BS 8525-2:2011

BSI Standards Publication

Greywater systems –

Part 2: Domestic greywater treatment equipment – Requirements and test methods

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Contents

Summary of pages

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

Foreword

Publishing information

This part of BS 8525 is published by BSI and came into effect on 15 August 2011. It was prepared by Technical Committee CB/506, *Water reuse*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

BS 8525 is published in two parts:

- Part 1: *Code of practice;*
- Part 2: *Domestic greywater treatment equipment – Requirements and test methods.*

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Hazard warnings

WARNING. This British Standard calls for the use of sewage effluent and this can be injurious to health if adequate precautions are not taken, such as the use of suitable personal protective equipment. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Assessed capability. Users of this part of BS 8525 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.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

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

Contractual and legal considerations

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

Compliance with a British Standard cannot confer immunity from legal obligations.

In particular, attention is drawn to the following regulations:

- The Water Industry Act 1999 [1];
- The Water (Scotland) Act 1980 [2];
- The Water and Sewerage Services (2006 Order) (Commencement No. 3) Order (Northern Ireland) 2010 [3];
- The Water Fittings Regulations [4];

NOTE In this standard, the following national regulations, which apply to plumbing systems in water has been, or is to be, provided, are referred to as the "Water Fittings Regulations [4]":

a) The Water Supply (Water Fittings) (Amendment) Regulations 1999, in England & Wales;

b) The Water Byelaws 2004 (Scotland), in Scotland;

c) The Water Supply (Water Fittings) Regulations (Northern Ireland) 2009, in Northern Ireland.

- The Private Water Supplies Regulations 2009 [5];
- The Private Water Supplies (Scotland) Regulations 2006 [6];
- The Private Water Supplies (Wales) (Amendment) Regulations 2010 [7];
- The Private Water Supplies (Amendment) Regulations (Northern Ireland) 2010 [8];
- The Health and Safety at Work etc. Act 1974 [9];
- The Workplace (Health, Safety and Welfare) Regulations 1992 [10];
- The Building Regulations (England and Wales) 2010 [11];
- The Building Standards (Scotland) Amendment Regulations 2001 Amendment Regulations 2002 [12];
- The Building (Amendment) Regulations (Northern Ireland) 2010 [13];
- The Confined Spaces Regulations 1997 [14];
- The Work at Height Regulations 2005 [15].

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1 Scope

This part of BS 8525 specifies requirements and gives methods of test for packaged and/or site-assembled domestic greywater treatment equipment. This standard applies to treatment equipment where all prefabricated components are factory- or site-assembled by one manufacturer and tested as a single unit.

This part of BS 8525 does not require specific water treatment processes to be used. However, it applies to equipment that treats bathroom greywater so that it is of a quality suitable for prescribed domestic uses in residential, commercial, industrial or public premises. It is not applicable to treatment equipment which processes waste from WCs and kitchens.

The test methods described in Annex B and Annex D have been devised for the type testing of domestic greywater treatment equipment with a nominal treatment capacity of up to 10 m^3 per day. They are intended to be carried out on greywater treatment equipment under controlled conditions using public mains water and synthetic greywater. These test methods are not intended for commissioning or validation of the on-site performance of the domestic greywater treatment equipment.

NOTE 1 Recommendations for the installation, commissioning and validation of on-site performance of packaged and/or site-assembled domestic greywater treatment equipment as part of a greywater system are given in BS 8525-1.

NOTE 2 Annex A specifies requirements for the greywater treatment equipment test set-up and preparation; Annex B to Annex D specify greywater treatment equipment test methods; Annex E and Annex F are informative annexes, the former giving recommendations regarding analytical methods and the latter providing an example of a product information sheet.

2 Normative references

Standards publications

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 1427, *Guide to on-site test methods for the analysis of waters*

BS 6068-2.34, *Water quality – Part 2: Physical, chemical and biochemical methods – Section 2.34: Method for the determination of the chemical oxygen demand*

BS 8525-1:2010, *Greywater systems – Part 1: Code of practice*

BS EN 1899-1 (BS 6068-2.63), *Water quality – Determination of biochemical oxygen demand after n days (BODn) – Part 1: Dilution and seeding method with allylthiourea addition*

BS EN ISO 7027 (BS 6068-2.13), *Water quality – Determination of turbidity*

BS EN ISO 7393-2 (BS 6068-2.26), *Water quality – Determination of free chlorine and total chlorine – Part 2: Colorimetric method using N,N-diethyl-1,4-phenylenediamine for routine control purposes*

BS EN ISO 7899-1 (BS 6068-4.3), *Water quality – Detection and enumeration of intestinal enterococci – Part 1: Miniaturized method (Most Probable Number) for surface and waste water*

BS EN ISO 7899-2 (BS 6068-4.4), *Water quality – Detection and enumeration of intestinal enterococci – Part 2: Membrane filtration method*

BS EN ISO 9308-1 (BS 6068-4.14), *Water quality – Detection and enumeration of Escherichia coli and coliform bacteria – Part 1: Membrane filtration method*

BS EN ISO 9308-3 (BS 6068-4.10), *Water quality – Detection and enumeration of Escherichia coli and coliform bacteria – Part 3: Miniaturized method (Most Probable Number) for the detection and enumeration of E. coli in surface and waste water*

BS EN ISO 10304-1, *Water quality – Determination of dissolved anions by liquid chromatography of ions – Part 1: Determination of bromide, chloride, fluoride, nitrate, nitrite, phosphate and sulfate*

BS EN ISO 13395, *Water quality – Determination of nitrite nitrogen and nitrate nitrogen and the sum of both by flow analysis (CFA and FIA) and spectrometric detection*

Other publications

[N1] ENVIRONMENT AGENCY. *The chemical disinfecting agents in waters and effluents – Methods for the examination of waters and associated materials*. Blue book 218. Bristol: Environment Agency, 2008. [1)]

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this part of BS 8525, the terms and definitions given in BS 8525-1 and the following apply.

