PDHonline Course C611 (4 PDH)

Rainwater Harvesting Fundamentals

Instructor: John M. Rattenbury, PE, CIPE, LEEDap

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5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

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Translation of DIN 1989-1:2001-10

Rainwater harvesting systems — Part 1: Planning, installation, operation and maintenance

Regenwassernutzungsanlagen — Teil 1: Planung, Ausführung, Betrieb und Wartung

Systèmes d'utilisation des eaux pluviales — Partie 1 : Etablissement de l'avant-projet, installation, entretien et exploitation

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Foreword

This standard was prepared by the study group V 8 "Rainwater Harvesting Systems".

Ecological and sustainable water management is a goal of the precipitation water management. The alternatives to the customary drainage of precipitation water are, among other things, rainwater harvesting and infiltration, as well as the decentralized retention of rainwater. A new system technology with new components has been developed for rainwater harvesting in households and commercial and industrial companies.

The standard for rainwater harvesting systems was developed taking the generally-recognized rules of technology for drinking water installations into consideration according to the standard series DIN 1988 and according to DIN EN 1717 and for drainage systems according to the standard series DIN EN 12056 and DIN 1986. Requirements on system technology for the planning, installation, operation and maintenance that have proven themselves in practice are set down in this standard.

The standard series DIN 1989 "Rainwater Harvesting Systems" consists of the following parts:

— Part 1: Planning, Installation, Operation and Maintenance,

— A Filter part (being prepared),

— Part 3: Rainwater Reservoirs (currently in draft form) and

— A part for Components for Control and Monitoring (being prepared).

1 Scope

This standard applies to systems utilizing rainwater in households and commercial and industrial companies, as well as in public organizations, in which it is used for flushing toilets, for cooling purposes, for washing and cleaning systems and for watering green areas, for instance.

According to the Drinking Water Act, drinking water is to be made available for cleaning objects that don't just temporarily come into contact with the human body when used as intended (e.g. laundry)[1)] .This standard contains specifications for the planning, installation, operation and maintenance of rainwater harvesting systems.

2 Normative References

This standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

DIN 1072, *Road and foot bridges; design loads.*

DIN 1986-3, *Drainage and sewerage systems for buildings and plots of land; Rules for service and maintenance.*

DIN 1986-4, *Drainage systems on private ground - Part 4: Fields of application of sewage pipes and fittings of different materials.*

E DIN 1986-100, *Drainage systems on private ground - Part 100: Additional specifications to DIN EN 752 and DIN EN 12056.*

DIN 1988-1, *Drinking water supply systems; general (DVGW code of practice).*

DIN 1988-2, *Drinking water supply systems; materials, components, appliances, design and installation (DVGW code of practice).*

DIN 1988-3, *Drinking water supply systems; pipe sizing (DVGW code of practice).*

DIN 1988-4, *Drinking water supply systems; drinking water protection and drinking water quality control (DVGW code of practice).*

DIN 1988-5:1988-12, *Drinking water supply systems; pressure boosting and reduction (DVGW code of practice.*

E DIN 1989-3, *Rainwater harvesting systems - Part 3: Collection tanks for rainwater.*

DIN 1997-1, *Shut-off valves for site drainage systems; backflow gates for non- faecal sewage; requirements, design principles and materials*

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1) The following has been stated in the official grounds for the decree to amend the Drinking Water Act (Federal Printing 271/00 of Nov. 08, 2000, page 53):

In the same way, water that meets the requirements of the act has to also be available in the household for the cleaning of objects that come into contact with food when used as intended and for cleaning other essential goods as defined by § 5, paragraph 1, Nos 1 to 6, of the Food and Essential Goods Act. Particularly high requirements, especially for preventing communicable diseases, are to be placed on the cleaning of these essential goods if they come into contact with food or with the human body in a way that is not just temporary when used as intended. It follows from the protective purpose of the specification that the cleaning of towels and dishcloths is also affected in connection with this, along with the cleaning of clothing. It follows from this that an opportunity has to exist in every household for using water with the quality of water for human use for washing laundry. It is up to the consumer himself whether an additional connection that supplies water of lower quality exists and is used."

DIN 2403*, Identification of pipelines according to the fluid conveyed.*

DIN V 3260-10, *Measurement of water flow in closed conduits - Meters for cold potable water - Part 10: Specifications (ISO 4064-1:1993).*

DIN 4046, *Water-supply; terms; DVGW code of practice.*

DIN 4049-3, *Hydrology - Part 3: Terms for the quantitative hydrology.*

DIN 4102, *Fire behaviour of building materials and building components - Part 1: Building materials; concepts, requirements and tests.*

DIN 4109, *Sound insulation in buildings; requirements and testing.*

DIN 4124*, Building pits and trenches; Slopes, working space widths, sheeting.*

DIN 4807-5, *Expansion vessels - Part 5: Closed expansion vessels with membrane for drinking water installations; Requirements, test, design and designation; DVGW code of practice.*

DIN 4844-1, *Safety marking - Part 1: Dimensions, distance of observation.*

DIN 4844-2*, Safety marking - Part 2: Overview of safety signs.*

DIN 18195-5, *Water-proofing of buildings - Part 5: Water-proofing against non-pressing water on floors and in wet areas; design and execution*

DIN 18195-6*, Water-proofing of buildings - Part 6: Water-proofing against outside pressing water and accumulating seepage water; design and and execution.*

DIN 18306, *Contract procedures for building works - Part C: General technical specifications for building works; Sewage channel works.*

DIN 18381, *Contract procedures for building works - Part C: General technical specifications for building works; Gas, water and sewage plumbing works inside of buildings.*

DIN 19632*, Mechanical filters for drinking water installations; requirements, testing (DVGW code of practice).*

DIN EN 124, *Gully tops and manhole tops for vehicular and pedestrian areas - Design requirements, testing, marking, quality control; German version EN 124:1994.*

DIN EN 476, *General requirements for components used in discharge pipes, drains and sewers for gravity systems; German version EN 476:1997.*

DIN EN 1610, *Construction and testing of drains and sewers; German version EN 1610:1997.*

DIN EN 1717, Protection against pollution of potable water installations and general requirements of devices to prevent pollution by backflow - Technical rule of the DVGW; German version EN 1717:2000.

DIN EN 12050-2, Wastewater lifting plants for buildings and sites - Principles of construction and testing - Part 2: Lifting plants for faecal-free wastewater; German version EN 12050-2:2000.

DIN EN 12056-1, Gravity drainage systems inside buildings - Part 1: General and performance requirements; German version EN 12056-1:2000.

DIN EN 12056-3*, Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation; German version EN 12056-3:2000.*

DIN EN 12056-4, *Gravity drainage systems inside buildings - Part 4: Wastewater lifting plants, layout and calculation; German version EN 12056-4:2000.*

DIN EN 12056-5*, Gravity drainage systems inside buildings - Part 5: Installation and testing, instructions for operation, maintenance and user; German version EN 12056-5:2000.*

ATV-Arbeitsblatt 138, *Bau und Bemessung von Anlagen zur dezentralen Versickerung von nicht schädlich verunreinigtem Niederschlagswasser (Abwassertechnische Vereinigung e.V. – ATV*[2)]

VBG 37*BGV C 22, Bauarbeiten.

VBG 40, *Bagger, Lader, Planiergeräte, Schürfgeräte und Spezialmaschinen des Erdbaues (Erdbaumaschinen)*

Verordnung zur Novellierung der Trinkwasserverordnung von 21. Mai 2001, veröffentlicht in Bundesgesetzblatt I Nr 24 vom 28.05.2001, Seite 959

Verordnung über Allgemeine Bedingungen für die Versorgung mit Wasser (AVBWasser V) vom 20. Juni 1980, Bundesgesetzblatt, Teil I, Nr. 31, Seite 750

ZH 1/77*, Richtlinien für Arbeiten in Behältern und engen Räumen*[3)]

3 Terms

For the purpose of this standard, the following terms apply:

3.1
Precipitation
Water that has precipitated from the atmosphere (e.g. rain, snow, mist, dew)
[DIN 4049-3]

3.2
Rainwater
Water from natural precipitation that was not contaminated by use [DIN EN 12056-1:2000]

3.3
Rainwater line
Supply, drainage, overflow and emptying lines of a rainwater harvesting system

3.4
Quantity of precipitation
Precipitation at a certain place, expressed as the water height over a horizontal area for a span of time under consideration
[DIN 4049-3]

3.5
Precipitation characteristics
Characteristics of a precipitation event (e.g. intensity, duration)

3.6
Process water
Water for household and commercial areas of use that does not have to have the quality of drinking water

3.7
Rainwater harvesting system
Process water system for utilizing rainwater

3.8
Back-up level
The highest level that water from a drainage system can rise to [DIN EN 12056-1]

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2) Can be purchased through: Gesellschaft zur Förderung der Abwassertechnik e.V., Theodor-Heuss-Allee 17, D-53773 Hennef.

