



Assets Planning and Delivery Group  
Engineering

# Strategic Product Specification

---

**SPS 295**

**Penstocks for Waterworks Purposes**

---

VERSION 1  
REVISION 4

MAY 2022

## FOREWORD

Each Strategic Product Specification has been prepared to inform Water Corporation staff, consultants, contractors and land developers of the requirements for selecting and acquiring a manufactured product to be used in strategic Corporation infrastructure. The definition of ‘Product’ includes items that comprise assembled components, equipment or plant for mechanical, electrical and civil infrastructure applications.

The objective of a Strategic Product Specification is to specify fit-for-purpose Product which will contribute to the provision of effective water services at least whole-of-life cost and with least risk to service standards and safety. A Strategic Product Specification also provides uniform standards for compatibility of new water infrastructure with existing water assets.

Many Strategic Product Specifications have drawn on the design, asset management and operational experience of Product performance in live service gained by the Corporation over time. Some Strategic Product Specifications have drawn on the experience of the water industry nationally by referencing Australian or WSAA standards.

Strategic Product Specifications are intended for reference and use in the following typical procurement scenarios:

- Capital funded infrastructure design and construction work;
- Private developer funded subdivision infrastructure for takeover by the Corporation;
- Operationally funded infrastructure design and construction work;
- Corporation period contracts for Product purchases;
- Product purchases for stock or for miscellaneous minor work.

A published Strategic Product Specification will, in some cases, comprise technical content that is typical of a range of products of the same type (type specification) but may exclude specific requirements that should apply to a particular project or application. In such cases, the project designer is required to document the supplementary project specific requirements in the appropriate Clause of the ‘Project Specific Requirements’ Appendix of the Specification.

The text of a published Specification should not be directly modified. In the event that a text variation is considered necessary to accommodate the needs of a particular project or application, the text modification should be documented in the appropriate Clause of a ‘Project Specific Requirements’ Appendix.

Enquiries relating to the technical content of this Specification should be directed to the Senior Principal Engineer, Mechanical, Engineering to whom all enquiries relating to the technical content of the Specification should be directed. Future Specification changes, if any, will be issued to registered Specification users as and when published.

### Head of Engineering

*This document is prepared without the assumption of a duty of care by the Water Corporation. The document is not intended to be nor should it be relied on as a substitute for professional engineering design expertise or any other professional advice.*

*It is the responsibility of the user to ensure they are using the current version of this document.*

© Copyright – Water Corporation: This standard and software is copyright. With the exception of use permitted by the Copyright Act 1968, no part may be reproduced without the written permission of the Water Corporation.

## REVISION STATUS

The revision status of this specification is shown section by section below:

REVISION STATUS						
SECT.	VER./REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
1	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
1	1/1	19.12.08	9-15	Clause 1.1 amended, Allowable Operating Head, Pressure Class deleted, 1.3.13, 1.3.18, 1.3.19, 1.3.29, 1.3.30, 1.3.35 added	SE	AAK
1	1/3	21.12.16	10-11	Clause 1.1(c) generally revised Clause 1.2 amended to add AS1400, AS4797, DIN5687-1 and AS5688-1. DS95, A1 & C2 added to list of specifications Clause 1.3.15, 29, 31 and 35 added or amended	GP	SE
1	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
2	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
2	1/1	19.12.08	16	Clause 2.1, 2.5 amended	SE	AAK
2	1/2	28.06.13	17	Use of Nylon 6 for spindle nuts in wastewater application is revoked. Notes amended to allow use of Aluminium Bronze spindle nuts in wastewater applications	GP	SE
2	1/3	21.12.16	16-17	Table 2.1 amended to include Neoprene as door seal material and Plasticised PVC as a bottom seal material Clause 2.5 amended to reference to AS listed in table 2.1	GP	SE
2	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
3	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
3	1/1	19.12.08	19 - 26	Clause 3.1 to 3.9, 3.12, 3.13 amended	SE	AAK
3	1/2	28.06.13	18	Clause 3.1.(i) amended to define minimum life expectancy for m& equipment	GP	SE
			19	Clause added to sections 3.3 & 3.4 specifying minimum deflection requirements		
				Clause 3.3(g) allowing 5mm minimum thickness for structural members		

REVISION STATUS						
SECT.	VER./REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
			20	Clause 3.6 (b) revised replacing category 2B with “ Category 1B with Class II 9a) surface finish		
				Clause 3.7(c) revised to make this requirement optional based on purchasing schedule		
				Heading of section 3.6 change to “ Mounting Type”		
			22-25	Clause 3.13 amended		
3	1/3	21.012.16	18	Section 3.3 is generally revised. Refer previous version for record of changes.	GP	SE
3	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
4	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
4	1/1	19.12.08	26-27	Clause 4.5, 4.6, 4.7 amended	SE	AAK
4	1/3	21.12.16	25	Section 4.5.1 on Weld Examination added, Sections 4.5.3, 4.5.4, 4.6.1, 4.6.2 & 4.6.3 amended.	GP	SE
4	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
5	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
5	1/3	21.12.16	22	Section 5.2.2 amended to replace galvanised wire with non-metallic or non-ferrous tie wire	GP	SE
5	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
6	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
6	1/1	19.12.08	30	Clause 6.2, 6.3 amended	SE	AAK
6	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
7	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
7	1/3	04.11.16	40	Section 7.1.2 amended	GP	SE
7	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
8	1/0	15.12.07	All	New version using SPS standard template	SE	AAK

REVISION STATUS						
SECT.	VER./REV.	DATE	PAGES REVISED	REVISION DESCRIPTION (Section, Clause, Sub-Clause)	RVWD.	APRV.
8	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
9	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
9	1/3	21.12.16	35	New section 9.2 added with heading Quality Assurance of Stainless Steel Welding.	GP	SE
				Section 9.4.2 on Manufacturing Repairs (In Process) removed	GP	SE
9	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
10	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
10	1/1	19.12.08	36	Table 10.1 amended	SE	AAK
10	1/2	28.06.13	36-37	Table 10.1 and Note 1 amended	GP	SE
10	1/3	21.12.16	37	Table 10.1 amended. Notes to table 10.1 removed.	GP	SE
10	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
11	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
11	1/1	19.12.08	29	Table 12.1 amended	SE	AAK
11	1/3	21.12.16	39	Tables 11.1 and 12.1 amended	GP	SE
11	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV
12	1/0	15.12.07	All	New version using SPS standard template	SE	AAK
12	1/1	19.12.08	41	Table 12.2 amended	SE	AAK
12	1/3	21.12.16	45-46	Appendices C&D added	GP	SE
12	1/4	16.12.21	n/a	Full document review, no required changes to content	SE	BV

# Strategic Product Specification

## SPS 295

### Penstocks for Waterworks Purposes

#### CONTENTS

<i>Section</i>	<i>Page</i>
<b>1</b>	<b>Scope and General .....10</b>
<b>1.1</b>	<b>Scope.....10</b>
<b>1.2</b>	<b>Referenced Documents .....10</b>
<b>1.3</b>	<b>Definitions and Notation.....12</b>
1.3.1	Aperture .....12
1.3.2	Certificate.....12
1.3.3	Certification Body.....12
1.3.4	Certification Mark.....12
1.3.5	Certification Scheme.....12
1.3.6	Classification of Penstocks .....12
1.3.7	Compliant Product .....13
1.3.8	Corporation .....13
1.3.9	Door .....13
1.3.10	Frame .....13
1.3.11	Leakage .....13
1.3.12	Manufacturer.....13
1.3.13	Maximum Static Head .....13
1.3.14	Nominal Size.....13
1.3.15	Non-Rising Spindle.....13
1.3.16	Notation.....13
1.3.17	Officer .....13
1.3.18	OffSeating.....13
1.3.19	On-Seating .....14
1.3.20	Penstock .....14
1.3.21	Product .....14
1.3.22	Product Appraisal.....14
1.3.23	Product Assessor.....14
1.3.24	Product Certification .....14
1.3.25	Product Verification Report .....14
1.3.26	Product Warranty .....14
1.3.27	Purchasing Schedule .....15
1.3.28	Quality System.....15
1.3.29	Radius of Gyration $R_g$ (Spindle).....15
1.3.30	Rising Spindle .....15
1.3.31	Slenderness Ratio $\lambda$ (Spindle).....15
1.3.32	Strategic Product.....15
1.3.33	Supplier .....15
1.3.34	Testing.....15
1.3.35	UHMWPE.....15
1.3.36	WSAA.....16
1.3.37	Yoke .....16

1.4	<b>Designation of Size</b> .....	16
2	<b>Materials and Components</b> .....	17
2.1	<b>General</b> .....	17
2.2	<b>Non-metallic Materials</b> .....	17
2.3	<b>Dezincification-resistant Materials</b> .....	18
2.4	<b>Contamination of Water</b> .....	18
2.5	<b>Seals</b> .....	18
3	<b>Design and Manufacture</b> .....	19
3.1	<b>General</b> .....	19
3.2	<b>Drawings</b> .....	19
3.2.1	Drawings - Installation.....	19
3.2.2	Drawings - Fabrication.....	19
3.2.3	Drawings – As Constructed .....	19
3.3	<b>Aperture Dimensions and Tolerances</b> .....	20
3.3.1	Dimensions.....	20
3.3.2	Tolerances .....	20
3.4	<b>Frame</b> .....	20
3.5	<b>Door</b> .....	20
3.6	<b>Lifting Attachments and Chain</b> .....	21
3.6.1	Chain .....	21
3.6.2	Fittings .....	21
3.7	<b>Fabrication and Welding of Stainless Steels</b> .....	21
3.7.1	General.....	21
3.8	<b>Seals</b> .....	22
3.9	<b>Spindle, Nut, Cap and Spindle Guides</b> .....	22
3.9.1	Design .....	22
3.9.2	Arrangement – Rising or Non-Rising .....	23
3.9.3	Limit Stops.....	23
3.9.4	Spindle Protection Tube.....	23
3.9.5	Spindle Cap.....	23
3.10	<b>Mounting Type</b> .....	23
3.11	<b>Side Wear Strips</b> .....	23
3.12	<b>Pedestals</b> .....	23
3.13	<b>Yoke</b> .....	23
3.14	<b>Door Operator</b> .....	24
3.14.1	General.....	24
3.14.2	Gearbox.....	24
3.15	<b>Permanent Electric Actuators</b> .....	25
3.15.1	General.....	25

