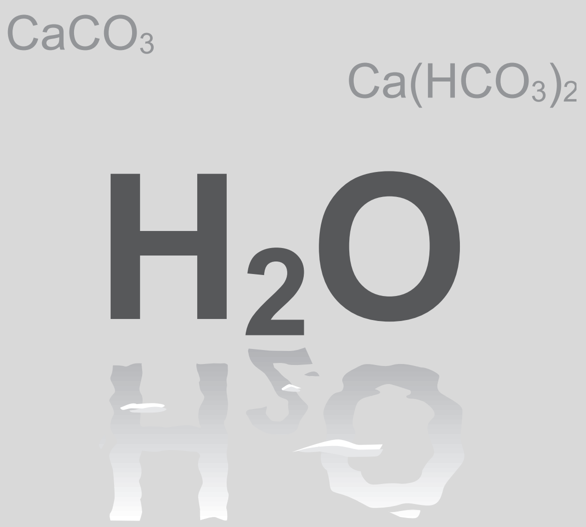
Operator's log

Water quality

Heat sources made of aluminium materials



For heat sources with heat exchangers made of aluminium materials

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1 About this document

This operator's log includes important information on the water treatment of heating water for heat sources (hereafter called floor-standing boilers) with heat exchangers made from aluminium materials and combinations of different materials, operating at temperatures of ≤ 100 °C.

The details given below regarding our floor-standing boilers are based on our experience over many years as well as service life tests, and they specify the maximum amounts of fill and top-up water depending on the heat output and water hardness. This ensures that local guidance (e.g. ICOM Commercial Water Treatment Guide) is met.

This document shows you how you can keep an operator's log on water treatment. Examples will show you how to carry out and record essential calculations.

At the end of this document you will find an operator's log table, which you can complete.

This operator's log is intended for system operators and heating contractors who, due to their training and experience, are familiar with heating systems.

Warranty claims for the boilers will only be considered, provided the requirements for the water quality have been met, and the operator's log has been maintained.

Important information

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The info symbol indicates important information where there is no risk to people or property.

Additional symbols

Symbol	Meaning
▶	a step in an action sequence
→	a reference to a related part in the document
•	a list entry
–	a list entry (second level)

Table 1

2 Water quality

As chemically pure water for heat transfer can not be obtained from the public water mains, water quality is important and must be observed. The water quality is determined by the mineral constituents of the water. Poor water quality can damage heating systems due to scale formation and corrosion.

2.1 Maintaining an operator's log

In the case of heating systems with a total rated output ≥ 50 kW, it is a mandatory requirement to install a water meter in the filling line for the heating system, as well as maintaining an operator's log (see also EN 12828 ICOM Commercial Water Treatment Guide). These points are a constituent part of our warranty.

In order to prove the water quality:

▶ Record the required values in the operator's log.

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Water quality is an essential factor for increasing the efficiency, functional reliability, service life and operating readiness of a heating system. For this reason, we generally recommend using treated water (→ Chapter 2.6).

- As well as the filled quantity of fill and top-up water, also record the concentration of calcium hydrogen carbonate [$Ca(HCO_3)_2$] or the water hardness, and enter this in the operator's log.

You can ask your water supply utility for the $Ca(HCO_3)_2$ concentration or the water hardness, or you can determine it yourself based on the calculation (→ Chapter 2.4, page 4).

2.2 Prevention of corrosion damage

Additional protection against corrosion

Damage due to corrosion occurs, if oxygen constantly enters the circulating water, e.g. due to the following:
- Inadequately sized or faulty expansion vessels,
- Incorrectly set pre-charge pressure or
- Open vented systems.
- Check the pre-charge pressure and the functioning of the pressure maintenance annually.

In the case of systems with correctly functioning and sized pressure maintenance, the oxygen introduced via the fill and top-up water is rapidly broken down and is therefore negligible.

