
# Expert Report

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## Double-flue boilers

In the 1950s, Bosch Industriekessel GmbH developed for the first time double-flue boilers in three-pass compact technology and it builds them today with capacities up to 55 t/h: the pioneering factor is still regarded as being the continuous separation of the two burners and their flue tubing right through to the flue gas chamber. The ZFR boiler series was patented and it has met all the industrial requirements for use from the very beginning.


The design principle of the original ZFR patent has been retained until today. But the boiler details have inevitably been further developed, due to the progress that has been made and the increasing diversity of the systems used.

## Good reasons for using double-flue boilers

One of the most frequently discussed questions is: “When can a double-flue boiler be used?”. The answer is “Always, if there is no need for a second, fully fledged standby boiler”. The following arguments demonstrate the overwhelming advantages of the double-flue boiler:

- more cost-effective than two single-flue boilers
- less space required
- less installation work required
- cheaper boiler house
- simple heat retention
- faster provision of capacity
- less maintenance required
- easier to inspect
- higher operating pressures possible

## Introduction to the problems of operating double-flue boilers

Naturally, one of the important operating criteria is whether a double-flue boiler always needs to be operated with both burners at the same time or whether it can keep on working perfectly in single burner operation even if the performance regulation of its burners is independent. Here – how could it be otherwise – it depends largely on the boiler design.

### Double-flue boiler with burners in parallel operation

In double-flue boilers with the burners operating in parallel, a common rear flue gas reversing chamber has not proved effective, even it is built as a water tube by-pass chamber. Flue gases from the flame tube are mixed there. Optimum burner adjustments are hardly possible. On the other hand, the operating frequencies of the two burners can build up against each other, resulting in burner adjustment problems, noise, and vibrations which can damage the material. All of these disadvantages disappear in the case of double-flue boilers in which the flue gas channels are separated as far as the flue gas chamber.

### Double-flue boilers with unlimited individual operation of burners

Double-flue boilers, which also need to be ready for operation with just one burner, require separate flue gas channels through to the flue gas chamber and also require, at the boiler end, a flue-gas-side pressure of ≤ 0 mbar. However, this alone is insufficient. Tensions in the boiler arising from uneven thermal expansion must be neutralised from the start through the design. This level of know-how can be detected by

- large distances between both flame tubes and between the flame tubes and the boiler casing
- stable connections between both flame tubes and the rear boiler floor as well
- robustly embedded flue gas reversing chambers.

The boiler floor/flame tubes and boiler floor/flue gas reversing chamber must be rigidly anchored to each other.

There is a high degree of strength if the flame tubes and flue gas reversing chamber penetrate the rear boiler floor and are welded all around. The thermal expansion is absorbed without problems in this case by the front boiler floor, which is made more dynamic.

In addition, it is a good sign if the boiler water can flow around without impedance, and if it passes the heating surfaces quickly thus providing a thermal balance in the boiler which is as even as possible. And this should be the case with any load. This applies for steam boilers with independent water circulation and also hot water boilers with a boiler water pump.

The return flow of a double-flue hot water boiler is passed directly into the boiler base between the two flame tubes This gives rapid mixing and ensures that there is a good flow through the boiler base.

Water deflection elements that improve the circulation of the boiler water help to avoid critical temperature drops. This applies particularly in low-load phases and when a boiler is being commissioned/decommissioned.

Top-mounted Economiser for unlimited individual use of burners

## Flue gas heat recovery in double-flue boilers

Even a calculation of the operating costs shows that high-capacity boilers – as double-flue boilers now are – should always have an Economiser, ideally mounted on a piggy-back basis.

Double-flue boilers which sometimes work with just one boiler consequently also have separate flue gas conduits in the Economiser. A free extraction of the flue gases is normal because of the flue-gas-side pressure of ≤ 0 mbar at the Economiser end. Of course flow-blocking additional units, such as flue gas silencers, also have to be taken into account. Here, in individual cases, the resistances of the flue-gas-side additional units must be determined, and it must be clarified whether these resistances can be overcome by the burner or the chimney draft.

There are two types of separated flue gas circulation:

1. in each case, a complete Economiser for the first and the second burner;
2. a single Economiser body with a central flue gas separating wall, but continuous water tube bundles for both burners.

The last option is not a problem. Calculated as a heat recovery system for both burners, the flue gas heat is used well even if the burner is operated with individual burner regulation, and the water in the Economiser is always heated continuously. There is no stepped heating, and certainly no steam impacts.

## Regulation for Economisers on double-flue boilers

Whereas, in earlier times, the focus was on protecting the components downstream from the Economiser, such a masonry chimneys for example, nowadays it is increasingly the effectiveness of the boiler which is the most important decision-making criterion.

