



Building Services

Pumps and pipes in theory and practice

The anatomy of a comfortable
and cost-efficient indoor climate



Engineered for life

Introduction

For owners or administrators of a building, the comfort of tenants is not the only concern. Long-term economy and environmental aspects are every bit as important. And, if you are a building contractor or a consultant, your customer will surely trust you to share this responsible approach.

This guide aims to answer some fundamental questions about heat distribution and circulation systems – from basic pump theory and energy conservation to pipe work design and how to choose the right pump for the job.

Our main aim is to provide general information about conventional heating systems, but we will also touch on topics such as floor heating, solar panel systems, and chiller systems.

For detailed information you are always welcome to visit www.lowara.com or contact your nearest ITT representative.

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Creating a comfortable indoor climate

There are several ways to ensure a comfortable indoor climate. This brochure describes closed heating/chiller systems where the preferred room temperature is achieved by circulating hot or cold water in pipes around the building.

Such systems typically comprise a boiler or chiller, pipe work, fittings, a pump, emitters (e.g. radiators) and a control system. As water expands when the temperature rises, the system must also contain a large enough expansion tank to hold the variable volume of water in the system.

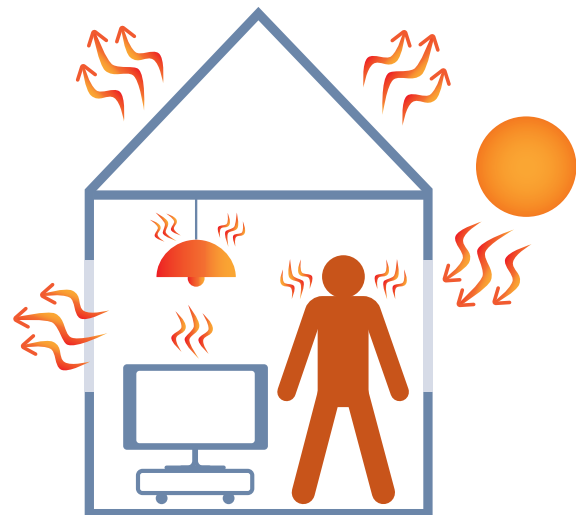
The capacity of the system must be sufficient to compensate for any heat or cooling loss in the building. This loss essentially depends on the indoor/outdoor temperature, the insulation of the building, and the area/indoor volume to be heated.

Determining the required flow

The flow needed in a heating/chiller system is dependent on

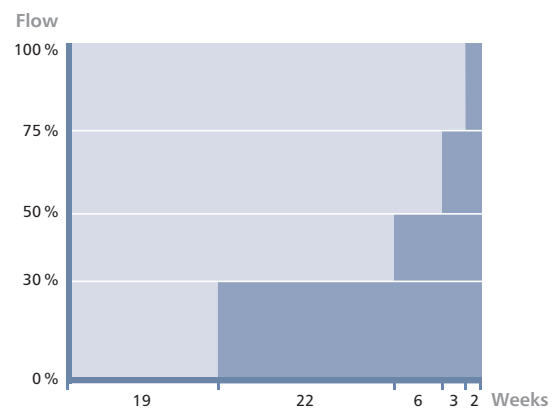
- the difference in temperature between the pressure pipe and the return pipe.
- the heat requirement, which varies throughout the year and around the clock due to both indoor and outdoor conditions.

In climate zones with varying temperatures, the full capacity of the system is only needed during a very short period each year (see load profile diagram). The most cost-effective way to handle such variations is by combining thermostatically regulated emitters and speed-controlled pumps. A load profile can be used to calculate the energy consumption of a heat pump and to perform an LCC (life cycle cost) analysis.



Heat gains and losses in a building

The need for heating and chilling varies and different factors affect the indoor climate: outdoor temperature, sunshine, the number of people in the room, heat emitters (lamps, televisions, etc.).



Load profile

The dark area shows the real need for pumping during the year. By using speed-controlled pumps, unnecessary pumping is avoided and energy saved. This profile is based on an average heating system in northern Europe. Good pump economy means matching pump operation to requirements as much as possible.

Determining the required head

When dimensioning a heating or chiller system, both system pressure and pressure losses have to be taken into account.

The system pressure is the part of the pressure not created by the pump. It is generated instead by the weight of the water column in the system and additional pressure created by the pressure vessel (expansion tank). If this pressure is too low, it can generate noise in the pipe system and cause cavitations in the pump, especially at high temperatures. It must also be verified that the pump can withstand the maximum system pressure.

The system pressure is determined by

- the height of the building
- the temperature of the liquid
- the preset pressure in the expansion tank
- the density of the liquid.

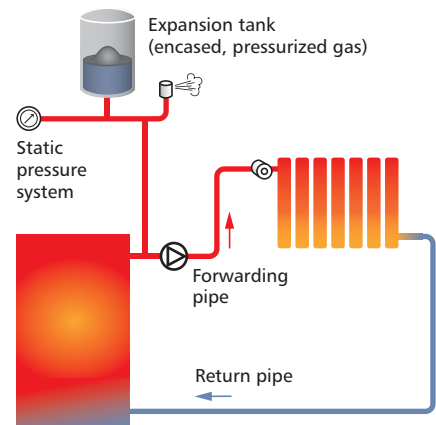
In a loop system, the pump need only produce sufficient pressure to compensate for the pressure loss, as there is no geodetic head to overcome. (Geodetic head = the difference in height between the average water level in the pipe work and the highest point of the system.) All water that goes up to the top comes down again.

The pump must compensate for any loss of pressure in the system. Losses are dependent on the size of the system and any system components. (See the System curve section overleaf.)

Open and closed loop systems

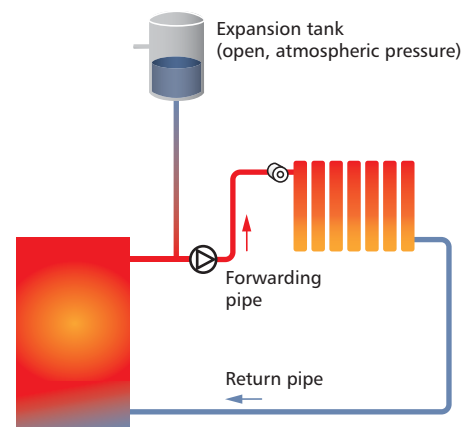
Most heating/chiller systems are closed loops, which means that the same water is circulated in the pipe work again and again, and that the expansion tank is pressurized. A rubber membrane separates the compressed gas from the water in the system.