3.1.1 acceptance flow rate

flow rate of greywater that the domestic greywater treatment equipment can accept without overflow or spillage

3.1.2 acceptance volume

volume of greywater that the domestic greywater treatment equipment can accept without overflow

3.1.3 back-up water supply

supply of potable water, e.g. from the public mains water supply, that can supplement the non-potable water supply in times of drought and/or heavy demand

3.1.4 bathroom greywater

greywater from domestic baths, basins, showers and clothes washing machines

3.1.5 domestic greywater treatment equipment

purpose-designed equipment containing one or more treatment processes with associated storage, pumping and control systems that accepts and treats bathroom greywater for defined applications

NOTE Examples of defined applications are WC flushing and garden irrigation.

3.1.6 greywater

domestic wastewater excluding faecal matter and urine

[BS EN 1085]

*NOTE This British Standard covers equipment treating bathroom greywater. For ease of reference, where the standard refers to "greywater", this is assumed to be "bathroom greywater". See **3.1.4**.*

[1)] This is available from the Environment Agency website, http://www.environment-agency.gov.uk.

3.1.7 greywater system
system for collecting, treating and distributing greywater which includes the treatment equipment, collection and distribution pipework and controls

3.1.8 maximum pumping head
maximum working pressure of the treated greywater pump

NOTE This is expressed in metres.

3.1.9 maximum storage period
maximum period that treated greywater can be stored without a deterioration in water quality

NOTE The water quality and maximum storage period is declared by the greywater treatment equipment manufacturer.

3.1.10 nominal hydraulic daily flow
daily flow of untreated greywater for which the greywater treatment equipment is considered suitable by the manufacturer

NOTE This can be measured in L/day or m^3/day.

3.1.11 public mains water
wholesome water supplied by a water undertaker or licensed water supplier

NOTE Attention is drawn to the Water Industry Act 1999 [1] in England & Wales, the Water (Scotland) Act 1980 [2] in Scotland, and the Water and Sewerage Services (2006 Order) (Commencement No. 3) Order (Northern Ireland) 2010 [3] in Northern Ireland.

3.2 Abbreviations

For the purposes of this part of BS 8525, the following abbreviations apply.

BOD biochemical oxygen demand

COD chemical oxygen demand

NTU nephelometric turbidity units

4 Nominal designation

The greywater treatment equipment shall be designated according to the following parameters:

- type of greywater input as defined in BS 8525-1 (for example, bathroom greywater from shower and bath);
- category of treated greywater output as defined in BS 8525-1 (for example, bathroom greywater for WC flushing and non-spray garden watering);
- nominal hydraulic daily flow;
- acceptance flow rate (see Clause **5**);
- acceptance volume (see Clause **5**);
- maximum storage period.

5 Acceptance flow rate and acceptance volume

Preparation for testing shall be carried out in accordance with Annex A. A test method for hydraulic functions shall subsequently be carried out in accordance with Annex B.

When tested in accordance with **B.3.1**, the greywater treatment equipment shall accept public mains water at the acceptance flow rate and acceptance volume declared by the manufacturer, without overflow. Unless higher minimum values are specified by the manufacturer, the acceptance flow rate shall be not less than 0.4 L/s and the acceptance volume shall be not less than 80 L.

NOTE 1 These values are deemed to be suitable for single family housing containing one bathroom. Higher values might be necessary for larger greywater systems and manufacturers might declare higher values for these systems.

*NOTE 2 Acceptance volume is assessed with the treated greywater cistern empty, but otherwise normal resident levels of water within the greywater treatment equipment. The acceptance volume may be determined using the minimum acceptance flow rate (see **3.1.1**).*

6 Water tightness and overflow

When tested in accordance with **B.3.2**, the greywater treatment equipment shall be free from leaks.

When tested in accordance with **B.3.3**, any overflow(s) shall accommodate 110% of the acceptance flow rate.

NOTE Attention is drawn to the Water Fittings Regulations [4].

7 Controls and failsafe provisions

7.1 Controls

7.1.1 General

For electrically powered treatment equipment, a control panel and at least one alarm shall be provided to indicate different operational conditions in accordance with **7.1.2**.

For non-electrically powered treatment equipment, a manual control regime shall be specified in the information provided by the manufacturer in accordance with Clause **9**.

NOTE Attention is drawn to the Water Fittings Regulations [4] which require adequate backflow prevention to be provided so that water supplied from the public mains for domestic uses does not become contaminated. In premises where a public mains water supply exists, or is to be provided, notification needs to be given to the local water supplier prior to work commencing, with a plan, schematic diagram and details of what is proposed.

Backflow prevention devices shall conform to BS 8525-1:2010, **4.7.2**.

7.1.2 Control panel and alarm(s)

Where a control panel is provided, when tested in accordance with Annex B, it shall give visual indicators to demonstrate the following conditions:

- that the system is powered;
- that the system is connected to the back-up supply (e.g. public mains water).

Where an alarm is provided, when tested in accordance with Annex B, it shall give either visual or audible indicators for the following conditions:

- electrical failure;
- failure of the back-up water supply, where fitted.

7.2 Discharge of stored water

7.2.1 General

Where the maximum storage period for the treated greywater is less than or equal to 30 days, either:

- the greywater treatment equipment shall have an automatic dump facility incorporated in accordance with **7.2.2**; or
- instructions regarding the manual discharge of stored water shall be given in the information provided by the manufacturer, in accordance with Clause **9**.

