WILO
Pumpen Intelligenz.

Rainwater utilisation technology

Planning Guide

2007

Introduction

Water is life

We need fresh water for our daily lives, for producing food and industrial goods. In particular, water contamination and inefficient utilisation have to be counteracted.

When you consider that nearly one quarter of the world population doesn't have access to clean drinking water, it becomes clear how the struggle for water creates potential for conflicts worldwide. Drinking water is a necessary food for which there is no substitute.

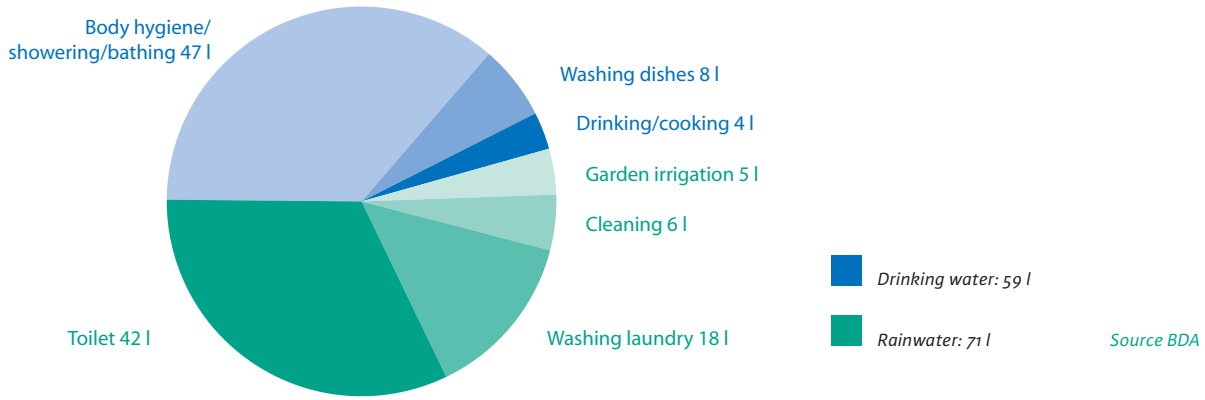
The sensible utilisation of rainwater with systems specially designed for that is inexpensive and good for the environment. They perform excellently both in the house as well as in the yard: After all, except for drinking, hygiene and preparing food, expensively treated drinking water isn't absolutely necessary.

Especially the water demand for the garden and outdoor installations, as well as for toilet flushing and the washing machine, can be very easily covered with a self-sufficient water supply. That's good for the environment and the household budget: By utilising rainwater, you can save up to 71 litres of drinking water per person and day. With the increasing cost for water, it's becoming more and more worth it to utilise rainwater.

What can I save?

By utilising a rainwater utilisation system, up to 71 litres of drinking water can be saved.

130 litre water demand per person and day



10 good reasons to use rainwater

1. **Rainwater for a future worth living for**
   Protecting the environment is mandatory for keeping the world livable for our children. With a rainwater utilisation system, you actively commit to helping the environment and therefore to the future of our children.

2. **Ecological awareness is in the spirit of the age**
   With a rainwater utilisation system, you demonstrate that you can combine modern technology with ecological awareness. That's modern.

3. **Rainwater utilisation can do a lot**
   Thanks to modern technology, hygienically harmless rainwater is used reliably for garden irrigation, but also for operating toilets, washing machines and in many other areas where the use of valuable drinking water would be a waste.

4. **Rainwater utilisation is the most modern environmental technology**
   The environmental technology of specialised German companies has the best reputation worldwide in the area of rainwater utilisation. Their sanitary and heating tradespeople have the know-how to integrate this technology expertly into your home automation.

5. **Rainwater utilisation saves money**
   Up to 60% of drinking water can be saved by means of rainwater utilisation. In many places, there is also aid money available. Even more important is the conservation of water, the essential resource.

6. **Rainwater utilisation: As understood as waste separation**
   Rainwater utilisation will soon be as commonplace as waste separation. That's an important precondition, committing oneself now to rainwater utilisation.

7. **Rainwater utilisation is reliable in the house**
   Modern rainwater utilisation systems meet the high standards of German water regulations (which are among the strictest in the world) reliably with no problems.

8. **With rainwater utilisation, you are self-sufficient**
   New technologies give us some independence from the supplier companies. Make rainwater utilisation part of your own water supply now.

9. **Rainwater utilisation: Technology with a future**
   Especially in the last few years, we have documented an above-average increase in the installation of rainwater utilisation systems. This, too, is proof for the guaranteed future of your investment.

10. **Professional systems installed by professionals**
    Modern rainwater utilisation systems are no "do-it-yourself" products, but are highly developed environmental technology. Invest in reliability and performance by having the installation done by an expert, your sanitary and heating company.

Practical example – renovation
Ev. Waldheim Lindental in Stuttgart, Germany (public building)

The rainwater utilisation system could not be accommodated in a technical room, so had to be built into the stairwell. All toilet systems are operated with rainwater. Also, children and teenagers are told how they can use rainwater in play.

Building information

New building and modification of the children's vacation home with outbuildings in Stuttgart-Weilimdorf. Due to their ecological commitment, the Evangelical Regional Church in Stuttgart wanted to make a contribution to environmental protection in this nearby recreation area.

Background information: Rainwater utilisation is not only designed for new buildings, but also for renovations. The newest numbers prove that about 20% of the installed systems are in new buildings and about 80% in renovations.

Practical example – new building
"Haus Tobias" – Kindergarten, school and home in Freiburg, Germany (educational facility)

The operators and home directors want to put the philosophy of their social facility into action by having a lasting interaction with nature as a basis of existence for following generations.

For this reason, not only were green roofs realized, but also a rainwater system. The "Haus Tobias" not only uses rainwater for toilets and the outdoor installations, but also for the washing machines in the residential area.

Building information

The "Haus Tobias" is a kindergarten, school and home for children and teenagers in need of psychiatric care. The organization supporting the facility is the remedial Sozialwerk Freiburg e.V. The new home and school were built to satisfy the constantly increasing demand for space. The number of spots in the home was increased to 45. Overall, 130 children are cared for here.

Fundamentals of rainwater utilisation

Design of a rainwater utilisation system

Determine yield

Determine collection area
- Calculation of the projected collection area (= covered basic area), see also collection areas *page 12*

Determine rough estimate of yield according to Wilo:
Yearly precipitation of the place of residence, e.g. German mean value is 774 mm (is equivalent to 774 litre per m^2) with a basic roof area (multiply length x width at the height of the eaves). 75% of the result is the available yield. The losses come from the wetting of the roof and storage tank overflow.

Determine yield according to DIN 1989
- See also basis for assessment *page 18*

Local precipitation data can be obtained from your local weather office.

Determine demand

Determine rough demand according to Wilo
- See also basis for assessment *page 17*

Determine demand according to DIN 1989
- See also basis for assessment *page 18*

Determine storage tank size

Experience has shown that stocking up for a demand for 2–3 weeks is optimal.

- For larger stocked amounts, the water quality goes down in the storage tank.
- For smaller volumes, the replenishment demand for drinking water is too high.
- If rainwater is primarily used for garden irrigation, a larger tank range may also be chosen.
- Avoid having too large a tank.
- A periodical storage tank overflow is desired.
  - Overflowing supports the self-cleaning of the rainwater.
  - Surface contamination is rinsed out (skimmer effect)

If the yield and demand are approximately the same (max. 20% deviation), the economically reasonable size for the outdoor storage tank is about 8% and that for the indoor tank about 5% of the yearly requirement.

Rough storage tank determination according to Wilo
- See also assessment bases *page 17*

Determine storage tank according to DIN 1989
- See also assessment bases *page 18*

System selection

Fundamentally, the following is true: Only high-quality products should be used for the core piece of a well-functioning rainwater utilisation system. Inefficiency and low wear-resistance in many cheap offers will end up costing a lot of money in the course of operation.

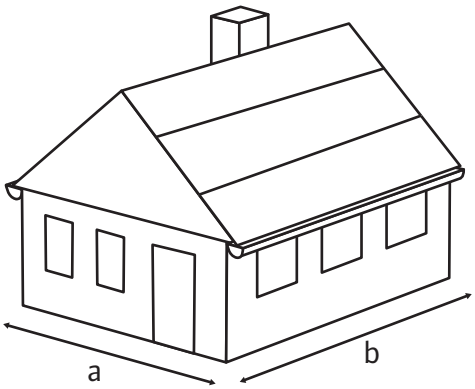
Demands on a pump or on domestic water system
- Demand-oriented design saves energy
- Higher efficiency, low electric and hydraulic losses
- Use of corrosion-free materials
- Operational reliability thanks to high-quality mechanics
- Low noise emissions
- Dry running safeguard
- No stagnation areas for water in the tank

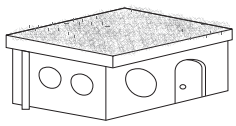
Collection areas

Calculation of the projected collection area (= basic covered area)

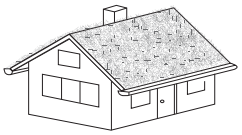
a _____ m x b _____ m =

_____ m^2 (collection area)

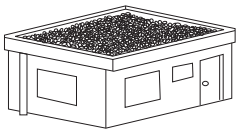




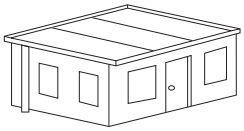
Flat roof, planted
Discharge coefficient: 0,20



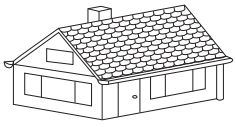
Gabled roof, planted
Discharge coefficient: 0,25



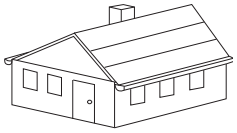
Flat roof, gravel
Discharge coefficient: 0,60



Flat roof, slabs
Discharge coefficient: 0,70



Gabled roof, shingles
Discharge coefficient: 0,75



Gabled roof, slabs
Discharge coefficient: 0,80

Note:
Discharge coefficients help calculate the size of the storage tank. See page 18, assessment bases.

For planted or bitumen-covered roofs, the use of rainwater systems should be checked on a case-by-case basis.

Yearly precipitation amounts on average, in litres per m² (= mm precipitation)

Note:
Local precipitation amounts are to be found out from the responsible weather service.

Filtering

The roof run-off water must be finely filtered before entering the storage tank.

Approximate size:
Mesh width 0.3 mm to 1.8 mm

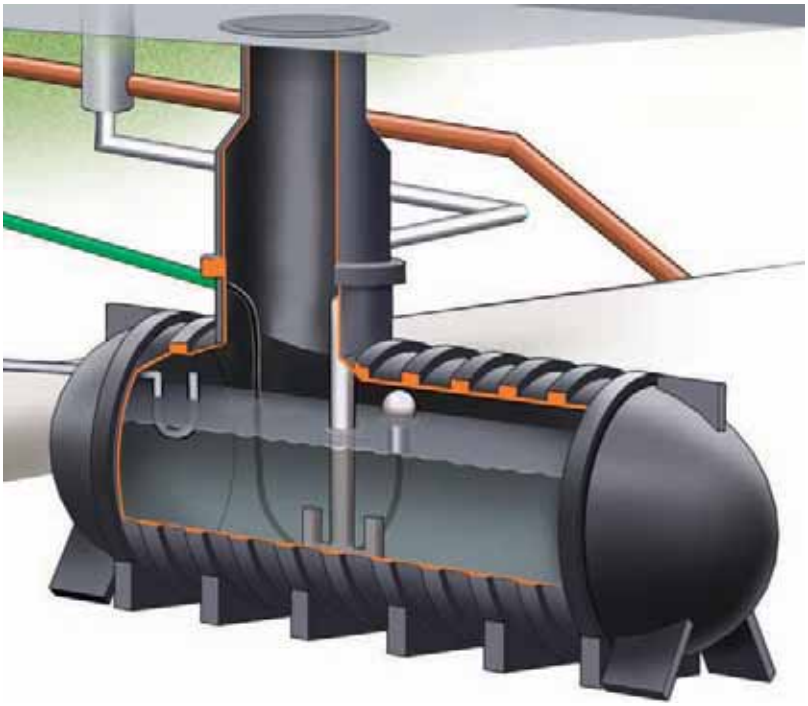
Note
- It has been shown that a mesh width between 0.3 mm and 1.8 mm guarantees both good filtering as well as a good filter service life (complies with the building drainage criteria according to DIN EN 12056)
- Max. amount of rainfall of 300 l/(s x ha) must be able to pass through the filter without backing up.
- Passability even when the filter is clogged or the storage tank inlet is blocked.
- The line cross section must be guaranteed continuously.
- In the case of a free connection to the drainage pipe, the ball passage must be kept continuously (tennis ball criterion)

Criteria for the selection of the filter system in the storage tank inlet (according to DIN 1989 part 2)
- Good accessibility
- Simple cleaning without consequential costs
- Maintenance must be quick and able to be done without major effort
- Low-maintenance
- Frost-safety
- No clogging or plugging up of the filter, no contamination by mould spores, no moulding (lightproof design, self-cleaning design)
- Reliable filtration of rough and small particles from the roof run-off water
- Long-term good filter effect with high efficiency
- High material durability
- If possible, drainage of debris from water surface

When the filter is professionally installed, additional filtering in the suction and pressure pipe can be omitted. Here, malfunctions in the system operation could occur (pump damage, bacterial growth).

Storage

Rainwater storage tanks are not only for storing roof run-off water. Biological self-cleaning also takes place. The cleaning capacity depends on the flow conditions in the storage tank and the inlet, overflow and suction versions. This is true both for the outdoor as well as the indoor storage tank.



Demands on the storage tank (cistern):

- Storage tanks are construction materials. For this reason, it is especially important to make sure they are durable.
- Dimensional stability
- Upward pressure reliability
- Permanent water and light impermeability
- Frost-safety
- Settled feed line of the precipitated water
- Reliable overflow, avoidance of backflow occurring, channel gases and small animals
- Good accessibility
- Permanently tight pipe inlets for feed line, drain and empty pipe for technology

Outdoor storage tank

- Are used much more often than indoor storage tanks
- Are especially suitable in new buildings
- Concrete or PE version
- Risk of root onset

Indoor storage tank

- Are suitable for retrofitting, renovation, and also in new buildings where excavation work isn't being done.
- Battery design made up of several storage tanks allows flexible volume
- Requires set-up space in cellar or in house connection area

Indoor storage tanks require an overflow above the backflow level. Otherwise, a feed line block must be installed, since a lifting unit also doesn't provide 100% protection against overflow.

Note
Underground storage tanks are always preferable to indoor storage tanks since they can also serve as a natural air conditioning system.

Storage tank material

There is no clear recommendation as to whether storage tanks made of concrete or PE should be used. Both have their justifications and the advantageous selection criterion must be determined depending on the local conditions.

Concrete storage tanks

- Especially suited for installation in traffic and set-up areas
- Are usually ready for connection with built-in filters, feed line and overflow
- High stability for outdoors
- Flexible drill holes for feed line and overflow as well as variable installation depth
- With calculated upward pressure safeguard, not sensitive to high ground water level
- Installation costs higher due to crane use
- Excavation pit must be easily accessible
- Load capacity class A–D
- In C35/45 according to DIN 1045-1 or according to DIN EN 206

PE storage tank

- Low weight allows for inexpensive transportation
- Simple lowering in the excavation pit
- Well suited for hard-to-access excavation pits
- Are usually ready for connection with built-in filters, feed line and overflow
- Load capacity class A–D

Load capacity classes

Coverage			Load
Class A:	Can be walked on	Sidewalks, bike paths	15 kN
Class B:	Can be driven over with restrictions	Sidewalks, pedestrian zones, passenger car parking lots, parking decks	50 kN
Class C:	Can be driven over with limitations	Curb area (extending up to 0.5 m) under the road surface	125 kN
Class D:	Can be driven over	Road surfaces, shoulders, parking lots, can handle trucks, logistics and commercial areas with forklift traffic	400 kN
Class E:	Can be driven over	Docking systems, airport runways	– kN
Class F:	Can be driven over	Airport runways	– kN

Retrofit of former cesspools or oil tanks

From a technical aspect, there's no reason why they can't be used as rainwater storage tanks. Professional cleaning and lining is required.

Feed line, overflow and drain lines

- ... of the rainwater utilisation system must meet the general demands on earth-laid sewage pipes in accordance with DIN EN 476.
- The dimensioning, regular inspection and maintenance, as well as the selection of the pipe materials to be used, must be done according to DIN EN 12056 and DIN 1986-100.

Overflow lines

- ... in sewers and sewage pipes are to be provided with anti-syphon traps. Hereby, DIN EN 12056 is to be observed (protection against backflow). You can find further information in our sewage technology planning guide 2006.
- The intrusion of small animals and channel gases is to be prevented.
- None of the installed parts may cause there to be a cross section bottleneck.
- The floating layer in the storage tank must be drained by means of the overflow lines.

Ventilation pipes and gas leads

- ... for rainwater storage tanks are to be arranged so that surface water, vegetation, garbage or small animals can't penetrate.