Open systems are very rare but are preferable if the heat source is, for example, a solid fuel boiler. In such cases, the system pressure is determined by the water column in the expansion tank.



Closed loop system

This general design is used in most modern buildings.



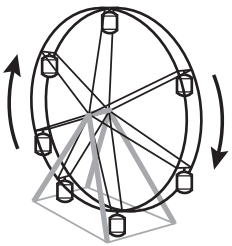
Open loop system

This design is mostly used with solid fuel boilers and similar heat sources.

Basic pump theory

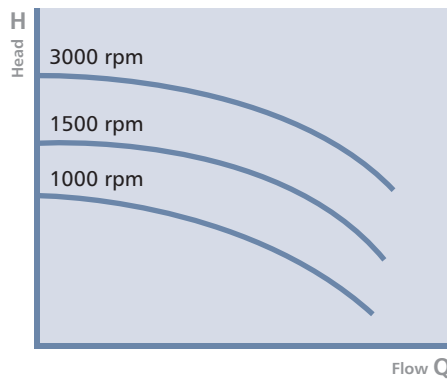
The *system curve* describes the resistance that exists in the pipe system, i.e. all losses in the pipe work. Since a circulation system is usually a closed loop system, there is no geodetic head to overcome, only friction losses. The friction losses in a pipe increase as the square of the velocity increases. This is why it is important to choose the right pipe, with the right dimensions relative to the flow.

In a loop system, the weight of liquid on the way up is balanced by the liquid on the way down. Therefore, when the system is filled, the geodetic head for the building is zero, regardless of the height of the building. The required pump capacity is determined instead by the total length, diameter and routing of the pump system. See the Ferris wheel illustration below.



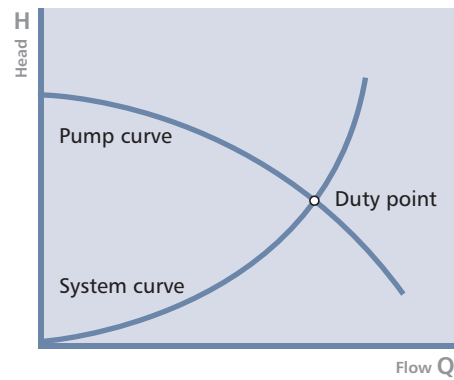
Ferris wheel

The principle can be illustrated with a Ferris wheel. When the wheel rotates, the ascending baskets are balanced by those on the way down, and the motor only needs to overcome the friction.



QH curve

The pump curve (QH curve) shows the pump's properties and indicates the flow that it produces at a particular pressure.



Duty point

The point at which the pump curve and the system curve intersect is called the duty point.

The hydraulic power is calculated as follows:

$$P_{hydr} = Q \cdot H \cdot \rho \cdot g$$

where

Q = the pump's flow

H = the pump's head

ρ = the density

g = the gravitational constant

The outputs relate to each other as follows:

$$P_1 = \frac{P_2}{\eta_{motor}} \quad P_2 = \frac{P_{hydr}}{\eta_{hydr}}$$

where

P_1 = supplied power

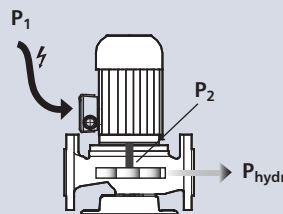
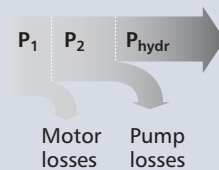
P_2 = shaft output

P_{hydr} = useful output (transferred by the pump impeller to the water)

η_{motor} = motor efficiency

η_{hydr} = pump efficiency

Efficiency/power requirement: Another way of linking power concepts is by examining the power losses in the motor and the pump.

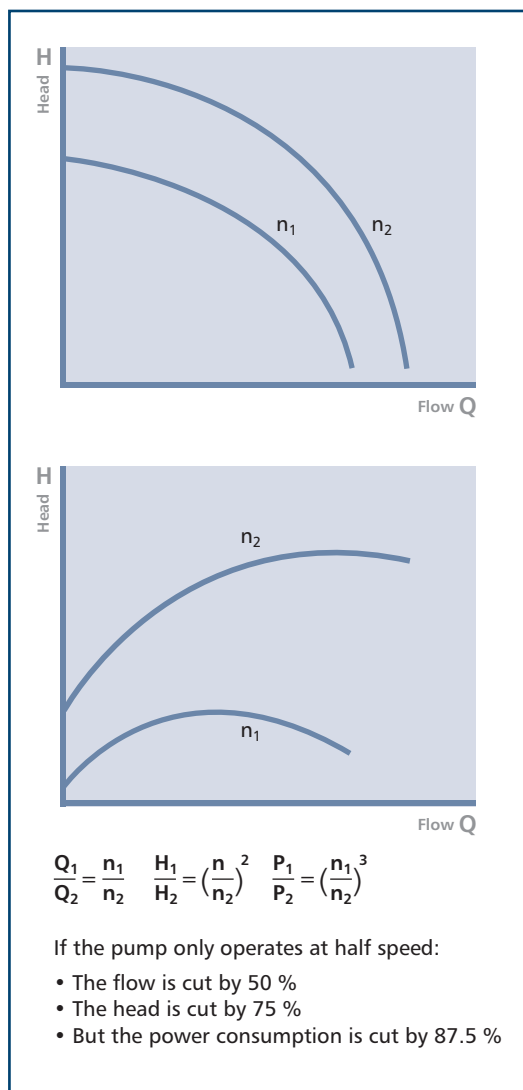


How much power do you need?

The efficiency/power requirement indicates the pump's efficiency, i.e. how well a pump unit converts the supplied electric power into produced output.

How much energy is lost in the pipe work?

In order to calculate a system curve, you must first calculate the *friction losses* (h_f) in the pipe work. These occur at bends and in valves (known as point losses or h_{fp}), as well as in straight pipe sections (h_{fr}). Point losses depend on the number of bends and valves in the pipe system, and increase with liquid velocity. Losses in straight pipe sections depend on the liquid velocity and the length, diameter and surface smoothness of the pipe.