3) Can be purchased through: Carl Heymanns Verlag KG, Luxemburger Straße 449, D-50939 Cologne.

3.9
Yield coefficient
Ratio of the rainwater annually flowing into the rainwater harvesting system to the total amount of rainwater in the accompanying precipitation area

3.10
Useful volume
Volume that can be completely used during operation

3.11
Minimum water volume
Residual water volume that is constrained by the process in which neither sediment nor scum can be sucked in for the protection of the pump

3.12
Rainwater yield
Useful water volume (water inflow) determined over a certain period of time for use as process water

3.13
Process water requirements
Planning value for the process water amount that is expected to be required in a specified period of time

3.14
Collection area
Area from which rainwater is collected for use in a rainwater harvesting system (e.g. roof area)

3.15
Hydraulic filter efficiency
Ratio between the water amount flowing to the filter and the water amount supplied for utilization

3.16
Quiescent inflow
Routing of rainwater into rainwater reservoirs so that the existing sediment is not activated in the rainwater reservoir and an immediate sedimentation of solids is possible

3.17
Sedimentation
Separation of solids from the water via gravity
[DIN 4046]

3.18
Overflow line
Line for leading away rainwater when the rainwater reservoir is full, e.g. into the sewage system or a seepage system

3.19
Hybrid container
Collection container for the process water pump to which both process water and rainwater are supplied

3.20
Trench
Element in the ground that is filled with gravel, ballast or special plastic elements and that stores rainwater that is fed into it on an intermediate basis before the water seeps into the surrounding soil

3.20
Trench
Element in the ground that is filled with gravel, ballast or special plastic elements and that stores rainwater that is fed into it on an intermediate basis before the water seeps into the surrounding soil

3.21
Trough - trench
Combination of a seepage trough from which rainwater that has been supplied seeps into a trench lying below this

3.22
Process water pump
Pumps process water from the rainwater reservoir to the points at which it is drawn

3.23
Suction line
Line through which a process water pump sucks in rainwater

3.24
Process water lines
System of lines from the process water pump to the individual points at which water is drawn

3.25
System control unit
Control unit for the automatic operation of the rainwater harvesting system

3.26
Dry-running protection
System for protecting the process water pump against running dry

3.27
Safety equipment
Equipment for protecting the drinking water (free outlet)

3.28
Supplemental supply unit
Equipment for providing a supplemental supply of drinking water or non-drinking water into process water systems

4 General

4.1 General issues

Rainwater harvesting systems are to be planned, installed, operated and maintained in such a way that the required operating safety is ensured and that the required servicing work can be easily carried out. It is to be ensured, in particular, that there is no possibility that the quality of the drinking water will be affected. If special characteristics of the components have to be taken into consideration in the installation, the manufacturer has to provide binding instructions with regard to this that are to be observed in the planning and installation.

Rainwater harvesting systems are subject to registration. The Drinking Water Act, the AVB Water Act and the municipal sewage water ordinances are to be taken into consideration.

4.2 Noise Protection

Rainwater harvesting systems are to be planned and installed in observance of the standards of series DIN 4109.

4.3 Fire Protection

The appropriate construction supervision acts (construction acts of the states) and the standards of series DIN 4102 are to be observed when implementing pipelines on which requirements have been placed with regard to fire resistance time through walls or ceilings.

4.4 Sealing of External Walls

If lines are routed through the external walls lying in the soil, these break-through points have to be permanently closed up, sealed against gas and water. If necessary, suitable protective pipes are to be installed. The connection to the building seals is to be provided with swivel joints.

The hydrological soil conditions are to especially be taken into consideration. The design types of the pipe conduits will be separated into those for pressurized water and those for non-pressurized water according to this (see DIN 18195-5 or DIN 18195-6, as the case may be).

4.5 Freedom from Frost Inside Buildings

The system parts are to be planned and installed inside buildings in such a way that frost can neither destroy them nor endanger them when they are used as intended. Lines that are emptied in the frost period are excepted from this.

4.6 Freedom from Frost Outside of Buildings

Lines and odor traps are to be laid at a depth that is free of frost outside of the floor area of buildings. Because the depth at which there is freedom from frost is different depending on the climactic circumstances, the relevant government office should specify this depth in accordance with the local requirements, e.g. at 800 mm, 1000 mm or larger values.

4.7 Lines and Reservoirs in the Soil

The relevant accident-prevention regulations, such as the regulations VBG 37 and VBG 40 of the workers' compensation association, are to be adhered to when there is earthwork. Excavation pits and trenches are to be created according to DIN 4124.

Sewage lines are to be laid and checked according to DIN EN 1610. The building-contract regulations for construction services according to DIN 18306 and DIN 18381 are to be observed.

5 Collection Areas

5.1 General Issues

Qualitative and quantitative aspects are to be taken into consideration when doing the planning for rainwater harvesting systems with regard to the areas that are used for collecting rainwater.

5.2 Qualitative Aspects for Areas Used for Collecting Rainwater

Under the qualitative aspects, the collection areas are to essentially be evaluated, and to be evaluated in dependence upon, the system technology used to treat the rainwater and the intended use.

Areas with as little pollution as possible are to be used as a general rule.

Roof areas are preferred for uses involving rainwater, in combination with filters according to 6.2 and sedimentation in rainwater reservoirs according to 6.3.

If it is also fruitful to make use of collection areas with a higher degree of pollution in part (e.g. traffic areas) in commercial and industrial facilities, or in public facilities, due to the high level of requirements for process water, appropriate further treatment according to 6.4 (e.g. flocculation) is to be chosen depending on the use.

The following roof materials or systems are to be assessed on a case-by-case basis, in dependence upon the areas of application of the process water:

— In the case of green roofs, a brown discoloration of the water arises over the long term as a rule.

— In the case of bitumen roofs, a yellow discoloration of the water arises in many cases.

— Roofs made of materials containing asbestos-fiber cement emit fibers over the long term.

— Heavily increased concentrations of metal could arise in water drained from the roof in the case of newly-built, large-surface, uncoated copper and zinc roofs.

— Solids accumulate during dry periods on weathered, rough roof areas that are flushed away when there is rain.

5.3 Quantitative Aspects for Areas Used for Collecting Rainwater

The principle that as much of all of the available collection areas as possible that are qualitatively suitable according to 5.2 should be used for harvesting rainwater in households generally applies.

The optimum level with regard to the reservoir volume and the connected collection area is to be determined under the existing requirements in the case of rainwater harvesting systems in commercial, industrial and pubic areas within the framework of the dimensioning of the system.

The fact that collection areas made of different materials have different characteristics regarding the drainage of rainwater is to be included in the planning. For example, only around 50% of the precipitation water drains off green roofs as an annual average. The precipitation will be completely stored and evaporated after longer dry periods (see Table 3).

6 Treatment

6.1 General Issues

Treatment as defined by this standard involves measures for improving the quality of precipitation water in rainwater harvesting systems. This could involve biological, chemical or physical processes or a combination of them.

As a rule, filter systems operating on a mechanical basis according to 6.2 and sedimentation according to 6.3 are adequate as treatment measures.

It is not necessary to disinfect the process water or to separate the rainwater from roof areas at the start of a precipitation event.

Additional precision filters in the process water lines are not required as a rule, because water that is taken from rainwater reservoirs is free of solids to a very great extent. It can be directly supplied to the applications that have been mentioned.

When precision filters according to DIN 19632 (e.g. for uses with special requirements on the water characteristics) are used, they require regular inspection and maintenance so that germination on, and a clogging of, the filter material are avoided. The information of the manufacturer is to be followed.

Leaf traps in gutters are not filters as defined by this standard and have no relevance to the treatment of precipitation water in connection with a use of rainwater according to this standard. Leaf traps are not necessary when there are filters with a separate discharge of foreign materials in front of the reservoir.

6.2 Filters

There is a multitude of special filters for rainwater harvesting systems that are distinguished by the design, installation position and functional principle (e.g. filter matting, filter screen). Filters are to be installed in the supply line to the reservoir as a general rule. They keep foreign material away from the rainwater reservoir that could bring about malfunctions in the system or make the water quality poorer. Rainfall pipes or a central location in front of the reservoir are possible installation places. Furthermore, filters can be directly located in the rainwater supply line inside of the reservoir.

A distinction is made between filters according to their design with regard to

— Systems with a separate discharge of foreign material from the filter and

— Systems with a retention of foreign material within the filter.

The following notes are to be observed in the planning and installation:

— Filters are to be selected according to their purification performance (e.g. efficiency, service life, permeation size). Standardized filters are to be used[4)] .

— The size and the hydraulic performance of the filter are to be selected for the installation location. The filters are not permitted to cause any water losses, or only small water losses, in the supply to the reservoir. Filters that have been checked with regard to their hydraulic performance are to be used.

— Operation during the Winter is to be taken into consideration when arranging the filter systems.

