Foreword

Do you need controls?
The demands for controls increase and are often requested on pumps, when it comes to optimum operation, high reliability and monitoring of data.
Therefore, Grundfos has developed the Controls Guide, which gives in a simple manner an overview about applications and the related controls of speed contolled pumps and pump systems.

We have elaborated a Guide for engineers and technicians who work with design and installation of pumps and pump systems, containing answers to a wide range of controls for pumps. The handbook can either be read from one end to the other or partly on specific topics. The handbook is divided into chapters which deal with different applications and pump systems.

Additional to the mentioned controllers there is a huge variety of electronic speed regulated pumps which can be used in several applications when only a single pump is needed. Details of the respective controller and pumps you can find in the related databooklets of the products.

We sincerely hope that you will make use of the Guide and find it useful in your daily work.
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1. Heating
Medium/large buildings

Plan heating systems from the outside in.

Knowing the flows and temperatures required for radiators, under-floor heating, etc., lets you design your system based on known demands on central equipment. Our external controls and integrated frequency converters ensure maximum system intelligence, flexibility and the lowest costs.

Think about the whole system

In heating systems, energy efficient pumps are only half the story. With the right system design, you can minimise energy consumption, increase comfort levels and future-proof your building.

Speed control

Speed controlled pumps are key to an efficient and noiseless system. Grundfos speed-controlled pumps can be controlled by variations in pressure, temperature, flow, differential pressure or any other specific measurable parameter. This ensures high efficiency, low energy consumption and ultimately the best life cycle cost.

The term central heating covers hydronic heating systems with a central boiler or furnace either inside the building being heated or in the immediate vicinity.

Heat is generated in the boiler. Pipes carry the heated water to the buildings heat sources (radiators) and returns the cooled water to the boiler again.

A central heating system is a closed system with either an expansion tank or open expansion vessel. A buffer tank can also be installed in these systems.

Knowing the flows and temperatures required for radiators, floor heating, etc., lets you design your system based on the buildings heat sources and returns the cooled water to the boiler again.

Using MAGNA and TPE Series 2000, no external pressure sensor and motor protection is necessary for parallel operation. It is essential to have proportional pressure without a sensor placed in the system.

For pumps above 22 kW both external sensor, motor protection and a pump control unit is necessary.

1.1 Main pumps

Main Pumps

Due to variation in the heat demand and the flow, we recommend to use speed controlled pumps in parallel as main pumps. Maximum 3 pumps plus 1 as standby pump. By speed controlling all the pumps it is possible to obtain the maximum energy saving.

It is important to check the efficiency at the duty point where the system has a high number of operating hours.

Using MAGNA and TPE Series 2000, no external pressure sensor and motor protection is necessary, only a ControlMPC is needed for parallel operation. It is possible to have proportional pressure without a sensor placed in the system.

For pumps above 22 kW both external sensor, motor protection and a pump control unit is necessary.
1.2 Boiler shunt pumps

**Boiler shunt pump**

The primary task of the boiler shunt pump is to ensure that the temperature differences between top and bottom of the boiler are not too big, big temperature differences cause tension in the material and thus reduce the life of the boiler. For certain types of fuel there is a risk of corrosion at too low temperatures at the bottom of the boiler. Maximum safety is ensured when using a controlled pump, and the energy saving is optimal.

Due to variation in use and heat demand in different parts of the building, the system is divided into zones controlled by a mixing loop. The flow temperature will be lower than in the mains supply, which will result in a higher flow in the zone than in the mains supply. This will help obtain a better hydraulic balance in the total system. Speed controlling the pump makes it possible to obtain the maximum energy saving.

When using a two-way valve, the pressure lost in the valve will be managed by the main pump. When using a three-way valve, the pump in the mixing loop also has to manage the pressure lost in the valve.

Using MAGNA and TPE Series 2000 there is no need for an external pressure sensor and a motor protection. It is possible to have proportional pressure without a sensor placed in the system.

1.3 Mixing loops

**Mixing loops**

Mixing loops

Due to variation in use and heat demand in different parts of the building, the system is divided into zones controlled by a mixing loop. The flow temperature will be lower than in the mains supply, which will result in a higher flow in the zone than in the mains supply. This will help obtain a better hydraulic balance in the total system. Speed controlling the pump makes it possible to obtain the maximum energy saving.

When using a two-way valve, the pressure lost in the valve will be managed by the main pump. When using a three-way valve, the pump in the mixing loop also has to manage the pressure lost in the valve.

Using MAGNA and TPE Series 2000 there is no need for an external pressure sensor and a motor protection. It is possible to have proportional pressure without a sensor placed in the system.
1.4 Heat surfaces

A heating surface heats the air which then the ventilation system is blown into the building. The temperature in the heating surface depends on the outdoor temperature and is controlled by way of the ventilation system’s control unit. The system has a constant flow and variable temperature, where it is important that the flow is correct. Normally the flow is adjusted by a regulating valve, it may also be an advantage to use an adjustable pump (E-pump).

**MAGNA:**
The pump is set to constant curve and then adjusted to the correct flow.

TPE Series 1000:
The pump is set at uncontrolled mode, and then adjusted to the correct flow.

R100 remote control must be used in connection with setting up the unit is connected to the analog entry (0-10V or 0/4-20 mA). The pump is set at uncontrolled, and the signal from the central control unit is connected to the analog entry (0-10V or 0/4-20mA). The saving potential of using a controlled pump in stead of a three-way valve to reach the correct temperature is very big.

3 way valve controlled system

### Heat recovery

**Heat recovery**
The purpose of the system is to recover the heat of the outlet air. The primary task of the pump is to ensure an optimal flow between the heating surfaces. The pump/valve is controlled from the general control unit of the ventilation system. The saving potential of using a controlled pump in stead of a three-way valve to reach the correct temperature is very big.

The pump is set at uncontrolled, and the signal from the central control unit is connected to the analog entry (0-10V or 0/4-20 mA). R100 remote control must be used in connection with setting up the pump.

### Recommended product types

#### Heat surfaces

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1.6 DHW recirculation

District hot water circulation

The purpose of the system is domestic hot water heating. The function of the circulator pump is to ensure that hot water is always available as close as possible to the tapping point as possible, in order to reduce waste of water and increase the comfort. In certain installations (loading circuits) the pump can at the same time ensure the circulation between the inverter and the storage tank.

Normally uncontrolled pumps are used, because usually the flow variation is only small. It may be advantageous to use controlled pumps for adjustment of the flow when starting up the system, though. In large systems it will also be an advantage to use a temperature controlled pump.

Because of the contents of gasses in water, it is important that this gas will also be an advantage to use a temperature controlled pump.

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Because of the contents of gasses in water, it is important that this gas will also be an advantage to use a temperature controlled pump.

1.7 DHW production

District hot water production

To make the system as flexible as possible, the heating and storage of the domestic hot water are divided into two units, one for heating and one for accumulation of the hot water. The construction of the systems among others depends on the kind of heat exchanger (charger) used.

The pump is controlled by the temperature in the storage tank, either ON/OFF or variable speed.

If one pump is used for both accumulation and circulation, the minimum flow of the pump must be the same as the required flow for circulation. If the pump is installed on the "hot" side of the exchanger, it must be ensured that the temperature does not exceed required max. temperature, as this may cause lime depositing in the pump. Because of the contents of gasses in the water, it is important that this gas is not gathered in the pump.

The circulator pump is to ensure that hot water is always available as close as possible to the tapping point as possible, in order to reduce waste of water and increase the comfort. In certain installations (loading circuits) the pump can at the same time ensure the circulation between the inverter and the storage tank.

Normally uncontrolled pumps are used, because usually the flow variation is only small. It may be advantageous to use controlled pumps for adjustment of the flow when starting up the system, though. In large systems it will also be an advantage to use a temperature controlled pump.

Because of the contents of gasses in water, it is important that this gas will also be an advantage to use a temperature controlled pump.
District heating describes a water-based heating system where there is a considerable distance between the place the heat is generated (power plant) and the place the heat is used (the building).

District heating has become more and more popular all over the world, and is found in the majority of larger cities. At the power plants, flue gas undergoes an exceptionally advanced treatment before being released. This has become an important factor in improving air quality in cities.

A district heating system consists of:

1. A generation system (power plant)
2. A distribution system (underground pipes)
3. A user solution (individual heating system at the user)

Heat generation is often combined with the generation of electricity in the same power plant. From the power plant, the heat is sent through transmission piping to heat exchanger substations. The heat is traditionally produced at the power plants, where fossil fuel (coal, oil, etc) or alternative fuels (straw, wood chips, etc) is burned. A few power plants also have solar energy.

Heat is traditionally exchanged down to around 90°C. The heat is then transferred through the distribution system (pipes) to the users.

One of the drawbacks with district heating is that the long distances between the power plant and user causes relatively large heat losses.

Connection to district heating can take place either directly or through an indirect system.

2.1 Main pumps

Main pumps

Due to variations in heating demand and flow, we recommend that the main pumps be speedregulated and installed in parallel. Install a maximum of 8 pumps plus 1 as a standby. The use of speed-regulated pumps maximises the potential energy saving.

It is important to check the efficiency at the duty point at which the system has a high number of operating hours.

Using MAGNA and TPE Series 2000, no external pressure sensor or motor protection is necessary. Only a Control/MPC is needed for parallel operation. It is possible to have proportional pressure without a sensor placed in the system.

When pumps are installed in parallel non-return valves must be installed.

When pumps are installed in parallel non-return valves must be installed.
2.2 Booster pumps

In instead of using a large closed pressure tank, one or more pumps together with an open storage tank will maintain constant static pressure in the system. If the system pressure exceeds the allowable level, a relief valve will lead the water back to the tank. It is recommended that treated water be used.

The set point will be the static pressure of the system.

It is recommendable always to install a standby pump. If the system is used for reﬁlling the system please note that there is a risk of cavitation in the pump when the system pressure is very low. To avoid this the ﬂow from the pump has to be throttled down.

2.3. Distributed pumps

Due to variations in the use and heat demand in different parts of the buildings, the system is divided into zones controlled by a mixing loop. The ﬂow temperature is lower than in the mains supply, and this results in a higher ﬂow in the zones than in the mains supply. As a result a better hydraulic balance is achieved in the system as a whole. Speed regulated pumps maximise energy savings.
2.4 Boiler shunt pumps

The primary task of the boiler shunt pump is to ensure that the temperature difference between the top and bottom of the boiler is kept low. Excessive temperature differences cause tension in the materials, thus reducing the life of the boiler. With certain types of fuel, corrosion can result if the temperature at the bottom of the boiler is too low. A speed-regulated pump will ensure maximum safety and maximise the energy saving. Often the pumps are operating under conditions of high flow and low head. In such systems it is important to check the NPSH value of the pump.

TP/NK: These pump types require an external frequency converter and an external regulator. A temperature transmitter with an output signal of 0/5-10V or 0/4-20 mA should be used. R100 remote control is used for start-up and protection.

TPE: The pumps have an integrated frequency converter and motor protection. A temperature transmitter with an output signal of 0/5-10V or 0/4-20 mA should be used. R100 remote control is used for start-up and later for extracting operating data.

2.5 Lull heating pumps

Lull heating

When the boiler is on standby, flow through the boiler must continue in order to maintain the correct boiler temperature. This can be done using a small temperature regulated lull heating pump (E-pump).

The controlled pump will follow the system characteristic, so the max. head/flow point must be at the highest efficiency point.

TPE: The pumps have an integrated frequency converter and motor protection. A temperature transmitter with an output signal of 0/5-10V or 0/4-20mA should be used. R100 remote control is used for start-up and later for extracting operating data.

TP/NK: These pump types require an external frequency converter and an external regulator.
2.6 Flow filter pumps

Flow filter pump
It is necessary to continuously filter the water in the system to maintain the quality of the water. This is done using a partial flow filter with a flow of 10% of the maximum flow in the system.

By measuring the pressure drop in relation to a known resistance and using a speed-regulated pump, it is possible to maintain constant flow in the filter.

TPED: The pumps have an integrated frequency converter and motor protection.
A Δp transmitter with an output signal of 0/5-10V or 0/4-20 mA should be used. R200 remote control is used for start-up and later for extracting operating data.
TP/NK: These pump types require an external frequency converter and operating data.

In order to maintain constant flow in the filter, it is possible to maintain constant flow in the filter with a partial flow filter with a flow of 10% of the maximum flow in the system. The set point will be the static pressure of the system.
If the system pressure exceeds the allowable level, a relief valve will lead the water back to the tank. It is recommended that treated water be used. A Δp transmitter should be used for refilling the system please note that there is a risk of cavitation in the pump when the system pressure is very low. To avoid this the flow from the pump has to be throttled down.

Flow Filter pumps

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Pressure holding pumps

Pressure holding pumps
In instead of using a large closed pressure tank, one or more pumps together with an open storage tank will maintain constant static pressure in the system. If the system pressure exceeds the allowable level, a relief valve will lead the water back to the tank. It is recommended that treated water be used. The set point will be the static pressure of the system. It is recommendable always to install a standby pump if the system is used for reffilling the system please note that there is a risk of cavitation in the pump when the system pressure is very low. To avoid this the flow from the pump has to be throttled down.

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Testing the filter

| Testing the filter | | | |
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2.7 Pressure holding pumps

Pressure holding pumps
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2.8 Temperature shunt pumps

Temperature shunt pumps
A temperature shunt must ensure a constant temperature at the top of the heat exchanger to avoid tension on the material and to minimize the risk of leakage. The correct temperature depends on the heat exchanger. TP/NK: These pump types require an external frequency converter and an extracting operating data. mA should be used. R100 remote control is used for start-up and later for extracting operating data.

A temperature transmitter with an output signal of 0/5-10V or 0/4-20 mA should ensure a constant temperature at the top of the heat exchanger to avoid tension on the material and to minimize the heat exchanged by the main pump. When using a three-way valve, the pump in the mixing loop also has to manage the pressure lost in the valve.

Due to variations in the use and heat demand in different parts of the building, the system is divided into zones controlled by a mixing loop. The flow temperature is lower than in the mains supply and this results in a higher flow in the zones than in the mains supply. As a result a better hydraulic balance is achieved in the system as a whole. Speedregulated pumps maximize energy savings. When using a two-way valve, the pressure lost in the valve will be managed by the main pump. When using a three-way valve, the pump in the mixing loop also has to manage the pressure lost in the valve.

With MAGNA and TPE Series 2000 there is no need for an external pressure sensor or motor protection. It is possible to have proportional pressure without having a sensor in the system.

2.9 Mixing loop pumps

Mixing loops
Due to variations in the use and heat demand in different parts of the building, the system is divided into zones controlled by a mixing loop. The flow temperature is lower than in the mains supply and this results in a higher flow in the zones than in the mains supply. As a result a better hydraulic balance is achieved in the system as a whole. Speedregulated pumps maximize energy savings. When using a two-way valve, the pressure lost in the valve will be managed by the main pump. When using a three-way valve, the pump in the mixing loop also has to manage the pressure lost in the valve.

With MAGNA and TPE Series 2000 there is no need for an external pressure sensor or motor protection. It is possible to have proportional pressure without having a sensor in the system.
### 2.10 DHW pumps

**DHW recirculation**

The purpose of the system is to heat domestic hot water. The function of the circulator pump is to ensure that hot water is always available as close to the tapping point as possible in order to reduce wastage and increase comfort. In certain installations (loading circuits) the pump can at the same time ensure circulation between the inverter and the storage tank. Unregulated pumps are normally used because the variations in flow are usually only small. However, it may be advantageous to use regulated pumps to adjust the flow when starting up the system.

In large systems it will also be an advantage to use a temperature-regulated pump. Because of the gas content in water, it is recommended that the pump always be installed with an upward flow direction and a minimal horizontal flow direction. It is important that gas does not collect in the pump as this reduces its lifetime.

#### District hot water production

To make the system as flexible as possible, the heating and storage of the domestic hot water are divided into two units, one for heating and one for accumulation of the hot water. The construction of the systems among others depends on the kind of heat exchanger (charger) used. The pump is controlled by the temperature in the storage tank, either ON/OFF or variable speed. The pump is controlled by the temperature in the storage tank, either ON/OFF or variable speed.

If one pump is used for both accumulation and circulation, the minimum flow of the pump must be the same as the required flow for circulation. If the pump is installed on the "hot" side of the exchanger, it must be ensured that the temperature does not exceed required max. temperature, as this may cause lime depositing in the pump.

Because of the contents of gases

### 2.10.B DHW production

### District hot water production

To make the system as flexible as possible, the heating and storage of the domestic hot water are divided into two units, one for heating and one for accumulation of the hot water. The construction of the systems among others depends on the kind of heat exchanger (charger) used. The pump is controlled by the temperature in the storage tank, either ON/OFF or variable speed. The pump is controlled by the temperature in the storage tank, either ON/OFF or variable speed.

If one pump is used for both accumulation and circulation, the minimum flow of the pump must be the same as the required flow for circulation. If the pump is installed on the "hot" side of the exchanger, it must be ensured that the temperature does not exceed required max. temperature, as this may cause lime depositing in the pump.

Because of the contents of gases
3. Air-Conditioning
Medium/large buildings

Comfort and efficiency from the right pump
Pumps are the heart of any circulation system and accurately controlled circulation is the key to the users' comfort and the efficiency of the entire system. When it comes to air-conditioning, Grundfos CBS has a long history of supplying superior, intelligent, quality pumps that guarantee performance and reliability. Our controls and integrated frequency converters ensure maximum system intelligence, flexibility and the lowest life cycle costs.

