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BRITISH STANDARD

BS 7775:2005

Penstocks for use in water and other liquid flow applications — Specification

ICS 23.060.30

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BSI
British Standards

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee PSE/7, Valves, to Subcommittee PSE/7/3, Cast iron isolating, check and hydrant valves for industrial use and valves water industry applications, upon which the following bodies were represented:

British Chemical Engineering Contractors Association

BSI Testing Product Certification

BVAA — British Valve and Actuator Association

CMF — Cast Metals Federation

Ductile Iron Producers Association

Energy Industries Council

Institution of Mechanical Engineers

Pipeline Industries Guild

SBWWI — Society of British Water and Wastewater Industries

Water UK

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Foreword

This British Standard has been prepared under the authority of Technical Committee PSE/7 by Subcommittee PSE/7/3. It supersedes BS 7775:1995, which is withdrawn.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 16, an inside back cover and a back cover.

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1 Scope

This standard specifies the design and performance criteria for penstocks for use in waste water, water supply and other liquid flow applications. This standard also sets out the requirements for packaging and installation of penstocks.

Annex A sets out information to be supplied by the purchaser for the correct supply of a penstock.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 449-2, *Specification for the use of structural steel in building — Part 2: Metric units.*

BS 4618 (all parts), *Recommendations for the presentation of plastics design data.*

BS 5950-2, *Structural use of steelwork in building — Part 2: Specification for materials, fabrication and erection — Rolled and welded sections.*

BS 6920-1, *Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water — Specification.*

BS EN 287-1, *Qualification test of welders — Fusion welding — Part 1: Steels.*

BS EN 287-2, *Approval testing of welders for fusion welding — Part 2: Aluminium and its alloys.*

BS EN 288 (all parts), *Specification and approval of welding procedures for metallic materials.*

BS EN 1011-1, *Welding — Recommendations for welding of metallic materials — General guidance for arc welding.*

BS EN 1011-2, *Welding — Recommendations for welding of metallic materials — Arc welding of ferritic steels.*

BS EN 1074-1, *Valves for water supply — Fitness for purpose requirements and appropriate verification tests — Part 1: General requirements.*

BS EN 1418, *Welding personnel — Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.*

BS EN 1561:1997, *Founding — Grey cast irons.*

BS EN 1563:1997, *Founding — Spheroidal graphite cast iron.*

BS EN 10088-3:1995, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes.*

BS EN ISO 15614-8, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 8: Welding of tubes to tube-plate joints.*

BS EN ISO 9000, *Quality management systems — Fundamentals and vocabulary.*

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3 Terms and definitions

For the purposes of this standard, the following terms and definitions apply.

3.1 Equipment

3.1.1
penstock
piece of equipment used to isolate and/or control the flow or level of a liquid consisting of a sliding door moving over the aperture in a frame which is secured on to a structure

3.1.2
penstock aperture
opening in the penstock frame for the passage of liquids

NOTE 1 See Figure 1.

NOTE 2 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.

3.1.3
penstock door
obturator retained within the frame which is opened or closed by **operating equipment** to expose or obscure the frame aperture to isolate and/or control the flow or level of a liquid

NOTE See Figure 2.

3.1.4
penstock frame
means of fixing the penstock to a structure and retaining the door for the range of movement between the open and closed positions

NOTE See Figure 2.

3.1.5
seal
material fitted between the frame and the door to minimize leakage

NOTE 1 See Clause **5**.

NOTE 2 The material can be either rigid (i.e. metal to metal) or resilient.

3.1.6 Stems

3.1.6.1
stem
means of raising and lowering the penstock door

NOTE There are two basic options for stems, given in **3.1.6.2** and **3.1.6.3**.

3.1.6.2
non-rising stem
stem in which the rotation of the threaded stem in the operating nut, located in the top of the door, moves the door up or down the stem

3.1.6.3
rising stem
stem in which the rotation of the operating nut, located in the operating equipment, or the operation of a hydraulic or pneumatic cylinder raises or lowers the stem to which the door is connected by a stem block

3.1.7
wedging device
pressure device
component which forces the door and frame together

NOTE See Figure 2.

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3.1.8
yoke
integral or separate cross-member at the top of the frame sides and/or door guides of a penstock

NOTE See Figure 2.

