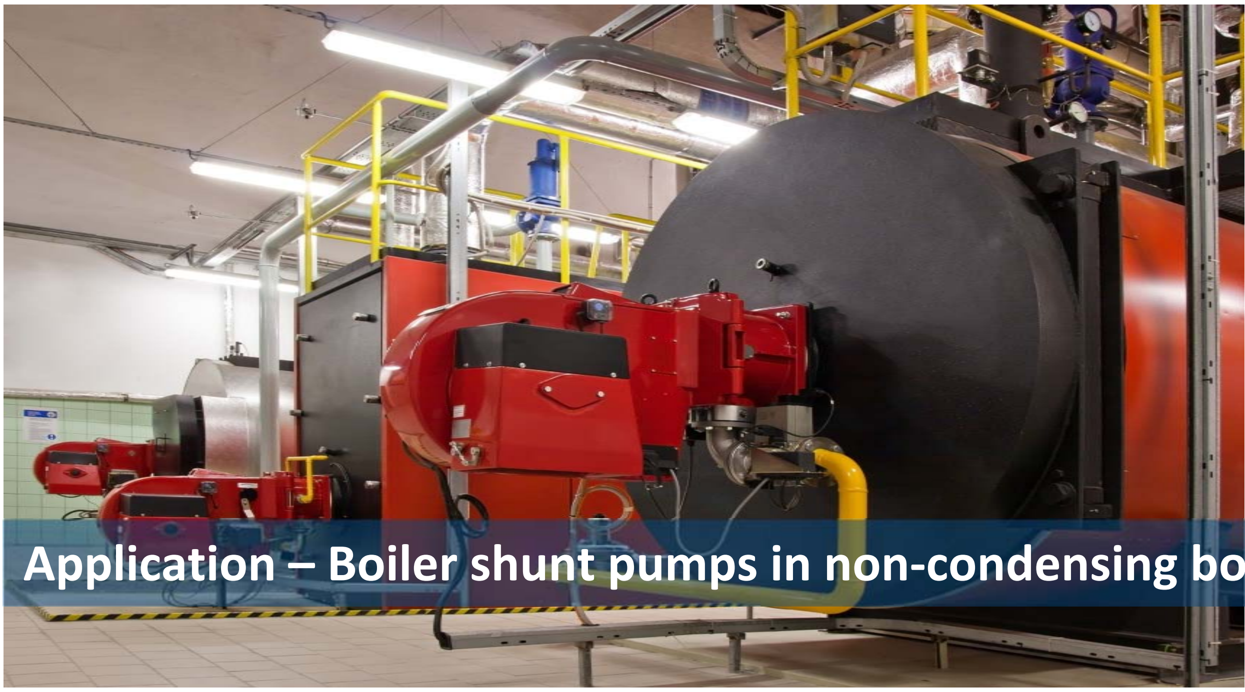

Application – Boiler shunt pumps in non-condensing boilers

Introduction:

A boiler is an essential part of modern heating systems, and in the case of large-scale district heating, it represents a major capital investment. However, like any thermo-hydraulic engineering system, it is constantly under attack from corrosion during its lifespan, and requires careful treatment and protection.

Among many measures that may be used to protect vital components, shunt pumps are arguably the most important.

Purpose:

The purpose of this white paper is to look at the function of boiler shunt pumps in non-condensing boiler systems. In addition, we shall consider how to size the pump to meet system flow requirements, and how modern pumps are commissioned via remote digital controls.