If regular oxygen permeation can not be prevented, for example if using plastic pipes that are not oxygen-tight in underfloor heating systems, or if large amounts of top-up water are continually required, it is necessary to take corrosion prevention measures, e.g. by means of system separation with the aid of a heat exchanger.

pH value

The pH value of untreated circulating water should be between 8.2 and 9.0 for heat sources made with aluminium materials. Note that in the months following commissioning, the pH value of the circulating water may increase due to what is referred to as the self-alkalising effect. We recommend checking the pH value after several months of heating system operation.

A pH value of up to 7 is acceptable with low-salt operation (conductivity < 100 µS/cm in the circulating water) and in systems that are closed from a corrosion standpoint. To identify a system that is not closed from a corrosion standpoint, the circulating water can be sampled on site. If the sampled water is clear and without discolouration, it can be assumed for all practical intents and purposes, that a system is closed from a corrosion standpoint. If the sampled circulating water has an intense brown discolouration, it can be assumed that the system is not closed from a corrosion standpoint. The reason for this as a general rule is oxygen permeation.

If the oxygen permeation is permanent, it must be ensured that the pressure maintenance is operating correctly.

Installation of a dirt trap

If a boiler is installed in an existing heating system, impurities may build up in the boiler, leading to localised overheating, corrosion and noise. We therefore recommend the installation of a dirt trap and blow-down device.

Dirt traps hold back impurities and thereby prevent faults in control devices, pipework and boilers.

- Install dirt traps close to the lowest point of the heating system return.
- Ensure that the dirt trap is easily accessible.
- Clean the dirt trap every time maintenance is carried out on the heating system.

Installation in a heating system of a floor-standing boiler with heat exchanger made of aluminium materials

Before the new floor-standing boiler is connected:
- Flush the heating system.

It is especially important to flush the heating system, if the floor-standing boiler with heat exchanger made of aluminium materials is installed in existing heating systems, where additives or water treatment measures have been used, which are unsuitable for heat exchangers made of aluminium materials (e.g. softened water or trisodium phosphate for alkalisation). Draining and flushing the existing heating system before installing the new floor-standing boiler removes harmful additives and incorrect water treatment measures, and this prevents damage to the floor-standing boiler.

Additives

If additives or antifreeze (where approved by the manufacturer of the heat source) are used in the heating system, the manufacturer's instructions for the additive or antifreeze must be observed. This applies particularly to the concentration in the fill water, to the regular checks of the heating water and to any corrective measures that may be required.

Approved antifreezes can be found in Document no. 6720841872.

In the case of all other additives, an assurance must also be obtained from the additive manufacturer, that it is suitable and effective for all the materials installed in the heating system, and a copy of this assurance should be kept permanently with the operator's log.

The following points must be taken into account:
- Observe the antifreeze manufacturer's instructions.
- Follow the manufacturer's details regarding mixing ratios.
- When designing the system components (e.g. pumps) and the pipework, bear in mind that the specific thermal capacity of Antifrogen N antifreeze is lower than the specific thermal capacity of the water. To enable the transfer of the required heat output, the required flow rate must be increased accordingly.
- The heat transfer medium has a higher viscosity and density than water. This means that the pressure drop of the media flowing through the pipework and other system components is higher, and it is important to take this into consideration.
- Check the resistance of all plastic or non-metallic components in the system separately.
- The pH value of the circulating water must be checked annually and documented in the operator's log.

Sealants in the heating water can cause deposits in the heat exchanger. We therefore advise against their use.

2.3 Water hardness

- Only fill the heating system with clean mains water from the public drinking water supply.

To protect the heat source from limescale damage throughout its service life and ensure trouble-free operation, the overall quantity of substances that cause hardness must be limited in the fill and top-up water of the heating circuit.

The details given below about our heat sources are based on many years of experience and service life tests, and they specify the maximum amounts of fill and top-up water depending on output and water hardness.

This ensures that local regulations – and prevention of damage through scale formation – are met.

2.4 Checking the maximum amounts of fill water depending on water quality

If the total amount of fill and top-up water exceeds the calculated water volume V_{max}, damage to the heat source may occur.