7.2.2 Automatic dump facility

An automatic dump facility that is incorporated in the greywater treatment equipment, when tested in accordance with **B.3.4**, shall:

- register the time since the treated greywater was last used;
- automatically discharge the stored treated greywater to drain once the maximum storage period has been exceeded;
- operate until the water level in the treated greywater storage cistern drops to the level that initiates the back-up water supply, where fitted.

NOTE Treated greywater stored in a WC cistern is excluded from this requirement unless the cistern forms part of the packaged unit.

7.3 Failsafe in the event of an interruption to the power supply

When tested in accordance with **B.3.5.1**, a timer that is provided as part of an automatic dump facility (see **7.2.2**) shall continue to operate when the power supply to the greywater treatment equipment is interrupted.

Where a back-up water supply is incorporated and is intended to operate when the power to the greywater system fails, it shall be tested in accordance with **B.3.5.1** and shall supply water to the greywater treatment equipment when there is no power.

7.4 Failsafe in the event of disinfection failure

When tested in accordance with **B.3.5.2**, the greywater treatment equipment shall be configured to prevent the supply of untreated greywater in the event of a disinfection delivery failure.

Where a back-up water supply is incorporated, the greywater treatment equipment shall be configured to automatically make water from this supply available to the point of use in the event of a disinfection failure when tested in accordance with **B.3.5.2**.

8 Treated greywater quality (based on end use application)

When a sample of synthetic greywater conforming to Annex C is tested in accordance with Annex D, the greywater treatment equipment shall produce treated greywater that conforms to the following, after the maximum storage period has elapsed.

- 90% of the B and C specimens shall meet the microbiological criteria specified in Table 1 for the application declared by the manufacturer and no result produced shall be more than twice the criteria.

- 90% of the B specimens shall meet the criteria for turbidity, pH and residual disinfectant specified in Table 2 for the application declared by the manufacturer.

Where the greywater treatment equipment is intended for use as part of an integrated greywater and rainwater system with a single storage tank, the quality of the treated greywater shall be tested after 30 days or, where the system incorporates an automatic dump facility, the maximum storage period; as determined by the automatic dump facility (see **7.2.2**).

NOTE Typical analytical methods relating to microbiological sampling and analysis and residual disinfectant should be followed as given in Annex E, Table C.1 and Table D.1.

Table 1 **Microbiological quality of treated greywater for type tests**

Parameter	Spray applications	Non-spray applications			Testing	
	Pressure washing, garden sprinkler use and car washing	WC flushing	Garden watering	Washing machine use	Spray applications	Non-spray applications
E. coli number/ 100 mL	Not detected	25	25	Not detected	BS EN ISO 9308-1	BS EN ISO 9308-3
Intestinal enterococci number/ 100 mL	Not detected	10	10	Not detected	BS EN ISO 7899-2 or BS EN ISO 7899-1	BS EN ISO 7899-1

Table 2 **Chemical and physical quality of treated greywater for type tests**

Parameter	Spray applications	Non-spray applications			Testing
	Pressure washing, garden sprinkler use and car washing	WC flushing	Garden watering	Washing machine use	
Turbidity NTU	<10	<10	N/A	<10	BS EN ISO 7027
pH	5–9.5	5–9.5	5–9.5	5–9.5	BS 1427
Residual chlorine [A)] mg/L	<2.0	<2.0	<0.5	<2.0	BS EN ISO 7393-2
Residual bromine [A)] mg/L	0.0	<5.0	0.0	<5.0	Blue Book 218, Method E10 [N1]

[A)] Where chlorine or bromine is used in the treatment process.

9 Marking and information to be supplied by the manufacturer

9.1 Marking

The following information about the greywater treatment equipment shall be provided on a rating plate or an indelible label affixed to the control panel:

- number and date of this British Standard, i.e. BS 8525-2:2011 [2)];
- type of greywater input as defined in BS 8525-1;
- category of treated greywater output as defined in BS 8525-1;
- nominal hydraulic daily flow;
- maximum acceptance flow rate;
- maximum acceptance volume;
- details of the disinfection process;
- maximum storage period;
- power supply requirements, where applicable;
- year of manufacture.

9.2 Installation and commissioning manual

The greywater treatment equipment shall be supplied with an installation and commissioning manual. The manual shall include the following information.

a) A description of equipment supplied, including annotated diagrams clearly identifying components.

b) The intended use(s) and applications of the greywater treatment equipment.

c) The installation requirements (i.e. location/limitations).

d) A warning notice for installers to obtain the relevant permissions prior to installing a greywater treatment system (e.g. from local authorities and water undertakers).

e) The greywater collection system connections and drains.

f) The treated greywater distribution system connections, identification and insulation.

g) The electrical installation, power requirements and tolerances, earth bonding and means of isolation.

h) The back-up water supply, required pressure and flow rate, backflow prevention measures.

i) The commissioning requirements, including fault-finding and drain-down instructions.

j) The operating instructions for users and maintenance personnel.

k) The maintenance schedule and maintenance requirements.

NOTE Decommissioning procedures may also be included.

[2)] Marking BS 8525-2:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

l) Contact details for further information or help with installation or commissioning (e.g. manufacturer or supplier's website, phone number and address).

m) Information for non-electrically powered treatment equipment in accordance with **9.3**, where applicable.

The installation and commissioning manual shall also contain a copy of the information in **9.1** and a product information sheet (see Annex F).

