

Specification for Penstocks

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- Association of Bronze and Brass Founders
- British Chemical Engineering Contractors' Association
- British Effluent and Water Association
- British Foundry Association
- British Gas plc
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- Society of British Water Industries
- Water Companies Association
- Water Services Association of England and Wales
- West Midlands CBI

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Foreword

This British Standard has been prepared under the direction of the Engineering Sector Board and is equivalent to British Water: P.12.92 [1] in technical content but differs in presentation.

This standard allows options to the standard product, the preferred option being indicated by a note to the appropriate clause.

Particular requirements should be stipulated by the purchaser, as stated in Annex A, otherwise the manufacturer will supply the product with the following preferred options:

- a) type of penstock (see 2.1.2);
- b) type of spindle [see 2.1.5.2 b)];
- c) means of operation (see 2.1.6.1);
- d) cast iron penstocks (see Table 1);
- e) composite penstocks (see Table 5);
- f) fabricated penstocks (see Table 6).

For purchasers of penstocks conforming to BS 7775, it is emphasized that strict compliance with the manufacturer's instructions and recommendations for installation, usage and maintenance is necessary. Where there is an appropriate application standard or code of practice, it is the responsibility of the purchaser to ensure that such requirements are complied with.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Section 1. General

1.1 Scope

This British Standard specifies design and application (including materials and dimensions), testing and inspection procedures, designation and marking, preparation for transportation and documentation for different types and configurations of penstock for use in water supply, sewage treatment and other liquid flow applications.

It specifies requirements for general purposes for vertical wall, channel, thimble or pipe mounted penstocks either in cast iron, composite plastic or fabricated metal. The range of penstock sizes covered is 100 mm to 2 000 mm for various shaped apertures for maximum static heads up to 6 m (on-seating) and 6 m (off-seating).

It specifies material combinations with metal, resilient and/or low friction sealing faces, and gives test and inspection procedures, allowable leakage rates related to the penstock aperture size, differential head and direction of the resultant pressure.

1.2 References

1.2.1 Normative references

This British Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this standard only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

1.2.2 Informative reference

This British Standard refers to another publication that provides information. The edition of this publication current at the time of issue of this standard is given on inside back cover, but reference should be made to the latest edition.

1.3 Definitions

For the purposes of this British Standard, the following definitions apply.

1.3.1 General

1.3.1.1 penstock

a piece of equipment used to control the flow or level of a liquid consisting of a sliding door, controlled by a mechanically operated spindle, moving vertically over the aperture in a frame which is secured on to a structure

1.3.1.2 penstock aperture

the opening in the penstock frame for the passage of liquids [see Figure 2 a)]. For rectangular penstocks the width refers to the horizontal aperture dimension and the height refers to the vertical aperture dimension; aperture size is always the width dimension followed by the height

1.3.1.3 penstock door

a closure retained within the frame which is raised or lowered by operating equipment (see 1.3.1.11) to expose or obscure the frame aperture and effect a seal (see Figure 1)

1.3.1.4 penstock frame

a means of fixing the penstock to a structure and retention of the door allowing vertical movement between the open and closed positions (see Figure 1)

1.3.1.5 leakage

liquid passing between the door and frame sealing faces of a penstock with the door in the fully closed position

1.3.1.6 coping

the top surface of a wall or channel wall (see Figure 1)

1.3.1.7 floor

the overhead operating level (see Figure 1)

1.3.1.8 invert

the bottom surface of a channel or aperture [see Figure 2 a)]

1.3.1.9 outreach

a dimension measured from the face of a vertical wall to the centre line of a spindle [see Figure 2 a)]

1.3.1.10**soffit**

the under surface of the top of an aperture
[see Figure 2 a)]

1.3.1.11**operating equipment**

a means, integral with the penstock, of raising or lowering the door manually or by power operation as itemized in a) and b) respectively:

a) *manually operated equipment*

- 1) handwheel;
- 2) handwheel/gearbox combination;
- 3) tee key or crank handle;
- 4) tee key or crank handle/gearbox combination.

b) *power operated equipment*

- 1) electric actuator;
- 2) electric actuator/gearbox combination;
- 3) hydraulic cylinder;
- 4) pneumatic cylinder.

1.3.1.12 Thrust**1.3.1.12.1****direct type thrust**

a thrust transmitted from the operating equipment directly to the penstock frame yoke (see 1.3.7.6)

1.3.1.12.2**remote type thrust**

a thrust transmitted from the operating equipment to the structure remote from the penstock frame (see Figure 2)

1.3.1.13 Operating frequency**1.3.1.13.1****isolating penstock**

a penstock operated daily or less frequently

NOTE Operationally it may be either fully open or fully closed and may be selected from one of the types defined in 2.1.2.