If, through a failure to meet these requirements, damaging deposits have already occurred inside the heat source, then it is most likely that the service life will already have been reduced as a result. Removing these deposits can be one option for restoring suitability for operation. Scale deposits must only be removed by an approved contractor.

To check the permitted amounts of water depending on the fill water quality (water quality), either use the following basis for calculation or consult the graphs. If the system capacity is unknown, fully desalinated water can generally be used.

2.4.1 Basis for calculation

In the following calculation examples, the concentration of calcium hydrogen carbonate is stated in the units of mol/m^3 / °dH (°fH).
°dH = German hardness
°fH = French hardness
For further conversion formulae
→ "Example (for water hardness in °dH):", refer to page 4.

The fill and top-up water has to meet certain requirements depending on the total rated output and the resulting water volume of a heating system. Use the following formula to calculate the maximum amount of water without water treatment, which may be filled in a floor-standing boiler < 600 kW with heat exchanger made of aluminium materials:

Calculation variables:

$$V_{max} = 0,0235 \times \frac{Q}{Ca(HCO_3)_2} \frac{(kW)}{(mol)/(m^3)}$$

F. 1 Calculation variables

V_{max} Maximum fill and top-up water, which may be introduced over the entire service life of the floor-standing boiler [m^3]
Q Rated output [kW] (< 600 kW)
$Ca(HCO_3)_2$ Concentration of calcium hydrogen carbonate [mol/m^3]

The concentration of calcium hydrogen carbonate must be a maximum of 2.0 mol/m3 for a heat output of up to 200 kW (corresponds to 11.2 °dH or 20 °fH), and a maximum of 1.5 mol/m3 for a heat output of up to 600 kW (corresponds to 8.4 °dH or 15 °fH). If there are higher concentrations of calcium hydrogen carbonate, the water must be treated as a matter of principle, irrespective of V_{max}.

From 600 kW upwards, generally use only treated fill and top-up water.

Information about the concentration of calcium hydrogen carbonate ($Ca(HCO_3)_2$) in the mains water can be obtained from your water supply utility. If the water analysis does not include this information, the calcium carbonate concentration can be calculated from the carbonate hardness and calcium hardness as follows:

Example (for water hardness in °dH):

Conversion factors:
1 °dH (German hardness) = 1.79 °fH (French hardness)
Hardness in [°dH] x 0.179 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]
Hardness in [°fH] x 0.1 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]
Hardness in [°e] x 0.142 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]
Hardness in [gpg] x 0.171 = Ca $(HCO_3)_2$ concentration in [mol/m^3]

Calculation of the maximum permitted fill and top-up volume V_{max} for a heating system with a total boiler output of 200 kW.

Details of water analysis figures for carbonate hardness and calcium hardness in the ppm unit of measurement.

Carbonate hardness: 10.7 °dH

Calcium hardness: 8.9 °dH

The following can be calculated from the carbonate hardness:

$$Ca(HCO_3)_2 = 10,7\ °dH \times 0,179 = 1,91\ mol/m^3$$

The following can be calculated from the calcium hardness:

$$Ca(HCO_3)_2 = 8,9\ °dH \times 0,179 = 1,59\ mol/m^3$$

The lower of the two values calculated from the calcium and carbonate hardness is used to calculate the maximum permitted water volume V_{max}.

$$V_{max} = 0,0235 \times \frac{200}{1,59} \frac{(kW)}{(mol/m^3)} = 3,0\ m^3$$

Example (for water hardness in °fH)

Calculation of the maximum permitted fill and top-up volume V_{max} for a heating system with a total boiler output of 200 kW.

Details of water analysis figures for carbonate hardness and calcium hardness in the ppm unit of measurement.