NOTE Attention is drawn to the Water Fittings Regulations [4], the Private Water Supplies Regulations 2009 [5]; the Private Water Supplies (Scotland) Regulations 2006 [6]; the Private Water Supplies (Wales) (Amendment) Regulations 2010 [7]; the Private Water Supplies (Amendment) Regulations (Northern Ireland) 2010 [8]; the Health and Safety at Work etc. Act 1974 [9]; the Workplace (Health, Safety and Welfare) Regulations 1992 [10]; the Building Regulations (England and Wales) 2010 [11]; the Building Standards (Scotland) Amendment Regulations 2001 Amendment Regulations 2002 [12]; the Building (Amendment) Regulations (Northern Ireland) 2010 [13]; the Confined Spaces Regulations 1997 [14]; and the Work at Height Regulations 2005 [15].

9.3 Additional information for non-electrically powered treatment equipment

Non-electrically powered treatment equipment shall be supplied with additional information relating to the manual control regime, including instructions relating to:

a) procedures to be undertaken in the event of equipment failure;

b) general maintenance procedures (e.g. the replacement of disinfection components); and

c) the manual discharge of stored water once the maximum storage period has been exceeded.

Annex A (normative) Preparation for testing

A.1 General

Prior to testing, the tester shall be provided with a complete data file including the following documents:

- process description;
- product information sheet (see Annex F);
- installation and commissioning manual.

The water supply used to test the greywater treatment equipment shall have backflow protection from the greywater treatment equipment it is to test.

NOTE Attention is drawn to the Water Fittings Regulations [4], the Private Water Supplies Regulations 2009 [5]; the Private Water Supplies (Scotland) Regulations 2006 [6]; the Private Water Supplies (Wales) (Amendment) Regulations 2010 [7]; the Private Water Supplies (Amendment) Regulations (Northern Ireland) 2010 [8]; the Health and Safety at Work etc. Act 1974 [9]; the Workplace (Health, Safety and Welfare) Regulations 1992 [10]; the Building Regulations (England and Wales) 2010 [11]; the Building Standards (Scotland) Amendment Regulations 2001 Amendment Regulations 2002 [12]; the Building (Amendment) Regulations (Northern Ireland) 2010 [13]; the Confined Spaces Regulations 1997 [14]; and the Work at Height Regulations 2005 [15].

A.2 Test set-up

A.2.1 Installation and commissioning

The greywater treatment equipment shall be installed and commissioned according to the manufacturer's instructions.

NOTE 1 The manufacturer's instructions might include a defined period of operation prior to the start of performance testing.

NOTE 2 Where testing is undertaken by a third-party testing authority, it is recommended that the greywater treatment equipment is commissioned by the manufacturer or their agent and that satisfactory operation is established before being handed over to the test laboratory.

A.2.2 Arrangement

NOTE The volume of greywater added to the greywater reservoir (see Figure A.1 and Figure A.2, "3") can be measured by the observed change in level, having previously calibrated the tank with a known volume of water. The average rate of discharge from the greywater reservoir is calculated from a measurement of the time taken to discharge the contained volume of water. For automated tests, it is desirable to operate the pump in the greywater mixing tank "2" in response to a level detector in the greywater reservoir with an electrically actuated valve "V2" for the discharge.

A.2.2.1 Gravity-fed greywater system with intermediate storage cistern

Where the greywater system is designed to feed treated greywater by gravity from an intermediate high-level storage cistern to the point of use, the test shall be set up in accordance with Figure A.1.

The test arrangement shall be such that:

a) the synthetic greywater is mixed in the mixing tank "2" to be of the correct quantity, composition and temperature required for the test (as given in the relevant annex), which is then pumped to a high-level greywater reservoir "3";

b) the synthetic greywater is then discharged to the greywater treatment

equipment by gravity though valve "V2" which can also be used to control the flow rate when required by the test procedure;

NOTE 1 The rate of discharge from the greywater reservoir to the treatment plant can be adjusted by varying the height of the reservoir "3" and/or the characteristic of the discharge valve "V2".

c) the treated greywater is pumped to a treated greywater cistern "5" to be fed by gravity to the point of use.

NOTE 2 An optional pressure gauge "P" and valve "V3" may be added to simulate and test the greywater treatment equipment's pumping head where it is not practicable to raise the treated greywater cistern to a height at which it is sufficient to test the nominal pumping head.

A.2.2.2 Pumped greywater system without intermediate storage cistern

Where the greywater system is designed to pump treated greywater directly to the point of use without an intermediate storage cistern, the test shall be set up in accordance with Figure A.2.

The test arrangement shall be such that:

a) the synthetic greywater is mixed in the mixing tank "2" to be of the correct quantity, composition and temperature required for the test given in the relevant annex, which is then pumped to a high-level greywater reservoir "3";

b) the synthetic greywater is then discharged to the greywater treatment equipment by gravity though valve "V2" which can also be used to control the flow rate when required by the test procedure;