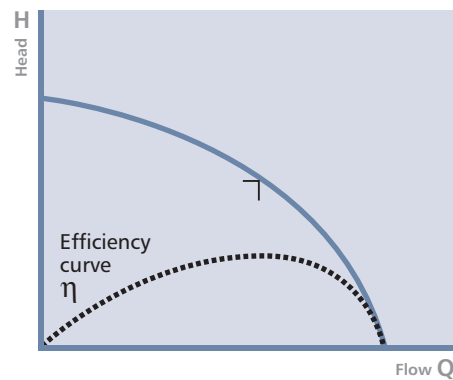
Affinity laws

The term 'affinity laws' refers to the known relationship that always exists between speed of rotation, flow, head and required power. This relationship gives you an instant indication of what is happening in a system when the duty point is altered in variable speed-controlled pump systems, for example.

Efficiency and best efficiency point

The best efficiency point (BEP), or nominal point, is the point at which the maximum level of efficiency is achieved. The efficiency curve shows how the efficiency varies at different flows.

When dimensioning the pump, two parameters are essential in order to achieve cost-effective pumping: the power requirement and the duty point (see previous page). This is particularly true when the pump is to be dimensioned for several different duty points, for example, a heating system that is not used all year round.



Best efficiency point (BEP)

The BEP is often indicated by a narrow angle on the QH curve.

Components	Pressure loss
Boiler	1–5 kPa
Compact boiler	5–15 kPa
Heat exchanger	10–20 kPa
Heat meter	15–20 kPa
Water heater	2–10 kPa
Heat pump	10–20 kPa
Radiator	0.5 kPa
Convactor	2–20 kPa
Radiator valve	10 kPa
Regulating valve	10–20 kPa
Clack valve	5–10 kPa
Filter (clean)	15–20 kPa

Example of approximate point losses for heating system components. See specs from supplier for exact data.

Regulating the pump flow

The capacity of a circulation system can be regulated in different ways, using pumps with speed control, throttle valves, a bypass system or reduced impeller diameter.

Speed control

Variable speed can either be achieved manually with fixed multi-speed pumps or automatically, using electronically controlled pumps. Apart from reducing energy consumption, a speed-controlled pump will always run at optimal differential pressure. This will minimize the noise in the pipe system and increase living comfort.

In pumps where the speed is **controlled manually**, the flow has to be regulated manually by selecting one of the fixed speeds. The flow will never exactly meet the need.

With **electronically controlled** pumps the speed is automatically adjusted to the speed required to achieve the required flow (variable speed control). The pressure generated by the pump is monitored continually, and the pump speed is adjusted to

deliver the required pressure.

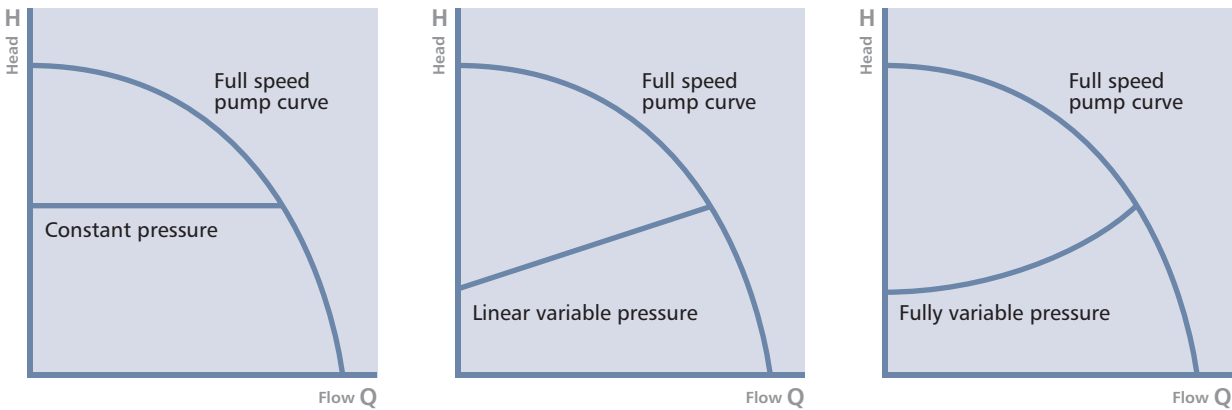
When demand increases, the pressure will start to drop and the pump will increase its speed to compensate. When demand drops, the pressure will increase and the pump will reduce speed to maintain the right level of pressure.

There are different ways to regulate the pumps:

A **constant pressure** (Δ_{pc}) mode will deliver the same pressure all the way up to its maximum speed, regardless of flow.

A **linear variable pressure** (Δ_{pv}) mode will deliver the preset pressure at maximum speed. When the speed (and flow) is reduced, the pressure also drops. This is to simulate the pump system curve. When the flow is low, demand for pressure is also lower.

The **fully variable pressure** (Δ_{pv}) curve is the same as a linear one, except that the pressure will follow a second degree (rather than linear) curve, which will further reduce energy consumption, and better meet the actual need.



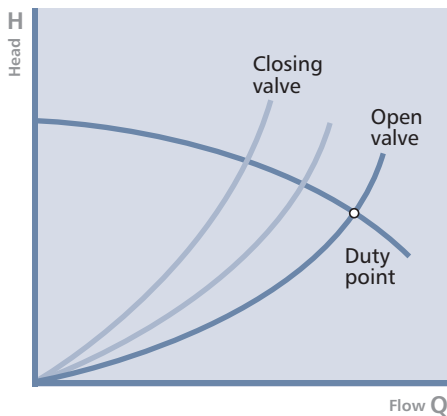
Pressure regulation curves

The relationship between different modes when regulating pressure.

Other ways to regulate the flow

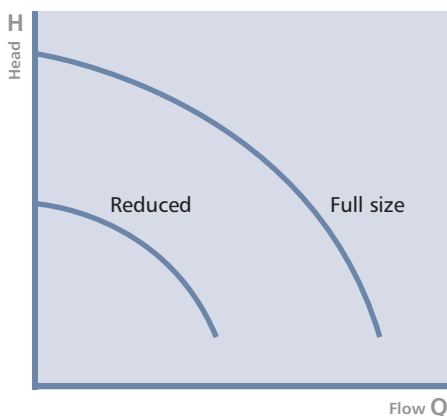
Here are a few other ways to control the flow in your system without using a speed control unit. This will give you a lower initial cost, but lowering the flow will not reduce energy consumption, and the life cycle cost will not be reduced.