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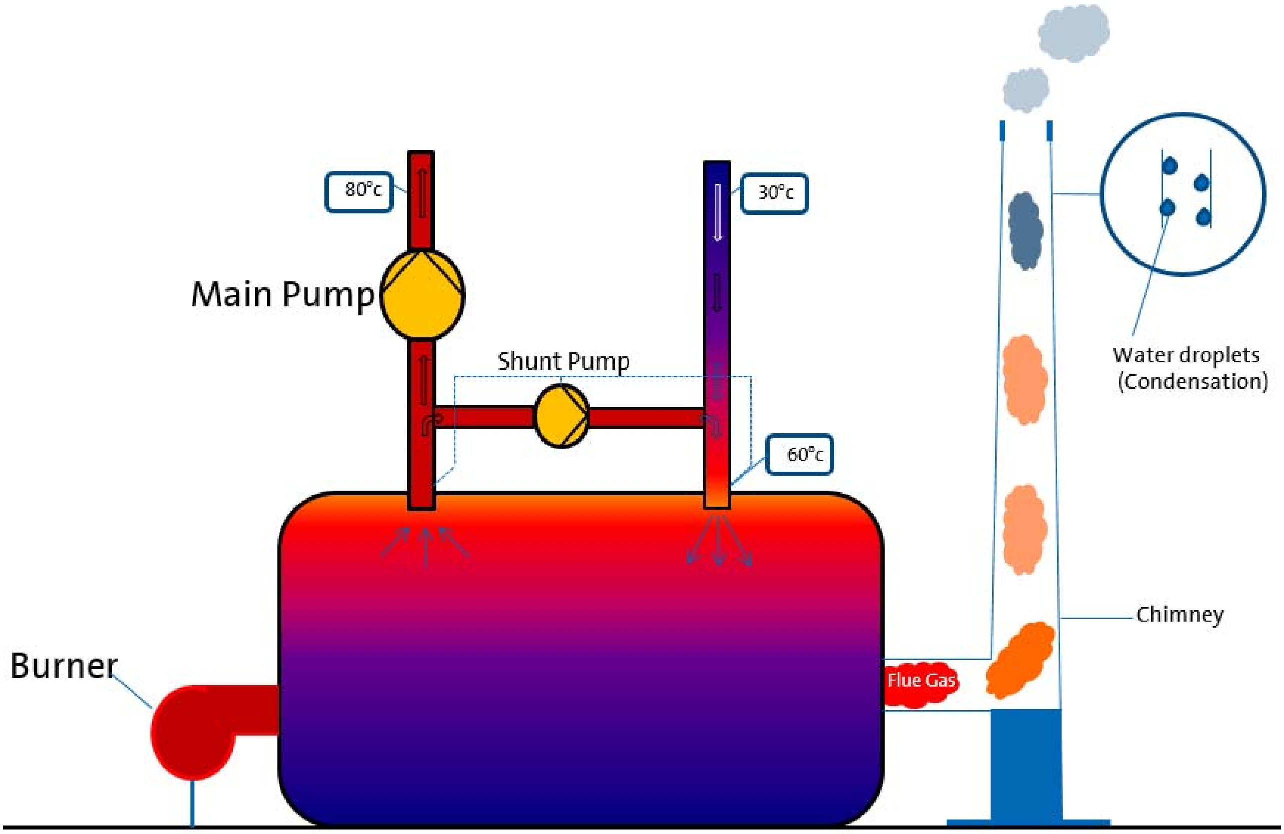
Boiler systems:

Boiler systems come in many sizes, ranging from small, domestic wall-mounted units to large industrial types. Boilers are designed to operate with thermal oil, steam or water, but this white paper deals only with non-condensing water boiler systems. They all have the following components in common:

- A boiler, which houses a source of heat (a burner) and a system of pipes that brings the heat (flue gas) into close contact with the circulation water, which is the medium used to transport the heat to where it is needed.
- A main pump, which distributes the hot water through the network.
- A shunt pump, which is used to ensure the correct return temperature.



Corrosion

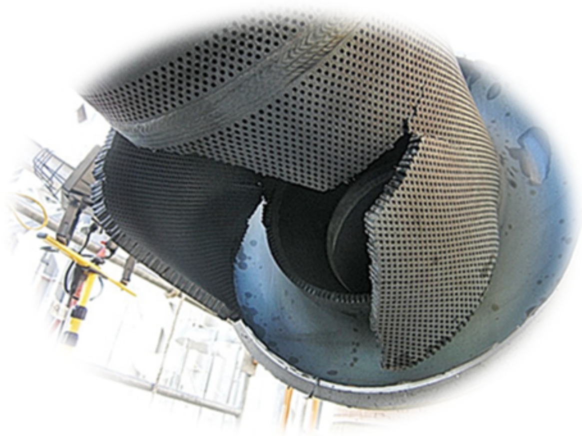
Flue gas contains acid particles such as sulphur, which in condensed form can cause corrosion on steel surfaces of the boiler. Damage caused by corrosion represents a potential hazard, and at the very least, is a source of leaks and impaired system efficiency. Maintenance and repairs will require the entire boiler to be isolated, and is an extra operating expense.

Therefore, measures to prevent corrosion may be viewed as sensible precautions to protect investments.

The calculation of the temperature at which the flue gas condenses -the hydrocarbon dew point (HCDP) as it is known- is complex, and requires data on the gas pressure, the percentage of water vapour and the chemical mix involved.

