BS EN 13077:2023

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BSI Standards Publication

Devices to prevent pollution by backflow of potable water — Air gap with non-circular overflow (unrestricted) — Family A — Type B

bsi.

National foreword

This British Standard is the UK implementation of EN 13077:2023. It supersedes BS EN 13077:2018, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/504/-/14, Valves and fittings for buildings & devices to prevent pollution by backflow.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

Devices to prevent pollution by backflow of potable water - Air gap with non-circular overflow (unrestricted) - Family A - Type B

Dispositifs de protection contre la pollution de l'eau potable par retour - Surverse avec trop-plein non-circulaire (totale) - Famille A - Type B

Sicherungseinrichtungen zum Schutz des Trinkwassers gegen Verschmutzung durch Rückfließen - Freier Auslauf mit nicht kreisförmigem Überlauf (uneingeschränkt) - Familie A - Typ B

This European Standard was approved by CEN on 23 January 2023.

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Ref. No. EN 13077:2023 E

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European foreword

This document (EN 13077:2023) has been prepared by Technical Committee CEN/TC 164 "Water supply", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2023, and conflicting national standards shall be withdrawn at the latest by September 2023.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13077:2018.

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The main changes compared to the previous edition are listed below:

a) terms and definitions have been amended;

b) Figure 1, Figure 4 and Figure 5 have been updated and redrawn;

c) Figure 6 has been added as an additional overflow arrangement;

d) the dimension D has been redefined;

e) 7.4 and 7.5 have been revised;

f) Annex B has been deleted.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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Introduction

With respect to potential adverse effects on the quality of water intended for human consumption, caused by the product covered by this document:

a) this document provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA;

b) it should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

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1 Scope

This document specifies the characteristics and the requirements of air gap with non-circular overflow (unrestricted) Family A, Type B for nominal flow velocity not exceeding 3 m/s. Air gaps are devices for protection of potable water in water installations from pollution by backflow. This document applies to air gaps in factory-assembled products and to constructed air gaps *in situ* and specifies requirements and methods to verify and ensure compliance with this document during normal working use.

The fluid in the receiving vessel is assumed to have similar properties to water. Where this is not the case, additional care or tests could be required to verify the efficacy of the solution in practical use.

The AB device is intended to be used in potable water installations according to EN 806 (all parts).

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 806-1, *Specifications for installations inside buildings conveying water for human consumption - Part 1: General*

EN 806-5:2012, *Specifications for installations inside buildings conveying water for human consumption - Part 5: Operation and maintenance*

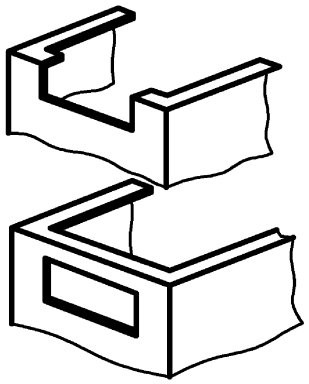
EN 1717, *Protection against pollution of potable water in water installations and general requirements of devices to prevent pollution by backflow*

3 Terms and definitions

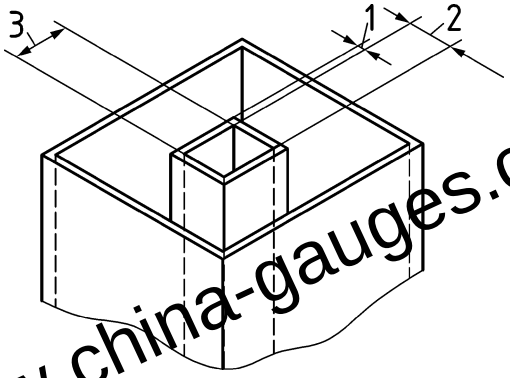
For the purposes of this document, the terms and definitions given in EN 806-1 and EN 1717 and the following apply.

3.1
air gap with non-circular overflow (unrestricted) Family A, Type B
permanent and vertical distance between the lowest point of the inlet orifice and the critical water level of the receiving vessel having an overflow which is non-circular in design

Note 1 to entry: See Figure 1 for the design principle.



a) Air gap with non-circular overflow



b) Internal non-circular overflow arrangement

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Key

1 $Cw \leq 20$ mm

2 $Ow \geq 2D + h$ and never < 20 mm (single inlet)
$Ow \geq A + h$ and never < 20 mm (multiple inlets)

3 $l \geq 10\ h$

Figure 1 — Design principle

3.2
spillover level
level at which water will start to overflow the receiving vessel with all outlets closed

3.3
critical water level
physical or piezometric level of the liquid reached in any part of the appliance 2 s after closing the water inlet starting from maximum level

3.4
dimension *h*
height between the spillover level and the critical water level

Note 1 to entry: See 7.6 for measurement and calculation. For example, see Annex A.

