

DESIGN GUIDE FOR

Low Temperature District Heating



Cetetherm

COOL DH
COOL DISTRICT HEATING





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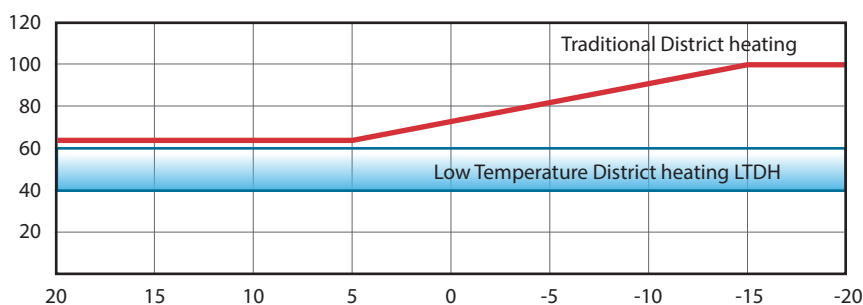
Introduction

This guide explains how to design and prepare buildings to be able to integrate low temperature district heating. It will assess the best of hot water and space heating system design for different buildings categories.

TRADITIONAL DISTRICT HEATING VS LOW TEMPERATURE DISTRICT HEATING (LTDH)

Traditional district heating provides heating media at high temperature and pressure through a culvert system to buildings for space heating and tap water production. During the winter period when space heating demand capacity increases, the supply temperature on the district heating net increases to meet the need for capacity/energy for heating and tap water. This temperature increase will also increase the heat loss from the culvert system.

Operating temperature



In the Low Temperature District Heating grid, the flow temperature is lower than in the traditional district heating net. This means that space heating systems and tap water systems need to be designed in a way that we can fulfil legislations as well as demanded temperatures.

The transition to low-temperature supply in district heating networks requires new technical solutions to meet the heat requirements of the consumers and guarantee their safety, mainly in connection to avoid Legionella contamination through the domestic hot water system. At the same time, the efficiency of the district heating system must be ensured.

We found that, the district heating unit (HIU/flat station) is a technology that can guarantee the decentralized production of domestic hot water and space heating with a pre-assembled unit. It reduces the risk of Legionella contamination while fulfilling the heat requirements of the user. The district heating unit must work at the lowest possible temperature and ensure a good temperature difference (delta T), with low return temperature.

- Follow National building regulations for tap water temperatures
- Adapt the technical solution to minimize the energy consumption and optimize the LCC for the building. This means that LTDH (dependent on temperature level) can be combined with a heat pump to deliver the demand for space heating and DHW.

Buildings with different domestic hot water, DHW, demand

The DHW demand is different depending on type of building. In office buildings, there are a low use of DHW. Residential buildings with apartments have a lot higher demand of DHW. Technical solutions for hot tap water differ a lot from market to market. This depends on customer usage pattern and national legislations. There is no common rule for DHW temperature level within Europe (see table 3, from Report on solutions for avoiding risk of legionella). The temperature level allowed in the DHW system is important because it indirect affect the return temperature on the LTDH grid.

Overview of national legislations for Legionella prevention in domestic hot water systems

Country	Min. system T	Min.tank T	Min. tap T	Max. tap T
Sweden	50 °C	60 °C	50 °C	60 °C/38 °C
Denmark	55 °C (45 °C)**	55 °C (up to 60)		
Norway	65 °C (circulating)			55 °C/38 °C
Finland			55 °C	65 °C
Germany	50 °C, unless small system	60 °C		
France	50 °C, unless V < 3 liters	55 °C		

* Only for locations with increased risk of scalding

** Exceptions of temperature requirements are made at peak hours

Space heating systems

When connecting to LTDH, it is important to design the space heating system for low temperature. Traditional space heating systems like radiators, convectors and under floor heating systems can be used. The lower flow- and return temperature we can get from the space heating system, the better it is to use LTDH.

