District heating application handbook

Making applications future proof
all our knowledge – is now yours

+30 years of experience
in district heating applications, with more than 5 million installations worldwide.

districtenergy.danfoss.com
District heating application handbook

Introduction to the handbook ...................... 3
4 District heating from the inside
6 Matching district heating to building needs
8 How to read this book
9 Application benchmarking
10 District heating application types – overview

General principles ...................................... 13
14 Hydronic balancing – control types
16 Hydronic balancing – control functions
18 Idling functions
21 Weather compensation

Recommended applications ....................... 23
27 1. Domestic hot water applications
35 2. Indirectly and directly connected room heating applications
43 3. Supply systems to flat stations applications
53 4. Directly and indirectly connected room heating and instantaneous domestic hot water heat exchanger applications
63 5. Directly and indirectly connected room heating and domestic hot water charging tank applications
71 6. Directly and indirectly connected room heating and domestic hot water cylinder applications
79 7. Two-step applications
85 8. Indirectly connected room heating and secondary side connected domestic hot water charging tank application S.1.2
89 9. Indirectly connected room heating and secondary side connected domestic hot water cylinder application S.1.3

About Danfoss District Energy ................. 92

Appendix .................................................. 96
98 Abbreviations
98 Application symbols
99 Reference list
Introduction to the handbook

• District heating from the inside
• The relevance of district heating
• Matching district heating to building needs
District heating from the inside

For more than 35 years, Danfoss has been taking an active role working in close cooperation with customers to offer the right solutions for district heating systems.

No matter the project size, no matter the specification, Danfoss components and substations excel throughout the world.

This is the platform for sharing experience, application expertise and making recommendations on optimum performing district heating applications and key applied control components.

113 million metric tons of CO₂ are saved per year in Europe through district heating supplying 9-10% of the heat demand. This corresponds to Belgium’s total annual CO₂ emmissions.

Danfoss District Energy is the leading supplier of products, systems and services for district heating and cooling (DHC), with decades of experience in the industry.

In this way, Danfoss provides customers worldwide with expertise and knowledge that bring truly energy-efficient solutions to life.
Green district

District heating

District heating and cooling networks provide an ideal fit in the heart of a green city or district. In dense urban environments where heat demand is inevitably highest, they are the ideal means of exploiting locally available streams of renewable energy and surplus heat supply for a useful purpose. Such systems generate significant, provable reductions of primary energy consumption, cut CO₂ emissions and provide citizens with the standard of comfort and reliability they expect.

Network conditions and system design

District heating networks differ in size, layout and conditions in cities and urban areas around the world. To achieve the ideal level of performance and user comfort, temperature settings, operating pressure level as well as technical building connection requirements need to be appropriate to ensure reliable supply and operational safety.

Influencing trends in district heating

Today, the heating sector is influenced by multiple trends. These are driven by increased user expectations of comfort and supply security, product design and usability as well as energy-efficient performance prescribed by legislation. This has led to district heating application design needing to offer:

- Reduced temperature and pressure levels in DH networks
- Energy-efficient operation with higher levels of control performance
- Monitoring of energy performance and billing according to individual consumption
- Secure and safe heat supply

District heating from 1G to 4G

[Diagram showing the development of district heating from 1G to 4G with temperature levels, energy sources, and system designs for each generation.]
District heating

Matching district heating ...

System infrastructure and available heat sources

Where available, district heating is the best heat source you can choose. District heating is good for you financially and good for society as a whole. Where district heating is not available, try to make the best use of the available alternatives, especially renewable energy. The best solution is always when you succeed in matching the system infrastructure and design with the available supply of energy sources, building type and your customers’ specific needs.
... to building needs

Examples of how controls optimize heat systems

1. Adjusting to outside temperatures
When flow temperature in the heating system reflects outside temperature, the user will enjoy both increased comfort and lower heating bills. In one-family homes, the expected energy saving from weather compensation is 10% on average and can be as high as 40%.

2. Using available energy sources
Whether a building uses single or multiple heat sources, correct control mechanisms ensure optimum output and match supply to the actual needs of the building. In this way, comfort is kept high and energy consumption low.

3. Balance = savings and comfort
A properly hydronic-balanced heating system supplies the correct heating capacity to all rooms, regardless of load conditions. Energy is saved because temperatures match the need in every part of the heating system.
A comprehensive overview

When connecting a building to district heating, different options are available for heating and preparation of domestic hot water.

The aim of this handbook is to give a comprehensive overview of different applications with a special focus on applications recommended by Danfoss.

All applications are illustrated and described, including how they work and what options are available.

For the recommended applications, you will find key benefits and limitations, benchmarking, comparison of different applications and documented values.

All applications are prioritized using the following symbols:

- **Danfoss-recommended application**
- **Primary alternative** to Danfoss-recommended application
- **Secondary alternative** to Danfoss-recommended application

Principle and purpose of application benchmarking

Qualitative as well as quantitative measures are included, supporting the understanding of the benefits and limitations on the various applications.

The intention is not to give product-specific information or detailed theory behind the components or applications.