Part of a bigger picture
Pumps have a severe influence on how efficiently other individual components in a circulation system work, and they exert a major influence on the overall system performance. That's why it's absolutely crucial to focus on pump selection when designing an air-conditioning system.

Speed control means full control
Grundfos' electronic speed control pumps give you intelligent pump operations that always match system loads. You are guaranteed maximum efficiency and a minimum of energy consumption. Furthermore, operating profiles can be adjusted to meet both seasonal and climatic changes.

3.1 Primary pumps
Application with one chiller.
The chiller is fitted with temperature sensors which control the temperature difference depending on the cooling load. Care must be taken to ensure that there is no freezing up of the evaporator coils. Because of this, a constant water flow is required and usually a fixed speed pump is installed. Control is normally via a regulating valve, but it may be possible to use a variable speed pump which is controlled according to the start/stop sequence of the chiller. Pump is set to uncontrolled operation and then adjusted to the correct flow. It is easily done with the remote control R100. Pump terminals for start/stop input are connected.

To secure a high comfort a standby pump can be added. Controller ControlMPC will be used for alternation between two pumps.

2 chillers are connected in parallel, each having its own pump. The chillers have their own control systems and as there is a risk of ice forming inside the evaporators, a constant water flow is recommended. The chillers run in cascade with the pumps being controlled by a start/stop signal from the chillers. On start, pumps start before the chillers start. On stop, pumps stop just after the chillers stop. With fixed speed (uncontrolled) pumps there is a variation of pressure in the circuit hence a flow variation.

See diagram Solution. Using variable speed pumps the pressure drops through the evaporators are controlled by differential pressure sensors. In order to keep this pressure constant, pump performances are controlled, the right flow attained and energy consumption minimized. Pump is set to controlled operation (Ap control). It is easily done with the remote control R100. Pump terminals for start/stop input are connected.

To secure a high comfort, a standby pump can be added. Controller ControlMPC will be used for alternation between two pumps.
3.2 Secondary pumps

Installation with 2 way valve.

The demand for cooling varies greatly during the year. When the installation is equipped with two-way valves, the flow is variable. In this case we recommend the use of variable speed pumps installed in parallel as main pumps. Using a ControlMPC controller a maximum of 4 pumps can be controlled. By varying the speed of all the pumps, maximum energy savings can be obtained.

It is important to check the efficiency at the duty point, where the system has a high number of operating hours.

Using TPE Series 2000, no external pressure sensor and motor protection is necessary, only a ControlMPC series 2000 is needed for parallel operation. It is possible to have proportional pressure without a sensor placed in the system. For bigger systems, both external sensor, motor protection and a pump control unit is necessary.

The demand for cooling varies greatly during the year. When the installation is equipped with three-way valves, the flow around the primary circuit is constant, with the flow to the room coolers being controlled by the three-way valves. When the cooling demand is low, water coming from the chiller is bypassed and the return temperature is reduced. If the chiller is not controlled by this return temperature, we recommend the use of variable speed pumps mounted in parallel up to a maximum of 4 pumps.

By controlling the speed of all the pumps, the return temperature is maintained, and maximum energy savings obtained. Temperature sensor is placed on the return pipe after the last connecting point. Using TPE Series 2000, no external pressure sensor, and motor protection can be used, and maximum energy savings obtained. Temperature sensor is installed over the pump.

Using TPE Series 2000, no external pressure sensor and motor protection is necessary, but for bigger systems, a pump control unit must be added for parallel operation. For bigger systems, motor protection is necessary.

### Secondary pumps

<table>
<thead>
<tr>
<th>Recommended product types</th>
<th>Differential pressure control</th>
<th>Features</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGNA</td>
<td>Ap</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Control MPC</td>
<td>Ap, F, S, DTC, L, T</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>TPE series 2000</td>
<td>Ap, F, S, DTC, L, T</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Control MPC series 2000</td>
<td>Ap, F, S, DTC, L, T</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

### 3.3 Condenser

The chiller varies its performance according to the cooling demand of the system. It is recommended that the system has a constant flow, normally adjusted by an regulating valve. It may be an advantage to use a variable speed pump which can provide a financially viable alternative.

In such systems, risk of frost will involve the use of glycol mixture.

Pump is set to uncontrolled operation and then adjusted to the correct flow. It is easily done with the remote control R100.

To secure a high comfort, a standby pump can be added. Controller ControlMPC has to be used for alternation between two pumps.

---

**Condenser pumps**

<table>
<thead>
<tr>
<th>Recommended product types</th>
<th>Temperature control</th>
<th>Features</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGNA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control MPC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Secondary pumps

- **Recommended product types**: Differential pressure control
- **Features**:
  - No external sensor required
  - Sensor installed over the pump
  - Sensor installed in the system
  - Analogue setpoint influence (0-10 V)
  - Grafic display with user interface
  - Start-up wizard
  - Motor protection
- **Pumps**:
  - MAGNA-D, MAGNA with GENiBusmodule
  - TP100
  - with external Control MPC
  - 0.25-7.5 kW: 1 relay, 12-22 kW: 2 relays
  - 0.25-15 kW: CIM interface / 11-22 kW CIU interfaces
  - 100% setpoint influence

### Condenser pumps

- **Recommended product types**: Temperature control
- **Features**:
  - No external sensor required
  - Sensor installed over the pump
  - Sensor installed in the system
  - Analogue setpoint influence (0-10 V)
  - Grafic display with user interface
  - Motor protection
- **Pumps**:
  - MAGNA
  - Control MPC
  - TPE
  - with external Control MPC
  - 0.25-7.5 kW: 1 relay, 12-22 kW: 2 relays
  - 0.25-15 kW: CIM interface / 11-22 kW CIU interfaces
  - 100% setpoint influence
3.4 Cooling Tower recirculation

The chiller varies its performance according to the cooling demand of the system. The cooling tower has to be controlled, in order to keep a constant return water temperature for the condenser.

Usually, the cooling tower water flow is controlled by a three-way valve. The condenser has a constant flow, normally adjusted by a regulating valve. As an alternative, we recommend control of cooling tower water flow by variable speed pumps. Pumps adapt their speed according to the return water temperature measured by the sensor. The complete system has a variable flow, and therefore maximum energy savings can be obtained. In such systems, risk of frost will involve the use of glycol mixture.

Temperature sensor is placed on the return pipe. When using TPE Series in such systems, risk of frost will involve the use of glycol mixture. Variable flow, and therefore maximum energy savings can be obtained.

3.5 Heating recovering

If there is a demand for Domestic Hot Water when the air conditioning system is in operation it is a good idea to recover the energy from the condenser to preheat the water. It can be done in a storage tank or via a heat exchanger. The pump must only be in operation together with the chiller and when the temperature of the cold water is below the temperature in the condenser. This can be secured by either an ON/OFF control or a temperature controlled pump. Using temperature control the maximum allowed coming back to the condenser will be the set point and can be measured in the bottom of the storage tank. The Start/Stop function for in the pump can be used.
3.6 Pressure holding

In stead of using a large closed pressure tank, one or more pumps together with an open storage tank will keep a constant static pressure in the system. If the system pressure is exceeding the allowable level a relief valve will lead the water back to the tank.

It is recommended to use treated water. It is recommendable always to install a standby pump. If the system is used for refilling the system please note that there is a risk of cavitation in the pump when the system pressure is very low. To avoid this the flow from the pump has to be throttled down.

### Pressure holding pumps

<table>
<thead>
<tr>
<th>Recommended product type: Pressure control</th>
<th>Features</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Hydrowise</td>
<td>- Analogue setpoint influence (0-10 V)</td>
<td></td>
</tr>
<tr>
<td>- Control MPC</td>
<td>- Start-up wizard</td>
<td></td>
</tr>
<tr>
<td>- MP204 (Motorprotection)</td>
<td>- Sensor installed over the pump</td>
<td></td>
</tr>
</tbody>
</table>

### Tertiary pumps

A cooler battery cools the air, which is blown into the building through the air conditioning system. The temperature in the cooler battery is dependent on the outside temperature and is controlled via the air conditioning system’s control unit. To ensure a good heat transmission coefficient, the system requires a constant flow.

The cooler battery output is controlled by a temperature controller, using a mixing circuit equipped with either a two-way or three-way valve. Normally the flow is adjusted by a regulating valve but it may be an advantage to use a variable speed pump.

### Cooling Ceiling/ Floors

Due to the risk of condensation, the flow temperature through a chilled beam/floor network must be higher than the temperature in the pipe-work from the chiller. A mixing circuit equipped with either two-way or three-way valves controls this temperature.

Due to variation in use and cooling demand in different parts of the building, the cooling duty of the chilled beam / floor network is controlled by two-way valves via a room control unit. By varying the speed of the pump, it is possible to increase the electrical energy saving of the system. It is important to check the efficiency at the duty point where the system has a high number of operating hours. Using TPE Series 2000 there is no need for an external pressure sensor and a motor protection. It is possible to have proportional pressure without a sensor placed in the system.
### 3.7.b Tertiary pumps

**Fan Coils**

In order to avoid too cold air flow, the flow temperature through the fan coil network must be higher than the water temperature from the chiller.

A mixing circuit with either two-way or three-way valves controls this temperature. Due to variation in use and cooling demand in different parts of the building, the cooling duty of the fan coil network is controlled by two-way valves via a room control unit. By varying the speed of the pump, it is possible to increase the electrical energy saving of the system. It is important to check the efficiency at the duty point where the system has a high number of operating hours.

Using TPE Series 2000 there is no need for an external pressure sensor and a motor protection. It is possible to have proportional pressure without a sensor placed in the system.

### 3.8 Mixing loops

Due to variation in use and heat demand in different parts of the building, the system is divided into zones controlled by a mixing loop. The flow temperature will be lower than in the mains supply, which will result in a higher flow in the zone than in the mains supply. This will help obtain a better hydraulic balance in the total system. Speed controlling the pump makes it possible to obtain the maximum energy saving.

When using a two-way valve, the pressure lost in the valve will be managed by the main pump. When using a three-way valve, the pump in the mixing loop also has to manage the pressure lost in the valve.

Using MAGNA and TPE Series 2000 there is no need for an external pressure sensor and a motor protection. It is possible to have proportional pressure without a sensor placed in the system.
4. District cooling

Campus/ large scale DH

District cooling describes a water-based cooling system where there is a considerable distance between the place the chill is generated (power plant) and the place the chill is used (the building).

District cooling has become more and more popular all over the world if the requirements fit into the local area.

4.1 Primary pumps

Main Pumps

Due to variations in heating demand and flow, we recommend that the main pumps be speedregulated and installed in parallel. Install a maximum of 3 pumps plus 1 as a standby. The use of speed-regulated pumps maximises the potential energy saving.

It is important to check the efficiency at the duty point at which the system has a high number of operating hours.

Using MAGNA and TPE Series 2000, no external pressure sensor or motor protection is necessary. Only a ControlMPC is needed for parallel operation. It is possible to have proportional pressure without a sensor placed in the system.

For pumps above 22 kW an external sensor, motor protection and a pump control unit are necessary.

District cooling describes a water-based cooling system where there is a considerable distance between the place the chill is generated (power plant) and the place the chill is used (the building).

District cooling has become more and more popular all over the world if the requirements fit into the local area.

### Primary pumps

<table>
<thead>
<tr>
<th>Recommended product types</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential pressure control, Temperature control</td>
<td><strong>Control MPC</strong> Differential pressure control, Temperature control</td>
<td><strong>Control MPC series 2000</strong> Differential pressure control, Temperature control, Proportional pressure, Frequency</td>
<td><strong>CUE (Frequency converter)</strong> Differential pressure control, Temperature control, Proportional pressure, Frequency, Level, pH-Wert, Chlorine, Chlorine dioxide, Ozone, Peracetic acid, Hydrogen peroxide</td>
</tr>
</tbody>
</table>
4.2 Secondary pumps

Installation with 2 way valves.

The demand for cooling varies greatly during the year. When the installation is equipped with two-way valves, the flow is variable. In this case we recommend the use of variable speed pumps installed in parallel as main pumps. Using a ControlMPC controller a maximum of 4 pumps can be controlled. By varying the speed of all the pumps, maximum energy savings can be obtained.

The demand for cooling varies greatly during the year. When the installation is equipped with three-way valves, the flow around the primary circuit is constant, with the flow to the room coolers being controlled by the three way valves. When the cooling demand is low, water coming from the chiller is by passed and the return temperature is reduced. If the chiller is not controlled by this return temperature, we recommend the use of variable speed pumps mounted in parallel up to a maximum of 4 pumps.

By controlling the speed of all the pumps, the return temperature is maintained, and maximum energy savings obtained. Temperature sensor is placed on the return pipe after the last connecting point. Using TPE Series 2000, no external pressure sensor and motor protection is necessary, but for bigger systems, a pump control unit is necessary.

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By controlling the speed of all the pumps, the return temperature is maintained, and maximum energy savings obtained. Temperature sensor is placed on the return pipe after the last connecting point. Using TPE Series 2000, no external pressure sensor and motor protection is necessary, but for bigger systems, a pump control unit is necessary.

4.3 Condenser pumps

Dry Cooler

The chiller varies its performance according to the cooling demand of the system. It is recommended that the system has a constant flow, normally adjusted by an regulating valve. It may be an advantage to use a variable speed pump which can provide a financially viable alternative.

In such systems, risk of frost will involve the use of glycol mixture. The dry cooler is a financially viable alternative.

The demand for cooling varies greatly during the year. When the installation is equipped with three-way valves, the flow around the primary circuit is constant, with the flow to the room coolers being controlled by the three way valves. When the cooling demand is low, water coming from the chiller is by passed and the return temperature is reduced. If the chiller is not controlled by this return temperature, we recommend the use of variable speed pumps mounted in parallel up to a maximum of 4 pumps.

By controlling the speed of all the pumps, the return temperature is maintained, and maximum energy savings obtained. Temperature sensor is placed on the return pipe after the last connecting point. Using TPE Series 2000, no external pressure sensor and motor protection is necessary, but for bigger systems, a pump control unit is necessary.

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By controlling the speed of all the pumps, the return temperature is maintained, and maximum energy savings obtained. Temperature sensor is placed on the return pipe after the last connecting point. Using TPE Series 2000, no external pressure sensor and motor protection is necessary, but for bigger systems, a pump control unit is necessary.
4.4 Pressure holding

In stead of using a large closed pressure tank, one or more pumps together with an open storage tank will keep a constant static pressure in the system. If the system pressure is exceeding the allowable level a relief valve will lead the water back to the tank. It is recommended to use treated water. It is recommendable always to install a standby pump. If the system is used for refilling the system please note that there is a risk of cavitation in the pump when the system pressure is very low. To avoid this the flow from the pump has to be throttled down.

4.5 Booster pumps

Booster pumps

In stead of using a large closed pressure tank, one or more pumps together with an open storage tank will maintain constant static pressure in the system. If the system pressure exceeds the allowable level, a relief valve will lead the water back to the tank. It is recommended that treated water be used. The set point will be the static pressure of the system. It is recommendable always to install a standby pump. If the system is used for refilling the system please note that there is a risk of cavitation in the pump when the system pressure is very low. To avoid this the flow from the pump has to be throttled down.
4.6 Tertiary pumps

Cooling surface
A cooler battery cools the air, which is blown into the building through the air conditioning system. The temperature in the cooler battery is dependent on the outside temperature and is controlled via the air conditioning system’s control unit. To ensure a good heat transmission coefficient, the system requires a constant flow. The cooler battery output is controlled by a temperature controller, using a mixing circuit equipped with either two-way or three-way valves. Normally the flow is adjusted by a regulating valve but it may be an advantage to use a variable speed pump.

Cooling Ceiling/ Floors
Due to the risk of condensation, the flow temperature through a chilled beam/floor network must be higher than the temperature in the pipework from the chiller. A mixing circuit equipped with either two-way or three-way valves controls this temperature. Due to variation in use and cooling demand in different parts of the building, the cooling duty of the chilled beam/floor network is controlled by two-way valves via a room control unit. By varying the speed of the pump, it is possible to increase the electrical energy saving of the system. It is important to check the efficiency at the duty point where the system has a high number of operating hours.

Using TPE Series 2000 there is no need for an external pressure sensor and automatic adaptation of the pressure is possible. It is possible to have proportional pressure without an external sensor placed in the system.

Due to variation in use and cooling demand in different parts of the building, the cooling duty of the chilled beam/floor network is controlled by two-way valves via a room control unit. By varying the speed of the pump, it is possible to increase the electrical energy saving of the system. It is important to check the efficiency at the duty point where the system has a high number of operating hours.

Using TPE Series 2000 there is no need for an external pressure sensor and automatic adaptation of the pressure is possible. It is possible to have proportional pressure without an external sensor placed in the system.

Real life calculation case

In connection with the renovation of one particular 23-year-old air-conditioning system, all the three-way control valves were replaced with two-way valves, to alter the system from constant flow to variable flow. The constant-speed pumps were also subsequently replaced with Grundfos variable-speed pumps. The following example shows the impact on the main pumps.

Area with air conditioning: 23,000 m²
Cooling season: 7,000 hours
Fan coils: 450 pcs.
Air handling units: 35 pcs.
Total cooling power: 1,200 kW

System 1
Flow: constant • Configuration: one constant-speed pump selected at best efficiency point.

System 2
Flow: variable • Configuration: two speed-controlled pumps
• Control: PFU (PO)

Pump configuration: proportional pressure control measured within the system.

