

Drinking water installations

Liability risk for the installer

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Drinking Water Installations in accordance with EN 806-4:2010 – Liability risk for the installer in case of failure to observe

Numerous requirements for the avoidance or removal of microbacterial contaminations and deposits during the commissioning of drinking water installations make it difficult for the installer to keep everything in mind. But the installer must ensure a hygienically perfect installation. If the applicable rules of technology are not followed, the builder could be entitled to claim that the installer who carried out the work should repair any damages caused by microbacterial contamination. This article deals with the requirements that need to be considered after re-installation, conversion and repairs, when testing, flushing and disinfecting drinking water installations.

European standard EN 806-4 – in force throughout Europe since 2010

Based on the currently valid "Directive 98/83/EC of the Commission of the 3rd of November 1998 on the quality of water for human consumption", the European standard EN 806-4:2010 "Specifications for installations inside buildings conveying water for human consumption – Part 4: Installation" was adopted by the European Committee for Standardisation (CEN) and had to attain the status of a national standard in all European countries by September 2010. This standard defines Europe-wide regulations for the commissioning of drinking water installations, e.g. for filling, hydrostatic pressure testing, flushing and disinfection, for the first time. "This European standard is applicable to new installation, conversion and repairs." [1]

National Requirements

Apart from the requirements of the European standard EN 806-4 [1], national regulations must be observed and followed, e.g. for Germany [2] [3] [4].

Does the installer have to observe/fulfil the named rules?

If the installer has not executed the work in accordance with the recognised rules of technology (pertinent national or international standards), he must prove, in the case of damage, if necessary by an independent expert, that the work he has executed is in accordance with the state of the art. If this is not the case then the installer is liable for the damage. Therefore it is urgently recommended to satisfy the requirements of the named rules to reduce the liability risk.

Hydrostatic Pressure Testing

EN 806-4 [1], Section 6 "Commissioning", deals in 6.1 with the "filling and hydrostatic pressure testing of installations inside buildings for water for human consumption". "Installations inside buildings must be subjected to pressure testing. This can be done either with water or, if national regulations allow, oil-free, clean air with low pressure or inert gases may be used. The possible

risk from high gas or air pressure in the system must be considered." Apart from this note, the standard EN 806-4 [1] contains no test criteria whatsoever for testing with air. For hydrostatic pressure testing on the other hand 3 test methods A, B, C depending on the material and size of the installed pipes are described. The test methods A, B, C differ in different test sequences, pressures and times. A standard method was defined for Germany: "For reasons of practicability on the building site, a modified method based on practical tests which can be used for all materials and combinations of materials was chosen." [3]

The leak test with water usually performed in the past was performed before covering the drinking water pipes. If the installation is then not put into operation immediately afterwards, there is a risk of bacterial contamination both in filled, partially filled and emptied pipes. Therefore EN 806-4 [1] prescribes: "The drinking water installation must be flushed as soon as possible after installation and pressure testing as well as immediately before putting into operation with drinking water." "If a system is not put into operation immediately after commissioning, it must be flushed at regular intervals (up to 7 days)." Since the drinking water installation is usually not put into operation immediately after leak testing and commissioning often does not take place until months later, the demand to flush every 7 days is theoretically sensible but practically and economically debatable.

For the same reason, regulations were defined in the information leaflet [3] of the ZVSHK for Germany alternatively to the hydrostatic pressure testing with water, in which a leak test with oil-free compressed air at 150 hPa (150 mbar) and a load test with 0.3 MPa (3 bar) or 0.1 MPa (1 bar) can be carried out, depending on the rated widths of the drinking water installation. Test pressures > 0.3 MPa (3 bar) may not be used for the following reason: "Due to the compressibility of gases, the rules for the prevention of accidents "Working on Gas Systems" and the "Technical Rules for Gas Installations DVGW-TRGI" must be