With systems which are being built as new, the parts of chimneys at risk from dew points are almost exclusively corrosion-resistant.

To achieve an optimum efficiency, the most effective approach is to flood the Economiser completely in every load state on the flue gas side, i.e. the Economiser is designed to be unregulated.

With boiler systems which are integrated into existing flue gas system at risk of corrosion, or which are operated with heavy oil, a flue gas temperature regulator is recommended.

## Striking facts about operating burners in double-flue boilers

Double-flue boilers have two individual burners and thus open up the possibility of expanding the control range. For a whole series of boiler systems, such as central heating units which have to cover a heat requirement that varies considerably between summer and winter, a broad-span control range is absolutely essential.

### Parallel operation of burners

Naturally, there are boiler systems for which low-load phases could never be considered. The regulation of both burners in parallel operation is easily conceivable here. But the fact is that every time there is an operating fault in a burner because of a blockage in the fuel flow or a defect, the other cannot operate either. An emergency operation with just one burner is not possible, nor is sequence control of the burners.

The only advantages of parallel operation lie in the rather smaller system costs: the blower, load regulator, automatic firing device and gas filter, gas shutoff valve and gas pressure regulator for gas burners can be shared equipment.

### Individual operation of burners

Here, the regulation range goes from the lower performance limit of one burner through to the maximum performance of both burners. This advantage assumes that the double-flue boiler including its Economiser generally has separated flue gas channels and that each burner can operate separately: independently, with automatic operation and controls, blower, flue gas heat usage, and fuel supply. If gas is the fuel chosen, there are also separate gas pressure regulators. Their smaller nominal widths also improve the comtrol behaviour. The burners are automatically switched on and off as a function of the heating requirements using sequence control, as is generally normally with multi-boiler systems.

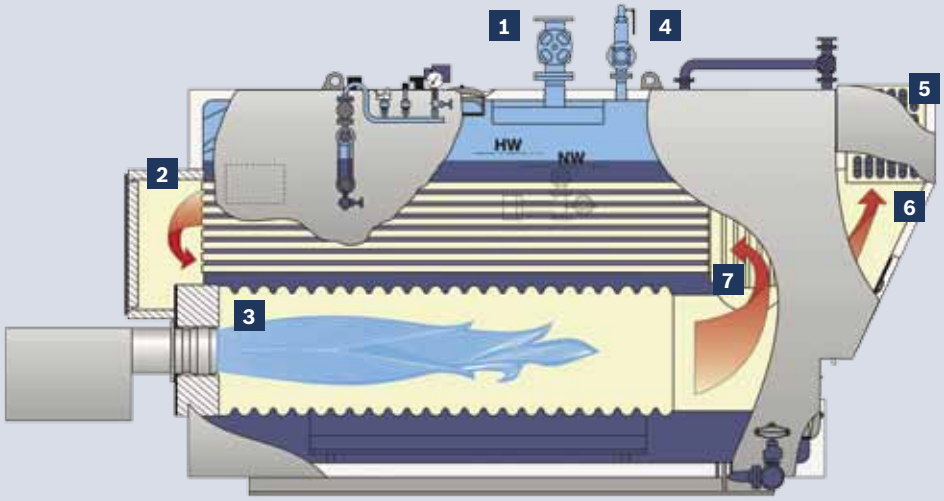
## Summary

Double-flue boilers cover a high heat requirement. It has been found in practice that there are also times when operation with just one burner is important: in low-load phases and in the event of faults on one of the two burners. Double-flue boilers which allow an unlimited single operation of the burners offer excellent load flexibility and minimise switching ON and OFF, which wastes fuel and causes boiler wear.

Continuous burner operation, due to its wide control range brings continuity to the boiler heat management: water circulation and heat convection are not interrupted. This also prevents material tensions caused by abrupt temperature changes. In the evaluation of various double-flue boiler designs, attention should also be paid to a long working life without damage. This applies for steam boilers as much as it does for hot water boilers. If a double-flue boiler is designed and approved for unlimited single operation of the burners, this is tested by the competent TÜV test authority. It is important to ask the boiler supplier to provided this certificate. It is also important to inspect reference systems which have been in operation for 10 years or more, and which have to cope with changing loads and which are used extensively all year round.

With double-flue boilers in particular, reliability and technical expertise are selection criteria that should not be underestimated.

Section through a steam double-flue boiler in three-pass compact technology and piggy-back-welded Economiser. The two flue gas channels are separate right through to the flue gas connection. This means that the burners can be operated individually.




1 Steam valve
2 into the 3rd pass
3 Steam valve 1st pass
4 Feed water valve
5 Economiser
6 Flue gas collector chamber
7 into the 2nd pass

Production facilities:
Factory 1 Gunzenhausen
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