3.5
maximum level
highest water level *H* reached above the spillover level with flow rate *Q* applied and all outlets closed

3.6
diameter of feed pipe outlet orifice (bore *D*)
internal diameter size of the outlet feed orifice (or calculated from the equivalent cross sectional area)

3.7
unrestricted
during fault condition, the water pathway to the overflow (of the receiving vessel) is not compromised including through the overflow itself

4 Designation

An air gap with non-circular overflow (unrestricted) Family A, Type B is designated by:

— name;

— reference to this document, EN 13077;

— family and type;

— maximum permitted flow rate (Q).

EXAMPLE Air gap, EN 13077, Family A, Type B, Q l/min.

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5 Symbolization

The graphic representation of the air gap with non-circular overflow (unrestricted) Family A, Type B is as follows (see Figure 2).

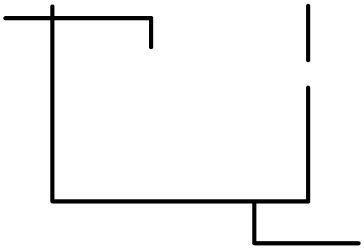

Figure 2 — Graphic symbol

6 Materials

All materials coming into contact with water intended for human consumption shall present no health risk nor cause any change of the drinking water in terms of quality, appearances, smell or taste. All materials shall be compatible among themselves and with the water supplied and with the fluids or substances that can come into contact with them.

There are no special requirements concerning the materials downstream of the feed orifice provided they do not have any harmful effect on the upstream part or the overflow arrangement.

7 Requirements

7.1 General

The protection assembly comprises three parts:

— water inlet device;

— receiving vessel (container);

— non-circular overflow.

7.2 Characteristics and tests

7.2.1 General

Performance tests shall be carried out on the device as installed in accordance with the manufacturer's technical documents. If not specified, all tests shall be performed with water at an ambient temperature.

7.2.2 General tolerances and measurements

— flow rate and pressure: ±2 % of the value specified;

— temperature: ±5 °C of the value specified;

— time: $\frac{+10}{-0}$ % of the value specified.

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7.2.3 Accuracy of measuring instruments

All the measuring instruments shall have an error limit of ±2 % of the measured value.

7.2.4 Measurements

All measurements shall be in mm or l/min unless otherwise specified.