<table>
<thead>
<tr>
<th>Tertiary pumps</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R100 Infrared communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>BACnet data communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LONWorks data communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ethernet (VNC Server) data communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GRM (Grundfos Remote Management)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GENIbus data communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No external sensor required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor (0-4-20mA / 0-10V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor installed over the pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensor installed in the system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analogue setpoint influence (0-10 V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grafic display with user interface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A = Autoadapt, Dp = Differential Pressure, P = Const. Pressure, PP = Proportional Pressure, T = Const. Temperature, DT = Differential Temperature, F = Const. Flow, SV = Const. Speed/Frequency, L = Level, pH = pH-Wert, Cl₂ = Chlorine, ClO₂ = Chlorine dioxide, O₃ = Ozone, PAA = Peracetic acid, H₂O₂ = Hydrogen peroxide

*1) MAGNA-D, MAGNA with GENIbus module
*2) TPE
*3) with external Control MPC
*4) 0,25-7,5 kW NBE: 1 relay, 11-22kW MGE: 2 relays
*5) 0,25-7,5 kW CIM interfaces / 11-22kW CIU interfaces
*6) CIM interfaces
*7) DDA Option E-Box Profibus
*8) GENIbusmodule MPC
*9) version CIM xx2 needed
*10) CIU interfaces
*11) incl. differential pressure sensor
*12) 4-20 mA Sensor required
*13) prepared for CIM interface, profiles follow later

Life Cycle Cost – 20 years operation

<table>
<thead>
<tr>
<th></th>
<th>System 1</th>
<th>System 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>EUR 200,000</td>
<td>EUR 250,000</td>
</tr>
<tr>
<td>Energy</td>
<td>EUR 100,000</td>
<td>EUR 150,000</td>
</tr>
<tr>
<td>Maintenance</td>
<td>EUR 50,000</td>
<td>EUR 100,000</td>
</tr>
<tr>
<td>Total</td>
<td>EUR 350,000</td>
<td>EUR 500,000</td>
</tr>
</tbody>
</table>

Initial cost = 200,000
Energy cost = 100,000
Maintenance cost = 50,000
5. Pressure boosting

Medium/ large buildings

Pressure boosting large buildings is necessary whenever the public water supply is inadequate, either because of too low pressure or because of too low flow to supply the building during peak consumption. The objective is to ensure a constant pressure throughout the building. The profile depends on what the building is used for, but most multi-storey buildings are used for commercial matters. Commercial buildings have quite predictable variations during the day. The Multi-E is normally the perfect choice for this application. It has the capability to follow the fluctuations of demand caused by the 2-3 speed controlled pumps, but also the reliability and user-friendliness that is needed for multi-storey buildings.

Application

Whenever water has to be moved from ground-level and upwards in a building, there is always a risk of a pipe bursting due to the pressure. The soft pressure build-up function in the MPC protects the piping during start-up of the system, and provides the user with protection from costly flooding.

5.1 PB with break tanks

The water supply to a building have to be reliable and comfortable. To fulfill this requirement a pressure boosting system is very recommendable. A complete pressure boosting system will automatically compensate for the variations in the pre pressure from the water mains and the variations in consumption and by varying performance – ensure that the supply pressure to the building is constant.

We recommend the speed controlled Hydro MPC-E pressure boosting systems, which can give a constant pressure to the building and at the same time ensures optimum operation costs and supply security. If system cost is very important, the lower cost systems Hydro Multi-E can be selected.

If standby pump capacity is not required, the Hydro Solo-E solution can be recommended.

Use the Consumption Profile as the basis for selecting the optimum system. The number of pumps and the size of these shall fit to profile. Grundfos pressure boosting systems are easy to install. Connect the unit to mains supply and the piping, prime the system and we are ready to go.

It is recommendable to install a water shortage detection on the suction side the booster. By direct boosting systems a pressure switch can be used – in case of a break tank system, a level switch in the tank will be the best solution.

Break tanks are often required in areas where:
- the piping in the mains are weak and can’t stand pressure surges caused by pumps starting and stopping.
- local requirements

---

**Break tank system**

---

**Recommended product types**

<table>
<thead>
<tr>
<th>Pressure control</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
<th>Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB with break tank</td>
<td>Hydro MPC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control MPC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1) PB with break tanks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2) PB with break tanks</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### Features

- **S**= Const. Speed/Frequency
- **L**=Level, pH, pH-Wert, **P**= Chlorine, **ClO2**=Chlorine dioxide, **O3**=Ozone, **PAA**=Peracetic acid, **H2O2**=Hydrogen peroxide
- **A**= Autoadapt
- **Dp**= Differential Pressure
- **T**= Const. Temperature
- **DT**= Differential Temperature
- **F**= Const Flow

---

### Pumps

- **CIU interfaces**
- **CIU interfaces**
- **CIU interfaces**
- **CIU interfaces**
- **CIU interfaces**

---

*1) MAGNA-D, MAGNA with GENIbusmodule
*2) TP90
*3) with external Control MPC
*4) D20.75 kW MGE - 1 relay, 11-22 kW MGE - 2 relays
*5) CIU interfaces
*6) CIU interfaces
*7) CIU interfaces
*8) CIU interfaces
*9) CIU interfaces
*10) CIU interfaces
*11) incl. differential pressure sensor
*12) 4-20 mA sensor required
*13) 2) 4-20 mA sensor required
*14) 1) incl. differential pressure sensor
*15) 2) 4-20 mA sensor required
*16) 2) 4-20 mA sensor required
5.2 PB with direct connection

The system layout have to be considered before the booster system can be selected.

Direct boosting – or break tank

The connection to the water supply mains can either be directly or via a break tank. If direct connection is allowed this will be recommendable.

The pressure requirement to a pressure boosting system with direct connection will be less than systems with break tank, as the system then can use the water supply mains pressure as a pre-pressure.

Depending of area the water supply mains pressure typically will be in the range 1.5 – 4.0 bar.

---

5.3. PB with roof tanks

The system layout have to be considered before the booster system can be selected.

**Roof tank systems**

In some areas roof tank systems are required. The reason is to ensure water supply for a certain period also if the electrical power supply disappears.

The transfer pump can pump from a break tank or direct from supply mains.

Water supply (pressure) to the building is obtained by a Booster System, boosting down to the 3-4 upper floors. The rest of the building is supplied by gravit.
5.4 Transport to roof tanks

When an application requires a rooftop tank speed controlled boostersystem, it can be beneficial in order to make sure that the filling of the tank takes place in a manner where the pipes are protected from waterhammer and pressure surges that in the end can result in peebursts and noise.

Boostersystems that are used for tank filling should incorporate a filling-phase that slowly fills the pipe up and makes sure that the noise and surge from the start up of the pumps are kept at a minimum.

The Hydro Multi-B with dedicated tankfilling software gives the possibility to do exactly that.

5.5 PB zone divided

Zones

In high rise buildings it is necessary to split the water supply system up in zones to ensure:

1. That the pressure from one floor to another doesn’t vary too much.
2. Min. pressure upper floor in each zone should be higher than 1.5-2 bar
3. Max. pressure in lowest floor in each zone should not be higher than 4.5-5 bar

System layout can be with:

1. All booster systems in basement. Boosting up in the building (see figure).
2. Cascade booster system layout. One booster in the basement supplies all the water up to zone 1, where a second booster will boost up to zone 2, etc.
3. In combination with roof tank. A booster on the roof top are boosting down to the 3-4 upper floors. The rest of the building is supplied by gravity.

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### Transport to roof tank

**Recommended product types:**

Level control, pressure control

**Control (depend on connected sensor):**

**Features:**

**Pumps:**

---

### PB zone divided

**Recommended product types:**

Pressure control

**Control (depend on connected sensor):**

**Features:**

**Pumps:**

---

**GRUNDFOS CONTROLS – PRESSURE BOOSTING**
5.B. Rainwater
Medium/ large buildings

A well-designed rainwater harvesting system integrates several design disciplines, including civil, mechanical and electrical engineering, architecture and landscape architecture, toward the common goal of using one of nature’s most renewable resources. Depending on the application, rainwater becomes the sole or partial source of water for water closets and urinals, irrigation, hose bibs, water features, cooling towers or second-ary fire suppression.

From a building owner’s perspective, rainwater harvesting offers the opportunity to decrease water and wastewater charges that often are assessed on new buildings to help pay for expanding municipal infrastructure and separate stormwater systems. It can ease the burden of system development costs, which are rising faster than energy costs in some parts of the country. It can create a partial source of water for water closets and urinals, irrigation, hose bibs, water features, cooling towers or secondary fire suppression.

Rainwater harvesting also can turn a potential liability—runoff and resulting erosion—into an asset. Perhaps the best and most prevalent reason, for integrating rainwater harvesting into a new building’s design is increasing interest in green building.

Rainwater harvesting is a relatively easy and excellent way to demonstrate environmental stewardship to the community and stakeholders. And, depending on the design, rainwater harvesting can help a project garner up to LEED Silver, Gold or Platinum levels.

Rainwater control

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5.B.1 Rainwater Control

**Reliability**
Absence of multistage centrifugal self-priming pumps. Their presence can overcome all the problems or the suction lines are likely to suffer. In addition, the designer of the building will not be constrained to be constrained by laws that restrict the hydraulic suction pump self-priming up to MWK 30.18. (Note: This value corresponds to maximum height, it should be corrected according to the dynamic pressure drop and NPSH value (net positive suction) of the pump)

**Energy efficiency**
Very important, especially in case of shortage of rainfall and water use necessary potable. The standard EN727 and guidelines in this area clearly state that the pressure of the water should be reduced to atmospheric pressure before being again brought to its pressure by a pump. In large buildings dimensions characterized by the presence of many sampling points does not require the distribution of drinking water, farmers often face a shortage of rainfall.

User friendly and easy to set
The installation is done though Grundfos RCM graphic display (CUT 361). The range of Grundfos Hydro booster blowers MPC and consoles Dedicated Control Controls pumps for waste water have also this proven technology.

**Synthesis**

Designed to supply rainwater sampling points installed in the non-residential buildings and does not require the distribution of drinking water, this Grundfos offers is under the sign of reliability, energy efficiency and operational safety. If this system has no self-priming pump to prevent any problems likely to affect the suction (air pockets, irregular slope of the pipe, etc.), however it is equipped with a pump power of steel stainless steel tank connected to a rainwater tank hybrid. In case of shortage of rainfall, the system switches to the installation of water potable. This constant pressure pump and control the rotation speed has a high efficiency motor that provides water sampling points.
6. Wastewater
Medium/ large buildings

Wastewater in building, especially in commercial building need to be collected and discharged to the main sewer systems outside the building when sanitary appliances, cantines, backwashfilter from swimming pools, drainage, deep-level garages etc. are located in the basements below the sewer system outside. The must be effluent these sections of the buildings is beyond dispute. Wastewater from a building is devided into blackwater with faeces from toilets and greywater w/o faeces e.g. from washing machines, showers, wash basins etc. and in close connections to the building also drainage: surface- and rainwater need to be collected. That must happen outside the building in pumping stations and not be led into the building. The portfolio of wastewater transport can be interrupted in case of service, maintenance or failure. For more security an alarm device or a controller with a level sensor connected to a controller which need to be selected due to application and the pump type and size. For most of commercial applications a level sensor connected to a controller which need to be selected due to application and the pump type and size.

Submersible wastewater pumps:
UNILIFT (up to 1.5 kW) - are available with level switch for automatic start and stop. Or without for usage of a separate level detection and controller. They can be installed in customized concrete wells in the basement plate or special collecting tanks like Liftaway C, Liftaway R, Uno/ Duo/ lift and PUST

Small SL (up to 4 kW) - are available with level sensor and control device (AutoAdapt3) inside the pump or without for the use of a separate level detection and controller. They can be installed in customized concrete wells in the basement plate or special collecting tanks like PUST.

SEG (grinder pump up to 4 kW) - are available with level sensor and control device (AutoAdapt3) inside the pump or without for the use of a separate level detection and controller. They can be installed in special collecting tanks like Uno/Duo/ lift or pumping stations like PUST.

SE and SL (up to 11 kW) - are without controller for the use of a separate level detection and controller. They can be installed in pumping stations like PUST.

Pre-assembled lifting stations:
SOLOLIFT2 - are designed for a limited number of sanitary appliances (e.g. single toilet, wash basin, shower). All SOLOLIFT2 are without controller for the use of a separate level detection and controller. They can be installed in customized concrete wells in the basement plate or special collecting tanks like PUST.

MULTILIFT - are designed to dewater areas or complete basements. They are supplied as complete units consisting of a collecting well (300 - 2000 litre), one or two pumps, complete pipework with non-return valve(s), a level sensor connected to a controller which need to be selected due to application and the the pump type and size.

Pumping stations:
PUST - are designed to dewater complete buildings up to whole districts depending on the size. They are supplied customized, complete units consisting of a collecting well (300 - 2000 litre), one or two pumps, complete pipework with non-return valve(s), a level sensor connected to a controller which need to be selected due to application and the the pump type and size.
6.2 Drainage

When installed permanently in a pump pit, the pumps are typically used for drainage and pumping effluent from cellars, air handling units, boiler rooms, elevator shafts or other situations where water is unwanted in and around buildings. In drainage systems the min. free passage for the pump must not be less than 5 - 10 mm.

The Unilift KP and Unilift AP pump range is ideal for permanent installation in the Liftaway B pump pits and allows for a very fast and flexible installation. With a flow switch connected, the pump can be used for automatic operation.

For larger quantities of drainage water the range of Grundfos SE1 and SEV pumps can meet virtually all systems in and around buildings. The most common used installation is submerged in a pumping station, where the pump is lowered into position on guide rails, and it automatically connects with the discharge pipe system. To prevent backflow, a non-return valve is normally installed in connection with the system.

Increased clogging risk

Semi-open multi-stage impeller

Free passage [mm]

4 8 12 16 20

6.3 Surface water

Rain water from catchment areas of the building is in most cases gathered in a pit. Often there is a need for a pump to pump the water into the municipality rainwater system. The amount of drainage collected depends on both the vertical area of the building as well as the roof and gravel area surrounding the building incl. parking areas and gardens. In rain water systems the min. free passage for the pump must not be less than 25 – 30 mm.

Pump failure in rain water systems will normally cause heavy expenses for considerable cleaning and disinfection before drying-out can take place. Therefore we recommend 100% spare capacity in the system. Common to all the variants in the Grundfos pump range is their easy-to-install design. The Unilift KP and Unilift AP pump range is ideal for permanent installation in pump pits and allows for a very flexible installation. With a flow switch connected, the pump can be used for automatic operation.

For larger quantities of surface water the range of Grundfos EF, SL, SE, S pumps can meet virtually all systems in and around buildings.
### 6.4 Sewage

Pumping stations are designed for collecting and pumping sewage and effluent from discharge levels below the sewer line. The Super Vortex hydraulic is specially designed to handle unscreened sewage and its performance is superior in situations where small volumes of flow are pumped against high heads. For larger volumes channel hydraulics is normally used.

The range of Grundfos SEG, SL, SE, S Wastewater Pumps is used for pumping sewage, wastewater and considerable quantities of surface water and ground water.

Pump failures in a sewage system may additionally result in evacuation and rehousing of people, due to contamination. Therefore we recommend to always have 100% spare capacity in the system.

Grundfos offer a wide range of PLST pre-fabricated pumping station, for this purpose.

Sewage pumps in common systems are frequently operated in parallel to this purpose.

### 6.5 Dewatering

For emptying of smaller tanks, ponds and pools the lightweight composite Uniflif DP or stainless steel range of Uniflif KP, Uniflif AP and DP pumps are very easy to handle and install.

For larger quantities of drainage water, and more demanding applications like excavation of construction sites for larger buildings, or flooded basements, the range of Grundfos DP, DPK, DW, DWK pumps can meet virtually all demands in and around buildings.

The vertical discharge port at the top of the pumps allows for quick installation. The pump range is ideal for temporary as well as permanent installation, and allows for vertical, horizontal or even inclined installation.

In the systems the min. free passage for the pump must not be less than 10 mm.

With a flow switch connected, the pump can be used for automatic operation. The DW pumps offers own integrated automatic start-stop system. To prevent backflow, a non-return valve is normally installed in connection with the system.
7. Fire

Medium/ large buildings

Beyond standard products
Grundfos provides top performance electric- and diesel fire pump systems with all relevant listings and approvals. The fire pump sets are tested thoroughly to ensure maximum performance and premium reliability. Grundfos has the widest range of fire pumps, covering the fire pump approvals globally i.e.: FM, UL, VDS, LPCB, VNIIPO, CCCCE, EN 12845, OKF, PVUS, CNBOP etc.

Fire pump ranges
Our quick delivery programme contains more than the electrically or diesel-driven EnSuction and Horizontal Split Case pumps. We also supply In-Line fire pumps (vertical turbine pumps for wet pit applications, or applications where positive inlet pressure is not available).

Modularised systems
Grundfos designs and builds customised systems that meet your specific needs. We mount the fire pump, driver, controller and piping with complete interconnected wiring on a common base or a modularised base frame for final assembly on location.

Packaged / containerised systems
With Grundfos’ enclosed systems, your installation-to-operation time is minimal. Our enclosed systems are typically built as an integrated pump and control centre with:

- Diesel engine
- All the required controllers
- In-house piping
- Fittings
- Interconnected wiring
- A complete installation that meets the requirements of UL, FM, NFPA 13 and NFPA 20

7.1 Jockey pump
The Jockeypump is activated by a signal from the pressure switch, to maintain the pressure in the pipesystem.