Throttling the flow with a valve alters the losses in the system and thereby the flow from the pump. At a low flow the pump will produce a lot of unnecessary head, which leads to excessive energy consumption (as shown in the figure below).



Throttling

As the valve closes, the duty point shifts with the system curve along the pump curve.

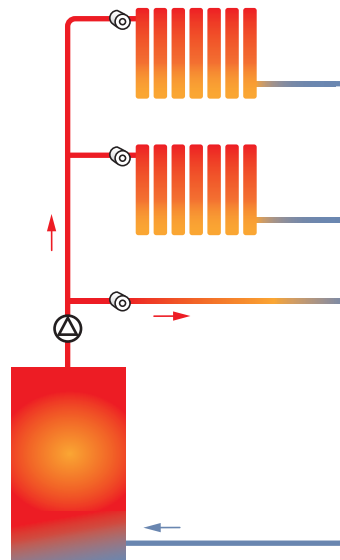


Reduced impeller diameter

As the impeller diameter is reduced, the curve shifts and the flow is reduced.

In a **bypass system** the pump is always running at full speed. The flow has a bypass loop, and the flow is controlled by routing some of the flow from the pressure side of the pump back to the suction side. In certain chiller systems a bypass loop is needed to avoid problems with the chiller.

With a **reduced impeller diameter** both head and flow decrease in proportion to the reduction. Energy consumption is significantly reduced with a smaller impeller diameter, as the affinity laws apply. The drawback compared to speed control is that it is not possible to adjust the flow in the system – once the diameter is fixed, the pump will always deliver the same output.

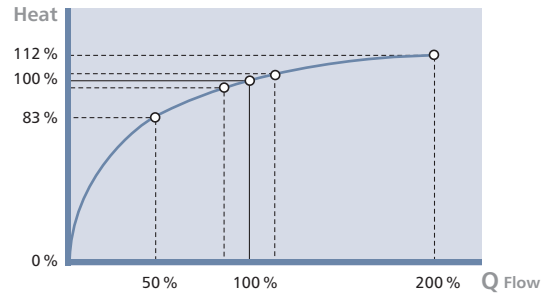


Bypass system

The flow is controlled through a bypass circuit that runs directly to the suction side of the system.

Pump economy and environmental care

The total cost of pumping is largely determined at the very outset, i.e. when the circulation system is designed. Intelligent system design can help to minimize the resistance of components and friction in the pipes that must be overcome by the pump. This in turn reduces the amount of energy required to circulate the water. This is, by far, your best opportunity to optimize pump economy. To give you an example, the friction loss increases as the square of the velocity increases. This means that a pipe with a small diameter will have a much higher friction loss than one with a larger diameter.



Radiator curve

Increasing the heat output by increasing the flow is not cost-effective.

The real cost of oversized pumps

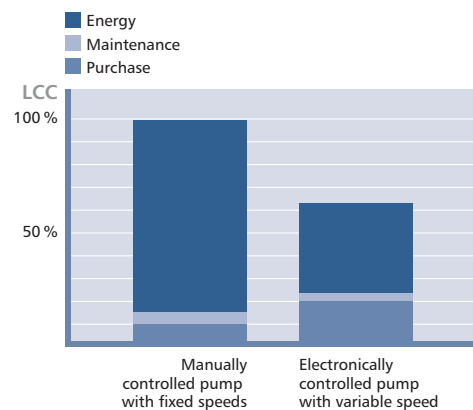
Many building owners and operators install oversized pumps 'to be on the safe side'. This is an extremely costly strategy, as such pumps generate far more head and flow than required, but without adding any heat to the room. The diagram below shows how a 10 % flow increase will only increase heat output by 2 %. While doubling the flow only increases the heat output by 12 %. The higher flow also creates more noise in the pipe work. Fortunately, as shown overleaf, there are far more effective solutions.



Energy consumption in the EU

Fully 30 % of all electrical energy consumed in the EU is attributable to electric motors. A large proportion of these are installed in circulation systems.

Equally important is the fact that additional energy used to control the indoor climate has a substantial impact on our environment. Fully 30 % of all electricity consumed in EU countries is used by electric motors, and millions of these motors are used in circulation systems. Considering the immediate and long-term threats to our climate, the huge potential of effective system design and optimal pump selection becomes even more important.



The only sensible perspective: Life cycle cost (LCC)

The LCC is the total cost for a pump over a period of time, including costs associated with purchase, installation, commissioning, power consumption, operation, downtime, maintenance and decommissioning. There are several ways to minimize the LCC:

Reducing power consumption costs

Electricity will be the largest single cost during the pump's life time; therefore the biggest gain can be achieved by reducing power consumption:

Save money with speed control

Buying a pump without a speed control unit means a lower initial cost. But when comparing life cycle costs, the benefits of speed control are obvious. 85 % of the total cost over a 10-year period is attributable to energy consumption (for a pump running at full speed all the time).

1. Use pumps with variable speed control, as they use up to 70 % less energy than an uncontrolled pump running at full speed all the time. This is the single most effective way to reduce the total operating cost – the payback time for an investment in speed control is often less than two years.
2. Look for high-efficiency pumps and motors. For example, EFF1 motors (supplied by ITT) are 3–5 % more efficient than EFF2 motors. Another vital factor is efficient hydraulics, which can be even more important for energy efficiency than the pump motor. ITT's in-house experts invest considerable effort to maintain a leading position in this area, both in product development and modern manufacturing methods.
3. Stop the pump when no heating or cooling is needed.

Reducing installation and commissioning costs

When using pumps with integrated controllers with variable speed drive, such as ITT's Hydrovar, the cost for installation and commissioning is lower compared with using a system with separate variable speed drive (VSD). The difference is that the integrated unit already features components such as VSD, pressure transmitters, control software, etc. When using a separate variable speed drive all those functions must be performed by separate units, which requires a more complex and costly procedure for installation and commissioning.