7.3 Water inlet device

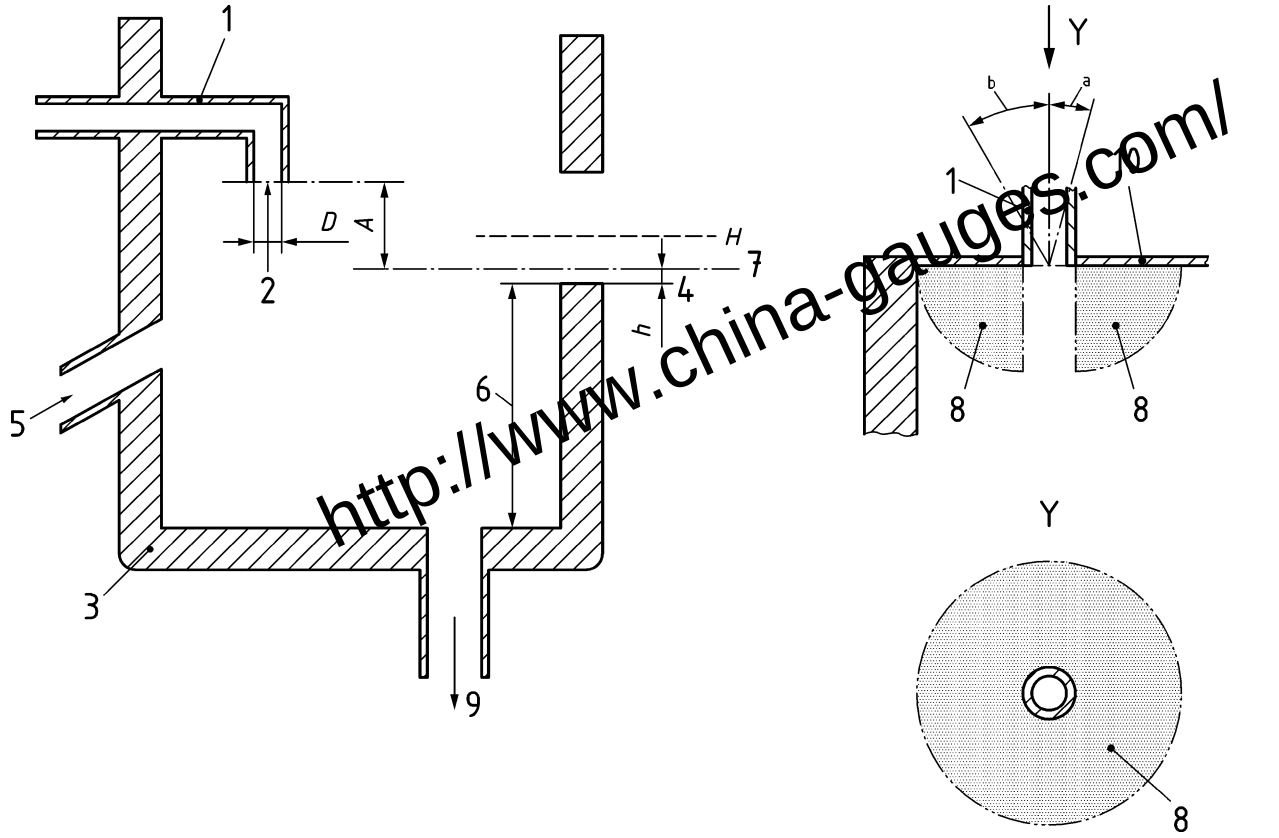
Any device controlling the supply of water into a receiving vessel shall be securely attached to the vessel. Every feed pipe supplying water to such a valve assembly or other device shall be fixed in its position to prevent it from moving or buckling and to maintain a 2D radial clearance around the outlet. If a 2D with a minimum of 20 mm clearance is not present, in addition to the air gap validation a vacuum test in accordance with Annex B shall be undertaken and the radial clearance shall be > D.

The direction of flow from a feed pipe into the receiving vessel shall be into air at atmospheric pressure, downwards and not more than 30° from the vertical. If the direction of flow is < 15°, the air gap shall be validated by calculation or by test, if it is ≥ than 15° it shall be verified by test.

There shall be no contact between the upstream potable water carrying components and the liquid in the receiving vessel.

When maintaining the maximum flow rate at normal operating conditions, the feed pipe, inlet device and its outlet shall not come into contact in any way with a product from downstream; it shall always be above level *H* (see Figure 3).

The water pathway to the overflow shall be unrestricted.



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a) AB air gap general assembly

b) Radial clearance around vertical inlet

Key

A air gap (distance)
D bore or equivalent cross section
H maximum level
h height between spill over and critical water level
a 15° maximum from the vertical flow (validation by test or calculation)
b 30° maximum from the vertical flow (validation by test only)
1 feed pipe
2 feed orifice with a minimum diameter *D*
3 receiving vessel
4 spillover level
5 optional warning pipe
6 $Uw \geq 5h$ (internal vertical surface)
7 critical water level
8 minimum radial clearance around the feed orifice
9 outlet from the receiving vessel
10 fixing plate, lid or roof

Figure 3 — Air gap with non-circular overflow (unrestricted) Family A, Type B

7.4 Overflow arrangements

The overflow arrangements at the receiving vessel shall be of non-circular design and discharge immediately into free air.

Overflow extensions are permitted and shall discharge into free air (*p* = atmosphere). The overflow arrangements at the receiving vessel shall be of non-circular design. After the receiving vessel, the geometry of the water pathway may change, as long as it is unrestricted. Any circular overflow extension shall be sized to accommodate the geometry of the original noncircular overflow (Figure 5 b)). Where a wastewater connection is required then they shall discharge via an air break to drain as detailed in EN 1717.

If an overflow extension is used then the air gap shall be confirmed by test, this will also verify that the overflow is unrestricted.

If the overflow is the only air inlet to the receiving vessel, then a vacuum test shall be undertaken as specified in Annex B.

The height of the overflow arrangement *Ow* is ≥ 2D + h and never < 20 mm (see Figures 4, 5 and 6).