Thermal shock

Corrosion, however, is not the only severe result of having low return temperatures within non - condensing boiler systems.
Once the temperature difference between supply and return pipeline exceeds 30K thermal shock effects kick in.
Sudden changes in temperature due to cold water entering a hot boiler cause system components to expand and shrink. Since the parts are not homogenous in the material, such thermal tension might cause anything from leaking tubes to cracked sections in iron boilers.

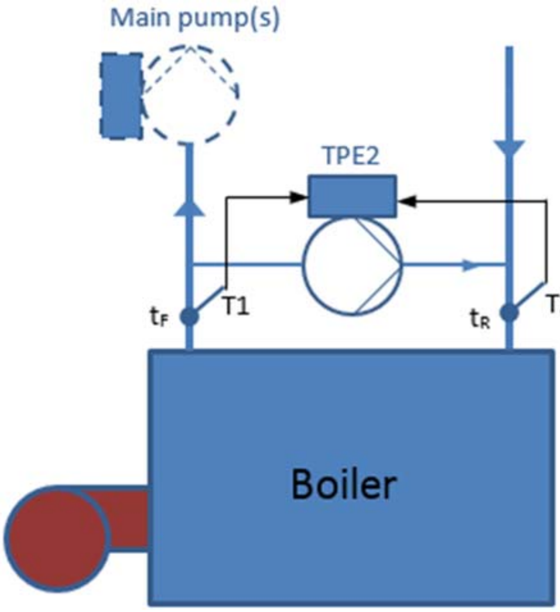


Boiler shunt pump operation and configuration

Originally, pumps were designed to operate at a single speed, relying on throttle valves to match the required flow. However, modern shunt pumps and variable frequency drives, combined with digital sensors allow for a variety of ways in which they can be configured and controlled. Here we shall consider Grundfos intelligent solution:

Direct control via boiler return temperature, with feedback and additional energy savings

A TPE pump (a TPE with MGE model H, I or J) is installed across the boiler supply and return pipe as shown below.



Temperature sensors/transmitters 0 - 150 °C / 4-20 mA are installed in the supply and return pipes respectively, return temperature sensor at the bottom of the boiler.

In this way, the pump reacts immediately whenever the temperature of the boiler falls below the recommended value of 60 °C, and reduces the risk of flue gas condensation.

On the other hand, it is not required of the shunt pump to operate when the return temperature is above 60°C. Using Limit Exceed Function within the TPE pump (MGE motor model H, I and J), the pump stops its operation when temperature of 65°C is reached and starts to run again when it drops below 60°C. This way the optimal shunt pump, as well as system, operation is guaranteed.

The TPE pump (MGE motor model H, I and J) also sends out a warning message in case of differential temperature across supply and return pipeline exceeding 30K, thus preventing possible mechanical damage on the boiler.