Carbonate hardness: 19.1 °fH

Calcium hardness: 15.9 °fH

The following can be calculated from the carbonate hardness:

$$Ca(HCO_3)_2 = 19,1\ °fH \times 0,1 = 1,91\ mol/m^3$$

The following can be calculated from the calcium hardness:

$$Ca(HCO_3)_2 = 15,9\ °fH \times 0,1 = 1,59\ mol/m^3$$

The lower of the two values calculated from the calcium and carbonate hardness is used to calculate the maximum permitted water volume V_{max}.

$$V_{max} = 0,0235 \times \frac{200}{1,59} \frac{(kW)}{(mol/m^3)} = 3,0\ m^3$$

2.5 Water treatment limit curves

Total output [kW]	Requirements for water hardness and volume V_{max} of fill and top-up water
≥ 50	Determine V_{max} according to Graph 1
> **50...600**	Determine V_{max} according to Graph 1...3
> **600**	Water treatment is required as a matter of principle (total hardness according to VDI 2035 < 0.11 °dH)
Irrespective of output	In the case of systems with a very large water content (> 50 l/kW), water treatment should be carried out as a matter of principle.

Table 2 Outline parameters and limits of use for applying the graphs to a floor-standing boiler with heat exchanger made of aluminium materials

As an alternative, you can read off the V_{max} value on the following graphs.

Floor-standing boilers < 100 kW with heat exchangers made of aluminium materials

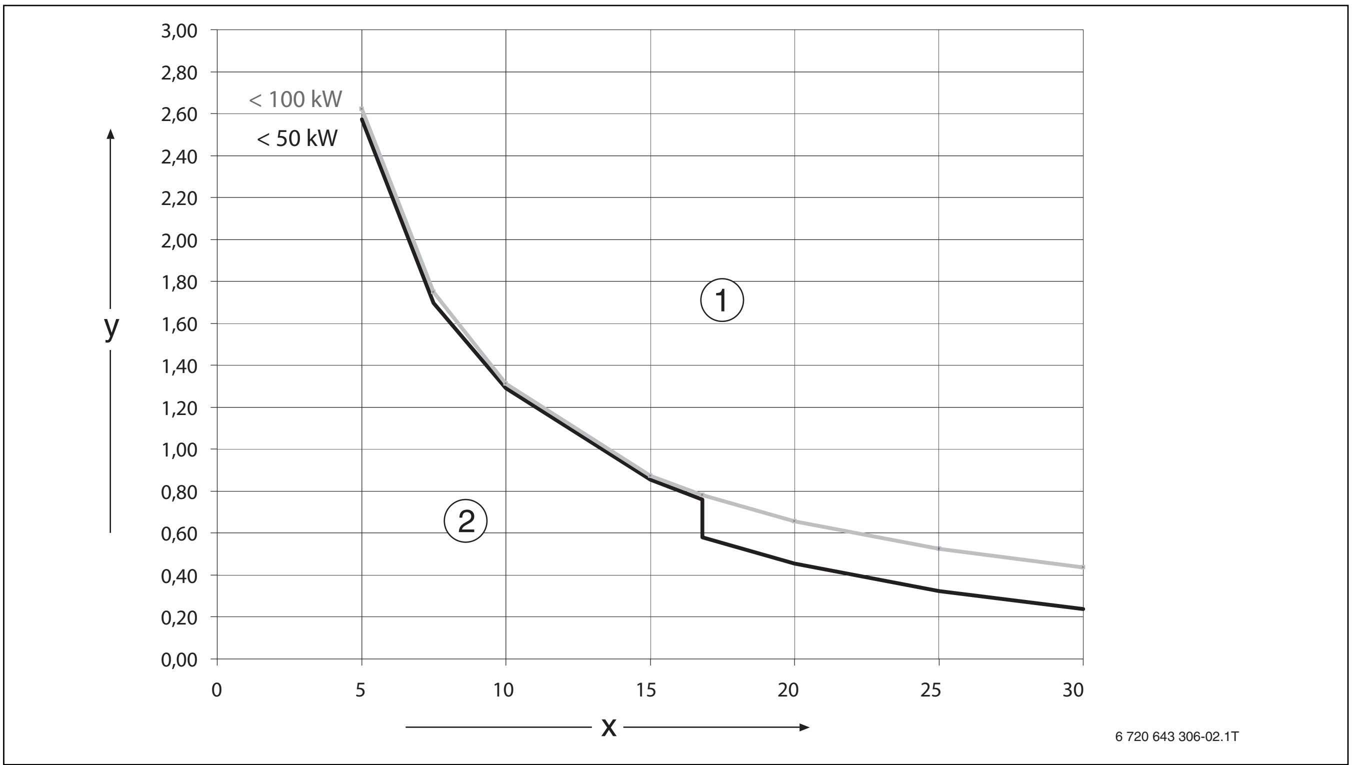

Fig. 1 Requirements of the fill and top-up water for floor-standing boilers < 100 kW with heat exchangers made of aluminium materials