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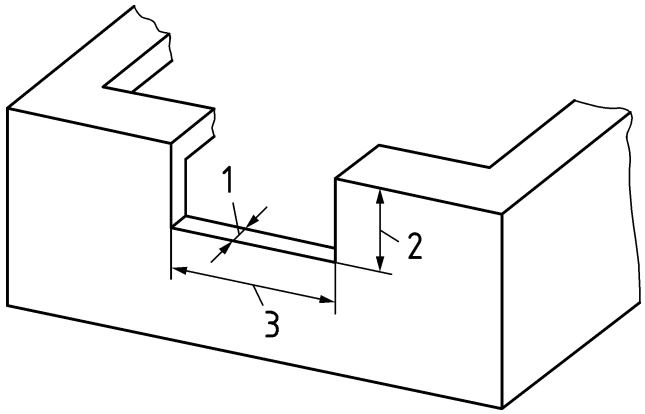


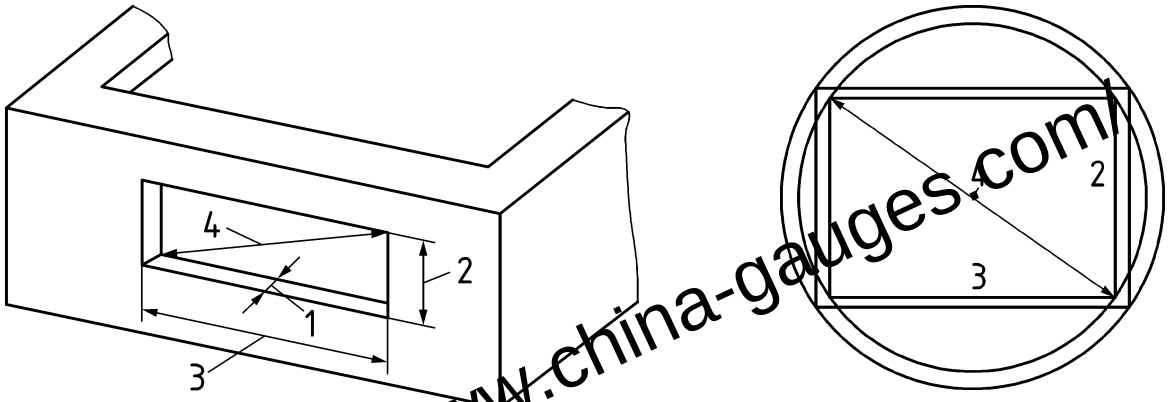
Key

1 *Cw* ≤ 20 mm

2 *Ow* ≥ 2*D* + *h* and never < 20 mm (single inlet)
Ow ≥ A + *h* and never <20 mm (multiple inlets)

3 *l* ≥ 10 *h*

Figure 4 — Rectangular overflow arrangement



a) Letterbox overflow arrangement

b) Minimum inner diameter of a circular extension

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Key

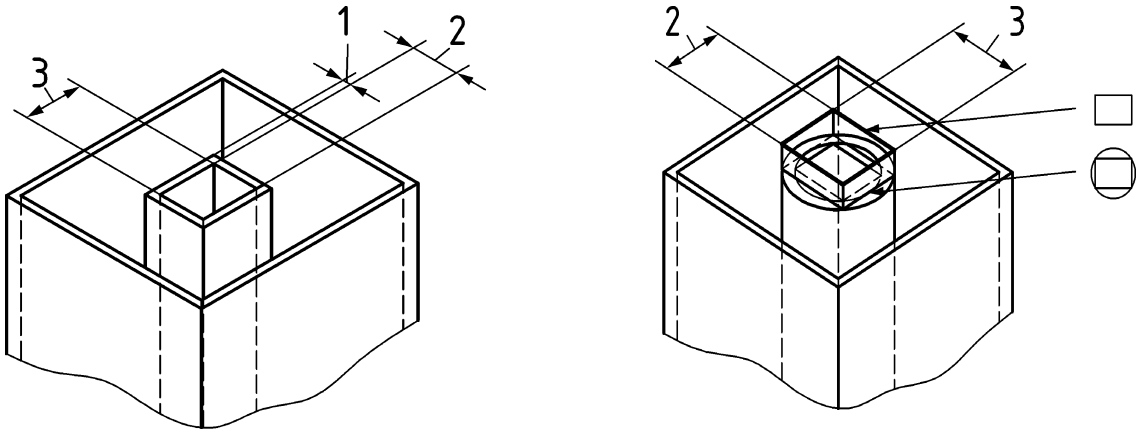
1 $Cw \leq 20$ mm

2 $Ow \geq 2D + h$ and never <20 mm (single inlet)
$Ow \geq A + h$ and never < 20 mm (multiple inlets)

3 $l \geq 10\ h$

4 minimum inner diameter circular / round overflow extension

Figure 5 — Overflow arrangement



a) Internal overflow arrangement

b) Internal overflow arrangement from angular to circular

Key

1 $Cw \leq 20$ mm

2 $Ow \geq 2D + h$ and never < 20 mm (single inlet)
$Ow \geq A + h$ and never < 20 mm (multiple inlets)

3 $l \geq 10\ h$

Figure 6 — Internal overflow arrangement

NOTE There is no relationship between the maximum water level and the top-most level of the overflow arrangement. An additional warning pipe can also be fitted if required.