observed for physical and safety reasons when conducting pressure tests with air". Therefore, the test pressures have been defined as maximum 0.3 MPa (3 bar), the same as for load and leak tests for gas pipes, in agreement with the responsible industrial liability insurance association and based on these rules." [3] "Leak tests should be performed with compressed air or inert gases as a rule. Leak tests with water of a perfect nature should only be used when certain prerequisites are satisfied such as commissioning shortly after the leak test." [3] Such national regulations are expressly permitted in EN 806-4 [1]. The leak test with compressed air avoids the drinking water installation having to be flushed every 7 days at the latest in case of longer standstill between the leak test and commissioning, as it is prescribed in EN 806-4 [1] for hydrostatic pressure testing with water.

The respective national safety provisions, rules and regulations valid for the application site must be considered and observed.

Flushing

EN 806-4 [1] prescribes: "The drinking water installation must be flushed as soon as possible after installation and pressure testing as well as immediately prior to commissioning with drinking water." Drinking water or a water/air mixture can be used for flushing. According to EN 806-4 [1] and the rules of the DVGW [2] and the ZVSHK [4], the drinking water used for flushing must be filtered,



whereby particles $\geq 150 \mu\text{m}$ must be held back and the water must be of perfect drinking quality. The system must be flushed section for section depending on the size of the installation and the arrangement and lay of the pipes. Flushing must start on the lowest floor of the building and continue upwards line by line, within a line floor by floor, i.e. from the nearest line to the farthest line and floor. The minimum flow velocity when flushing the installation must be 2 m/s and the water in the system must be replaced at least 20 times during flushing.

However, microbacterial contaminations and incrustations are often only removed insufficiently by flushing with drinking water alone so that it is recommended to reinforce the cleaning effect by adding compressed air surges to the water. EN 806-4 [1] recommends: *"The pipe system can be flushed under pressure with a water/air mixture intermittently with a minimum flow velocity in every pipe section of 0.5 m/s. A certain minimum number of tap fittings must be opened for this. If the minimum volume flow is not reached with full filling of the distribution pipe in a section of the pipe system to be flushed, a storage tank and a pump must be used for flushing."* [1] *"The system must be flushed section by section depending on the size of the installation and the lay of the pipes." No flushing section may exceed a pipe section length of 100 m.* [1]. For Germany see also the rules of the DVGW [2] and the ZVSHK [4].

Disinfection

EN 806-4 [1] prescribes: *"Drinking water installations may be disinfected after flushing if a responsible person or authority prescribes this." "All chemicals that are used for disinfecting drinking water installations must meet the requirements for chemicals for water treatment which are defined in European standards or, if European standards are not applicable, in national standards and technical rules." "Transport, storage, handling and application of all these disinfectants can be dangerous, therefore health and safety regulations must be strictly observed."*

In Germany hydrogen peroxide H_2O_2 , sodium hypochlorite NaOCl and chlorine dioxide ClO_2 are recommended for the disinfection of drinking water installations [2] [4]. User friendliness, work protection and environmental protection must also be considered for the choice of disinfection chemicals. It must be taken into account that, for example, when using oxidants containing chlorine (sodium hypochlorite NaOCl and chlorine dioxide ClO_2) organic chlorine compounds are produced which are to be considered critical for the environment and that chlorine dioxide must be created directly on the building site

by chemical reactions.

It is therefore recommended to disinfect drinking water installations with hydrogen peroxide H_2O_2 . Hydrogen peroxide offers the best alternative with regard to user friendliness, work protection and environmental protection because it decomposes into hydrogen and water when used and therefore forms no critical decomposition products. Because of the rapid decomposition, weak concentrated disinfection solutions of hydrogen peroxide can be drained into sewers without problems. In addition, concentrations of hydrogen peroxide $< 5\%$ are not classified as dangerous and are therefore not a hazardous substance. The recommended use of dosing solutions in a concentration of 1.5 % hydrogen peroxide in a dilution with 100 l drinking water gives a disinfection solution of 150 mg $\text{H}_2\text{O}_2/\text{l}$, according to the recommendations of the DVGW [2] and ZVSHK [4]. Dosing solutions of this concentration are offered in 1 l bottles so that the user has ready to use dosing solutions which can be distributed into 100 l water volumes with conventional devices.