3.1.9
door guide
component which may be secured to, or be an integral part of, the penstock frame for the purpose of retaining/guiding the door during operation and when in the fully open position

3.1.10
operating equipment
means, integral with the penstock, of opening and closing the door manually or by power operation

3.2 General

3.2.1
leakage
liquid passing between the door and frame sealing faces of a penstock with the door in the fully closed position

3.2.2
coping
top surface of a wall or channel wall

NOTE See Figure 2.

3.2.3
floor
overhead operating level

NOTE See Figure 2.

3.2.4
invert
bottom surface of the frame or aperture

NOTE See Figure 1.

3.2.5
soffit
under surface of the top of the frame aperture

NOTE See Figure 1.

3.2.6
outreach
dimension measured from the mounting face of the penstock frame to the centre line of a stem, not making any allowance for sealing material between the frame and the wall

NOTE See Figure 1.

3.3 Thrust types

3.3.1
thrust
operating force required to open and close the penstock door

3.3.2
direct thrust
thrust transmitted from the operating equipment directly to the penstock frame **yoke**

3.3.3
remote thrust
thrust transmitted from the operating equipment to the structure remote from the penstock

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3.4 Operating function

3.4.1
isolating penstock
penstock which can be either fully open or fully closed

3.4.2
control penstock
penstock which can be stopped at any position within its movement range in order to provide flow control

3.5 Invert types

3.5.1
flush invert type
penstock in which closure is effected by the downward movement of the door on to the invert seal

NOTE The invert seal is arranged at right angles to the side and **soffit** seals and can be fixed to either the frame or door (see Figure 1).

3.5.2
rebate invert type
penstock in which closure is effected by the downward movement of the door past the frame aperture invert

NOTE Side, **soffit** and invert seals are all in the same vertical plane (see Figure 1).

3.5.3
weir type
penstock in which closure is effected by the vertical upward movement of the door

NOTE Side and invert sealing is effected at all intermediate positions between open or closed.

3.6 Fixing types

3.6.1
channel rebate fixing
flush invert penstock fixed into pre-formed rebates in the sides and invert of channels with or without anchor bolts and sealed into the rebate in accordance with the manufacturer's instructions

3.6.2
pipe flange fixing
penstock bolted to a pipe flange

3.6.3
wall fixing
rebate/flush invert penstock fixed to vertical walls of channels, chambers or similar structures by means of anchor bolts and sealed to the wall in accordance with the manufacturer's instructions

3.6.4
wall thimble fixing
penstock bolted to a suitable insert, of the required shape, pre-cast into the civil structure

NOTE Wall thimbles may be considered for use when there are very high **off-seating heads**.

3.7 Fluid loadings

3.7.1
head
height of liquid above the penstock invert

3.7.2
operating head
maximum **differential head** against which the penstock can be operated

3.7.3
differential head
difference between the **on-seating head** and the **off-seating head** with the door in the closed position

NOTE See Figure 1.

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3.7.4
maximum static head
maximum possible differential head for which the penstock has to be structurally designed