— The difference in height between the filter supply line and the filter discharge line is to be kept as small as possible in the case of installation in the ground. The height of the reservoir and of the subsequent drainage facilities are dependent upon this.

— The filter system is not permitted to narrow the cross-section of the supply feed, including connection lines. It has to also be ensured, even when there are malfunctions of the filter, that an unobstructed drainage of the precipitation water is possible.

— Filters that are connected to the sewage canal below the backwater level have to be protected against back-up.

— Filter systems are to be installed in such a way that there is good access. Simple inspection and cleaning have to be possible in order to ensure the filter operation on a permanent basis (see Section 18).

— If a filter with a separate discharge of foreign material via water is used, it is to be discharged into the sewage system or into a seepage system. In the case of a connection to an underground seepage system, the retention of the discharged foreign material is additionally required.

— When installed, filters are not permitted to interfere with the hydraulic performance of the drainage system.

6.3 Sedimentation

The rainwater contains finely-distributed solids in small amounts independent of the filtration of the rainwater in the supply line of reservoirs. Sedimentation is to be made possible in rainwater reservoirs to remove these solids. Sediment only accrues to a small degree as a rule.

The sedimentation time depends on the density, size and form of the particles and can be precisely determined as an approximation according to Stoke's law. Rainwater reservoirs are reactors with diffuse mixtures with regard to the sedimentation as a rule. The sedimentation is essentially made possible by the form and arrangement of the supply and overflow lines, as well as by the water removal, based on empirical knowledge. The sediment in the reservoir does not have a disadvantageous effect on the water quality when there is proper maintenance.

The following requirements are to be met in connection with this:

— The supply feed should not obstruct the sedimentation with disruptive flows - to the extent possible - and existing sediment in the area of the base of the reservoir should not be distributed again. The supplied water is to be distributed broadly and diffusely over the water level for this, for example, or is to be led in via a supply pipe to the bottom of the reservoir and deflected there into an upward flow with a low exist speed (quiescent supply).

— The water removal is to be coordinated in such a way that:

  — No solids are sucked in (sediment and scum),

  — Low suction speed is ensured,

  — Flows that are disruptive arise as little as possible and

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4) A standard for the requirements on, and the checking of, filters (DIN 1989-2) is being prepared.

  - The removal is done in a zone in which the sedimentation has been concluded to a very great degree.

- When multiple containers are used for storage, they are to be connected in series taking the above-mentioned factors into consideration. The supply and overflow lines are to be located in the first container. The water removal should be done from the last container.

- Notes on the removal of sediment are listed in Section 18.

In addition to the sedimentation, other effects such as precipitation processes and biological decomposition processes, which have a positive effect on the water quality as a rule, also take place in the rainwater reservoir.

6.4 Treatment for Special Systems

Further treatment of the stored water could be necessary depending on the type of the collection areas and the type of use of the process water.

In regions with a regular appearance of pollen in larger amounts, the separation of the floating layers resulting from this is to be made possible with a suitable dimensioning of the reservoir to ensure a regular overflow and with the optimization of the hydraulic design of the overflow system.

Further treatment steps are necessary if polluted collection areas, such as areas in which there is traffic, for example, are connected to the rainwater harvesting systems or if increased requirements are placed on the quality of the process water.

The following processes can be used as a general rule within the framework of the further treatment of rainwater:

- Flocculation

- Flocculation filtration

- Flotation

- Biological processes

- Further filtration

- Disinfection

- Diaphragm processes

The respective processes are to be checked for their suitability on an individual basis and are to be planned, constructed and operated on a case-by-case basis according to the relevant rules of technology.

7 Rainwater Reservoir and Add-On Parts

Rainwater reservoirs are for both the storage and the cleaning of the rainwater. Reservoirs can be set up both above-ground and below-ground.

The setup location should be chosen in such a way that the stored water is protected against strong thermal effects, frost and light. The selection of the reservoir has to be done in coordination with the installation location and the pollution to be expected (see Table 1). Standardized reservoirs are to be used.

Reservoirs from factory production are subject to a factory inspection and have to be visually checked for damage on site before the installation. The external insulation or the external coating of steel reservoirs is to be checked via an insulation test.

Systems made up of segments or in situ concrete are subject to an installation inspection and have to be checked for tightness before being filled according to E DIN 1989-3.

The materials used are not permitted to have a damaging effect on the water content and the environment of the installation. Suitable materials are, for example:

— Concrete

— Plastics

— Steel (corrosion-protected) or steel (corrosion-resistant)

Individual containers can be connected to each other. The connection parts provided by the manufacturer are to be used in the process.

When selecting underground reservoirs, the stability and up-swell safety are to be observed, as well as the traffic quantities to be expected, while taking the installation location and the soil characteristics into consideration. Reservoirs, inspection shafts and covers have to be in accordance with the load classes according to Table 1.

The load assumption of SLW 30 according to DIN 1072 is adequate as a rule for the assumption of the traffic load on travelled surfaces.

Table 1 — Load Classes for Underground Rainwater Reservoirs under a Traffic Load

Load Class		Examples for the Traffic Loads		Cover to be Chosen according to DIN EN 124
		Type of Load	Max. Axle Load, Tons	
1	Accessible on foot	Persons		A 15
2	Passenger car – accessible by vehicle	Passenger car	1.2	B 125
		Van	2.2	
3	LKW 12 – accessible by vehicle	Tractor	7.2	D 400
		Truck, 12 tons	8.0	
4	SLW 30 – accessible by vehicle	Truck, 26 tons	11.5	D 400
		Fire truck, 30 tons	13.0	
5	SLW 60 – accessible by vehicle	Heavy truck, 60 tons[a]	20.0	D 400
6	Special loads according to information of the customer			

[a] Heavy trucks (axle load > 13 tons) of Load Class 5 (SLW 60, accessible by vehicle) require a special authorization according to the Road Traffic Authorization Act.

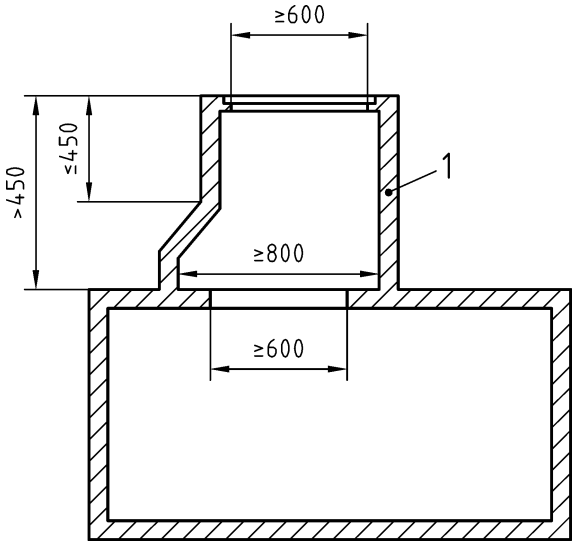
DIN EN 1610 and the information of the manufacturer are to be observed for the bedding and filling. The reservoir dimensions and weight are to be coordinated with the local circumstances for the installation location, transport and assembly.

The openings of the reservoir are not permitted to go below the following diameters to carry out inspection and maintenance (also see E DIN 1989-3):

Table 2 — Reservoir Openings

Type of Reservoir	Reservoir Opening mm
Above-ground reservoir ≤ 3000 l individual volume	≥ 200
Above-ground reservoir > 3000 l individual volume	≥ 600
Underground reservoir up to a dome height ≤ 450 mm	≥ 600
Underground reservoir up to a dome height > 450 mm with expansion of the dome diameter to ≥ 800 mm (see Illustration 1)	≥ 600

Dimensions in millimetres



Legend

1 Inspection shaft

Figure 1 — Entry opening for rainwater reservoir with a shaft structure > 450 mm

Reservoir connection lines are to be designed according to 4.6 and Section 12. The reservoir size is to be determined according to Section 16.

8 Process Water Pumps

8.1 Planning Fundamentals

Process water pumps are to be designed, operated and maintained in such a way that continual operational reliability is provided for the rainwater harvesting system. A decision has to be made, depending on the supply reliability and the hydraulic system, as to whether a pump or multiple-pump systems will have to be used.

NOTE One pump is sufficient as a rule in single and two-family houses.

8.2 Design

The establishment of the pressure zones, the determination of the pump flow, and the required pressure of the process water pump are to be done in the style of DIN 1988-5:1988-12, Section 4.

The suction conditions, e.g. in the case of longer suction lines, larger geodetic height differences and larger friction losses, as well as various pressure level losses in pipelines, fittings and shaped pieces, are to be observed in particular in the selection of the pumps.

8.3 Pump Selection and Installation

8.3.1 General Issues

Centrifugal pumps with a stable characteristic curve are to be used as a preference.

8.3.2 Pumps Outside of the Rainwater Reservoir

If the pump is to be set up outside of the rainwater reservoir, a pump with its own suction mechanism should be used. The suction line to the pump should be laid so as to be continually increasing.

