Fuji Electric

Innovating Energy Technology

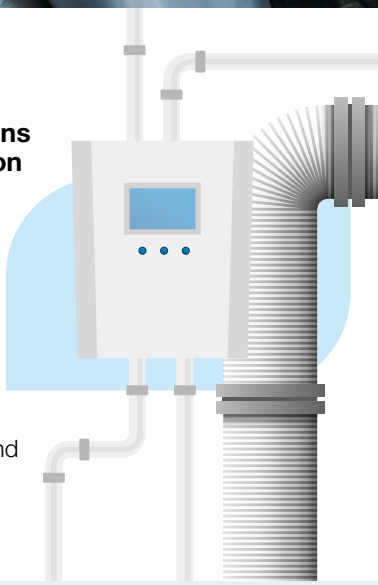
How to optimise your industrial boiler combustion and safety?

Industrial boiler

Key words

- Industrial boiler
- Energy plant
- Combustion control in boiler
- Boiler efficiency
- Energy saving
- Boiler controller

What are industrial boilers used for?

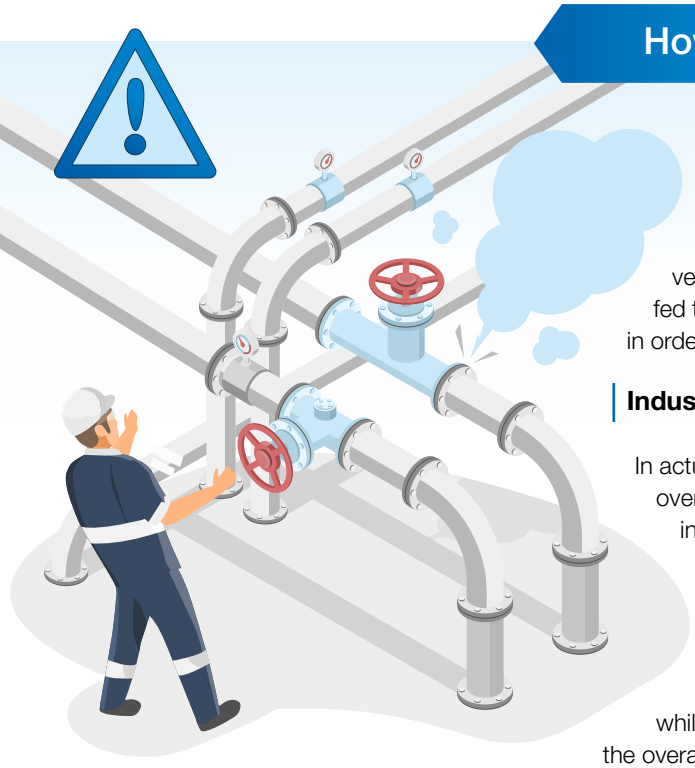


Industrial boilers are essential for providing citizens and businesses with the heating, power generation and hot water they need.

These industrial heaters are likely to consume a significant amount of fuel to operate, which can impact on your operational expenditure budget and the environment.

With rising energy costs, the challenge for industrial boiler plant operators is to increase energy efficiency to minimise fuel consumption, improve profits while ensuring plant safety and environmental preservation.

How does boiler work?



A boiler is a closed vessel in which water or other fluid is heated. The heated or vaporised fluid exits the boiler for use in various heating processes or applications, including power generation in which pressurised steam is used to revolve a turbine, and heating for use as a reactant or diluent in a production vessel, or heating for building air conditioning. The boiler's burner burns the fuel fed together with air to generate steam. It is necessary to regulate the air/fuel mass in order to maintain a constant ratio of the mixture.

Industrial boiler troubleshooting

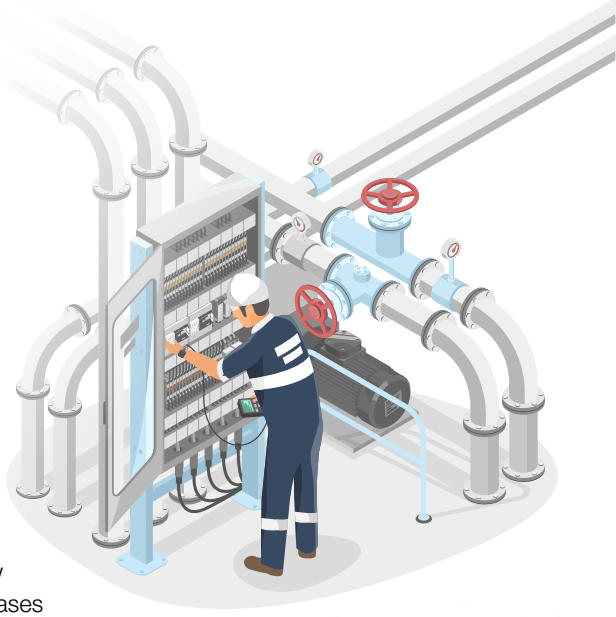
In actual applications, however, steam loads can vary significantly and unpredictably over time. Either air or fuel flow may be delayed in tracking such changes, resulting in a temporary imbalance of the air/flow ratio.

