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## Expert Report

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### Steam boiler with superheater module

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Superheated steam is used mainly for complex, extensive steam systems and for driving steam motors and steam turbines for independent power generation. For the parameters of 2.6 – 50 t/h steam output, of up to 30 bar pressure and of superheated steam temperatures up to 300 °C, single and double flame and smoke tube boilers are combined in a wide variety of ways with superheaters to produce superheated steam.

#### Does it have to be like this?

Flame and smoke tube boilers are generally regarded as easy to operate and maintain, undemanding, robust and durable. These advantages for the operator do however, because of the type and layout of the superheater, sometimes become the Achilles heel of the boiler system, e.g. due to the limited working life of the superheater, complicated control of the temperature of the superheated steam, time-consuming operation and reduced accessibility for inspections.

The working life of the superheater basically depends on the thermal load of the superheater tube bundle, which means that high heating temperatures or the effect of direct radiated heat should be avoided.

In some cases, superheated steam temperatures far above the setpoint temperature are produced, and these subsequently reduced to the setpoint temperature using surface or injection coolers. Superheater systems of this type are preferred if the superheater tube bundle is small and/or the setpoint

temperature of the superheated steam is to be kept constant over the largest possible load range. They are flooded and cooled for start-up with complex operating procedures. Surface coolers in the boiler's water section can also make accessibility and inspections more difficult.

## Superheater module for Bosch single and double flame and smoke tube boilers

### Heating with low temperatures and definite flow

In developing its superheater module, Bosch Industriekessel deliberately avoided reaching superheated steam temperatures of more than 100 °C above the saturated steam temperature (dependent on pressure, max. 300 °C), see graphic 1. This meant that it was possible to position the superheater basically after the 2nd pass.

### Superheated steam temperature controlled

With a superheater module fitted, the front reversing chamber is equipped with a flue gas deflector and a flue gas control damper with actuator in the by-pass from the 2nd pass to the 3rd pass. This means that there is fully automatic operation with controlled superheated steam temperature. The heating gas quantity for maintaining the superheated steam setpoint temperature is controlled with a temperature

sensor and a temperature controller. (Figure 1 and Graphic 2).

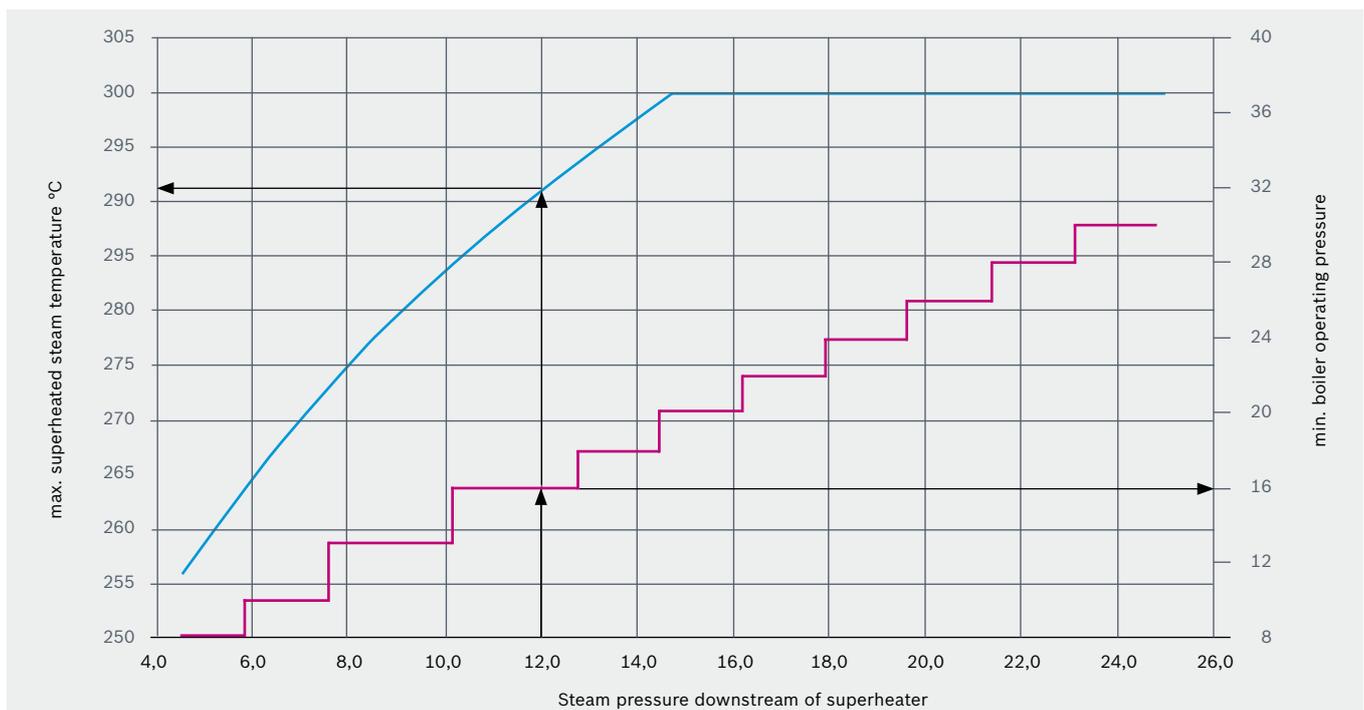
The superheater is only provided with the amount of heat that is necessary to superheat the flowing steam to the setpoint temperature. The superheaters are designed on a customer-specific basis in such a way that the superheated steam temperature is reached from a defined boiler loading. This specifically designed point lies in the range of 50 to 100 % of the boiler loading.