If disinfectants, e.g. hydrogen peroxide H_2O_2 , with higher concentrations are used, the user may have to dilute these to the recommended concentration of the dosing solution. Such actions with disinfectant concentrations $> 5\%$ are dangerous so that hazardous substance and chemical prohibition directives and other national laws must be observed. Errors in the preparation of the self-mixed dosing solution can also lead to personal injury and damage to the drinking water installation.

Recording of Executed Work

In accordance with EN 806-4 [1], records of the executed testing, flushing and disinfection process as well as inspection results must be submitted to the owner of the building. The appendices to the regulations of the DVGW [2] and the ZVSHK [4] show examples of reports for the documentation of the respective results of the flushing and disinfection of drinking water installations, the regulations of the ZVSHK [3] show such sample reports for the documentation of results of testing.

Printing strips which can be printed directly by the equipment used for testing, flushing and disinfection of drinking water installations are helpful for the documentation.

Devices with which the requirements of the named regulations can be met

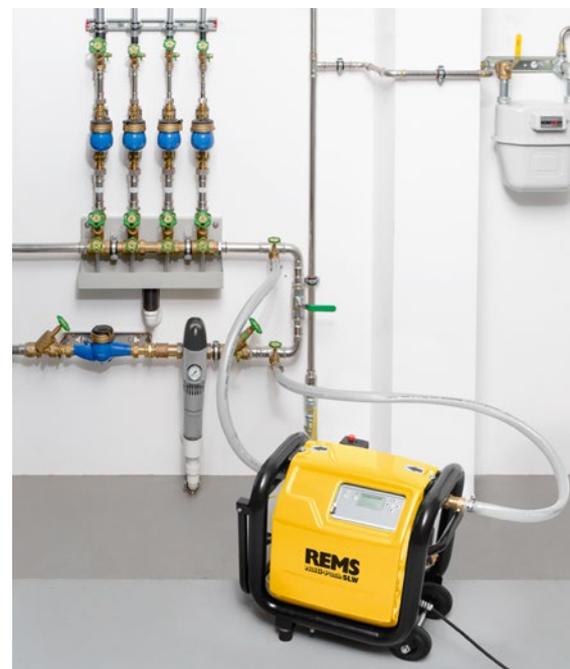
The following table shows a list of the demands made by the regulations for testing, flushing and disinfecting drinking water installations and the types of devices/

devices on the market with which these demands can be met. The information in the table makes no claim to being complete.

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Literature:

- [1] European standard EN 806-4:2010 "Specifications for installations inside buildings conveying water for human consumption – Part 4: Installation"
- [2] Technical Rule – Worksheet DVGW W 557 (A) October 2012 "Cleaning and disinfection of drinking water installations" DVGW German Gas and Water Association.
- [3] Information leaflet "Leak tests of drinking water installations with compressed air, inert gas or water" (January 2011) Central Association for Sanitary, Heating, Air Conditioning (ZVSHK)
- [4] Information leaflet "Flushing, disinfection and commissioning of drinking water installations" (August 2014) Central Association for Sanitary, Heating, Air Conditioning (ZVSHK)



|  Info | Requirements | | Satisfaction of requirements | | | |
|---|----------------------------|----------------------------|------------------------------|-------------------------------|--------------------|---------------------|
| | European standard EN 806-4 | Information leaflets ZVSHK | Flushing Compressor | Digital measuring instruments | REMS Multi-Push SL | REMS Multi-Push SLW |
| Testing drinking water installations with water A | • | | | • | | • |
| Testing drinking water installations with water B | • | | | • | | • |
| Testing drinking water installations with water B+ (GER) | | • | | • | | • |
| Testing drinking water installations with water C | • | | | • | | • |
| Leak testing of drinking water installations with compressed air | | • | | • | • | • |
| Load testing of drinking water installations with compressed air | | • | | • | • | • |
| Flushing of drinking water installations with water | • | • | • | | • | • |
| Flushing of drinking water installations with water/ air mixture with intermittent compressed air | • | • | • | | • | • |
| Flushing of drinking water installations with water/ air mixture with constant compressed air | | | • | | • | • |
| Disinfection of drinking water installations | • | • | • | | • | • |
| Recording of the results of the flushing and test programs | • | • | (•) | (•) | • | • |
| Cleaning, preservation of heating systems | | | • | | • | • |
| Operation of pneumatic tools | | | • | | • | • |