Observation and utilisation of the 3 cleaning stages

1st cleaning stage: Filtering
2nd cleaning stage: Sedimentation
3rd cleaning stage: Overflow

Filtering, feed line and sedimentation

After filtering, the precipitation water is stored in the storage tank. The storage tank also simultaneously serves as another cleaning stage. The oxygen-enriched rainwater is fed downward via a steady-flow feed line without eddies. Dirt particles which are heavier than water form a layer of sediment on the bottom which carries out a clarification function thanks to the constant oxygen entry and microbiological processes.

If there is reliable filtering in front of the cistern, the sediment layer only grows by a few millimetres per year. For this reason, the cistern should only be cleaned at long intervals (5 – 10 years). The sediment layer is only kept from being constantly subject to turbulence with a steady feed line. Also, even with low amounts of rain, there is oxygen entry in the sediment layer.

Overflow

The overflow is for feeding water to a drainage pipe or a drainage system when the cistern is full. Thanks to the overflow, another cleaning stage of the storage tank is achieved by rinsing out floating particles, such as pollen, etc. Periodical storage tank overflow is desired by all means. When the reservoir overflows, this supports the self-cleaning of the rainwater in that contaminants which float on the surface of the storage medium are rinsed out of the reservoir. The diameter of the overflow must be dimensioned at least as large as the feed line and must lie underneath the feed line.

The trap and small animal block protect the storage tank from drainpipe gases and animals. The storage tank must be protected against backflow from the drainage pipe or the drainage system. If the overflow is not connected to a drainage system or rainwater drainage pipe backflow-safely, a backflow seal is sufficient. When connected to a mixed water drainage pipe, however, a lifting unit has to be used if there's a danger of backflow, which is designed in accordance with DIN 1986-100 for $r_{5.100}$ (5 minutes for 100-year rain event).

Water draw-off

The water should be drawn off using a floating suction line, since here the filter fastened to a ball float draws off the clean water underneath the surface of the water. In the case of a permanent foot valve installation, the rigid suction line must end high above the cistern floor so that nothing is suctioned out of the sediment layer.

Calculation of the rainwater storage tank size according to Wilo

Yield calculation

	Amount of precipitation per year	Area (projected roof surface)	Discharge coefficient	Rainwater yield/year		Rainwater yield/day
Example	800 l/m²*	x 120 m²	x 0.75	= 72 000 l/year	: 365	Ø 200 l/day*

*** rounded-off value**

If no value for the yearly precipitation is known, one can approximately use a value of 774 l/m² per year for Germany for calculation.

Determination of requirements

	Average values	Example
Toilets with/without saving button (per person)	8/14 m³/year	14 m³/year
Washing machine (per person)	6 m³/year	+ 6 m³/year
Tap for cleaning, etc. (per person)	1 m³/year	+ 1 m³/year
Requirement per person/year		= **21 m³/year**
Number of persons in the household x requirement per person/year = Requirement in house	_____ Persons	4 persons x 21 m³ = **84 m³/year**
Garden irrigation (for every 100 m²)	6 m³/year	for 250 m² of garden: 2.5 x 6 m³ = **15 m³/year**
Requirement in house + garden irrigation = Total requirement/year		84 m³ + 15 m³ = **99 m³/year**
Total requirement : 365 = Daily requirement		99 m³ : 365 = **0.271 m³/day (271 l/day)**

Storage tank design

Experience has shown that stocking up for a demand for 2 – 3 weeks is optimal. For larger stocked amounts, the water quality goes down in the storage tank, and for smaller volumes, the replenishment demand for fresh water is too high. The following formula results:

Daily requirement in m³ x 15 days = storage tank requirement in m³

Example: 0.271 m³/day x 15 days = 4 m³ storage tank requirement

If rainwater is mostly used for garden irrigation, the volume of the reservoir can also be selected to be larger. You should avoid overdimensioning the storage tank in any case.

Recommendation:
Wilo experience has shown that an approach with 30 days for one- and two-family houses is more realistic.
This is equivalent to a storage tank size of 4 to 6 m³.

Calculation of the rainwater storage tank size according to DIN 1989

Calculation formula for the rainwater yield

120 m² x	**0.8 m³ x**	**0.75 x**	**0.9**	**=**	**64.8 m³**
Collection area	**Amount of precipitation**	**Discharge coefficient**	**Filter efficiency**		**Rainwater yield**

If no filtering degree is indicated in the documentation, a factor of 0.9 is used for calculations.

Calculation of the rainwater requirement

–	Persons x 8.8 m³	toilet flushes/year (with saving/stop button)	=	0 m³
4 –	Persons x 14 m³	toilet flushes/year (without saving/stop button)	=	56 m³
–	Persons x 4.4 m³	for washing machine/year	=	0 m³
250	m² x 0.06 m	intensive garden irrigation/year	=	15 m³

Total rainwater requirement: 71 m³

Determining the storage tank size

64.8 m³ x	**0.06**	**=**	**3.89 m³**
Rainwater yield or requirement*	**discharge coefficient**		**Useful storage tank volume**

***To calculate the useful volume, only the smaller value from the determined values of the rainwater yield or rainwater requirement is used.**

Coverage rate

Yield 64.8 m³/year : Yield 71.0 m³/year x 100 = 91.3% yearly coverage rate (min. 80%)

To compare whether the water requirement is equivalent to the statistical average, one can assume a yearly total water consumption of about 47 m³ per person and compare with the actual total water consumption.

Collection area – roof	discharge coefficient
Flat roof with grass or other plants	0.20
Inclined roofs with grass or plants	0.25
Flat roof with gravel covering	0.60
Flat roof with roof sheeting or roof slabs made of plastic or bitumen	0.70
Inclined roofs with tiles or concrete blocks	0.75
Inclined roofs with roof sheeting or roof slabs made of plastic or bitumen	0.80

Pump/system technology

Typology of the rainwater pump

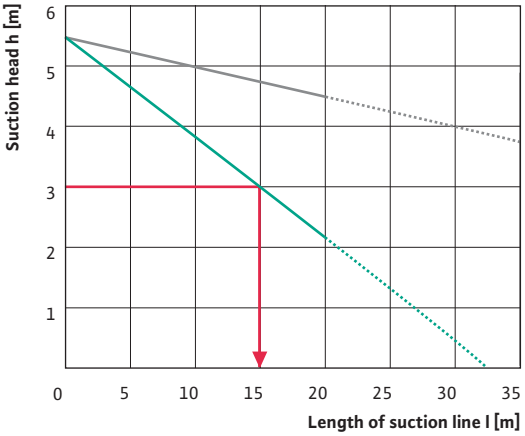
Non-self priming, dry set-up pumps
- Design for pressure operation
- Available in horizontal and vertical construction form
- Utilisation in large plants which work with intermediate reservoirs

Self-priming, dry set-up pumps
- Can evacuate air from the suction line thanks to air separation technology in the pump hydraulics and suction water from a lower-lying reservoir
- System design under exact consideration of suction conditions
- For multi-pump systems, a separate suction line is necessary for each pump.

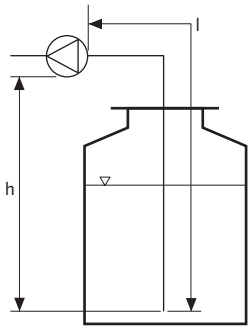
Notes regarding suction line
- Lay the suction line continuously rising to the pump (don't allow air pockets)
- Install foot valve (prevents the suction line from running empty)
- Cross-sections which are too large reduce the suction power
- Design suction line to be vacuum-tight (water-tight is by no means vacuum-tight. Use suction- and pressure-proof spiral hoses)
- Do not use fittings except for a foot valve in the suction line (filter, non-return valve, no shut-off valves on suction side)
- No cross-section reduction in suction line (lay minimum suction connection cross-section, better one nominal diameter larger)
- Keep suction lines as short as possible (long suction line = large frictional resistance = smaller suction head)

Notes with regard to the pressure pipe
- Drainage valve at lowest point in the pressure system

Suction line and suction head of a centrifugal pump



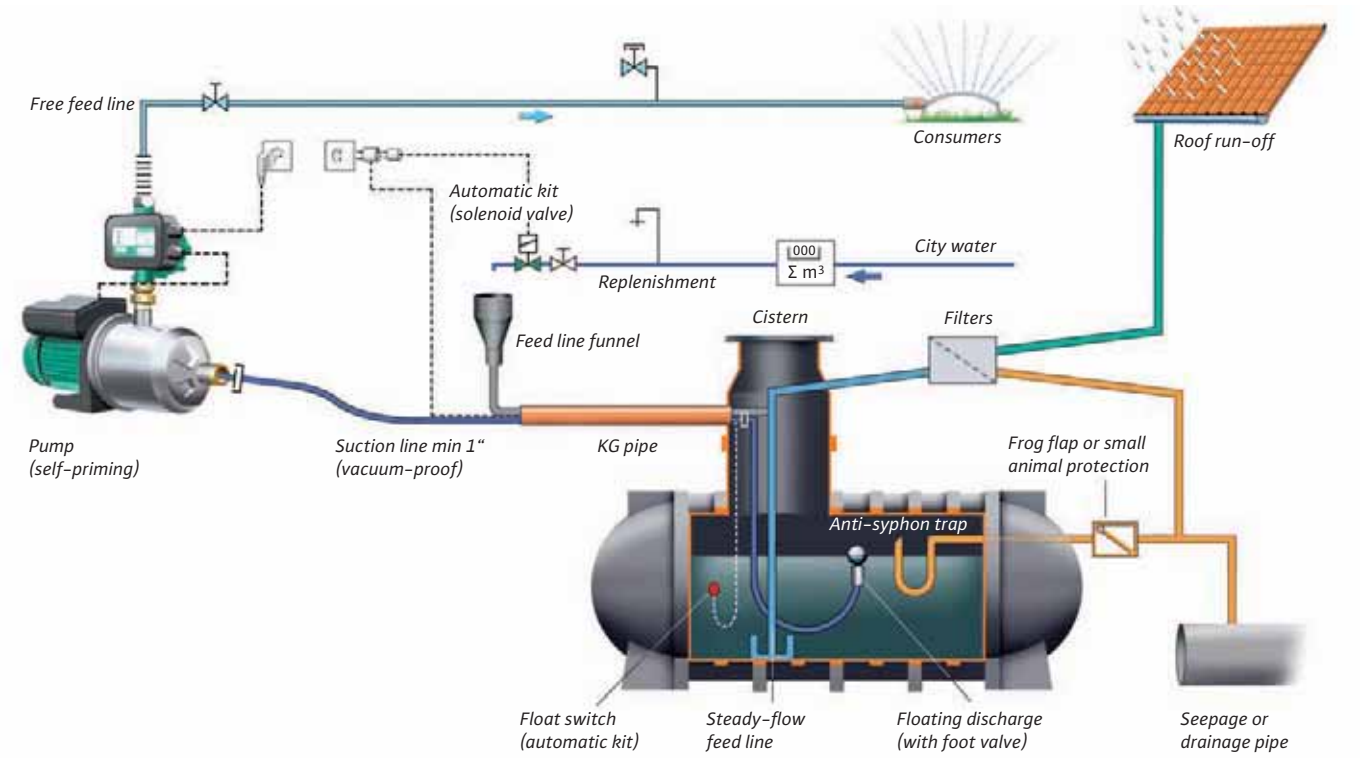
Suction line: PE-HD, 1
Suction line: PE-HD, 1¼
Volumetric flow: 3 m³/h



Single-stage submersible pumps or multi-stage submersible pumps
- Required for overcoming greater geodetic heights or resistances
- Used directly in the rainwater cistern
- Multi-stage, i.e. several impellers connected in series
- Higher investment is compensated by better efficiency
- Equip with detachable connection technology
- Occasional use in problematic systems

Fresh water metering
Guarantee of the operational state of a rainwater utilisation system during long dry or frost periods by means of demand-oriented drinking water feed
- As "free outlet" in accordance with EN 1717
- Manual or automatic
- In the storage tank or in a replenishment module

System diagram: Garden/one-family house



System with self-priming pump

- Low noise operation due to multistage design
- Ideal as a system for garden irrigation
- Excellent suction behaviour
- Control by means of flow switching device
- All parts that come into contact with the fluid are corrosion-free

Field of application:

- Sprinkling
- Irrigation and spraying
- Rainwater utilisation
- Operating water utilisation

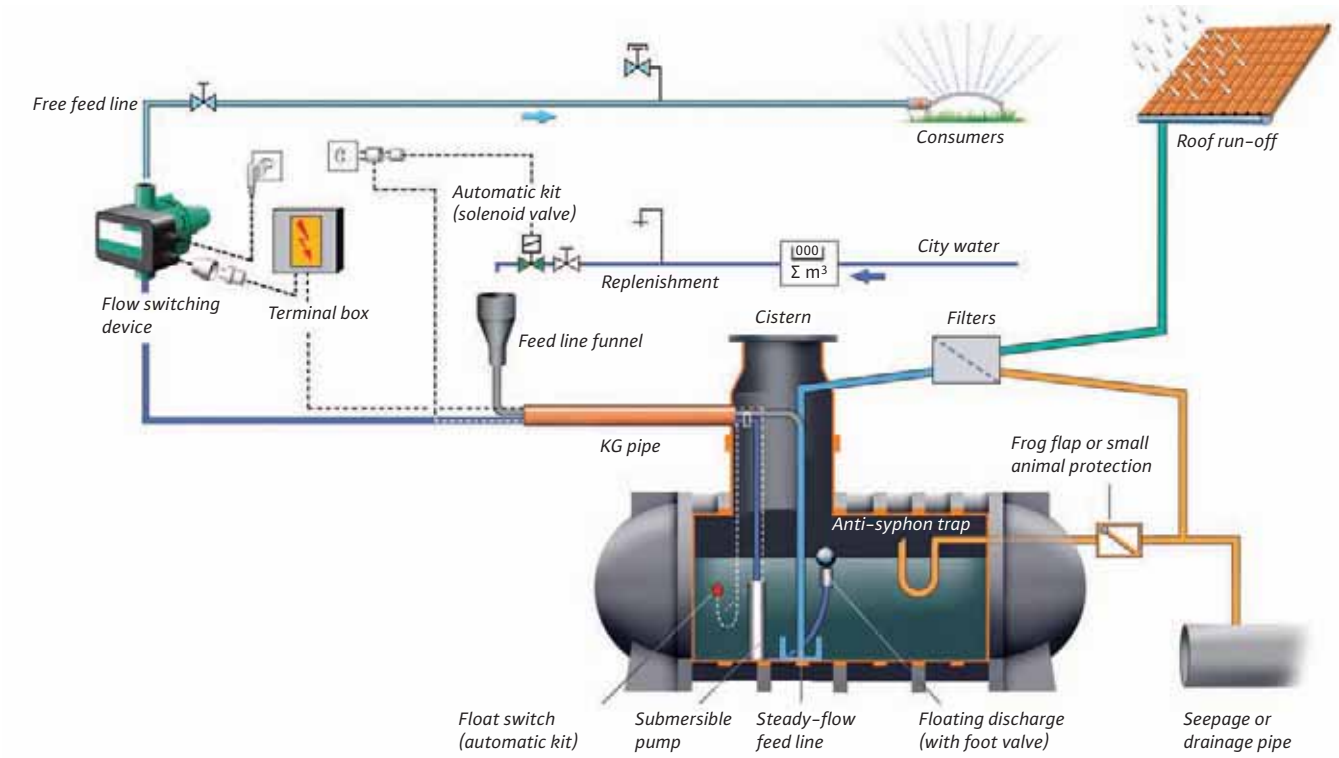
Description:

- Pumps water in suction operation from wells, cisterns underground storage tanks or in pressure operation (intake pressure max. 1.5 bar) from open pre-reservoirs
- Replenishment via solenoid valves/float switches directly in the cistern
- Pressure-/flow-dependent pump switching with built-in protection against low water level

Note:
Observe pipe installation as well as max. suction head/ length (see page 19)

Observe backflow level!