Reducing maintenance costs

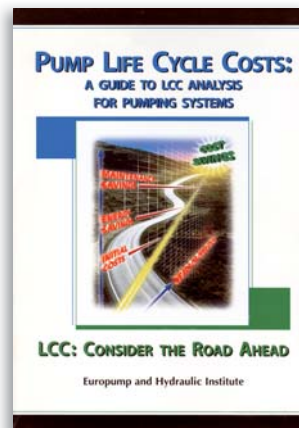
As a speed-controlled pump seldom operates at full speed, there is less mechanical stress, compared to full speed operation. This will result in longer maintenance intervals, as pump and motor components last longer. Turning off the pump when it is not needed will further reduce maintenance costs.



Lowara Hydrovar

– break even in a year

The Lowara Hydrovar speed control unit saves you money and has less environmental impact through reduced energy consumption.



Standard of reference

This book provides further information on the subject. It is the result of collaboration between Hydraulic Institute and Europump, which also involved employees from ITT.

Pipe work design

In the early stages of the design process it is necessary to consider potential zoning needs, alternative heating or cooling sources, and operating and control strategies. Based on the information gathered about the building you also need to calculate space heat losses and assess the hot water system demand, as well as various ventilation aspects. Before designing the pipe work you must also determine that you have selected the most suitable emitters and connections for each position and consider the best distribution layout, taking into account all necessary balancing and regulating requirements.

Two-pipe systems

In a two-pipe system the supply pipe is used to supply the heated or cooled water to the emitters, while the return pipe transports used water back to the heating or chiller source.

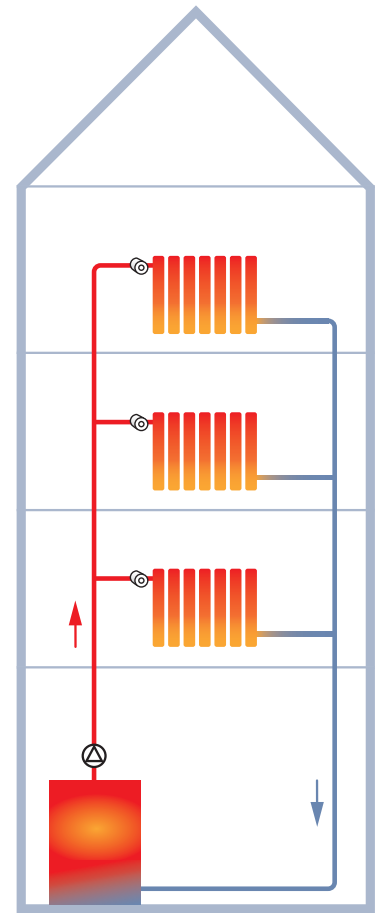
One major advantage of two-pipe systems is that you can vary and control the water flow to save pump power. Another is that all radiators receive water of the same temperature, as the supply pipe feeds directly from the boiler. (When feeding from the previous radiator, some heat is emitted and the water may cool slightly.)

Steam traps should be checked frequently. If they stick open, steam will flow through the radiator and down the return pipe preventing efficient heat transfer and perhaps also disturbing the balance of the entire distribution system.

Depending on the need for heating, a thermostatic valve is used to regulate the flow through the radiator. When the valve closes, the pressure in the system will increase and a speed-controlled pump is a good way to compensate for this increase.

Solutions in large buildings

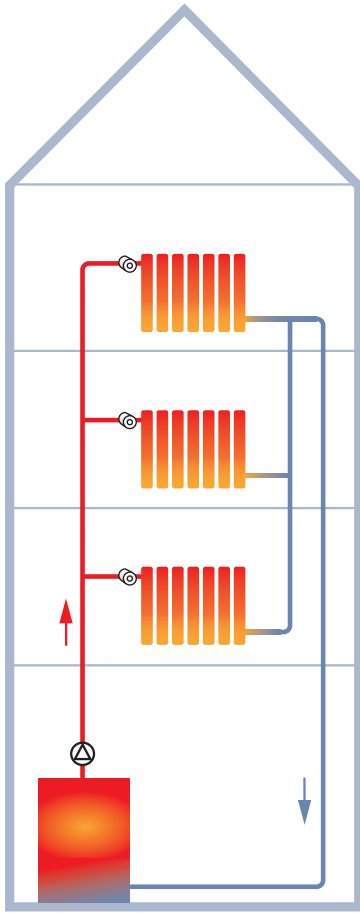
In hybrid systems, the principle is that there is a low loss head circuit and separate heating circuits, each with its own pump. Such systems are used to separate hydronic systems. This makes it easier to extend existing hydronic systems without changing the pressure conditions, as the different sub-systems are independent of each other. Another advantage



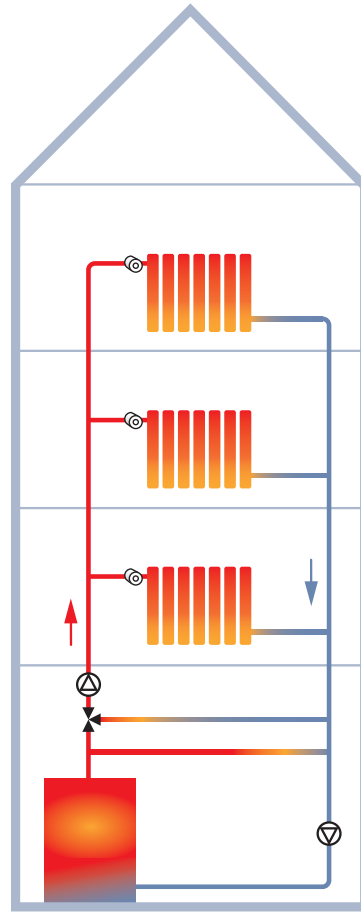
Two-pipe system

The basic two-pipe system makes it possible to vary and control the water flow to save pump power. It distributes the heat more evenly than a single-pipe system.

is the fact that some boilers are sensitive to low temperatures and have a minimum flow limit. In order to minimize the time it takes for the water to reach the desired temperature, the water is circulated only in the low loss head circuit. When the desired temperature is reached, the radiator circuit opens. The 3-way valve regulates the flow either to the radiator circuit(s) or to the boiler. Another way to save energy is to change the system to a throttle system by using a 2-way valve in the radiator circuit and using speed-controlled pumps.