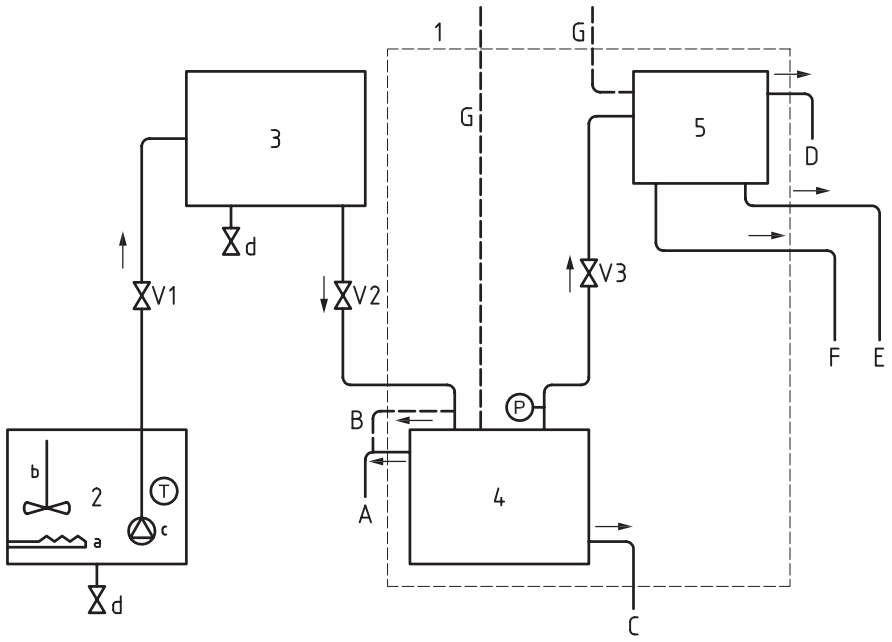
NOTE The rate of discharge from the greywater reservoir to the treatment plant can be adjusted by varying the height of the reservoir "3" and/or the characteristic of the discharge valve "V2".

c) the treated greywater is pumped directly to the point of use.

A.3 Test conditions

The temperature in the laboratory shall be maintained at 20 °C ±5 °C.

Figure A.1 **Test arrangement for a gravity-fed greywater system with intermediate storage cistern**

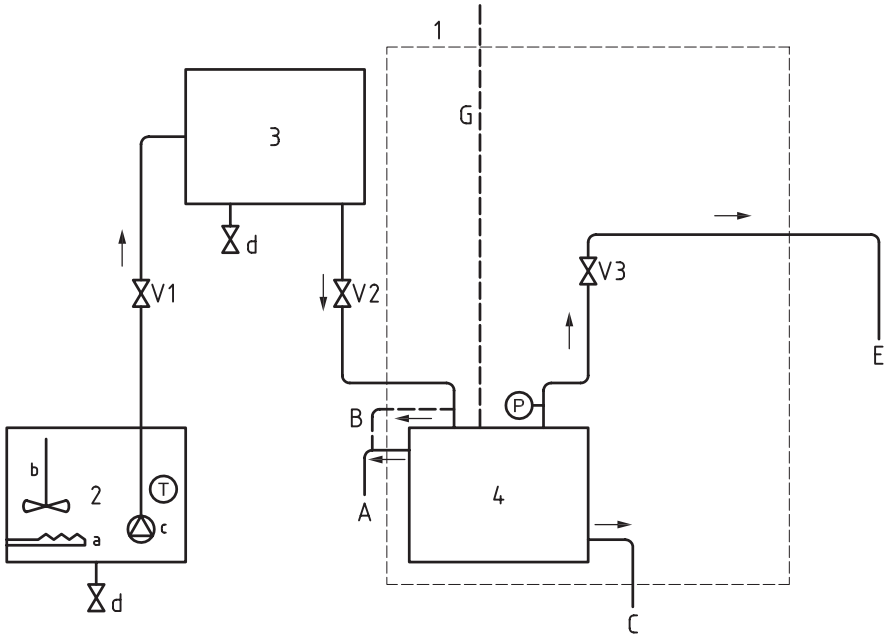


Key

1 Greywater system boundary
2 Greywater mixing tank
a) heater
b) slow speed mixer
c) pump
d) drain valve
3 Greywater reservoir
4 Greywater treatment equipment, with optional back-up supply detection
5 Treated greywater cistern, with alternative optional back-up supply detection
A Greywater treatment equipment overflow
B Alternative optional overflow (where not incorporated in treatment equipment)
C Greywater treatment equipment discharge to foul drain
D Greywater storage overflow/warning pipe
E Treated greywater outlet
F Treated greywater dump
G Optional back-up water supply feed
P Optional pressure gauge
T Temperature sensor
V1 Greywater reservoir inlet valve
V2 Greywater reservoir discharge valve
V3 Treated greywater back pressure control valve

NOTE The back-up water supply feed shall be in accordance with the manufacturer's specification, which might specify whether the water supply is to be high-pressured, low-pressured or mains supplied, e.g. cistern fed.

Figure A.2 **Test arrangement for a greywater system with direct pumping**



Key

1 Greywater system boundary
2 Greywater mixing tank
a) heater
b) slow speed mixer
c) pump
d) drain valve
3 Greywater reservoir
4 Greywater treatment equipment, with optional back-up supply detection
A Greywater treatment equipment overflow
B Alternative optional overflow (where not incorporated in treatment equipment)
C Greywater treatment equipment discharge to foul drain
E Treated greywater outlet
G Optional back-up water supply feed
P Pressure gauge
T Temperature sensor
V1 Greywater reservoir inlet valve
V2 Greywater reservoir discharge valve
V3 Treated greywater back pressure control valve

NOTE The back-up water supply feed shall be in accordance with the manufacturer's specification, which might specify whether the water supply is to be high-pressured, low-pressured or mains supplied, e.g. cistern fed.

Annex B (normative) Method of test for hydraulic functions

B.1 Principle

Public mains water is flowed into the greywater treatment equipment to test its hydraulic functions.

B.2 Apparatus

B.2.1 *Greywater system*, arranged in accordance with **A.2**.

B.2.2 *Equipment for measuring water flow rates and volumes*, with an uncertainty of measurement of ±5%.

NOTE The average flow rate during the acceptance flow rate test can be calculated from the time taken to discharge the acceptance volume from the treated greywater cistern.

B.2.3 *Colourant*, suitable for use in water systems, such as cochineal E124.

*NOTE See **B.3.5.2**.*

B.3 Procedure

B.3.1 Acceptance flow rate and acceptance volume

Isolate the back-up water supply, where fitted.