System diagram: Garden/one-family house



System with submersible pump

- Intake connecting piece for connection, floating discharge
- Control by means of flow switching device

Field of application:

- Pumping from wells, cisterns and vessels
- Irrigation, sprinkling or pumping out
- Rainwater utilisation
- Operating water utilisation

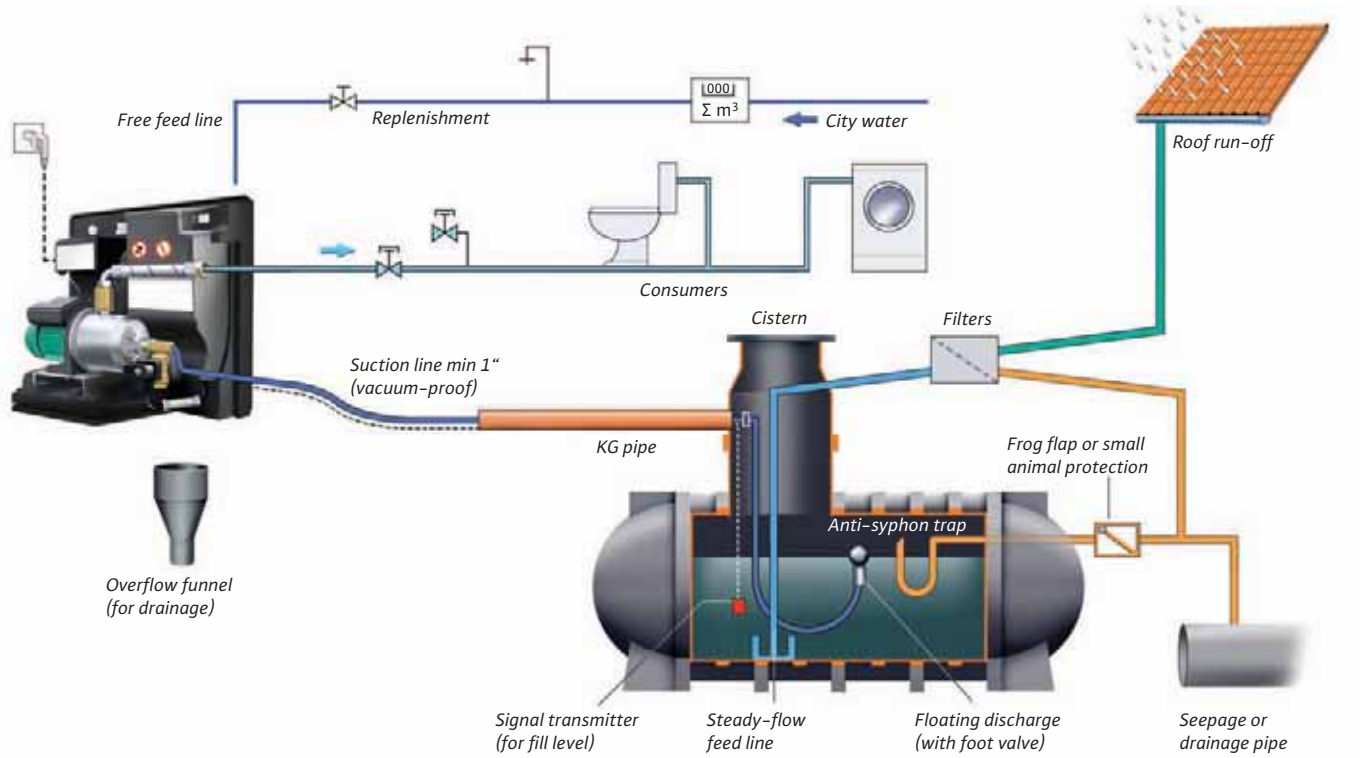
Description:

- Pumps water from wells, cisterns and underground storage tanks
- Replenishment via solenoid valves/float switches directly in the cistern
- Pressure-/flow-dependent pump switching with built-in protection against low water level

Note:
Suitable for long and unfavourable line installation as well as low-lying reservoirs.

Observe backflow level!

System diagram: One-family house



Rainwater utilisation system in connection with cisterns or reservoirs

- Compact rainwater utilisation system, complete with plug connector
- Low-noise thanks to multistage, self-priming centrifugal pump
- Meets the requirements according to DIN 1989 and EN 1717
- Highly economical due to the metering of fresh water to meet demands

Field of application:

- Toilet flushing
- Washing machine
- Sprinkling/irrigation
- Minor cleaning functions and other non-drinking water applications

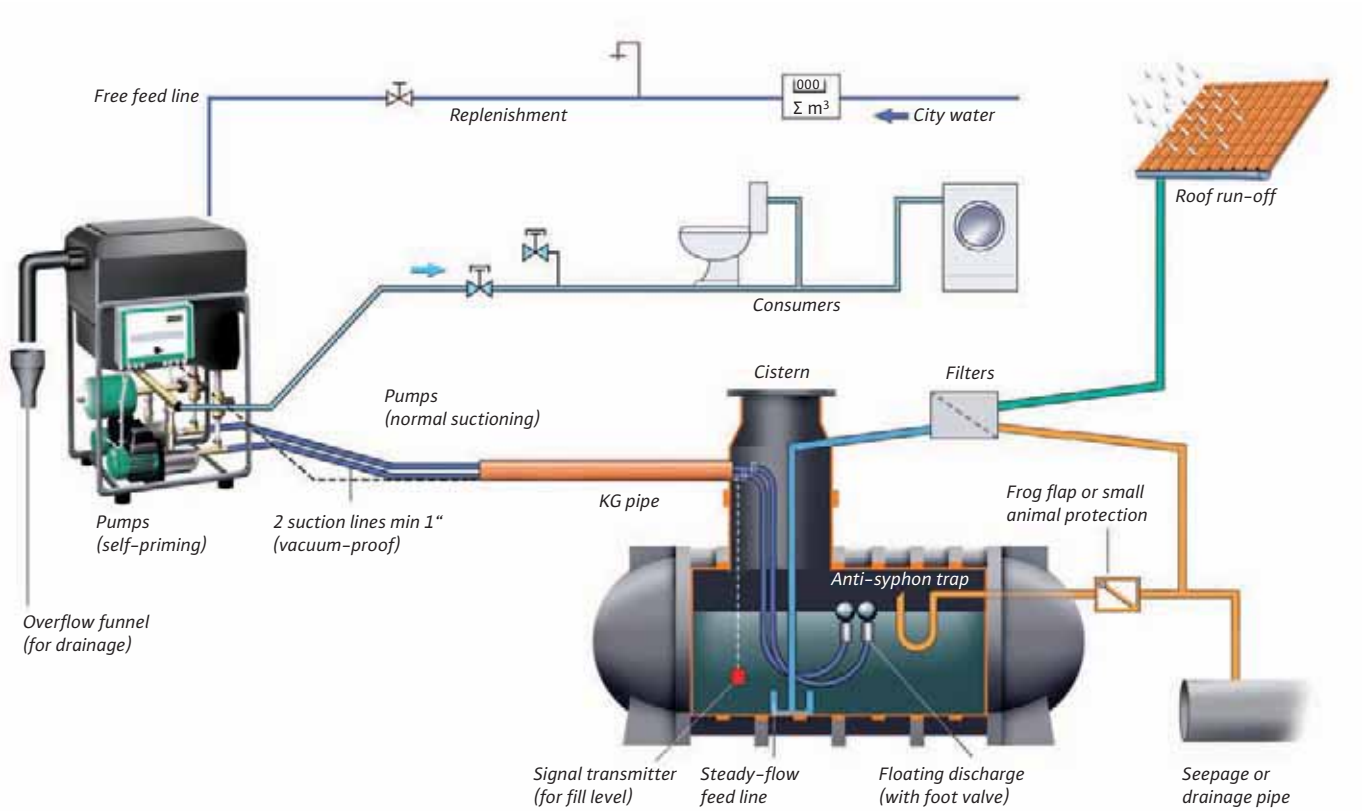
Description:

- Demand-oriented fresh water metering in the module
- Pumps water in suction operation from wells, cisterns and underground storage tanks
- Pressure-dependent pump control and automatic switchover to replenishment

Note:
Observe pipe installation as well as max. suction head/ length (see page 19)

Observe backflow level!

System diagram: Multi-family houses, public buildings, businesses



Rainwater utilisation system with twin-head pump in connection with cisterns or reservoirs

- Low-noise thanks to multistage, self-priming centrifugal pumps
- Highest operational safety through 2 pumps
- Highly economical due to the metering of fresh water to meet demands

Field of application:

- Toilet flushing
- Washing machine
- Sprinkling/irrigation
- Minor cleaning functions and other non-drinking water applications

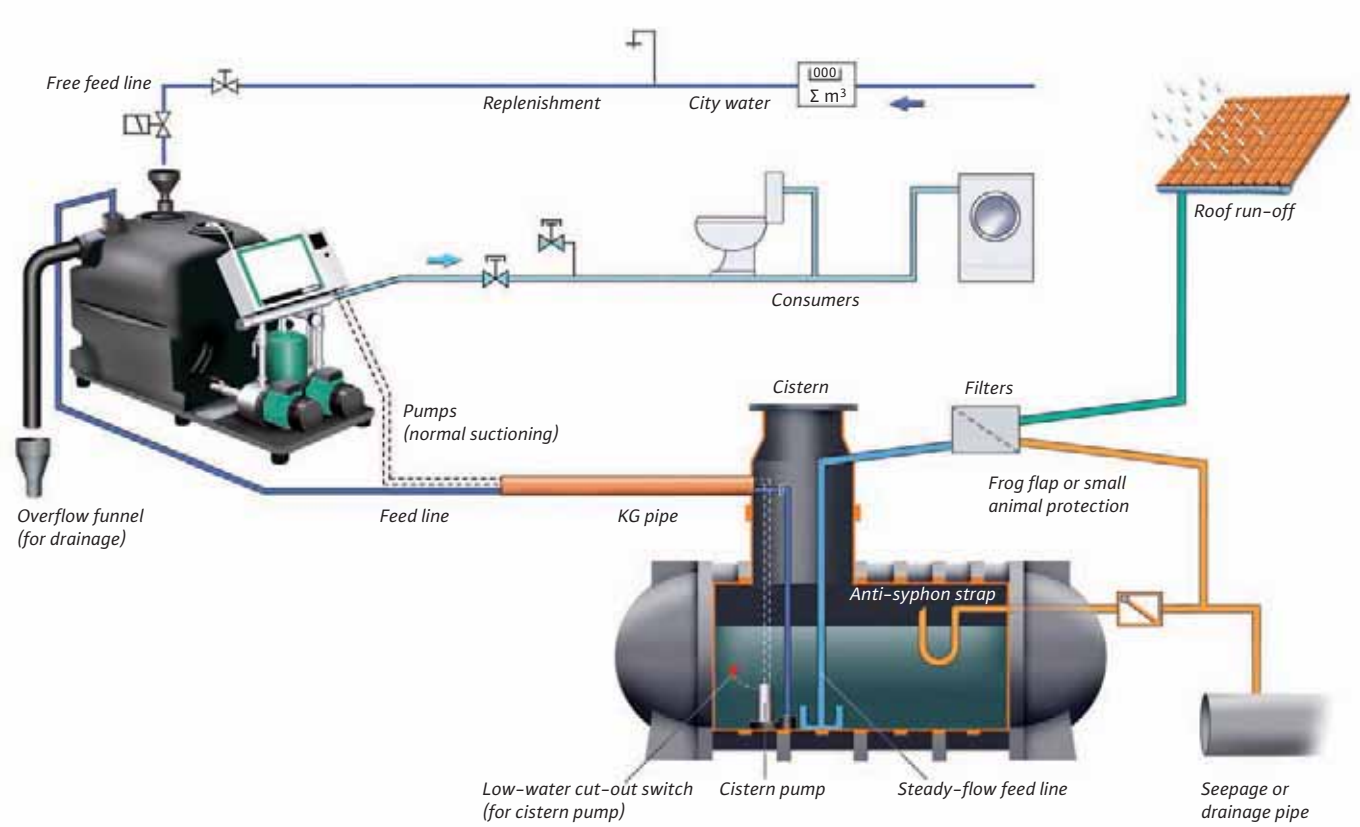
Description:

- Demand-oriented fresh water metering in the module
- Pumps water in suction operation from wells, cisterns and underground storage tanks
- Pressure-dependent pump control and automatic switchover to replenishment
- Demand-oriented pump control by means of basic/peak load operation and/or reserved operation

Note:
Each pump requires a separate suction line. Observe pipe installation as well as max. suction head/length (see page 19)

Observe backflow level!

System diagram: Multi-family houses, public buildings, businesses and industry



Rainwater utilisation system with twin-head pump, including booster pump in connection with cisterns or reservoirs

- Low-noise operation due to multistage centrifugal pumps
- Highest operational safety through 2 pumps
- Highly economical due to the metering of fresh water to meet demands
- Built-in feed pump control

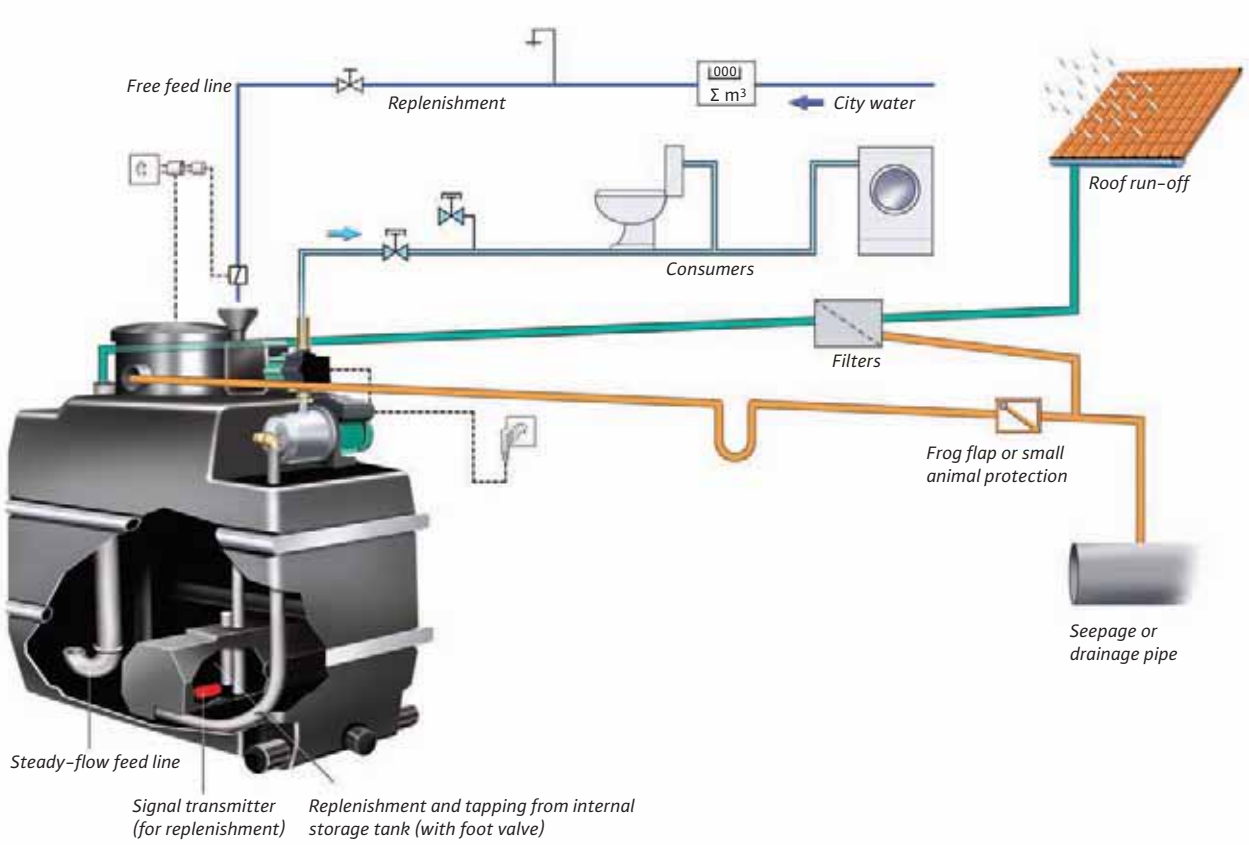
Note:
Suitable for long and unfavourable line installation between underground storage tank (low-lying reservoir) and intermediate storage tank.

Observe backflow level!