Two-pipe reverse return system
The main benefit of the reverse return system is that the head loss will be the same in all circuits.



Two-pipe hybrid system
The main benefit of the hybrid system is that the primary low head loss loop makes it easy to expand the system. The 3-way valve will close and send water back up through the system if it is still hot enough to heat the emitters. The valve will open when the water requires reheating.

Constant or variable flow

The two-pipe category can be divided into systems with **constant** or **variable flow**, and either system can be designed for **single** or **multiple loads**.

A two-pipe multi-load system with constant flow offers better control of temperature and the temperature to each coil remains the same. Energy can also be saved by using variable speed with temp/diff pressure sensors. The main advantages of a variable flow are that you can use a smaller pump and have better control of temperature and humidity. Each coil is also supplied with the same temperature.

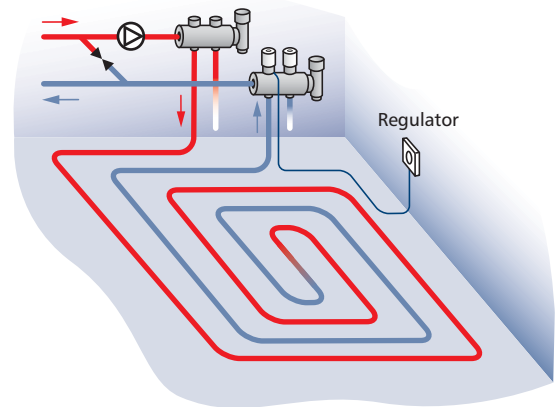
Floor heating systems

In a floor heating system, heat is transferred from the pipes to the floor structure. Such a system can be self-sufficient or combined with conventional radiator heating.

The main difference between radiator and floor heating systems is the temperature of pumped media. Radiator systems can be designed for working temperatures up to 80 °C, and a differential temperature of 20–40 °K. In a floor heating system the working temperature should never exceed 40 °C and the differential temperature should be kept at 5–8 °K. The floor heating system should always include a mixing loop to avoid too high a supply temperature.

A floor heating system can be designed in many different ways, and manufacturers each have their own guidelines that must be observed, but some principles are universal, for example:

- Each room should have its own control system.
- All circuits should be balanced to give the same head loss and the pump should be specified and selected based on the circuit with the highest head loss.
- A pipe circuit should never exceed 120 m.
- A floor heating system requires a higher pump capacity than a radiator system for the same size building. The reason is the relatively high head losses and low differential temperature in floor heating systems.



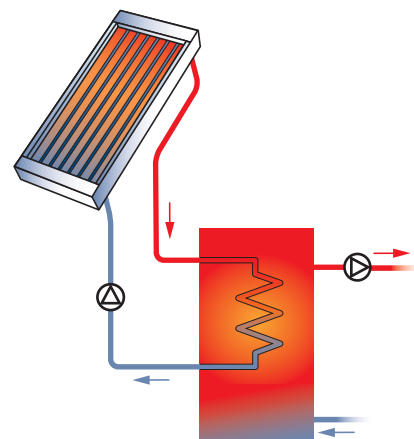
A floor heating system

Each room requires its own regulatory system and all pipe circuits must be balanced to generate the same head loss.

Solar panel systems

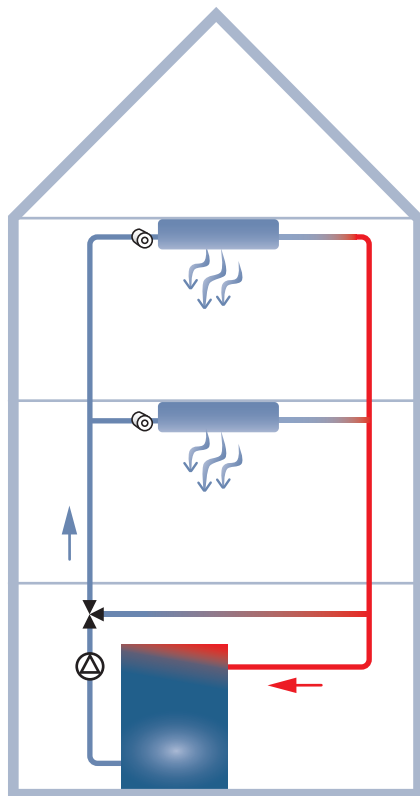
Like the systems described above, solar panel systems are water based and require a circulator. They operate at a higher and more variable temperature compared to normal heating applications. As solar panels are placed on the roof, it's common to use some kind of antifreeze agent in the water. The most common antifreeze agent is glycol. The addition of glycol increases the density and viscosity of water, which must be taken into account when choosing a pump.

For the foreseeable future, solar panels are mainly of interest as a supplement to regular water circulation systems.



A solar panel system

The solar panel supplements the regular heat source.



A chiller system

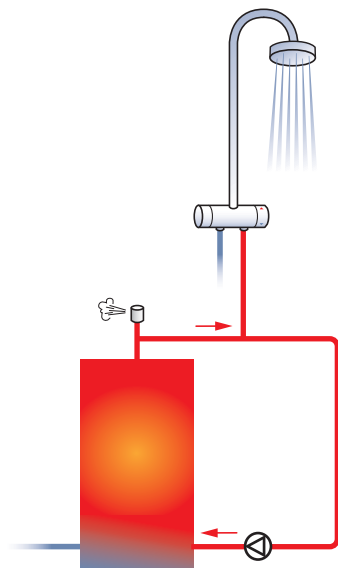
The chiller system operates the same way as a hybrid heating system, but circulates cold media instead of hot.

Chiller systems

The design of a chiller system depends to a large degree on the choice of cooling agent. Different cooling agents have different densities and generate different levels of friction in the pipes. Therefore, you must also take the cooling agent into account when choosing a pump.

The most common cooling agents used are salinated water and water mixed with glycol. As the cooling agent gets colder it will generate more friction in the pipes. This will have to be taken into account when the pump is being dimensioned. Information on required pump dimensions for different cooling agents can be obtained together with the cooling agent.

A chiller system is usually a hybrid system. Chiller systems often require a certain minimum flow, for example 30 %, to eliminate the risk of ice build-up. As valves close, the differential head across the evaporator is reduced. A controller senses this and opens the bypass valve to maintain a minimum flow, mixing cold supply water with warm return water.