<b>3.16</b>	<b>Fasteners .....</b>	<b>25</b>
<b>3.17</b>	<b>Lockout Devices.....</b>	<b>25</b>
<b>4</b>	<b>Performance Tests.....</b>	<b>26</b>
<b>4.1</b>	<b>General.....</b>	<b>26</b>
<b>4.2</b>	<b>Notification of Testing .....</b>	<b>26</b>
<b>4.3</b>	<b>Access to the Place of Manufacture .....</b>	<b>26</b>
<b>4.4</b>	<b>Place of Manufacture other than WA .....</b>	<b>26</b>
<b>4.5</b>	<b>Tests at Manufacturer’s Works.....</b>	<b>26</b>
4.5.1	Weld Examination.....	26
4.5.2	Functional Test (Test 1) .....	26
4.5.3	Hydrostatic Test (Test 2).....	27
4.5.4	Seal Leakage Test (Test 3).....	27
<b>4.6</b>	<b>Site Tests .....</b>	<b>27</b>
4.6.1	Manufacturer’s Certification of Penstock Installation .....	27
4.6.2	Functional Test at Site (Test 4) .....	27
4.6.3	Site Seal Leak Rate Test (Test 5).....	27
<b>4.7</b>	<b>Test Certificates.....</b>	<b>27</b>
<b>5</b>	<b>Marking and Packaging .....</b>	<b>29</b>
<b>5.1</b>	<b>Marking.....</b>	<b>29</b>
5.1.1	Penstock Frame Marking .....	29
5.1.2	Gear Operator Marking .....	29
5.1.3	Electric Actuator Marking.....	29
<b>5.2</b>	<b>Packaging.....</b>	<b>30</b>
5.2.1	General.....	30
5.2.2	Identification Tag.....	30
5.2.3	Marking of Packaging .....	30
<b>6</b>	<b>Manuals.....</b>	<b>31</b>
<b>6.1</b>	<b>Format and Language .....</b>	<b>31</b>
<b>6.2</b>	<b>Installation Instructions .....</b>	<b>31</b>
<b>6.3</b>	<b>Commissioning, and Operation and Maintenance Instructions Content .....</b>	<b>31</b>
<b>7</b>	<b>Spare Parts and Special Tools.....</b>	<b>32</b>
<b>7.1</b>	<b>Spare Parts.....</b>	<b>32</b>
7.1.1	Interchangeability.....	32
7.1.2	Availability.....	32
<b>7.2</b>	<b>Special Tools .....</b>	<b>32</b>
<b>8</b>	<b>Transportation, Handling and Storage .....</b>	<b>33</b>
<b>8.1</b>	<b>General.....</b>	<b>33</b>
<b>8.2</b>	<b>Preservation of Product in Storage .....</b>	<b>33</b>
<b>9</b>	<b>Quality Assurance.....</b>	<b>34</b>
<b>9.1</b>	<b>Certification.....</b>	<b>34</b>
9.1.1	Certification of Product.....	34
9.1.2	Quality System .....	34
9.1.3	Product Re-verification .....	34

<b>9.2</b>	<b>Quality Assurance of Stainless Steel Welding .....</b>	<b>34</b>
9.2.1	Qualification of Welding Procedure .....	34
9.2.2	Qualification of Welding Personnel.....	35
9.2.3	Welding Consumables .....	35
9.2.4	Pre-approval of Welding Procedures .....	35
<b>9.3</b>	<b>Compliance and Acceptance .....</b>	<b>35</b>
9.3.1	Means of Demonstrating Compliance.....	35
9.3.2	Acceptance Criteria.....	36
<b>9.4</b>	<b>Non-compliant Product .....</b>	<b>36</b>
9.4.1	General.....	36
9.4.2	Product Warranty .....	36
9.4.3	Product Repair.....	36
<b>10</b>	<b>Appendix A: Project Specific Requirements (Normative) .....</b>	<b>37</b>
<b>10.1</b>	<b>General.....</b>	<b>37</b>
<b>10.2</b>	<b>Technical Requirements .....</b>	<b>37</b>
<b>11</b>	<b>Appendix B: Technical Compliance Schedules (Normative) Compliance Schedules .....</b>	<b>40</b>
<b>12</b>	<b>Appendix C .....</b>	<b>44</b>
<b>13</b>	<b>Appendix D .....</b>	<b>45</b>
<b>14</b>	<b>Appendix E .....</b>	<b>46</b>

## **1.0 Scope and General**

### **1.1 Scope**

This Specification sets out requirements for the manufacture, supply, handling and delivery of stainless steel wall and channel (embedded) mounted penstocks for waterworks purposes. The penstocks may be used as the primary means of isolation of liquids for confined space entry and therefore have critical health and safety implications which are reflected in the stringent certification, performance and test requirements of this document. The specification covers:

- (a) Rising and non-rising spindles;
- (b) On-seating or off-seating sealing;
- (c) Rectangular and square apertures in sizes from 300 to 2000 mm;
- (d) Applications requiring top sealing and with a maximum static head of up to 10 m from penstock invert to top water level;
- (e) Applications involving channel installations where top sealing is not required.

This Specification additionally includes:

- (a) Requirements for manufacturer certification of installation;
- (b) Means by which compliance with the Specification shall be demonstrated and the criteria for acceptance.

Penstocks shall be in a new unused condition.

### **1.2 Referenced Documents**

The Specification refers to the following standards.

#### **AS**

- 1111.1 ISO metric hexagon nuts – Product grade C – Bolts
- 1112.3 ISO metric hexagon nuts – Product grade C
- 1275 Metric screw threads for fasteners
- 1359.101 Rotating electrical machines – General requirements – Rating and performance
  
- 1565 Copper and copper alloys – Ingots and castings
- 1627.1 Metal finishing – Preparation and pre-treatment of surfaces - Removal of oil, grease and related contamination
- 1646 Elastomeric seals for waterworks purposes
- 1830 Grey cast iron
- 2205.10.1 Method for destructive testing of welds in metal – Corrosion test for welded austenitic stainless steel
- 2317 Collared eyebolts
- 2345 Dezincification resistance of copper alloys
- 2369.2 Materials for solar collectors for swimming pool heating – Flexible or plasticized polyvinyl chloride
- 2550.1 Cranes, hoists and winches – Safe use - General
- 2550.3 Cranes, hoists and winches – Safe use – Bridge, gantry, portal (including container cranes), jib and monorail cranes

- 2550.5 Cranes, hoists and winches – Safe use - Mobile
- 2550.11 Cranes, hoists and winches – Safe use – Vehicle loading cranes
- 2938 Gears – Spur and helical – Guide to specification and rating
- 4100 Steel Structures
- 4797 Stainless Steel Chain for Lifting Purposes
- 60529 Degrees of protection provided by enclosures (IP Code)

**AS/NZS**

- 1554.6 Structural steel welding – Welding stainless steels for structural purposes
- 4020 Testing of products for use in contact with drinking water

**AS/NZS ISO**

- 9001 Quality management systems – requirements

**ASTM**

- A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
- A276 Standard specification for stainless steel bars and shapes
- A312M Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A380 Standard practice for cleaning, descaling, and passivation of stainless steel parts, equipment, and systems

**BS**

- BS 7775:2005 Penstocks for use in Water and other liquid flow applications – Specifications

**DIN**

- 5687-1 Rounded Steel Link Chains Part 1: Grade 5. Medium Tolerance Tested
- 5688-1 Grade 5 Chain Slings with hook or ring type terminal fittings

**IEC**

- 60085 Electrical insulation – Thermal evaluation and designation

**ISO/IEC**

- 17025 General requirements for the competence of testing and calibration laboratories

**SAA Guides**

- HB 18 Guidelines for third-party certification and accreditation
- HB 18.2 Guide 2-General terms and their definitions concerning standardization and related activities
- HB 18.22 Guide 22-Information on manufacturer’s declaration of conformity with standards and other technical specifications
- HB 18.23 Guide 23-Methods of indicating conformity with standards for third-party certification systems
- HB 18.28 Guide 28-General rules for model third-party certification system for products
- MP 52 Authorisation procedures for plumbing and drainage products

## Corporation Technical Specifications

DS95	Standard for the selection, preparation, application, inspection and testing of protective coatings on Water Corporations assets
A1	Surface Preparation for the application of protective coatings on Steel and/or Cast Iron
C2	Zinc rich epoxy primer, epoxy mastic coat, polyurethane top coat on Steel or Cast Iron
WS-1	Metal arc welding

## 1.3 Definitions and Notation

### 1.3.1 Aperture

The opening in the penstock formed by the frame and door through which the liquid passes. The aperture size is designated as the width dimension followed by the height dimension.

### 1.3.2 Certificate

A formal certificate defined in SAA HB 18.2 and operated in accordance with SAA HB 18.22 that, as an outcome of Product Certification, attests Product conformity with the nominated product and test standards and authorizes the use of a Certification Mark.

### 1.3.3 Certification Body

An independent (or third party) organization duly accredited by the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) to operate Certification Schemes.

In the case of a non-strategic plumbing Product, a Certification Body means an organization approved by Standards Australia to administer the National Certification of Plumbing and Drainage Products (NCPDP) Scheme in accordance with SAA MP 52.

### 1.3.4 Certification Mark

A trademark or other mark of product conformity with a specified standard defined in SAA HB 18.2 and applied in accordance with SAA HB 18.23 that is issued under the rules of a Certification Scheme.

### 1.3.5 Certification Scheme

A product certification program or system which is operated in accordance with JAS-ANZ Procedure 15 – General requirements for bodies operating product certification systems and in accordance with the general rules of SAA HB 18.28 and System No. 5 as defined in ISO/ITC publication - Certification - Principles and practice. In the case of a non-strategic plumbing Product, a Certification Scheme means the NCPDP Scheme.

**NOTE:** The effect of this is to require maintenance by the manufacturer of effective production control planning in addition to full type testing from independently sampled production and subsequent verification of conformity with specified standards.

### 1.3.6 Classification of Penstocks

Penstocks shall be classified on the basis of:

- (a) Aperture shape and size; and
- (b) Type of mounting, seating arrangement and spindle.

### **1.3.7 Compliant Product**

Product that has been assessed, by means of Product Appraisal, as conforming to standards and specifications that are nominated by the Corporation.

### **1.3.8 Corporation**

The Water Corporation of Western Australia.

### **1.3.9 Door**

A sliding door retained within a frame that isolates the liquid when in the fully closed position. Also may be referred to as gate.

### **1.3.10 Frame**

A fabrication that retains and guides the door and fixes the penstock to the structure.

### **1.3.11 Leakage**

Liquid that passes between the door and frame when the door is fully closed.

### **1.3.12 Manufacturer**

An entity or combination of entities that are responsible for selection, processing and control of Product constituent materials or compounds and for the processing equipment that collectively result in the manufactured product.

### **1.3.13 Maximum Static Head**

The maximum possible differential head to which the penstock can be subject in service, expressed in metres of water. In most Corporation applications this is equal to the vertical distance from the bottom of the penstock to the overflow level of the upstream tank, channel or pipe.

### **1.3.14 Nominal Size**

An alphanumeric designation of size for components of a pipe work system, which is used for reference purposes. It comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections.

### **1.3.15 Non-Rising Spindle**

A configuration where the spindle does not rise with movement of the door. Rotation of the threaded spindle in a door mounted spindle nut moves the door up or down its length.

### **1.3.16 Notation**

Statements expressed by use of the word 'shall' are mandatory or 'normative' requirements of the Specification. Statements expressed by use of the words 'should' or 'may' are 'informative' but not mandatory and are provided only for information and guidance. Notes in Specification text are informative. Notes that form part of Specification Tables are normative. An Appendix to the Specification that is designated 'normative' contains mandatory requirements. An Appendix that is designated 'informative' is provided for information and guidance only. The term 'specified' includes requirements of the Specification and requirements stated or referenced in other project documentation.

### **1.3.17 Officer**

A duly authorised representative or appointed agent of the Corporation.

### **1.3.18 Off-Seating**

Off-seating refers to penstock design where the pressure forces the door away from the frame.