Field of application:
- Toilet flushing
- Washing machine
- Sprinkling/irrigation
- Minor cleaning functions and other non-drinking water applications

Description:
- Demand-oriented fresh water metering in the intermediate reservoir
- Feeding pump pumps water out of wells, cisterns and underground storage tanks into the intermediate reservoir
- Pressure-dependent pump control and automatic switchover to replenishment
- Demand-oriented pump control by means of basic/peak load operation and/or reserved operation

System diagram: One-family house, businesses and industry



Rainwater utilisation system with indoor storage tank

- Low-noise, self-priming pump
- Extensible by additional tanks
- Separate replenishment and settling zone for better water quality

Field of application:

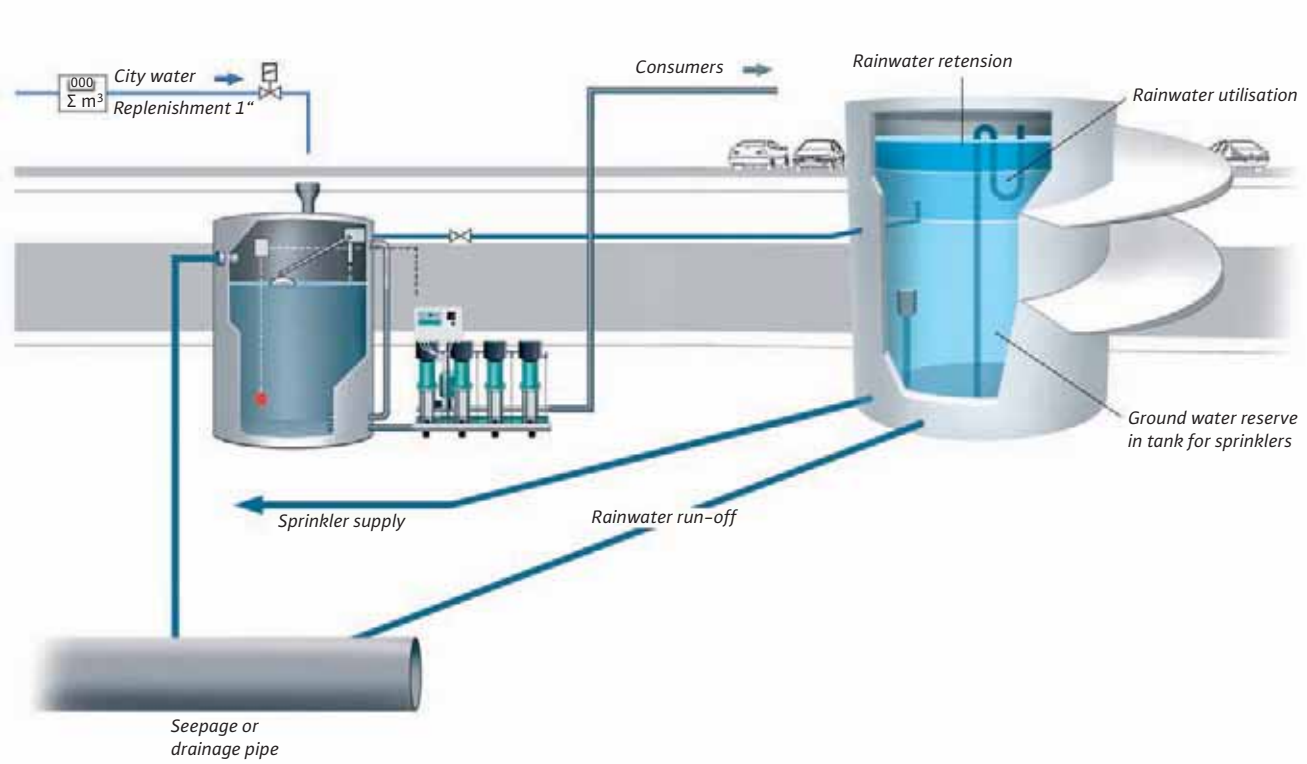
- Toilet flushing
- Sprinkling/irrigation
- Water supply to washing machines
- Minor cleaning functions and other non-drinking water applications

Description:

- Rainwater collection tank for indoor set-up, modularly extensible
- Demand-oriented fresh water metering in internal reservoirs.
- Pressure-dependent pump control and automatic switchover to replenishment

Note:
Observe backflow level!

System diagram: Example application for business and industry



Rainwater utilisation system with high pressure multistage centrifugal pumps in connection with cisterns or reservoirs

- Multistage high-pressure centrifugal pumps
- Highest operational safety with up to 6 single-head pumps
- Two adjustable pressure levels for different applications
- High economic efficiency

Field of application:
- Fire extinguishing equipment
- Toilet flushing, sprinkling and irrigation
- Cooling
- Rainwater retention

Description:
- Utilisation of the rainwater storage tank for rainwater retention, water storage for fire fighting and keeping operating water available
- Pressure-dependent multi-pump control and automatic switchover to replenishment
- Demand-oriented multi-pump control by means of basic/peak load operation and/or reserved operation

Note:
Suitable for long and un-favourable line installation between underground storage tank (low-lying reservoir) and intermediate storage tank.

Observe backflow level!

Self-priming pumps

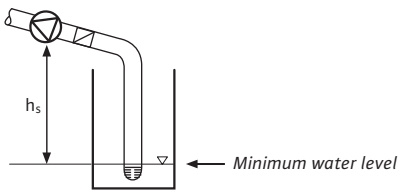
Suction operation

A self-priming pump is able to deaerate the suction line, i.e. evacuate air. During commissioning, the pump may have to be filled several times. The max. suction head is theoretically 10.33 m and depends on the air pressure (1013 hPa = normal).

Due to the technology, only a max. of 7–8 m suction head h_s can be achieved. This value not only includes the height difference from the lowest possible water surface to the suction port of the pump, but also the resistance losses in the connection lines, pump and fittings.

In designing the pump, it is to be observed that the suction head h_s must be included in the delivery head to be designed with a negative sign.

Suction head of the pump h_s



Suction line

The suction line, which should be kept as short as possible, is to be installed at least with the nominal diameter of the pump connection piece, and if possible, should be dimensioned by a nominal diameter larger.

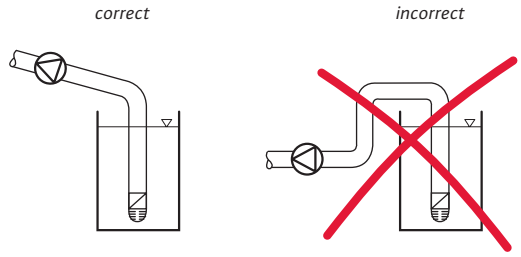
In the case of a long suction line, there is higher frictional resistance, which can greatly impair the suction head.

The suction line should be installed so that it continuously rises toward the pump. When hose material is used as the suction line, spiral suction hoses with high impermeability and strength should be favoured. Leaks have to be avoided no matter what since otherwise pump damage and operating faults can occur.

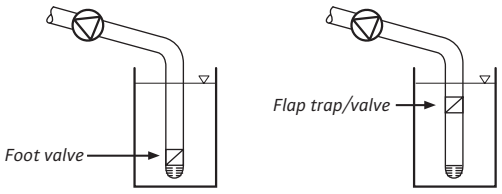
The suction hose should be made of EPDM. PVC hoses are attacked by rainwater and become porous with time. The suction line which leads to the building should be made of a PE material. Furthermore, this suction line should be vacuum-proof/tight and pressure-proof/tight.

In the case of suction operation, a foot valve is always recommendable to prevent the pump and suction line from running empty. A foot valve (floating discharge) with strainer also protects the pump and the downstream systems from coarse contaminants (leaves, wood, stones, insects, etc.).

Installing the suction line

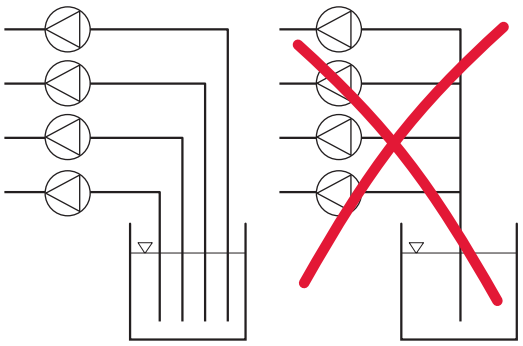


Suction operation



Installation with foot valve or flap trap/valve

Diagram of a multi-pump system with normal or self-priming pumps



Note!
Each pump should be provided with one suction line.

Never attach several pumps to one suction line.

Multi-pump system in suction operation

It is recommended to always provide each pump with a suction line with foot valve. In this case, the non-return valves on the discharge side can be omitted. Systems with one collective suction line are not recommended.

When non self-priming pumps are operated in suction operation via a common suction line, it's possible that the running pump could lower the water level of the switched-off pump and simultaneously sucks in air into the pump via the mechanical seal. When the pumps are changed, due to the remaining air pocket, the mechanical seal runs dry which leads to a considerable reduction in the maximum discharge capacity of the pump.

Note
Inquire about the minimum volumetric flow of the pumps from the pump manufacturers. Our experience has shown that pumps can be operated up to a minimum flow volume of 5% of the optimum flow.

Technical implementation regulations

Fresh water metering and free outlet in accordance with EN 1717 for protecting the drinking water network

The fresh water metering ensures the operational state of the rainwater utilisation system when there is insufficient rain in dry periods.

To protect the drinking water network, the replenishment is to take place via a free outlet in accordance with EN 1717. Thus, return of non-drinking water into the drinking water network is prevented.

The possibility of overflow (e.g. backflow) must be ruled out.

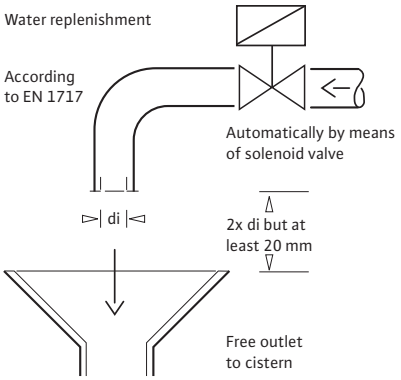
The replenishing equipment must be installed outside of the rainwater storage tank and the entry shaft.

The water drainage must be visible at the overflow of the replenishing equipment.

In order to guarantee uninterrupted operation at the removal points, the replenishing volumetric flow (nominal diameter of the feed valve and line network pressure) must be adapted to the pump volumetric flow at the duty point.

If, for example, a constant operational state of the rainwater utilisation system is demanded in public buildings, the system must be designed so that it can also be operated independent of the rainwater storage tank (e.g. run-down tank container with free outlet).

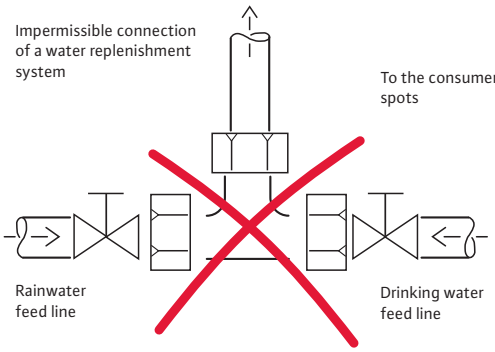
Correct



Note!
The unobstructed distance between the drinking water feed line and the highest possible water level must be greater than or equal to twice the inner diameter of the drinking water outlet, but at least 20 mm.

Wilo recommendation: at least 30 mm

Wrong



Note!
A direct connection from drinking water systems to non-drinking water systems is forbidden!
Failure to observe this regulation can lead to the system being shut-down or might lead to damage claims to the building contractor and skilled craftsmen.

Hygiene – Rainwater utilisation in the household

Hygiene is understood to be maintaining health by keeping the body clean, as well as clothing and the working environment. This especially includes measures which prevent the unwanted growth of bacteria and microorganisms, which prevents the spread of diseases.

Rainwater utilisation in the household is becoming more and more interesting. For this reason, it is important to check and guarantee that the utilisation of rainwater for toilet flushing or in the washing machine meets the demands.

When existing installation-related standards and behaviour is complied with, with regard to health, it is harmless to feed collected rainwater via a second household pipeline system to the toilet or washing machine.

The public drinking water supply is subject to the strict demands of the drinking water ordinance. The quality of the drinking water in Germany is setting standards. Illnesses which are caused by contaminated water are a thing of the past.

A critical point are impermissible connections of the rainwater system to the public drinking water network – unfortunately, not an uncommon matter. It has already happened several times that an incorrectly installed rainwater utilisation system, for example due to an illegal connection to the drinking water network and the resulting return of rainwater in the drinking water network, has endangered the local water supply of a community.

In such cases, the following is to be observed: The operator of a rainwater system must pay for any resulting costs.

With regard to this, Dr. Holländer, one of the leading German hygiene experts, gives the following opinion: "When a rainwater system is properly installed and utilised, there is no reason to worry about any health risk, which has been proven to us every day by thousands of systems and their users."

Hygienic considerations

In assessing the health risk, the presentation and dose play major roles. To assess the risk, it is to be judged to what degree the user of a toilet or urinal comes into contact with pathogens or chemicals (directly or indirectly) and what amount of germs and pollutants can be transferred during this contact.

In the literature, there is a series of studies which investigate the microbiological and chemical burden of rainwater in cisterns and toilets.

These studies prove that cistern water meets the EU directive for bathing freshwater (75/160/EWG) in over 95% of the cases when the system is professionally designed and maintained. Bathing freshwater quality means that prolonged skin contact or accidental swallowing is harmless health-wise.

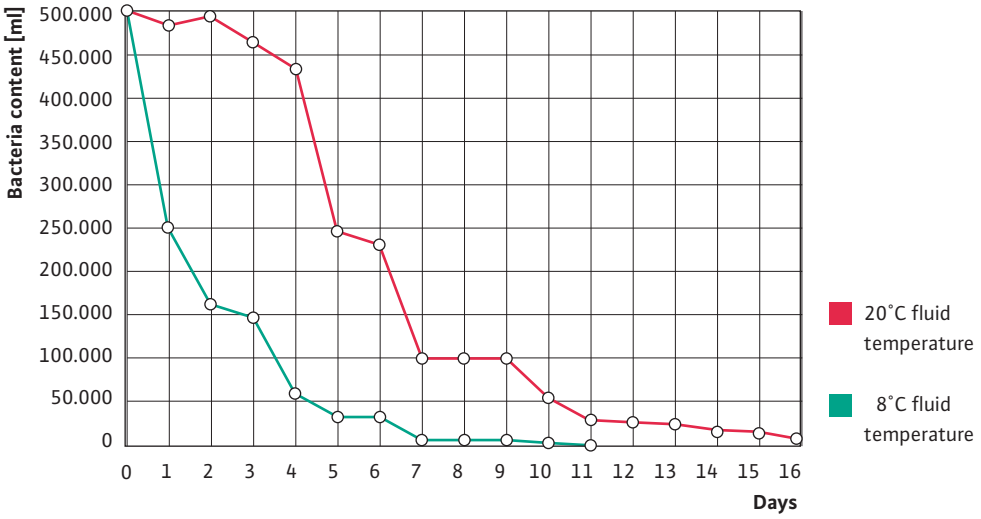
Bacteriological guide and limit values

	Drinking water [ml]	Bathing freshwater Guide value [ml]	Bathing freshwater Limit value [ml]	Gourmet salads [g]	Median values of 102 cisterns over a longer period of investigation [ml]
Escherichia coli	0/100	100/100	2000/100	1000	26/100
Coliform germs	0/100	500/100	10000/100		198/100
KBE* (20°C)	100	100/100			1200
KBE* (37°C)	100			1,000,000	230

**Colony-forming units*

Source: fbr – Fachvereinigung Betriebs- und Regenwassernutzung e. V. (professional association for operating and rainwater utilisation)

Change in bacterial content (e.g. salmonella) with fluid temperature and time



Source: Asst. prof. Dr. Reinhard Holländer, national investigation institute for chemistry, hygiene and veterinary medicine, department of general hygiene, Bremen, Germany

Washing laundry with rainwater

Relief to the environment, lowered operating costs while complying with hygiene specifications

"Children's home washes with rainwater": Under this caption, the utilisation of rainwater in "Haus Tobias", a house of the remedial Sozialwerkes Freiburg e.V., was described in the "fbr-wasserspiegel 1/06". This house offers 30 kindergarten spots, 45 home spots and 100 school spots. For the residents and users of this facility, it is now a matter of course that rainwater is used for toilet flushing, washing laundry and garden irrigation. The water is collected on 900 square metres of extensively planted roof area and 520 square metres of shingled roof area, is conducted into a cistern and is fed to the consumers via an intermediate storage tank and a pressure boosting system (WILO AF 150) with two centrifugal pumps according to the state of the art (WILO AF 150). Rainwater is not drinking water, however. Its quality is not equivalent to the specifications of the drinking water ordinance we're used to. Are the users in "Haus Tobias" endangered because of this? Do the right to ecological interaction with resources or even the economic relief of one's budget justify such a utilisation, and do our legal constraints even allow this?

Was does the drinking water ordinance require?

The ordinance, which became effective on January 1, 2003, is also referred to as the drinking water ordinance, but the content of it actually has to do with "water for human consumption". This is an extension of the term which, as defined in Article 3, defines all water in the domestic area, even that used for "cleaning objects which do not only come into contact with the human body temporarily".

Excerpt from the drinking water ordinance comment

On Article 2 paragraph 2

"By means of this regulation, it should be clarified that the quality requirements of the ordinance are not to be applied to water from privately used rainwater utilisation systems and comparable systems, when these are used in addition to the "normal" water supply, i.e. when water is available having the quality demanded by the ordinance for all purposes of human consumption, as defined in Article 3 no. 1."

On Article 3

" ... that in every household the possibility must exist to wash laundry in water having the quality of water for human consumption. Whether an additional connection exists and is used which supplies water of lower quality is the responsibility and decision of the consumer."

Fig. 1: Separate tapping points for wash water left drinking water, right cistern water

This includes the water used for washing clothes. Every law and every ordinance must be made understandable for the user by means of comments. In the comment about this definition, specifically about the utilisation of rainwater as wash water, it says that "... in every household, it must be possible to wash laundry with water having the quality meant for human consumption. Whether an additional connection exists and is used which supplies water of lower quality is the responsibility and decision of the consumer".

Thus, this comment makes it clear, and also opinions from the Federal Ministry of Health and Social Safety as well as various court decisions, that rainwater can be used for doing laundry on one's own responsibility. For a multi-family house, this means that the tenants must be able to choose between rainwater or drinking water (Fig. 1). What is the status for facilities like "Haus Tobias" or for commercial laundries where laundry is done for the residents or customers? The comment about the drinking water ordinance doesn't say anything about this. If one follows the argument of having the option to choose, then the residents and customers must at least be made aware that in this house, in this laundry, etc. the laundry is washed with rainwater. So there is an obligation to make the user aware of the situation so that he ultimately has a choice.

Is there a risk of infection when utilising rainwater?

