Water quality instructions for central heating systems

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BAXI

Contents

1 About this manual

1.1 Symbols used in the manual

This manual uses various symbols to draw attention to special instructions. We do this to improve user safety, to prevent problems and to guarantee correct operation.

Caution
Risk of material damage.

Important
Please note: important information.

1.2 Introduction

Central heating (CH) systems are complex. The systems comprise a lot of different components and materials: steel, copper, brass, aluminium, stainless steel and cast iron, as well as all kinds of plastic and rubber. It is important for all of the components and materials within the central heating system that the water quality is managed and corrosion is prevented. Good-quality, clean water in the installation ensures optimum heat transfer to all applicable parts of the system. It also helps to maximise efficiency and reduce energy consumption, and lengthens the service life of the components in the installation.

The latest high-performance boiler models feature increasingly compact designs. As a result, heat exchangers are delivering a greater flow of heat over a smaller heat transfer area. The presence of hard water in a central heating system can cause limescale deposits to form in hot areas. Most notably, this happens in heat exchangers in central heating boilers, regardless of the material from which them heat exchangers are made. In some cases it may be necessary to decalcify/soften the water in the central heating system. The decalcification method and the scope have a considerable impact on the corrosive effect of the water in the CH system.

This document includes guidelines and advice for the quality of the water in the system, to ensure that the heat exchanger and other system components continue to function reliably and continuously.

Failure to follow the instructions may result in the warranty for the CH boiler being invalidated.

The user or manager of the system is always responsible for ensuring that the water in the system is of high quality.

2 Water quality

2.1 General points to consider about water quality

The water in the central heating system must comply with the limit values shown in the table in this document in order to prevent potential problems with the CH boiler and CH system.

It is not only the quality of the water in the central heating system that is important, but also the quality of the central heating system itself. If gas-permeable plastic pipes are used (such as older-style underfloor heating pipes), oxygen may enter the water in the central heating system. This must be prevented. If oxygen does enter the water in the central heating system, use a plate heat exchanger to isolate the boiler hydraulically from the central heating system.

If the system is regularly topped up with fresh tap water, oxygen and other substances (including limescale) can also infiltrate the CH water again. Monitor all top ups with tap water for this reason.

2.2 Cleaning and flushing the central heating system

Always flush an existing or new CH system thoroughly before a new CH boiler is connected. This step is absolutely crucial. The flushing helps to remove residue from the installation process (weld slag, fixing products, etc.) and accumulations of dirt (silt, mud, etc.) The flushing process also encourages heat transfer within the system and reduces energy consumption. Use a cleaning product to flush the system if necessary. The cleaning product manufacturer must confirm that the product is suitable for use with all of the materials used throughout the central heating system.

Flush the system section by section. Prevent complications by ensuring that each section has adequate circulation. Special attention must also be paid to 'blind spots', where there is limited flow and where dirt can accumulate. When using chemicals to flush the system, the points listed above are even more important. Chemical residue in the system can have a negative effect. The flushing process must be carried out by a professional and with a great deal of care. Once the central heating installation has been cleaned and flushed, it can be filled.

2.3 Filling and topping up the central heating system

In many cases, the boiler and central heating system can be filled or topped up with tap water and water treatment will not be necessary. To check whether this is possible, you must measure the quality of the top up water or of the water in the central heating system. The quality of the water in the central heating installation can be assessed by establishing acidity level, hardness, conductivity, chloride content and sulphate content. The water in the central heating installation must comply with the limit values shown in the table below. If one or more of the conditions are not met, the CH water must be treated.

Tab.1 **Limiting values for CH water**

Acidity level (treated and untreated water)	6.5 – 9.0 pH			
Conductivity(1)	≤ 800 µS/cm (25ºC)			
Chlorides	≤ 150 mg/l			
Sulphates	≤ 50 mg/l			
Hardness of the water (standard starting point: 10 litres/kW)				
Boiler family	mmol/litre $CaCO_3$	ºGerman	ºFrench	ºEnglish
Wall-hung boilers, boiler power ≤ 45 kW(2)	≤ 2.0	≤ 11.2	≤ 20.0	≤ 14.0
Wall-hung boilers, boiler power ≤ 45 kW(3)	≤ 3.5	≤ 19.6	≤ 35.0	≤ 24.5

Wall-hung boilers, boiler power 45 – 115 kW(3)	≤ 3.5	≤ 19.6	≤ 35.0	≤ 24.5
Wall-hung boilers, boiler power 150 kW(3)	≤ 2.0	≤ 11.2	≤ 20.0	≤ 14.0
Wall-hung boilers, boiler power 80 – 200 kW(3)	≤ 1.6	≤ 9.0	≤ 16.0	≤ 11.2
Floor-standing boilers, boiler power 285 – 1300 kW(3)	≤ 1.5	≤ 8.4	≤ 15.0	≤ 10.5
Correction formula for all boiler families: # litres/kW, correction = (hardness according to table/actual hardness) x standard number of litres per kW				

(1) Of untreated water
(2) With a SS heat exchanger
(3) With an aluminium heat exchanger

Important
In boiler sequences with different boilers, the boiler with the lowest permitted water hardness in the table determines the overall water hardness of the installation.