7.5 Air gap distance A

7.5.1 General

For air gaps Family A, Type B the critical water level shall be established and the air gap distance A measured from the lowest point of the water inlet(s) (2) to the critical water level (see Figure 3).

For single supply see 7.5.2 and multiple supplies see 7.5.3.

For non-circular inlet orifices, the dimension D shall be determined by calculating the cross sectional area of the non-circular orifices and then determining the corresponding diameter having an identical cross sectional area of the original.

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7.5.2 Single supply

If (D) < 25mm, then the critical water level (3.3) shall be determined by test only using 7.5.2 a).

If (D) ≥ 25mm, then the critical water level (3.3) may also be determined by calculation using 7.5.2 b).

The air gap distance A shall be ≥ $2D$ and ≥ 20 mm and h is determined either by:

a) test, by measurement of the depth of water above the spillover level of the overflow arrangement, 2 s after the inflow equal to $Q = 0{,}14\ D^2$ in litres per minute has stopped. If the flow rate Q cannot be achieved, then apply a dynamic pressure of 1 MPa (10 bar) at the inlet of the arrangement;

   If the maximum recommended flow rate for manufactured appliances is greater than the calculated flowrate Q, then the air gap shall be validated by test using the maximum recommended flow rate.

   NOTE Converting mm to m, m^3/s to l/min results in the factor "0,14".

b) calculation if the diameter D ≥ 25mm by determining the depth of water above the spillover level of the overflow arrangement using the following formula:

$$h = \sqrt[3]{\left(\frac{10^3 \times Q}{3{,}143 \times l}\right)^2} \qquad (1)$$

   where

   Q is the inflow in litres per minute at 3 m/s;

   l is the width of the overflow arrangement in millimetres.

The calculation is only valid where:

— no overflow extension is used;

— width (l) ≥ 10 h at the spillover level;

— crest thickness of the overflow arrangement (Cw) ≤ 20 mm;

— upstream internal vertical face of the overflow arrangement (Uw) ≥ 5 h;

— the depth of the overflow arrangement or notch (Ow) ≥ $2D + h$ and never ≤ 20 mm;

— the direction of flow from the feed pipe into the receiving vessel is downward and ≤ 15° from the vertical;

— the overflow at the receiving vessel is rectangular in design.

In all other cases the air gap dimension *A* shall be determined by test; see 7.5.2 a).

7.5.3 Multiple supplies

In the case of multiple feed pipes to a single vessel having a non-circular unrestricted overflow, the minimum air gap for the potable water supplies shall be dimension *A* (2xD') above the critical water level (see Figure 3), calculated by using all (potable and non-potable) bore diameters *D*.

The equivalent diameter (*D*') shall be calculated as follows:

$$D' = \sqrt{\sum D1^2,\ D2^2 etc} \quad (2)$$

If (D') < 25mm, then the critical water level (3.3) shall be determined by test only using 7.5.2 a).

If (D') ≥ 25mm, then the critical water level (3.3) may also be determined by calculation using 7.5.2 b).

If the critical water level (3.3) is determined by test, this shall be done 2 s after stopping the inflow of each potable inlet in turn and the critical water level determined for each inlet with all feed pipes discharging at an individual inflow calculated at $Q = 0{,}14\ D^2$ in litres per minute at 3 m/s. If the flow rate *Q* cannot be achieved, apply a dynamic pressure of 1 MPa (10 bar) at all inlets. No potable feed orifice shall be < distance *A* above the critical water level.

For calculating air gap distance *A*, use:

$$A = 2xD' \quad (3)$$

For multiple inlets the dimension:

$$Ow \geq A + h. \quad (4)$$

7.5.4 Backflow/back pressure

If the receiving vessel can be subject to positive pressure backflow, it is important that the inlet orifice is positioned so that the ascending/returning backflow fluid cannot contaminate it.