In many investigations it has been shown that there is no contamination of rainwater or cistern water with pathogenic microorganisms. Specifically, such pathogens which can lead to the classical water-borne contagions, such as typhus, cholera, dysentery or hepatitis A, are missing. Cistern water surely doesn't have the microbiological composition of drinking water and is of lower quality. But the question must be asked whether doing laundry with such water could cause any kind of disadvantage to the later user of this laundry. It should also be made sure that the aesthetic demands put on the laundry, such as those regarding discolouration or odour, are met by the cistern water. Laundry for everyday use is usually contaminated with high concentrations of microflora produced naturally in the body; bedding and towels have up to 600 bacteria per 100 square centimetres, underwear has up to 200 per 100 square centimetres. In the washing machine, these bacteria, which generally don't lead to illness, are dissolved by the cistern water, and a mixture of the bacteria of both origins is formed, on average up to 10 000 bacteria per ml wash water with peak values of 200 000 bacteria per ml (Holländer et al., 1993). In the washing cycle, these bacteria are affected by the detergent and increased temperature. Detergents reduce the bacteria numbers by a factor of 100, approximately, and temperatures > 60°C by a factor of 105 or more. Temperatures around 40°C, however, have little effect. After washing. the laundry is rinsed, so that only those bacteria survive on the wet laundry which come from the rinsing water, including those which survived the washing process. It could be demonstrated that the magnitude

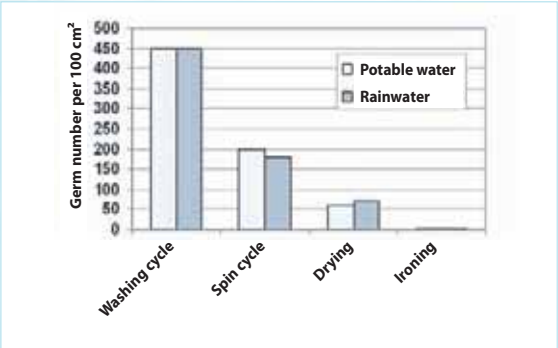


Fig. 2: Reduction in the concentration of bacteria during the entire washing process.

of the bacteria concentrations do not depend on the amount of bacteria in the cistern water, but on the degree of contamination of the laundry, especially underwear (Holländer et al., 1993). Each article of clothing is dried and possibly ironed or pressed. Dryness is the worst problem for microorganisms. The heat from ironing kills every form of life. Thus, when the laundry dries, there is a clear reduction in the germ number concentrations and after ironing/pressing, this is next to zero (Fig. 2).

Asst. Prof. Dr. Reinhard Holländer

Dr. Holländer is the director of the Institute for General Hygiene, Hospital Hygiene and Environmental Hygiene, Bremen, Germany In many publications, he has scientifically addressed the question of potential hygienic disadvantages of rainwater. As a long-term member of "fbr" and expert on hygiene, he advises cities and communities, planning offices and craftsmen and gives generally understandable professional lectures on the subject.

Aesthetic loss in quality

Sceptics often argue that when cistern water is used for washing laundry, the laundry comes out discoloured or has an unpleasant odour. This may be true occasionally in individual cases. When the system is professionally designed according to DIN, and high-quality system components are used and the system is used properly, however, such as in the case of "Haus Tobias", such fears can't be realised. Many users confirm this, and not least of all the managing director of the facility, Mr. Nikolaus Ebner, who looks back on 2.5 years of experience now. During this time, more than 200 cubic metres of water were used for doing laundry. Besides savings in water costs, correspondingly lower amounts of detergent had to be used thanks to the use of very soft wash water. The savings in detergent ranged between 30% and 45%, depending on the degree of hardness of the drinking water which would have otherwise been used.

Hygiene risks in washing laundry

In summary, it can be said from the various publications and our own investigations that there is no health risk when washing laundry with rainwater/cistern water. The fact that there are next to no pathogens in the cistern water and that germs are reduced during the washing process represent a high dimension of safety for the user. Here it is assumed that the system is built and operated according to the hygienic and technical standards, such as those described in DIN 1989. • **Reinhard Holländer, Bremen, Germany**

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Ordinance about the amendment of the drinking water ordinance
from May 21, 2001 (BGBl. I S 2542) incl. comment

fbr-wasserspiegel

Environment relieved, operating costs lowered – Children's home washes with rainwater

"Haus Tobias" lies at the edge of a forest above Herdern. It houses residential groups, a kindergarten, a school and a therapy workshop for children and teenagers with handicaps. The supporting organisation of the facility is the remedial Sozialwerk Freiburg e.V. Since 1968, the "Haus Tobias" is a fixed component of the social and pedagogic structure of the city of Freiburg in Breisgau (www.hsw-freiburg.de). The extension of the home and school in 2003 helped meet the

Extension building with extensively planted roof, retention value 50%

constantly increasing demand for space. The number of spots in the home could then be stepped up from 15 to 45. A total of about 130 children are cared for here. The Breisgau metropolis Freiburg is known worldwide for its ecological commitment. For the "green" mayor Dieter Salomon, the secret of the environmental head-start lies in the special "Freiburg mix": the communal-political decisions of the city, the commitment of the people in the region, the active support of the regional electric utilities and many organisations, institutions and companies. One of these institutions is the "Haus Tobias". The philosophy of the social facility: The lasting interaction with nature is a prerequisite for the bases of existence of the following generation. Keeping additional costs in mind, the new building was equipped with a green roof and rainwater utilisation. Rainwater here isn't only considered to be a raw material, but also an element of the natural cycle. Before it reaches the earth, this water runs through a fascinating metamorphosis in the atmosphere and is too valuable to conduct it directly into the sewage system. Now only the overflow from cisterns when these are full and it continues to rain. The overflow could be fed to the groundwater through the ground; but seepage is not possible here due to the hillside situation. A stream is planned in the centre of the facility with recirculation of the rainwater, which runs off the reinforced area of the square and paths. It is not yet clear how this will be financed since it depends on donations.

He who wants to save must invest

A system was realised for utilising rainwater in order to collect it from the surrounding roof surfaces at a justifiable cost. The Freiburg engineering group responsible for planning the heating, ventilation and sanitary systems got the idea of using rainwater and the knowledge for the right design at a seminar of the pump manufacturer WILO. The responsible planning engineer, Bernhard Bruse, recalls: "The idea of killing two birds with one stone convinced us: by using rainwater, drinking water can be saved and also the rain drainage in the sewage system can be reduced. The operator benefits from this financially, it relieves the municipal sewage system and contributes to protecting the environment." The facility director was thankful for this suggestion, which helps to lower the operating costs. When financing with public funds, however, such motives weren't given priority in order to save on investment costs. The rainwater technology could ultimately only be realised with donations.

Little maintenance

The caretaker Hans-Jörn Bosse is happy about the well-working system and explains: "The rainwater is cleaned in the central filter shaft, even before the cistern. Vertical sieves with less than 1 mm passage keep out the particles rinsed off the roof. Even floating substances, such as pollen, are kept out." The filter shaft and cistern lie underneath the central square. They were delivered as prefabricated concrete reservoirs and were connected to the collection and tap lines during the on-site installation. Of these underground components, only the shaft cover can be seen in the pavement.

Washing machines in the home

1/06

Water, a "gift from the sky"

In "Haus Tobias", the relief rainfall is "harvested", which the clouds of meteorological depressions leave on the hillsides of the Black Forest. In this way, more than 1000 millimetres of precipitation are collected per year. That's 1000 litres per square metre of free raw material, or a gift from the sky, depending on the way you look at it.

Paved area with shaft covers for the underground filter and cistern (left). Mechanical room with pressure boosting system and rainwater distributor to toilets, washing machine and irrigation taps (right).

Ahead of the time

Specialist engineer Bruse designed the rainwater utilisation based on DIN 1989. He already knew before this standard appeared in 2002 what the major components of this technical directive would be. "The company WILO already informed us planners early on about the future state of the art. The speaker at the daytime seminar back then was himself a member in the DIN committee." Thus it is understandable why the pump technology from 2000, in a sense the core of the rainwater system, meets this standard as well as the filter and storage tank components. The cistern water is used for toilet flushing in the five-storey new building, where rooms were created for administration and public events. In order to be able to bridge over power failures with no effort, the planners set up a centrally-located toilet with a drinking water connection. More than ten times the toilet flushing amount is used for the washing machines of the home. Despite the green roof, there were no drawbacks due to the slightly discoloured water. The cistern overflow feeds a pond when the storage tank is full and there is persistent rain . Only when this is full as well is the sewage system required. Like the green roof, the pond contributes well toward the evaporation of rain on-site. That's important when, like here, seepage isn't possible.

Manufacturer guarantee

The filter and storage tank are delivered directly to the building site from the manufacturer as one module and are placed into the prepared excavation pit, including the necessary accessories. The pressure boosting system with pump, automatic pressure switching system, drinking water feed and break tank make up the second module. It is completely installed and electrically wired. One feature of the supply reliability is the twin-head pump system. If one pump is defective, the other one takes over the complete supply. A prefabricated mechanism for refilling the tank with drinking water in case of insufficient rain water also guarantees that no mistakes can be made during installation with the DIN-compliant free outlet. A solenoid valve, which is part of the pressure boosting module, like the water level sensor, and which is mounted on the device takes over replenishment. For the specialised engineer, the compact modules are a real blessing: The manufacturer, who delivers everything prefabricated from one source, guarantees the function of the individual components. This not only makes planning and construction supervision easier, but also makes it easier to handle any warranty claims. The supplier can simply exchange the entire pressure boosting module, thanks to the plug-in prefabricated design. It is appropriate for lifting trucks and fork lift transportation.

Conclusion

Since commissioning the rainwater system in May 2003, more than 2 years have gone by. The managing director, Nikolaus Ebner, sums up positively: "We are satisfied in many respects. It was exciting to watch how far our rainwater supply can go. We were even able to go through the dry summer of 2004 without having to use the drinking water feed. Even in the dry fall of 2005 the contents of the storage tank were enough to cover our high demand for the washing machines, plus the flushing water for the toilets and the irrigation of the outdoor installations. We are also happy that we haven't been able to tell a difference in the laundry washed with conventional drinking water from that washed alternately in rainwater."

• Klaus W. König, Überlingen

Project data

Address:	"Haus Tobias", Winterer Straße 83, 79104 Freiburg, Germany (www.haus-tobias.de)
Capacity:	30 kindergarten spots, 45 home spots, 100 school spots
Rainwater use:	Toilet flushing, washing machines, plant irrigation, indoors and outdoors
Washing machine requirement:	1500 l per week
Toilet flushing requirement:	200 l per week
Collection areas:	900 m^2 extensively planted roof and 520 m^2 roof surface with bitumen shingles
Storage tank size:	38 m^3
Pressure boosting system:	WILO AF150 with 150 l intermediate storage tank and two centrifugal pumps
Commissioning:	May 2003
Involved in the project:	Engineering group "Ingenieurgruppe Freiburg GmbH", Mr Bruse WILO office in Stuttgart, Mr Gick

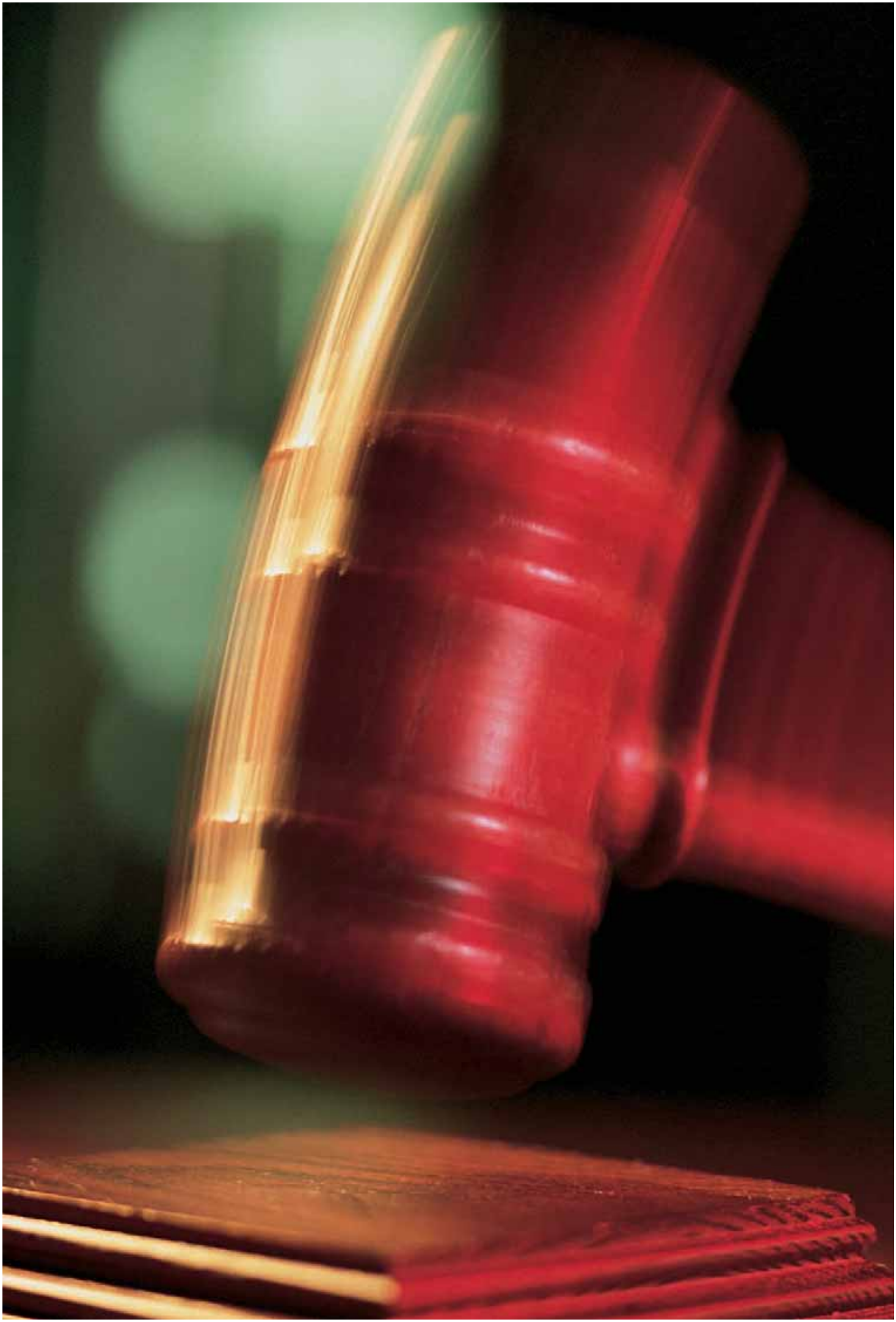
Practical example – Sachsen Fahnen GmbH, Dresden

Having over 16,000 m^2 of production space and approx. 180 employees, Sachsen Fahnen GmbH is one of the world's largest textile printing works producing flags and large advertising banners. Under the roof of the printing hall, which is curved like a flag, the largest and most modern systems for chemical screen dye printing and digital large-image printing are set-up. Sachsen Fahnen GmbH consistently bets on rainwater cultivation in order make good ecological use of the enormous amounts of water which come down on the roof surfaces and to inexpensively cover a large portion of the process water requirement.

From a 500 m^3 ground cistern, the two hybrid systems are filled via 2 submersible pumps, which alternately work as the main/reserve system.

It is required to pump 24 m^3 process water at 6 bar in order to supply the printing machines with process water for the production process and to make the necessary amount of extinguishing water available in the event of a fire.

A compact module was installed for the screen washing after printing. The toilet systems are also fed with rainwater, of course.



Law

Regulations, standards, ordinances

Legally fixed regulations	
Meeting of demand, notification obligation and safety of the public network	AVBWasserV Article 3 (2)
Customer systems, significant drinking water modifications	AVBWasserV Article 12
Check of customer system after commissioning by municipal water supplier	AVBWasserV Article 14
Public network safety, pipeline labelling, notification to public health department	Drinking water ordinance 2001
Technical implementation regulations	
Rainwater utilisation systems, free outlet, fresh water metering	EN 1717, DIN 1988, DIN 1989
Labelling of taps	DIN 1988, Part 2, 3.3.2
Overflow backflow	EN 12056, EN 476, DIN 1986-100
Drainage outside of buildings	DIN EN 752
Labelling of the rainwater installation network	DIN 2403, Par. 7.4
Concrete	DIN EN 206
Local regulations	
Overflow seepage	Water rights authority, District office, Water management office
Drainage/fees	Local ordinance
Size of the system, building permit	District building regulations

AVBWasserV Article 3 (2)

Article 3 Meeting of demand
(2) Before setting up one's own recovery system, the customer has to inform the local water-supply company. The customer must make sure that there can be no retroactive effects on the water supply network from his system by taking appropriate measures.

AVBWasserV Article 12

Article 12 Customer system
(1) The customer is responsible for the correct set-up, extension, modification and maintenance of the system behind the house connection, with the exception of the measuring equipment of the local water-supply companies. If the customer rented the system or system parts to a third party or otherwise allowed them use, the customer is responsible in addition to them.

(2) The system may only be set up, extended, modified and maintained under the observance of the regulations of this ordinance and other legal or official provisions, as well as the recognized rules of technology. The set-up of the system and major modifications may only be done by the water supply company or an installation company registered in an installation directory of a water supply company. The water supply company has the right to monitor the work being done.