x Total hardness in °dH
y Maximum possible amount of water over the service life of the boiler in m³

[1] Above the curve, use fully demineralised fill water with a conductivity < 10 μμS/cm.
[2] Below the curve, untreated mains water compliant with the Drinking Water Regulations can be used as fill water.

Floor-standing boilers from 100...300 kW with heat exchangers made of aluminium materials

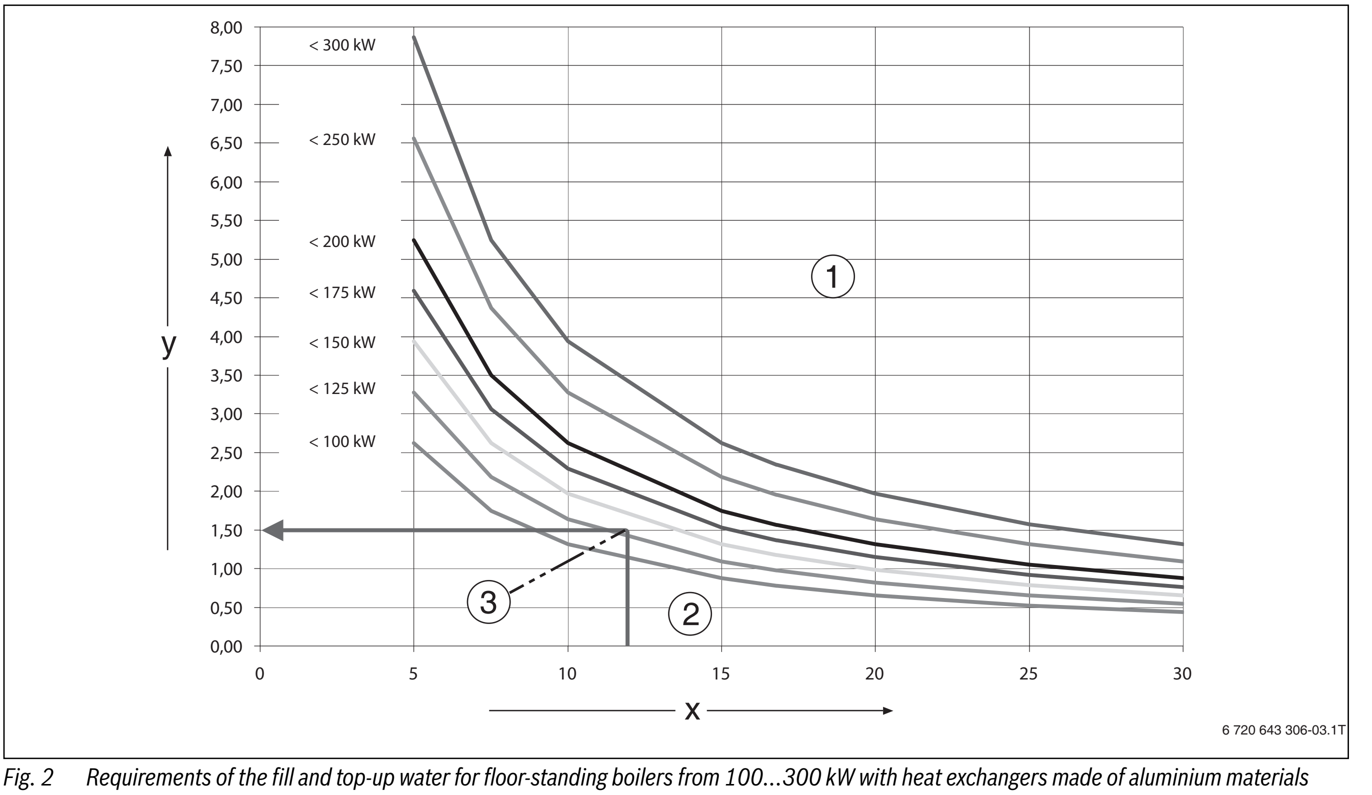

Fig. 2 Requirements of the fill and top-up water for floor-standing boilers from 100...300 kW with heat exchangers made of aluminium materials

x Total hardness in °dH

y Maximum possible amount of water over the service life of the boiler in m³

[1] Above the curves, use fully demineralised fill water with a conductivity < 10 μμS/cm. For boilers 600 kW and higher, generally