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Siphonic roof drainage systems – Guide

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from the British Standards Institution, and came into effect on 28 February 2025. It was prepared by Technical Committee B/505, *Wastewater engineering*. A list of organizations represented on this committee can be obtained on request to the committee manager.

Supersession

This British Standard supersedes [BS 8490:2007](#), which is withdrawn.

Relationship with other publications

This British Standard should be read in conjunction with [BS EN 12056-3](#).

[BS EN 12056-3](#) covers with the layout and calculation of roof drainage. The provisions for non-siphonic systems are described in detail, but those for siphonic systems are limited to performance requirements. The standard applies to all materials used for roof drainage systems.

This British Standard gives information facilitating the use of [BS EN 12056-3](#) in the United Kingdom with regard to siphonic roof drainage systems; it does not alter any of the provisions of that standard. This British Standard is based on laboratory and site-monitoring studies, involving extensive consultation with manufacturers and installers of siphonic roof drainage systems used in the UK, as well as specifiers.

Information about this document

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Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Use of this document

As a guide, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

This British Standard has been prepared to give information about the majority of installations of siphonic systems but it is impractical to cover every eventuality. In some particular cases, it might not be possible to reflect all the provisions of this standard. In such cases it is advisable to discuss any departures with the client or the client's appropriately qualified representative.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The guidance in this document is presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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Introduction

This British Standard has been written to assist a specifier, designer or installer of a siphonic drainage system to embody a good practice approach, providing guidance on how to meet the performance requirements of [BS EN 12056-3:2000](#), **6.2**. It also provides detailed guidance on methods and practises developed to meet the particular methods of construction, but which have applicability outside the UK with similar construction methods.

1 Scope

This British Standard provides guidance and recommendations for roof drainage systems using circular-section pipes that operate under siphonic action, including:

- a) design parameters;
- b) installation;
- c) verification; and
- d) maintenance needs of siphonic roof drainage systems conforming to the performance requirements in [BS EN 12056-3:2000](#), **6.2**.

Guidance is also given on carrying out testing of outlets and checks of designs, for the use of specifiers and regulatory authorities.

Recommendations for site drainage systems that receive flows from siphonic roof drainage systems are also covered.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document¹⁾. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[BS EN 12056-3:2000](#), *Gravity drainage systems inside buildings – Roof drainage, layout and calculation*

[BS EN 16933-2:2017](#), *Drain and sewer systems outside buildings – Design – Part 2: Hydraulic design*