Power up the greywater treatment equipment, where applicable, and check that the control panel gives a visual indicator that the system is powered.

Open valves "V1", "V2" and "V3".

Flow public mains water into the greywater treatment equipment via the greywater reservoir until the equipment is filled with water and the water reaches the treated greywater outlet. Stop adding water.

NOTE When the flow of water from the treated greywater outlet ceases, the greywater treatment equipment has reached its minimum fill state.

Open valve "V1", close valve "V2" and fill the greywater reservoir with the acceptance volume of public mains water stated by the manufacturer.

Close valve "V1" and open valve "V2" and discharge the water into the equipment at the acceptance flow rate stated by the manufacturer.

As the water flows through the system and is supplied to the treated greywater outlet, observe whether any water overflows to the foul drain or spills over at any other point.

Where overflows or spills are observed, record the greywater treatment as having failed the test.

Where no water overflows or spills are observed, the acceptance flow rate and acceptance volume stated by the manufacturer may be confirmed.

In cases where a specific range of operational flow rates is to be determined, the test may be repeated using a flow of 10% above the measured acceptance flow rate, as given in **B.3.3**, and using flows below the measured acceptance flow rate.

B.3.2 Water tightness

Switch off the equipment and isolate the back-up water supply, where applicable.

Open valves "V1" and "V2" and fill the equipment with public mains water via the greywater reservoir until the greywater treatment equipment overflow begins to operate. Close valve "V1".

Observe whether water leaks from any part of the greywater treatment equipment other than the overflow.

After 30 min, repeat the observations.

B.3.3 Overflow

Switch off the equipment and isolate the back-up water supply, where applicable.

Open valves "V1" and "V2" and fill the equipment with public mains water via the greywater reservoir until the equipment overflow begins to operate.

Allow the overflow to cease before closing valve "V2" and refilling the greywater reservoir with the declared acceptance volume of public mains water.

Close valve "V1" and open valve "V2" and discharge the water into the equipment at 10% above the measured acceptance flow rate (see **B.3.1**).

Observe whether water spills over at any other part of the greywater treatment equipment.

B.3.4 Automatic dump facility

Isolate the back-up water supply, where fitted, and set the timer on the automatic dump facility to zero.

Fill the treated greywater cistern with public mains water to its upper limit.

NOTE This may be achieved by adding water either through the equipment or directly into the cistern.

After 30 min, observe whether the timer has registered the elapsed time.

Draw off 2 L of water from the treated greywater outlet and observe whether the timer is reset.

Advance or bypass the timer to simulate the end of the maximum storage period stated by the manufacturer so that the automatic dump facility is triggered.

Observe whether the automatic dump facility:

- discharges the water in the treated greywater cistern to drain;
- operates until the water level in the cistern drops to the level that would initiate the back-up water supply, where fitted.

B.3.5 Failsafe conditions

B.3.5.1 Interruption to power supply (for electrically powered equipment)

Fill the greywater reservoir with the measured acceptance volume (see **B.3.1**) of public mains water.

Power up the equipment.

As the water flows through the system, cut off the power supply to the equipment.

Observe whether:

- the timer on the automatic dump facility continues to operate;
- the water pressure is detected and water is supplied by the back-up water supply detection device;
- the control panel registers the electrical failure;
- the alarm(s) gives a visual and/or audible indicator of the electrical failure.

B.3.5.2 Disinfection failure

Switch off the equipment, where applicable.

Fill the greywater reservoir with the measured acceptance volume (see **B.3.1**) of clean, coloured water.

Disable the disinfection system.

Power up the equipment, where applicable, and begin to draw off water.

Observe whether:

- the water pressure is detected and water is supplied by the back-up water supply detection device, where applicable;
- the water delivered to the treated greywater outlet is clear or coloured;
- the alarm(s) gives a visual and/or audible indicator of the disinfection failure, where applicable.

B.4 Test report

The test report shall include the following:

- reference to this British Standard, i.e. BS 8525-2:2011; [3)]
- full details of the equipment being tested;
- a schematic diagram of the test system;
- details of the tests carried out; and
- details of the results obtained.

Annex C (normative) Synthetic greywater for type testing

C.1 General

Synthetic greywater in quantities sufficient for use during testing (up to 10 m^3 per day) shall be produced in accordance with **C.2** or **C.3**, as appropriate, from de-chlorinated public mains water, shampoo and/or liquid soap, sunflower oil and an inoculant of bacteria from settled treated sewage effluent.

The ingredients shall be thoroughly mixed and continuously circulated by submersible pump or paddle during storage, avoiding agitation and aeration.

The settled sewage effluent used shall contain *E. coli* at a concentration of at least 10^5 cfu/100ml so that the effluent in the synthetic greywater is less than 10% by volume. The effluent shall be stored below 20 °C prior to use. Samples for analysis shall not be taken until 1 h after mixing and any batches of mixed greywater shall be used within 24 h.

*COMMENTARY ON **C.1***

Sewage effluent from public sewage works is suitable. Fresh effluent may need to be collected for use the following day after analysis for coliform bacteria.

Active ingredients constitute between 5% and 15% of shampoos. Quantities might need to be adjusted to achieve a chemical oxygen demand within the required range. Typical supermarket products are normally suitable but those with enhanced bactericidal or deodorant properties should be avoided.

Where the nitrogen content of the resulting greywater is too low, this may be boosted to the required level by the addition of sodium nitrate solution.

There is likely to be an initial kill then re-growth of bacteria due to ingredients in the shampoo/soap.

C.2 Class 1 basic bathroom synthetic greywater

Class 1 greywater shall conform to Table C.1.