Standard CR pump, that are activated by pressure switch.
3 different controller alternatives:
- Controlled by the Electric fire pump controller “VDS Control FS1”
- Controlled by a separate standard pump controller “Hydro Mono”
- Controlled by a separate special Jockey pump controller “Control CS 1”

From 0,75 - 18,5 kW - this is a special jockey pump controller with features: runtime, power, run, error indicators, start/test set.

7.2 Hydrant pump systems
Beyond standard products
Grundfos provides fire pump systems for hydrants/ hose reel systems. The firepumps can be CR- or NB/NK pumps including controller compliant to local standards.

7.3 Sprinkler Pump systems
Grundfos provides Fire pump systems to automatic sprinkler systems. The Fire pumps can be NBF, NKF, DNF, HSEF, HSM and VTF including controllers compliant to local standards.

Electric Firepump controllers
Grundfos made controllers:
- Control FS 1 Electric - approved by VDS
- Hydro MX Electric controller - approved by VNIIPO (Russia)
- LPC Electric controller – compliant to BS EN 12845

Sourced controllers:
- EN 12845 electric controller – compliant to EN 12845
- NFPA 20 Electric controller – approved by UL FM
- DBI 251 Electric controller – approved by DBI

Diesel Firepump controllers
Grundfos made controllers:
- Control FS 1 Diesel - approved by VDS

Sourced controllers:
- EN 12845 Diesel controller – compliant to EN 12845
- NFPA 20 Diesel Firepump controller – approved by UL FM
- LPC Diesel controller – approved by LPC
- DBI 251 Diesel controller – approved by DBI

For details of analog and digital signals and available data communication or GRM as accessory please ask your fire control cabinet builder (e.g. GWP, GMR, GBW)
8 Const pressure - speed controlled or ON/OFF regulated

Industry

Consumption patterns vary from one industry to the next. Some require frequent use of water in smaller amounts while others need to fill several large tanks in no time – without it affecting the water supply in different parts of the building. Grundfos’ extensive range of utility pumps have been carefully developed to ensure constant pressure at all times in water supply applications. Depending on your specific application, our reliable pumps can be customised to provide the exact pressure required. Single-stage and multistage pumps are available to guarantee constant pressure in critical or demanding applications. Multi pump systems can be delivered complete with VFDs and controls.

8.1 Const pressure

Recommended product

Pressure control

Single pump control
Constant Pressure - speed control.
(The function is described in details in the Grundfos Pump Handbook)

Pump will operate with constant pressure from Qmin to Qn.
From Zero flow to Qmin the system will operate in On/Off mode by use of an attached tank.
Surveillance and monitoring can be attached i.e.
- Dry run protection
- Protection against closed valve
- Protection against bursted pipe
- e.t.c.

Remote / Satellite operations is possible if needed. (Several Fieldbus standards are supported and also the GRM (Grundfos Remote Monitoring), e.t.c.)

8.2 On/Off pressure control

On/off pressure control:
By means of pressure switch, connected to a relay, and MP204 motor protection unit we have an operation, protection and surveillance in one package.
This can be used for monitoring of pumps in remote areas or for advanced control of large pumps in demanding applications.

Features

Pumps

Consumption patterns vary from one industry to the next. Some require frequent use of water in smaller amounts while others need to fill several large tanks in no time – without it affecting the water supply in different parts of the building. Grundfos’ extensive range of utility pumps have been carefully developed to ensure constant pressure at all times in water supply applications. Depending on your specific application, our reliable pumps can be customised to provide the exact pressure required. Single-stage and multistage pumps are available to guarantee constant pressure in critical or demanding applications. Multi pump systems can be delivered complete with VFDs and controls.

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Based on decades of experience, Grundfos’ E-solutions offer professional control that will add even more value to your system. Specifically in applications where reliable temperature control is essential, an E-solution will guarantee that the temperature never deviates the slightest from what is necessary to ensure optimum operating conditions. E-pumps with integrated frequency converter offer a superb array of pump-related functionality that will benefit most systems in terms of comfort, user-friendliness, process adaptability and not least operating economy. By regulating pump speed according to demand energy consumption and operating costs are significantly reduced. Compared to conventional fixed-speed pump solutions E-solutions enable annual energy savings up to 50%.

### 9.1 Process Cooling or Heating

**Temperature control**

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**Additional benefits of E-solutions are:**

- **Constant temperature** – temperature is kept constant irrespective of the flow.
- **Automated derating** – ensures optimum tolerance of ambient temperatures.
- **Set point influence** – ensures reliable and precise response to parameter regulations.
- **Stand still heating** – heats up the motor during stand still to avoid damaging condensation.
- **Communication with most SCADA systems**

Naturally, Grundfos E-solutions can be customised to meet specific requirements. Pump curves can be stretched, extra functions can be added and special operating panels can be included to mention but a few of the options. So if standard optimisation just isn’t enough, please contact us for dedicated solutions.
10 Boiler feed - duty/standby level control /speed control

Industry

Hot water boiler:
Grundfos’ single-stage and multistage pumps for hot water boilers are available for temperatures up to 140°C. All pumps can be controlled by a frequency converter which is either integrated in the motor or in a standard wall-mounted version, ensuring that the pressure and temperature in the system are constant. If the boiler requires a shunt in order to avoid thermal stress, we offer highly reliable pump solutions that will keep the temperature difference over the boiler constant.

Steam boiler:
Grundfos’ unique feeding pumps for steam boilers offer unsurpassed efficiency. CR multistage pumps are capable of feeding boilers between 0.5 and 180 m³ of water at 180°C per hour, and the volume is easily increased by applying more pumps.

Thermal oil:
Thermal oil is a highly suitable – and safe – alternative to steam in many processes, particularly where the dangers of high pressure are to be avoided. Grundfos’ range of feeding pumps for thermal oil applications handles temperatures up to 240°C.

Boiler feed

Note: Boiler feed application is described in details in the Grundfos Engineering manual including this topic.

Hot water boiler:
- Constant pressure and constant temperature control on shunt pump.

Steam boiler:
- Constant level control, against high system pressure
- Cavitation prevention, by controlling the duty point.
- Curve compensation of unstable pump characteristics
- Duty stand by function.

Thermal oil boiler:
- Constant pressure and constant temperature control on shunt pump.

Boiler feed

Recommended product types:
Pressure control
- Single pump
- Duty / standby
- Parallel cascade operation
- Non e-pump
- Relay outputs
- R100 Infrared communication
- BACnet data communication
- LONWorks data communication
- Profibus data communication
- Modbus data communication
- GSM/GPRS wireless data communication
- GRM data communication (Grundfos Remote Management)
- GENIbus data communication
- Ethernet (VNC Server) data communication

Energy optimizing functions
- Grafic display with user interface
- Start-up wizard
- Motor protection
- CR
- CM

Control MPC
- Δp, PP, Δp, PP, Δp, PP

CUE (Frequency converter)
- Δp, PP, Δp, PP, Δp, PP

MP204
- Δp, PP, Δp, PP, Δp, PP

Control MP204 + IO112
- Δp, PP, Δp, PP, Δp, PP


*1) MAGNA-D, MAGNA with GENIbusmodule
*2) TPED
*3) with external Control MPC
*4) 0.25-7.5 kW MGE: 1 relay, 11-22 kW MGE: 2 relays
*5) 0.25-7.5 KW: CIM interfaces / 11 -22 kW CIU interfaces
*6) version CIM X2 needed
*7) CIU interfaces
*8) 0.25-7.5 kW: CIM interfaces / 11 -22 kW CIU interfaces
*9) CIU interfaces
*11) incl. differential pressure sensor
*12) 4-20 mA Sensor required
*13) prepared for CIU interface, profiles follow later

* available

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11 Level control - tank filling and emptying

Industry

The level can be controlled by a large variety of sensors i.e.
- Pressure sensor
- Differential pressure sensors
- Capacitive sensors
- Ultra sound sensors

Consumption patterns vary from one industry to the next. Some require frequent use of water in smaller amounts while others need to fill or empty one or more large tanks in no time – or keep a constant level in said tanks. For constant level control, Grundfos offers P and PI control for filling and emptying applications.

The full range of Grundfos pumps can be used for this application, of course depending on the specific demands.

Standard level control, filling and emptying, based on level sensor or a pressure measuring.

In both cases a zoom function on the signal is needed (the whole regulation should be within a few mA of the measuring range).

This can be done by means of a standard PI-regulator or by a clean P-regulator.

Filling requires direct regulation.

Emptying requires inverse regulation.

Level Control

Recommended product types: Level control

Control (depend on connected sensor)

Features

Pumps

Control MPC

- Pressure sensor
- Differential pressure sensors
- Capacitive sensors
- Ultra sound sensors

The level can be controlled by a large variety of sensors i.e.

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0.25-7.5 kW: CIM interfaces / 11-22 kW CIU interfaces

*4) 0,25-7,5 kW MGE: 1 relay, 11-22kW MGE: 2 relays

*7) DDA Option E-Box Profibus

*8) GENIbusmodule MPC

*9) CIM interfaces

*10) CIU interfaces

*11) incl. differential pressure sensor

*12) 4-20 mA Sensor required

*3) *3) prepared for CIM interface, profiles follow later

*2) with external Control MPC

*1) MAGNA-D, MAGNA with GENIbusmodule

*5) 0.25-7.5 kW MGE: 1 relay, 11-22kW MGE - 2 relays

*6) 0.25-7.5 kW CIM interfaces / 11-22 kW CIU interfaces

*13) available

11.1 Level control

This can be done by means of a standard PI-regulator or by a clean P-regulator.

Filling requires direct regulation.

Emptying requires inverse regulation.
Grundfos has many years of experience in the wash and cleaning business. We offer a variety of dedicated solutions for e.g.:

- Vehicle washes
- Wash-down systems
- Part washers
- CIP/SIP

The thoroughly tested range is built on more than 60 years of experience and includes very compact pumps that will save you space without compromising performance. In addition to the pumps themselves, Grundfos offers you an array of motors, controls and monitors that will improve the performance of the system.

If you are building a new washing and cleaning system, we recommend that you talk to us as early in the development process as possible. By far the majority of our pumps can be easily adjusted to match your specific requirements and optimise the entire system.

Grundfos’ pumps are highly suitable for part washer applications in the industry, allowing the pumps to be customised in terms of flow and pressure to accommodate individual requirements. The single-stage or multistage centrifugal pumps operate in temperatures up to 180°C and at pressures up to 50 bar in a large variety of applications.

On top of the range of standard pumps available for washers, Grundfos also offers special pumps developed to handle different media. If the water contains oil, the shaft seal material must be able to withstand this specific liquid – while particularly aggressive detergents require that also the pump material has been designed for this challenge.

Naturally, all pumps for part washers can be supplied with dosing pumps that accurately dose the detergent and solvents. Naturally, all pumps for part washers can be supplied with dosing pumps that accurately dose the detergent and solvents.

CIP (Cleaning In Place) and SIP (Sterilisation In Place) systems are ideal in industries where hygiene is of the utmost importance and contamination must be avoided at all costs. Without dismantling any equipment, tanks, pipes and entire process lines can be efficiently cleaned, saving time and in turn money.

Grundfos’ CIP pumps, handling temperatures all the way up to 180 °C, are made of stainless steel to be able to withstand the aggressive detergents encountered in cleaning processes. As the CIP system is never in contact with the actual process – be it food or pharmaceuticals – sanitary pumps are not required. CIP pumps are, however, usually electro-polished to make sure that no residues stick to the inside. Precise dosing pumps can further speed up the CIP process by adding only the necessary detergent, consequently reducing the flushing of the system. As for the slightly more demanding SIP process, Grundfos multistage pumps are used to feed the boiler producing the steam that efficiently cleans e.g. bottles at very high temperatures.

Wash and cleaning operate with a variety of control principles. The idea is to have the pump running and generating pressure when the washing is going on. For systems with feeding pressure, they typically start on flow signal from either flow switch or flow-meter. They stop on either pressure or flow signal, and operate without tank or accumulation.

For systems with break tank, they need a small tank to keep pressure. Stop signal comes from either flow or pressure signal. Start will typically be on pressure, but can be combined with flow signal.

Signal can here mean both analog signal and switch.

The instrumentation can be used for monitoring and control.

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**12 Wash ‘n’ clean Industry**

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**12.1 Wash ‘n’ clean**

Wash and cleaning operate with a variety of control principles. The idea is to have the pump running and generating pressure when the washing is going on. For systems with feeding pressure, they typically start on flow signal from either flow switch or flow-meter. They stop on either pressure or flow signal, and operate without tank or accumulation.

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Signal can here mean both analog signal and switch.

The instrumentation can be used for monitoring and control.
13 Filter application

Reliable filtration is crucial in many industrial applications, prolonging the life of the products, pumped media, machines etc. Grundfos offers dedicated pumps for any filtration application.

Our range includes single-stage and multistage pumps, offering a very high flow essential to some filtration processes. Specifically for applications with particles in the media conveying into the filtration system, pumps with open impellers – and yet high efficiency – are available.

The pumps are ideal for both single filtration systems and central filtration systems and can be optionally supplied with E-solutions to optimise processes and increase reliability even further. Single filtration systems include for example:

- Paper belt filter
- Edge filter
- Vacuum filter
- Hydrostatic filter
- Drum filter
- Centrifugal filter
- Conveyors
- etc.

For operating the pumps we can use a variety of control systems. Some of the control ways normally used in filter applications are as follows:

- Constant pressure
- Constant differential pressure across a filter unit
- Constant flow through filters
- Change in duty point for backflushing
- etc.

Monitoring functions for filter units:

- Clogging
- Filter burst
Grundfos will continue to be at the forefront in promoting and implementing innovative pumping solutions that ensure the best possible efficiency and sustainability. Over the decades of experience developing controller and monitoring systems for pumping solutions and manufactures its own pump motors for all fluid types and flow requirements, Grundfos has pioneered numerous innovations that will enable water supply infrastructure to meet future challenges and regulations.

The sustainability of drawing water from a source over time requires that the pumping solution is cost-effective, offers trouble-free operation and is energy optimised. Grundfos has decades of experience developing controller and monitoring systems for pumping solutions and manufactures its own pump motors for all fluid types and flow requirements.

External frequency converters (CUE) for variable speed drives and motor protection (MP204) to monitor motor conditions ensure optimal adaptation to changing conditions. This ensures a perfect match with hydraulics, motors, electrics, and all other mechanical components that make up a comprehensive pumping solution, ensuring the best possible efficiency point.

Over the years Grundfos has pioneered numerous innovations that have become or are becoming industry standards. Grundfos will continue to be at the forefront in promoting and facilitating energy efficiency and sustainable technology. It is these innovations that will enable water supply infrastructure to meet future challenges and regulations.

The high-efficiency motors developed by Grundfos combined with an integrated or external variable frequency drive meet and in some cases exceed the requirements set by motor-efficiency legislation around the world. Considering that on average 85% of a normal pump system's Life Cycle Cost (LCC) is energy costs, switching to high-efficiency motor technology can mean a LCC reduction of up to 50% and a reduction in environmental impact.

Grundfos solutions are designed specifically for utility installations and all the components are fully integrated from the outset. Grundfos can go further than most to bring water to life in a manner that is financially and environmentally sustainable. Our insight can be applied to addressing the key issues of safeguarding water resources, meeting consumer needs, and ensuring cost-effective infrastructure. Grundfos commissioning agreements ensure correct installation and service agreements cover all eventualities, from routine maintenance to spare parts and pump audits.

Groundwater is a favoured source for municipal water supply systems offering a stable source based on natural filtration through the earth’s substrata, compared to polluted surface waters and the dry season water shortages from rivers and lakes.

Correct groundwater abstraction is central for ensuring the highest levels of energy optimisation and sustainability, which in turn is reflected in reduced lifecycle costs. Optimising this process means bringing together a number of areas of specialisation in the well field, such as the groundwater reservoir, the abstraction wells, the submersible pumps chosen, the raw water pipeline system, and the groundwater quality.

Grundfos offers submersible multistage SP pumps for all well types. The Grundfos SP pumps represent state-of-the-art hydraulic design. Built to deliver optimum efficiency during periods of high demand, the SP pumps provide low long-term costs and high operating reliability. In addition to a durable pump, you gain reliability and trouble-free, continuous operation, with very long service intervals when compared with other solutions. With a superb build quality and utilising our proven abilities with hydraulics, Grundfos pumps ensure reliable operation without pump failure, and are designed to withstand wear from sand.

Well field optimisation is an important issue. Typical problems encountered at a well field may be that the pumps used are too big or too small, the water table level may be lowering, requiring the pumps to manage greater head, and there may be issues with the water speed and pressure in the pipes network. These issues may result in inefficiency, increased costs, and the need to protect the water table.

Grundfos looks closely at the entire well field operation and through increased efficiency can achieve energy savings with a quick pay-back time. Experience has shown that half of all the savings in energy consumption that can be made in a municipal water supply are to be made in the well field.

By integrating variable speed drives and motor protection components, Grundfos can offer complete systems that are pre-engineered to work together. The Grundfos CUE represents one of the most comprehensive and versatile ranges of external variable speed drives for pump applications currently on the market. Together with the easy to use MP 204 motor protection, we ensure 24-hour monitoring and control of all vital parameters, such as dry-running or overload, to ensure operational stability.
### 14.2 Surface water

As lakes and rivers may have been exposed to pollution and pesticides, a careful balance needs to be maintained between slow filtering through a lakeside or river bank well and the optimum chemical disinfection. Adding the benefits of remote management could mean savings of up to 20% on power consumption, chemicals and testing at final treatment.

