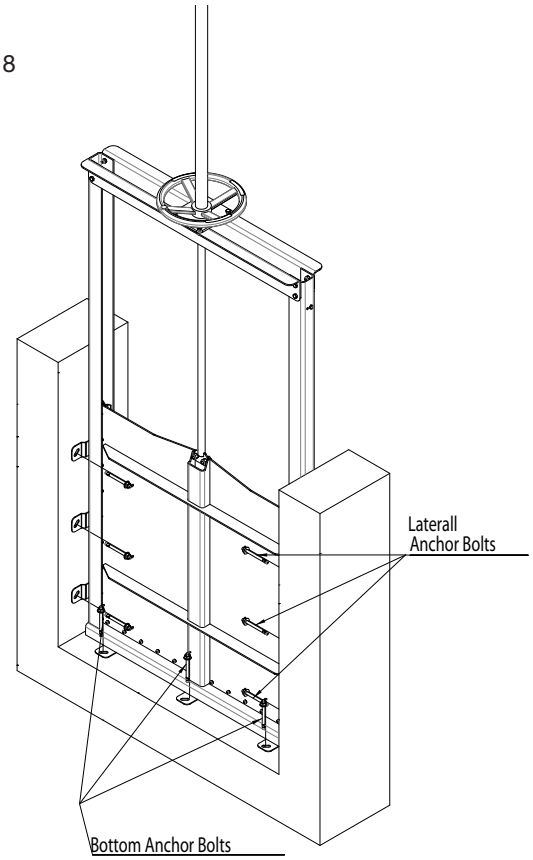


Figure 9

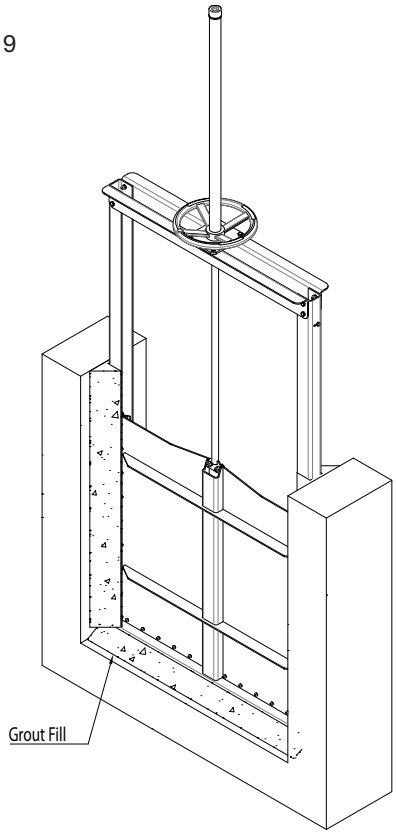


Figure 10

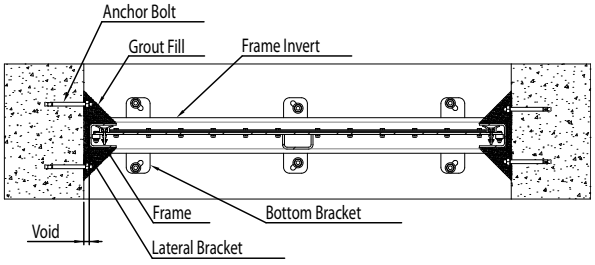
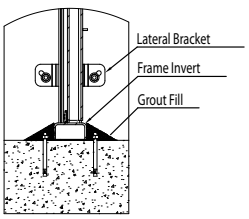


Figure 11



5.3 INSTALLATION: WALL MOUNTED

Required materials:
For the wall mounted (WM) mounting option, the channel penstock is installed by means of mechanical anchor bolts (Hilti Kwilt 3 or equivalent) and construction sealant (Sikabond or equivalent).

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

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'.

5.3.1 INSTALLATION PROCEDURE

Step 1: Concrete construction inspection:

- 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. The minimum concrete strength shall be 3,000 PSI (20.7 MPa).

- The wall surface shall be dry.