### Dry start-up allowed

The boiler is started up dry at low load and with the superheater heating switched off. The output is increased gradually as soon as there is a partial flow through the superheater. After the superheated steam temperature control and burner control have been enabled, fully automatic operation starts.

### Demister improves steam quality

For flame-tube smoke-tube boilers, operation with feed water containing salt is permitted. In order to avoid salt deposits in the superheater with this operating mode, boilers with superheater module are fitted – if necessary – with a highly effective demister for drying the steam for improving steam quality. This means that there is no need for superheater purging to maintain permanently trouble-free and damage-free operation.



Graphic 1: The graphic shows the max. possible superheated steam temperatures and the min. required pressure stage depending on the requested steam pressure downstream of the superheater

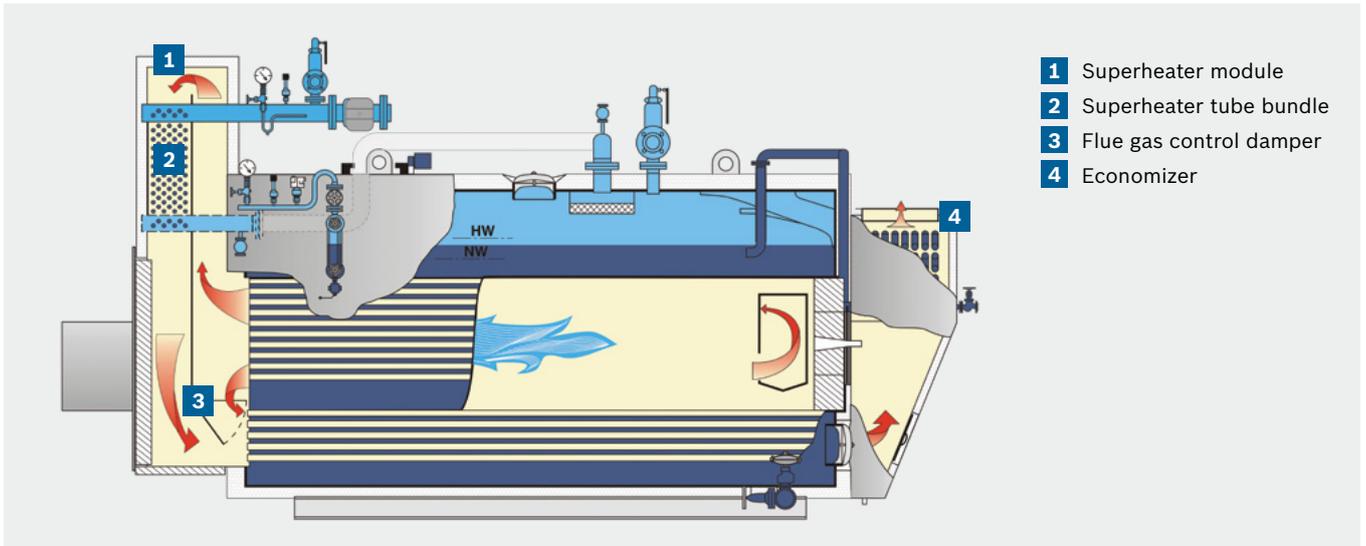


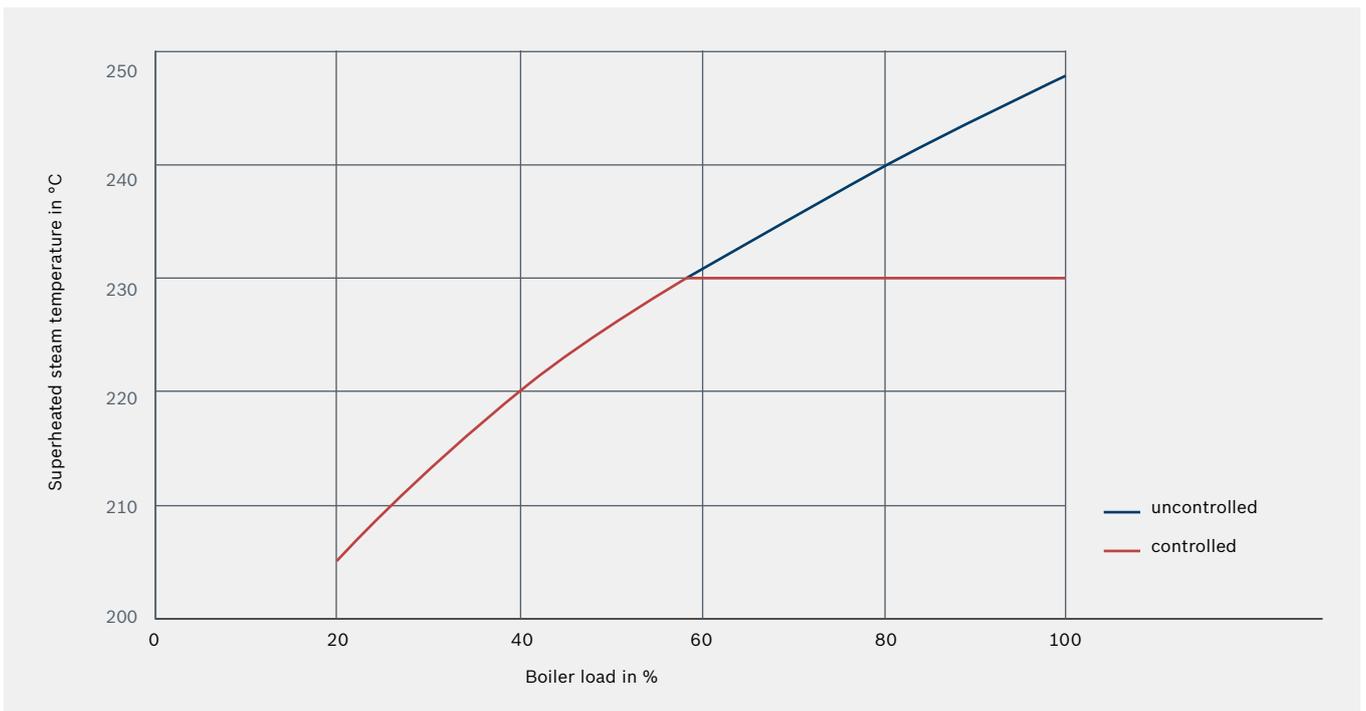
Figure 1: UNIVERSAL high-pressure steam boiler with superheater module and integrated economizer

**Modulating burner and feed water control**

Flame-tube smoke-tube boilers with superheater modules are fitted with modulating burner and feed water continuous controls. The flow of fuel and feed water is adjusted infinitely variably to the quantity of steam removed, depending on pressure and level.

**Double flame and smoke tube boilers for TÜV-approved single-flame tube operation**

For superheated steam demands of 18 – 55 t /h, double flame and smoke tube boilers with superheater modules are used. Boilers of this type are designed and equipped by Bosch Industriekessel for unrestricted single flame tube operation. The flue gas lines of both burners are separated as far as the flue



Graphic 2: Superheated steam diagram for controlled and uncontrolled operation  
 Calculated superheated steam temperatures Example: 230 °C at 60 % load

gas collector chamber and the burners and superheater modules are fitted for independent single operation. The approved single flame tube operation doubles the modulating control range, improves economy in the load area below 50 % and increases supply reliability.

#### **Tried and tested in practice**

Superheated steam boilers with superheaters in the front reversing chamber and superheated steam temperature control on the flue gas side have proved successful in practice for over 30 years for Bosch Industriekessel. Customers in almost every industry, e.g. foods, plastics, chemistry, paper, leather and petrochemicals, value their simple, undemanding and

reliable operation, as do local authorities and heat suppliers with local and remote steam systems.

The superheater tube bundle is exposed to neither the flame heat radiation nor high heating gas temperatures. The superheater module is located on top of the attached front reversing chamber. The flue tube areas of the 2nd and 3rd pass remain freely accessible from the front. The heating gases pass vertically from above as a counterflow through the superheater tube bundle by means of an integrated bypass, and any steam quantity and superheated steam temperature can be definitively calculated and the system designed for it.

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