### **1.3.19 On-Seating**

On-seating refers to a penstock design where pressure forces the door onto the frame.

### **1.3.20 Penstock**

A valve comprising a single-faced sliding door and guide frame secured to a structure that controls the flow or level of liquid.

### **1.3.21 Product**

A single unit or multiple units of manufactured end product or an assembly of manufactured component products, materials or equipment. This Specification and accompanying Purchasing Schedule define the nature and details of Product to be supplied. In this Specification the Product shall refer to a penstock or penstocks.

**NOTES:**

1. An end product is most commonly an output of manufacturing processes that result in finished end products having the same features and characteristics and can be the result of a single or multiple production batches.
2. Manufactured equipment and assemblies of Product components or materials are commonly procured for mechanical, electrical and civil infrastructure applications.

### **1.3.22 Product Appraisal**

A formal process whereby Product, including product design, is subjected to systematic engineering assessment to determine Product fitness for prescribed end uses and to evaluate the extent of Product and production systems conformity with nominated standards and specifications. Product Appraisal includes verification of the extent of compliance in accordance with the requirements of a relevant 'Technical Compliance Schedule' Appendix.

### **1.3.23 Product Assessor**

An organization, Officer or other person who, having demonstrated specialist product knowledge and competence acceptable to the Corporation, is nominated by the Corporation, subjects Product to Product Appraisal and issues one or more Product Verification Reports.

### **1.3.24 Product Certification**

A formal process whereby the production and management systems for the manufacture of Product, are assessed by a Certification Body to evaluate compliance of these systems with prescribed product standards and tests, under Certification Scheme rules.

### **1.3.25 Product Verification Report**

A formal report wherein a Product Assessor evaluates the extent of Product compliance with the nominated product standards and specifications.

**NOTE:** Verification may be on a project-by-project basis or at agreed intervals, as appropriate to the scope of a Purchasing Schedule and Product end use, subject to determination by the Corporation.

### **1.3.26 Product Warranty**

A formal express undertaking by a Supplier or Manufacturer that Product is:

- (a) In conformity with the nominated product specification and referenced standards;
- (b) Fit for the nominated Product end use or application;
- (c) Designed for sustained operation at the nominated service performance levels for the specified design life;
- (d) Adequately packaged for intended transportation, handling and storage conditions;
- (e) Supported by English language installation, operating and servicing instructions;
- (f) Adequately supported by Supplier capacity to provide technical Product support.

**NOTE:** Where required, a Product Warranty should indemnify the Corporation against claims made or losses suffered as a result of breach of the Warranty by means of Public and Products Liability Insurances as specified in the undertaking.

### 1.3.27 Purchasing Schedule

A Corporation purchase order, tender, schedule of prices, bill of quantities, or specification that details the nature, quantity and other characteristics of Product to be supplied, purchased or installed.

**NOTE:** Table 10.1 of this Specification contains information relating to the Purchasing Schedule.

### 1.3.28 Quality System

A management system that establishes, documents, implements and maintains organizational structures, resources, responsibilities, processes and procedures for the manufacture of Product and provision of Product related services in accordance with the requirements of AS/NZS ISO 9001.

### 1.3.29 Radius of Gyration $R_g$ (Spindle)

The distribution of the Cross sectional area of the spindle around its centroidal axis defined by  $R_g = (I/A)^{0.5}$ . Where 'I' is the second moment of area ( $\pi.r^4/2$ ) and 'A' is the area ( $\pi.r^2$ ) of the spindle section radius 'r'. For threaded sections 'r' shall be half the root diameter of the thread.

### 1.3.30 Rising Spindle

A configuration whereby the spindle rises or descends with movement of the door. Rotation of the spindle operating nut, located in the equipment operator, raises or lowers the spindle to which the door is connected.

### 1.3.31 Slenderness Ratio $\lambda$ (Spindle)

The ratio obtained by dividing the unsupported length of the spindle by the *Radius of Gyration* of spindle cross section  $\lambda = L/R_g$ .

### 1.3.32 Strategic Product

An essential product whose performance is critical in eliminating risk to the safe and effective provision of water services, which are functions of the Corporation under the Water Corporation Act as licensed under the Water Services Coordination Act.

**NOTES:**

- 1 Strategic product is most commonly an element of permanent Corporation infrastructure. Ancillary operational and safety equipment, not intended to form part of this infrastructure, may be considered strategic by virtue of enhanced operational performance or personnel safety.
- 2 Plumbing products (end-of-line water service fittings DN 32 or smaller) used in strategic services may, by virtue of statutory and regulatory requirements, be considered strategic in Corporation applications.

### 1.3.33 Supplier

An entity or combination of entities that is responsible for the supply of Product.

**NOTE:** A Supplier may be a Product manufacturer, owner, producer, distributor or vendor or an agent, tenderer or contractor for supply of Product or Product related service.

### 1.3.34 Testing

The determination of Product characteristics by inspection and by the application of specified test procedures.

### 1.3.35 UHMWPE

Ultra-High Molecular Weight Polyethylene

### **1.3.36 WSAA**

The Water Services Association of Australia of which the Water Corporation is a corporate member.

### **1.3.37 Yoke**

Integral or separate cross member at the top the frame sides and/or door guides of a penstock may also be referred to as headframe or headstock.

## **1.4 Designation of Size**

Penstock size shall be as specified in the Purchasing Schedule (Table 10.1).

## 2 Materials and Components

### 2.1 General

Penstocks shall be constructed from the materials detailed in Table 2.1 below. The stated material grades represent the **basic or minimum** requirements, and materials of equivalent or superior quality may be acceptable subject to being authorized for use by the Corporation.

Penstocks shall comply with the relevant minimum requirements of Table 2.1 below.

**Table 2.1 – Penstock Basic Material Requirements**

Component	Material <sup>1</sup>	Standard	Grade
Side frame, Yoke, door and guides	Stainless steel	ASTM A240M	316, 316L
Spindle, spindle couplings & spindle guides	Stainless steel	ASTM A276	316
Spindle pedestal	Stainless steel	ASTM A276	316, 316L
Spindle nut	Gunmetal	AS 1565	C83600 <sup>2</sup>
	Aluminium bronze	AS 1565	C95810
Spindle protection tube	Stainless steel	ASTM A312M	316
	Polycarbonate	-	-
Door guide wear strips	UHMWPE	-	-
Door seal	Elastomer	AS 1646	EPDM <sup>3</sup> , NBR
		AS 2369.2	Plasticized PVC
	UHMWPE	-	-
Bottom seal	Polyurethane	-	-
	Elastomer	AS 1646	EPDM <sup>3</sup> , NBR, Neoprene
		AS 2369.2	Plasticized PVC
Spindle Guide Bushing	UHMWPE	-	-
Spindle column guide and support	Polypropylene	-	-
Fasteners	Stainless steel	ASTM A276	431, 316
Hand wheel	Cast iron with coating as per AS 4158	AS 1830	ISO 185/JL/250
	Stainless steel	ASTM A312M	316

**NOTES:**

1. Excludes penstocks for seawater service for which materials and corrosion mitigation methods shall be specified in the project specific requirements of the parent document.
2. Not to be used in un-vented sewage applications due to presence of hydrogen sulphide.
3. EPDM seals shall be used only for water application

### 2.2 Non-metallic Materials

Non-metallic materials used in the components of the Product shall be fit for the intended purpose and shall exhibit dimensional stability when exposed to weather, sunlight and where relevant after extended periods of immersion.

## **2.3 Dezincification-resistant Materials**

Copper alloy components subject to immersion shall be dezincification resistant complying with AS 2345.

## **2.4 Contamination of Water**

All penstocks intended for contact with raw, drinking and recycled water shall comply with AS/NZS 4020. A scaling factor of 0.01 shall be applied.

## **2.5 Seals**

Seals shall be manufactured from an elastomeric material that is not injuriously affected by the fluid, temperature or environmental conditions to which the seals will be subjected to in service. Seals shall comply with relevant Australian Standards as per Table 2.1.

## **3 Design and Manufacture**

### **3.1 General**

Penstocks shall be designed for:

- (a) The safe isolation of flow for personnel entering a ‘confined space’ where the potential for engulfment may exist.
- (b) Isolation or flow control of either water or wastewater, as specified in the Purchasing Schedule (Table 10.1). For wastewater, atmospheric hydrogen sulphide may be present.
- (c) Use in channels, access chambers and tanks.
- (d) Continuous and stable operation in the fully open, fully closed or partially open positions.
- (e) Operation under maximum on-seating/off-seating static head specified in the Purchasing Schedule (Table 10.1).
- (f) Installation with the spindle in the vertical position.
- (g) Installation and operation without undue flexing or distortion.
- (h) A minimum life expectancy of 50 years for all structural components excluding seals, 25 years for all mechanical and electrical equipment (Gearboxes and Actuators) and 15 years for all instrumentation.
- (i) Uni-directional or bi-directional isolation under maximum static head as specified in the Purchasing Schedule (Table 10.1).

### **3.2 Drawings**

#### **3.2.1 Drawings - Installation**

Details drawings of the proposed penstock arrangement and accommodating structure should be provided by the Corporation to the supplier, in both hard copy and digital format. These drawings should show the intended arrangement for mounting the penstock and include dimensions, structural and technical details of concrete, reinforcement, plastic lining, etc., within or upon which the penstock and accessories are to be installed. Drawings will be provided in both hard copy and digital format.

The supplier shall revise these drawings, showing details of the penstock and any required accessories, supports, fixtures, etc., and submit to the Corporation for review and comment. Final drawings, revised to incorporate any comments, shall be provided as Revision A (for construction).

#### **3.2.2 Drawings - Fabrication**

The supplier shall submit to the Corporation, dimensioned penstock assembly and fabrication drawings - showing details of all components, seals, welds and materials (standard and grade). The drawings will be reviewed/commented by the Corporation. Final accepted drawings, revised to incorporate any comments, shall be provided as Revision A (‘for construction’).

#### **3.2.3 Drawings – As Constructed**

Upon completion of works, the supplier shall provide final ‘As constructed’ drawings for both Installation and Fabrication, incorporating any changes that were made during the installation process.

### 3.3 Aperture Dimensions and Tolerances

#### 3.3.1 Dimensions

Penstocks shall be manufactured in either a rectangular or square configuration with an aperture width and aperture height ranging from 300 mm to 2000 mm.

For rectangular shaped apertures, the Height to Width ratio shall be greater than 0.6 for single spindle operation. If the height to width ratio is less than 0.6, the penstock shall be designed for operation with twin spindles.

#### 3.3.2 Tolerances

The tolerances for penstock aperture dimensions shall be as shown in Table 3.1.