1.3.1.13.2**modulating penstock**

a penstock operated in excess of 60 times per hour to provide precise flow control by frequent repositioning of the door may be selected from one of the types defined in 2.1.2

1.3.1.13.3**regulating penstock**

a penstock operated up to 30 times per hour or less to regulate flow rates by occasional repositioning of the door which may be selected from one of the types defined in 2.1.2

1.3.2 Penstock types**1.3.2.1****flush invert type**

a penstock in which closure is effected by the vertical downward movement of the door on to the invert seal. The invert seal is arranged at right angles to the side and soffit (see 1.3.1.10) seals and may be fixed to either the frame or door [see Figure 2 a)]

1.3.2.2**rebate invert type**

a penstock in which closure is effected by the vertical downward movement of the door. In the closed position the bottom of the door is below the frame invert. Side, soffit and invert seals are all in the same vertical plane [see Figure 2 b)]

1.3.2.3**weir type**

a penstock in which closure is effected by the vertical upward movement of the door. Side and invert sealing is effected at all intermediate positions between open or closed

1.3.3 Seal types**1.3.3.1****low friction seals**

one or more low friction seals on the penstock frame and/or door which are secured to the frame and/or door to provide lower frictional resistance properties than either metal seals (see 1.3.3.2) or resilient seals (see 1.3.3.3), usually combined with one or more metal or plastic seal faces

1.3.3.2**metal seals**

metal seal faces on the penstock frame and/or door which may be integral or secured to the frame and/or door

1.3.3.3**resilient seals**

one or more resilient type material seal faces on the penstock frame and/or door secured to the frame and/or door, usually combined with one or more metal or plastic seal faces

1.3.3.4**weir penstock seals**

seals on weir (see 1.3.2.3) penstock doors having a flat full faced metal or low friction seal

1.3.4 Fixing types

1.3.4.1

channel fixing

penstocks fixed into pre-formed rebates (see 1.3.2.2) in the sides and invert of channels with or without anchor bolts and sealed into the rebate with a non-shrink grout

1.3.4.2

pipe flange fixing

penstocks bolted to a pipe flange

1.3.4.3

wall fixing

penstocks fixed to vertical walls of channels, chambers or similar structures by means of anchor bolts and sealed to the wall with a non-shrink grout

1.3.4.4

wall thimble fixing

penstocks bolted to a metal insert, of the required shape, pre-cast into the civil structure. Wall thimbles are usually recommended for use when there are very high off-seating heads (see 1.3.6.3)

1.3.5 Spindles

1.3.5.1

non-rising spindle nut

a threaded spindle nut that is located in the door so that the nut and door move up or down [see 2.1.5.2 a)]

1.3.5.2

rising spindle nut

a threaded spindle nut that is located in the operating equipment so that the spindle and door move up or down [see 2.1.5.2 b)]

1.3.5.3

spindle block

a component for easy attachment of a spindle to a penstock door nut pocket or to a piece of the operating equipment

1.3.5.4

spindle coupling

a structural component used where spindles are manufactured in more than one length (see Figure 1)

1.3.5.5

spindle guide bracket

an intermediate support for the spindle that prevents buckling under compressive loading conditions (see Figure 1)

1.3.5.6

spindle protection tube

a tube that protects the rising spindle from damage and isolates the operator from moving machinery (see Figure 1)

1.3.6 Head

1.3.6.1

maximum static head

the maximum possible differential head for which the penstock has to be structurally designed

NOTE The static head can be greater than the operating head (see 1.3.6.6).

1.3.6.2

differential head

the difference between the on-seating head (see 1.3.6.4) and the off-seating head (see 1.3.6.3) with the door in the closed position (see Figure 2)

1.3.6.3

off-seating head

the head of liquid which acts to force the door away from the frame seals [see Figure 2 b)]

1.3.6.4

on-seating head

the head of liquid which forces the door on to the frame seals [see Figure 2 a)]

1.3.6.5

on off-seating head

a situation where the head of liquid acts to force the door on to or away from the frame (see Figure 2)

1.3.6.6

operating head

the maximum differential head against which the penstock will be operated (see 2.1.6.2)

1.3.7 Other components

1.3.7.1

coping bracket

a support for the operating equipment at a coping level or on a wall (see Figure 1)

1.3.7.2

door position indicator

a component, usually attached to a rising spindle which indicates the position of the door within the aperture (see Figure 1)