A hot water system

A secondary return system ensures better user comfort by providing hot water immediately.

Hot water systems

The most obvious difference in hot water systems, compared to most heating systems, is that they are open systems. To ensure quick delivery of hot water to any tap in a building, the hot water system is often designed as a loop system, with a secondary return pipe. This also saves hot water and, consequently, energy.

The return circuit flow is generally very low, so a small pump is sufficient. Selecting an oversized pump will consume more energy and cause noise in the system due to unnecessarily high water velocity.

Always use pump housings made of bronze or stainless steel to prevent corrosion. Fresh water, which is always present in hot water circuits, contains oxygen.

Pumps used in heating/chiller systems

In a heating or chiller system a centrifugal pump is used to move the liquid from the generator to emitters around the building, overcoming the flow resistance in the pipe system.

The pump essentially comprises the pump housing, an impeller and an electric motor.

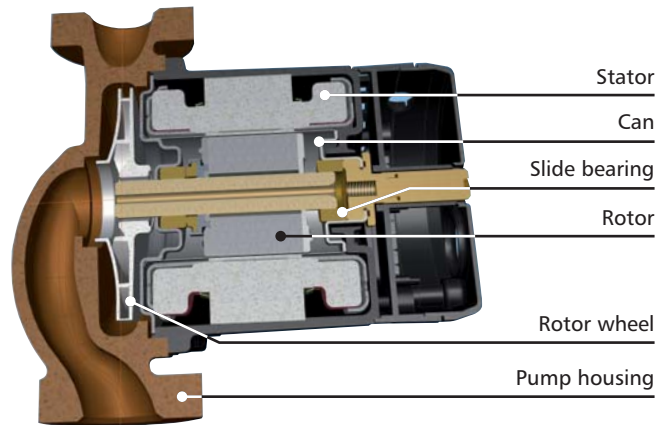
Wet rotor pumps – the cheap and easy choice

In a 'wet rotor' or 'canned motor' pump, the pump media is circulated inside the rotor can, cooling the motor and lubricating the bearings. Wet rotor pumps are simple, leak-free, and the purchase price is relatively low. With a comparably short lifetime and low energy efficiency, however, the final calculation is not necessarily favorable. Furthermore, wet rotor pumps are sensitive to debris in the pump liquid, and cannot handle aggressive media.

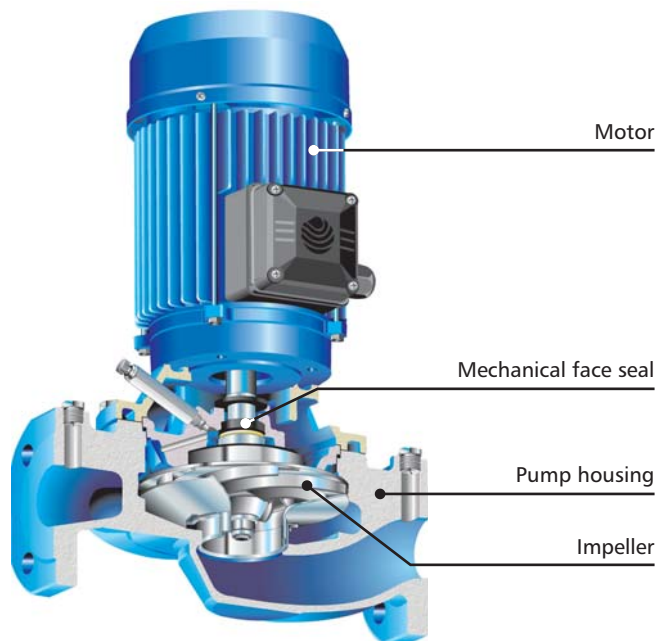
Wet rotor pumps must always be installed with the motor shaft in a horizontal position. This is because the motor is lubricated by the pump medium, and vertical installation may result in insufficient lubrication. Furthermore, to prevent clogging, this type of pump must be operated at least every second week. In general, wet rotor pumps have a lower initial cost, but will be less energy efficient compared to dry motor pumps. The EU has decided on an energy classification system for wet rotor circulators up to 2.5 kW. Class A options are available but usually come at a higher price.

Dry motors – the cost-effective choice

The motor is a standard air-cooled IEC motor, either with an extended shaft to which the impeller is directly attached, or a stub shaft with a coupling or shaft extension. The pump shaft is sealed by a mechanical face seal, comprising two rings and a spring that presses the rings together. A thin film of water lubricates and cools the seal.



A wet rotor pump



A dry motor pump

The purchase price of these pumps is higher, but remember: the purchase price is typically a mere 5 % of the total life cycle cost. Dry motors are more energy efficient and reliable and have a longer bearing life. Also, since the pumped liquid is kept out of the motor, this design is less sensitive to debris and aggressive media.

All in all, dry motors have a more robust design and more favorable long-term economy.

Twin head pumps – more than just a backup solution

Both wet rotor pumps and dry motor pumps are available in twin head versions. In-line circulators are generally available in single and twin versions.

Historically, twin head pumps were mainly used to ensure backup capacity in case of pump failure. Today, the twin version is more often used to ensure improved economy and minimal environmental impact, as the second pump will be activated at peak load only. Today's premium pumps rarely fail but, just in case, the backup is already in place. And, even though the one pump only provides a little more than half the flow required to maintain the indoor climate on the coldest days, heat output can still satisfy 83 % of demand (see radiator curve below). The pump control for a twin head pump alternates the running pump to ensure equal running hours.

There are also savings to be made in the pipe works compared to using two single head pumps. In the case of a twin head pump, only one set of pipes is required, while single head pumps require twice the pipe work. Also, as the twin head pump has a higher capacity than a single pump, it is possible to upgrade the system with only minor changes to the pipe work.

In chiller systems or systems with liquid temperatures below 10 °C it is not advisable to use twin head pumps. As the pump housing is larger, increased condensation could lead to ice build-up in the pump housing, seal area, etc.