only use fully demineralised fill water with a conductivity < 10 μμS/cm. In the case of systems with several floor-standing boilers (cascade), observe the information regarding the control.

[2] Below the curves, untreated mains water compliant with the Drinking Water Regulations can be used as fill water.

[3] Example:
Rated output of the floor-standing boiler 120 kW, with a total hardness of 12 °dH, the maximum amount of fill and top-up water is approx. 1.5 m³.
If a greater amount of water is required, the water must be treated.

Floor-standing boilers from 300...600 kW with heat exchangers made of aluminium materials

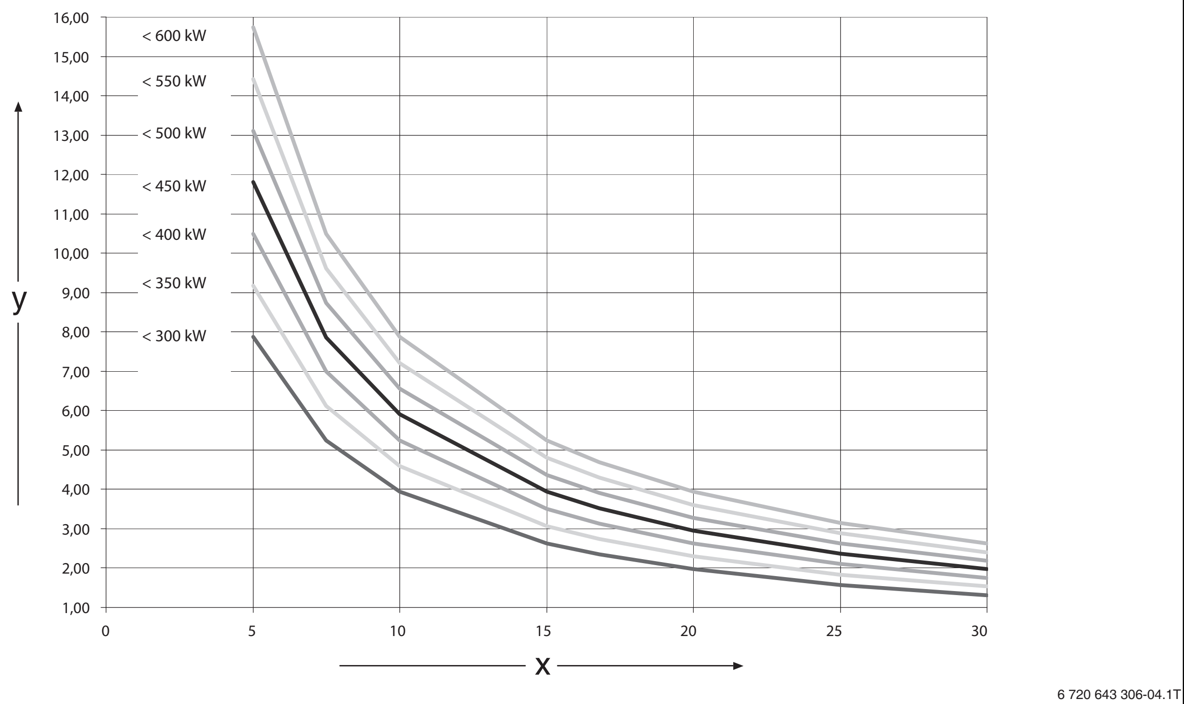

Fig. 3 Requirements of the fill and top-up water for floor-standing boilers from 300...600 kW with heat exchangers made of aluminium materials