A frost-free, well-ventilated room is to be selected as the setup location. A sound-absorbing setup of the process water pump according to DIN 4109, for example with flexible connectors and vibration dampers, should be provided as a preference.

A reflux prevention device is to be provided in the suction line of the pump in order to prevent the water column from being torn down. The pressure line of the pump has to be supplied with a shut-off valve for changing the reflux prevention device. A shut-off valve is to be additionally provided in front of the pump for intake operations.

8.3.3 Pumps Inside of the Rainwater Reservoir

A minimum water level that is necessary for the flawless functioning of the pump is to be maintained that depends on the installation location of the pump. Neither sediment nor scum is permitted to be sucked in. The manufacturer's information with regard to the immersion depth of the pump is to be observed. Pumps inside of the rainwater reservoir should be capable of being pulled out, e.g. for maintenance. A reflux prevention device is to be added to the pressure line of the pump. The pressure line of the pump has to be supplied with a shut-off valve for changing the reflux prevention device.

8.4 Pump Control Unit

The control unit has to switch the pump on and off in orientation to the requirements. In the process, pressure knocks and flutter switching are to be avoided with suitable measures (e.g. in the case of multiple pump systems – diaphragm expansion vessel according to DIN 4807-5). The pumps are to be protected against a lack of water (dry-running protection). The pump motor has to be protected against overload thermally or electrically. Manual operation of the control unit has to be possible. The regulations that are customary in the country are to be observed.

8.5 Multiple Pump Systems

Multiple pump systems are to be used following DIN 1988-5:1988-12, Section 4. A decision has to be made, depending on the area of deployment, as to whether a reserve pump is necessary.

9 Supplemental Feed System

Rainwater harvesting systems have to be provided with a supplemental feed system.

The supplemental feed system has to ensure the operational reliability of the system when there is a drop below the minimum water volume. The quality of the water that is fed in on a supplemental basis has to be suitable for the intended purpose.

The supplemental feed system is to be designed in such a way that flawless functioning is ensured without interruption at all of the removal points that the rainwater harvesting system is connected to. The maximum volume flow of the supplemental water feed system has to be in line with the peak flow according to DIN 1988-3 at the very least. The supplemental feed system has to automatically switch on when the minimum filling level of the reservoir has been reached.

Low pressure impact operation has to be ensured when fittings are used that close quickly (see DIN 1988-2 and DIN 1988-3).

The supplemental feed has to be done via a safety device Type AA (unobstructed, free outlet) or Type AB (free outlet with a non-circular overflow) according to DIN EN 1717 when drinking water is used. The supplemental feed line is to be installed according to DIN 1988-2 and dimensioned according to DIN 1988-3. The possibility of a flooding of the safety device (e.g. via reflux) has to be eliminated. The safety device is to be installed outside of the rainwater reservoir and outside of the entry shaft (dome). The overflow unit of the safety device is to be installed in such a way that the function is ensured and that the outflow of the water can be observed.

If continuous operating reliability of the system is required, e.g. in public facilities, the rainwater harvesting system has to be designed with a holding container with a free outlet (supplemental feed module or hybrid system) in such a way that it can also be operated independently of the rainwater reservoir.

10 System Control Unit

The system control unit automatically controls the functioning of the rainwater harvesting system and consequently brings about the supply reliability. Standardized devices are to be used for control and monitoring. System control units could include the following functions:

— Control of the supplemental feed system

— Measurement of the filling level

— Reflux monitoring

— Malfunction message

— Pump control

— Consumption measurement

— Data recording

— Building control station technology

The respective operating statuses should be displayed on the control unit. The filling level of the rainwater reservoir has to be monitored and should be capable of being displayed. When the minimum water volume in the rainwater reservoir is reached, the supplemental feed system is to be controlled in such a way that as little water as possible is fed in on a supplemental basis. Malfunctions are to be displayed with malfunction messages. A potential-free output should be available, depending on the area of deployment, to indicate the malfunction message.

11 Supplemental Feed Modules, Central Rainwater Systems and Hybrid Systems

Supplemental feed modules consist of a supplemental feed device and a system control unit and are usually produced in the factory as an assembly.

Process water pumps, the supplemental feed system and the system control unit are combined in one assembly in the factory into central rainwater systems.

Hybrid containers are used as a preference in larger rainwater harvesting systems. They are to be selected for system concepts that could only be realized with suction pumps, for example, at a high cost. In addition, they serve to regulate different hydraulic conditions and to increase the operating reliability.

Hybrid containers are to be viewed as being holding containers with regard to the process water pump and are to be dimensioned accordingly. Their volume should not be greater than a half day's requirements for process water. A means of draining the container is to be provided at the deepest point of the hybrid container. The supplemental feed into the hybrid container will be done automatically when there is a shortage of water.

Otherwise, the comments according to Sections 7 to 10 will apply.

12 Pipe Systems and Labelling

12.1 Rainwater Lines

Pipes and fittings of the rainwater lines (supply, overflow, emptying lines) for the rainwater harvesting system have to meet the general requirements on sewers and sewer lines laid underground according to DIN EN 476 or the respective product standards that are in effect. The dimensioning, regular inspection and maintenance and the selection of the pipe materials to be used have to be done in accordance with DIN EN 12056-1, DIN EN 12056-3 to DIN EN 12056-5, DIN 1986-100, DIN 1986-3 and DIN 1986-4. DIN EN 1610 is to be observed for rainwater lines laid underground.

12.2 Aeration and Ventilation Lines

Aeration and ventilation lines for rainwater reservoirs are to be arranged in such a way that surface water, leaves, garbage or small creatures are not able to get into the reservoir.

12.3 Overflow Lines

Overflow lines in sewers and sewer lines are to be provided with odour traps; the penetration of small creatures and sewer gases is to likewise be prevented. Odour traps that block out small creatures are to be installed. If an overflow unit is connected to an above-ground seepage system, a "frog flap" is to be provided for protection against pollution and the penetration of small creatures. The mounted parts are not permitted to cause any narrowing of the cross-section.

Overflow lines are to be attached in such a way that scum in the reservoir is led off. An overflow line is to be provided in the reservoir with the inlet when multiple reservoirs are used.

12.4 Removal Lines

Removal lines are to be arranged in such a way that scum or sediment layers are not sucked in. The removal can be done via a floating removal line or via a stand pipe.

The removal line (suction line) from the rainwater reservoir to the building is to be laid in such a way as to be free of frost. The suction line has to have adequate dimensional stability against underpressure and has to be vacuum-tight.

12.5 Empty Pipes

If empty pipes are laid between the rainwater reservoir and the building rooms to accommodate the removal line and control lines, for example, they should be located above the reservoir overflow system and at an incline to the reservoir. It is to be ensured with suitable measures that water is not able to get into the building through the empty pipe (also see 4.4).

12.6 Process Water Lines

The dimensioning of the process water lines and their laying should be done according to DIN 1988-2 and DIN 1988-3. When process water lines and heating lines are laid in parallel, attention is to be paid to their full thermal insulation.

NOTE The pipe systems registered by DVGW that are utilized in the drinking water installation can be used.

12.7 Labelling

Process water lines are to be clearly and permanently labelled according to the Drinking Water Act and according to DIN 2403.

In addition to this, process water lines are to be labelled with the notice "Process Water" or "Rainwater" or "Not Drinking Water".

A sign with a notice that conveys the gist of the following is to be installed close to the drinking water inlet of the house or on the water meter of the building:

Attention!

A rainwater harvesting system is installed in this building.
Cross-connections are not permitted.

A graphic symbol according to DIN 4844-1 or DIN 4844-2, or a sign "Not Drinking Water", is to be visibly and permanently attached to the removal points. Freely accessible removal points for rainwater are to be secured with a removable or lockable twist lever.

12.8 Condensation Water Protection

Rainwater and process water lines should be laid with thermal insulation in buildings in order to avoid the formation of condensation water if this is necessary due to climactic conditions, temperatures and humidity.

12.9 Water Meters

The installation of water meters is necessary if a sewage fee is to be paid for the routing of the waste water out of the rainwater harvesting system and the rainwater quantity that is used is taken as a basis for the assessment in accordance with the local circumstances. Water meters have to be in compliance with DIN V 3260-10 and the calibration-law regulations. Provisions are to be made for a supplemental installation of water meters.

Water meters can be used to control the rainwater harvesting system independently of the fee regulations.

13 Seepage of the Overflow Water

If the existing soil conditions permit rainwater seepage, the water the overflows from the reservoir should be subjected to seepage (shaft, trench, trough or trough-trench). The regulations regarding seepage that are relevant in the specific country are to be observed in the case of metal roofs.

