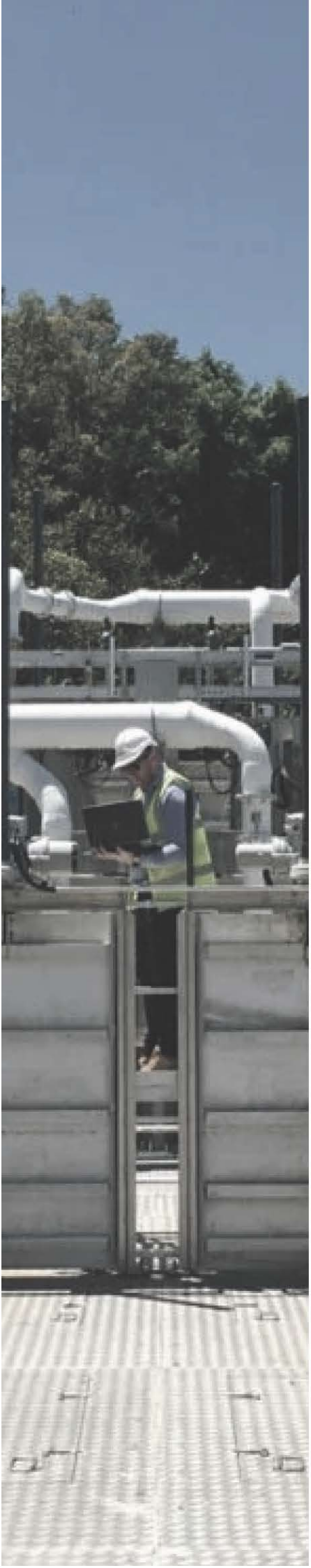

Installation Instructions

Australian Water Engineers

F35 Penstocks
ZW Penstocks
P1000 Penstocks & Stopgates

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General

1. Remove all strapping and protective packaging.

2. Check all parts are undamaged and accounted for. Fasteners and anchor bolts (if supplied by AWE) will be packed in a separate box – please ensure this is located.

3. Ensure the equipment is kept well clear or protected when mild steel is being cut or welded in the vicinity to avoid iron contamination and rust staining.

4. Keep the gate or board in the frame in the closed position. This provides rigidity and assists with alignment during installation.

5. Do not disassemble or alter the settings of any sealing arrangements.

6. Do not remove any frame bracing until installation is complete.

7. Actuator and gearbox enclosures achieve IP68 rating only when fully installed and connect with all conduit entry transit plugs removed and replaced with equivalent IP rated fittings.

8. Exposed carbon steel surfaces shall be coated with Tectyl 506 rust and corrosional preventative or approved equivalent. Coating shall be applied immediately after degreasing achieving a uniform thickness.

9. Please take the time to read and understand these instructions before starting. If in doubt, ask! The following set of instructions outlines the critical aspects of the installation with guidelines and recommendations. It is not a substitute for the knowledge and know-how of an experienced and competent mechanical installer.

10. These instructions are to be read in conjunction with the general arrangement drawing and any other relevant project documentation. If there is any inconsistency, ambiguity or contradiction seek advice and approval from the project superintendent.

11. Lifting should be performed using the anchor bolt holes or slinging under the head rail beams with certified webbing straps.

NEVER SLING WITH CHAINS AS THIS CAN DAMAGE AND CONTAMINATE THE EQUIPMENT!

Refer to the drawings for weights.

Wall Mounted Penstocks and Stopgates

1. Check the concrete wall face for flatness in both the vertical and horizontal planes. The surface should be free from debris, dust, sludge and algae growth. Ideally it should be pressure washed and scabbled to ensure cleanliness and provide good keying in of the grout.

2. Check the opening dimensions and the distance from invert to top of concrete are correct to drawing.

3. Mark a vertical centre line of the opening on the wall extending beyond the top and bottom of the opening. If there is a precast or cored hole in an overhang or cover slab above for the stem to pass through, check that this aligns with the center of the opening, is off sufficient size and is set at the correct offset position out from the wall as per the drawing.

4. If the invert of the penstock or stopgate is to be embedded, the floor will have been provided with a block-out across and in front of the opening to suit. If not, one will need to be cut and chased out. Check that the block-out size is positioned correctly and is of sufficient size to accommodate the penstock or stopgate frame. Refer to the drawing for details.