**Table 3.1 – Penstock Aperture Tolerances**

Aperture width and height - mm	Tolerance - mm
Width 500 and height $\leq$ 500	$\pm$ 3.0
Width or height $>$ 500	$\pm$ 5.0

### 3.4 Frame

The frame design shall:

- (a) Withstand the maximum static head specified with a minimum safety factor of 2.5 with regard to tensile, compressive and shear strength.
- (b) Ensure any frame member shall not deflect more than  $L/500$  under maximum design load.
- (c) Comprise either the wall-mounted or embedded type (flush bottom type). Wall mounted frames shall be sealed against the wall using a compressed elastomeric sealing system, appropriate to the environment. Grout shall only be used against unlined concrete wall surfaces and in non-corrosive environments.
- (d) Incorporate a guide rail to facilitate sliding of the door over the length of its operating travel. Guide rail length shall extend to engage at least one-half of the door height in the fully open position. The guide rail shall be designed for self-cleaning with minimal clogging.
- (e) Provide guides for self-contained doors that shall adequately support the yoke and resist all operating loads with minimum factor of safety of 2.5 with regard to tensile, compressive and shear yield strength.
- (f) Provide a means of fixing the penstock to a structure, whilst maintaining free movement of the door vertically between the open and closed positions.
- (g) Provide a sufficient number of fasteners to prevent movement under the specified operating conditions. (Refer also to Clause 3.16).
- (h) Ensure that all side frames and structural components (except seal retainers) shall have a minimum thickness of 6 mm.
- (i) Where seals are attached to the frame allow replacement of all seals without removing the frame from the supporting structure (Optional if specified in the purchasing schedule).

### 3.5 Door

The door shall be designed:

- (a) With a minimum safety factor of 2.5 with regard to tensile, compressive and shear yield strength to withstand the maximum static head and operating forces.
- (b) Ensure that maximum deflection of door assembly, under maximum static head, shall not exceed  $L/500$  across the face most likely to deform.
- (c) To clear the flow in the fully open position.
- (d) With lifting attachments and a provision (chain) for emergency lifting where required (Clause 3.6).
- (e) For easy removal for maintenance purpose.
- (f) From stainless steel flat plate, reinforced with formed plates or structural members.
- (g) Utilising a minimum thickness of 6 mm for all members except seal retainers.

## 3.6 Lifting Attachments and Chain

If the penstock has to be handled as an assembly it shall be provided with a means for safe lifting during its transportation, handling and installation. The penstock door shall also be provided with a means of lifting it out of the frame for maintenance purposes. Where eyebolts are provided they shall comply with AS 2317.

Where the penstock is critical to operations (e.g. a single flow path to a treatment plant or wastewater pump station) and the door is not readily accessible in the closed position, a suitably rated chain shall be attached to the door to enable emergency lifting of the door by a crane. The chain and fittings shall extend to an accessible level and comply with the following.

### 3.6.1 Chain

Where required in the Purchasing Schedule (Table 10.1) the supplier shall supply a nominated length of stainless steel lifting chain including termination fittings. The chain shall have Working Load Limit in excess of 2.5 times maximum lifting force required for opening the gate under maximum static pressure. The chain and fittings shall be assembled by a suitably experienced person (i.e. licensed dogman).

Lifting chain shall comply with either AS4797 or with DIN 5687- Grade 50.

### 3.6.2 Fittings

Termination fittings installed on the chain shall be Stainless Steel 316 L Grade 50 in accordance with DIN 5688. All fittings shall have working load limit (WLL) in excess of 2.5 times the maximum lifting force required for opening the penstock, under maximum differential pressure and shall comply with ASTM A276. The upper terminal fitting shall comprise of a master link suitable for lifting hook entry. The lower terminal fitting shall comprise of a master link and suitably sized shackle for connection to the penstock lifting point. Connection to the master link shall be via a clevis shackle or connection link (i.e. Hammerlock).

NOTE: Stainless steel chains and fittings which comply with the above requirements are available from Bullivants (Welshpool) and other specialist suppliers

## 3.7 Fabrication and Welding of Stainless Steels

### 3.7.1 General

Fabrication and welding of the penstock shall comply with the following:

- (a) Welding quality, procedures, prequalification, inspection and testing, and consumables shall comply with Corporation Technical Specification WS-1.
- (b) All welded joints shall be continuous and shall be conducted in accordance with Corporation Technical Specification WS-1, AS/NZS 1554.6 category 1B, with class II (a) surface finish and shall be capable of meeting the requirements of the inter-granular corrosion test specified in AS 2205.10.1. Non continuous weld joints are not acceptable as

they may cause crevice corrosion. Welding shall be employed to remove all crevices and openings which permit entry and retention of biological materials.

- (c) All fabrication of stainless steel items shall be carried out in a manner which will avoid surface contamination by other materials e.g. carbon steel. All cutting discs and other tools used shall be dedicated for use on stainless steel. Wire brushes shall be stainless steel type.
- (d) After fabrication, all stainless steel surfaces shall be electro-polished or pickled and passivated with nitric and hydrofluoric acid in accordance with ASTM A380 to remove oxides, heat discolouration and any contamination from manufacturing processes.

## 3.8 Seals

Sealing of the door and frame shall be provided as follows:

- (a) At the top (where applicable), sides and bottom of the door.
- (b) Embedded (flush) bottom closing designs shall incorporate a continuous resilient seal which shall be positively secured at the frame invert. The bottom seal shall be designed so as to eliminate grit traps.
- (c) Seals shall allow for full channel flow and shall be either:
  - i. Resilient, providing continuous contact between the frame and wear strips; or
  - ii. Where UHMWPE is the seal material, the design shall incorporate a compression chord or alternate means of providing a spring force driving the seal onto the gate, to ensure efficacy of the seal and to compensate for wear.
- (d) The seal arrangement shall be either Option A, Option B or Option C as specified in the Purchasing Schedule (Table 10.1) and described as follows:
  - i. Option A – All seals, including bottom seal, are attached to the door and are replaceable in-situ, from an accessible surface or ground level (preferred where safe access of the penstock for seal replacement is impractical).
  - ii. Option B – All seals are attached to the frame and replaceable without removing the frame from the structure (access/shutdown/bypass required).
  - iii. Option C – Embedded (flush) bottom seal, all other seals are attached to the door and replaceable from an accessible surface or ground level.
- (e) Where the top water level is above the top frame full sealing shall be provided between the top of the door, frame and the wall.
- (f) Seal system shall ensure that the leakage requirements specified in Section 4.6.3 are met.

## 3.9 Spindle, Nut, Cap and Spindle Guides

### 3.9.1 Design

The spindle, spindle nut and guides design shall:

- (a) Be based on utilising solid stainless steel bar for the spindle and couplings.
- (b) Provide a minimum factor of safety of 1.5 with regard to tensile, compressive and shear yield strength when the door is subjected to the greater of:
  - i. 2 Times the maximum computed breakaway torque at the maximum static head or,
  - ii. 320N total (push and pull) rim full force applied to the hand-wheel or
  - iii. 1.25 times the output torque of an electric actuator in the stalled condition
- (c) Withstand buckling and distortion during normal operation of the penstock door.
- (d) Have a geometrical slenderness ratio  $\lambda$  less than 200 (for the spindle).

- (e) Utilise an ACME / trapezoidal type single start thread which shall be machined to a smooth finish on the bearing surfaces e.g. no chattering or roughness.
- (f) Incorporate a spindle guide and bushing as required to prevent buckling. Guides shall be adjustable and spaced in accordance with the required Slenderness Ratio  $\lambda$ .
- (g) Utilise materials and quality of thread finishes that will avoid galling of all spindle components.
- (h) Incorporate a grease lubrication point except where the spindle nut is of the self-lubricating type.
- (i) Non-rising spindle drive nuts shall be located above the normal operating levels of the operating medium.

### 3.9.2 Arrangement – Rising or Non-Rising

The Penstock shall be either Rising (with a headstock) or Non-Rising spindle design as specified in the Purchasing Schedule (Table 10.1) and illustrated in Appendix E.

**Note:** A Rising Spindle arrangement is preferred and has the advantage of keeping the drive mechanism and spindle nut out of the fluid and accessible for maintenance. However public safety, aesthetic impact, and potential for vandalism generally require a secure site, with no public access, to accommodate a rising spindle/headstock arrangement.

### 3.9.3 Limit Stops

Penstocks which are manually operated with rising spindles shall be fitted with adjustable limit stops to prevent over-travel of the door in either direction.

### 3.9.4 Spindle Protection Tube

A spindle protection tube shall be provided for all rising spindle applications. The tube shall be rigid to prevent oscillations due to wind effects. The material shall be either clear polycarbonate or stainless steel as specified in the Purchasing Schedule (Table 10.1). The tube shall incorporate a position indicator which shall indicate the position of the gate.

### 3.9.5 Spindle Cap

Spindles which terminate below ground, slab or platform level and are designed for manual operation from above shall be fitted with an industry standard Spindle Cap suitable for use with a Tee Key. The spindle cap shall have the dimensions specified in Appendix C and be capable of accommodating the locking device shown in Appendix D

## 3.10 Mounting Type

Penstocks shall be of the wall-mounted or embedded type for mounting in or on structures respectively as specified in the Purchasing Schedule (Table 10.1).

## 3.11 Side Wear Strips

Penstock guides shall be fitted with replaceable wear strips of an UHMWPE, low friction, and wear-resistant polymer.

## 3.12 Pedestals

- (a) Pedestals for mounting of geared or electric actuators shall be fitted with gas tight seals where H<sub>2</sub>S is present to minimise risk of damage to the spindle nut.
- (b) Pedestals shall be designed to withstand all loads from the actuator during operation

## 3.13 Yoke

Self-contained doors shall be provided with a yoke made of structural members or formed plates. The yoke shall be designed to withstand the thrust of the actuator for maximum static head

conditions with a minimum factor of safety of 2.5 with regard to tensile, compressive and shear yield strength.

The actuator mounting and guide contact surfaces shall be accurately formed to ensure proper spindle alignment. The maximum deflection of the yoke shall be  $L/500$  at maximum operating load.

The yoke shall be designed to allow removal of the door from the frame.

## 3.14 Door Operator

### 3.14.1 General

Door lifting shall be via a manual operator (handwheel, or for below ground – spindle cap and Tee Key with or without gearbox) or an electric actuator as specified in the Purchasing Schedule (Table 10.1). Hand wheel orientation shall be specified where applicable.

The hand wheel of any operator shall be located between 900 mm and 1200 mm above the operating floor level. Handwheel diameter shall not exceed 600mm.

The hand wheel or manual gear operator shall:

- (a) Close the penstock when the hand wheel or input shaft of the gear operator is rotated anti-clockwise.
- (b) Be designed such that the maximum (push/pull) rim pull force on the operator handwheel shall not exceed 160N during running operation, or 240N maximum (breakaway) of the door under maximum static head conditions.
- (c) Be self-locking with the penstock in any position.
- (d) Where  $>100$  turns are required, and an actuator is not required, be suitable for operation by using a portable power actuator applied to the end of the input shaft.

**NOTE:** Where pneumatic, electric or hydraulic actuators are to be used on penstocks covered by this Specification, they should be sized to deliver a torque no greater than 20% above the maximum torque required to operate the penstock as specified above.