The fully automated disinfection systems developed by Grundfos offer an easy solution for chlorine-based disinfection methods. Grundfos can advise and supply disinfection solutions using chlorine compounds such as chlorine gas (Cl₂), sodium hypochlorite (NaOCl), and chlorine dioxide (ClO₂).

By integrating variable speed drives and motor protection components, Grundfos can offer complete systems that are pre-engineered to work together. Grundfos CUE frequency converters represent one of the most comprehensive and versatile control solutions for water intake.

| Recommended product types: Dosing, level control, pressure control, flow control |
|---------------------------------|---------------------------------|
| **Features**                     | **Pumps**                      |
| **Surface water**                | **Sea water**                  |
| **Control** (depend on connected sensor) | **Control** (depend on connected sensor) |
| **Recommended product types**    | **Recommended product types**  |
| Surface water                    | Sea water                      |

### 14.3 Sea water

Desalination of seawater is rapidly becoming an additional and necessary source of potable water in many parts of the world, and Grundfos is a market leader supplying total pumping solutions for desalination.

Grundfos can equip reverse osmosis plants operating in a one-stage or two-stage systems utilising pumps constructed in stainless steel with high corrosion classes and energy recovery systems with pump turbines at discharge. Such a construction can result in cost savings on maintenance, repair, power consumption and chemicals at the desalination plant.

Seawater is best treated at source to ensure the easiest disinfection processes can result in cost savings on maintenance, repair, power consumption and chemicals at the desalination plant. Seawater is best treated at source to ensure the easiest disinfection processes can result in cost savings on maintenance, repair, power consumption and chemicals at the desalination plant.

Grundfos can supply pumps for both dry and submerged installation. In particular, Grundfos SPE pumps are specifically designed to withstand corrosion, especially where the water has a high concentration of hydrocarbons and many chemicals.

The fully automated disinfection systems developed by Grundfos offer an easy solution for chlorine-based disinfection methods. Grundfos can advise and supply disinfection solutions using chlorine compounds such as chlorine gas (Cl₂), sodium hypochlorite (NaOCl), and chlorine dioxide (ClO₂). The automated processes require very little maintenance, provide very high efficiency, and reduce running costs.

By integrating variable speed drives and motor protection components, Grundfos can offer complete systems that are pre-engineered to work together. Grundfos CUE frequency converters represent one of the most comprehensive and versatile control solutions for water intake.

| Recommended product types: Dosing, level control, pressure control, flow control |
|---------------------------------|---------------------------------|
| **Features**                     | **Pumps**                      |
| **Surface water**                | **Sea water**                  |
| **Control** (depend on connected sensor) | **Control** (depend on connected sensor) |
| **Recommended product types**    | **Recommended product types**  |
| Surface water                    | Sea water                      |

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**Table:**

- **Surface water**
  - **Recommended product types:** Dosing, level control, pressure control, flow control
  - **Control** (depend on connected sensor)
  - **Features**
  - **Pumps**

- **Sea water**
  - **Recommended product types:** Dosing, level control, pressure control, flow control
  - **Control** (depend on connected sensor)
  - **Features**
  - **Pumps**

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**Legend:**

- "R" = rev. or re-coated, N = NBE, E = e-pump
- "x" = available
- "required" for this variable
- "Sensor (0) 4-20mA / 0-10V"
- "Energy optimizing functions"
- "Grafic display with user interface"
15 Treatment Process
Municipal waterworks

Even with a good water source, water treatment should be considered to ensure a good water quality. Water treatment describes those processes used to make water more acceptable for a desired end-use and to ensure that stringent quality standards to the consumer are maintained. Grundfos can supply pumping solutions for solids separation using mechanical treatments such as settling and filtration, dosing solutions for chemical treatments such as disinfection and coagulation.

For example, dissolved substances that are removed during drinking water treatment include calcium and magnesium from hard water, sulphur and carbon dioxide from acid water, iron from red water, manganese from brownish-black water, nitrate from fertiliser-contaminated water, hydrogen sulphide gas from rotten-egg smelling water, and sediments and organic matter from turbid water, where minerals may also be dissolved in high concentrations. Other desired end-uses for water could be for industrial processes or medical use.

Grundfos pump systems range from submersibles to end-suction pumps and huge split-case pumps as well as our highly successful vertical multistage centrifugal pump (CR) – and covering all performance requirements in between.

The sustainability of water treatment solutions requires that the pumping solution is durable, ensuring cost effective and trouble-free operation. Grundfos has decades of experience developing controller and monitoring systems for pumping solutions and manufactures its own pump motors for all fluid types and flow requirements.

External frequency converters (CUE) for variable speed drives and motor protection (MP204) to monitor motor conditions are connected sensor) (depend on connected sensor)

Backwashing refers to the reverse-pumping of water, for example for the periodic washing of filters. Grundfos can supply pumping solutions that deliver the very strong force with well-executed flush times and speeds required for effective backwashing. Backwashing is a form of preventive maintenance to prevent further clogging of the filter medium. Backwashing in water treatment plants is an automated process, usually run by programmable logic controllers (PLCs). The backwash cycle is usually triggered when the differential pressure over the filter exceeds a set value.

Grundfos can supply pumping solutions to cope with the hugely varying flow requirements for backwashing, ranging from huge split-case and mixed-flow pumps, where the focus is on moving water rather than added pressure, to our highly successful vertical multistage centrifugal pump (CR) – and covering all performance requirements in between.

### 15.1. Filtration/ backwash

Final filtering of water for distribution is efficiently assisted by the Grundfos ranges of high-capacity pumps offering any pressure for any flow. Filtering processes range from a simple physical barrier to chemical or biological processes.

---

**Recommended product types:**
- Dosing, level control, differential pressure control
- Control (based on connected sensor)

**Control:**
- Differential Pressure
- Level
- pH
- Chlorine
- Chlorine dioxide
- Ozone
- Peracetic acid
- Hydrogen peroxide

**Features:**
- Energy optimizing functions
- Start-up wizard
- Motor protection
- NB, NK
- CRHS
- Control MPC Δp, PP ,S,F,Dt,T,P x x x 2
- External frequency converters (CUE) for variable speed drives

**Pumps:**
- E-pump NKE S,F,Dt,T,P x
- E-pump NBE S,F,Dt,T,P x
- E-pump CRE S,F,Dt,T,P x
- Control MP204 + IO112 L,Dp,F,Dt,T,P x
- Dosing & Disinfection pH, Redox etc.

---

Grundfos can supply pumping solutions to cope with the hugely varying flow requirements of water to be filtered, ranging from huge split-case and mixed-flow pumps, where the focus is on moving water rather than added pressure, to our highly successful vertical multistage centrifugal pump (CR) – and covering all performance requirements in between.

Municipal waterworks
### 15.2 Chemical treatment

Complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

Moving water for treatment places many demands on a pumping solution, and Grundfos pumps systems range from huge submersibles, where the focus is on moving water rather than added pressure, to our highly successful vertical multistage centrifugal pump (CX) – and covering all performance requirements in between.

Traditionally, chlorine compounds are the most widely used method for chemical disinfection. Grundfos can advise and supply disinfection solutions using chlorine compounds such as chlorine gas (Cl₂), sodium hypochlorite (NaOCl), and chlorine dioxide (ClO₂).

Water quality improvement with an efficient, economical system for dry-material preparation is increasingly used for water treatment. Grundfos can supply PLC-controlled, fully automatic systems to handle preparation and the reliable dosing of organic coagulants or poly-electrolytes.

Chemical disinfection are used in water treatment to substantially reduce the number of microorganisms and thereby increase water quality.

Grundfos can supply complete dosing pump systems for large or small volumes and based on different technologies for floucculation, disinfection, and pH adjustment. Moreover, the Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

**Recommended product types:**
- Dosing, pressure control, flow control

**Control** (depend on connected sensor):
- S, F, Dt, T, P
- Δp, PP, S, F, Dt, T, P

**Features**:
- Infrared communication
- Profibus data communication
- Modbus data communication
- GSM/GPRS wireless data communication
- BACnet data communication
- LONWorks data communication
- GENIbus data communication
- Remote Management
- No external sensor required
- Sensor (0)4-20mA / 0-10V
- Energy optimizing functions
- Grafic display with user interface
- Motor protection

- Dosing controller
- Pump controller
- Process controller
- Motor protection
- Control MPC
- Motor protection
- Control MPC
- Motor protection

**Pumps**:
- Pump CX
- Pump NE
- Motor protection

### 15.3 Disfections

Grundfos can supply complete dosing pump systems for large or small volumes and based on different technologies for flocculation, disinfection, and pH adjustment. Moreover, the Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

Traditionally, chlorine compounds are the most widely used method for chemical disinfection. Grundfos can advise and supply disinfection solutions using chlorine compounds such as chlorine gas (Cl₂), sodium hypochlorite (NaOCl), and chlorine dioxide (ClO₂).

Disinfection is accomplished both by filtering out harmful microbes, by adding disinfectant chemicals in the last step in purifying drinking water. Water is disinfected to kill any pathogens which pass through the filters. Public water supplies in most countries are required to maintain a residual disinfecting agent throughout the distribution system, in which water may remain for days before reaching the consumer.

**Recommended product types:**
- Dosing, pressure control, flow control

**Control** (depend on connected sensor):
- S, F, Dt, T, P
- Δp, PP, S, F, Dt, T, P

**Features**:
- Infrared communication
- Profibus data communication
- Modbus data communication
- GENIbus data communication
- Remote Management
- No external sensor required
- Sensor (0)4-20mA / 0-10V
- Energy optimizing functions
- Grafic display with user interface
- Motor protection

- Dosing controller
- Pump controller
- Process controller
- Motor protection

**Pumps**:
- Pump CX
- Pump NE
- Motor protection

### Chemical treatment

<table>
<thead>
<tr>
<th>Chemical treatment</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
<th>Pumps</th>
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<tr>
<td><strong>Recommended product types:</strong></td>
<td>Dosing, pressure control, flow control</td>
<td>S, F, Dt, T, P</td>
<td>Pump CX</td>
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### Disfections

<table>
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<tr>
<th>Disfections</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
<th>Pumps</th>
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<tr>
<td><strong>Recommended product types:</strong></td>
<td>Dosing, pressure control, flow control</td>
<td>S, F, Dt, T, P</td>
<td>Pump CX</td>
</tr>
</tbody>
</table>
15.4 Flocculation

Correct flocculation requires reliable flow management from pumps systems and mixers and dosing pump systems -- and Grundfos can supply all components. The Grundfos range of SE pumps are specifically designed for durable use and flow management, and can be installed dry or submerged. They offer the reliability you need to ensure correct sedimentation.

Grundfos can supply complete dosing pump systems for large or small volumes and based on different technologies for flocculation, disinfection, and pH adjustment. Moreover, the Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

Changing load conditions require a pumps system that can handle large flows at low head. Grundfos AFC floormakers offer an optimum, energy-efficient solution for mixing in big tanks, creating a bulk flow with an almost uniform flow velocity and limited risk of dead zones. Where tank design doesn't allow the use of flowmakers, Grundfos AMD and AMG mixers offer a robust solution for moving water rather than added pressure to our highly successful vertical multistage centrifugal pump (CR) – and covering all performance requirements in between.

Flocculation and sedimentation are widely employed in the purification of drinking water. Flocculants are used in water treatment processes to improve the sedimentation or filterability of small particles, for example to aid removal of microscopic particles that would otherwise cause the water to be turbid (cloudy) and which would be difficult or impossible to remove by filtration alone.

15.5 Sedimentation

Sedimentation is a physical water treatment process used to settle out suspended solids in water under the influence of gravity. One of the requirements for correct sedimentation is maintaining gentle fluid handling with a pump system that is designed to avoid contact between the sediment and vital pump parts, reducing wear and tear.

Grundfos can supply pump systems that match these demands, and in addition has a range of disinfection solutions that lead to an increase in the settling speed of suspended material and help raise water quality.

Maintaining gentle and controlled flows in sedimentation tanks and moving water to and from the tanks places many demands on a pumping solution. Grundfos pump systems range from huge split case and mixed flow pumps, where the focus is on moving water rather than added pressure to our highly successful vertical multistage centrifugal pump (CR) – and covering all performance requirements in between.

Grundfos can supply complete dosing pump systems for large or small volumes and based on different technologies for flocculation, disinfection, and pH adjustment. Moreover, the Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

Water quality improvement with an efficient, economical system for dry-material preparation is increasingly used for water treatment. Grundfos can supply PLC controlled, fully automatic systems to handle preparation and the reliable dosing of organic coagulants or poly-electrolytes.
16 Water distribution

Municipal waterworks

The reliable, clean and safe distribution of drinking water to homes and businesses is the obvious first priority of any water supplier. However, leakage and overflow can cost water companies much more than the water lost from the distribution system.

How water is distributed depends on topography and local regulation, and often a mix of gravity pipes and pressure pipes systems are used for the best results. Grundfos can supply pumps and controls for the entire water distribution system, including main and local pumping stations, ensuring reliable management of pressure zones throughout the pipes network.

Grundfos helps reduce costs and limit water loss in a water distribution system by effective pressure control. This is done by compensating for surplus pressure in the pipes system and by reducing water hammer which causes new holes.

Grundfos Demand Driven Distribution is a multi-pump solution operating at proportional pressure, where the system is designed to supply precisely the flow needed at the pressure required, with a number of pumps running at best efficiency point, instead of one big pump. The Grundfos Control MPC provides proportional pressure control, gradual ramp-up and ramp-down, the cascade operation of up to six pumps, and monitoring and control with clear text messages. The Grundfos Control MPC works with all pump types, offering substantial economic benefits from energy savings and reduced leakage losses.

The sustainability of water distribution systems from a source over time requires that the pumping solution is durable, ensuring cost effective and trouble-free operation. Grundfos has decades of experience developing controller and monitoring systems for pumping solutions and manufactures its own pump motors for all fluid types and flow requirements. This ensures a perfect match with hydraulics, motors, electric, and all other mechanical components that make up a comprehensive pumping solution, ensuring the best possible efficiency point. The high-efficiency motors developed by Grundfos, with or without an integrated or external variable frequency drive, meet and in some cases exceed the requirements set by motor efficiency legislation around the world. Considering that on average 85% of a normal pump system’s Life Cycle Cost (LCC) is energy costs, switching to high-efficiency motor technology can mean a LCC reduction of up to 50% and a reduction in environmental impact.

Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies external variable speed drives (Grundfos CUE), Dedicated Controls and internet based supervision (Grundfos Remote Management) that are fully integrated into a pumping system. Dedicated Controls enable easy controlling of pump functionalities with an easy-to-use SCADA interface. Grundfos monitoring and control systems include plug and play communication interfaces that communicate with 95% of the communication standards available on the market. Ensuring the right balance between self-contained systems and pressure zones is a very important part of managing a water distribution system. The precision management of pressure zones offered by the Grundfos Hydro MPC range of multistage pressure boosting systems using vertical multistage centrifugal pump (CR) pumps ensures system reliability and minimised system stress.

The Grundfos series of level controllers offers highly reliable monitoring and control for up to six pumps, and can work together with motor protection and frequency converters. A comprehensive range of sensor accessories – such as level, flow and temperature sensors – ensures that you have the data required for your pumps’ control system.

Grundfos has developed a range of dedicated communication modules and controls to cover every eventuality, from sensors through BUS units to remote controls and customised software, we make sure you can get the data and control you want. Our products are all open protocol, so they work with the system you prefer.

Traditionally, chlorine compounds are the most widely used method for chemical disinfection. Grundfos can advise and supply disinfection solutions using chlorine compounds.

Grundfos can supply complete dosing pump systems for large or small volumes and based on different technologies for flocculation, disinfection, and pH adjustment. Moreover, the Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

16.1 Pumping station

<table>
<thead>
<tr>
<th>Pumping station</th>
<th>Recommended product types</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
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<thead>
<tr>
<th>Pumping unit</th>
<th>Control (on connected sensor)</th>
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<table>
<thead>
<tr>
<th>Control (on connected sensor)</th>
<th>Features</th>
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</table>

The following table shows the different control units available from Grundfos for pumping stations:

- **MAGNA-D, MAGNA with GENibusmodule**
- **TP**
- **TPED**
- **TPM**
- **TPPC**

Pumps

- **5) 0.25-7.5 kW: CIM interfaces / MGE: 2 relays**
- **6) 0.25-7.5 kW MGE: 1 relay, 11-22 kW MGE: 2 relays**
- **7) CIM interfaces**
- **8) GENibusmodule MPC**
- **9) GENibusmodule**
- **10) CIU interfaces**
- **11) GENibusmodule**
- **12) 4-20 mA Sensor required**
- **13) CIU interfaces**

*1) MAGNA-D, MAGNA with GENibusmodule
*2) TPED
*3) with external Control MPC
*4) 0.25-7.5 kW MGE: 1 relay, 11-22 kW MGE: 2 relays
*5) CIU interfaces

> A= Autoadapt, Dp= Differential Pressure, P= Const. Pressure, PP= Proporational Pressure, T= Const. Temperature, DT= Differential Temperature, F= Const Flow, S= Const. Speed/Frequency, L=Level, pH= pH-Wert, CIU= CIU, CUE= CUE, CLO= Chlorine dosed, O3=Ozone, MA= Magnetite acid, H2O2= Hydrogen peroxide
16.2 Water towers

Distribution from the water tower is often the final step before delivery to the consumer. Grundfos offers a user-friendly range of dosing pumps for those final adjustments, ensuring prime water quality.