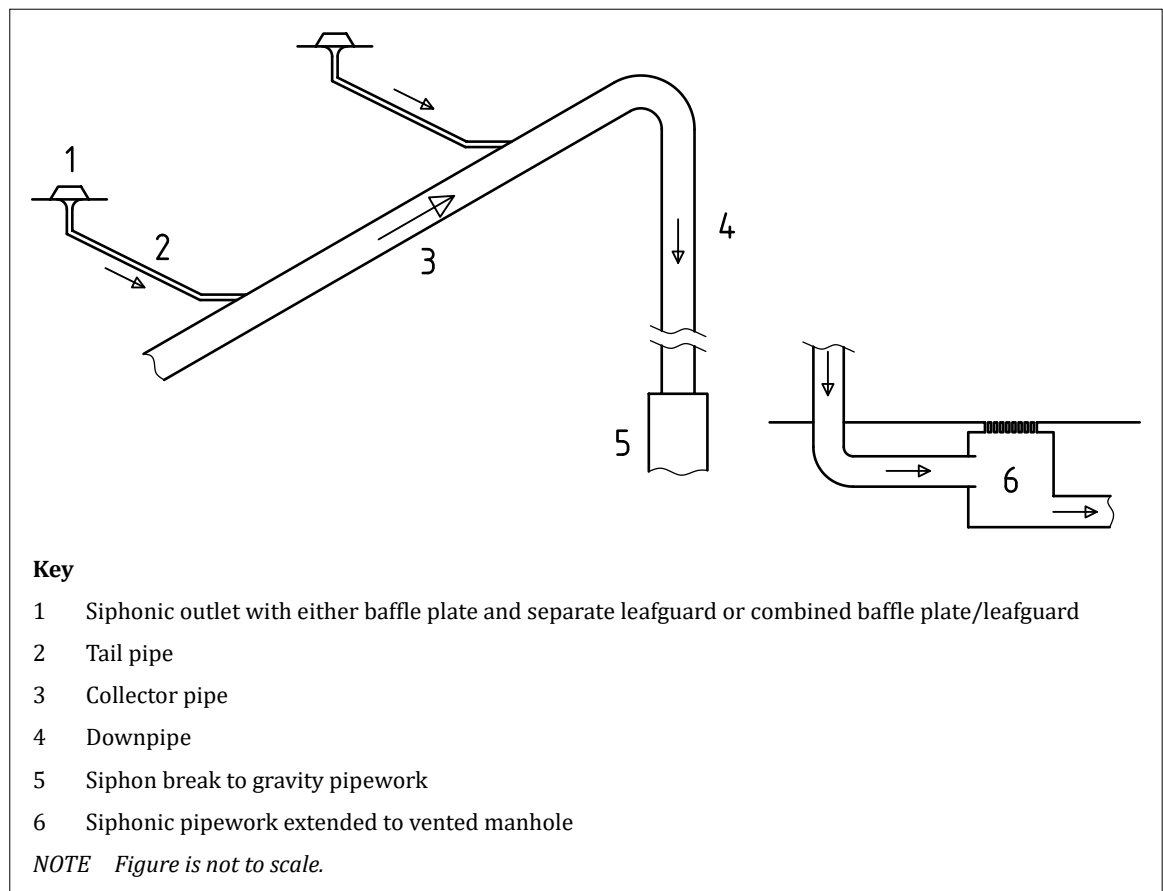
3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in [BS EN 12056-3](#), [BS EN 16323](#) and the following apply.

NOTE The principal components of a siphonic roof drainage system are illustrated in [Figure 1](#).

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

Figure 1 — *Principal components of siphonic roof drainage systems***3.1.1 brown roof**

roof where the substrate surface is left to self-vegetate

3.1.2 cavitation

phenomenon involving the formation and subsequent sudden collapse of vapour cavities in a liquid

NOTE Cavities form when the local pressure within the flow reduces close to that of the vapour pressure of the liquid.

3.1.3 collector pipe

horizontal pipe installed below a roof or gutter that collects and conveys the flow from the tailpipes of roof outlets

3.1.4 design flow rate

flow rate in a siphonic roof drainage system or associated gutter

NOTE The design flow rate is calculated using design rainfall data from BS EN 12056-3, plus a safety factor of not less than 1.1.

3.1.5 downpipe

section of vertical pipe in pipework connecting a collector pipe to a siphon break or to the point of discharge from a siphonic system

3.1.6 full-bore flow

flow conditions under which the water (and any entrained air carried by the water) occupies the full cross-section of a pipe

3.1.7 green roof

roof on which vegetation or a habitat for wildlife is established

3.1.8 overflow

device installed in a gutter or flat roof that discharges the flow if the water level rises above the designed overflow level

NOTE 1 For example, due to exceptional rainfall or blockages at outlets.

NOTE 2 Possible devices include weirs, chutes, conventional outlets or additional siphonic outlets.

3.1.9 primary system

fittings and pipework designed to drain a roof or gutter for rainfall conditions up to a selected frequency of occurrence

3.1.10 rating curve of outlet

relationship between the flow rate entering an outlet and the water depth in a gutter or flat roof close to the outlet

3.1.11 secondary system

fittings and pipework designed to drain a roof or gutter if rainfall conditions exceed the capacity of the primary system or if a failure of the primary system were to occur

3.1.12 siphon break

termination point of a siphonic system at which the pressure is maintained equal to atmospheric pressure and which is designed to stop siphonic action downstream