Step 2: Pre-installation of the channel penstock

- Position the channel penstock against the wall and line up with the opening (See Figure 12). The slide shall be in the closed position.

- Drill and install an anchor bolt on each side of the penstock. After installing the first anchor bolt, and prior to drilling the hole on the other side, make sure the frame is perfectly levelled (see Figure 13).

Figure 12

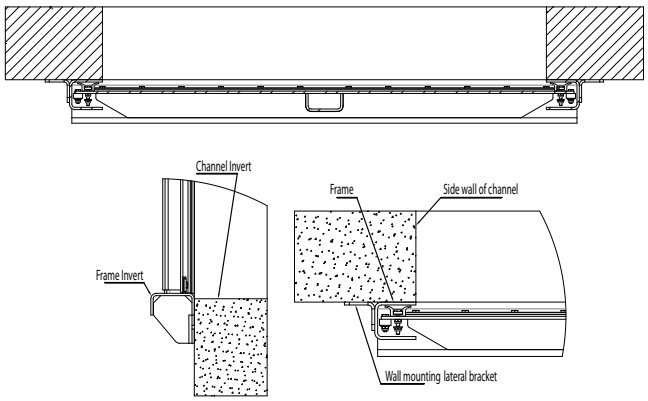
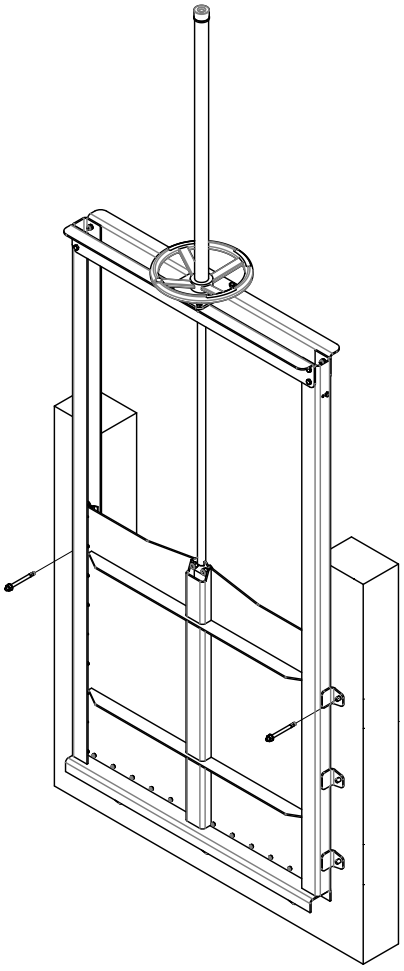


Figure 13



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Step 3: Construction sealant application (Sikabond or equivalent)

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

- Remove the channel penstock from the wall (first remove the nuts of the anchor bolts).
- Apply construction sealant all around the perimeter of the frame, where it will be in contact with the wall.
  Sikabond (200 ml/m) or equivalent construction sealant shall be used (See figure 14).
  Be sure not to get sealant on the seals, guides, and/or stem, as this may cause leakage damage.
- Re-install the penstock on the wall and tighten both anchor bolts.

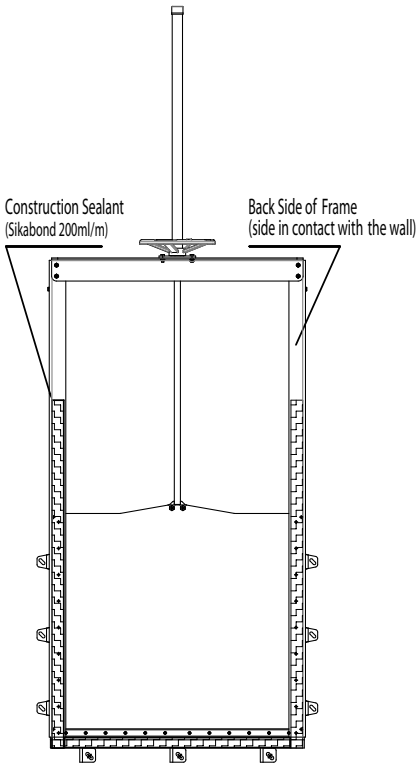


Figure 14

Step 4: Final installation of channel penstock

- Drill and install the rest of the anchor bolts (see Figure 15).