(3) System parts which are in front of the measurement equipment can be sealed. Also, system parts which belong to the customer system can be sealed to guarantee problem-free measurement. The system is to equipped as required by the specifications of the water supply company.

(4) Only materials and devices may be used which satisfy the recognized rules of technology. The marking of a recognized testing body (e.g. DIN-DVGW, DVGW or GS markings) indicate that these preconditions have been met.

(5) The parts of the house connection which are the property of the customer in the application of Article 10 Paragraph 6 and for the maintenance of which he is obligated are components of the customer system.

Article 14 Checking the customer system
(1) The local water-supply company is authorized to check the customer system before and after its commissioning. It is to make the customer aware of any detected safety deficiencies and can demand their elimination.

(2) If defects are found, which endanger safety or might cause considerable damage, the local water-supply company has the right to deny the connection or the supply; in the event of life-threatening danger, it is obligated to do this.

(3) The local water supply company accepts no liability for the system being defect-free by executing or omitting the check of the system as well as its connection to the distribution network. This does not apply when it has determined during a check that there are defects which pose life-threatening danger.

Drinking water ordinance 2001

The purpose of the ordinance is to protect human health from disadvantageous influences which result from the contamination of water meant for human consumption by guaranteeing the consumability and purity according to the following regulations.

Area of application
This ordinance regulates the quality of water for human consumption. It does not apply to natural mineral water or curative water. For systems and water from systems which are meant for tapping or discharging water, which does not have the quality of water for human consumption, and which is to be used in addition to the water supply systems in the household, this ordinance applies only when it expressly refers to such systems.

DIN EN 1717

Protecting drinking water from contamination in drinking water installations and general requirements for safety equipment to prevent drinking water contamination due to backflow.

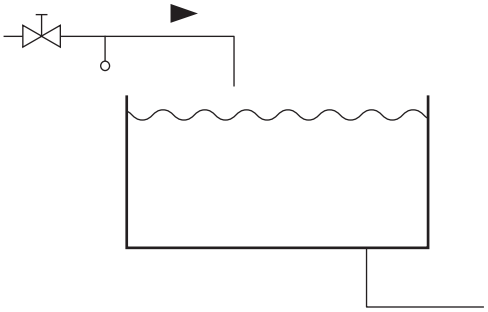
A standard technical rule for protecting the drinking water from contamination in drinking water installations was determined in Europe with the European standard DIN EN 1717.
In parallel with DIN EN 1717, DIN 1988-4 may be applied until the standard series EN 806 has appeared in all parts. A few planning and design aids, as was included in DIN 1988-4, were not included in DIN EN 1717, however.

The design aids were therefore included in this nationally informative appendix, as are known from DIN 1988-4, e.g. a table for the selecting safety equipment as well as other planning and design hints.

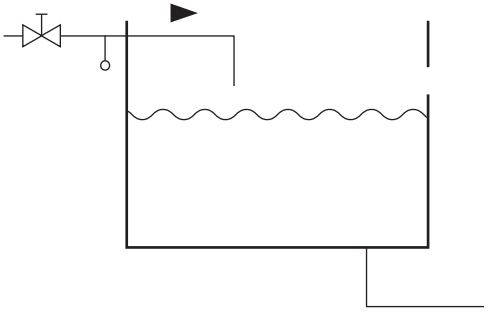
Safety equipment
For the constant use of a rainwater utilisation system, it is necessary to replenish water in a separate reservoir or in the cistern when the water level in the cistern is insufficient. In general, drinking water is used for this.
The protection of the drinking water from contamination in installations as well as "... the general requirements for safety equipment to prevent drinking water contamination due to backflow" is regulated in "DIN EN 1717" and is a must in the installation of rainwater utilisation systems.

Thus, it is clearly regulated that rainwater pipes may not be connected with drinking water pipes. It is also determined that when replenishing drinking water in rainwater reservoirs, a "free outlet" of type "AA", "AB" or "AD" must be used.

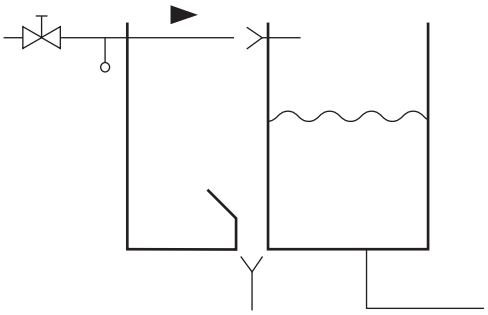
Definition: Free outlet, type "AA"
A free outlet "AA" is a visible, unobstructed and completely free flow path which is constant and vertical between the lowest point of the intake opening and any surface of the supplied reservoir, the maximum operating water level, which is reached in the event of an overflow.



Definition: Free outlet, type "AB"
A free outlet "AB" is a constant and vertical distance between the lowest point in the intake opening and the critical water level. The overflow may not be designed to be circular and must be able to drain the maximum flow under normal pressure conditions in the event of a malfunction.



Definition: Free outlet, type "AD"
A free outlet "AD" is a constant distance between the intake opening and the inlet opening on the drainage side.



DIN 1988

This standard applies in connection with DIN 1988 part 2 to 8 for planning, setting up, modifying, maintaining and operating drinking water systems in buildings and on sites.

Is specifically contains the responsible persons for planning, construction and operation of the system, as well as the technical terms, graphical symbols and abbreviations.

DIN 1989

This standard applies to systems for the utilisation of rainwater in households, businesses and industrial operations, as well as in public facilities where it is used for toilet flushing, cooling purposes, washing and cleaning systems and for irrigation of parks. According to the drinking water ordinance, drinking water is to be made available for cleaning objects which are intended to come into contact with the human body for longer periods of time (e.g. laundry).

Part 1
This standard contains regulations for planning, designing, operating and maintaining rainwater utilisation systems.

Part 2
Filters

Part 3
Storage

Part 4
Modules for control/replenishment

DIN 1988, Part 2, 3.3.2

In the interest of clarity and to avoid operational errors, vital equipment of the drinking and extinguishing water system are to be sufficiently and permanently labelled for operation.

DIN EN 12056

This European standard applies to drainage systems, which are operated using gravity.
It applies for drainage systems within residential buildings, businesses, institutes and industrial buildings.

EN 12056-1
Gravity drainage systems within buildings –
Part 1: General and design requirements

EN 12056-2
Gravity drainage systems within buildings – Part 2: Waste water systems, planning and calculation

EN 12056-3
Gravity drainage systems within buildings – Part 3: Roof drainage, planning and dimensioning

EN 12056-4
Gravity drainage systems within buildings – Part 4: Sewage lifting units, planning and dimensioning

EN 12056-5
Gravity drainage systems within buildings – Part 5: Installation and testing, instructions for operation, maintenance and use

DIN EN 476

This European standard defines general requirements for components, such as pipes, plain fittings and shafts with their respective connections, which are meant for sewage (drainage) pipes, and which are operated as gravity drainage systems with the highest possible pressure of 40 kPa. The standard serves as a general basis for the development or revision of product standards. It doesn't apply for the assessment of products.

DIN 1986-100

This standard applies for drainage systems for draining waste water in all buildings and on sites in connection with DIN 1986-3, DIN 1986-4, DIN 1986-30, DIN EN 12056-1 to DIN EN 12056-5, DIN EN 752-1 to DIN EN 752-7 as well as DIN EN 1610, which are mostly operated with open channels.

In the interest of public safety, the standard defines unified technical provisions for the planning, construction, operation and maintenance of drainage systems for draining waste water in buildings and on sites as a supplement to DIN EN 12056-1, DIN EN 12056-2, DIN EN 12056-3, DIN EN 12056-4 and DIN EN 12056-5.

DIN EN 752

This European standard applies for drainage systems which are mainly operated as open channels. It applies from that point where the waste water leaves the building/roof drainage system or flows into a street drainpipe, up to the point where the waste water is fed into a treatment system or a drainage ditch.

DIN 2403

Area of application
This standard applies for the labelling of pipelines not installed in the ground after the flow.

Purpose
A clear labelling of the pipelines after the flow substance is essential in the interest of safety, proper maintenance and effective firefighting. It should point out hazards in order to avoid accidents and damage to health.

Labelling
Pipelines are clearly marked with labels after the flow substance. When a colour code is used:
- either labels or stickers are to be used in the group colour according to table 1 or
- coloured rings are to be attached in the group colour or
- the pipeline is to be painted in the group colour along its entire length or
- labels, stickers or coloured rings are to be attached at operationally essential points, e.g. beginning, end, branches, wall feedthroughs, fittings.

DIN 4109

Noise protection in buildings is important for human health and feeling of well-being. Especially important is noise protection in residential buildings, since a person's home serves for rest and relaxation and one's own domestic area should shield one from one's neighbours.

DIN EN 206

Applies for concrete, which is used for local concrete buildings, for prefabricated buildings, as well as for prefabricated parts for buildings and engineered buildings. The concrete may be manufactured as construction site concrete, transportation concrete or concrete in a prefabricated part factory. This standard defines requirements on: concrete raw materials; properties of fresh concrete and solid concrete and their verifications; restrictions for concrete composition; fixing the concrete; delivery of fresh concrete; production control procedures; conformity criteria and conformity assessment.

Maintenance checklist

Inspection and maintenance intervals in accordance with DIN 1989-1

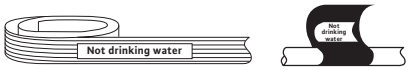
No.	System part, Unit	Inspection		Maintenance	
		monthly	yearly	monthly	yearly
1	Rainwater storage tank	3			Every 10 years
2	Control shaft/cleaning shaft	3		6	1[3)]
3	Filter systems	3		6	1[3)]
4	Operating water pump, system control, switching elements, replenishment, dry-running protection, pressure maintenance, foot valve and strainer				1
5	Free outlet		1		1
6	Water content display	1			1
7	a) Water meter, fresh water metering	1			Every 6 years
	b) Water meter, rainwater removal	1			Every 6 years
8	Non-return valve		1		1
9	Lifting unit	1		3[1)]/6[2)]	1[3)]
10	Anti-syphon trap, ground drains	3/6			1
11	Rainwater inlets	6			1
12	Gutters, rainfall drain pipes	6			1
13	Cleaning openings/seals		1		1
14	Backflow seals	1		6	
15	Pressure and drainage hoses	6			1
16	Flushing equipment (toilet tank, toilet systems)		1		1
17	Pipelines, feed lines, drainage pipes, overflow, fresh water replenishment and operating water pipes		1		1
18	Tap fittings		1		1

The information in the columns "monthly" and "yearly" mean time intervals, e. g. 6: every 6 months, 1: once a year.

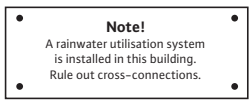
[1)] in commercial operations, [2)] in multi-family houses, [3)] in one-family houses

Labelling and safety equipment

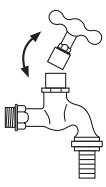
Permanent labelling of the extraction points with "Not drinking water"



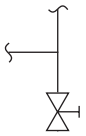
Labelling of the operating water pipe



Warning sign on the rainwater system at the main tap of the drinking water supply



Safety equipment for outdoor extraction points against unauthorized use



Drainage valve at lowest point in the pressure system

Frequently asked questions

Rainwater utilisation systems pose no hygienic risk for the user according to the state of the art for the use of rainwater for the purpose of toilet flushing, garden irrigation and for doing laundry. Decisive for long-term safe operation and an important precondition for the acceptance of the rainwater utilisation at the responsible public authorities are the professional planning and construction, regular maintenance, as well as strict compliance with the valid legal regulations and standards.

1. Are there dangerous pathogens in storage tanks and can they multiply there?

No! Bacteria which affect health are typically not in rainwater, or if they are, only temporarily in very small concentrations. All known investigations thus far have shown that water running off roofs from appropriate sites usually have a much better water quality than required by law for bathing freshwater.

Bird droppings are the only relevant source of possible pathogens in most rainwater utilisation systems. Such pathogens require heat and sufficiently large source of nutrients in order to be able to multiply outside of a host organism. Since no such life-sustaining conditions exist in rainwater, the hygienically relevant bacteria even die when they are experimentally added in high amounts.

2. Are there any hygienic concerns against using rainwater?

No! When used as intended and when strictly separated from the drinking water network, the usual methods of infection, such as swallowing, extensive bodily contact or intensive inspiration of spray mist, don't play a role. For example, with regard to the toilet flushing, the danger of infection from rainwater is negligible compared to the possible danger from the excretions which are to be flushed away.

3. Can rainwater be used for doing laundry without risk?

Yes! Extensive studies have shown that using rainwater neither worsens the washing result nor is the germ content of the finished laundry increased. The bacteria in the washing machine due to dirty laundry is many times higher than the amount from rainwater. Already during the washing cycle, and latest during drying, the bacteria are almost completely removed or destroyed, independent of where the used wash water comes from. Also, due to the very low hardness of rainwater, a lot less detergent has to be used.

In summary, it can be said from the various publications and our own investigations that there is no health risk when washing laundry with rainwater/cistern water.

The fact that there are next to no pathogens in the cistern water and that germs are reduced during the washing process represent a high dimension of safety for the user.

4. Does rainwater have to be disinfected before use?

No! Disinfection is not necessary! It would also be counterproductive to the objectives of long-term water use if more energy, material or chemicals had to be used. Even disinfected rainwater doesn't have the quality of drinking water, so even disinfecting it won't add to the consumer points.

5. Does the rainwater have to be tested regularly, e.g. yearly?

No! The information one gets from single tests is too little and especially the financial cost is high. If one does testing within the framework of research programs, however, one should use the EU bathing freshwater directive and not the drinking water ordinance as the basis of assessment for assessing the microbiological limit values.

6. Is rainwater utilisation also recommendable for public areas?

Yes! The use of rainwater poses no fundamental hygienic risk. For this reason, the installation of rainwater utilisation systems according to the state of the art is also recommendable in public buildings. As a result, rainwater is already being used in many schools, kindergartens and event halls, etc.

7. What does the drinking water ordinance regulate?

a. Rainwater utilisation systems are to be reported to the public health department during commissioning.
b. In rented apartments, the tenants must have the option of operating the washing machine with drinking water.
c. Only in especially sensitive areas, such as in kindergartens, hospitals, retirement homes and comparable facilities does drinking water have to be used for washing laundry.

Source:
Questions 1–8 from a special issue of fbr-top[2]

8. What other regulations relevant to hygienic safety are to be observed in the planning, construction and operation of a rainwater utilisation system?

The strict compliance with the legal regulations and standards by the planners, installation businesses and operators is indispensable for the protection of the public drinking water supply. In the most important legal and technical regulations (drinking water ordinance, DIN 1986, DIN 1988, DIN 1989-1) the following points, among others, are mandatory:

- Strict separation between the drinking water and rainwater network
- Replenishment of drinking water in the rainwater storage tank or in the replenishment reservoir only in the free outlet above the highest possible water level (backflow level) to protect the public network from back-suction effects.
- Permanent and clear labelling of all rainwater pipes (concealed, with warning foil, exposed, with adhesive flags) as well as all extraction points. Protection of rainwater extraction points against unauthorized or unintentional tapping – especially by children (e.g. by means of removable keys of lockable valve covers).
- Protection against the penetration of waste water (backflow) from the sewer system.

9. Is there an aesthetic loss in quality when using rainwater?

Sceptics often argue that when cistern water is used for washing laundry, the laundry comes out discoloured or has an unpleasant odour. This may be true occasionally in individual cases. When the system is properly and professionally designed according to DIN, the use of high-quality system parts and their corresponding use, such fears cannot be confirmed.

10. Which criteria must a suction line meet?

1. 1.0 bar vacuum-proof (pressure-proof is not suction-proof).
2. When hoses are used, make sure they have long-term elasticity.
3. Plug connections and couplings should be avoided.

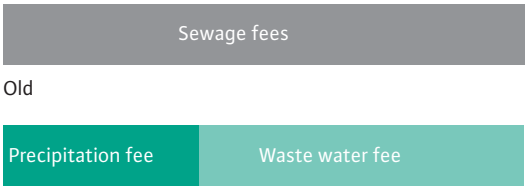
11. What criteria should be observed when setting up the rainwater utilisation system with regard to noise development?

1. Vibration free decoupling from the pipe system and installation wall.
2. Noise-conducting walls should be avoided (if necessary, column or floor installation).

12. In the construction planning, do sealed natural ground fees have to be taken into consideration?

More and more communities are reforming their sewer fees according to ecological aspects. Environmentally conscious behaviour of the building contractor is to be rewarded. According to the motto: "Where rain comes down, it should be fed into the water cycle". With the new system of split sewer fees, the revenues aren't higher, but the actual costs are distributed more fairly.

Example: Fee splitting in Germany



He who plants on roofs, uses cistern water for the garden or paves with water-permeable material should be able to lower the fees he owes.

13. Are there municipal aid programs at the site of the building measure?

Applications should be submitted before building the system and aid conditions should be observed.
A standard federal aid program doesn't exist.
In various states and communities, rainwater utilisation is promoted:
- The amount and type of aid varies.
- Exact information should be obtained at the town hall or from the county administration.
- Advance information can be found on the Internet.