[3)] Marking BS 8525-2:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

NOTE In order to achieve the necessary concentrations, Class 1 greywater may have the following formulation per 100 L:

- *97.5 L of de-chlorinated public mains water at 30 °C, with a total hardness between 100 mg/L and 200 mg/L as $CaCO_3$;*
- *86 mL of shampoo and/or liquid soap;*
- *1 mL of sunflower oil;*
- *sufficient settled sewage effluent to give the required final concentration E. coli in 100 L of an approximate range of 10^5–10^6 cfu/100 mL (for example, 1 L of settled sewage effluent containing 10^7 cfu/100 mL could be made up to a contributory volume of approximately 1.63 L using de-chlorinated public mains water. This latter volume would then be combined with the ingredients listed and the final concentration of E. coli would be 10^5/100 mL).*

To obtain the necessary water hardness, hard water and soft water may be mixed together. Alternatively, the hardness of soft water may be increased, for example by adding calcium carbonate.

Where the public mains water needs to be de-chlorinated, sodium thiosulfate shall be added in the smallest quantity possible such that chlorine is not detectable when the testing described in Annex D is undertaken.

Table C.1 **Composition of synthetic greywater**

Parameter	Acceptable range	Test method
E. coli (cfu/100 mL)	10^5–10^6	BS EN ISO 9308-3
COD (mg/L)	180 ±40	BS 6068-2.34
BOD (mg/L)	110 ±40	BS EN 1899-1
NO_3 nitrogen (mg/L)	7.2 ±0.8	BS EN ISO 13395 or BS EN ISO 10304-1
pH	7.0–8.0	BS 1427
Temperature (°C)	30 ±2.5	—

C.3 Class 2 bathroom synthetic greywater including washing machine effluent

Class 2 greywater shall conform to Table C.1 and have a non-biological laundry detergent added at a concentration equivalent to 1% of the washing solution concentration recommended for the product in hard water areas by the detergent manufacturer.

NOTE In order to achieve the necessary concentrations, Class 2 greywater may have the following formulation per 100 L:

- *96.5 L of de-chlorinated public mains water at 30 °C, with a total hardness between 100 mg/L and 200 mg/L as $CaCO_3$;*
- *1 L solution of the laundry detergent at the concentration recommended for hard water;*
- *86 mL of shampoo and/or liquid soap;*
- *1 mL of sunflower oil;*
- *sufficient settled sewage effluent to give the required final concentration in 100 L of an approximate range of 10^5–10^6 cfu/100 mL (for example, 1 L of settled sewage effluent containing 10^7 cfu/100 mL could be made up to a contributory volume of approximately 1.63 L using de-chlorinated public mains water. This latter volume would then be combined with the ingredients listed and the final concentration of E. coli would be 10^5/100 mL).*

Annex D (normative) Method of test for water quality

D.1 Principle

After the untreated greywater has been mixed in accordance with Annex C, a specimen is collected from it and designated as Specimen A. This is sent for microbiological testing.

Untreated synthetic greywater is introduced into the greywater treatment equipment. Following treatment (and storage, where applicable), two volumes of treated greywater are collected and designated as Specimen B and Specimen C.

From Specimen B, two samples are extracted and refrigerated for subsequent analysis, one for microbiological testing and the other for physical and chemical testing. The test methodologies are referenced in Table D.1.

Specimen C is maintained at room temperature in a covered (but not airtight) container for its maximum storage period before a sample is taken (Sample C1) and sent for chemical and physical testing. The remainder of Specimen C is designated Sample C2, which is sealed and refrigerated prior to being sent for microbiological testing.

The results of the tests on the Specimen B and Specimen C treated greywater are compared with the results from the Specimen A analysis, the difference in *E. coli* levels is calculated and the water quality of the treated greywater assessed. The results from Specimen A are also used to validate the test cycles.

D.2 Materials

D.2.1 *Synthetic greywater,* conforming to Annex C, with a total volume equivalent of not less than five days of operation at the nominal hydraulic daily flow or the minimum volume corresponding to two filter regeneration cycles, whichever is greater. Class 1 synthetic greywater shall be used for testing equipment which is designed to collect greywater from showers, baths and wash basins, but not from washing machines. Class 2 synthetic greywater shall be used for testing equipment which is designed to collect greywater from showers, baths, wash basins and washing machines.

D.3 Apparatus

D.3.1 *Water thermometer*, capable of achieving an uncertainty of measurement of ±0.5 °C.

D.3.2 *Greywater system*, arranged in accordance with **A.2**.

D.3.3 *Sterile containers*, for the collection of treated greywater samples.

D.3.4 *Equipment capable of measuring the mass balance of water*.

D.4 Preparation

The synthetic greywater sample shall be supplied at a temperature of 30 °C ±2.5 °C.

D.5 Procedure

D.5.1 General

Record the volume of treated greywater produced in each test cycle.

For each test cycle, flow a minimum of 80 L of synthetic greywater from the greywater reservoir “3” into the greywater treatment equipment “4”, via the treated greywater outlet valve “V2” (see Figure A.1 and Figure A.2).

Repeat the test procedure until results have been obtained from a minimum of 10 valid test cycles (see **D.5.4**) and number each test cycle for identification.

Label the lids and bottles of all specimens and samples that are to be analysed by a test laboratory with indelible ink. Include the following information:

a) name of sample/specimen;

b) time and date of collection;

c) test cycle number.

D.5.2 Collecting samples

After the untreated synthetic greywater has been mixed to the chosen specification in Annex C, continue mixing. After one hour, collect at least 500 mL from the greywater reservoir (see Figure A.2 or Figure A.3, greywater reservoir, "3") and designate it as Specimen A. Send Specimen A to a test laboratory for microbiological analysis in accordance with Table D.1.