If no other areas are directly drained into the seepage system and if it is not connected to the sewage system, there is no need for reflux protection for the overflow line of the rainwater reservoir. When the overflow line is connected to a trough seepage system, a blocking unit against small creatures (siphon, rat protection, frog flap) is to be provided. When the supply water is collected on non-metallic roof areas, underground seepage systems are to be put on an equal level with seepage systems with a lively soil zone with regard to the qualitative aspects of the seepage due to the cleansing effect of the rainwater harvesting systems.

When a filter is used with a separate discharge of foreign material, this line is only permitted to be connected to underground seepage systems when there is pre-cleaning of the water, in order to avoid clogging of the seepage systems.

Construction principles and the dimensioning of rainwater seepage systems are specified in ATV Worksheet A 138. The retention effect of rainwater reservoirs can be taken into consideration if applicable when dimensioning seepage systems.

The direct introduction of collected precipitation water (seepage) into a body of water (ground water) represents a use of a body of water. An application is to be made for a permit from the water management authority responsible for this for seepage of precipitation water according to § 7 Water Management Act (WHG) as a general rule. The regulations of the states for the seepage of precipitation water and any regulations that may exist for permit-free seepage are to be observed.

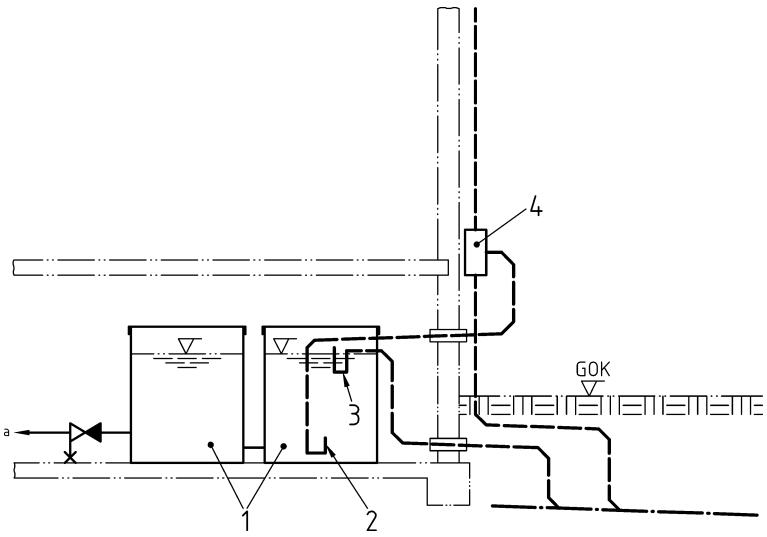
14 Protection against Backflow

Reflux is planned into mixed-water and rainwater sewers of the public sewer system in dependence upon the design fundamentals and also cannot be permanently avoided in ongoing operations. Property drainage systems that are connected with an overflow system below the reflux level are to therefore be effectively and permanently protected against the damaging consequences of reflux via proper installation and operation as intended. The controlling reflux level is specified by the operators of public sewage systems in the drainage regulations. If no reflux level has been specified in the regulations, the upper edge of the road is considered to be the reflux level.

If the overflow of rainwater reservoirs is fed into the mixed-water sewer, or the overflow of rainwater reservoirs set up in basement rooms is fed into the rainwater sewage system, this is to be set up so as to be free of reflux (see Illustration 2) or via an elevating system (see Illustration 3). The elevating system can be installed in the rainwater reservoir, in a separate shaft, or in the form of a container system, e.g. in the basement. It has to be in compliance with DIN EN 12050-2 and is to be dimensioned according to DIN EN 12056-4 and DIN 1986-100.

The overflow of a ground reservoir can be connected to a rainwater sewer via a reflux valve for fecal-free sewage according to DIN 1997-1 (see Illustration 4). Reflux valves for connecting rainwater reservoirs only require, in contrast to the specifications of DIN 1997-1, one operating valve and no additional emergency valve. Connection to a mixed-water sewer via a reflux valve is not permitted.

The pumping output of the elevating system has to be designed for the filter performance in the supply line to the rainwater reservoir when the filter is located above the reflux level (e.g. in the downpipe). when the filter is located below the reflux level, the pumping performance of the elevating system is to be dimensioned for the five-minute rain event ($r_{5,\,100}$) that could occur once in 100 years (see 9.3.7.1 of DIN 1986-100).



Key

1	Rainwater reservoir	2	Quiescent supply	3	Overflow with odour trap
4	Filter	a	To the process water pump		

Figure 2 — Example of a Basement Reservoir Above the Reflux Level

Legend

1 Rainwater reservoir

2 Quiescent supply

3 Overflow with odour trap

4 Sewage water elevating system

5 Filter

a To the mixed-water sewer

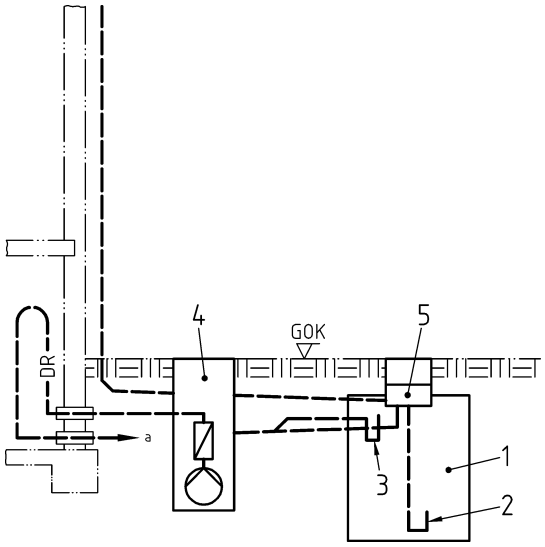
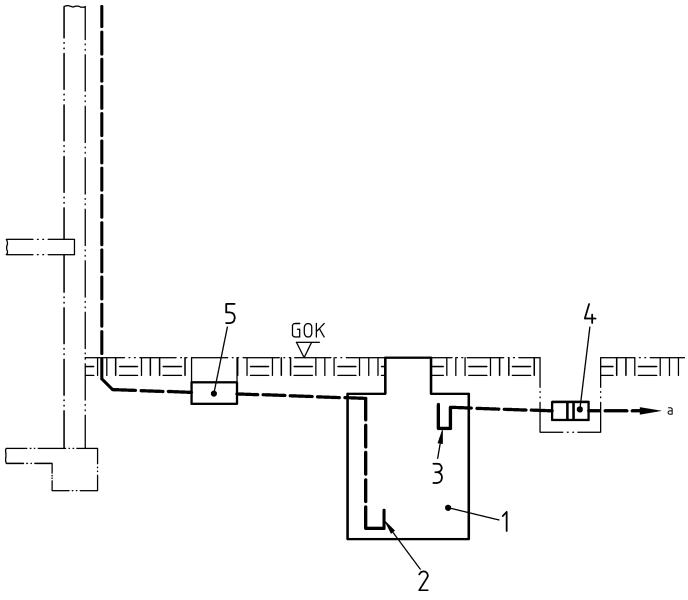


Figure 3 — Example of a ground reservoir with a connection to a mixed-water sewer with an elevating system