Too much fuel or air can cause environmental and safety problems and reduce the energy efficiency of the boiler.

Insufficient air leads to unburned fuels (fuel, soot, smoke and carbon monoxide), while too much air leads to heat loss due to increased flue gas flow, which reduces the overall efficiency of the boiler in terms of fuel-to-steam ratio.

The Fuji Electric solution

Multi-function process controllers for boilers



Fuji Electric's multi-function process controllers offer a reliable and cost-effective solution to regulate the combustion of your industrial boiler and maintain the expected operational efficiency.

Combustion control with «cross-limit ratio» logic is used to prevent the ratio feeding the burner from becoming too rich (too much fuel) or too lean (too much air) when operating conditions change.

An example of a control loop configuration with the cross-limit architecture is shown in Figure 1. When the firing demand is stable, the air/fuel ratio is balanced by the ratio setting (× μ). The high select override (high selector) and the low select override (low selector) block the current air/fuel flow signals added with the positive and negative biases (+β −β to prevent them from affecting each of the flow controllers.

When the firing demand increases (steam pressure decreases), the main steam pressure controller increases its output C to compensate. At this point, the setpoint signal to the fuel flow controller is limited to the maximum value A (air flow + β1) by the low selector. It only increases by the value of the bias β1, unless the airflow increase is greater. On the other hand, the high selector transmits the same signal C directly to the ratio setting (× μ), so that the airflow mass is always increased before the fuel, to avoid the emission of carbon monoxide and unburned fuel, which is harmful to the environment. At the same time, it is limited to a maximum value of D (fuel flow + β3) to avoid too much energy loss due to the additional heating of the exhaust air through the stack. In this way, the fuel flow and the air flow limit each other and increase stepwise.

If the firing demand decreases, the low selector transmits the signal C so that the fuel flow rate decreases proportionally, but the air flow rate cannot go below the value B (fuel flow rate -β2) by the high selector override, so the mass of the air flow rate always decreases behind the fuel flow rate to avoid black smoke.

The PSC210 multi-function process controllers

The PSC210 is particularly suitable for use in a critical control loop, such as for boilers, due to its backup and manual control functions.

Its extensive software function blocks of signal selection, addition/subtraction and leag/lag computation in addition to PID control allow for sophisticated control such as ratio with cross-limit override. It also has Modbus/TCP communication capability to realize remote monitoring and control of boilers from a SCADA system.

With cross-limit override combustion ratio control available on the SC100/200 series multifunctional PID controllers, plant managers have an effective way to optimise their steam boiler operation. Fuel consumption is reduced and the environment is protected.