The heating demand for the building is often an even load, especially when comparing to DHW. Scheduling and other types of setbacks, limiting the time to distribute the heat will increase the heating load when heating is allowed. Rapid changes in the set temperatures will also create a high instantaneous demand of heating power.

The estimation of heat losses and consequent heating loads for dwellings is explained in EN 12831. Heating Systems in Buildings – Method for calculation of the design heat load. Peak heating demands should be calculated based on this guidance.

5-pipe systems—mainly used in the Nordic countries

COMMERCIAL BUILDINGS

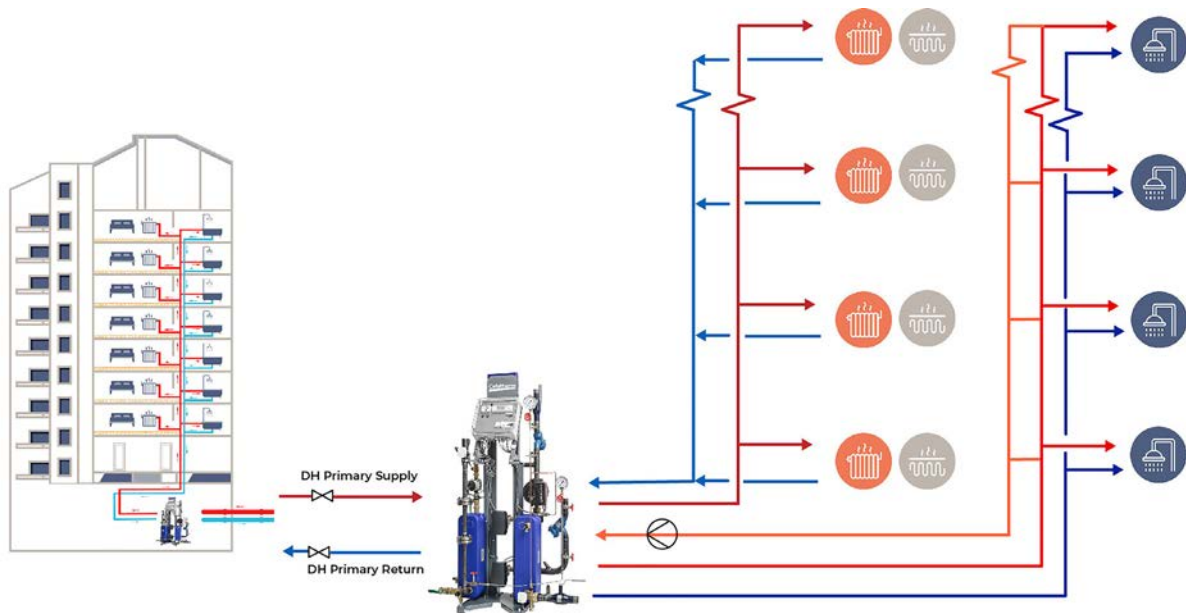
Commercial buildings like offices are often designed with a collective substation, connected to a distribution network for space heating and DHW. DHW taps should be placed close to each other to avoid long distribution- and recirculation pipes.

If there are no possibility to design for short distribution lines inside the building, consider a local DHW production with an electrical heater.

RESIDENTIAL BUILDINGS

Residential buildings in the Nordic countries are built with a common system for DHW and a recirculation to distribute DHW according to the building legislation. Individual metering of consumption of DHW within each apartment is not commonly applied. DHW systems designed with a hot water recirculation have an impact on the district heating return temperature, especially when no DHW is drawn off.

The district heating return temperature will in this case never be lower than the minimum DHW circulation temperature.