x Total hardness in °dH

y Maximum possible amount of water over the service life of the boiler in m³

[1] Above the curves, use fully demineralised fill water with a conductivity < 10 μμS/cm. For boilers 600 kW and higher, generally only use fully demineralised fill water with a conductivity < 10 μμS/cm. In the case of systems with several floor-standing boilers (cascade), observe the information regarding the control.

[2] Below the curves, untreated mains water compliant with the Drinking Water Regulations can be used as fill water.

From 600 kW upwards, generally use only treated fill and top-up water.

2.6 Water treatment measures

Untreated mains water may be introduced, if the amount of fill water actually required is less than V_{max}.

Water treatment is required, if the amount of fill water actually required is greater than V_{max}.

Water treatment for all floor-standing boilers with heat exchangers made of aluminium materials is carried out by means of the complete demineralisation of the fill and top-up water to a conductivity of ≤ 10 μS/cm.

Low-mineral operation

The complete demineralisation process removes all substances that cause hardness (e.g. lime) and all corrosive agents (e.g. chloride) from the fill and top-up water.

Only introduce fully demineralised fill and top-up water with a conductivity of ≤ 10 μS/cm into the heating system. Fully demineralised water with this conductivity can be provided by mixed-bed cartridges (with anion and cation exchange resin) and by osmosis systems.

Filling with fully demineralised water will result in a low-mineral operating mode for the heating water (within the meaning of VDI 2035, for Germany; ≤ 100 μS/cm) after several months of heating operation. When operating in low-mineral mode, the heating water has reached an ideal state. The heating water is free from all substances that cause hardness, all corrosive agents have been removed, and the conductivity is at an extremely low level. The general tendency towards corrosion or speed of corrosion is reduced to a minimum.

Complete demineralisation is a suitable water treatment measure for all heating systems and is a recommended measure in accordance with local regulations (e.g. ICOM Commercial Water Treatment Guide).

CAUTION:

Risk of damage to the heat source due to incorrect water treatment!

Softening of the fill and top-up water is not permitted for heat sources made from aluminium or for a combination of heat sources made from ferrous materials and aluminium materials, and this can result in damage to the heat exchanger.

- ▶ Do not soften fill and top-up water (do not carry out either partial or full softening).

Information regarding cascades

The use of certain controls and modules (optional) ensures that each floor-standing boiler in the cascade achieves approximately the same number of hours run by switching the lead boiler on a daily basis. This ensures that the total of alkaline earths in the fill water is evenly distributed between all of the floor-standing boilers.
If the daily switchover of the lead boiler is provided by the control, the total rated output of all floor-standing boilers can be used to determine the V_{max} volume. Otherwise, the smallest individual output in the graph must be used.

Observe the technical documentation for the control and additional modules used.

3 Operator’s log

The records also serve as a master copy.

3.1 Fill and top-up water

Heating system details:______________________________

Commissioning date:______________________________

Max. amount of water V_{max} ___________ **m^3 at $Ca(HCO_3)_2$ Concentration:**__________ **mol/m^3**

	Date	Amount of water (measured) m^3	Ca $(HCO_3)_2$ concentration 1) mol/m^3	Total amount of water m^3	Company name (stamp) Signature
Total fill water in m^3					
Top-up water in m^3					

1) Conversion factors:
1 °dH (German hardness) = 1.79 °fH (French hardness)
Hardness in [°dH] x 0.179 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]
Hardness in [°fH] x 0.1 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]
Hardness in [°e] x 0.142 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]
Hardness in [gpg] x 0.171 = Ca $(HCO_3)_2$ - concentration in [mol/m^3]

Table 3 Operator's log, fill and top-up water

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