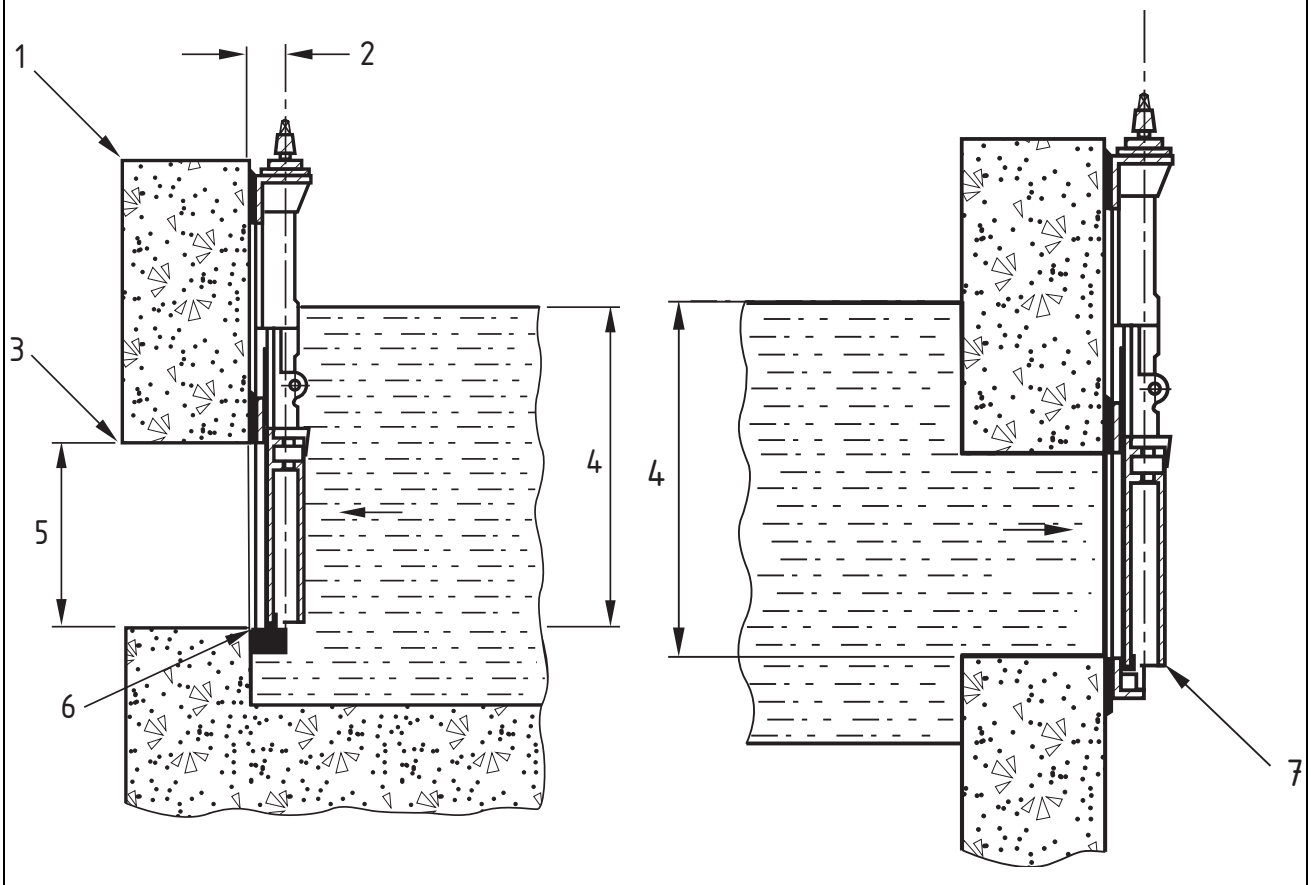
NOTE The static head can be greater than the **operating head**.

3.7.5
on-seating head
head of liquid which forces the door and frame together

NOTE See Figure 1.

3.7.6
off-seating head
head of liquid which acts to force the door and frame apart

NOTE See Figure 1.



a) On-seating head **b) Off-seating head**

Key
1 Coping
2 Outreach
3 Soffit
4 Head (measured from invert to water level)
5 Aperture
6 Flush invert
7 Rebate invert

Figure 1 — Seating arrangements

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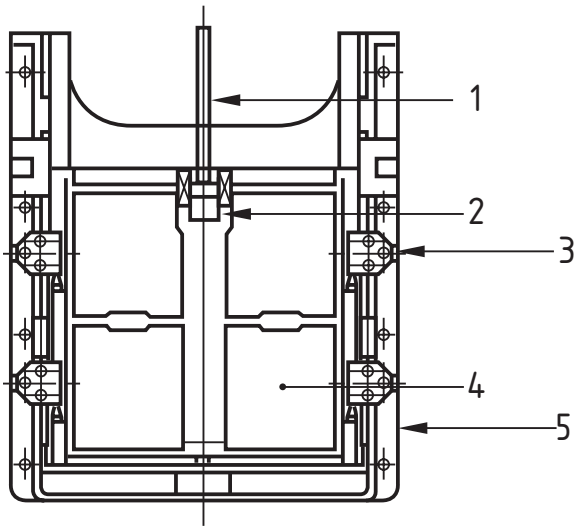
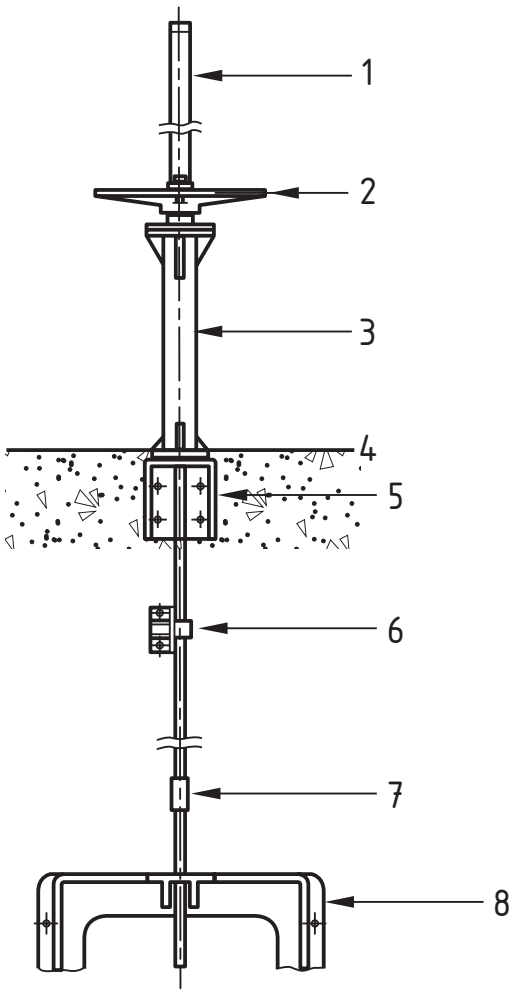