Grundfos can supply complete dosing pump systems for large or small volumes and based on different technologies for flocculation, disinfection, and pH adjustment. Moreover, the Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

Grundfos can advise and supply disinfection solutions using chlorine compounds. Grundfos monitoring and control systems increase the potential for improving both efficiency and reliability.

<table>
<thead>
<tr>
<th>Water Tower</th>
<th>Recommended product types: Dosing, level control, pressure control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Features</td>
</tr>
<tr>
<td>Hydro MPC</td>
<td>Δp, P, S, F, Dp, T, P</td>
</tr>
<tr>
<td>Control MPC</td>
<td>P</td>
</tr>
<tr>
<td>MPC</td>
<td>Δp, P, S, F, Dp, T, P</td>
</tr>
<tr>
<td>Dosing &amp; Disinfection</td>
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<tr>
<td>Hydro Protect</td>
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<tr>
<td>Hydro Multi-B</td>
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<td>Hydro Multi-S</td>
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<tr>
<td>E-pump CRE</td>
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</tbody>
</table>

16.3 Boosting

Pressure boosting requirements can vary, from small systems for remote villages to separate urban pressure zones that guarantee swift responses to contamination scenarios. The precision management of pressure zones offered by the Grundfos Hydro MPC range of multistage pressure boosting systems using vertical multistage centrifugal pumps (CR) ensures system reliability and minimised system stress.

The Grundfos range of electronic and electrochemical accessories offers complete control of your dosing and disinfection processes and can be seamlessly integrated into your system.

HydroProtect from Grundfos is a compact chlorine disinfection system with an integrated booster station that can be tailored precisely for your requirements. HydroProtect is our solution for preventing the build-up of detectable organic chlorine compounds and is used extensively for water treatment in the food and beverage industry.

The Grundfos series of level controllers offers highly reliable monitoring and control for up to six pumps, and can work together with motor protection and frequency converters. A comprehensive range of sensor accessories – such as level, flow and temperature sensors – ensures that you have the data required for your pumps’ control system.

The considered application of technology ensures the best possible fit to your pumping requirements. Grundfos submersible multistage pumps bring together pump controllers (Control MPC), external frequency converters (CUE) for variable speed drives, motor protection (MP204) to monitor motor conditions and adapt to changing conditions, and a flexible riser hose for keeping system friction to a minimum.

<table>
<thead>
<tr>
<th>Boosting</th>
<th>Recommended product types: Dosing, pressure control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Features</td>
</tr>
<tr>
<td>Hydro MPC</td>
<td>P</td>
</tr>
<tr>
<td>Control MPC</td>
<td>Δp, P, S, F, Dp, T, P</td>
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<tr>
<td>Dosing, pressure</td>
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<tr>
<td>Hydro Protect</td>
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<td>Hydro Multi-B</td>
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<td>E-pump CRE</td>
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<td>Dosing &amp; Disinfection</td>
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<td>Hydro Protect</td>
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<tr>
<td>E-pump CRE</td>
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</table>

NB

*10) CIU interfaces
*9) CIM interfaces
*8) GENIbusmodule MPC
*7) DDA Option E-Box Profibus
*6) version CIM xx2 needed

"SMART-Digital (DDE-P, DDC, DDA)
DDI, DME-AR, DMX/DMH-AR, DMX/DMH-AT"
17 Wastewater transport

Municipal waterworks

Compared to a water supply system that distributes water and ensures sufficient pressure at the end-user, transporting wastewater requires a wide range of pumps to keep the wastewater moving in an environment of constantly varying pressure. Depending on topography and local regulation, a mix of gravity sewers and pressure sewerage systems may be required.

Grundfos can cover all eventualities, from large-scale, fully-customised pumping stations to complete prefabricated submersible pumping stations; from large axial and mixed-flow pumps that can cope with moving vast flows of surface or storm water at low head to sewage grinder pumps for pressurised systems with small amounts of water and small lifting stations for transporting effluent away from buildings. Furthermore, Grundfos supplies complete control and monitoring solutions.

Grundfos solutions are designed specifically for pumping installations and all the components are fully integrated from the start. The sustainability of wastewater transport over time requires that the pumping solution is durable, ensuring cost effective and trouble-free operation.

Experience with project design means Grundfos can ensure泵 decades of experience developing controller and monitoring systems for pumping solutions and manufactures its own pump motors for all fluid types and flow requirements. This ensures a perfect match with hydraulics, motors, electrics, and all other mechanical components that make up a comprehensive pumping solution, ensuring the best possible efficiency point.

The high-efficiency motors developed by Grundfos combined with dedicated variable speed drives meet and in some cases exceed the requirements set by motor-efficiency legislation around the world. Considering that on average 85% of a normal pump system’s Life Cycle Cost (LCC) is energy costs, switching to high-efficiency motor technology can mean a LCC reduction of up to 50% and a reduction in environmental impact.

Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies external variable speed drives (Grundfos CUE), Dedicated Controls for easy control of pump functions, pump starters and external variable speed drives (Grundfos CUE), Dedicated Controls for easy control of pump functions, and can be installed dry or submerged.

When designing a pumping station, Grundfos specialists can apply Computational Fluid Dynamics (CFD) simulations to depict accurately fluid flows and pressure graphically at any location in the pipes system. This means that we are able to simulate and discover flow problems in the simulation and correct them before construction begins, building pump pits that function well at low and high flows, and that are self-cleaning, reducing wear and smell by continuously removing deposits and solids.

The Grundfos ranges of SE/S1 and S pumps are specifically designed for durable use and heavy, fluctuating sewage flows and can be installed dry or submerged.

Grundfos can supply pump systems and pumping solutions for large-scale pumping stations that can be fully customised, both for existing installations and all new projects, complete with all valves, electrics and pumps that are easy to service.

Pumping stations in wastewater transport systems are designed to handle raw sewage that is fed from underground gravity pipelines or network pumping stations. Main pumping stations are typically designed so that one pump or one set of pumps will handle normal peak flow conditions. Many main wastewater pumping stations operate with dry-installed pump systems, although submerged pumps systems can offer many advantages for reduced operation costs, enhanced reliability and less infrastructure investment. Grundfos is able to supply complete pumping solutions for both dry and submerged installations.

17.1 Main pumping stations

Grundfos monitoring and control systems include plug-and-play communication interfaces that work with 95% of the communication standards available on the market. A comprehensive range of sensor accessories – such as level, flow and temperature sensors – ensures that you have the data required for your pumps’ control system.

### Recommended product types:
- **Dosing, level control**

### Control (depends on connected sensors):
- **Motors**
- **Relay outputs**
- **MPCs**
- **External sensor**

### Features:
- **Graph display with user interface**
- **Start-up wizard**
- **SSE, SL**
- **Sensor (0-4-20mA / 0-10V**)
- **Communication interfaces that communicate with 95% of the communication standards available on the market.**

### Pumps:
- **MAGNA-D, MAGNA with GENIbusmodule**
- **Recommended product**

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1. MAGNA-D, MAGNA with GENIbusmodule
2. FFED
3. with external Control MPC
4. (Philips, Siemens, Danfoss, ABB, Flowserve, Grundfos CUE, Siemens) GENIbusmodule
5. with direct-drive
6. (Ebara, Grundfos, Siemens, Danfoss)
7. (Philips, Siemens, Danfoss, ABB, Flowserve, Grundfos CUE, Siemens) GENIbusmodule
8. (Philips, Siemens, Danfoss, ABB, Flowserve, Grundfos CUE, Siemens) GENIbusmodule
9. 4-20 mA Sensor (not included)
10. 4-20 mA Sensor required
11. CIU interfaces
12. CIM interfaces

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### Grundfos monitoring and control systems:
- **Control DC (Dedicated Controls) with an easy-to-use SCADA interface.**
- **CUE**, Dedicated Controls for easy control of pump functions,
- **pump starters and external variable speed drives (Grundfos CUE), Dedicated Controls for easy control of pump functions**
- **Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies external variable speed drives (Grundfos CUE), Dedicated Controls for easy control of pump functions, and can be installed dry or submerged.**

Grundfos can supply pump systems and pumping solutions for large-scale pumping stations that can be fully customised, both for existing installations and all new projects, complete with all valves, electrics and pumps that are easy to service.

When designing a pumping station, Grundfos specialists can apply Computational Fluid Dynamics (CFD) simulations to depict accurately fluid flows and pressure graphically at any location in the pipes system. This means that we are able to simulate and discover flow problems in the simulation and correct them before construction begins, building pump pits that function well at low and high flows, and that are self-cleaning, reducing wear and smell by continuously removing deposits and solids.

The Grundfos ranges of SE/S1 and S pumps are specifically designed for durable use and heavy, fluctuating sewage flows and can be installed dry or submerged.

Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies pump starters and external variable speed drives (Grundfos CUE), Dedicated Controls for easy control of pump functions, and can be installed dry or submerged.

Grundfos monitoring and control systems include plug-and-play communication interfaces that work with 95% of the communication standards available on the market. A comprehensive range of sensor accessories – such as level, flow and temperature sensors – ensures that you have the data required for your pumps’ control system.

### Recommended product types:
- **Dosing, level control**

### Control (depends on connected sensors):
- **Motors**
- **Relay outputs**
- **MPCs**
- **External sensor**

### Features:
- **Graph display with user interface**
- **Start-up wizard**
- **SSE, SL**
- **Sensor (0-4-20mA / 0-10V**)
- **Communication interfaces that communicate with 95% of the communication standards available on the market.**

### Pumps:
- **MAGNA-D, MAGNA with GENIbusmodule**
- **Recommended product**
17.2 Pressurized systems

In areas with a high water table, where the topography is flat or where pumping is required, Grundfos can fit pressurized stations with pumps, level sensors and Dedicated Controls that let you reduce pipe diameters and increase fluid speed in closed, pressurised pipes systems, all managed with precision and efficiency.

The SEG AutoAdapt sewage grinder is an example of an innovative Grundfos solution for pressurised pumping systems. In addition to efficient cutting of all material in the wastewater, the SEG AutoAdapt simplifies pump pit management and reduces costs, eliminating 71% of all service calls and reducing installation and commissioning costs by 10%.

Grundfos can supply Grundfos PUST, which is a complete pressurised pumping system designed for easy transport and which are self-cleaning, with smooth surfaces. Essential for these prefabricated pumping stations is low maintenance and easy service. The Grundfos sewage grinders used in PUST are ideal for pressurised sewer systems where the demand is for efficient cutting when required, and the Grundfos sewage grinders used are designed for durable use with submerged operation and concentrated sewage flows.

Dedicated Controls for pumping stations has anti-clogging functionality built-in. The “flush and reverse” function prevents clogging caused by the increasing amounts of the fibrous component in sewage today. The anti-clogging function acts on any abnormal events to stop pumps from blocking, avoiding costly downtime.

Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies pump starters and external variable speed drives (Grundfos CUE), Dedicated Controls for easy control of pump functionalities, and internet-based supervision (Grundfos Remote Management) with an easy-to-use SCADA interface.

17.3 WWTP - Inlet stations

The wastewater entering at a wastewater treatment plant’s inlet pumping station contains all substances that have entered the sewer system. This is not only what we flush down the toilet, but also industrial effluents, wastewater from hotels, hospitals and restaurants, and substances drawn directly into the sewer system. This is not only what we flush down the toilet, but also industrial effluents, wastewater from hotels, hospitals and restaurants, and substances drawn directly into the sewer system through manholes.

Grundfos has the pumps to cope with these heavy demands. The Grundfos ranges of SE/SL, S, and KWM pumps are specifically designed for durable use and heavy sewage flows and can be installed dry or submerged. If the design of the pump sump does not prevent sedimentation, the Grundfos range of robust AMD mixers ensure full mixing and thereby ensure trouble-free operation and prevent odours.

The inlet pumping station involves great fluctuations in demand for performance. With multiple inlet pumps installed, adding external variable speed drives (Grundfos CUE) will equalize the hydraulic load to the wastewater treatment plant. Computational Fluid Dynamics (CFD) simulations at the design phase help ensure the optimum delivery of wastewater through the inlet pumping station for mechanical treatment by visualising hydraulic conditions at the pumping station.

Control and monitoring systems increase the potential for improving both efficiency and reliability. In addition to variable speed drives, Grundfos supplies motor protection (MP204) to monitor motor conditions, ensuring optimal operation.
17.4 Network and prefabricated pumping stations

A network pumping station ensures collection and transport of wastewater to larger pumping stations. Grundfos can supply and customize a complete network pumping station to match your requirements for size and design. Grundfos can supply complete prefabricated pumping stations with submerged pumps systems, level sensors and control solutions, and dosing solutions can also be added.

Wastewater systems involve great fluctuations in demand for performance, and your pumping solutions must be able to respond immediately when demand changes or incidents occur, protecting your system against the risk of water hammer, for example.

The Grundfos range of SE/SL and S pumps used are specifically designed for durable use and heavy sewaget flows, and can be installed dry or submerged, while the SEC range of grinder pumps is ideal for pressurised sewage systems and is capable of continuous operation when fully submerged. Innovative Grundfos solutions, such as wastewater pumps with AutoAdapt functionality, simplify pump pit management and reduce costs, eliminating 75% of all service calls and reducing installation and commissioning costs by 50%.

The Grundfos series of level controllers offers highly reliable monitoring and control for up to six pumps, and can work together with motor protection and frequency converters. A comprehensive range of sensor accessories – such as level, flow and temperature sensors – ensures that you have the data required for your pumps’ control system.

Dedicated Controls for pumping stations has anti-clogging functionality built-in. The “flush and reverse” function prevents clogging caused by the increasing amounts of the fibrous component in sewage today. The anti-clogging function acts on any abnormal events to stop pumps from blocking, avoiding costly downtime.

Control and monitoring systems increase the potential for improving both efficiency and reliability Grundfos supplies pump starters and external variable speed drivers (Grundfos CV). Dedicated Controls for easy control of pump functionalities, and internet-based supervision (Grundfos Remote Management) with an easy-to-use SCADA interface.

17.5 Flood control

Limiting the potential damage of coastal and inland flooding requires a pumps system that won’t fail when required. There’s a lot at stake — initially, protection of people, crops and livestock, and in the longer term preventing contamination, damage to infrastructure and the potential risk of famine.

Ensuring that flood events can be controlled often requires careful planning. The application of Computational Fluid Dynamics (CFD) simulations at the design phase enables a tailored solution utilising Grundfos pumps that can cope with the heavy demands of moving vast flows of surface or storm water at low head, for flood control, harbour management, and such like. The Grundfos ranges of axial and mixed flow pumps are specifically designed for strength and heavy flows and can be installed dry or submerged.

Stormwater tanks are an effective way of reducing peak flow and equalising flow rates from storm water runoffs in the sewer system. Placed strategically, stormwater tanks mean better utilisation of the existing sewer system, allow for intelligent management of storm water flows, and ultimately save on infrastructure investments. Stormwater tanks can be built to almost any size and shape. The inlet and outlet can be managed by gravity, by a pump system or a combination of both, depending on hydraulic conditions in the system.

Grundfos offers a range of pumping and control solutions as well as mixers and cleaning equipment that together ensure reliable and automatic operation of the stormwater tank. Once the hydraulic load is reduced and capacity is available, you can get wastewater moving again with perfect efficiency.

Grundfos has the pumps to cope with these heavy demands. The Grundfos ranges of SE/SL, S and KPL/KWM pumps are specifically designed for durable use with heavy flows and can be installed dry or submerged. The Grundfos range of level sensor accessories ensures that your pump system can control possible fluctuations in demand for performance. This ensures the optimum delivery of wastewater to and from the stormwater tank. The Grundfos DW pumps are robust, portable submersible pumps with a vertical discharge port, designed to handle dewatering at construction sites, excavation sites, buildings drainage and similar applications where there is a need to pump raw water or/and at high pressure.

Efficient mixing and cleaning of equalisation tanks is essential to minimize operation costs and avoid odour problems. The Grundfos range of Rainjets is especially designed for this purpose, offering a robust construction and easy service and maintenance. The Rainjets can work either alone or together with the robust and durable AMD mixer.
Wastewater treatment is the process of removing contaminants from water discharged from domestic, industrial or commercial premises as well as surface run-off. Wastewater treatment typically utilises mechanical, biological, and chemical processes to remove these contaminants. Grundfos can supply a whole range of components for a complete mechanical, biological, and chemical wastewater treatment plant.

The process of wastewater treatment varies from simple tanks, relying solely on sedimentation, to the refined treatment processes for the bacteria, a certain retention time for wastewater and sludge is necessary for the biological processes to take place.

During biological treatment, bacteria circulate between different process zones which provide them with specific living conditions. The different zones use aerobic, anoxic and anaerobic conditions utilising different biological processes for the removal of organic matter and nutrients, such as Nitrogen and Phosphorous. Biological treatment is the most commonly used method for additional treatment of wastewater to remove high amounts of organic matter and nutrients following mechanical treatment and is one of the largest and most expensive elements at a wastewater treatment plant.

The activated sludge process that is most common in biological treatment utilises the growth of specific floc-forming bacteria that live suspended in the wastewater. To create optimal conditions for the bacteria, a certain retention time for wastewater and sludge is necessary for the biological processes to take place.