14. Are there notification requirements for rainwater utilisation systems?

Drinking water ordinance, 2001:
Since January 1, 2003, the commissioning of a rainwater utilisation system in accordance with Article 13 Par. 3 of the Drinking water ordinance 2001 is to be announced to the public health department 4 weeks before commissioning.
Furthermore:
- The public health department must be immediately informed of existing rainwater utilisation systems (old systems) since January 1, 2003.
- Putting a system out of operation must also be announced to the public health department within 3 days.
- The notification requirement also applied when there is a change of ownership or if there is a modification to the system.
- Not informing the public health department constitutes an administrative offense according to the drinking water ordinance 2001!
- Sample letters for announcing the operation of a rainwater utilisation system to the public health department can be found in the planning, design and service templates, page 54.

Application for partial exemption at the water supply companies:
- Notification requirement and safety of the public network (Article 3.2).

15. Can the storage tank overflow be seeped away?

This is the responsibility of the lower water authority on a regional basis. If not, the civil engineering office is to be contacted about whether the connection to the sewer system is allowed / free of charge. If necessary, use a retention storage tank with a delayed drain.

15.a Storage tank overflow above the backflow level.

- The bottom of the drain is higher than the backflow level of the drainage pipe.
- Usually, the top edge of the street/pipe shaft cover is the relevant backflow level.
- Feed in accordance with the technical regulations.

15.b Storage tank overflow below the backflow level:

When there is a mixed sewer connection, a lifting unit with pipe loop must be used above the backflow level or in the case of an outdoor storage tank and connection to the rain pipe/separation system, a backflow seal must be used without electrical drive. For indoor storage tanks, a backflow seal should be avoided due to the danger of water damage in the case of a closed shutter and continuing feed.

For further details, see the Wilo Planning Guide on sewage technology

16. Is there a preventive measure taken against water penetrating into the building?

For outer wall feed-throughs, there are commercially available seals. Otherwise, PU foam or mortar can also be used. Empty pipes and fresh water metering in the outdoor storage tank must flow in the building above the maximum water level in the storage tank.

17. What happens when the frost-free depth for rainwater pipes isn't complied with?

Planners and design companies sometimes go against the technical regulations in the interest of the building contractors. A typical case is when drainage pipes are installed between the downpipe and rain storage tank at a depth not in the required frost-free depth in the ground (in accordance with DIN EN 476, DIN EN 12056 and DIN 1986-100). The reason for such a violation might be the unfavourably high position of the street sewage system, i.e. there is no gradient from the storage tank overflow to the drainage pipe; or the maximum permissible ground cover for the plastic tank doesn't allow a certain depth.

Although a planning violation in these cases doesn't always lead to damage as far as what's known so far, planners and construction companies should always protect themselves from later damage claims, like improvement, price reduction, etc. also in agreement with the building contractors.

To do this, it is necessary that the building contractor be advised and informed about all consequences of deviating from the "state of the art". This should be documented in writing and signed by the building contractor. On this way can it be verified that the contractor was aware of the significance and consequences of such a "planning error".

This information refers to the currently valid law in Germany:
BGH–VII ZR 181/93.

18. Should rainwater utilisation systems have a certificate or quality seal?

Yes, since recognized certification ensures the following:

- Product quality
- Installation reliability
- Legal certainty
- Durability of the system
- Compliance with the currently recognized rules of technology

This is guaranteed by the conformity with DVGW provisions (at least in the form of a manufacturer certificate), product monitoring by independent bodies (e. g. by the RAL association for quality assurance) and GS testing laboratories.

19. In which other areas can rainwater be used?

Our experience has shown that rainwater is being used more and more often to supply fire extinguishing equipment and for cooling purposes in buildings.

Practical example – Sony-Center, Berlin

The toilet and urinal systems in the office tower at Potsdamer Platz are supplied with cistern water, along with the irrigation of the outdoor installations and a fire extinguishing supply in the office tower. When the storage tank system is full, in the case of an overflow, between 14 and 34 m^3 per hour can be drained in the mixed water pipe. In the case of a lack of rainwater, drinking water is fed into the system.

The entire rainwater utilisation is connected via a ring control system and is controlled centrally.

Copyright: BE-ST KG

Appendix

Planning and creation of a rainwater utilisation system

Checklist for the project preparation

- ☐ Check connectable yield surfaces, storage tank sites and connection heights
- ☐ Determine rain yield, required amount and storage tank size
- ☐ Ask about financial aid / public subsidies from the state or community
- ☐ Ask about regulations/conditions due to the development plan or local charter
- ☐ Select system (filter/storage tank/pump/replenishment principle)
- ☐ Check the regulations and options for the storage tank overflow (seepage, feeding in a flowing body of water, connecting to a mixed or separate drainage pipe)
- ☐ Check the necessity of a meter and backflow protection
- ☐ In the case of outdoor storage tanks, observe the maximum ground water level and upward pressure reliability, whether it can be driven over and the stability with respect to earth pressure
- ☐ When planted roof surfaces are connected, point out that the water might be discoloured.
- ☐ Observe the recognized rules of technology (DIN/EN standards, Drinking water ordinance 2001, ZVSHK bulletins)
- ☐ Tell the building contractors about the legal notification requirement to the drinking water supplier and the public health department

Checklist for the project execution

- ☐ In the case of meter installation for sewage fee, branch off garden water pipe beforehand.
- ☐ In the case of a suction pump, install continuously rising service pipe.
- ☐ In the case of suction pumps, make sure the notes on the designing of the suction line are observed (see suction line installation instructions)
- ☐ If a pressure compensation container is needed, select reservoir which can have a flow through it, in accordance with DIN 4807/T5
- ☐ During installation of the pressure boosting system, take measures for noise protection
- ☐ For multi-family houses, businesses and public buildings, supply with a standby pump
- ☐ In the case of fresh water metering through short pipe, avoid stagnation, observe drinking water ordinance.
- ☐ Avoid daylight exposure of the operating water with suitable storage tank and pipe material
- ☐ Design storage tank feed line and tap so that sediment is not stirred up from the bottom of the storage tank.
- ☐ Only install filter in the storage tank feed, not in the operating water network.
- ☐ Label all taps and rainwater pipes not buried underground

Rating sheet

Calculation of the rainwater storage tank size according to Wilo

Yield calculation

	Amount of precipitation per year	Area (projected roof surface)	Discharge coefficient	Rainwater yield/year		Rainwater yield/day
Your yield calculation	_____ l/m²	x _____ m²	x _____	= _____ l/year	: 365	= _____ l/day

Determination of requirements

	Average values	Your requirement calculation
Toilets with/without saving button (per person)	8/14 m³/year	_____ m³/year
Washing machine (per person)	6 m³/year	+ _____ m³/year
Tap for cleaning, etc. (per person)	1 m³/year	+ _____ m³/year
Requirement per person/year		= _____ m³/year
Number of persons in the household x requirement per person/year = Requirement in house	x _____ persons	= _____ m³/year
Garden irrigation (for every 100 m²)	6 m³/year	_____ m³/year
Requirement in house + garden irrigation = total requirement/year		_____ m³/year
Total requirement : 365 = Daily requirement		_____ l/day

Storage tank design

Experience has shown that stocking up for a demand for 2 – 3 weeks is optimal. For larger stocked amounts, the water quality goes down in the storage tank, and for smaller volumes, the replenishment demand for fresh water is too high. The following formula results:

Daily requirement in m³ x 15 days = storage tank requirement in m³

Your storage tank calculation: _____ m³ x 15 days = _____ m³ storage tank requirement

If rainwater is mostly used for garden irrigation, the volume of the reservoir can also be selected to be larger.
You should avoid overdimensioning the storage tank in any case.

Calculation of the rainwater storage tank size according to DIN 1989

Calculation formula for the rainwater yield

_____	**m x**	_____	**m^2 x**	_____	**x 0.9**	**=**	_____	**m^3**
Amount of precipitation		**Collection area**		**Discharge coefficient**	**Filter efficiency**		**Rainwater yield**	

Calculation of the rainwater requirement

_____ Persons x 8.8 m^3	toilet flushes/year (with saving/stop button)	= _____	m^3
_____ Persons x 14 m^3	toilet flushes/year (without saving/stop button)	= _____	m^3
_____ Persons x 4.4 m^3	for washing machine/year	= _____	m^3
_____ m^2 x 0.06 m	intensive garden irrigation/year	= _____	m^3
	Total rainwater requirement:	_____	**m^3**

Determining the storage tank size

_____	**m^3 x**	**0.06**	**=**	_____ **m^3**
Rainwater yield or requirement*		**Discharge coefficient**		**Useful volume, storage tank**

*To calculate the useful volume, only the smaller value from the determined values of the rainwater yield or rainwater requirement is used.

Coverage rate

Yield _____ **: Requirement** _____ **x 100 =** _____ **% yearly coverage rate**

To compare whether the water requirement is equivalent to the statistical average, one can assume a yearly total water consumption of about 47 m^3 per person and compare with the actual total water consumption.

Application for partial exemption

In accordance with AVBWasserV Article 3 (2)

Address of local water-supply company or community

Public health department

Street

ZIP code Town/city

Sender/owner

Notification according to AVBWasserV Article 3 (2)

Application for partial exemption from connection and use obligation

Dear Madam(s) and Sir(s),

Starting on _____ (enter date), it is planned to utilise the water which precipitates on roof surfaces for

- ☐ garden irrigation
- ☐ toilet flushing
- ☐ washing machine
- ☐ business/industry

Building, land parcel number and address

Owner

Town or city, street, house number

The installation will be done by professionally by

Please confirm the partial exemption and send the associated design provisions. The system will only be constructed after receipt of this. I agree to acceptance by an expert before commissioning.

Place Date

Signature of applicant

Response from water supplier

Partial exemption, as response from the local water-supply company/community

Address of applicant

Sender

Place Date

Your application for partial exemption from the connection and use obligation

Your notification from _____
Date

Dear _____

As far as your own water supply for

- ☐ garden irrigation
- ☐ toilet flushing
- ☐ washing machine
- ☐ business/industry

for your building _____

is guaranteed by a operating/rainwater system created and operated according to the recognized rules of technology, your application is approved. It is mandatory that the following listed legal provisions of the ordinance about the general conditions for water supplies (AVBWasserV) and the drinking water ordinance be complied with:

AVBWasserV Article 3 (2)
Before setting up one's own recovery system, the customer has to inform the local water-supply company. The customer must make sure that there can be no retroactive effects on the water supply network from his system by taking appropriate measures.

Drinking water ordinance Article 17 (1)
Water supply units, from which drinking water or water for food businesses is dispensed with the composition of drinking water, may not be connected with water-supply units which dispense water which does not have the composition of drinking water. The pipelines of different supply systems are to be marked with different colours, as far as they aren't underground.

The local provisions for the sewage fees for utilised rainwater (or for the precipitated water fee) and the technical recommendations for systems for rainwater utilisation can be found in the enclosed design provisions.

Place Date

Signature of local water-supply company/community

Sample letter to the public health department

To the

Public health department

Enter address here

Place, date

Announcement of the operation of a rainwater utilisation system

Dear Madam(s) and Sir(s),

I hereby announce the operation of a rainwater utilisation system in accordance with Article 13, Paragraph 3 of the drinking water ordinance 2001.

The rainwater utilisation system will be operated for the partial private supply in my building **(indicate address here)** in addition to the freshwater supply system in terms of Article 3, Paragraph 2 of the drinking water ordinance 2001.

I affirm as responsible operator that there is no direct connection between the rainwater utilisation system and the drinking water supply system in terms of Article 3, Paragraph 2 of the drinking water ordinance 2001.

The interface between both water supply units, the so-called drinking water feed, is designed according to the state of the art as a "free outlet" in acc. with EN 1717 or DIN 1988, part 4 so that effects on the water supply for human consumption are ruled out, even in the event of technical malfunctions.

The taps of the rainwater utilisation system are permanently marked with the warning "Not drinking water" in accordance with Article 17, Paragraph 2 of the drinking water ordinance 2001.

The utilisation of the rainwater utilisation system is permissible for the supply of toilets and washing machines as well as garden irrigation and other cleaning purposes where the direct contact with food can be ruled out in accordance with Article 3, Paragraph 1 of the drinking water ordinance 2001 in connection with the legal justification (document 721/00 of the German Bundesrat).

Best Regards,

Display for using/modifying/shutting down a process water system

In accordance with Article 13 Paragraph 3 of the drinking water ordinance 2001

Address of public health department

Public health department

Street

ZIP code Town/city

Sender/owner

1. System site

Property

Building/building part

ZIP code/ Town or city

Telephone

2. Herewith, I announce the following:

☐ Operation of an existing system
☐ Commissioning of a system
☐ Putting a system back into operation
☐ Major modification of a system
☐ Shut-down of a system for/on

3. Origin of operating water

☐ House well
☐ Roof run-off water
☐ Surface water
☐ Grey water
☐ Drainage
☐ Other

4. Origin of replenishment water

☐ Central water supply
☐ Other

5. The drainage of excess operating water goes via

☐ separate sewage pipe
☐ mixed sewage pipe
☐ seepage
☐ Other

6. Utilisation of operating water

☐ Toilet flushing
☐ Washing machine
☐ Garden irrigation
☐ Other

7. Scope of utilisation

a) Number of supplied residential units — Number

b) Number of supplied consumers — Number

c) How high is the operating water consumption per year? — Amount [m³]

8. Special requirements

d) Was the system made by a certified professional company?
☐ yes ☐ no

e) Were the pipelines marked permanently with a different colour at installation?
☐ yes ☐ no

f) Were the tap sites marked as such with the label **"Operating water – NOT drinking water"**?
☐ yes ☐ no

g) Is the water replenishment from the drinking water supply exclusively via a free outlet?
☐ yes ☐ no

If not, how?

Is there a maintenance plan? ☐ yes ☐ no

h) Have you closed a maintenance contract?
☐ yes ☐ no

(Place, date) (Signature of applicant)

Commissioning and maintenance record
Rainwater utilisation system

Installation site:

Last name, first name

Street

ZIP code Town/city

Company stamp

Connected collection area approx.: _____ m^2

Type of filter: _____

Number of filters: _____

Filter maintenance:

☐ Function checked and cleaned

Next cleaning date: _____

Material of the rainwater storage tank: _____

Contents: _____ litres

Type of storage tank:

☐ Cellar storage tank
☐ can be driven over
☐ Sewage system connection
☐ Overflow with syphon
☐ Backflow protection
☐ Empty pipe seal
☐ Underground storage tank
☐ cannot be driven over
☐ Seepage
☐ With small animal block
☐ Steady-flow feed line

Storage tank maintenance:

☐ Storage tank cleaned (every 5–10 years)

Next date: _____

☐ Odour and optical state of the water
(o.k. = 1, polluted = 2 + comment/measure)

Comment/measure:

☐ Visual inspection – storage tank cover
(o.k.=1, damaged = 2 + comment/measure)

Comment/measure:

☐ Function test of the backflow/small animal protection
(o.k.=1, doesn't work = 2)

Comment/measure:

☐ Visual inspection – leak-tightness
(tight = 1, leaky = 2 + comment/measure)

Comment/measure:

Pump/system make / type:

☐ submersible pump ☐ suction pump

Pump control:

☐ automatic ☐ manual

Dry-running protection of the pump:

☐ electronically built-in ☐ float switch

Freshwater replenishment equipment:

☐ no ☐ free outlet, _____ cm
☐ built in (module)

Maintenance of the fresh water metering:

☐ correct and tight closing of the replenishment valve
(o.k.=1, defective/leaky= 2 + comment/measure)

Comment/measure:

☐ Compliance with DIN 1988/DIN 1989/EN 1717
(o.k. = 1, no = 2 + comment/measure)

Comment/measure:

System control:

☐ yes ☐ no
☐ float switch
☐ electronic ☐ built-in (module)

Pump / system maintenance:

☐ Visual inspection of the electric installation
(o.k.=1, damaged = 2 + comment/measure)

Comment/measure:

☐ Visual inspection of the (screwed) connections
(o.k.=1, damaged = 2 + comment/measure)

Comment/measure:

☐ Check of the switch-on/off functions
(o.k. = 1, malfunction = 2 + comment/measure)

Comment/measure:

☐ Check of pressure stability in the system
(stable = 1, unstable = 2 + comment/measure)

Comment/measure:

☐ Visual inspection – leak-tightness
(tight = 1, leaky = 2 + comment/measure)

Comment/measure:

Material of the pipeline: _____

Different from that in the drinking water network:
☐ yes ☐ no

Number of extraction points: _____ Pcs.
child-proof: ☐ yes ☐ no

Maintenance of the pipelines:

☐ Visual inspection for leaks and corrosion
(tight/corrosion-free= 1, leaky/corroded= 2 + comment/measure)

Comment/measure:

Labelling:

☐ Raw marking ☐ Extraction points
☐ Warning sign ☐ Cross-connections ruled out

Maintenance of the labels:

☐Visual inspection for completeness of labelling
(complete = 1, incomplete = 2 + comment/measure)

Comment/measure:

The rainwater utilisation system is free of defects:
☐ yes ☐ no

Supplementary comments:

Date

Signature of service technician

Signature of customer/proxy:

Tables and diagrams for calculations

Water consumption numbers (according to DIN 1986-100, table 4)

Case	from litres	to litres
Detached / multi-family house		
Drinking, cooking, cleaning, per person/day	20	30
Doing laundry, for every kg	25	75
Toilet flushing, once	6	10
Bath in bathtub	150	250
Shower bath	40	140
Lawn sprinkling, for every m^2/day	1,5	3
Vegetable garden sprinkling, for every m^2/day	5	10
Hotel/commune		
School, per person/day	5	6
Barracks, per person/day	100	150
Hospital, per person/day	100	650
Hotel, per person/day	100	130
Public swimming pool, per m^3/day	450	500
Fire hydrant, per second	5	10
Business/industry		
Slaughter house, per animal (cattle)	300	500
Slaughter house, per animal (small livestock)	150	300
Laundromat, per machine	1000	1200
Brewery, per hectolitre beer	250	500
Dairy, per litre milk	0.5	4
Weaving mill, per kg cloth	900	1000
Sugar refinery, per kg sugar	90	100
Meat processing factory, per kg meat/sausage	1	3
Paper mill, per kg fine paper	1500	3000
Concrete factory, per m^3 concrete	125	150
Construction, per 1000 bricks with mortar	650	750
Food industry, per kg starch	1	6
Food industry, per kg margarine	1	3
Weaving mill, per kg sheep's wool	90	110
Mining, per kg coal	20	30
Agriculture		
Large livestock, per animal/day	50	60
Sheep, calf, pig, goat per animal/day	10	20
Transportation		
Washing car	100	200
Washing truck	200	300
Washing a freight car	2000	2500
Cleaning a poultry car	7000	30,000

Precipitation in Germany (excerpt from DIN 1986-100: 2002-03 table A1)

$r_{x(y)}$ means rainfall which occurs x minutes long (duration) and statistically happens every 1/y years.
Example: $r_{5(0.5)}$ = five-minute rain, which statistically happens every 2 years 1/0.5 (= 2).