When the air gap is part of an installation which can generate positive pressure backflow, it is essential that a means of limiting the flow rate to a rate which shall not compromise the overflow arrangement is incorporated, i.e. non-return valve fitted upstream of the pressurization unit.

Potable water inlet orifice(s) shall terminate at a higher level than non-potable inlets and never closer than 2 *D* measured radially both horizontally and vertically downwards, see section Y in Figure 3.

7.6 Verification

7.6.1 Procedure for verification by test

The air gap shall be validated by test up to and including a diameter D of 25 mm (or equivalent D') and in all cases where an overflow extension is used. For diameter D ≥ 25 mm (or equivalent D') the air gap shall be validated by test or by calculation. Procedure for verification by test (see 7.5.2 a) or 7.5.3). If the air gap is incorporated in an appliance, then the appliance and air gap shall be validated by test.

a) Sequence of test:

   1) Close all outlets (except the overflow). If an overflow extension is fitted with an air break to drain the outlet of the air break to drain shall be closed.

   2) Identify *D*.

   3) Calculate *Q*.

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4) Apply flow rate *Q* or 1 MPa (10 bar) (if flowrate *Q* cannot be achieved) at the inlet and maintain the maximum water level (H) for at least 20 seconds.

5) Note contact with potable inlet device(s) during filling and at the maximum level. The water level may fluctuate during filling, but shall not be in contact with the potable inlet device(s).

6) Stop flow rate *Q*. (For multiple supplies, each source will be stopped individually, see 7.5.3.)

7) After a minimum of (2 +1) s establish the critical water level.

8) Measure the vertical air gap distance (A) between critical water level and the lowest point of the potable feed pipe orifice.

9) Measure the radial clearance around the outlet of the water inlet device.

10) Verify the angle of the feed pipe orifice and its outlet.

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b) Requirements:

1) No contact shall be observed between the receiving vessel fluid and the potable inlet device(s).

2) The radial clearance around the water inlet feed pipe shall be ≥ 20mm or ≥ 2D, whichever is the greater.

3) Where this is not the case then undertake a vacuum test in accordance with Annex B. During the vacuum test there shall be no evidence of backflow.

4) For single inlets, the height *Ow* shall be ≥ 2*D* + *h* and never < 20 mm.

5) For multiple inlets, the height *Ow* shall be ≥ A + *h* and never < 20 mm.

6) The angle of the feed pipe and its outlet < 30°.

7.6.2 Procedures for verification by calculation

a) Sequence of test:

1) Calculate h if all the parameters detailed in 7.5.2 b) are satisfied.

2) Identify *D*.

3) Measure the vertical air gap distance (A) between critical water level and the lowest point of the potable feed pipe orifice.

4) Measure the radial clearance around the outlet of the water inlet device, if the radial clearance around the water inlet feed pipe < 2D or 20 mm then undertake a vacuum test in accordance with Annex B.

5) Verify the angle of the feed pipe and its outlet.

b) Requirements:

1) The air gap distance A shall be ≥ 2D' and never < 20 mm.

2) The radial clearance around the outlet of the inlet device shall be > 2D.

3) The angle of the feed pipe and its outlet is < 15°.

8 Marking

Each appliance incorporating an air gap with non-circular overflow (unrestricted) Family A, Type B shall be clearly and permanently marked and accessibly visible.

Marking shall indicate:

a) manufacturer's brand or logo;

b) letter indicating family and type of air gap (AB-protection unit symbol according to EN 1717);

Following addition information shall be supplied in technical documentation or operation instruction:

c) reference to this document, EN 13077;

d) reference (type or model, etc.);

e) serial number, where applicable;

f) maximum permitted flow rate.

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9 Technical documents

The manufacturer's documentation shall include the appropriate installation requirements to ensure that the air gap is not compromised, including positive pressure backflow and ensures that the overflow is not compromised.

The manufacturer shall state the type of materials chosen in his technical and commercial documents.

The manufacturer shall make reference to EN 806-5:2012, Annex A and Annex B, which give details for operation and maintenance required for these arrangements.