1.3.7.3

pillar

a structural component to support the operating equipment at a convenient height (see Figure 1)

1.3.7.4

universal coupling

a structural component used where non-rising spindles need to be offset [see 2.1.5.2 a)]

1.3.7.5

wedging or pressure device

a component which forces the door and frame sealing faces together (see Figure 1)

1.3.7.6

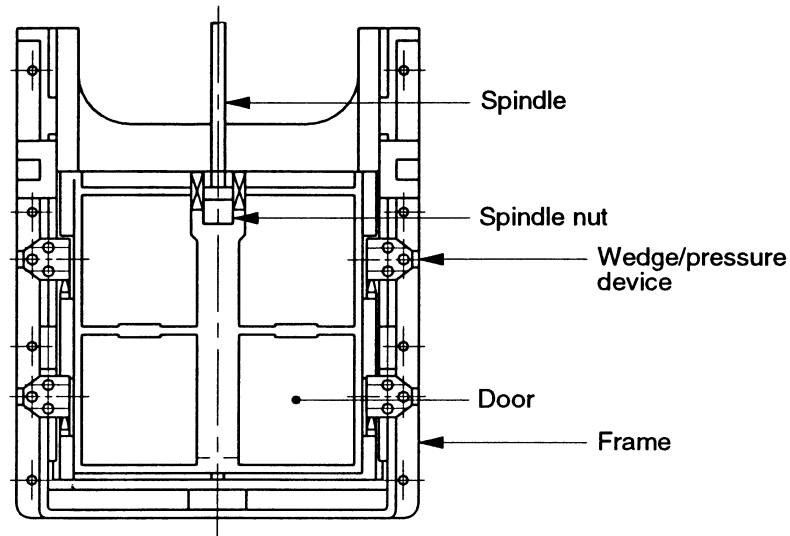
yoke

an integral or separate cross-member at the top of the frame sides of a penstock (see Figure 1)

1.3.7.7

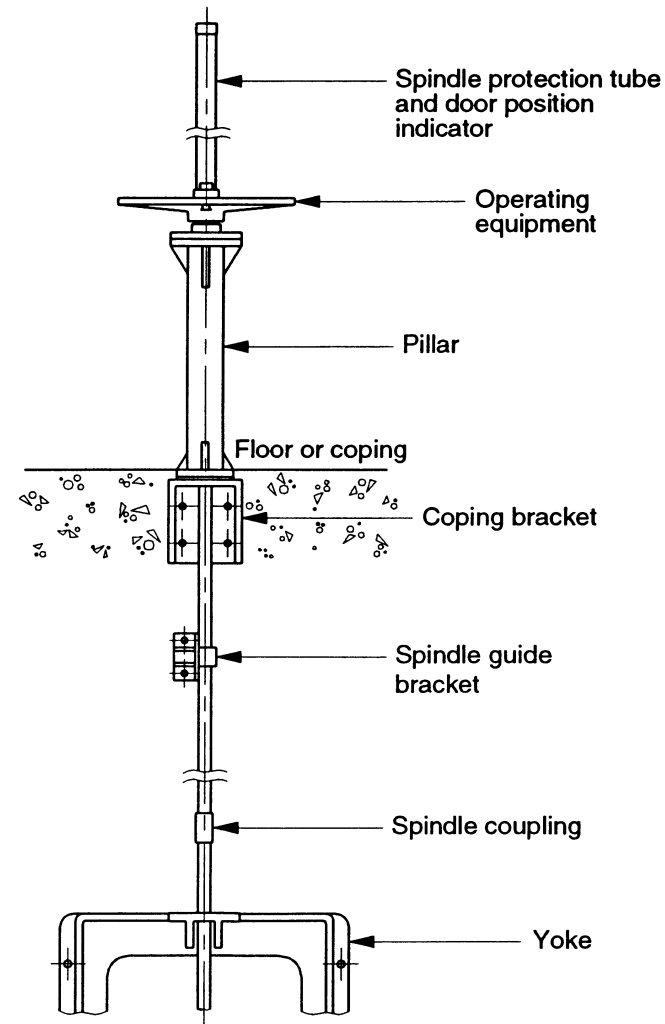
door guide

a component which may be secured to, or be an integral part of, the penstock frame for the purpose of retaining the door during operation and when in the fully open position (see 2.1.3.4)



Open top penstock frame with door

a) On-seating head



Closed top penstock frame with operating gear

b) Off-seating head

NOTE Head is measured from invert to water level

Figure 1 — Typical penstock components