CAUTION!:
If the channel 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 16).

- 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 15

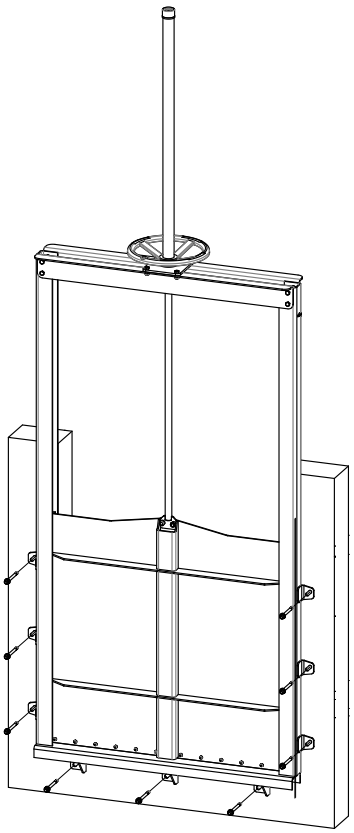
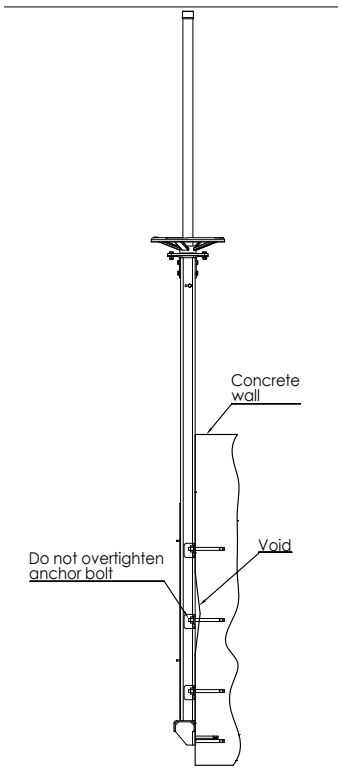


Figure 16



6. OPERATION

6.1 INITIAL OPERATION

Before cycling the channel 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 11 for detailed information about the required grease type.

Manual operation:

- 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 slide 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 channel penstock is closed by a clockwise rotation, and opened by a counter-clockwise rotation of the operator.

- The frame incorporates a slide stopping device to stop the slide when it reaches the fully opened position.

- The channel penstock is designed to be self-locking, so that the slide maintains its position in open, closed or intermediate positions.

7. MAINTENANCE

7.1 CLEANING AND LUBRICATION

AVK channel penstock needs practically no maintenance. In order to assure maximum performance of the channel 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 penstock 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 channel penstock. Operating the slide with dry seals may damage the seals. Additionally, more torque may be required to operate the channel penstock.

7.1.1 SPARE PARTS

AVK does not recommend stocking any spare parts by the owner of the equipment as the channel 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
Grease	Silica-gel silicone grease	Verkos il G-2
Glue	Instant adhesive	Loctite 495

7.2 SIDE SEALS AND BOTTOM SEAL REPLACEMENT

The following procedure describes how to replace the channel penstock's lateral seal, bottom seal or both seals.
Note that in any case, first the slide shall be removed from the frame. The frame does not need to be removed.

7.2.1 SLIDE REMOVAL (FIGURE 17)

Step 1: Start from the closed position.

Step 2: Remove bolts and nuts (items 3 and 4) that are used to join the stem (item 5) and slide (item 2). For the non-rising stem configuration, the stem nut shall be detached from the slide.

Step 3: Remove bolts and nuts (item 9 and 10) with caution, as major components of the penstock (yoke, operator and stem) are no longer secured.
Remove the stem (item 5), yoke (item 8) and the operator (item 11) as one item.