Example calculation with known actual hardness:

Floor-standing boiler with nominal output = 461 kW

Maximum system content = 461 kW x 10 L = 4610 litres with 8.4 ºGerman water hardness.

Actual hardness measured in the system = 10 ºGerman water hardness.

According to the correction formula, the permitted system content is: (8.4º/ 10º) x 10 L = 8.4 L/kW; so 461 kW x 8.4 L = 3872 litres.

Water treatment is necessary if the system content is more than 3872 litres.

Example calculation with known actual system content:

Floor-standing boiler with nominal output = 461 kW

Maximum system content = 461 kW x 10 L = 4610 litres with 8.4 ºGerman water hardness.

Actual system content measured = 10,000 litres.

According to the correction formula, the permitted hardness is: (4.610 litres/ 10.000 litres) x 8,4º = 3,9º German water hardness.

Water treatment is necessary if the water in the system has a ºGerman water hardness of more than 3.9.

Caution

- A maximum of 5% of the system water content may be topped up each year.
- Never use 100% demineralised or sterilised water to top up the system without using pH buffering. Doing so will create corrosive water in the central heating system, which can cause serious damage to various components of the central heating system, including the heat exchanger.

3 Water treatment

3.1 Water treatment when acidity levels are too high or too low

If the pH value (acidity level) is outside the specified limits, materials can become degraded and must therefore be treated by the addition of special inhibitors that regulate acidity levels.

3.2 Water treatment when hardness levels are too high

If the water hardness level is too high, limescale can form in high-temperature areas of the system, particularly in the central heating boiler. Limescale deposits reduce efficiency and cause heat loss and mechanical faults. If water hardness levels are too high, treatment is therefore necessary.

Water hardness can be reduced in the following ways:

- Demineralisation using mixed ion exchange or reverse osmosis
  Demineralisation removes all ions, including calcium and magnesium. The demineralisation process results in low conductivity (lower than 100 µS/cm), which is beneficial in terms of corrosion. If a demineralisation process is used, ensure good pH buffering. Calcium (limescale) is a pH stabiliser for water in the central heating system. Water that has been fully softened must only be used in conjunction with an inhibitor that uses the function of limescale as a pH stabiliser.
- Removal of calcium and magnesium ions by means of softening through ion exchange
  Avoid cation exchange with sodium ions when dealing with a pH increase associated with the formation of sodium hydroxide. Anion exchange using Cl^- and CO_3^- as the resin must be avoided. Anions such as these can cause corrosion. Resin with SO_4^{2-} is permissible for anion exchange, but the SO_4^{2-} concentration must be limited due to biocorrosion considerations (SRB).
- Addition of special inhibitors that bind the limescale. Pay strict attention to the instructions and guidelines provided by the supplier of the water treatment product.

3.3 Suitability of water treatment products

All water treatment products must be suitable for use with all of the materials that are used throughout the central heating system. For further information, please consult the supplier of the water treatment product. Always pay strict attention to the instructions and guidelines provided by the supplier of the water treatment product. The applicable manufacturer must confirm that the product is suitable for use with all of the materials that are used throughout the central heating system.

4 General recommendations

- Install a water meter in order to measure top-up water quantities.
- Install a dirt separator in the return pipe of the boiler.
- Use diffusion-proof pipes and components.
- Fit the venting cocks and valves at the highest positions in the system.
- Conduct regular checks to ensure that the pre-pressure in the expansion vessel is correct, because a poorly functioning vessel can let oxygen into the installation.
- When topping up the installation, record the information using a water meter and a logbook (see appendix).

5 Appendix

5.1 Water quality logbook for the central heating system

Commissioning carried out by: (Company name)		.	
Name of engineer:		.	
Date of commissioning:		.	
Central heating system cleaned and flushed:		YES(1)	NO(1)
Water pressure in central heating system at time of commissioning	bar	.	
Water content in central heating system at time of commissioning	m³	.	
Initial position of the water meter (Zs)	m³	.	
(1) Delete as appropriate			

Tab.2 Logbook

Log date		Date of commissioning (Zn = Zs)	Date:	Date:	Date:	Date:
Water meter position (Zn)	m³	.	.	.	.	.
Quantity of water for top up (V= Zn-Zs)	m³	.	.	.	.	.
Water pressure in central heating system	bar	.	.	.	.	.
Total water hardness	ºD	.	.	.	.	.
pH value	-	.	.	.	.	.
Conductivity	µS/cm	.	.	.	.	.
Chlorides	mg/l	.	.	.	.	.
Sulphates	mg/l	.	.	.	.	.
Water analysis report number (if present)						
Is there a water treatment product which is suitable and which has been checked and registered in accordance with the requirements?	YES(1)	.	.	.	.	.
	NO(1)	.	.	.	.	.
Remarks	.	.	.	.	.	.
Signature of engineer	.	.	.	.	.	.
(1) Delete as appropriate						

5.2 Manufacturers of water treatment products

Well-known manufacturers of water treatment products include

- Fernox
- Sentinel
- Spirotech
- Cillit

Products from other manufacturers may also be used, provided that the relevant manufacturer guarantees that the products are suitable for all materials used in the central heating installation.