### 3.14.2 Gearbox

Where gearing is required to meet operator input requirements, it shall be capable of accommodating the maximum thrust and torque as required by Section 3.9.1(b). The manual gearbox operator shall comply with the following:

- (a) Manual gearbox actuators shall be constructed to an equivalent of an enclosure rated to IP 67 as specified in AS 6052.
- (b) Design of the gears and gearbox components shall be in accordance with AS 2938. Gearboxes shall be grease lubricated and incorporate seals on the input and output shafts to prevent the ingress of water and foreign matter.
- (c) All cast or ductile iron components shall be prepared for external coating in accordance Water Corporation Technical Specifications A1 Surface Preparation for the Application of Protective Coatings on Steel and Cast Iron and C2- Zinc Rich Epoxy Primer, Epoxy Mastic Coat, Polyurethane Top Coat on Steel and Cast Iron.
- (d) Where provision is required (refer Clause 3.14.1 (d)) - be suitable for use with either a portable electric or hydraulic actuator for penstock operation.
- (e) Where required by the Purchasing Schedule (Table 10.1), be supplied with a portable actuator.
- (f) Where required by the Purchasing Schedule (Table 10.1), be supplied with a hand-wheel, either fitted to or suitable for mounting on the input shaft (supplied loose).

## 3.15 Permanent Electric Actuators

### 3.15.1 General

Where specified in the Purchasing Schedule (Table 10.1) as electrically actuated, the penstock shall have an electric actuator fitted in accordance with the following:

- (a) The electric actuator shall comply with DS26-41 Type specification for an Electric Actuator for waterworks valve.
- (b) Designer shall complete the Annexure to DS26-41 Type Specification for Electric Actuator for Waterworks Valve (Pages 24 to 26 both inclusive). Pages 27 and 28 of DS26-41 shall be completed by the designer if the actuator is supplied by the principal. If the actuator is to be supplied by the penstock supplier, then pages 27 and 28 of DS26-41 shall be completed by the penstock supplier.
- (c) The electric actuator shall open and close the penstock door at the speed specified in the Purchasing Schedule (Table 10.1). The opening and closing times of the penstock shall be equal and adjustable.
- (d) The actuator shall be capable of providing 133% of the maximum (breakaway) torque requirements of the penstock, when opening or closing against the maximum static head.

## 3.16 Fasteners

Fasteners threads shall comply with AS 1275. Bolts and screws shall comply with the dimensions contained in AS 1111.1 and nuts to AS 1112.3. Bolts and studs shall be sized so that a minimum of one and a half threads shall protrude and thread protrusion shall not exceed one bolt diameter.

All fasteners shall be corrosion resistant and shall comply with the minimum material requirements of Table 2.1. Fasteners shall embody non-galling characteristics.

Fasteners that are critical to the long term safety of the penstock (e.g. frame mounting bolts) shall have a minimum factor of safety of 2.5 with regards to yield stress.

## 3.17 Lockout Devices

Valves shall be either fitted with lockout devices to enable their secure isolation, or be capable of accommodating them, as specified in the following:

- (a) Spindle cap operators shall accommodate the Corporation's valve locking device in accordance with Drawing No EG20-11-2 attached at Appendix D. The bottom plate of the locking device shall be capable of either being fitted under the spindle cap or alternatively locate into a groove in the body of the spindle cap. Other methods of accommodating the Corporation's valve locking device may be acceptable subject to approval by the Corporation.
- (b) Handwheels shall be fitted with provision for locking with a padlock.
- (c) Where the valve is electrically actuated, it shall incorporate lockable lockout devices in accordance with DS26-41.

## 4 Performance Tests

### 4.1 General

Product shall be tested in accordance with the test requirements of this Specification. Testing shall be deemed acceptable when test outcomes have been formally verified by a Certification Body or witnessed by a testing Officer. Product for which a test requirement has not been met shall be classified as non-compliant Product.

**NOTES:**

1. Testing should be carried out by an organisation accredited by NATA or in accordance with ISO/IEC 17025.
2. A testing Officer should normally be an Officer who has specialist knowledge of or training in product or materials testing appropriate to the Product characteristics to be tested.

### 4.2 Notification of Testing

The Corporation shall be notified in writing of each formal test proposal at least seven (7) days prior to the preparation of Product for testing except where a specified test has been the subject of a current valid Certificate issued by a Certification Body. This notification is required to enable the Corporation to make all necessary arrangements including appointment of a testing Officer in a timely manner.

### 4.3 Access to the Place of Manufacture

The testing Officer shall be afforded access, at all reasonable times, to all places of manufacture of Product or product components and shall be authorised to arrange or undertake such testing there as the Corporation deems appropriate to the testing regime specified.

### 4.4 Place of Manufacture other than WA

Where any Product or product component is being manufactured other than in Western Australia the Corporation may appoint a local inspecting Officer to undertake inspections and witnessed testing as required. The testing Officer shall be provided with all due authority and permits required to carry out testing at the place of manufacture.

**NOTE:** The cost of witnessed testing arranged by the Corporation will normally be borne by the Corporation unless otherwise negotiated.

### 4.5 Tests at Manufacturer's Works

The penstock shall be tested at the Manufacturers works in accordance with Clauses 4.5.1 to 4.5.4 (inclusive). Where the Contractor is not exempted by full Quality Assurance Certification, the Officer shall be present during testing.

#### 4.5.1 Weld Examination

All butt welded connections in penstocks shall be 10% radiographically tested whilst all fillet welds shall be 10% Dye Penetrant tested in accordance with the applicable standards per AS 1554.6.

#### 4.5.2 Functional Test (Test 1)

The operation of the penstock shall be tested in accordance with the following:

- (a) Mount the penstock vertically, preferably in a flooded channel (or alternatively with water sprayed onto the seals and guides).
- (b) With the door in the closed position, operate it over its full travel (to the fully open position) and return back to closed position.
- (c) Repeat 5 times.

The door shall operate freely and smoothly in the frame and shall remain stable throughout its travel without flutter, rattling or oscillation.

### 4.5.3 Hydrostatic Test (Test 2)

Where required in the Purchasing Schedule (Table 10.1) (generally for Penstocks with a gate area  $>0.5\text{m}^2$ ) the penstock shall be mounted in the factory to a suitable bulkhead and subjected to a hydrostatic test head of 1.5 x the maximum static head specified for a period of 10 minutes. Hydrostatic testing of “undershot” penstocks shall be performed at the maximum static head only.

Upon completion of the test, measurements shall be undertaken to demonstrate that no plastic deformation of the penstock’s structural components has occurred. Excessive leakage through the door seals shall not be a cause for failure of the test.

### 4.5.4 Seal Leakage Test (Test 3)

Penstocks shall be subjected to a seal leakage test, performed at the maximum static head as specified in the Purchasing Schedule (Table 10.1) for a minimum period of 5 minutes. The leakage between the door and frame shall not exceed 0.3 l/minute per metre of seat perimeter. Leakage rates in excess of this shall constitute a failure of the test requiring the defect to be rectified by the Manufacturer.

#### Notes

1. The testing of the penstock under off-seating configuration is acceptable for on-seating penstocks where facilities are not available for testing under on-seating conditions.
2. The manufacturer may provide a Finite Element Analysis equivalent stress and deflection model, demonstrating that the penstock design meets the nominated deflection requirements and safety factors as an alternative to tests specified under sections 4.5.3 and 4.5.4.

## 4.6 Site Tests

### 4.6.1 Manufacturer’s Certification of Penstock Installation

The Manufacturer shall be responsible for ensuring the installation of the penstock has been conducted in accordance with its requirements and undertaking site tests to demonstrate performance. Prior to the site tests the Manufacturer shall provide written certification that the penstock has been set, aligned and installed correctly onto the structure, and that the frame or door or other components are not subject to misalignment, distortion or twisting.

Site Tests 4 & 5 shall be conducted under the supervision of the manufacturer or his authorised representative.

### 4.6.2 Functional Test at Site (Test 4)

After completions of installation of the penstock the functional test (Test 1) shall be repeated under maximum static head conditions. The door shall operate freely and smoothly in the frame and shall remain stable throughout its travel without flutter, rattling or oscillation. The door operator shall perform correctly within the rim pull force limit specified in Clause 3.14.1 (b).

### 4.6.3 Site Seal Leak Rate Test (Test 5)

The seal leakage test (Test 3) shall be repeated on site under maximum static head conditions. The only leakage shall be through the seal. Seal leakage rates in excess of 0.3 L/minute per metre of seat perimeter shall constitute a failure of the test requiring the defect to be rectified by the Manufacturer.

## 4.7 Test Certificates

Test certificates shall be provided for the tests conducted both at the Manufacturer’s works and at site. For the purposes of acceptance, each test certificate shall, as a minimum, bear the relevant Product item serial number. Test Certificates shall certify that:

- (a) The Product item has complied with all the specified functional, hydrostatic and seal leakage test requirements,
- (b) The installation has complied with the Manufacturer's requirements.

A set of test certificates shall be supplied with each penstock.

## 5 Marking and Packaging

Each Penstock shall be marked and packaged in accordance with the following.

### 5.1 Marking

#### 5.1.1 Penstock Frame Marking

Each penstock shall have the following information provided on a nameplate permanently located where it can be readily viewed after installation:

- (a) Manufacturer's name or mark.
- (b) Model number.
- (c) Serial number.
- (d) Aperture dimensions (width x height).
- (e) A direction of flow arrow if penstock is unidirectional.
- (f) Maximum input operating torque - Nm.
- (g) Year of manufacture.
- (h) Maximum static head - m.

#### 5.1.2 Gear Operator Marking

The manual gear operator shall have the following markings:

- (a) Manufacturer's name or mark.
- (b) Model series number.
- (c) Year of manufacture.
- (d) Gear ratio.
- (e) Maximum allowable gearbox input torque.

#### 5.1.3 Electric Actuator Marking

The electric actuator shall have the following markings:

- (a) Manufacturer's name or mark.
- (b) Rated power in kW
- (c) Motor type.
- (d) Serial number.
- (e) Locked rotor torque
- (f) Voltage
- (g) Full load current
- (h) Power factor
- (i) Insulation class
- (j) Degree of protection.
- (k) Gear ratio.
- (l) Maximum output torque.

## **5.2 Packaging**

### **5.2.1 General**

Product shall be packaged with appropriate protection, which shall prevent damage or defects as a result of handling, storage or transportation. Flexible packaging material shall have a minimum expected life in outside storage conditions of 12 months from the date of delivery.

### **5.2.2 Identification Tag**

Wherever requested in the Purchasing Schedule (Table 10.1) each Product item shall be identified using a weatherproof marking pen on a corrosion resistant metal identification tag securely wired to the Product in a conspicuous position using a non-metallic or non-ferrous tie wire with the following information:

- (a) Contract number
- (b) Purchase order number.

### **5.2.3 Marking of Packaging**

The penstock shall be identified by marking on the outside of any protective packaging the same information as shown on the identification tag.

## **6 Manuals**

### **6.1 Format and Language**

Each penstock shall be supplied complete with appropriate installation, operation and maintenance instructions or manuals, in clear diagrammatic and text format, in English.

### **6.2 Installation Instructions**

The Supplier shall submit proposed installation methodology in detail for all types with the offer. This shall include details of

- (a) Details of surface preparations
- (b) Grouting/Sealing system appropriate to environment taking into account the wall lining material.
- (c) Anchor details

### **6.3 Commissioning, and Operation and Maintenance Instructions Content**

The manuals shall contain all the relevant information required to commission and maintain the Product in operational service, including the following:

- (a) Details of penstock features
- (b) Operational adjustments
- (c) Testing and commissioning instructions
- (d) Preventative maintenance requirements and intervals
- (e) Trouble shooting guidelines
- (f) Complete list of parts and associated exploded views or sectional diagrams and reference part numbers.