Annex A
(informative)

Relationship between *h* and *l* for air gap Family A, Type B with rectangular overflow

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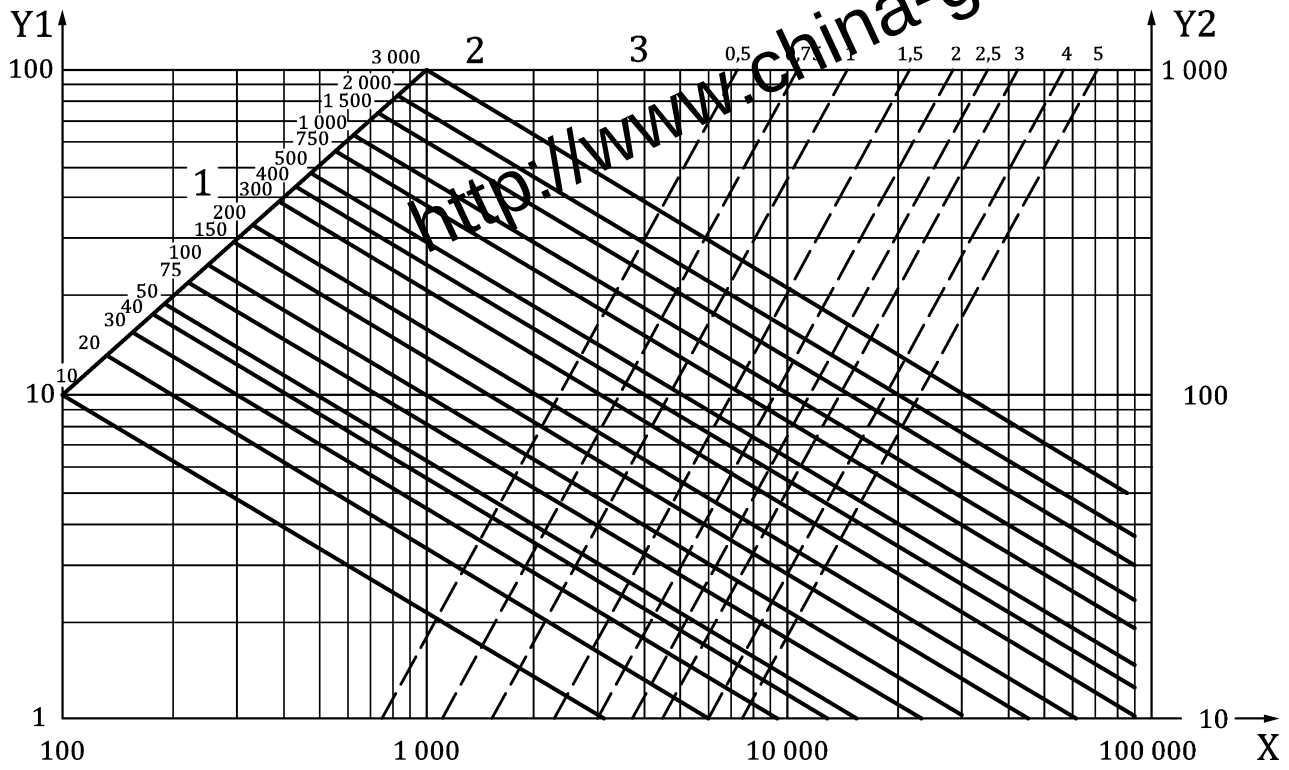

Key

Y1	depth over overflow arrangement (*h*) in millimetres
X	overflow width (*l*) in millimetres
Y2	pipe bore (*D*) in millimetres
1	flow (*Q*) in litres per minute
2	limit of the width of the overflow arrangement $l = 10\ h$
3	velocity (*v*) in metres per second

Figure A.1 — Relationship between *h* and *l* for air gap with rectangular overflow

Annex B
(normative)

Vacuum Test

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B.1 Apparatus

The test apparatus shall be arranged and constructed (example shown in Figure B.1) so that the absolute pressure measured near the device under test on its supply side remains < 50 kPa (0,5 bar) for at least 5 s.

NOTE These conditions indicate the existence of choking air flow. Details of the components are given in B.1.1 to B.1.4.

B.1.1 Vacuum vessel and connecting pipework, of sufficient strength to support a total vacuum safely. The vacuum vessel shall be provided with a drain valve to remove any water drawn into the vessel during the test.

Recommended capacities of the vacuum vessel are given in Table B.1.

B.1.2 Vacuum device, typically capable of reducing the absolute pressure within the vacuum vessel to 20 kPa (−80 kPa gauge pressure).

B.1.3 Pipes and fittings, of nominal size not less than the bore of the orifice at the lowest part of the inlet or feed part of the device under test. If the air gap is not visible, the connecting pipework shall be of transparent material.

Any valve fitted in the test pipe shall be a full-way valve offering an unimpeded flow path.

Connections to the vacuum vessel shall not unduly impede the fluid flow and shall have a low loss pipe.