3.1.13 siphonic outlet

fitting at the entrance to a siphonic roof drainage system to permit rainwater to drain from a roof or gutter and designed to exclude air entering the pipework

3.1.14 tailpipe

section of vertical, sloped and possibly horizontal pipework connecting a roof outlet to a horizontal collector pipe

3.1.15 vented cover

fully open grating fitted at the first manhole where the siphonic system discharges, allowing air to be vented during filling of the system and water to be discharged should the underground system become surcharged

3.2 Symbols

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

A effective roof area draining to outlet, in square metres (m^2)

d_i internal diameter of pipe, in metres (m)

g acceleration due to gravity, in metres per second per second (m/s^2)

NOTE The value of g is taken as 9.81 m/s^2 .

H_A overall head of water available for functioning of siphonic system, in metres (m)

H_D loss of water head between top of downpipe and point of discharge from system, in metres (m)

H_0 local atmospheric pressure measured above vacuum, expressed as equivalent head of water, in metres (m)

H_{PZ1} is the pressure at the top piezometer (m)

H_T	total loss of water head in system between an outlet and point of discharge, in metres (m)
H_{TF}	total frictional loss of water head in system between an outlet and point of discharge, in metres (m)
H_{TT}	average water depth in the tank during pressure measurement (m)
H_V	velocity head of flow, in metres (m)
h_i	value of h at point number i in system, in metres (m)
h_M	minimum pressure head of water occurring in system (relative to atmospheric pressure), in metres (m)
h_{min}	minimum allowable value of h in system, in metres (m)
h_{vp}	vapour pressure of water (expressed as equivalent head of water), in metres (m)
i_F	frictional head loss gradient in pipe, in metres loss of water head per metre length of pipe (m/m)
k_P	value of pipe roughness in Colebrook–White equation, in millimetres (mm)
L_P	length of section of pipe in siphonic system, in metres (m)
P_{Z1}	top piezometer
P_{Z2}	bottom piezometer
Q_{in}	initial flow rate of water entering collector pipe during priming of siphonic system, in litres per second (l/s)
Q_{max}	maximum flow rate of water used in test of outlet, in litres per second (l/s)
Q_o	design flow rate of water to an outlet (equal to area drained multiplied by design rainfall intensity multiplied by factor of safety), in litres per second (l/s)
Q_P	flow rate of water in pipe, in litres per second (l/s)
Q_T	flow capacity of tailpipe when acting siphonically and discharging to collector pipe at atmospheric pressure, in litres per second (l/s)
r	design rainfall intensity, in litres per second per square metre (l/s per m ²)
S	plan area of water surface in tank for testing outlet, in square metres (m ²)
S_F	factor of safety for design of siphonic system and associated gutters, applied as multiplier to flow rates determined using design rainfall intensity
T_F	time to fill siphonic pipework, in seconds (s)
u	mean flow velocity, in metres per second (m/s)
u_{OUT}	mean flow velocity in the outlet throat area (i.e. the spigot section of outlet prior to the connection to the test pipe)
U_{PZ1}	is the mean flow velocity in the pipe at P_{Z1} (m/s)
u_i	value of u at point number i in system, in metres per second (m/s)
V_P	total volume of collector pipe(s) and downpipe to the point of discharge from siphonic system, in litres (l)
Z_D	height of lip of siphonic outlet above top of downpipe, in metres (m)
Z_{PZ1}	vertical height from floor of tank to top piezometer, in metres (m)
Z_{PZ2}	vertical height from floor of tank to bottom piezometer, in metres (m)
Δh	loss of energy head in pipe length, in metres (m) (water head)
Δh_F	loss of energy head in pipe length due to wall friction, in metres (m) (water head)
Δh_L	localized loss of energy head at pipe fitting, in metres (m) (water head)
Δh_o	loss of energy head at siphonic outlet, in metres (m) (water head)
Δh_{12}	loss of energy head between points 1 and 2, in metres (m) (water head)
Δy_{max}	maximum allowable increase in water depth in non-steady test of outlet relative to steady-state water depth at same rate of flow, in metres (m)
Δz_{12}	vertical height of point 1 above point 2, in metres (m)