3-pipe systems—mainly used in Europe

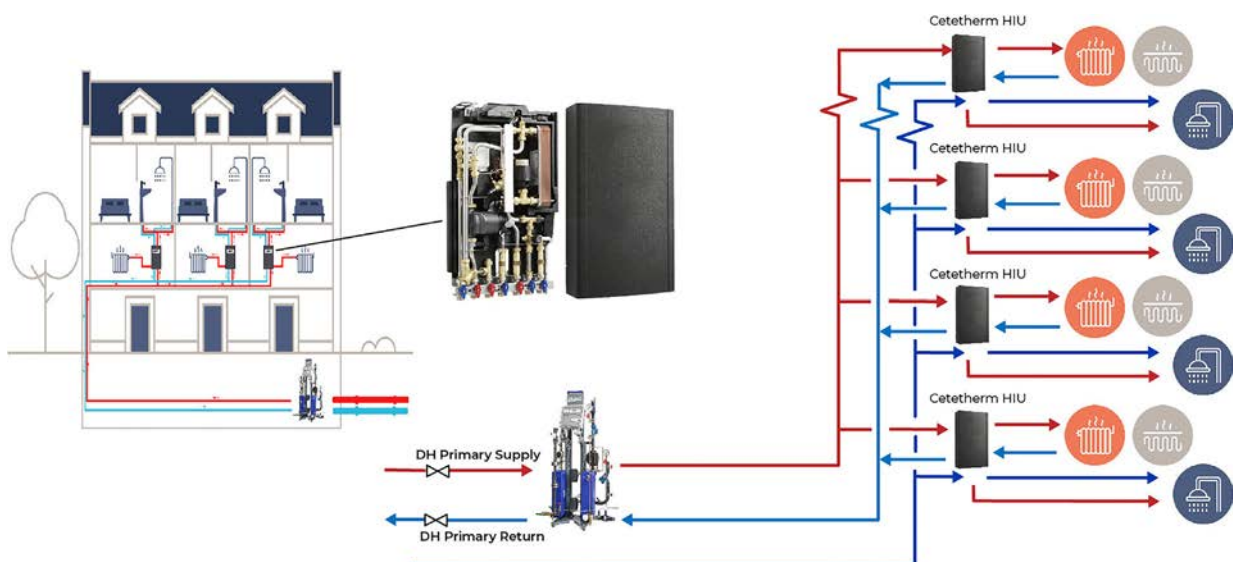
RESIDENTIAL BUILDINGS

Residential buildings in most of Europe are often using gas boilers for hot tap water. When converting from gas to local- or district heating, a system design with individual heat interface unit HIU (cold boiler) is easy to implement. Instead of gas, a district heating distribution pipe system needs to be installed. Each apartment already has their own pipe system for space heating and DHW. The individual meter for gas will be replaced by an energy meter for space heating and hot tap water.

Generating DHW in each apartment minimize the need of DHW circulation.

The benefits are:

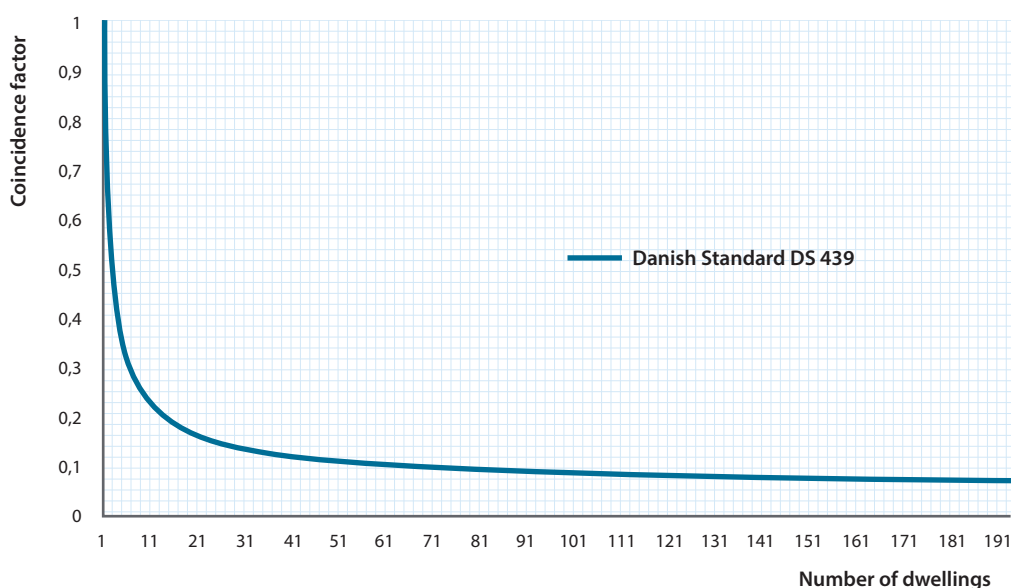
- lower energy consumption due to less heat losses in pipes.
- lower return temperature.
- easy to access when placed outside the apartment eg in stairwell.
- each apartment is in control of their own indoor temperature.
- opportunity to influence energy use with individual energy meters.