For product-specific information, we refer to data sheets belonging to the product groups. For detailed theory, we refer to technical papers and relevant scientific material in general.
<table>
<thead>
<tr>
<th>Benchmark parameter</th>
<th>Description</th>
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<tr>
<td><strong>Investment cost saving</strong></td>
<td>Cost of purchasing the heating system and the necessary components</td>
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<td></td>
<td>Reduced design and planning time for consultants/designers</td>
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<tr>
<td><strong>Installation time saving</strong></td>
<td>Time needed for installing and commissioning the heating system</td>
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<td></td>
<td>Weight of the installation</td>
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<tr>
<td></td>
<td>System complexity</td>
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<td><strong>Space requirement savings</strong></td>
<td>Ability to free-up space in the building that can then be used for other purposes</td>
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<tr>
<td></td>
<td>More compact heating system installation</td>
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<td><strong>Service/maintenance savings</strong></td>
<td>Compliance with DHW legislation (3 liter) – only currently in Germany</td>
</tr>
<tr>
<td></td>
<td>Low DHW system volume limits legionella growth</td>
</tr>
<tr>
<td></td>
<td>Instantaneous DHW preparation limits legionella growth compared to DHW circulation</td>
</tr>
<tr>
<td></td>
<td>Simplicity and robustness of system</td>
</tr>
<tr>
<td></td>
<td>Reduced number and duration of service visits will lead to lower service/maintenance costs</td>
</tr>
<tr>
<td></td>
<td>Lower temperature, pressure level and heat loss in the DH network and in the heating system</td>
</tr>
<tr>
<td><strong>Energy-efficiency performance</strong></td>
<td>Heat transfer effectiveness of heating system (HEX)</td>
</tr>
<tr>
<td></td>
<td>Lower return temperature back to the station and network</td>
</tr>
<tr>
<td></td>
<td>Weather compensation of the heating system</td>
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<tr>
<td></td>
<td>Highly efficient heating system</td>
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<td></td>
<td>Energy-saving potential</td>
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<td></td>
<td>Secondary temperature adapted/optimized to the building heat load</td>
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<td></td>
<td>Lower hydronic load to a group of customers due to HEX solution (less heat loss and pump energy)</td>
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<td></td>
<td>DHW quality, avoid bacteria growth – no storage of hot water by instantaneous production of DHW, compliance with DHW legislation (3 liter) – only currently in Germany</td>
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<tr>
<td><strong>System operation safety</strong></td>
<td>Risk of leakage and contamination of DH water supply</td>
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<td></td>
<td>Risk of exposure to high temperatures (e.g. radiator surface)</td>
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<tr>
<td></td>
<td>Unlimited amount of DHW</td>
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<tr>
<td><strong>User comfort</strong></td>
<td>Optimum room temperature level</td>
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<td></td>
<td>Indoor climate</td>
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<td></td>
<td>Length of maintenance cycle (if maintenance cycle is long, there is long time between supply stops)</td>
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<tr>
<td></td>
<td>System noise</td>
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<td></td>
<td>Waiting time for hot water</td>
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When connecting a building to DH, many options are available for heating the building and for the preparation of domestic hot water. In this handbook, a numbering system is used for different applications that relate to the numbering of their basic components, type of HE and DHW applications e.g. application 1.1 Directly connected HE and instantaneous DHW, which is a combination of applications 1.0 Directly connected HE and 0.1 Instantaneous DHW.

### Application type overview

<table>
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<tr>
<th></th>
<th>Domestic hot water applications</th>
<th>Directly and indirectly connected room heating applications</th>
<th>Supply systems to flat stations</th>
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<th>Directly and indirectly connected room heating and domestic hot water charging tank applications</th>
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District heating application types

1.3  1.1.1  S.1.2  S.1.3

2.3  1.1.2

3.3

Danfoss-recommended application
Primary alternative to Danfoss-recommended application
Secondary alternative to Danfoss-recommended application
Not recommended by Danfoss

Application 0.1 + Application 1.0 = Application 1.1
About Danfoss District Energy
We mind your business

Danfoss is more than a household name in heating. Driven by our customers’ needs, we build on years of experience to be at the forefront of innovation, continually supplying both expertise, components and complete systems for district heating and cooling applications.

As the leading total supplier, Danfoss provides customers worldwide with a complete range of automatic controls, heat exchangers, domestic hot water systems and substations, which are applied throughout the process of generating, distributing and controlling heat to homes and buildings.

The products contribute to individual comfort and reduce energy consumption as well as providing reliable and lasting operations and guaranteeing minimum servicing.

Build on site – components

Whether you are building heat transfer district heating stations or involved in the design of the heating system application, Danfoss can offer components and inherent knowledge that enables you to optimize the total solution and cope with current and future demands.

Keep your focus on performance

Using top-performing Danfoss controls and components for constructing your heating system allows you to focus on enhancing total system performance, and thereby creating superior solutions for you and your customers.

A complete product range:

» Electronic controllers
» Motorized control valves
» Self-acting pressure, flow and temperature controllers
» Ball valves
» Energy meters
» Plate heat exchangers

For more information, please visit our website districtenergy.danfoss.com
– and your applications

Doing business with Danfoss means gaining access to industry leading:
» Product portfolio for district heating and cooling
» Consultancy and customer dedication

Do you want to optimize the use and appearance of your heating room? Do you want high-performance and more time for your regular activities?

Danfoss enables you to deliver complete district heating substations that are optimized for high heat transfer performance with state-of-the-art control components. Danfoss substations can be rapidly designed, configured and manufactured. They are tested before delivery to ensure straightforward installation and a perfect fit in building services systems. This enables you and your customers to work smarter, save time and money, and reduce the amount of space occupied by your heating system.

Danfoss is therefore a sound choice whenever district heating and cooling systems are to be planned, installed and upgraded.

A complete product range:
» Fitted substations (15kW – 300 MW)
» Welded substations and mixing loops (15kW – 40 MW)
» Domestic hot water systems

Build to site – predefined applications

Are you looking for new heat transfer technology and higher energy efficiency? Do you want to optimize the use and appearance of your heating room? Do you want high-performance and more time for your regular activities?

Danfoss enables you to deliver complete district heating substations that are optimized for high heat transfer performance