Ratio with cross-limit override

1 Main Steam Pressure Control Loop

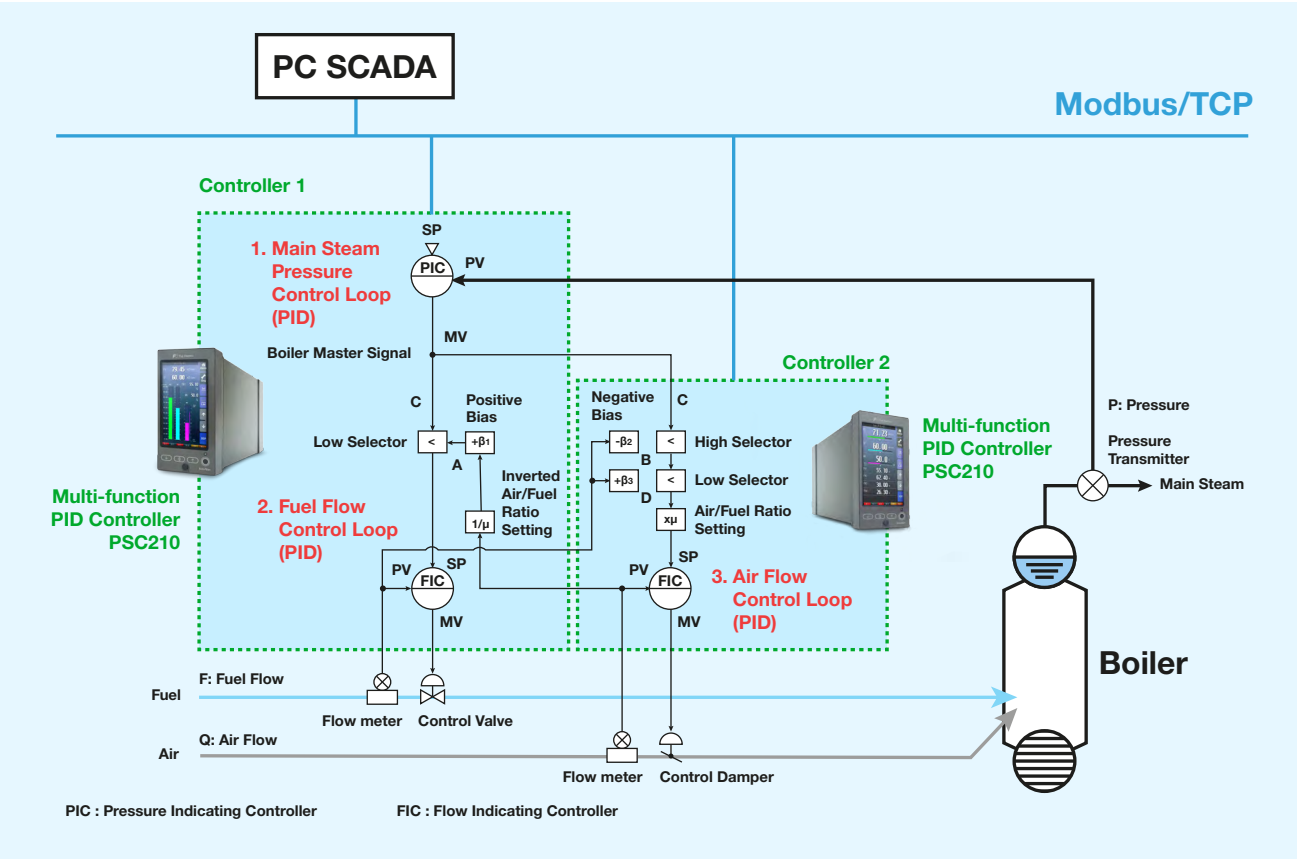
The PID controller is used to control the main steam pressure (P). The MV (output value) of the controller is called the Boiler Master signal.

2 Fuel flow control loop

The Boiler Master signal is provided as the SP (setpoint) of the PID to control the fuel flow mass. The cross-limit strategy does not affect the control action when reducing the SP, but limits it within a certain range when increasing the SP.

3 Air flow control loop

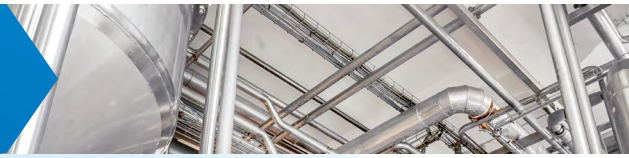
The boiler master signal multiplied by the preset air/fuel ratio is provided as the SP (setpoint) of the PID to control the air flow mass. The cross-limit strategy limits the deviation of the SP within a certain range in both directions to ensure that a sudden operational change does not result in incomplete combustion, by temporarily supplying additional air to the burner until equilibrium is restored. The air flow increases ahead of the fuel flow with higher ignition demand, while it decreases behind the fuel with lower demand.



Your advantages

+ **Optimisation of boiler combustion**
+ **Reduction of fuel consumption**
+ **Reduction of pollutant emissions**
+ **Increased profits**

Multifunctional, multi-loop and programmable combustion controller: model PSC210



Multifunction PID controller with manual function
Modbus/NestBus extension

- **Combustion optimisation and energy saving**
  Programmable PID controllers with advanced calculation functions
- **Ideal for upgrading existing instruments**
  Compact size, compatible with existing systems
- **Easy to use and operate**
  Large colour graphic display and PC configuration
- **High reliability for demanding applications**
  Independent control, display and I/O functions
- **Collect, analyse and optimise**
  Modbus communication and measurement data storage

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