a) Open top penstock frame with door

Key
1 Spindle
2 Spindle nut
3 Wedge/pressure device
4 Door
5 Frame



b) Closed top penstock frame with operating gear

Key
1 Spindle protection tube and door position indicator
2 Operating equipment
3 Pillar
4 Floor or coping
5 Coping bracket
6 Spindle guide bracket
7 Spindle coupling
8 Yoke

Figure 2 — Typical penstock frame with door

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4 Design requirements

4.1 General

The design of all penstock components shall take into account the loads generated directly by the heads and also those created by the selected method of operation. The procedures of **4.2** to **4.12** shall be observed in the design and manufacture of penstocks.

4.2 Penstock types

The operating function, invert type and fixing type of the penstock shall be selected from one of the types defined in **3.5.1**, **3.5.2** and **3.5.3** for the application as stipulated by the purchaser (see Annex A).

4.3 Penstock frame

4.3.1 *Frame design*

When correctly installed the frames shall be of sufficient strength to withstand safely the maximum static head (see **3.7.4**) stipulated by the purchaser (see Annex A) and the resultant forces generated by the operating equipment.

4.3.2 *Type of frame*

Frames shall be one of the following types.

a) Cast iron frames shall be designed and manufactured to conform to BS EN 1561:1997 or BS EN 1563:1997.

b) Fabricated metal frames shall be designed so that the stresses and deflections in the frame do not exceed the safe working figures specified in **4.9.4** and **4.9.5**. Welding shall be in accordance with BS EN ISO 15614-8, BS EN 1418, BS EN 287-1, BS EN 287-2, BS EN 1011-1, BS EN 1011-2 and/or BS EN 288 (all parts), as appropriate. Design and fabrication shall be in accordance with BS 5950-2.

4.3.3 *Frame fixings*

Where applicable, frame fixings shall be sufficient in number and size to prevent any movement of the penstock resulting from the design head conditions and the forces generated by the operating equipment.

4.3.4 *Door guides*

Door guides (see **3.1.9**) shall be provided on the frame.

4.3.5 *Sealing*

Provision shall be made within the frame design for the seal arrangement.

4.3.6 *Wedging or pressure devices*

Provision shall be made within the frame design for the wedging or pressure devices, should the operating conditions require them.

4.4 Penstock door

4.4.1 *General*

The door shall be designed to provide a means of safely withstanding the maximum static head (see **3.7.4**) specified by the purchaser (see Annex A) and the resultant forces generated by the operating equipment. It shall be able to travel freely between the fully closed and fully open positions.

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4.4.2 *Type of door*

Doors shall be one of the following types.

a) Cast iron doors shall be designed and manufactured from material conforming to BS EN 1561:1997 or BS EN 1563:1997.

b) Fabricated metal doors shall be designed so that the stresses and deflections in the door do not exceed the safe working figures specified in **4.9.4** and **4.9.5**. Welding shall be in accordance with BS EN ISO 15614-8, BS EN 1418, BS EN 287-1, BS EN 287-2, BS EN 1011-1, BS EN 1011-2 and/or BS EN 288 (all parts), as appropriate. Design and fabrication shall be in accordance with BS 5950-2.

c) Composite plastic doors shall be fabricated, formed or moulded and shall be suitably reinforced internally or externally as required. If the reinforcement is internal the plastic exterior shall be fully sealed and chemically bonded to the reinforcing matrix and to any cellular polymer or other infill material. The plastic material shall be ultraviolet stabilized in accordance with BS 4618.