•* with additionally required "external pump" for water/air

(•) partial

The electronic flushing and pressure testing unit with compressor REMS Multi-Push SLW meets all these requirements:

- Flushing of drinking water installations with water in accordance with EN 806-4:2010, according to Technical Rule – Worksheet DVGW W 557 (A) October 2012 "Cleaning and disinfection of drinking water installations" DVGW German Gas and Water Association and according to information leaflet "Flushing, disinfection and commissioning of drinking water installations" (August 2014) Central Association for Sanitary, Heating, Air Conditioning (ZVSHK), Germany and for flushing radiators and surface heating systems.
- Flushing of drinking water installations with water/air mixture with intermittent compressed air in accordance with EN 806-4:2010, according to Technical Rule – Worksheet DVGW W 557 (A) October 2012 "Cleaning and disinfection of drinking water installations" DVGW German Gas and Water Association and according to information leaflet "Flushing, disinfection and commissioning of drinking water installations" (August 2014) Central Association for Sanitary, Heating, Air Conditioning (ZVSHK), Germany and for flushing radiators and surface heating systems.
- Flushing pipe systems with a water/air mixture with constant compressed air
- Disinfection, cleaning and preservation with REMS disinfection and cleaning unit: Disinfection of drinking water installations in accordance with

- EN 806-4:2010, according to Technical Rule – Worksheet DVGW W 557 (A) October 2012 "Cleaning and disinfection of drinking water installations" DVGW German Gas and Water Association and according to information leaflet "Flushing, disinfection and commissioning of drinking water installations" (August 2014) Central Association for Sanitary, Heating, Air Conditioning (ZVSHK), Germany and other pipe systems. Cleaning and preservation of radiators and area heating systems. Use of various additives for disinfection, cleaning and preservation for different applications.
- Leak testing of drinking water installations with compressed air in accordance with information leaflet "Leak Testing of Drinking Water Installations" (January 2011) of the German Central Association for Sanitary, Heating and Air Conditioning (ZVSHK) and pressure and leak testing of other pipe systems and vessels.
 - Load testing of drinking water installations with compressed air in accordance with information leaflet "Leak Testing of Drinking Water Installations" (January 2011) of the German Central Association for Sanitary, Heating and Air Conditioning (ZVSHK) and pressure and leak testing of other pipe systems and vessels.
 - Hydrostatic pressure testing of drinking water installations with water in accordance with EN 806-4:2010, Test Method A and for pressure and leak testing of other pipe systems and vessels.
 - Hydrostatic pressure testing of drinking water installations with water in accord-

- ance with EN 806-4:2010, Test Method B
- Hydrostatic pressure testing of drinking water installations with water in accordance with EN 806-4:2010, Test Method B, modified in accordance with information leaflet "Leak Testing of Drinking Water Installations" (January 2011) of the German Central Association for Sanitary, Heating and Air Conditioning (ZVSHK) and for pressure and leak testing of other pipe systems and vessels.
 - Hydrostatic pressure testing of drinking water installations with water in accordance with EN 806-4:2010, Test Method C and for pressure and leak testing of other pipe systems and vessels.
 - Compressed air pump for controlled filling of all types of vessels with compressed air ≤ 0.8 MPa/8 bar,
 - Operation of compressed air tools up to an air requirement of ≤ 230 NI/min.