Step 4: Remove bolts and nuts (items 6 and 7) in order to be able to remove the slide.

Step 5: Remove the slide (item 2).

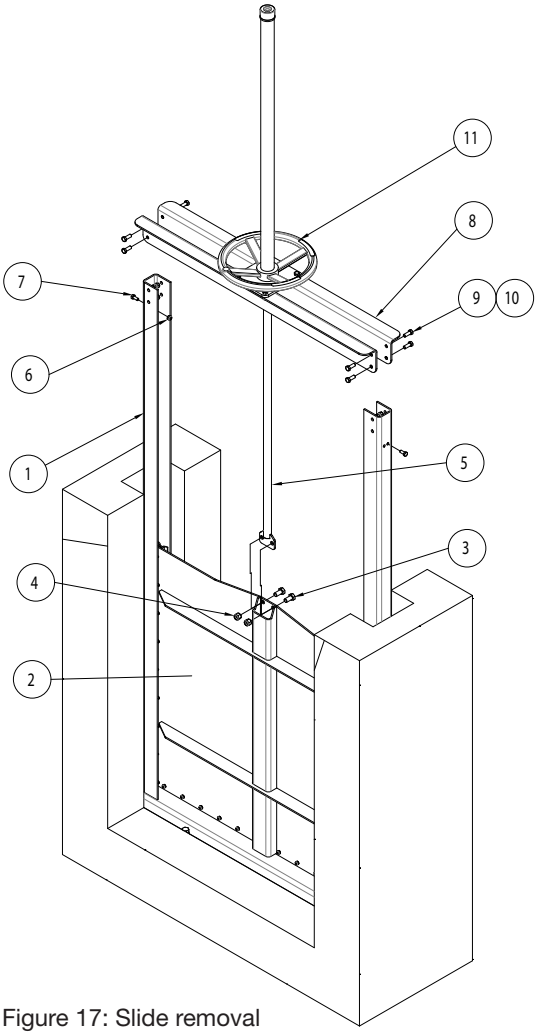


Figure 17: Slide removal

7.2.2 SIDE SEALS REPLACEMENT (FIGURE 18)

Step 6: Remove bolts, washers and nuts (items 3, 4 and 7) from the slide and remove retainers (items 2), lateral HMWPE guides (items 4) and front HMWPE guides (items 5).

Step 7: Remove side seals (item 8) 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.

7.2.3 BOTTOM SEAL REPLACEMENT (FIGURE 18)

Step 8: Remove bolts and nuts (items 10 and 12) and remove bottom retainer (item 9).

Step 9: Remove bottom seal (item 13) and replace it by the new seal.

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

7.2.4 REASSEMBLY

Follow steps 9 to 1.

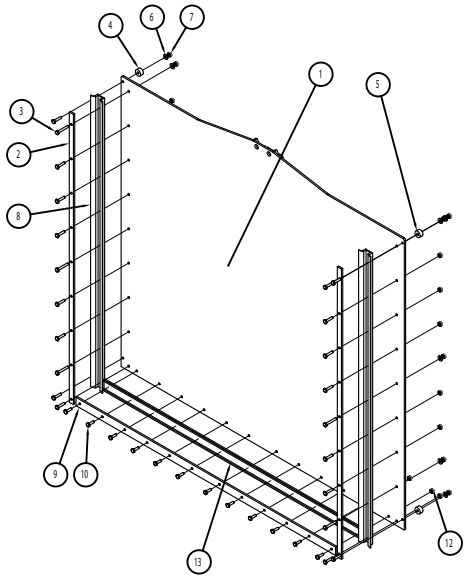


Figure 18: Side seal and bottom seal replacement

8. TROUBLE SHOOTING

Symptom	Cause	Solution
Leakage between channel penstock and concrete wall (for Face mounted In existing channel configuration)	Gaps between frame and face of wall due to miss-application of grout fill.	Grout fill remaining gaps.
	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 between channel penstock and concrete wall (for wall mounted configuration)	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.