Key

1 Rainwater reservoir

2 Quiescent supply

3 Overflow with odour trap

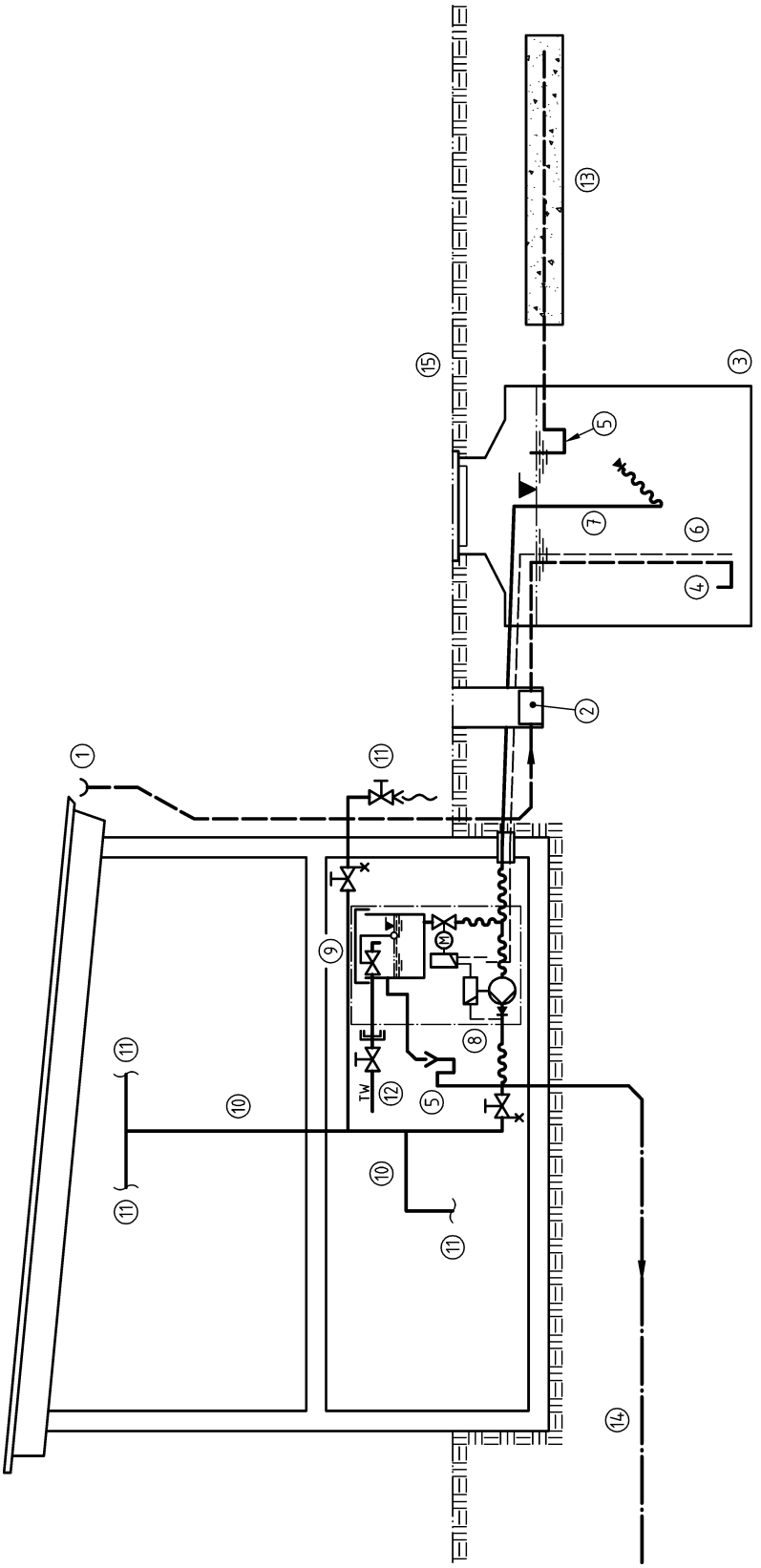
4 Reflux valve

5 Filter

a To the rainwater sewer

Figure 4 — Example of a ground reservoir with a connection to a rainwater sewer with a reflux valve

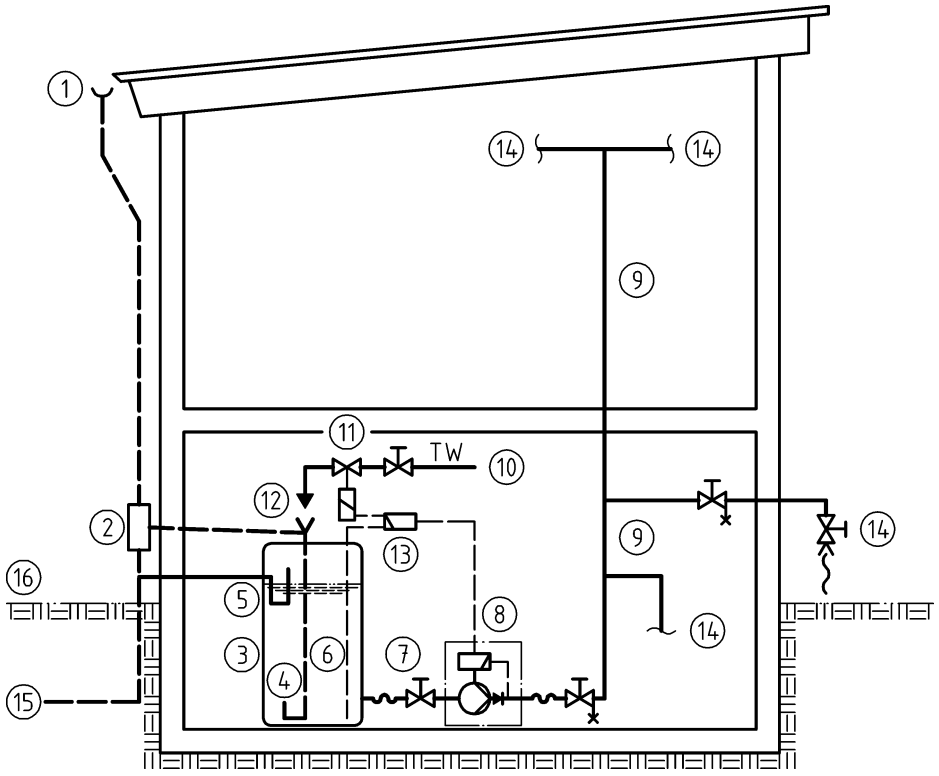
15 Types of systems and setup possibilities



Key

1 Gutter/downpipe
2 Filter
3 Rainwater reservoir
4 Quiescent supply
5 Overflow with odour trap
6 Water level recording
7 Removal line
8 Process water pump
9 Process water line
10 Drinking water line
11 Solenoid valve
12 Free outlet Type AA or Type AB according to DIN EN 1717
13 System control unit
14 Removal points
15 Seepage system / sewer
16 Reflux level

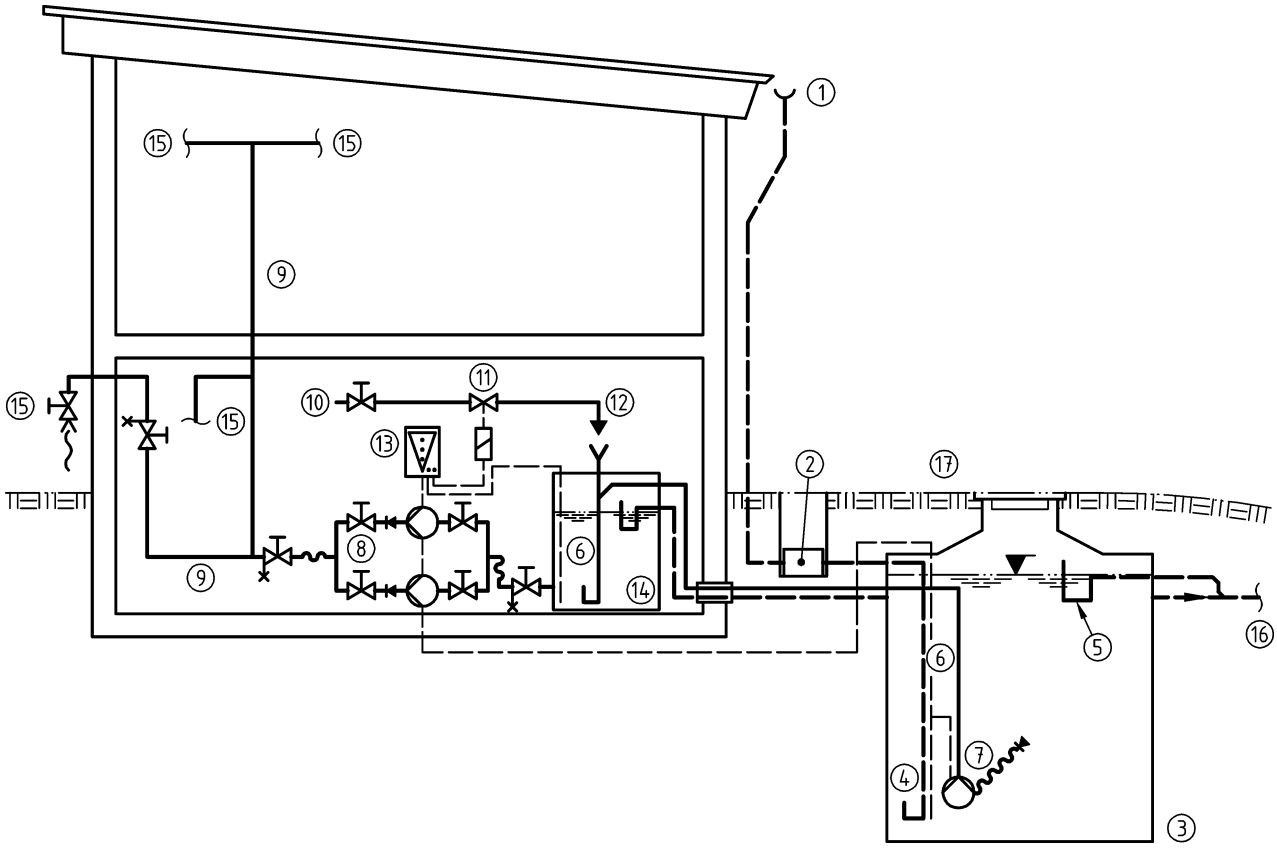
Figure 5 — Rainwater harvesting system with Ground reservoir and Seepage systems



Legend

1 Gutter/downpipe
2 Filter
3 Rainwater reservoir
4 Quiescent supply
5 Overflow with odor trap
6 Water level recording
7 Removal line
8 Process water pump
9 Process water lines
10 Drinking water line
11 Solenoid valve
12 Free outlet Type AA or Type AB according to DIN EN 1717
13 System control unit
14 Removal points
15 Seepage system / sewer
16 Reflux level

Figure 6 — Rainwater harvesting system with basement reservoir



Legend

1 Gutter/downpipe
2 Filter
3 Rainwater reservoir
4 Quiescent supply
5 Overflow with odor trap
6 Water level recording
7 Removal line with pump
8 Process water pumps
9 Process water lines
10 Drinking water line
11 Solenoid valve
12 Free outlet Type AA or Type AB according to DIN EN 1717
13 System control unit
14 Hybrid container
15 Removal points
16 Seepage system / sewer
17 Reflux level

Figure 7 — Rainwater harvesting system with ground reservoir and hybrid container, e.g. for commerce and industry

16 Design of the Reservoir Size

16.1 General Issues

In the selection of the reservoir volume (nominal volume), consideration must be given to the fact that a minimum water volume is not available for use due to the process. The nominal volume indicated by the manufacturer consists of the minimum water volume and the useful volume, which is the object of the following dimensioning procedure.