During biological treatment, bacteria circulate between different process zones which provide them with specific living conditions. The different zones use aerobic, anoxic and anaerobic conditions utilising different biological processes for the removal of organic matter and nutrients, such as Nitrogen and Phosphorous.

For circulation of wastewater between these zones the Grundfos SRP recirculation pumps keep vast flows at low head moving reliably. To avoid settling of the bacterial flocs Grundfos AFC flowmakers offer an optimum, energy-efficient solution for mixing in big tanks, creating a bulk flow with an almost uniform flow velocity and limited risk of dead zones.

For aeration of wastewater during biological treatment Grundfos offers fixed or retractable systems of fine bubble diffusers for efficient oxygen transfer. The self-aspirating AeroJet is made from stainless steel and is also available for aeration of wastewater, which handles both mixing and aeration.

Where tank design doesn’t allow the use of flowmakers, Grundfos AMO and AMG mixers offer a robust design with corrosion resistant materials, easy service and maintenance, and trouble-free operation in difficult environments.

Recirculation of sludge from the secondary clarifier to the aerobic tank is a key process of the activated sludge process. This can be reliably handled with the Grundfos ranges of SE/SL, S and KPL/KWM pumps, which are specifically designed for durable use and flow management, and can be installed dry or submerged. Variable speed drives (Grundfos CUE) can be added, depending on the specific control strategy at the treatment plant.

Grundfos can supply complete dosing pump systems for large or small volumes, based on different technologies. These pumps can be used for pH adjustment in the process tank and for substrate dosing, for example to keep biological phosphorous removal and de-nitrification running.

**18 Wastewater treatment**

**Municipal wastewater**

This ensures a perfect match with hydraulics, motors, electrics, and all other mechanical components that make up a comprehensive pumping solution, ensuring the best possible efficiency point.

Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies external variable speed drives (Grundfos CUE) that are pre-programmed for the Grundfos range of products, ensuring optimal operation.

The high-efficiency motors developed by Grundfos, with or without an integrated or external variable frequency drive, meet and in some cases exceed the requirements set by motor-efficiency legislation around the world. Considering that on average 85% of a normal pump system’s Life Cycle Cost (LCC) is energy costs, switching to Grundfos pumps with high-efficiency motor technology can mean a LCC reduction of up to 50% and a reduction in environmental impact.

**18.1 Biological treatment**

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**Biological treatment**

<table>
<thead>
<tr>
<th>Recommended product types</th>
<th>Control (depend on connected sensor)</th>
<th>Features</th>
<th>Pumps</th>
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<tbody>
<tr>
<td>Dosing, level control, pressure control, flow control</td>
<td>Environmentally friendly</td>
<td>4-20 mA Sensor required</td>
<td>AMD, AMG, AF</td>
</tr>
</tbody>
</table>
18.2 Sludge management

Sludge is a by-product from treatment of wastewater at any traditional wastewater treatment plant, and while treated water can be discharged to the receiving waters according to the requirements in the discharge permit, handling sludge treatment is more complicated. Generally final disposal will be utilisation as fertiliser on farmland, deposition at waste disposal sites, or incineration onsite or at an external partner, often as part of energy generation.

Sludge pumping requires equipment that can keep viscous media moving – without becoming clogged. Primary sludge needs to be pumped from the suspended matter tank to the sludge storage tank. The sludge pumping station requires careful selection of the pumps, depending on the sludge content and flow.

Centrifugal pumps like the Grundfos ranges of SE/SL or S pumps with vortex impellers are often used and are designed for durable use in difficult environments. For sludge pumping, dry installed pumps are preferred as this allows frequent inspection and easy maintenance.

Control and monitoring systems increase the potential for improving both efficiency and reliability. Grundfos supplies external variable speed drives (Grundfos CUE), motor protection (MP204) to monitor motor conditions, ensuring optimal operation.

Sludge can be dewatered directly from a concentration tank or sludge storage tank. Usually, sludge is thickened by gravitation in a sludge concentration tank or by mechanical dewatering in simple dewatering units, and quite simply involves removal of water from the sludge. Poly-electrolytes can be added to enhance formation of large sludge-flocs.

The tanks can be equipped with a low-speed AMC mixer in order to secure a homogeneous sludge concentration. Grundfos mixers offer a robust design with corrosion resistant materials, easy service and maintenance, and trouble-free operation in difficult environments.

Due to biological degradation of organic material, biogas will be produced in the system. The biogas can be utilised in a Combined Heat and Power (CHP) system, where it produces heat and electricity.

For large wastewater treatment plants, anaerobic digestion is the most widespread method for sludge treatment. Anaerobic digestion results in a further degradation of the sludge under anaerobic conditions, reducing the total organic content of the sludge by up to 40 to 60%.

18.3 Mechanical treatment

Raw wastewater has a high content of large materials, such as toilet paper, textiles, napkins, as well as plastic bags, pieces of wood. Such materials must be removed as the first part of the treatment process, not least to prevent clogging and possible malfunction of mechanical equipment at the wastewater treatment plant.

The screening station is therefore the first step in the mechanical treatment of wastewater. Effective washing of the detained material will reduce the amount of disposal significantly and prevent odour problems. Grundfos offers pump and control solutions for the effective backwash of the screens, ensuring reliable operation of your screening station.

The Grundfos Hydro MPC range of multistage pressure boost systems means you can manage your pressure zones with ease, and together with our range of level sensor accessories will ensure effective washing of the entire screening station.

Once wastewater has been screened for the removal of large materials, mechanical treatment’s next step is the removal of grit and grease. Removing these prior to commencing biological treatment of wastewater is essential for ensuring the smooth operation of the wastewater treatment plant.

Installed dry or submerged. They offer the reliability you need to ensure safe operation. Diffuser systems from Grundfos offer fine or coarse bubble diffusion for large air flows for the separation processes of the grit and grease removal.

The equalisation tank is where excess wastewater can be stored during heavy rain. Equalisation tanks can be an effective way of cost optimising the wastewater treatment plant as this allows for the construction of smaller tanks for treatment and ensures a steady hydraulic load through the plant.

Equalisation tanks can be built to almost any size and shape. The inlet and outlet can be managed by gravity, by a pump system or a combination of both, depending on hydraulic conditions in the system. Grundfos has the pumps to cope with these heavy demands. The Grundfos ranges of SE/SL and KPL/KWM pumps are specifically designed for durable use with heavy flows and can be installed dry or submerged. The Grundfos range of level sensor accessories ensures that your pumps system can control possible fluctuations in demand for performance. This ensures the optimum delivery of wastewater to and from the equalisation tank.

Control and monitoring systems increase the potential for improving both efficiency and reliability. In addition to variable speed drives (Grundfos CUE), Grundfos supplies motor protection (MP204) to monitor motor conditions, ensuring optimal operation.

Chemicals and poly-electrolytes can be added to increase efficiency and improve sludge settling, helping remove up to 80% of the suspended matter. Grundfos can supply complete dosing pumps systems for large or small volumes and based on different technologies for precipitation and flocculation and pH adjustment, and PLC-controlled, full automatic systems to handle preparation and the reliable dosing of organic coagulants or poly-electrolytes.
Recommended range: Sensors & Frequency converter

### Grundfos Differential-pressure sensor, kit DPI

- **Output:** 4-20 mA
- **Pressure range:** 0 - 2.5 bar
- **Type:** DPI v2 + T

### Grundfos Pressure sensor, MBS 3000

- **Pressure range:** 0.1 bar / 1 meter
- **Type:** MPS

### Siemens flowmeters, MAGFLO MAG 3100/5000

- **Flow range:**
  - 20 - 75 m³ (DN 100)
  - 6 - 30 m³ (DN 65)
  - 3 - 10 m³ (DN 40)
  - 1 - 5 m³ (DN 25)

### Siemens Ultrasonic transmitter Siemens Probe LU

- **Pressure range:**
  - 0.25 m to 8 m
  - 0.25 m to 12 m

### Siemens Pressure transmitter with 2 m screened cable

- **Pressure range:**
  - 16 bar / 160 meter
  - 10 bar / 100 meter
  - 1 bar / 10 meter

### Siemens Temperature sensor, TIX

- **Temperature range:**
  - 0 to +25 °C
  - -25 °C to +25 °C

### Siemens Ambient temperature sensor, WE 12

- **Temperature range:**
  - -50 °C to +50 °C

### Siemens Differential-temperature sensor, ETSD

- **Temperature range:**
  - 0 °C to +100 °C
  - 0 °C to +50 °C

### Grundfos frequency converter, CUE

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications

### Siemens Sensors for dosing & disinfection

- **Available with different cable length
  - 4 float switch MS1
  - 3 float switch MS1
  - 2 float switch MS1

### Grundfos CUE frequency converters for three-phase pumps

- **Applications:**
  - Energy saving, as the CUE is designed for Grundfos pumps
  - Adjusting the pump performance to the demand

### Grundfos CUE frequency converters with integrated frequency inverter

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications

### Grundfos CUE frequency converters with integrated pressure sensor

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications

### Grundfos CUE frequency converters with integrated flow sensor

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications

### Grundfos CUE frequency converters with integrated sensory unit

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications

### Grundfos CUE frequency converters with connected CIU interface unit

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications

### Grundfos CUE frequency converters with connected CIU interface unit

- **Application area:**
  - Industry
  - Building services
  - Municipal water supply
  - Municipal wastewater
  - Irrigation applications
Recommended range: Communication & Motor protection

CIM / CIU Fieldbus communication interfaces
For complete control of pump systems, the Grundfos fieldbus concept is the right solution. The Communication Interface Unit (CIU) and the Communication Interface Module (CIM) enable data communication via open and interoperable networks such as Profibus DP, Modbus RTU, LONWorks, BACnet MS/TP, GSM/GPRS, or using Grundfos Remote Management (GRM).

Complete process control based on standard functional profiles. CIM modules are add-on modules that allow communication with 11 to 22 kW E-pumps, Dedicated Controls (CIU 110), and Motor Multi-B (CIU 112). The CIU units are for products with a GENIbus interface such as small E-pumps, circulation pumps with GENIbus and boosters (CIU 111) with GENIbus.

CIM-050 for communication with GENIbus (Ded. Controls/ Hydro Multi-B).

GENIbus module for CIU 111, Hydro/MPC, MAGNA small and MAGNA large.

CIU 100 for communication via LIN (E-pumps up to 75 kW, MAGNA with GENIbus, CIU, Multi-E).

CIU 110 for communication via LIN (Control/ Hydro MPC with GENIbus).

CIU 100 for communication via LIN (11-22 kW E-pumps).

CIU 110 for communication via LIN (Hydro Multi-B).

CIU 150 for communication via Profibus DP (E-pumps up to 75 kW, MAGNA with GENIbus, CIU, Control/ Hydro MPC with GENIbus, Hydro Multi-E, MP204, CR-Monitor).

CIU 150 for communication via Profibus DP (11-22 kW E-pumps).

CIU 200 for communication via Modbus RTU (E-pumps up to 75 kW, MAGNA with GENIbus, CIU, Control/ Hydro MPC with GENIbus, Hydro Multi-E, MP204, CR-Monitor).

CIU 200 for communication via Modbus RTU (11-22 kW E-pumps/ Dedicated Controls/ Hydro Multi-B).

CIU 201 for communication via Modbus RTU (WW-AutoADAPT).

CIU 250 for wireless communication via GSM, GPRS or SMS (E-pumps up to 75 kW, MAGNA with GENIbus, CIU, Control/ Hydro MPC with GENIbus, Hydro Multi-E, MP204, CR-Monitor).

CIU 250 for wireless communication via GSM, GPRS or SMS (11-22 kW E-pumps/ Dedicated Controls/ Hydro Multi-B).

CIU 252 for wireless communication via GSM, GPRS or SMS (WW-AutoADAPT).

* GSM antennas for roof or for desk mounting needed.

CIU 300 for communication via BACnet MS/TP (E-pumps up to 75 kW, MAGNA with GENIbus, CIU, Control/ Hydro MPC with GENIbus, Hydro Multi-E).

CIU 300 for communication via BACnet MS/TP (11-22 kW E-pumps/ Hydro Multi-B).

CIU 302 for wireless infrared communication (WW-AutoADAPT).

I-Box Profibus-DP extension module for smart digital SDA driving pump

GRM - Grundfos Remote Management
Complete performance data available from Internet-based supervision allows optimisation of your pump or booster system.

- Receive SMS / e-mail alarms on issues you need to act on immediately, for example low system pressure, water shortage or power supply problems
- Adjust settings remotely via internet
- Ensure your system is correctly dimensioned to meet demand
- Analyse consumption profiles and follow energy usage

Internet based supervision also allows you to optimise the service and maintenance program for your pump or booster system. Data from pump installations is transferred to a central database and published to subscribers on a secure web server. Users have access to data from pump installations that are registered to their own account.

Grundfos offers the needed CIU 250 / CIM 250 / CIM 272 interfaces, GSM antenna and a licence contract of GRM. The needed SIM-card can be bought by the customer.

R100 wireless infrared Remote Control
For all Grundfos pumps & controllers designed for wireless in communication.

- Simple and quick setting of the pump
- Reading of various operating and fault signals
- USB interface for data storage and data transfer to a computer

Motor protection unit, MP 204
Monitoring and protection of pump installations.

- Protection against dry running and too high motor temperature
- Constant monitoring of pump energy consumption
- Reading of operating data via GRM
- Connection to large control systems via has communication (GENIbus)
- Options: Data communication to Profibus, Modbus, GSM/GPRS, GRM via CIU units
- Ready made control cabinets available: Control MP 204
- Connection of sensors enabling empty or filling applications based on sensor signals via IO 112.
- up to 200 A
- external current transformers to extend the range up to 999 A
- Accuracy for most measured values: ±0.2 %
- Enclosure class: IP 20
- Ambient temperature: -20 to 80°C
- Relative humidity: ±99 %
- Nominal Voltage: 400 VAC (1000 Volt on request)
- Current range: 1-999 A
- Frequency: 47-63 Hz
- IEC trip class: 1-45
- Special Grundfos trip class: 0-30 s
- Voltage variations: ±15-12 % of nominal voltage
- Approvals: EN 60479, EN 63095, CE/CSA 508
- Marking: CE, cUL, C-tick

Control MP 204
Ready made control cabinets with MP 204 motorprotection, fuses, relays, watch, lamps, clamps.

- Single control for emptying and filling applications
- Single control for analog sensor applications
- Control of analog sensor 4-10 mA for empty or filling applications based on sensor signals via optional IO 112 unit.

Options: Data communication to Profibus, Modbus, GSM/GPRS, GRM via CIU units available

CR Monitor
Monitoring of pump efficiency, cavitation and performance.

Applications:

- Pumps in processes where continuous monitoring and control are essential
- Pumps exposed to extreme wear or clogging due to materials in the pumped liquid
- Pumps in processes where continuous monitoring and control are essential
- Detects if the pump efficiency is reduced.
- Detects if the pump is about to cavitate.
- Detects if the pump is running outside its normal operating range.
- Enables planning of pump maintenance in order to prevent unplanned downtime.

Motor types supported: CR, CRI, CRN, CRN MAGdrive

- Motor range: 1.1 to 75 kW / 12
- Available for pumps with standard AEC/Siemens motors, ARC/Siemens motors supplied from a Grundfos CIU frequency converter and NCE motors with integrated frequency converter.
- Based on well-known components from Control/Hydro MPC and the LiqTec sensor
- Enclosure class: IP54
- Supply voltage: 3 x 400 VAC.

Options:

- Bus communication to SCADA systems via CIU units for Profibus, Modbus, GSM/GPRS, GRM available
- Data collection, monitoring and setting through local PC or via internet (VNC server) or Grundfos Remote Management (GRM)
Recommended range: Controls

Control MPC
- Control Cabinet with fuses, switch, controller
- Control of up to six identical pumps in parallel
- Motors from 0.37 – 75 kW can be connected (on request up to 315 kW)
- Enclosure class: IP54
- Energy optimizing control algorithms
- User friendly graphical display
- Start up wizard
- Easy installation and start-up
- Simple control
- Modular solution with possibility of expansion
- Application-optimised software , demand driven distribution

Applications:
- Heating systems
- Air-conditioning systems
- Booster systems
- Industrial processes
- Water supply systems

The Control/MPC is designed for these pump types:
- CR(E), CRI(E), CRN(E), CME
- NB(E), NBG(E)
- NK(E), NKG(E)
- TP
- TPE Series 1000
- TPE Series 2000
- HS
- SF
- MAGNA/ UPE series 2000

Variants for e-pumps and with integrated frequency converter
Options: Data communication via Ethernet (VNC Server), LON, PROFINET, Modbus, BACNet, CAN/GPIB, etc.