- ζ dimensionless head loss coefficient for pipe fitting
 ζ_o dimensionless head loss coefficient for siphonic outlet
 ν kinematic viscosity of water, in metres squared per second (m^2/s)
- NOTE* The value of ν for water at 15 °C is $1.14 \times 10^{-6} \text{ m}^2/\text{s}$.
- σ cavitation index of flow

4 General

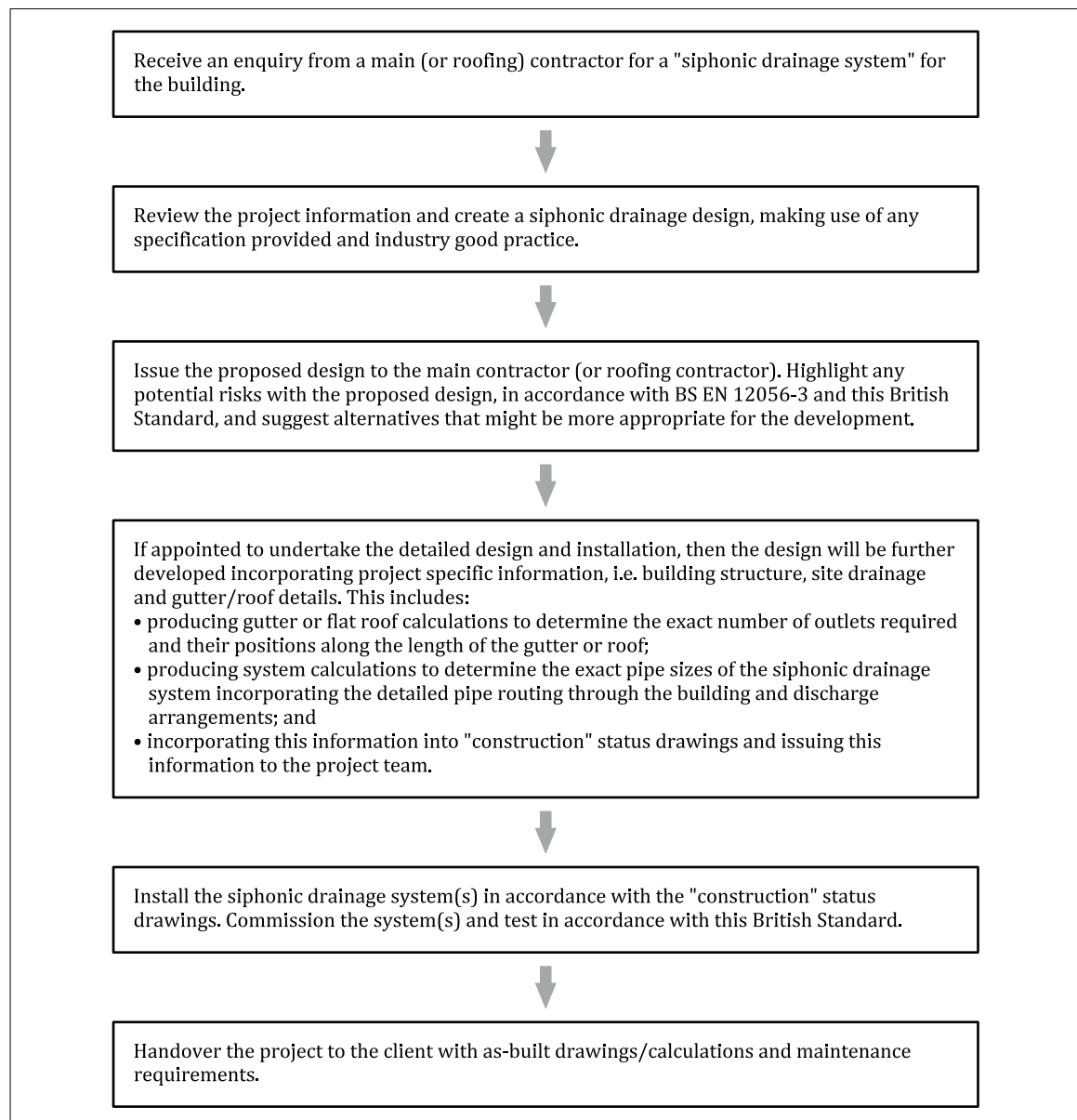
NOTE Annex A describes how siphonic systems operate.