## **7 Spare Parts and Special Tools**

### **7.1 Spare Parts**

#### **7.1.1 Interchangeability**

All spare parts shall be interchangeable for a manufacturer's Product of the same size and model.

#### **7.1.2 Availability**

Spare parts and servicing facilities for the product shall be readily available in Australia.

### **7.2 Special Tools**

Any special tools required for service and maintenance of the Product shall be supplied.

# 8 Transportation, Handling and Storage

## 8.1 General

Transportation, handling and storage facilities shall be designed to prevent Product damage or defects and to maintain Product free of deleterious matter. Product shall not be dropped off elevated vehicle platforms or sites. Mechanical handling equipment shall be in accordance with AS 2550.1, AS 2550.3, AS 2550.5 and AS 2550.11 and shall be appropriate to the loads to be lifted. Manual handling shall be in accordance with the National Standard for Manual Handling and the National Code of Practice for Manual Handling, published by National Occupational Health and Safety Commission, Australia. Product restraint during transportation shall be in accordance with Load Restraint Guide—Guidelines for Safe Carriage of Loads on Road Vehicles, published jointly by the Federal Office of Road Safety and the National Road Transport Commission, Australia.

**NOTE:** Where wire ropes or chains are used for loading and unloading, they should not come into direct contact with Product. Lifting elements in direct contact with Product should be of a non-abrasive design e.g. elastomeric or fabric webbing straps. During transportation, Product restraints should be checked for tension at regular intervals of travel and should not be released until the transporting vehicle is resting in a secure stable disposition on level ground.

## 8.2 Preservation of Product in Storage

Product shall be stored in original Product packaging in accordance with the published requirements of the manufacturer, prior to installation. Sensitive component materials shall be protected from extended exposure to direct sunlight and high temperatures e.g. elastomeric components shall be stored in accordance with the general principles of AS 1646. Designated Product storage areas shall be of sufficient size to accommodate Product deliveries and shall be flat, reasonably level and free of combustible vegetation, sharp stones or projections that could cause Product damage or defects.

## 9 Quality Assurance

### 9.1 Certification

#### 9.1.1 Certification of Product

Wherever this Specification requires compliance with nominated Product and test Standards, conformance shall be certified by means of a Certification Scheme, conducted by a Certification Body. Each Certificate shall expressly attest compliance of all Product items with the nominated Standards. Wherever specified, Certificates shall be submitted to the Officer nominated for this purpose. Product shall be marked in accordance with the requirements of the Certification Body.

**NOTE:** Compliance of Product including related accessories and services with nominated Standards and specified requirements may be verified by means of a Product Verification Report provided by a Product Assessor. The Product Verification Report should identify all relevant Certificates of Product compliance, duly issued in accordance with Certification Scheme rules.

#### 9.1.2 Quality System

The processes for manufacture, testing, supply, transportation, handling, delivery and storage of Product to be supplied in accordance with this Specification shall form part of a documented Quality System. The System shall be certified by a Certification Body as complying with the requirements of AS/NZS ISO 9001 and shall provide for identification and traceability, control of production and delivery to the specified destination, customer verification and control of documents and records.

#### 9.1.3 Product Re-verification

Product compliance with the Specification shall be subject to re-verification by a Product Assessor when, during the agreed Product supply period, there occurs any:

- (a) Substantive change in Product design, material formulation or performance
- (b) Product failure to perform in operational service to the nominated performance specification.

Re-verification shall require the issue of a new or supplementary Product Verification Report. Product components and test outcomes that are not significantly affected by the Product change or failure may be excluded from the scope of re-verification, provided that these outcomes have already been reported in a current valid Product Verification Report that is acceptable to the Corporation.

Wherever the requirements of the Specification apply to a Product supply period in excess of three years, continuing acceptance of Product shall be subject to re-verification. The purpose of re-verification shall be to confirm the continuing compliance of Product quality and production control processes with the requirements of the Specification

## 9.2 Quality Assurance of Stainless Steel Welding

### 9.2.1 Qualification of Welding Procedure

A weld procedure (i.e. the weld preparation, the welding consumable and welding parameters) shall be qualified before welding commences in accordance with AS 1554.6.

A weld procedure shall be established and the applicable parameters listed in the Welding Procedure Qualification Record PQR, which shall be held as a record shall be available for examination.

A welding procedure specification shall be developed from PQR based on the limits of the essential variables of clause 4.11 of AS/NZS 1554.6 and made available to the welder during fabrication.

Welding procedures shall be forwarded to the principal for review and approval.

## 9.2.2 Qualification of Welding Personnel

Welding shall be carried out under the supervision of a welding supervisor qualified in accordance with AS1554.6 Clause 4.12.1 employed by the fabricator.

Welding supervisor shall ensure that all stainless steel welding is carried out in accordance with the plans, the qualified welding procedure specifications and requirements of AS1554.6.

Welders shall be suitably qualified to carry out the welding procedures for which they are employed. The fabricator shall provide evidence acceptable to the Water Corporation that the welders are suitably qualified.

The names of all welders qualified in qualified to carry out weld procedures that will be used for the project together with their qualifications and experience shall be recorded and made available for perusal.

## 9.2.3 Welding Consumables

All welding consumables shall be handled in accordance with the manufacturer's instructions. When welding joints are carried out using FCAW or GMAW processes, weldable grade argon or argon mixtures with no greater than 2% CO<sub>2</sub> shall be used as shielding gas.

## 9.2.4 Pre-approval of Welding Procedures

Penstock suppliers shall submit following documentation for review by the principal for approval prior to commencement of fabrication:

1. Details of facility at which fabrication and welding of penstocks would be carried out
2. Details of subcontractors and how quality is controlled by the principal vendor
3. Location of subcontractors or welding facilities of principal vendor
4. Qualified welding procedures
5. Welder qualification with respect to welding procedures
6. Qualification of welding supervisors
7. What non-destructive testing is carried out and to what extent
8. Documented procedure for pickling and passivation
9. Final inspection to ensure manufactured goods are within dimensional tolerance;
10. Method for packaging and transport that would negate contamination during transport
11. Detailed ITP to control the fabrication and welding- ITP shall include all items of inspections and tests carried out from the award /acceptance of drawings to final delivery of the product, and reference to goods inward, dimensional checks, preparation of MRD etc. Each item shall include
  - a. Task No and Task description,
  - b. Location (Supplier / Subcontractor etc.)
  - c. Procedures, specifications and standards,
  - d. Acceptance Criteria/Reference drawings
  - e. Verifying Person and Equipment reference if any,
  - f. Action –Verify, Hold, Witness, Approve, Review etc.
  - g. Signed & Dated by supplier and client (if witnessed)
  - h. Supplementary documentation - check sheets for fabrication tests, hydrostatic test and Final Inspection etc.

## 9.3 Compliance and Acceptance

### 9.3.1 Means of Demonstrating Compliance

Compliance with this Specification shall be demonstrated by means of Product Appraisal and issue by a Product Assessor of a Product Verification Report that confirms compliance.

Otherwise, Product shall be deemed non-compliant and ineligible for registration as Product authorized for use in Corporation infrastructure.

**NOTES:**

1. Where a project includes design work including Product design, Product Appraisal may form part of the project design review process and the Product Assessor may be a member of the project design review team.
2. A Product Verification Report should verify the extent of compliance with the Specification including all relevant 'Technical Compliance Schedule' Appendices and the currency of a Certificate where relevant to the Product.

### **9.3.2 Acceptance Criteria**

For acceptance, Product shall be supplied as specified in the Purchasing Schedule (Table 10.1).

Prior to the implementation of any arrangement to supply Product, the Supplier shall, in accordance with specified requirements:

- (a) Nominate applicable Product Warranty terms; and
- (b) Provide documentary verification in the form of a current valid Certificate or Product Verification Report as appropriate to the Product; and
- (c) Detail each element of Product that does not comply with the specified requirements together with the extent of non-compliance.

**NOTE:** Where the Specification includes Technical Compliance Schedules, the nature and extent of all non-compliances should be provided in accordance with the appropriate Schedules.

## **9.4 Non-compliant Product**

### **9.4.1 General**

Product whose design, workmanship or performance fails to conform to the specified requirements shall be clearly tagged and quarantined by the Supplier as non-compliant and shall be subject to rejection for return to and replacement by the Supplier.

Where the Specification includes a 'Technical Compliance Schedule', Product shall be deemed non-compliant except where a Supplier has demonstrated compliance in accordance with the requirements of the 'Technical Compliance Schedule' Appendices of the Specification.

### **9.4.2 Product Warranty**

The Supplier shall replace non-compliant Product with Product that conforms to the acceptance criteria or shall repair or rectify all faults, damage or losses caused by defective Product. Except as may otherwise be specified, the Product Warranty shall indemnify and keep indemnified the Corporation against all losses suffered by the Corporation as a result of non-compliant Product for a period no less than 24 months after Product delivery or 12 months after Product installation, whichever period elapses first.

### **9.4.3 Product Repair**

All reasonable proposals for repair or remedy of defects will be considered, provided that each such proposal is accompanied by a methodology statement that accords with the performance objectives of this Specification, as determined by the Corporation. For acceptance, a proposal for repair or remedy of Product defects shall not void or otherwise diminish the provisions of the Product Warranty.

## **10 Appendix A: Project Specific Requirements (Normative)**

### **10.1 General**

Project specific information and requirements, not included elsewhere in this Strategic Product Specification shall apply as specified in the following Clauses.

### **10.2 Technical Requirements**

The following table details project specific requirements for the penstock to be procured.