5. Place the penstock or stopgate against the wall and support it over the opening ensuring correct positioning. For correct height positioning the bottom rubber invert seal should be flush with the invert of the opening.

6. Set the penstock or stopgate vertically and centred with the line marked on the wall. Using a spirit level ensure the penstock or stopgate is vertical in both directions i.e. front and side elevations.

Tip: *Use a plumb bob line to ensure positioning and alignment with any remote penstock operating equipment that is to be installed at a higher level above.*

7. At this point it is necessary to check with a feeler gauge that the bottom edge of the gate is making continuous and consistent contact with the bottom rubber invert seal. It may be necessary to pack up the bottom cross rail member to achieve this. A straight edge and/or string line may also be useful to ensure straightness.

8. Using the penstock or stopgate frame hole pattern as a template, drill all anchor holes as per the manufacturers recommendations and to depths stated on the drawing. Holes must also be thoroughly cleaned to the manufacturer's recommendations.

Important!*: Anchor bolt installation is critical to achieve full structural integrity and capacity of the equipment. Failure to install anchors correctly and to full specified depth could result in the penstock or stopgate "blowing" off the wall under hydrostatic loading.*

Tip: *Masking off the seals down each side and across the top of the door with self adhesive tape will assist in ensuring the seals remain free from drilling debris.*

9. Install chemical anchors as per the manufacturer's recommendations ensuring they are square and perpendicular to the frame and are centred in their holes through the frame.
   If the penstock or stopgate is to have non-shrink grout behind the frame, screw the backing nuts onto the anchor stud. *(Anchors supplied by AWE have a hex drive head to allow setting with a drill. The backing nut is held in the fingers behind the frame and the stud is drilled through it.)*
   Allow anchor adhesive to cure as per the manufacturer's recommendations.

Important!*: For ZW model penstocks the anchors across the top seal are to be set or trimmed back to allow the gate to open without clashing.*

10. The penstock or stopgate is to be positioned with a gap between the wall and frame to allow for grouting. This gap is normally 25mm but check the drawing to confirm. Importantly, it should be noted that the penstock should be set to align with any remote operating equipment that is to be installed at a higher level above. Therefore this gap may need to be slightly adjusted to accommodate wall verticality and construction tolerances.

11. Using a spirit level and straight edge or string line, ensure the penstock or stopgate is vertical in both directions and is free from distortion and twist which can affect operation and performance of the penstock or stopgate. Use the backing nuts and front nuts to achieve this and lock into position.

Important!*: It is necessary to use a nickel anti-seize compound to prevent galling of threaded stainless steel fasteners.*

12. If the penstock has a top seal or is a downward opening weir type penstock, the cross seal needs to be set. To set, the cross rail member is pushed out tightly against the gate so there is continuous contact and compression. Use the anchor bolt rear jacking nuts and setting screws in the cross rail member to achieve this.

Important!*: The correct setting of the cross seal is paramount to ensuring leakage is minimised through this seal.* ***DO NOT PULL THE CROSS SEAL AWAY FROM THE GATE WHEN TIGHTENING THE ANCHORS.*** *This may create gaps between the seal and the rear surface of the gate.*

13. Check for gaps between the seals and gate using a feeler gauge. If gaps are present, then the frame has been distorted or the cross seal has not been set correctly.

STOP! *If the penstock arrangement includes remote operating equipment to be installed at a higher level above, it should be fitted and installed at this stage prior to grouting the penstock. Refer to the relevant sections further on in this manual.*

14. To ensure a sound bond and seal for the grout, it is recommended a bonding primer agent be applied to the concrete wall and rear of the penstock or stopgate frame. A suitable product is Crommelin High Performance Bonding Agent. Install formwork as necessary ensuring all gaps are shuttered up sufficiently to prevent grout from leaking out.

Tip: *Masking off the seals down each side and across the top of the door with self adhesive tape will assist in ensuring the seals remain free from grout over spill.*

15. Grout fill the void between the penstock or stopgate frame and the wall using a pourable non-shrink type grout. Ensure air pockets are removed and all cavities are filled.