4.1 The specification of a siphonic system should take into account:

- the suitability of the roof to drain siphonically;
- the potential need for primary and secondary systems; and
- the rainfall intensity for the building, as defined in BS EN 12056-3.

4.2 Designing and installing siphonic systems should, as a minimum, be in accordance with Figure 2.

Figure 2 — Design and installation procedure for siphonic roof drainage systems



4.3 Efficient, long-term working of a siphonic system requires the following:

- a) an effective periodic maintenance regime should be implemented to prevent accumulations of debris (e.g. leaves, blown litter, bird feathers) blocking rainwater outlets at roof or gutter level;
- b) correctly dimensioned siphonic systems might have less reserve capacity than that of equivalent gravity systems and therefore safety margins should be taken into account, i.e. design safety factors and suitable overflows should be included;
- c) siphonic roof drainage systems rely on regular self-cleansing flows, which are unlikely to be generated by green roofs or brown roofs; for such types of roof, water is attenuated in the material of the roof and discharges more slowly, therefore the suitability of a siphonic system for green and brown roofs should be taken into account;
- d) roofs of different types (i.e. flat roofs, ballasted roofs, metal roofs with gutters) respond to rainfall differently, and so roofs of different types should not be drained into a common siphonic system, as effective filling of parts might not occur; and
- e) if a siphonic system is subject to a change (during construction and/or throughout the life of the building), a hydraulic reassessment of the system should be carried out.

4.4 When operating under full-bore flow, a siphonic roof drainage system creates a direct flow path between roof level and the site drainage system to which it discharges. Problems below ground can therefore cause flooding at roof level. For this reason, siphonic systems should be designed as an integral component of the building and the drainage infrastructure of the site. Designers of buildings should provide appropriate information on requirements for installation and operation of siphonic systems (see also [Clause 13](#)) to those responsible for the design of roofs, gutters, structures and site drainage systems, including:

- a) where blockage of siphonic outlets would result in water ingress to the building(s), the provision of separate primary and secondary siphonic systems should be determined as this can improve the operation and limit the consequences of blockages to the roof drainage;
- b) siphonic systems designed for long return periods (50 years or greater) do not experience regular operation at design flows and could be at an increased risk of blockages; to minimize this risk, the siphonic system designer should split the system into primary and secondary systems that together cater for the design flow rate, thereby inducing more regular operation;
- c) the siphonic system designer should liaise with the gutter designer to define the size, number and location of gutter outlets and overflows, and carry out calculations to determine flows in the gutter to each outlet;
- d) there should be a specifically engineered solution when draining sloping gutters, in order to reduce local flow velocities at outlets;
- e) space provided beneath gutters for tailpipes and horizontal collector pipes should allow a vertical drop sufficient to permit rapid priming of the tailpipes;
- f) when designing the interface between the siphonic and below-ground surface water drainage systems, any surcharging of the below-ground drainage should not reduce the required design/discharge capacity of the siphonic roof drainage system; and
- g) acoustically sensitive areas within a building should be taken into account when locating routes of internal siphonic pipes (see also [10.5](#)).

4.5 In order to exclude air, siphonic outlets have smaller free areas than equivalent gravity outlets for the water to flow through and are therefore prone to blockage by leaves, debris, etc. In areas where leaf fall is heavy, or where other detritus can collect, a siphonic roof drainage system needs additional routine cleaning measures and access to be incorporated in the building design to minimize the amount of debris reaching the areas around the outlets.