4.4.3 *Stem connection*

The door design shall include a means of connecting the door to the stem.

4.4.4 *Door locator*

The door design shall include a means by which it is retained within the frame throughout its travel.

4.4.5 *Sealing*

Provision shall be made within the door design for the seal arrangement.

4.5 Wedging or pressure devices

Wedging or pressure devices (see Figure 2 and **3.1.7**) shall be provided as a means of forcing the door and frame together to achieve the degree of watertightness specified (see **5.2**).

The number of wedges or pressure devices shall be sufficient to withstand the maximum static head specified and the resultant forces generated by the operating equipment (see **3.1.10**).

4.6 Penstock seals

The design of the seals shall take into account the leakage rate (see Clause **5**), environment, operating frequency and minimum life.

4.7 Penstock stem

The stem shall be selected from the types defined in **3.1.6**.

4.7.1 *Stem threads*

The stem threads shall be machine cut or rolled and be of square or trapezoidal form. The thread lead shall be sufficient to provide the required rate of door movement (see Annex A) compatible with the type of operating equipment. The standard thread form shall give clockwise closing.

4.7.2 *Stem size*

The stem shall be designed to withstand the critical compressive load for the operating equipment selected.

The stem slenderness ratio is determined by the unsupported length divided by the radius of gyration and shall be not greater than 200.

4.7.3 *Operating nut*

An operating nut shall be provided as appropriate to the type of stem (see **3.1.6.2** and **3.1.6.3**) and the operational requirements of the purchaser.

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4.8 Penstock operation

4.8.1 *General*

The type of operating equipment shall be selected from one of the types defined in **3.1.10** as specified by the purchaser (see Annex A).

The direction of closing shall be clockwise and shall be clearly marked.

Due consideration shall be given to the penstock construction with respect to the width/depth relationship to minimize lateral movement of the door and the possibility of door jam.

4.8.2 *Input effort*

The input effort shall be limited to a maximum of 250 N on the crank handle, tee key or handwheel rim. This excludes power operation with manual override.

Electric actuators, hydraulic/pneumatic cylinders shall have sufficient power (using the actuator or cylinder manufacturer's recommendations) for the calculated torque or thrust requirements, to operate the penstock against the maximum operating head.

4.8.3 *Operating loads*

The operating loads for penstock component design shall be based on the following maximum torque or thrust criteria.

a) Manually operated equipment: the maximum torque, T_{max}, shall be determined as:

$$T_{max} = T_{in} \times R_{gb} \times F_{eff}$$

where

T_{in} is the input torque;

R_{gb} is the gearbox ratio; and

F_{eff} is the efficiency factor.

b) Electrically operated equipment: after sizing the electric actuator the rated torque of the selected actuator shall be used.

c) Hydraulic/pneumatic cylinder operated equipment: the output thrust shall be determined by applying 80 % of the maximum hydraulic fluid, or air supply pressure to the effective piston area.

4.9 Materials

4.9.1 *General*

All materials selected shall be in accordance with the relevant British Standard and suitable for the environment in which they are to be used. Materials covered by **4.9.2** to **4.9.6** shall be sized in accordance with the design criteria given, and any materials outside this range should be sized to the requirements of the appropriate British Standard. If no standard exists, agreement should be reached between the customer and the supplier with regard to the design criteria to be used for the material.

4.9.2 *Grey cast iron components*

The tensile strength specified in Table 1 of BS EN 1561:1997 shall be used for calculating the required casting section thickness. A minimum factor of safety of five shall be applied to the tensile strength to provide a safe working stress for design purposes.

All cast iron components used in penstock manufacture shall be to BS EN 1561:1997, designation EN-GJL-250 as a minimum.

4.9.3 *Spheroidal graphite cast iron components*

A maximum figure of 0.4 times the 0.2 % minimum proof stress given in Table 3 of BS EN 1563:1997 shall be used when sizing components to be manufactured from spheroidal graphite cast iron.

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4.9.4 *Stainless steel components*

A maximum figure of 0.75 times the 0.2 % minimum proof stress given in Table 10 of BS EN 10088-3:1995 shall be used when sizing components to be manufactured from stainless steel.

All stainless steel components used in penstock manufacture shall be to BS EN 10088-3:1995, grade 1.4301(X5CrNi18-10) as a minimum.