**TABLE 10.1: SCHEDULE OF PROJECT TECHNICAL REQUIREMENTS**

Clause	Item	Requirement/ Value	
-	Number of penstocks required		
1.1 .(b), 1.3.18 & 1.3.19	Penstock sealing type e.g. on-seating or off-seating		
3.1. (b)	Water (no H <sub>2</sub> S), or Wastewater (H <sub>2</sub> S present) service		
3.1. (e)	Maximum static head m		
3.1 .(e)	Maximum off-seating head m		
3.1. (i)	Uni-directional or bi-directional flow isolation		
3.2.1	Drawings Provided to supplier (Arrangement and Structure – list drawing numbers appended)		
3.2.1	Installation drawings required	Yes	
3.2.2	Fabrication drawings required	Yes	
3.2.3	As-constructed drawings required	Yes	
3.3.1	Penstock size e.g. clear opening Width x Height mm	W..... x H.....	
3.4.(c)	Side frame type e.g. embedded or wall-mounted		
3.4.(c)	Bottom frame type e.g. embedded or floor-mounted		
1.1. 3.6	Door attachments required	Yes/No	
3.6.1	Lifting chain with fittings – required and length	Yes/No Length .....m	
3.8 (d)	Seals arrangement option A, B or C: Option A – all seals attached to door Option B – all seals attached to frame Option C – all seals attached to door except flush bottom seal		
3.9.2	Arrangement – rising (with Pedestal) or non-rising		
3.9.4	Spindle Protection Tube (if applicable) material - polycarbonate or stainless steel		
3.9.5	Spindle Cap Required (below ground) Tee-Key operation	Yes/ No	
3.14.1/2	Door operator type: (hand-wheel / tee-key / actuator)		
3.14.1	Hand-wheel orientation (horizontal / vertical / N/A)		
3.14.2 (e)	Portable Actuator to be supplied	Yes/No.	
3.14.2 (f)	Handwheel: Fitted to pedestal / loose / N/A		
3.15.1.(c)	Door opening/closing speed mm/min (Generally travel speed of 200-300mm/min is used by actuator designers)		
-	Operational frequency e.g. operations/ month or year		
-	Profibus communications module to be added	Yes/No	
3.15.1 (b)	Actuator: Actuator Specification DS26-41 attached	Yes/No	
3.17	Lockout devices	Spindle cap	Yes/No
		Handwheel	Yes/No

		Electric Actuator	Yes/No
4.5.1	Factory - Radiographic Tests Required		Yes/No
4.5.2	Factory - Functional Test required		Yes/No
4.5.3	Factory – Hydrostatic Test Required		Yes/No
4.5.4	Factory - Seal Leakage Test Required		Yes/No
4.6.1	Site – Manufacturer Certification of installation required		Yes/No
4.6.2	Site - Functional test required		Yes
4.6.3	Site - Seal Leakage Test Required		Yes/No
5.2.2	Identification tag requires per Clause 5.2.2		Yes/No

# 11 Appendix B: Technical Compliance Schedules(Normative) Compliance Schedules

Suppliers shall demonstrate Product compliance with the Specification by completing Technical Compliance Schedules 1 and 2 as shown in **TABLE 11.1** and **TABLE 11.2** on an item by item basis.

For acceptance, the extent of scheduled technical item compliance shall be supported by verifiable documentary evidence. Each scheduled item nominates a Standard or Specification clause number with which the extent of Product compliance shall be demonstrated.

The Supplier shall denote compliance of an item by ticking the unshaded ‘Yes’ column appropriate to that item. Where Product does not comply with specified requirements, the Supplier shall tick the ‘No’ column and shall detail the reasons for non-conformance and any proposed alternatives in the ‘Comments’ column. The Supplier shall denote acceptance and understanding of a Specification clause by ticking the corresponding ‘Noted’ column wherever unshaded.

**Failure to notify the Corporation of all non-compliant Product components, including the extent of non-compliance, may void an accepted offer to supply or may result in rectification of all non-compliant Product elements, at the Supplier’s cost.**

**TABLE 11.1: SPS 295 - TECHNICAL COMPLIANCE SCHEDULE 1**

Penstocks					
Section/Clause		Noted	Compliance		Comments
			Yes	No	
<b>1. SCOPE AND GENERAL</b>					
1.1	Scope				
1.2	Referenced Documents				
1.3	Definitions and Notation				
1.4	Designation of Size				
<b>2. MATERIALS AND COMPONENTS</b>					
2.1	General				
2.2	Non-metallic Materials				
2.3	Dezincification-resistant Materials				
2.4	Contamination of Water				
2.5	Seals				
<b>3. DESIGN &amp; MANUFACTURE</b>					
3.1	General				
3.2	Drawings				
3.2.1	Drawings-Installation				
3.2.2	Drawings-Fabrication				
3.2.3	Drawings –As Constructed				
3.3	Aperture Dimensions and Tolerances				
3.3.1	Dimensions				
3.3.2	Tolerances				
3.4	Frame				
3.5	Door				
3.6	Lifting Attachments and Chains				
3.6.1	Chain				
3.6.2	Fittings				
3.7	Fabrication and Welding of Stainless Steel				
3.8	Seals				
3.9	Spindle, Nut and Spindle Guides				
3.9.1	Design				
3.9.2	Arrangement – Rising or Non-Rising				
3.9.3	Limit Stops				
3.9.4	Spindle Protection Tube				
3.9.5	Spindle Cap				
3.10	Mounting Type				
3.11	Side Wear Strips				

3.12	Pedestals				
3.13	Yoke				
3.14	Door Operator				
3.14.1	General				
3.14.2	Gearbox				
3.15	Permanent Electric Actuator				
3.15.1	General				
3.16	Fasteners				
3.17	Lockout Devices				
<b>4. PERFORMANCE TESTS</b>					
4.1	General				
4.2	Notification of Testing				
4.3	Access to the Place of Manufacture				
4.4	Place of Manufacture other than WA				
4.5	Tests at Manufacturer's Works				
4.5.1	Weld Examination				
4.5.2	Functional Test (Test 1)				
4.5.3	Hydrostatic Test (Test 2)				
4.5.4	Seal Leakage Test (Test 3)				
4.6	Site Tests				
4.6.1	Manufacturer's Certification of Penstock Installation				
4.6.2	Functional Test at Site (Test 4)				
4.6.3	Site Hydrostatic Test (Test 5)				
4.7	Test Certificates				
<b>5. MARKING AND PACKAGING</b>					
5.1	Marking				
5.1.1	Penstock Frame Marking				
5.1.2	Gear Operator Marking				
5.1.3	Electric Actuator Marking				
5.2	Packaging				
5.2.1	General				
5.2.2	Identification Tag				
5.2.3	Marking of Packaging				
<b>6. MANUALS</b>					
6.1	Format and Language				
6.2	Installation Instructions				
6.3	Commissioning, and O&M Instructions Content				
<b>7. SPARE PARTS &amp; SPECIAL TOOLS</b>					
7.1	Spare Parts				
7.1.1	Interchangeability				
7.1.2	Availability				
7.2	Special Tools				
<b>8. TRANSPORTATION, HANDLING AND STORAGE</b>					
8.1	General				
8.2	Preservation of Product in Storage				
<b>9. QUALITY ASSURANCE</b>					
9.1	Certification				
9.1.1	Certification of Product				
9.1.2	Quality System				
9.1.3	Product Re-verification				
9.2	Quality Assurance of Stainless Steel Welding				
9.2.1	Qualification of Welding Procedure				
9.2.2	Qualification of Welding Personnel				
9.2.3	Welding Consumables				
9.2.4	Pre-approval of welding Procedures				
9.3	Compliance and Acceptance				
9.3.1	Means of Demonstrating Compliance				
9.3.2	Acceptance Criteria				
9.4	Non-compliant Product				
9.4.1	General				
9.4.2	Product Warranty				
9.4.3	Product Repair				

The Supplier shall provide the information required by Technical Compliance Schedule 2 as shown in **TABLE 11.2**.

**TABLE 11.2: TECHNICAL COMPLIANCE SCHEDULE 2**

<b>Penstocks</b>		
<b>1.</b>	<b>SUPPLIER'S REPRESENTATIVE</b>	
1.1	Full name	
1.2	Postal address	
1.3	Facsimile number	
1.4	Email address	
1.5	Phone number	
1.6	Mobile number	
<b>2.</b>	<b>QUALITY ASSURANCE</b>	
2.1	Extent of third party accreditation of supplier	
2.2	Extent of third party accreditation of manufacturer	
2.3	Details of certificates and verification reports attached	(Yes/No)
<b>3.</b>	<b>TECHNICAL INFORMATION</b>	
3.1	Performance information supplied	(Yes/No)
3.2	Details of the manufacturer's inspection and testing plans supplied.	(Yes/No)
3.3	Penstock and actuator drawings supplied	(Yes/No)
3.4	Details of servicing facilities in Perth supplied.	(Yes/No)
3.5	Additional pamphlets and drawings in conjunction with the technical literature supplied.	(Yes/No)
<b>4.</b>	<b>DESIGN AND MANUFACTURE</b>	
4.1	Manufacturer's name	
4.2	Place of manufacture	
4.3	Penstock model	
4.4	Penstock sealing type e.g. on-seating or off-seating	
4.5	Penstock clear opening width	mm
4.6	Penstock clear opening height	mm
4.7	Frame safety factor for tensile, compressive and shear strength	
4.8	Type of frame-to-wall sealing e.g. resilient or grout	
4.9	Side frame type e.g. embedded or wall mounted	
4.10	Bottom frame type e.g. embedded or wall mounted	
4.11	Guide safety factor for tensile, compressive and shear strength	
4.13	Frame material thickness	mm
4.14	Door safety factor for tensile, compressive and shear strength	
4.15	Door material thickness	mm
4.16	Door lifting attachment type e.g. eyebolts, lugs, holes	
4.17	Door opening/closing speed	mm/min
4.18	Door clearance above liquid in the fully open position	mm
4.19	Door is readily removable for maintenance purposes	
4.20	Penstock door lifting attachment provided	Yes/No
4.21	Lifting chain and fittings provided (if required)	Yes/No
4.22	Door and frame seal type e.g. profile	
4.23	Seals replaceable in-situ from the surface	Yes/No
4.24	Spindle, nut safety factor - tensile, compressive, shear strength	
4.25	Spindle slenderness ratio	
4.26	Spindle thread type e.g. ACME, single start etc.	
4.27	Spindle components and fasteners are of anti-galling design	Yes/No
4.28	Spindle nut lubrication type e.g. grease nipple or self-lubricating	
4.29	Spindle protection tube fitted for rising spindle type penstocks	Yes/No
4.30	Spindle protection tube indicator type	

4.31	Rising or non-rising spindle			
4.32	Yoke safety factor for tensile, compressive and shear strength			
4.33	Yoke maximum deflection	mm		
4.34	Actuation/lift type eg. direct-on-frame or pedestal or surface box			
4.35	Actuator method e.g. hand wheel, gearbox, electric etc.			
4.36	Hand wheel or manual operator height	mm		
4.37	Operator device direction of closing e.g. anti-clockwise			
4.38	Hand wheel maximum rim pull force	N		
4.39	Lifting arrangement is self-locking			Yes/No
4.40	Manual operators suitable for portable power actuator			Yes/No
4.42	Unidirectional or bi-directional flow			
4.43	Maximum static head rating	m		
4.44	Geared operator details:			
4.44.1	Manufacturer			
4.44.2	Model			
4.44.3	Gear ratio			
4.44.4	Gear operator IP rating as specified in AS 60529			
4.44.5	Gearbox external coating system and thickness			
4.44.6	Hand wheel coating			
4.45	Penstock input break-away and running torques			Break-away torque.....Nm ; Running torque.....Nm
4.46	Limits stops fitted			Yes/.No
4.47	Mass of penstock	kg		
<b>5.</b>	<b>MATERIALS</b>	<b>MATERIAL</b>	<b>STANDARD</b>	<b>GRADE</b>
5.1	Side frame, yoke, door and guides			
5.2	Spindle and couplings and spindle guides			
5.3	Spindle pedestal			
5.4	Spindle nut			
5.5	Spindle protection tube			
5.6	Door guide wear strips			
5.7	Frame and door seal			
5.8	Bottom seal			
5.9	Spindle column guide and support			
5.10	Fasteners			
5.11	Hand wheel			
<b>6.0</b>	<b>ELECTRIC ACTUATOR</b>			
6.1	Manufacturer			
6.2	Model			
6.3	Output shaft speed	rpm		
6.4	Mass of actuator	kg		
Supplier shall complete and submit pages Annexure to specification given in pages 27-29 of DS26-41 and Tender Technical Response Schedule given in pages 29-31 of DS26-41				Yes/No

Name of Supplier:

.....