B.1.4 Vacuum gauges, 100 kPa to 0 kPa (0 kPa to −100 kPa gauge pressure).

The gauge connection shall be made in such a way that it does not disturb the flow in the pipework.

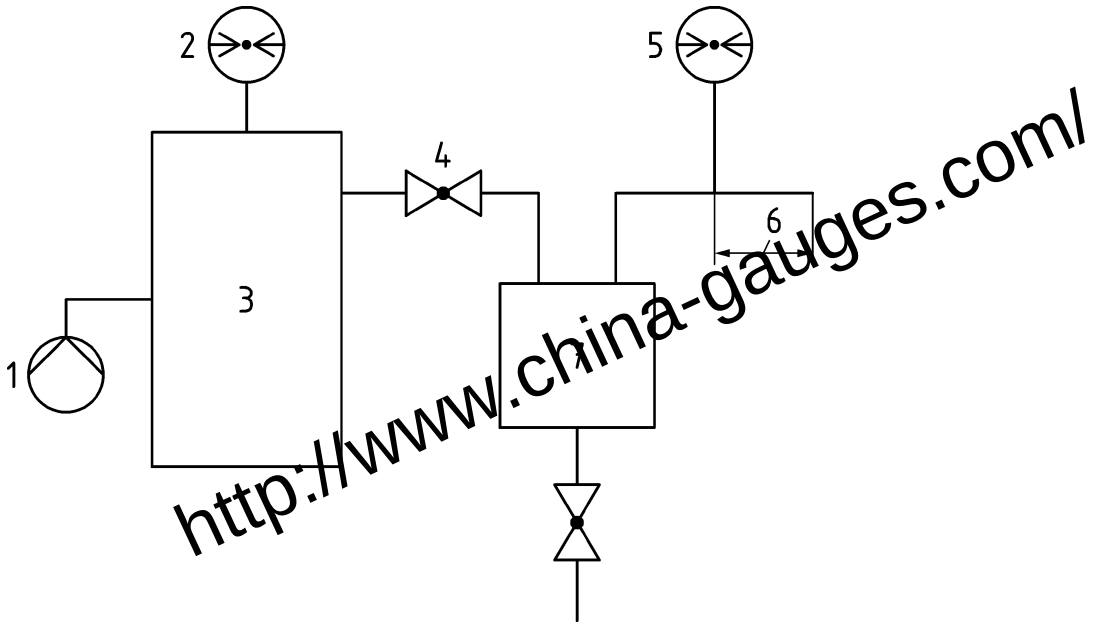
B.2 Procedure

B.2.1 Remove or render inoperative any upstream additional backflow prevention devices.

B.2.2 Connect the device to be tested to the test apparatus.

B.2.3 Maintain the inlet device in the open position.

B.2.4 Set the critical water level as detailed in 7.5.2 a) or 7.5.2 b) as appropriate to verify the air gap. The critical level shall be maintained undisturbed during the test by supply from a separate source that shall be submerged to prevent disturbance of the water surface.



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Key

1 vacuum pump
2 vacuum gauge A
3 vacuum vessel
4 full-way valve
5 vacuum gauge B
6 pipe length (5 DN to 10 DN) to the air gap arrangement being tested
7 transparent catch pot with drain

Figure B.1 — Example of an arrangement of apparatus for vacuum test

B.2.5 Close the full-way valve.

B.2.6 Evacuate the vacuum vessel to an absolute pressure of 20 kPa (–80 kPa gauge pressure, as indicated by vacuum gauge A).

B.2.7 Open the full-way valve within a period of 2 s.

B.2.8 Read the vacuum gauge B. Check that the absolute pressure does not exceed 50 kPa (–50 kPa gauge pressure) and maintain for a period of at least 5 s after the fullway valve is fully open.

B.2.9 If the absolute pressure does not remain below 50 kPa (–50 kPa gauge pressure) for at least 5 s reduce the flow resistance of the connecting pipework by increasing the bore of the pipe between the vacuum gauge B and the vacuum vessel and/or by reducing its length.

B.2.10 Observe the air gap, or the transparent tube for evidence of backflow of water.

B.3 Requirement

There shall be no visible evidence of backflow.

Table B.1 — Recommended Vacuum Vessel Capacities

Bore of orifice at lowest part of inlet or feed pipe (mm)	**Recommended minimum capacity of vacuum vessel** (m^3)
< 22	1,5
> 22 < 54	4
> 54 < 76,1	10
> 76,1 < 108	20
> 108 < 159	35

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