4.9.5 *Carbon steel components*

All carbon steel components shall be designed in accordance with BS 5950-2.

4.9.6 *Constructional fasteners*

Constructional fasteners shall be designed in accordance with the stress criteria specified in BS 449-2 and BS 5950-2.

4.10 Dimensions and tolerances

4.10.1 *Dimensions*

4.10.1.1 *Rectangular aperture ratios*

For penstocks with rectangular apertures (see **3.1.2**) the aperture ratio shall be as follows:

a) for vertical rectangular apertures the height of aperture shall not exceed 3.5 times the aperture width;

b) for horizontal rectangular apertures the width of aperture shall not exceed 2 times the aperture height; in the event that this width ratio is exceeded, then a twin-spindle mechanism should be provided.

4.10.2 *Tolerances*

4.10.2.1 *Metal to metal sealing faces*

Penstock sealing faces shall be accurately formed on the door and frame. When measured, using a feeler gauge, the seal interface gap with the door in the fully closed position shall be not greater than 0.10 mm.

4.10.2.2 *Resilient sealing faces*

Penstocks fitted with resilient seals shall be arranged such that the seals receive the correct amount of compression to meet the performance requirements of this standard (see **5.2**).

4.10.2.3 *Aperture*

The tolerance for penstock aperture dimensions shall be as given in Table 1.

Table 1 — Penstock aperture tolerances

Penstock aperture width or height mm	Cast iron mm	Fabrications mm
Up to and including 500	± 5	± 3
600 to 1 000 inclusive	± 10	± 5
1 000 to 2 000 inclusive	± 20	± 5
2 001 and over	± 1 % of dimension	± 1 % of dimension

4.11 Protective coatings

Unless otherwise stated (see Annex A), the manufacturer's standard protection system, as specified in their product literature, will be supplied.

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4.12 Requirements for penstocks for water intended for human consumption — Effect of materials on water quality

When used under the conditions for which they are intended, all materials in contact with or likely to come into contact with water for public supply should be introduced in accordance with the requirements of Regulation 31 of the Water Supply (Water Quality) Regulation 2000 [1] or Regulation 27 of the Water Supply (Water Quality) (Scotland) Regulation 2001 [2].

NOTE This applies pending the introduction of a European Scheme (EAS).

All materials that are likely to come into contact with water intended for human consumption in the UK shall conform to BS EN 1074-1 and for non-metallic materials including lubricants, the requirements of BS 6920-1.

5 Performance requirements

5.1 General

The performance requirements of the penstock shall be subject to the information supplied by the purchaser (see Annex A).

5.2 Penstock leakage rates

5.2.1 *Rigid sealing faces*

5.2.1.1 *On-seating heads*

For rigid sealing faces (see **3.1.5**) subject to an on-seating head (see **3.7.5**) the leakage rate shall not exceed 1.25 l/(min · m) of seal perimeter.

5.2.1.2 *Off-seating heads*

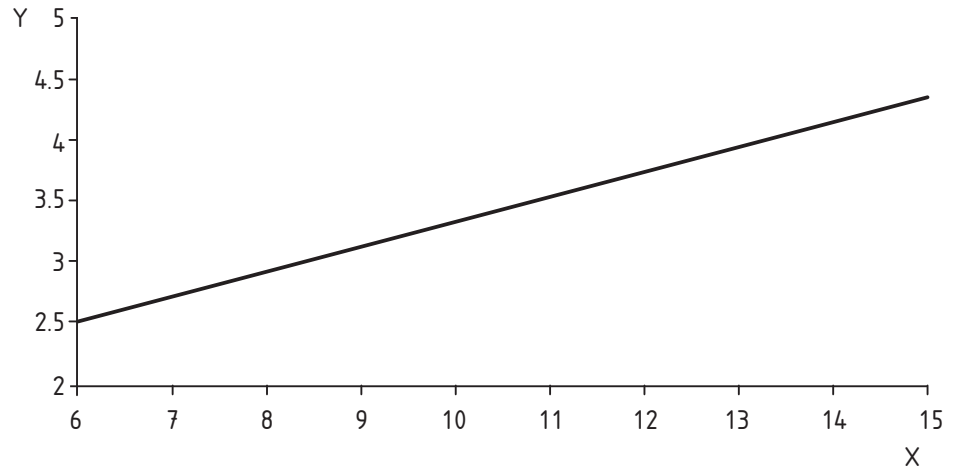
For rigid sealing faces (see **3.1.5**) subject to off-seating heads (see **3.7.6**) up to and including six metres the leakage rate shall not exceed 2.5 l/(min · m) of seal perimeter. For off-seating heads above six metres the maximum leakage rate, R_{lm} (in l/(min · m)), shall conform to:

$$R_{lm} = 1.25 + 0.21H_{os}$$

where

H_{os} is the off-seating head, in metres.