Sizing the system

Sizing the distribution network within the building is crucial. Always start with a mapping of the DHW heating demand. To fulfil the needs for each customer, an appropriate HIU must be selected.

Coincidence factor for DHW



NOTE: The Danish Standard DS 439 calculation method has been approved in BS 8558/BS EN 806-3 stating “the designer is free to use a nationally approved detailed calculation method for pipe sizing”. Furthermore CIBSE AM12:2013 states: “Experience from continental schemes indicates that the BS 6700 (BSI, 2009a) factors are too conservative and Danish Standard DS 439: 2009 (Dansk Standard, 2009) diversity factors are recommended for sizing supplies to multiple dwellings.”

DOMESTIC HOT WATER DEMAND

The peak simultaneous hot water demand must be taken in consideration, when calculating the load on the distribution network.

The DHW flow demand differs if it is an office or an apartment building.

In an **office building** consider using an electrical heater for local DHW production.

In an **apartment building** it is not realistic just adding the assumed peak usage for each consumer, i.e all consumer won't draw off peak consumption simultaneous.

To take in account the probability of simultaneous DHW draw off, the diversity factor is introduced. A well-known diversity factor applied in the business comes from the Danish standard DS 439.

SPACE HEATING DEMAND

When sizing the heat emitters, to get the best possible total system efficiency, the key is having a well-balanced heat emitter system with flow temperatures as low as possible. The DH network return temperature relies strictly to the heat emitter return temperature. Having efficient, well balanced, heat emitters will result in a low DH return temperature. Using a circulation pump on the heat emitter system to supply constant and proportional pressure is a great help when balancing the heat emitter system. For the best heating system, think of:

- isolate.
- demand modulated supply temperature.
- low temperature solutions.
- use traditional space heating systems like under floor heating, convectors and radiators.

Selecting the right HIU

With the heating load and the DHW demand known, a suitable HIU can be sized. The heating load must be taken in account for peak loads due to factors limiting the constant heat flow.

There are many factors to consider when choosing a HIU, some basic key factors are:

- primary network pressure.
- available differential pressure.
- heating emitter pressure.
- heating emitter circulator pump.
- potable water pressure.
- features such as keep warm functions/idle function.
- DHW prioritizations.

Choosing an HIU with a primary network design pressure that are compliant with the grid is crucial. For good performance, stable regulation is important. The KV value of the control valve needs to be chosen in respect to the available differential pressure, to get a good valve authority. The valve authority expresses the ratio between pressure drop across the control valve compared to total pressure drop across the whole system. To obtain good control it is recommended that the control valve size is selected so its authority is never less than 0.5.

To be able to distribute heating, a proper sized circulator pump is needed. Functions in modern pumps such as proportional pressure mode and constant pressure mode is desired. The pump should be able to deliver the nominal flow and head sized for the heating system.

Other important functions are, the keep warm function and the domestic hot water priority. To save potable water and having a fast supply of DHW, a keep warm function is needed. To limit the total peak load, functions that intermittent shuts off the heating during a domestic DHW off could limit the maximum flow and power on the primary network.

Commissioning

Before system commissioning commences an inspection should be undertaken to ensure that:

- the pipework installation is complete, and all components are correctly positioned, correctly installed, easily accessible, properly identified.
- the system has been filled, thoroughly vented and pressure tested.
- the system has been flushed and chemically cleaned.
- pumps and associated variable speed drives are installed, inspected and tested in accordance with the manufacturer's instructions and are ready to operate.



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