Boundary conditions that are to be taken into consideration for the dimensioning:

— The water removal system has to be capable of being set up in such a way that neither sediment nor scum, nor air, is sucked in.

— It must be ensured that the required immersion depth according to the information of the manufacturer is adhered to when underwater pumps are used.

The optimum size of the useful volume of rainwater reservoirs should have a balanced relationship between the rainwater yield and the process water requirements. The following factors are significant for this:

— Local quantity of precipitation and precipitation characteristics

— Size and type of the collecting areas

— Process water requirements (amount and distribution)

The useful volume is to be optimized from the point of view of quantitative and economic aspects.

A distinction is made between three dimensioning procedures for meeting the practical requirements:

— An abridged procedure for small systems (e.g. one and two-family houses) in which no calculations have to be carried out ;

— A simplified procedure for all of the system sizes with the objective of obtaining a calculation process that will provide sufficiently precise results for the design and the installation without a great deal of expense;

— A differentiated procedure for all of the system sizes with the objective of achieving a better approximation of the actual operating circumstances, above all for large systems.

16.2 Abridged Procedure

This procedure can be used for single and double-family houses or other comparable buildings or usage types if the following conditions exist:

— Quantities of precipitation of 500 mm to 800 mm per year

— Domestic use over the entire year

— Constant number of persons and use

— Roof areas as collecting areas

The useful volume should be 25 l/m^2 to 50 l/m^2 of the connected collecting area (not for green roofs), on the one hand, and 800 l to 1000 l of useful volume should be provided per user, on the other hand.

Around 4 m^3 of useful volume will consequently result for a 4-person household with a roof area of 100 m^2.

16.3 Simplified Procedure

16.3.1 General Issues

The simplified procedure can be used, for example, for multiple-family houses, administrative and office buildings, and commercial and industrial buildings with a uniform consumption structure. A calculation form for this procedure is contained in Appendix A.

The following factors are to be taken into account in the design of the reservoir.

16.3.2 Quantities of Precipitation

The respective quantities of precipitation that apply to the local area are available for a precise design from the local authorities, from the German Weather Service, Offenbach am Main, and from the Central Office for Hydro-Meteorological Developments and Applications, Berlin. The quantities of precipitation come to between 500 mm and 1 600 mm, or 500 l/m^2 and 1 600 l/m^2, per year.

16.3.3 Size of the Collecting Area

The size of the roof collecting area is the calculated base area of the house (plus the roof overhang), independent of the roof shape and roof slope. If only one side of the roof of the house is used as a collecting area, only the corresponding base area will be taken into consideration. In the case of other areas, the base area upon which there is rainfall will be used as an estimate.

16.3.4 Yield Coefficient

The position, slant, orientation and composition of the collecting area are to be taken into consideration in the determination of the yield coefficient. The values in Table 3 can be used as a planning basis for the slant and composition of the collecting area.

Table 3 — Yield Coefficients

Composition	Yield Coefficient % *e*
Slanted hard roof [a]	0.8
Flat roof, without gravel	0.8
Flat roof, with gravel	0.6
Green roof, intensive	0.3
Green roof, extensive	0.5
Paved surface/compound paved surface	0.5
Asphalt covering	0.8
[a] Deviations depending on the absorbency and roughness	

16.3.5 Filter Systems

The manufacturer information with regard to the usable rainwater volume flow is to be taken into consideration for hydraulic-action filter systems that are used in the reservoir supply line.

NOTE A hydraulic filter efficiency of 0.9 is achieved as a rule with filter systems that are maintained on a regular basis.

16.3.6 Annual Rainwater Yield

The annual rainwater amount that can theoretically be stored is to be calculated according to Equation (1):

$$E_R = A_A \times e \times h_N \times \eta \quad (1)$$

With the following meanings here:

E_R The rainwater yield in liters per year (l/a)

A_A The collecting area in square meters (m^2)

e The yield coefficient in %

h_N The quantity of precipitation in liters per square meter (l/m^2) or millimeters (mm)

η The hydraulic filter efficiency.

16.3.7 Annual Process Water Requirements

The annual process water requirements can be determined from Table 4.

Table 4 — Determination of the Annual Process Water Requirements

The following requirement values are provided for the individual calculations: Consumers		Daily Per-Person Requirements	Specific Annual Requirements
Toilets in the household[a]		24 l / person × day	—
Toilets in office areas[a]		12 l / person × day	—
Toilets in schools[a]		6 l / person × day	—
Garden watering per 1 m² useful garden area of green spaces		—	60 l/m^2
Watering or sprinkling amounts during the vegetation period of April to September			
For sports facilities	Total amount for 6 months	—	200 l/m^2
— For meadow land			
With light soil	Total amount for 6 months	—	100 l/m^2 to 200 l/m^2
With heavy soil	Total amount for 6 months	—	80 l/m^2 to 150 l/m^2
[a] In the case of toilets, only water-saving facilities should be connected as a general rule, for instance 6 l with double-quantity flushing systems. 4.5 l toilets can be used with the appropriate hydraulic conditions to increase the degree of coverage.			
NOTE If washing machines are connected, the daily personal requirements would be increased by 10 liters.			

The process water requirements in the household are comprised of personal data (e.g. toilet) in accordance with

$$BW_a = P_d \times n \times 365 \quad (2)$$

With the following meanings here:

BW_a Annual process water requirements

P_d Daily per-person requirements

n Number of persons

and of area-related data (green areas and garden) in accordance with

$$BW_a = A_{Bew.} \times BS_a \quad (3)$$

With the following meanings here:

BW_a Annual process water requirements

$A_{Bew.}$ Watering areas

BS_a Specific annual requirements

The process water requirements for commercial and industrial areas are to be determined in accordance with the particular application.

16.3.8 Useful Volume

The process water requirements have to be compared to the annual rainwater yield; the smaller value that is determined will be used for the dimensioning of the useful volume in the process. 6% of this smaller value that is determined will be assumed to be an adequate useful volume.

V_n = Minimum of (BW_a or E_R) $\times$ 0.06 (4)

With the following meanings here:

V_n Useful volume

BW_a Annual process water requirements

E_R Rainwater yield in liters per year (l/a)

The rainwater yield will be used in an optimum fashion, or process water for 3 weeks will be kept available when there is a full reservoir, with this dimensioning of the useful volume.

16.4 Differentiated Procedure

An optimization of the reservoir dimensions is to be done for large rainwater harvesting systems, especially with individual consumption structures. Only the simulation of the local precipitation situation and the consumption characteristics in daily time steps via a reservoir model make the required precision possible for mapping the later operating reality and thereby for determining the optimum reservoir size.

Daily data on the process water requirements and on the precipitation are to be used for the dimensioning. The daily process water requirements are to be estimated on an individual basis or are to be derived from measured values. Corrected quantities of local precipitation that have been prepared from representative measurement series are to be used as precipitation data.

The operation of the system is to be simulated over a period of time of at least 5 years to 10 years with these data, taking the system-related constraints into consideration. The longer the simulated period of time, the more precise reality will be mapped out by the results.

NOTE Relevant software is available for the data-processing simulation. Purchasing sources for this are included in the fbr sector guide[5)] .

17 Operation

17.1 General Issues

The conditions imposed by the Drinking Water Act, the AVB Water Act and the municipal regulations are to be taken into account before initiating operation.

Operating, maintenance and servicing instructions are to be turned over to the operator for the operation of a rainwater harvesting system.

Distinctions are made in DIN 18381 as to which documents regarding the operation and servicing of the system are to be turned over to the customer at the handover of the system without being requested to do so.

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5) To be purchased through: Fachvereinigung Betriebs- und Regenwasernutzung e.V. (fbr), Havelstraße 7A, D-64295 Darmstadt.