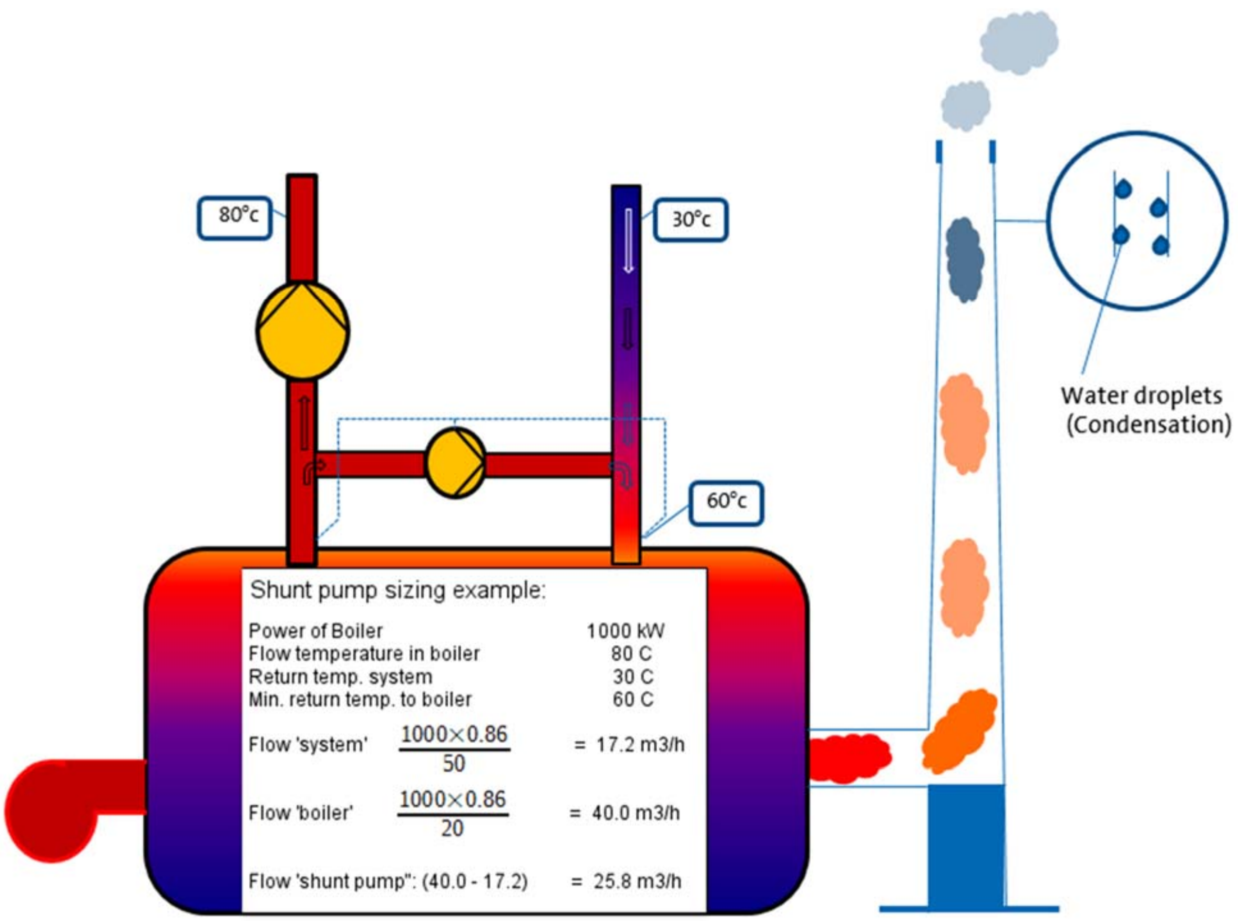
Setup via Grundfos GO

In both cases, the configuration and commissioning of the shunt pump is quite a straightforward process with the Grundfos GO application, which is available for both Android smart phones and iPhones.

Conclusion:

The widespread use of boiler systems in industrial processes and heating for buildings and districts represents a huge investment in infrastructure. The energy consumption of these systems also represents a massive financial commitment over many years. But these heating systems are a vitally important part of continuing efforts to provide heat in an efficient and affordable way. A shunt pump has a key role: it ensures that the boiler performs according to the specs, and protects it from corrosion.

Modern shunt pumps equipped with integrated variable frequency drives can monitor a variety of sensors, and operate to match different load profiles. They can be commissioned and configured quickly via PC or a smart phone, and the engineer can select from the default values to match the pump type and required effect. Used smartly, such pumps can lead to simpler, more cost-effective systems.



Sizing example

In this example, we have a boiler system for an efficient district heating solution, with an outlet temperature of 80 °C. A boiler like this is fuelled by natural gas, and according to the boiler specifications, it needs a minimum temperature of 60 °C. The reason for this is that the flue gas from a natural gas boiler contains some water in vapour form. If this water is allowed to condense, it could potentially harm the boiler internally by causing corrosion. The dew point for natural gas (under normal operating conditions) is 57 °C, so no part of the boiler must be below this level.

As the return temperature from the city is about 30 °C, we need to shunt hot water from the outlet flow pipe and into the return flow stream in order to raise the temperature to the necessary 60 °C.

To calculate the size of this boiler shunt pump for this particular boiler:

Boiler size: 1000 kW
Flow temperature (boiler): 80 °C
Return temperature (city): 30 °C

Formula used for flow calculation: $\frac{\phi \times 0.86}{\Delta t}$

Flow "city":
$\frac{1000 \times 0.86}{(80 - 30)} = 17.2\ m^3/h$

Flow "boiler":
$\frac{1000 \times 0.86}{(80 - 60)} = 40.0\ m^3/h$

Flow boiler "shunt":
$40 - 17.2 = 25.8\ m^3/h$

From this, we can see that the actual boiler shunt pump must have a capacity of 25.8 m^3/h.

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