Signature:

Date:

.....

## 12 Appendix C

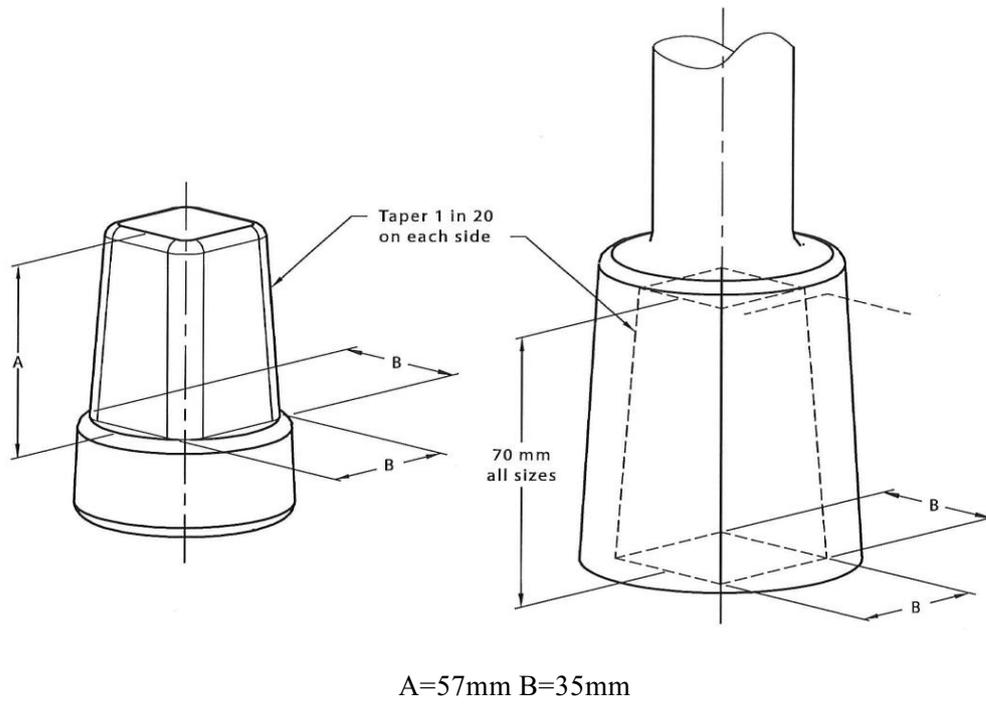
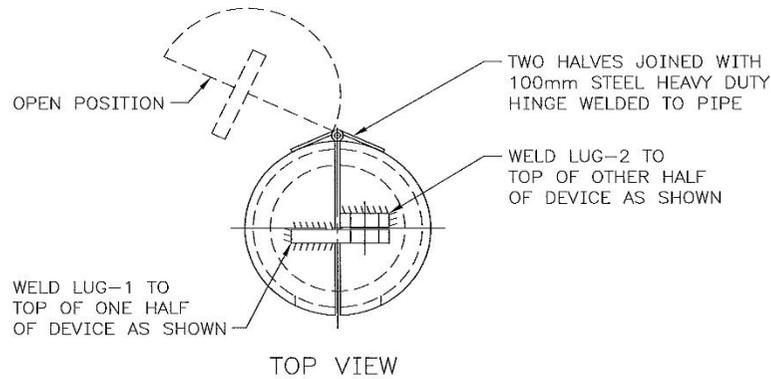
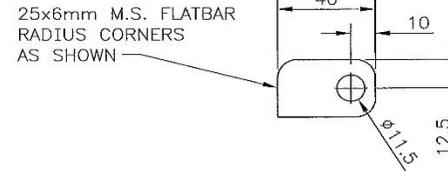


Figure 12.1- Dimensions for Spindle Caps & Keys (\*Source –AS 2638.2)

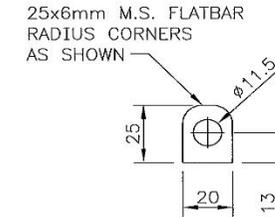
# 13 Appendix D



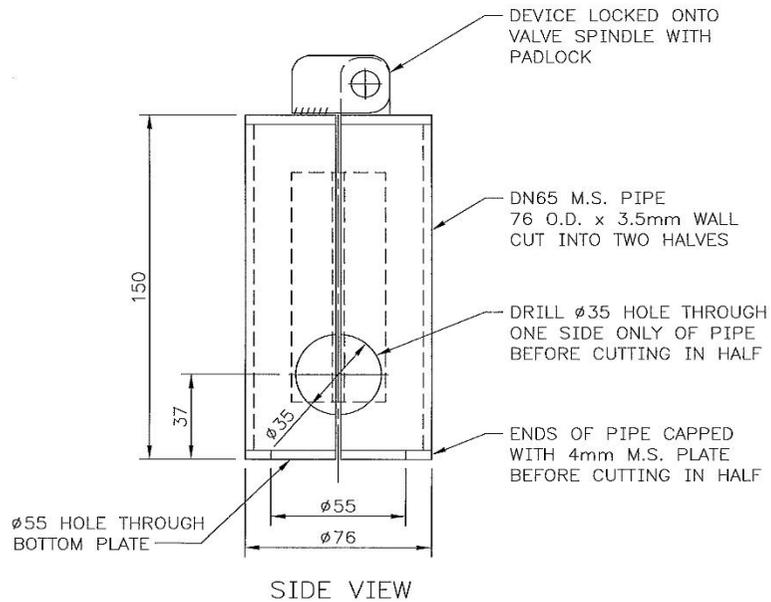
TOP VIEW



LUG-1 DETAIL



LUG-2 DETAIL



SIDE VIEW

VALVE LOCKING DEVICE SHALL BE USED IN CONJUNCTION WITH WATER CORPORATION LOCK AND TAG PROCEDURE "WC-OSH (109)"

### GENERAL NOTES

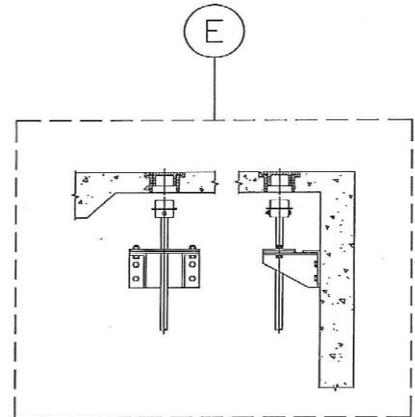
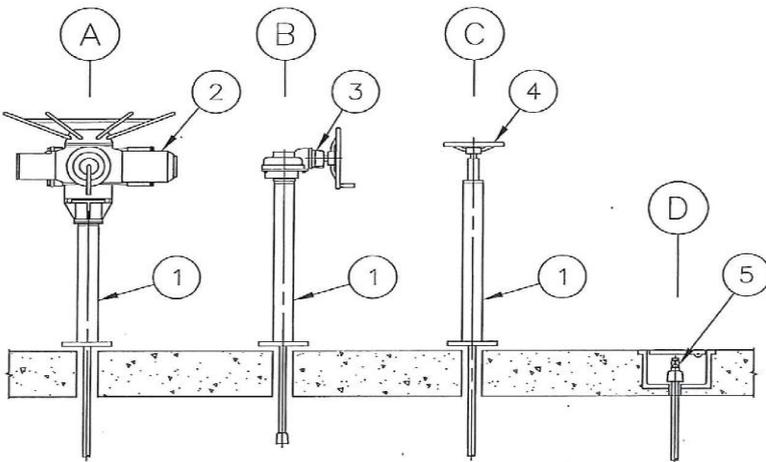
1. UNLESS OTHERWISE NOTED ALL DIMENSIONS ARE IN MILLIMETRES.
2. HAND TOOL CLEAN AND APPLY TWO BRUSH COATS OF "ZINGA" OR SIMILAR APPROVED TO 80 MICRONS DFT MINIMUM AFTER MANUFACTURE.
3. WELDING SHALL BE A MINIMUM 3mm FULLY SEALED CONTINUOUS FILLET WELD TO AS1554 AND WATER CORPORATION TECHNICAL SPECIFICATION WS-1 U.N.O.

**NOTE – THIS DRAWING IS DERIVED FROM DRAWING EG20-11-2**

# 14 Appendix E

## Typical Operating Arrangements

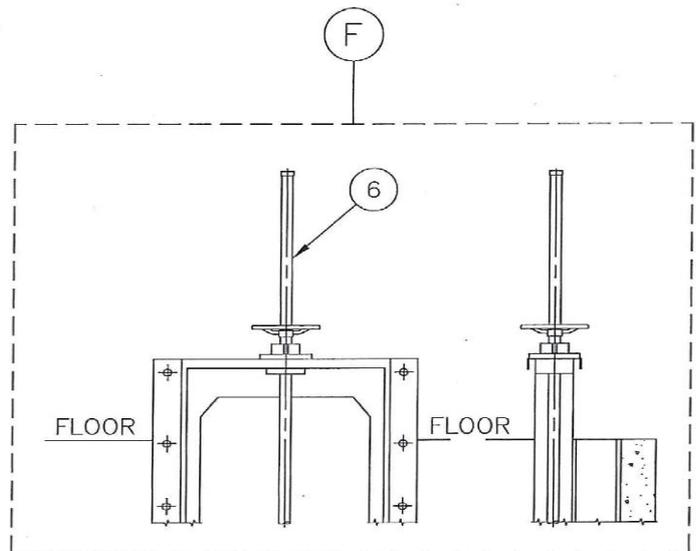
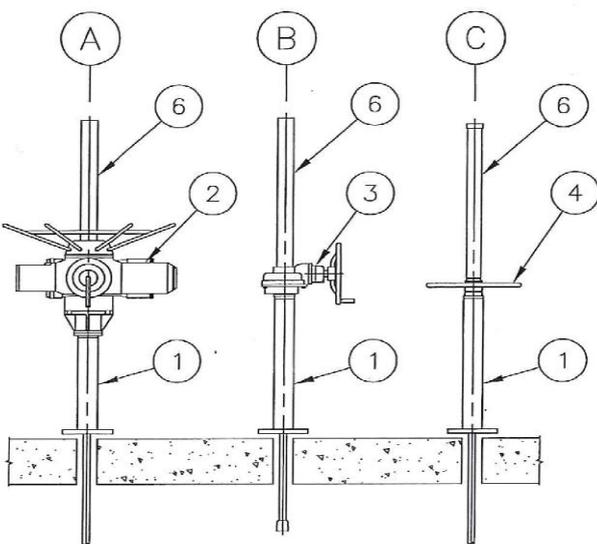
### Non-Rising Penstocks



Options	Descriptions
A	Permanent Electric Actuator
B	Handwheel with bevel gearbox on a pedestal.
C	Handwheel (horizontal) on pedestal.
D	Key cap in a surface box for Tee/Key operation
E	Wall mounted penstock with key cap below operating platform
F	Wall mounted penstock with yoke-mounted handwheel

Item Descriptions	
1	Pedestal
2	Electric Actuator
3	Bevel gearbox on a pedestal
4	Handwheel (horizontal) on pedestal
5	Key cap in a surface box for Tee/Key operation
6	Spindle Protection Tube

### Rising Spindle Penstocks



**END OF DOCUMENT**