Tip*: If the formwork leaks, slowing down the pour and letting the grout thicken often overcomes this. Lightly tapping the formwork and frame as the grout is being poured helps remove air pockets and bubbles.*

Beware!*: Do not pour in stages that allow previous pours to set. Non-shrink grout usually has an added expanding agent where the amount of expansion is dependent on the water/cement ratio. An expanding layer over a previously expanded layer that has already set can cause serious leaks between the frame and the grout.*

Important!: *Adding the correct water volume and mixing time are paramount to ensuring the grout performs and doesn't shrink. It is also recommended that grouting be performed late afternoon out of the heat of the day, not in direct sunlight and when the penstock or stopgate frame is cool. Shielding with a damp cloth drop sheet or hessian can assist to prevent the grout drying out too fast and cracking.*

PLEASE REFER TO AND STRICTLY FOLLOW THE GROUT MANUFACTURER'S INSTRUCTIONS.

16. When the grout has cured, (refer to manufacturer's recommendations), remove the formwork. Check that the grout has not shrunk away from the frame. Ensure any overspill of grout is removed from the penstock or stopgate especially on the seals, the stem and the rear surface of the gate. Operating a penstock with grout left stuck to the rear surface of the gate will damage the cross seal as it passes over it. Likewise, grout left on the stem will damage the threads.All anchor bolts should now be tightened and bracing removed.

Channel Embedded Penstocks and Stopgates

1. During construction, the channel will have been provided with block-outs in the walls and floor to suit the penstock or stopgate. Check that the channel width and depth as well as block-out sizes are correct and of sufficient size to accommodate the penstock or stopgate. Refer to the drawing for details.

2. Place the penstock or stopgate into the block-outs and evenly pack under the frame so the rubber invert seal is flush with the channel floor. Check with a spirit level and straight edge or string line that the penstock or stopgate is level straight across the channel. Using a feeler gauge check that the bottom edge of the gate makes continuous and consistent contact with the rubber invert seal.

3. Pack the penstock or stopgate in the wall block-outs so that it is held rigid and is vertical and square leaving equal space either side of the vertical frame member for grout. Check with a spirit level and staright edge or string line that they are vertical and staright. Do not over pack as this may cause distortion and twist which can affect operation and performance of the penstock or stopgate.

***Tip**: The gate should remain in the closed position to provide rigidity to the frame when positioning, packing and setting into the block-outs.*

4. Install formwork as necessary ensuring all gaps are shuttered up sufficiently to prevent grout leaking out.

5. It is essential to double check the frame is free of distortion and twist prior to grouting.

6. Grout fill the block-outs as per item 15 above.

***Tip**: The gate should remain in the closed position to provide rigidity to the frame whilst grouting.*

7. All embedded penstocks and stopgates are provided with a flush invert, therefore the grouting at the invert of the channel should finish flush with the seal.

8. Allow grout to cure (refer to manufacturer's recommendations) and remove formwork. ***Important!**: Do not remove the gate from the frame and do not remove any temporary frame bracing until after the grout has set.*

9. Remove all debris and any grout that may have come into contact with other parts of the penstock or stopgate. Pay particular attention to the seals, rear surface of the gate and stem as grout will damage these under operation.

10. All bracing can now be removed.

Remote Penstock Operating Equipment

1. After a penstock unit has been set in position level and plumb, all remote operating equipment such as extension stems, guide brackets and pedestals should be fitted prior to grouting. This is to ensure correct alignment and levels are achieved so that moving parts run smoothly and binding does not occur under operation.

2. Check the distance from the invert of the opening to the floor level against the drawing. It is important to maintain this distance in order for the operating equipment to fit and function correctly although a tolerance of +/-20mm can usually be accommodated.

3. It is important that stem guide brackets are positioned at heights as shown on the drawing. Guide brackets are adjustable in two planes and act as supports preventing the stem from buckling when the penstock is being closed.
   ***Important!**: Ensure to tighten all bolts after equipment has been aligned. Failure to do so may result in damage to components.*

4. Pedestals are anchored at floor level and should be set level, plumb and in true alignment with the stem. It is important that the chemical anchors are set correctly and installed to the manufacturer's recommendations to achieve full structural capacity. It may be necessary to grout under the pedestal base to achieve dead level or a correct height. Similarly, where wall support brackets are used it is necessary to achieve correct level and alignment. Grouting behind wall bracket fixing plates is generally necessary to achieve correct alignment.