This formula gives the relationship shown in Figure 3.



Key
X Off-seating head H_{os}, in metres
Y Maximum leakage rate R_{lm}, in litres per minute-metre

Figure 3 — Maximum leakage rate for rigid sealing faces under an off-seating head

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5.2.2 *Resilient sealing faces*

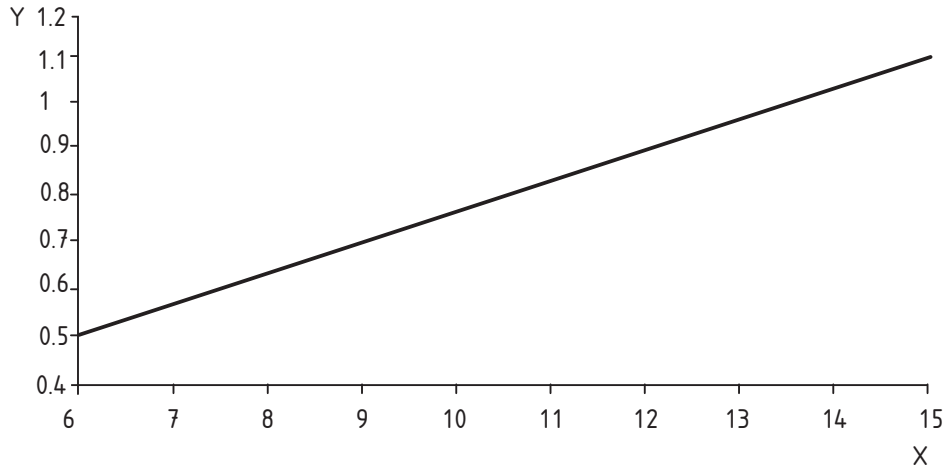
For resilient sealing faces (see **3.1.5**) subject to on- or off-seating heads (see **3.7.5** and **3.7.6**) up to and including six metres the leakage rate shall not exceed 0.5 l/(min · m) of seal perimeter. For on- or off-seating heads above six metres the maximum leakage rate, R_{lm} (in l/(min · m)), shall conform to:

$$R_{lm} = 0.1 + 0.067\ H_{os}$$

where

H_{os} is the on- or off-seating head, in metres.

This formula gives the relationship shown in Figure 4.



Key
X On- or off-seating head H_{os}, in metres
Y Maximum leakage rate R_{lm}, in litres per minute-metre

Figure 4 — Maximum leakage rate for resilient seating faces under either an on- or off-seating head

6 Conformity assessment

6.1 General

The conformity of products to the relevant part of this standard shall be demonstrated by:

a) carrying out all the type tests (see **6.2**) in order to ensure that all fitness for purpose criteria are met; and

b) controlling the production process (see **6.3**) in order to ensure that the required performance levels are continuously reached.

The manufacturer shall ensure that all delivered penstocks are in accordance with the relevant parts of this standard. Should the verification of a requirement be necessary on a supplied product, it shall be done by carrying out the corresponding type test.

6.2 Performance testing

The type tests shall comprise the tests corresponding to all the requirements, as given in the relevant part of this standard. Type tests shall be carried out on penstocks which are representative of the current production.

Type tests results shall be recorded in a test report giving the type, quantity, size and water head of the penstocks tested and indicating the test apparatus and measuring devices that have been used and their calibration criteria.

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In order to qualify a range of penstocks of the same design, manufactured by the same process and from the same materials or equivalent materials, the type tests may be carried out on a limited number of sizes by application of the following rule; when the type tests on one size have given results in accordance with the standard, the two sizes immediately above and the two sizes immediately below are presumed to have passed the same tests.

The type tests shall be carried out by the manufacturer or, at his request, by a competent testing institute. Full reports of these tests shall be retained by the manufacturer as evidence of conformity. The appropriate type tests shall be repeated when the design or the production process has been modified in a way likely to negatively affect its functional capacities.

6.3 Control of production process and quality system

The manufacturer shall control the quality of his products during manufacture by a system of process control to ensure that the manufactured products meet the performance requirements of this standard.