Control MPC Series 2000
- Control and monitoring units for Series 2000 pumps (MAGNA, UPF, TPE series 2000)
- Control Cabinet with Controller and switch
- Control of up to six Grundfos MAGNA, UPF, TPE Series 2000 pumps of identical pump type and size
- Supply voltage: 1 x 100-240 V
- All motor sizes can be connected
- Power supply for pumps have to be done external
- Enclosure class: IP54
- Energy optimizing control algorithms
- User friendly graphical display
- Start up wizard
- Easy installation and start-up
- Simple control
- Application-optimised software

Applications:
- Heating systems
- Air-conditioning systems

Optimal adjustment of the performance to the demand by closed-loop control of these parameters:
- proportional differential pressure
- constant differential pressure
- differential pressure (remote) *
- flow rate *
- temperature *
- temperature difference *
- External sensor required

Pressure manager PM1, PM2
PM1 and PM 2 pressure managers are designed for automatic start/stop control of Grundfos pumps and other water supply pumps in Blocks of flats, house and garden, agriculture and similar applications
- User-friendly interface
- Free position in installation
- Flexible power supply
- Incorporates functions which protect the pump
(Max. operat. pres.: 10 bar
Liquid temp.: 5 °C to + 40 °C (up to 60 °C if VDE approval is not required)

Conex® DIA, DIS
Measurement and control systems for dosing instrumentation
Application and instrumentation in disinfection processes:
- drinking water
- industrial water
- wastewaster (only effluent)
- pool water

Amplifier parameters:
Conex® DIA-1: C2, C20, D1, F10, pH or redox (DIF)
Conex® DIA-2: parameter 1: C2, C10,D1, F10 parameter 2: pH
Conex® DIA-20: parameter 1: C2, C10,D1, F10 or F102 parameter 2: pH or redox (DIF)
Conex® DIS-C: conductivity (inductive or conductive probe)
Conex® DIS-P: pH or redox (DIF)
Conex® DIS-D: C2, C20 or D1

- User-friendly plain-text menu (DIA) and operator prompting
- Device calibration feature with plausibility check prevents errors occurring
- Multilingual menu (DIA)
- Self-monitoring feature ensures excellent water quality at all times
- Compensation for disturbance factors ensures precise measurement. As a result, chemical consumption is reduced to a minimum
- Available as a preassembled system (amplifier and measuring cell) mounted on a plate and ready for connection

Available sensors: pH, Redox, C2, C20, D1, F10, H2O2, conductivity

DIP
Measurement and control systems for dosing instrumentation
Application and instrumentation in disinfection processes:
- drinking water
- industrial water
- wastewaster (only effluent)
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Amplifier parameters:
1: C2, C20 or D1
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Conex® DIA-2: parameter 1: C2, C10,D1, F10 parameter 2: pH
Conex® DIA-20: parameter 1: C2, C10,D1, F10 or F102 parameter 2: pH or redox (DIF)
Conex® DIS-C: conductivity (inductive or conductive probe)
Conex® DIS-P: pH or redox (DIF)
Conex® DIS-D: C2, C20 or D1

Conex® DIA-1: C2, C20, D1, F10, pH or redox (DIF)
Conex® DIA-2: parameter 1: C2, C10,D1, F10 parameter 2: pH
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- Available as a preassembled system (amplifier and measuring cell) mounted on a plate and ready for connection

Available sensors: pH, Redox, C2, C20, D1, F10, H2O2, conductivity
Recommended range: Sewage controller

**CU 100**
- Small pump control units
- The control unit CU 100 is designed for the starting, operation and protection of small pumps.
- The control unit is suitable for the following operating currents:
  - Single-phase: up to 9 A.
  - Three-phase: up to 5 A.
- Supply voltage: 1 x 230, 3 x 230 and 3 x 400 V, 50 Hz.
- Control of one pump
- Start/stop by means of a float switch or manual start/stop
- Several variants for single- and three-phase pumps
- Single-phase control units are supplied with capacitors and with or without float switch.
- Three-phase control units are supplied with a float switch
- IP54 cabinet with screwed metric cable entries.

**LC, LCD 107, 108 and 110**
- Pump controllers with pneumatic signal, float switch or electrodes for
  - Pumping stations
  - Filling/emptying of tanks.
- Supply voltage: 1 x 230, 3 x 230 and 3 x 400 V, 50/60 Hz.
- Automatic alternating operation (LCD)
- Automatic test run preventing shaft seals from seizing up during long periods of inactivity
- Water hammer protection
- Starting delay after power failure
- Stop delays
- Automatic alarm reset (if required)
- Automatic restart (if required)
- Liquid level indication
- High-level alarm
- Motor overload protection relay
- Protection against motor overheating via input from PTC resistor/thermalswitch.

**Optional**
- SMS modem with built-in hour and start counter (information on mobile phone)
- Hour counter/Start counter
- Signal lamp, Acoustic signal, External mains switch.

**LC 221**
- Lifting station controller to empty collecting tanks with one or two pumps
- Supply voltage: 1 x 230, 3 x 230 and 3 x 400 V, 50/60 Hz.
- Automatic alternating operation
- Automatic pump changover at fault
- High-level alarm
- Motor overload protection relay
- Protection against motor overheating via input form PTC resistor/thermalswitch.
- Automatic test run during long periods of inactivity (24 hours after last operation)
- Automatic pump changover at fault
- High-level alarm
- Motor overload protection relay
- Protection against motor overheating via input from PTC resistor/thermalswitch.
- Automatic current measurement for alarm indications
- Setting of current values:
  - Overcurrent
  - Undervoltage
  - Dry running current.
- Alarm indication of:
  - Pump status (running, fault)
  - Phase sequence failure
  - Thermal switch failure
  - High water alarm
- Alarm indication of:
  - Pump status (running, fault)
  - Phase sequence failure
  - Thermal switch failure
  - High water alarm
- Selection of automatic alarm resetting
- Selection between different start levels
- Selection of connected sensor type
- Calibration of sensor
- Further settings a PC Tool can be connected
- Motor protection by overload protection relay and/or measurement on board
- As standard, the LC 221 has four signal outputs for:
  - Pump is running
  - Pump failure
  - High water level alarm
  - Common faults and six digital inputs for:
  - Connecting the ultrasonic sensor
  - Connecting the pressure sensor
  - Connecting up to 4 float and pressure switches instead of analog sensors
- Connection of an external level alarm outside the Multilift
- Lifting stations are often installed in a well inside the basement - the lowest point in the building. In case of e.g. groundwater inflow or water pipe burst an alarm will be indicated via the level control.
- Connecting a pressure sensor board
- External alarm reset
- Connecting the thermal switch of the motor
- Prepared for bus communication, the LC 221 can be equipped with CANBus interfaces to get easier access to CIU units (May 2012)

**Optional**
- SMS modem with built-in hour and start counter (information on mobile phone)
- Hour counter/Start counter
- Signal lamp, Acoustic signal, External mains switch.

**Multilift controller (LC 221)**
- Pump controllers (LC 221) with analogue ultrasonic signal or pressure switch
- Lifting station controllers for emptying collecting tanks with one or two pumps
- Supply voltage: 1 x 230, 3 x 230 and 3 x 400 V, 50/60 Hz.
- Automatic alternating operation
- Automatic pump changover at fault
- High-level alarm
- Motor overload protection relay
- Protection against motor overheating via input form PTC resistor/thermalswitch.
- Automatic test run during long periods of inactivity (24 hours after last operation)
- Automatic pump changover at fault
- High-level alarm
- Motor overload protection relay
- Protection against motor overheating via input from PTC resistor/thermalswitch.
- Automatic current measurement for alarm indications
- Setting of current values:
  - Overcurrent
  - Undervoltage
  - Dry running current.
- Alarm indication of:
  - Pump status (running, fault)
  - Phase sequence failure
  - Thermal switch failure
  - High water alarm
- Alarm indication of:
  - Pump status (running, fault)
  - Phase sequence failure
  - Thermal switch failure
  - High water alarm
- Selection of automatic alarm resetting
- Selection between different start levels
- Selection of connected sensor type
- Calibration of sensor
- Further settings a PC Tool can be connected
- Motor protection by overload protection relay and/or measurement on board
- As standard, the LC 221 has four signal outputs for:
  - Pump is running
  - Pump failure
  - High water level alarm
  - Common faults and six digital inputs for:
  - Connecting the ultrasonic sensor
  - Connecting the pressure sensor
  - Connecting up to 4 float and pressure switches instead of analog sensors
  - Connection of an external level alarm outside the Multilift
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  - Connecting a pressure sensor board
  - External alarm reset
  - Connecting the thermal switch of the motor
- Prepared for bus communication, the LC 221 can be equipped with CANBus interfaces to get easier access to CIU units (May 2012)

**Optional**
- SMS modem with built-in hour and start counter (information on mobile phone)
## Recommended range: Sewage controller and Rainwater Controller

<table>
<thead>
<tr>
<th>Sewage controller</th>
<th>Rainwater controller</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIU 902: R100 Infrared communication</td>
<td>CIU 361 processor providing electronic control system of rainwater collection</td>
</tr>
<tr>
<td>CIU 272: Grundfos Remote Management</td>
<td>Multistage centrifugal pump (Grundfos) executed in stainless steel with a motor NGE (with a frequency regulator incorporated)</td>
</tr>
<tr>
<td>CIU 252: SCADA via Modbus TCP (Wireless)</td>
<td>Submersible pump 3&quot; - type SPO: The SPO pump is equipped with a submersible cable 20 meters long and a lateral connection allowing installation of a control device provided with a float filter.</td>
</tr>
<tr>
<td>CIU 202: SCADA via Modbus RTU (Cable)</td>
<td>Silent installation through the use of a multistage centrifugal pump type CME</td>
</tr>
<tr>
<td>CIU 252: SMS (to mobile phones)</td>
<td>Module ready employment, an extremely small footprint</td>
</tr>
<tr>
<td>CIU communication boxes</td>
<td>Possibility of transmission of various data operations and anomaly centralized management system for buildings displaying a large graphic display range of messages.</td>
</tr>
<tr>
<td>Enclosure class: IP 65</td>
<td>Exceptional reliability through the adoption of advanced technology.</td>
</tr>
<tr>
<td>Ambient temp.: -30°C to +50°C</td>
<td>Feed pump (Grundfos SPO) and booster pump for rainwater (Grundfos CME) carried out in materials extremely resistant to corrosion.</td>
</tr>
</tbody>
</table>

### Wastewater AUTOAdapt

- Drainage water & groundwater
- Domestic, municipal and industrial wastewater
- Pressurised domestic sewage
- Protection

#### Features / Benefits

- Advanced pump alternation with pump groups
- Start level variation
- Anti-blocking
- User-defined functions
- Mixer control or flush valve
- Daily emptying
- Supports several languages
- Advanced alarm and warning priority
- Advanced data communication
- Electrical overview
- Configuration wizard
- Easy installation and configuration
- Automatic energy optimization
- Start/stop levels
- Monitoring of water levels, duration of operation, number of commutations, hours of operation and the length of cycles.

### RCME - Rainwater Controller

**Designed to supply rainwater sampling points installed in the non-residential buildings and does not require the distribution of drinking water, this Grundfos offers is under the sign of reliability, energy efficiency and operational safety.**

If this system has no self-priming pump to prevent any problems likely to affect the suction (air pockets, irregular slope of the pipe, etc.), however it is equipped with a pump power of steel stainless steel tank connected to a rainwater tank hybrid.

In case of shortage of rainfall, the system switches to the installation of water potable. This constant pressure pump and control the rotation speed has a high efficiency motor that provides water sampling points.

**Features / Benefits**

- Installation CE certified, 3 x 380-480 V 50/60 Hz
- Solution energy efficient pump with integrated control the speed of rotation. This pump ensures the application of a constant pressure despite the large difference between the average flow and peak flow for which the installation is designed.
- Safe operation thanks to a very high charge pump (removal problems affecting the suction piping when using self-priming centrifugal pumps normal) which pushes the rainwater to tank hybrid.
- Hybrid tank complies with the specific requirements of EN 1717
- Feed pump (Grundfos SPO) and booster pump for rainwater (Grundfos CME) - carried out in materials extremely resistant to corrosion.

## Appendix Rainwater Control

### Wastewater AUTOAdapt

- Pumps have integrated sensors and needs no external sensors, they adapt automatically up to 4 start/stop levels
- Only one cable to the pump, powerless communication to CIU communication module: Integrated motor protection

#### 5G AutoAdapt

- 0.9 - 4 kW pressurized domestic sewage
- DF AutoAdapt, 0.9 - 2.6 kW Drain water & groundwater
- SL AutoAdapt, 0.9 - 15 kW Domestic, municipal and industrial wastewater, drainage water & groundwater
- EF AutoAdapt, 0.5 - 1.5 kW Drain water, Groundwater, Wastewater with fibres

**Supply voltage:** 3 x 230/ 3 x 400 V 50 Hz depending on pump type

- For 1 - 4 pumps in one pit
- Ambient temp.: -10°C to +50°C
- Enclosure class: IP 65

### Options

- CIU communication boxes
- CJI 252: SMS (to mobile phones)
- CJI 202: SCADA via Modbus RTU (Cable)
- CJI 252: SCADA via Modbus TCP (Wireless)
- CJI 272: Grundfos Remote Management
- CJI 902: 1000 Infrared communication

### RCME - Rainwater Controller

- High efficiency and operational safety.
- Exceptional reliability through the adoption of advanced technology.
- In case of absolute shortage of water (drinking and rain), the system is off service by a guard against the risk of running dry integrated into the pump CME
- Order provided via a graphic display console and microprocessor management of rainwater collection
- Exceptional reliability through the adoption of advanced technology.
- Exceptional reliability through the adoption of advanced technology.
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- Exceptional reliability through the adoption of advanced technology.
### Overview controller vs. applications

<table>
<thead>
<tr>
<th>Controller</th>
<th>Application</th>
<th>Heating</th>
<th>Water Heating</th>
<th>Water Treatment</th>
<th>Mechanical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grundfos Remote</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
<td>Y</td>
</tr>
<tr>
<td>Conex DiS-C</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conex DiS-pR</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
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</tr>
<tr>
<td>Conex DiS-D</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CiM-CiU 200 Modbus</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
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</tr>
<tr>
<td>CiM-CiU 150 Profibus</td>
<td></td>
<td>Y</td>
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<tr>
<td>Dip</td>
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<tr>
<td>Conex DiA-2Q</td>
<td></td>
<td>Y</td>
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<tr>
<td>Conex DiA-1</td>
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<tr>
<td>Sm111 Signal</td>
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<td>Y</td>
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<tr>
<td>Controls</td>
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<tr>
<td>iO111 Signal</td>
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<tr>
<td>Control DC</td>
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<td>Y</td>
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<tr>
<td>CiM-CiU 100/100 ION Works</td>
<td></td>
<td>Y</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Further information

For further details we recommend to use the related databooklets and brochures.

A wide range of quality pumps

Grundfos E-pumps   Pumps with built-in frequency converter
MAGNA, UPE    Series 2000 circulator pumps
Grundfos CUE      Frequency converters for pump control
MP204  Motor protection
Control MP 204  (IO 112)
PM 1, PM2    Pressure manager
Hydro Multi-E / Hydro Multi-S    Booster sets
Hydro MPC    Booster systems
Hydro Multi-B

Online information

Please consult the Grundfos homepage (www.grundfos.com) for more information on controls as well as for the databooklets in PDF format, for case stories, for IO-manuals etc.

Grundfos PC Tools for monitoring & commissioning

Grundfos PC Tools are available for several products to make it easy to commission and install Grundfos pumps and controllers. They are mainly developed for Grundfos sales and service people and they allow extended settings of parameter. There are several PC Tools for CU3, CU300, G100, Modular Controls, and also Tools for firmware upgrade available.

Grundfos internal link to Grundfos PC Tools - on GTI database (look at Service support Tools)

Often requested PC Tools are these:

PC Tool Wastewater: The Grundfos PC Tool Wastewater is made for Dedicated Controls. The PC Tool is a management and service tool for on-site service and remote preparation, verification and management. The PC Tool can be used for setup, commissioning and backup of settings and parameters. Settings can be sent via e-mail for easier commissioning.

PC Tool water utility: The Grundfos PC Tool water utility is made for MP 204, IO 111 and WW AutoAdapt pumps. The PC Tool can be used for setup, commissioning and backup of settings and parameters. Settings can be sent via e-mail for easier commissioning and backup of settings and parameters. The PC Tool is a management and service tool for on-site service, verification and data logging.

PC Tool E-products: The Grundfos PC Tool E-products enables service technicians to maintain and service Grundfos E-motors, E-pumps and controllers. The PC Tool E-products communicates with GENIbus products from a PC running Microsoft Windows and requires a "PC Tool link USB" adapter.

The PC Tool E-products enables you to monitor the operating status of E-products e.g., an e-pump with MGE motor or CU 351, perform standard configuration of E-products, perform custom configuration of E-products and save logged data from E-products.

PC Tool CIM CIU: The Grundfos PC Tool CIM / CIU with support for Modbus, GENIbus, Profibus and BACnet are delivered with each CIM-CIU interface for easy integration and commissioning of data communication interfaces into SCADA or BMS systems. Grundfos gives you an integration CD that ensures easy integration into supervisory systems and fast commissioning. You are provided with functional profiles, documentation and installation files, ready to use. Modbus, GENIbus and BACnet require a "PC Tool link USB" adapter, Profibus require a special IFAK IsPro Hardware adapter.
SEE THE BIGGER PICTURE

Grundfos is a global leader within water handling technology. Our passion is to bring you all the products you require to create and operate pump systems that combine reliability, cost-efficiency – and innovation. Our products are for use in water supply and wastewater infrastructure on any scale.

Grundfos has a full line of products and systems for the intake, treatment and distribution of drinking water and for the transport and treatment of wastewater. We also offer expertise and industry insight that can increase reliability and reduce lifecycle costs for water utilities.

Key product areas include:

- Submersible pumps
- Surface pumps
- Sewage pumps
- Mixers, flowmakers & recirculation pumps
- Pumping stations
- Monitoring & controls
- Dosing & disinfection
- Aeration equipment

Our products are the result of decades of engineering expertise. Supported by a worldwide service network. Visit www.grundfos.com/water-utility for more.