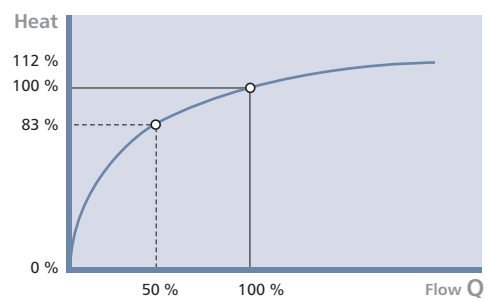
Efficiency comparison

(approximate values)

Wet rotor pumps		
Rated power	Typical efficiency	Max efficiency (Class A)
< 100 W	15%	25%
100–500 W	30%	40%
500–2500 W	40%	50%
Dry motor pumps		
Rated power	Typical efficiency	Max efficiency
< 1.5 kW	55%	65%
1.5–7.5 kW	65%	75%
> 7.5 kW	70%	80%



The Lowara FCT twin head pump



Radiator curve

It is possible to achieve 83 % of maximum heat output using just one of the pumps.

Choosing the right pump

Choose pumps based on the required flow and pipe resistance. When using speed-controlled pumps, always select a pump where the duty point is as close to the best efficiency point as possible. Often several alternatives are available and a good rule of thumb is to choose a pump within $\pm 10\%$ of the best efficiency point. When using a speed-controlled pump the duty point should always be within 10% of the best efficiency point. This is to ensure a broad-enough flow area to play with when regulating the pump. Do not oversize the pumps – the heat exchange is almost the same, but the pumps consume a lot more energy. (See radiator diagram.)

In heating systems the consequence of a pump failing is a less comfortable indoor climate. Therefore, in large buildings, it is recommended that several pumps be used instead of one to ensure a backup and a certain level of comfort, even if one pump fails. Either one pump is capable of handling the total flow and the other pump acts as backup. Or the total flow is handled by several pumps which all operate at full efficiency only when required.

Selection software

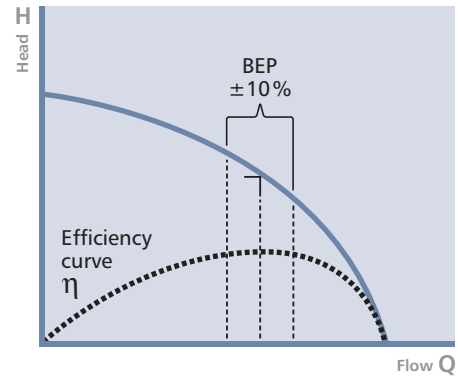
Using qualified pump selection software, it is easy to identify the most efficient pump for the job. Lowara offers the Loop 4U selection software package to identify your specific needs. This software enables you to calculate the right pump system specifications, find the optimal pump solution, and provides the documentation required to build and maintain the system.

Replacing old pumps

Water velocity/pipe noise can indicate that installed pumps need to be replaced. Always ask if the building has been modified or renovated since the old pump was installed. New windows with better insulation may, for example, have been installed. If so, the heat requirement is lower and a smaller, more energy-efficient pump can be used. Motor technology has also developed, providing the required flow in a more energy-efficient way. Complete replacement guides are available in catalogues and on the web.

Upgrading old systems

Sometimes upgrading old pumps can be more cost-effective than simply replacing them. In such cases pumps can easily be upgraded with an electronic pump control unit. Regulating pump speed and reducing unnecessary pumping will save a lot of money and reduce the environmental load. Lowara Hydrovar is a pump control unit that can easily be mounted on the old pump. It fits perfectly on any standard IEC motor and the pay-back period is often less than two years.



Best efficiency point (BEP)

The BEP is often indicated by a narrow angle on the QH curve. The duty point of the pump should be as close to the BEP as possible.



An upgraded system

The Lowara Hydrovar is an easy and cost-effective way of modernizing an old system.

Lowara pumps used in circulation systems

Type of system	System design	TLC/TLCH	EB/TLCB	TLCK	TLCSOL	FLC	FC	EA/EV	EFLC	FCH
Heating systems										
Small systems	Single-pipe system	▲						●		
	Two-pipe system	●						▲		
	Floor heating system	●						▲		
	Solid fuel boilers	●					▲	●		
	Solar panel systems			●	▲		●	●		
	Geothermal systems			▲	●		●	●		
Large systems	Single-pipe system Primary pumps					●			▲	▲
	Secondary pumps	▲				▲		●	●	
	Two-pipe system Primary pumps					●		▲	▲	▲
	Secondary pumps	●				●		▲	▲	
	Solid fuel boilers					●			●	▲
	Ventilation	▲				▲	▲	●	●	●
	Shunt pumps					●	▲			▲
	Heat recirculation	▲				▲	▲	●	●	▲
Hot water circuits										
Small systems	Circulation system		▲					▲		
Large systems	Circulation system		▲							●
Chiller systems										
	Primary pumps	●		▲		●	▲			▲
	Secondary pumps					●	●			▲
	Cooling towers						▲			●
	Chillers						▲			●

▲ = Most suitable
● = Suitable

Lowara pumps used in domestic buildings

For buildings up to a certain size, we recommend using the following pumps:

Area to be heated	Radiator system		Floor heating system	
	Standard pump	Electronic pump	Standard pump	Electronic pump
80–200 m ²	Lowara TLC xx-4	Lowara EA xx/40	Lowara TLC xx-6	Lowara EA xx/60
150–200 m ²	Lowara TLC xx-4	Lowara EA xx/40	Lowara TLCH xx-7	–
200–250 m ²	Lowara TLC xx-6	Lowara EA xx/60	Lowara TLC xx-8	–

Larger buildings contain more complex systems and careful analysis is required to determine the best pump solution.



ITT

ITT Lowara part of ITT Corporation and headquarters of "Residential and Commercial Water – EMEA".

World leading in offering high reliable fluid handling solutions for Building Services, Irrigation and Industrial applications. We provide a complete range of high quality pumps, packaged systems and controls and are specialized in engineering and manufacturing stainless steel products.

ITT Lowara is headquartered in Vicenza, Italy and operates in more than 80 countries across the world with own plants in Italy, Austria, Poland and Hungary.

The company has 1.300 employees and generated 2008 sales exceeding \$440 million. ITT Lowara is wholly owned by the ITT Corporation of White Plains, New York, and is the EMEA headquarter of ITT's Residential and Commercial Water division. ITT Corporation is a high-technology engineering and manufacturing company operating on all seven continents in three vital markets: water and fluids management, global defense and security, and motion and flow control. ITT Corporation generated 2008 sales of \$11.7 billion.

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