Assessed capability. Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body.

6.4 Certification

Material certification and/or certification of conformity to this standard shall be supplied upon request from the purchaser at the time of order (see Annex A).

7 Marking

7.1 Identification plate

A durable identification plate shall be permanently attached to the penstock. This plate shall show the following information as a minimum (see Figure 5):

a) the number of this standard;

b) the penstock aperture size (e.g. 800 mm × 600 mm);

c) the maximum on-seating head (e.g. 4 m ON);

d) the maximum off-seating head (e.g. 5 m OFF);

e) the weight of the penstock unit (e.g. 1 200 kg);

NOTE For weight purposes the penstock unit does not include any operating equipment.

f) a unique identification number for the penstock.

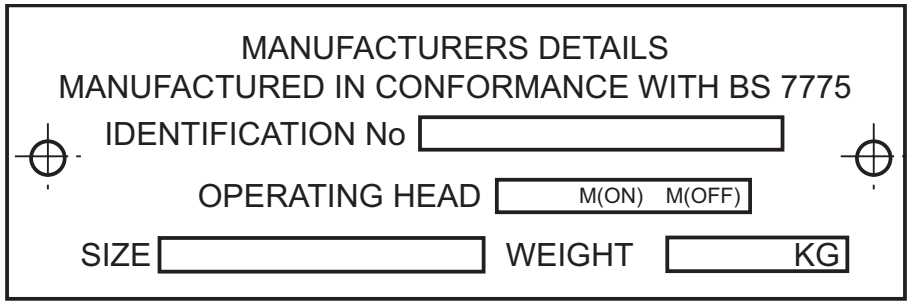

Figure 5 — Typical identification plate

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8 Packaging

Penstocks and associated equipment shall be packaged and/or protected by the manufacturer against mechanical damage and ingress of foreign matter during handling, transportation and storage, in accordance with the manufacturer's instructions except when otherwise agreed between manufacturer and purchaser.

9 Installation

9.1 General

Correct installation is critical if the penstock is to meet the requirements of the standard.

The manufacturer shall provide general installation, operation and maintenance documentation for the penstock and associated equipment supplied in accordance with this standard.

9.2 Operating manuals

If the purchaser requires detailed operating manuals (see Annex A), in addition to those supplied by the manufacturer under **9.1**, such operating manuals shall be the subject of a clearly defined agreement between the purchaser and the manufacturer.

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Annex A (normative)
Information to be supplied by the purchaser

Table A.1 shall be completed by the purchaser for the procurement of a penstock in accordance with BS 7775 and shall be provided with an enquiry and/or order. The purchaser is also required to provide drawings of the intended location of the penstock to the manufacturer.

In the absence of some or all of the above information being provided by the purchaser, the manufacturer may offer a default value. It is the purchaser's responsibility to ensure that all the above information is provided at the time of order.

Table A.1 — Information to be supplied to the manufacturer

Item	Subject	Subclause	Purchaser requirements (delete as required)
	Penstock type	**4.2**	a) On-seating / off-seating b) Flush invert / rebate invert / weir
	Fixing type	**3.6**	Channel rebate / pipe flange / wall / wall thimble
	Maximum static head	**3.7.4**	……m from penstock invert to top water level off-seating (upstream) ……m from penstock invert to top water level on seating (downstream)
	Penstock construction		Cast iron / fabricated (state material) / composite / other
	Material (if applicable)		Carbon steel / stainless steel / aluminium / other (give details)
	Stem type	**3.1.6**	Rising / non-rising
	Penstock operation	**3.1.10**	Manual / electric / hydraulic / pneumatic Height of hand wheel will be deemed to be nominally one metre above operating platform level unless advised otherwise
	Operating function	**3.4**	Control / isolation Penstock operation frequency Door speed ……mm/minute (250 mm/min to 300 mm/min is standard for power operation)
	Penstock aperture	**3.1.2**	Width …..mm, height ……mm, diameter …..mm
	Certificates of conformity	**6.4**	Required / Not Required
	Fluid	Water / waste water / other (give details)	
	Operating environment	Inland / industrial / coastal	
	Lubrication	Manual greasing / automatic greasing	
	Protective coating	Manufacturer's standard / other (give details)	
	Testing requirements	On site leakage test required / not required / other (give details)	
	Additional supply items	For example: installation, commissioning, control panels, hydraulic power pack (single/double skinned), operation and maintenance manuals	
	Particular requirements		

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