Halfway through the treated greywater discharge period, collect a representative volume of greywater (a minimum of 4 L) from the treated greywater outlet "E" into a sterile container. From the collected volume, obtain two sets of samples and designate these Specimen B and Specimen C. For Specimen B and Specimen C, carry out the procedure outlined in **D.5.2**.

D.5.3 Test procedure for Specimen B and Specimen C

Take Specimen B and complete the following steps.

a) Decant a volume of Specimen B into a separate sterile container and undertake the chemical and physical tests in accordance with Table D.1. Refer to this as Sample B1.

b) Seal the remaining treated greywater sample in a cooled, insulated container and refrigerate for storage prior to microbiological analysis. Refer to this as Sample B2.

NOTE Reference should be made to Annex E for general guidance on sampling, including the neutralization of disinfectant.

Store Specimen C at room temperature (20 °C ±5 °C) in a covered, but not airtight, sterile container for the maximum storage period stated by the manufacturer of the greywater system.

At the end of this period complete the following steps.

1) Decant a volume of Specimen C into a separate sterile container to carry out chemical and physical tests in accordance with Table D.1. Refer to this as Sample C1.

2) Seal the remaining treated greywater sample and refrigerate for storage prior to microbiological analysis. Refer to this as Sample C2.

D.5.4 Greywater testing cycle validation using Specimen A

To test for the validity of each test cycle, analyse the *E. coli* content of Specimen A at the same time as analysing the *E. coli* content of Specimen B. Where the *E. coli* content for Specimen A does not exceed the minimum concentration for the relevant class of synthetic greywater in accordance with Annex C, the identified cycle is invalid; exclude the results obtained from that cycle.

D.6 Test report

The test report shall include the following:

- reference to this British Standard, i.e. BS 8525-2:2011; [4)]
- full details of the equipment being tested;
- a schematic of the test system;
- details of the tests carried out; and
- details of the results obtained.

[4)] Marking BS 8525-2:2011 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Table D.1 **Test methods for microbiological, chemical and physical testing**

Type of test	Parameter	Test methods		Specimen A	Sample			
		Spray application	Non-spray application		B.1	B.2	C.1	C.2
Microbiological	*E. coli*	BS EN ISO 9308-1	BS EN ISO 9308-3	✓		✓		✓
	Intestinal enterococci	BS EN ISO 7899-2 or BS EN ISO 7899-1	BS EN ISO 7899-1	✓		✓		✓
Physical	Turbidity	BS EN ISO 7027	BS EN ISO 7027		✓		✓	
Chemical	pH	—	—		✓		✓	
	Chlorine	BS EN ISO 7393-2	BS EN ISO 7393-2		✓		✓	
	Bromine	Blue Book 218, Method E10 [N1]	Blue Book 218, Method E10 [N1]		✓		✓	

NOTE 1 Advice should be sought from the laboratory undertaking the analyses regarding the volumes of samples required to carry out the chemical, physical and microbiological tests.

NOTE 2 Samples should be analysed within 24 h of being taken or within 24 h after the maximum storage period stated by the manufacturer for Specimen C.

NOTE 3 Although only the samples for microbiological testing need to be refrigerated, it may be advisable to refrigerate all samples prior to despatch so that warmer samples do not affect cooler ones in transit. Refrigeration temperature should be between 2 °C and 8 °C.

Annex E (informative) Analytical methods

E.1 Microbiological sampling and analysis

Sample bottles should be sterile and made of a glass that is able to withstand autoclaving. Alternatively, pre-sterilized disposable or autoclavable plastic bottles may be used.

NOTE 1 The size of the sample depends on the number of factors that are to be analysed. For bacteriological examination, 500 mL is usually adequate.

Where the reclaimed water is likely to contain a disinfectant, a neutralizing agent should be added to the bottles so that the action of this disinfectant is stopped as the sample is taken.

The action of chlorine and bromine can be neutralized with sodium thiosulfate. This should be added to sample bottles before sterilization or introduced aseptically to pre-sterilized containers to produce a concentration of 18 mg/L in the sample.

NOTE 2 This is sufficient to neutralize up to 5 mg/L of free and combined chlorine. This can be achieved by adding 0.1 mL of a 1.8% m/V solution of sodium thiosulfate to each 100ml of sample.

Where copper or silver ions are being used as a disinfectant, EDTA (ethylene-diaminotetraacetate) should be added to give a final concentration in the sample of 50 mg/L.

Samples transported to a laboratory for microbiological analysis should be kept in a cool, dark location, at a temperature between 2 °C and 10 °C. Where necessary, samples may be stored in a refrigerator overnight. Samples should be analysed as soon as practicable, but always within 24 h of being collected.

E.2 Residual disinfectant

The suitable method for determining the residual concentration of the active ingredient should be determined in accordance with advice from the suppliers of the greywater system or disinfectant product.

Annex F (informative) Domestic greywater treatment equipment product information sheet

Figure F.1 gives an example of a product information sheet that can be included in the installation and commissioning manual (see **9.2**).

Figure F.1 **Example of a product information sheet**

Name and address of manufacturer:

Model designation:

This product has been tested to meet the requirements of BS 8525-2 in respect of the following operational parameters:

Class of greywater input	*Bathroom greywater only*
Class of treated water output	*WC flushing*
Nominal hydraulic daily flow	*160 litres/day*
Acceptance flow rate	*0.4 litres/second*
Acceptance volume	*100 litres*
Details of disinfection process	*Automatic dosing with household bleach (5% sodium hypochlorite solution)*
Nominal occupancy (housing applications)	*4 beds*
Power supply requirements	*240 volts* *5 amps* *Single phase*

Signed……

On behalf of …….

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