Place	$r_{5.2}$ [l/(s x ha)]	$r_{15.2}$ [l/(s x ha)]	$r_{5.30}$ [l/(s x ha)]	$r_{15.30}$ [l/(s x ha)]	$r_{5.100}$ [l/(s x ha)]
Aachen	240	121	431	214	516
Aschaffenburg	293	143	539	267	649
Augsburg	285	138	499	243	595
Aurich	240	121	416	214	494
Bad Salzuflen	282	133	455	233	532
Bad Tölz	416	205	655	355	762
Bayreuth	285	144	524	276	630
Berlin	341	169	605	321	723
Bielefeld	260	132	475	248	570
Bonn	266	132	505	248	611
Braunschweig	289	143	498	267	591
Bremen	238	118	403	202	477
Chemnitz	340	162	552	288	646
Cottbus	260	129	477	232	574
Dessau	292	137	530	250	635
Dortmund	277	134	441	226	513
Dresden	297	145	540	268	648
Düsseldorf	227	135	518	245	626
Eisenach	269	135	478	249	570
Emden	246	124	444	230	532
Erfurt	243	121	404	214	476
Frankfurt/Main	314	145	577	268	695
Halle/Saale	285	137	503	250	601
Hamburg	258	129	423	232	497
Hanover	275	124	538	230	655
Heidelberg	338	158	579	287	686
Ingolstadt	283	138	456	243	534
Kassel	273	140	505	266	608
Kiel	230	112	404	192	481
Cologne	281	138	535	266	648
Leipzig	324	147	545	276	690
Lingen	316	148	588	284	709
Magdeburg	277	129	517	232	624
Mainz	333	164	603	304	723
Munich	335	166	577	305	685
Münster	283	137	510	250	611
Neubrandenburg	330	148	607	284	731
Nuremberg	296	145	533	272	638
Rosenheim	402	191	733	350	880
Rostock	232	118	375	202	438
Saarbrücken	255	131	448	240	534
Stuttgart	349	169	663	325	802
Würzburg	293	140	511	266	608

Discharge coefficient C for the calculation of the rainwater precipitation Q_r

(DIN 1986-100: 2002-03, Table 6)

No.	Type of surfaces	Discharge coefficient C
1	Water-permeable surfaces, e. g.	
	• Roof surfaces > 3° gradient	1.0
	• Concrete surfaces	1.0
	• Ramps	1.0
	• Paved surfaces with chinking	1.0
	• Blacktops	1.0
	• Pavement with sealing compound	1.0
	• Roof surfaces ≤ 3° gradient	1.0
	• Gravel roofs	0.8
	• Planted roof surfaces*	
	• for intensive planting	0.5
	• for extensive planting from 10 cm composition thickness	0.3
	• for extensive planting under 10 cm composition thickness	0.5
2	Partially permeable and poor-draining surfaces, e.g.	
	• Unpaved streets, courtyards, promenades	0.5
	• Surfaces with slabs	
	• Surfaces with pavement, with joint portion > 15% e.g. 10 cm x 10 cm and smaller	0.6
	• Water-bound surfaces	0.5
	• Children's playgrounds with partial surfacing	0.3
	• Sport areas with draining	
	• Plastic surfaces, plastic lawn	0.6
	• "Barn-floor" surfaces	0.4
	• Lawn areas	0.3
3	Water-permeable surfaces without or with insignificant water drainage, e. g.	
	• Parks and vegetation areas, gravel and cinder ground, rolling gravel, also with partial surfaced areas, such as	
	• garden paths with water-bound cover or	0.0
	• driveways and single parking places with grass pavers	0.0

* According to the directives for planning, design and care of roof planting – Directives for roof planting

Pressure losses with respect to volumetric flows of plastic pipelines PE-HD

(DIN 1986-100: 2002-03, Table 6)

Nominal diameter	DN 25		DN 32		DN 40		DN 50		DN 65	
dxs	32 x 2.9		40 x 3.7		50 x 4.6		63 x 5.8		75 x 6.9	
dl	26.2		32.6		40.8		51.4		61.2	
Q	v	pressure loss Δ P	v	pressure loss Δ P	v	pressure loss Δ P	v	pressure loss Δ P	v	pressure loss Δ P
[l/s]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]
0.0315	0.06	0.041								
0.04	0.08	0.0061								
0.05	0.09	0.0088	0.06	0.0031						
0.063	0.12	0.013	0.08	0.0045						
0.08	0.15	0.0195	0.1	0.0067	0.06	0.0024				
0.1	0.19	0.0285	0.12	0.0098	0.08	0.0034				
0.125	0.24	0.0417	0.15	0.0144	0.1	0.005	0.06	0.0017		
0.16	0.3	0.0638	0.19	0.0219	0.12	0.0076	0.08	0.0027	0.05	0.0011
0.2	0.38	0.0939	0.24	0.0321	0.15	0.0111	0.1	0.0037	0.07	0.0016
0.25	0.47	0.1384	0.3	0.0473	0.19	0.0163	0.12	0.0055	0.09	0.0024
0.315	0.59	0.2072	0.38	0.0796	0.24	0.0244	0.15	0.0082	0.111	0.0036
0.4	0.75	0.3152	0.48	0.1071	0.31	0.0369	0.19	0.0123	0.14	0.0054
0.5	0.94	0.4672	0.6	0.1585	0.38	0.0544	0.24	0.0182	0.17	0.0079
0.63	1.19	0.7039	0.76	0.2381	0.48	0.0816	0.30	0.0272	0.21	0.0119
0.8	1.51	1.0776	0.96	0.3634	0.61	0.1242	0.39	0.0413	0.27	0.018
1.0	1.88	1.6072	1.2	0.5405	0.77	0.1842	0.48	0.0611	0.34	0.0266
1.25	2.35	2.4022	1.5	0.8053	0.96	0.2738	0.6	0.0906	0.43	0.0394
1.6	3.01	3.7567	1.92	1.2547	1.22	0.4253	0.77	0.1403	0.54	0.0609
2.0			2.4	1.8774	1.53	0.6345	0.96	0.2088	0.68	0.0904
2.5			3	2.8148	1.91	0.9483	1.21	0.3112	0.85	0.1345
3.15					2.41	1.4406	1.518	0.4714	1.07	0.2033
4.0					3.06	2.2247	1.928	0.7254	0.36	0.3123
5.0							2.41	1.0873	1.7	0.467
6.3							3.036	1.6567	2.14	0.7098
8.0									2.72	1.0965
10.0									3.4	1.6493

Pressure losses with respect to volumetric flows of plastic pipelines PE-HD

(continued)

Nominal diameter	DN 80		DN 100		DN 100		DN 125		DN 150	
dxs	90 x 8.2		110 x 10.0		125 x 11.4		140 x 12.8		160 x 14.6	
dl	73.6		90		102.2		114.4		130.8	
Q	v	pressure loss Δ P	v	pressure loss Δ P	v	pressure loss Δ P	v	pressure loss Δ P	v	pressure loss Δ P
[l/s]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]	[m/s]	[bar/100 m]
0.3	0.06	0.01								
0.3	0.07	0.0015								
0.4	0.09	0.0023	0.06	0.0009						
0.5	0.12	0.0033	0.08	0.0013	0.06	0.0007				
0.6	0.15	0.0049	0.1	0.0019	0.08	0.001	0.06	0.0006		
0.8	0.19	0.0075	0.13	0.0029	0.1	0.0016	0.08	0.0009	0.06	0.0005
1.0	0.24	0.0111	0.16	0.0043	0.12	0.0023	0.1	0.0014	0.07	0.0007
1.3	0.29	0.0163	0.2	0.0063	0.15	0.0034	0.12	0.0002	0.09	0.0011
1.6	0.38	0.0252	0.25	0.0097	0.2	0.0054	0.16	0.0031	0.12	0.0016
2.0	0.47	0.0374	0.31	0.0143	0.24	0.0078	0.2	0.0046	0.015	0.0024
2.5	0.59	0.0555	0.39	0.0212	0.31	0.0116	0.24	0.0068	0.19	0.0036
3.2	0.74	0.0838	0.5	0.032	0.38	0.0174	0.31	0.0102	0.23	0.0054
4.0	0.94	0.1285	0.63	0.489	0.49	0.0266	0.39	0.0155	0.3	0.0082
5.0	1.18	0.1917	0.79	0.0729	0.61	0.0396	0.49	0.0231	0.37	0.0121
6.3	1.48	0.2908	0.99	0.1103	0.77	0.0598	0.61	0.0348	0.47	0.0183
8.0	1.88	0.448	1.26	0.1695	0.98	0.0919	0.78	0.0534	0.6	0.0281
10.0	2.35	0.6722	1.57	0.2537	1.22	0.1373	0.97	0.0797	0.74	0.0419
13.0	2.94	1.0104	1.97	0.3804	1.52	0.2056	1.22	0.1193	0.93	0.0625
16.0			2.52	0.5966	1.95	0.3219	1.56	0.1865	1.19	0.0976
20.0			3.14	0.8977	2.44	0.4836	1.95	0.2798	1.49	0.1463
25.0					3.05	0.7279	2.43	0.4205	1.86	0.2195
32.0							3.0650	0.6424	2.34	0.3347
40.0									2.98	0.5188

Inside diameter of new pipes (according to corresponding DIN)

Respectively smallest diameter of nominal diameters

DN	GG pipe PN16	PVC pipe PN10	PE80HD pipe SDR11 PN12.5	PE100HD pipe SDR11	Minimum value according to DIN EN 12056-2 (for GG)
	[mm]	[mm]	[mm]	[mm]	[mm]
32	n/a	36	32.6	32.6	n/a
40	n/a	45.2	40.8	40.8	34
50	n/a	57.0	51.4	51.4	44
65	n/a	67.8	61.2	61.2	n/a
80	80	81.4	73.6	73.6	75
100	100	99.4	90.0	90.0	96
150	151	144.6	130.8	130.8	146
200	202	203.4	184	184	184

Pipe friction losses and correction factors

Continued

Factors for adjusting to other materials or older pipes:	
0.1	new galvanised steel pipes
0.8	new rolled steel pipes, new plastic pipes
1.0	new cast iron pipes, bitumen cast iron pipes
1.25	older rusted cast iron pipes
1.5	new galvanised steel pipes, cleaned cast iron pipes,
1.7	incrusted pipes
2	new concrete pipes, medium-smooth
2.5	stoneware pipes
3	new concrete pipes painted smooth
15-30	cast iron pipes with slight to heavy encrusting

Fitting losses

Guide values for rough calculation for loss calculations, indicated in m of pipeline length
(in the case of constrictions or enlargements, always refers to the larger diameter).

Resistance type		DN 32	DN 40	DN 50	DN 65	DN 80	DN 100	DN 150	DN 200
Branch or T-piece		2.02	2.74	3.87	5.61	6.58	8.85	15.45	23.36
Cross-section enlargement		-0.85	-1.13	-1.5	-2.29	-2.4	-3.72	-5.02	-13.22
Cross-section constriction		1.08	1.45	1.94	2.46	3.19	4.85	8.04	19.25
Sudden cross-sectional enlargement		-0.24	-0.34	-0.48	-0.56	-0.76	-1.05	-1.96	-2.6
Sudden cross-sectional constriction		0.29	0.42	0.6	0.7	0.95	1.31	2.45	3.25
Bend with R = d and smooth surface 45°		0.11	0.15	0.2	0.3	0.4	0.55	0.95	1.4
60°		0.15	0.2	0.28	0.43	0.59	0.93	1.5	2.28
90°		0.19	0.27	0.38	0.58	0.79	1.11	2.06	3.18
Non-return valve		1.7	1.48	1.84	2.6	3.3	4.26	7.26	10.58
Gate valve, Ball cocks		0.27	0.3	0.38	0.49	0.56	0.7	1.08	1.45

Seminars

Wilo seminars

Current information and dates for Wilo seminars can be found at: www.wilo.com

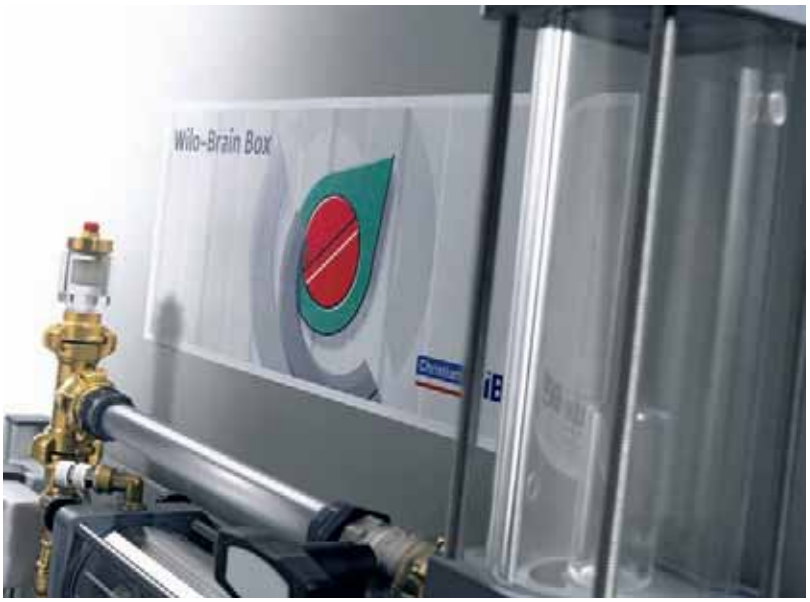
The Wilo seminars will help you always keep your professional expertise up-to-date: with many training programs in the areas of heating, cooling, air conditioning, water supply as well as sewage disposal.

The seminars are specifically tailored to the requirements of your daily work routine. Our trainers have many years of experience in skilled craft firms and for this reason always teach seminars with a direct reference to daily practice.

The training centres in Dortmund and Oschersleben offer an optimal environment for modern learning at the highest level. Besides conference and meeting rooms, they have practically equipped method rooms: ideal for the handling-oriented training on pumps and system models.

The one-day events – including lunch – are free of charge for you. You will get a Wilo certificate after successfully participating in the seminar.

Wilo-Brain



Addresses for the Wilo Brain Centres and seminar dates can be found at: www.wilo.com

80 to 90 % of all customer complaints with regard to heating and hot drinking water circulation systems can be easily avoided: by designing/adjusting the system to be demand-oriented.

Wilo-Brain will help you to make your customers happier and to make your business more successful. Hereby, this isn't a product training program, but a general system training program spanning many manufacturers. Wilo-Brain utilises existing knowledge, puts this in systematic context and offers brand new tips and tricks for installation and maintenance. Whether a hydraulic balancing of heating systems of hygiene protection in hot drinking water circulation: Wilo-Brain passes on expertise for noise-free, smooth system operation and long-term energy efficiency.

The system training programs take place in Wilo Brain Centres, industry-wide training centres for guilds, chambers and technical colleges all over Germany.

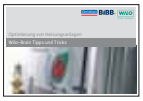
Information material

Basic knowledge

Product catalogues

Planning information

System knowledge



This information material can be ordered with the order forms on the following pages or you can order online at www.wilo.de

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