***Tip:** Use a plumb bob line to check alignment of components between top of pedestal and where the stem connects onto the gate.*

***Tip:** Components supplied loose are generally labelled and matched marked to assist with site assembly. The labelling and marking used generally refers to the drawings supplied.*

Rising Stem Penstocks

All manually operated rising stem penstocks are fitted with limit nuts to prevent over travel and exerting excessive force on the stem once the closed position has been reached. It is important that limit nuts are set correctly to prevent the stem from buckling and damage to the rubber invert seal. For transport reasons, handwheels and stem cover tubes are supplied loose so it is necessary to fit these.

1. Fit the handwheel onto the hexagon shaped bronze lift nut. Tighten the retainer bolt and locking nut.
   For gearboxes the handwheel is fitted to the input shaft in a similar way.

2. Fit the acme leadscrew stem by screwing through the lift nut from beneath.

3. Fit all stem extensions, couplings and guide brackets

Correct spacing of guide brackets is important and must be adhered to! Refer to drawing.

4. Check alignment of all components and tighten all bolts.

5. Wind the penstock to its fully closed position. The gate should be wound down to compress the rubber invert seal 1 to 2mm. ***DO NOT OVER WIND!***

6. Wind the limit nut down the stem thread to seat onto the top of the lift nut. Tighten the grub screw to lock into position. For gearboxes the penstock will need to be raised back up slightly to access the grub screw.

7. Fit the stem cover tube by pushing it into the spigot on top of the handwheel. Take care not to damage or dislodge the internal o-ring seal.***Tip:*** *A little lubrication with soapy water or petroleum jelly greatly assists with this.* For gearboxes and actuators the stem cover tube will have a threaded connection and PTFE thread sealing tape should be used to ensure water tightness. To gauge the correct length of stem cover tube to be used with a particular penstock refer to the drawing provided.

Important!*: Under no circumstances should the top of a gearbox or actuator be left exposed to the weather. Ingress of water may cause corrosion, damage and significantly reduce the life of internal components.*

8. Lubricating the whole threaded portion of the stem is necessary as handwheel or actuator forces assume that grease lubrication will be applied. This significantly reduces the co-efficient of friction and wear rate of the bronze drive nut. Prior to applying grease to the stem threads they should be fully cleaned to remove all grit and dust.

Tip: *If the penstocks are not going to be put into service and used for some time it is recommended that lubrication of the stem be performed at a later stage as the exposed grease can become contaminated over time.*

Non-Rising Stem Penstocks

Most non-rising stem penstocks are furnished with non-metallic thrust nuts fitted to the top of the gate. The interface between the stem and nut is self-lubricating and therefore requires no greasing. Most non-rising applications are operated with a removeable T-key that couples to the top of the stem terminating with a square cap.

1. If not already done so, fit the acme leadscrew stem by screwing through the thrust nut from above. When the gate is in the closed position the nut should be fully engaged with enough thread protruding through to fit the limit nut.

2. Fit all stem extensions, couplings and guide brackets.

Correct spacing of guide brackets is important and must be adhered to! Refer to drawing.
For gearboxes and actuators the stem is terminated with a stepped shaft and keyway suited for connecting and locking into the drive nut. Ensure the locking nut and washer are fitted and tightened.

A plug in the top of the gearbox or actuator will have a threaded connection and PTFE thread sealing tape should be used to ensure watertightness when fitted.

Important!*: Under no circumstances should the top of a gearbox or actuator be left exposed to the weather. Ingress of water may cause corrosion, damage and significantly reduce the life of internal components.*

3. Check alignment of all components and tighten all bolts.

4. Wind the penstock to its fully closed position. The gate should be wound down to compress the rubber invert seal 1 to 2mm. ***DO NOT OVER WIND!***

5. Wind the limit nut up the stem thread to seat onto the underside of the thrust nut housing. Tighten the grub screw to lock into position.
   Note: ZW range of penstocks do not have a limit nut.

FOR the detail fitting and installation of gearboxes and actuators please refer to the manufacturer's instructions