17.2 Initial Operation

The initial operation is to be prepared by a skilled technician. A trial run with several instances of back-and-forth switching (e.g. of the process water pump and the supplemental feed equipment) is necessary for the initial operation. The following are examples of what is to be checked before, during or after this trial run, as the case may be:

— Condition of the filter system

— Tightness against leaks of the supply/overflow lines

— If applicable, the functional capability of the reflux protection unit

— Tightness against leaks of the rainwater reservoir and its connections

— Tightness against leaks of the process water line

— The functional capability of the process water pump

— Setting of the switching levels in the reservoir

— Pump and flow noises

— Supplemental feed (in the case of the drinking water connection - free outlet)

— Reservoir content display

— Water meters

— Electrical fuse protection of the system according to VDE regulations

— Proper labelling

It is advisable that a record of the initial operation and instructions be prepared with regard to the initial operation and the handover of the documents (see Appendix B).

17.3 Operating Instructions

The operating instructions have to include the following notices for the operator of the system:

— Reference to this standard

— If changes in the water arise at the removal points with regard to odor, color or suspended particles, the system is to be checked and a technician is to be called in if necessary.

— The guideline ZH 1/77 of the workers' compensation association for work in containers and cramped areas is to be observed when there is inspection or maintenance work in the rainwater reservoir.

— There is to be a reference to protection against strong thermal effects for rainwater reservoirs that are set up in the basement.

— The penetration of dirt particles and surface water into inspection or entry openings of rainwater reservoirs is to be avoided.

— The filling level in the rainwater reservoir should be checked on a regular basis.

— No chemicals or additives are permitted to be used during the operation and cleaning of the rainwater harvesting system.

— Connections between drinking water lines and process water lines are not permitted.

— Removal points and process water lines that are not frost-free have to be shut off and emptied at the appropriate point in time.

— Additional static loading of any of the supply, overflow, emptying and removal lines is to be avoided (e.g. by hanging objects on them).

— All of the controls and system parts that are inspected and maintained on a regular basis have to be accessible at all times.

— Water losses can be recognized by a regular reading of the water meters that may be installed (e.g. leaks in the reservoir and clogged filters). At the same time, the quantity of the supplemental feed of water and, if applicable, the consumption of process water will be checked in this way.

— An operations manual with the monthly water removal and, if applicable, the supplemental feed of water should be maintained for better control and monitoring of the functions of the rainwater harvesting system.

18 Inspection and Maintenance

The operating and functional reliability will be increased, the useful life will be extended and structural damage and unplanned repairs will be prevented with regular inspection and qualified maintenance. The warranty period according to VOB is retained for new systems.

Rainwater harvesting systems have to be regularly inspected by the operator or by a technician. In particular, the water meters, the level and pump control unit, the filling level display, the quiet running of the pump and, to the extent possible, tightness against leaks should be checked.

Inspection and maintenance work on rainwater harvesting systems has to be done by the operator or by a technician at the intervals of time specified in Table 5, and the systems have to be inspected or maintained with regard to the system parts listed in Table 5 in the following scope.

Table 5 — Inspection and Maintenance Measures

System Part / Apparatus	Measure	Execution	Time Span
Roof drains	Inspection	Check that there is an unobstructed drain (also for any overflows), tightness against leaks, clean dirt traps, check heating if applicable	6 months
Gutters / rain downpipes	Inspection	Check for tightness against leaks, cleanliness, fastenings, if applicable the heating and paint; clean the screens	6 months
Filter systems	Inspection	Check the condition of the filter	1 year [a]
	Mainten.	Cleaning of the filter	1 year
Rainwater reservoir including mounted parts	Inspection	Check of the cleanliness, tightness against leaks, stability	1 year
	Mainten.	Emptying, cleaning of the interior areas of the reservoir, removal of the sediment if applicable	≈ 10 years
Process water pump	Inspection	Visual check of the switching response for operational capability and tightness against leaks	6 months
	Mainten.	Trial run: The following are to be checked before, during or after the trial run, as the case may be: — The electrical fuse protection of the pump system according to VDE regulations — Admission pressure of the diaphragm container (if present) — Tightness of the sliding ring seal of the pump — Functional capability of the reflux prevention device — Pump and flow noises — Tightness of the system and fittings — Cleanliness of the system — Corrosion of the system parts	1 year
Supplemental feed / free outlet Type AA or Type AB	Inspection	Check of the safety spacing (water level setting), of the inlet valve and of the overflow unit with a fully-opened inlet; visual inspection of the aeration and ventilation if applicable	1 year
System control unit	Inspection	Check by observing an instance of switching response of the pump system	6 months
	Mainten.	Trial run: The following are to be checked before, during or after the trial run, as the case may be: — On and off switching points of the system — Supplemental feed (solenoid valve)	1 year
Filling level display (rainwater reservoir)	Inspection	Comparison of the filling level in the reservoir with the filling level display	1 year
Pipelines	Inspection	Check of all of the visible lines for their condition, tightness, fastenings and external corrosion	1 year
Water meters	Inspection	Check of water meters for functional capability and tightness	1 year
	Mainten.	Water meters are to be exchanged for new ones every 6 years according to the calibration regulations if they are used in commercial settings	6 years

Table 5 *(continued)*

Reflux prevention unit	Inspection	To check for a tight connection, the pipeline in front of the reflux prevention unit in the direction of flow is to be shut off. A determination is made as to whether water flows out by opening the test device that is located at the inlet side of the reflux prevention unit. It is assumed here that the consumption lines after the reflux prevention unit are filled with water. The connection is tight if no water flows out of the test connector.	1 year
Reflux valves	Inspection	Actuate the reflux valve or emergency valve if applicable	1 month
	Mainten.	Cleaning, check for tightness and functional capability according to the manufacturer's documents	6 months
Odour traps	Inspection	Check for cleanliness and water level, tightness, shut-off capability if applicable	6 months
Waste water elevating system (according to DIN EN 12050-2)	Inspection	Check for operational capability, tightness, external corrosion	1 month
	Mainten.	Check for tightness, functional capability, inspection of the level switching, check adjustment levels of inlet, outlet and alarm levels, check of the reflux prevention unit for tightness.	3 months [b] 6 months [c] 1 year [d]
Removal fittings	Inspection	Check of all of the removal fittings for tightness and any possible changes of the water with regard to odour, colour or suspended particles	1 year
Flushing facilities (toilets)	Inspection	Check of the flushing process of flushing facilities (cisterns, flushing valves); correction of the flushing water volume if necessary	1 year
Labelling	Inspection	Check of the labelling of all of the pipelines and removal points	1 year

a According to location conditions and manufacturer's information

b In commercial companies

c In multiple-family houses

d In single-family houses

Intervals of time that are longer or shorter could result from special system and operation-related constraints.

In addition, the information of the manufacturers with regard to operation and maintenance is to be observed.

— Inspections may be done by the operator of the system himself.

— Maintenance and repairs are to be done by technicians.

Annex A
(informative)

Calculation Form for Determining the Rainwater Yield, Process Water Requirements and Useful Volume of Rainwater Reservoirs

Client:_____Project: _____

Rainwater yield				l/m² = Annual quantity of precipitation	
Collection Area A [m²]		Yield Coefficient *e*	A_{eff} [m²]	Precipitation Quantity h [l/m²]	Hydrl. Filter Efficiency η [-]
Base area roof		x	=	(according to information of the weather office)	e.g. 0.9
(including roof overhang)		x	=		
Other suitable areas		x	=		
		x	=		
	Σ	x	~~l/m²~~	x	
	Annual rainwater yield in l		=		

Process water requirements				
Drainage object	Process water requirements in liters per day and pers.	Number of persons	Period of time in days per year	Process water requirements in liters per year
Toilet			Year	
	Σ x	x	x	= (1)
	Garden size in m²	Water requirem. in l/m²		
Garden watering				= (2)
Other uses				= (3)
	Process water requirements Σ (1) + (2) + (3) in liters per year			=

Useful volume of the rainwater reservoir		
6 % of the annual process water requirements or annual rainwater yield		Note The smaller respective value of the annual process water requirements or the annual rainwater yield is to be used in the calculation.
Useful volume in liters =	[l/a] x 0,06	=
Selected useful volume in liters		=

NOTE The user of this form is permitted to duplicate it.

Annex B
(informative)

Example of a Record of the Iitial Operation and Instructions for a Rainwater Harvesting System

Construction project: _____

Customer represented by: _____

Contractor represented by: _____

No.	System part, apparatus [1)]	Remarks
1	Roof drains	
2	Gutters, rain downpipes	
3 4 5 6 7	Filter systems Rainwater reservoir Process water pump Supplemental feed, free outlet System control unit	
8 9	Pipelines Water meters	
10 11 12	Reflux prevention device Reflux valves Odor traps	
13 14	Elevating system Removal fittings	
15	Labeling of lines, removal points and sign	
[1)] Non-applicable items are to be deleted, lacking items are to be added.		

_____ _____

City Date

_____ _____

(Customer or representative) (Contractor or representative)

NOTE The user of this form is permitted to duplicate it.