

How to implement boiler sequence control

Introduction

The thermal efficiency of a heating boiler decreases when it is operating under low thermal load due to the increasing significance of fixed heat losses such as:

- radiation/convection losses from the hot boiler casing
- draught losses up the flue when the burner is not firing
- purge losses when the burner starts up and/or shuts down

For this reason, energy savings can be obtained in multi-boiler installations by ensuring that only the minimum number of boilers is allowed to fire at any time.

This can be most reliably achieved by installing an electronic boiler sequence controller to regulate the operation of the plant in line with the prevailing heat load.

Typically these would cost around £600 to install and can pay for themselves in 1-5 years (depending on the number and size of boilers being controlled).

The technology

A boiler sequencer is a panel mounted, electronic control device.

It takes its input from a temperature sensor which is normally positioned to measure the temperature of the combined water flow produced by a multi-boiler installation. (See diagram below).

The controller has a user adjustable set point and once set, will switch successive boilers on and off in order to maintain the required combined flow temperature.

In new boiler installations, the temperature sensor would normally be fitted within an immersion pocket (welded into the side of the heating pipework), but clamp-on sensors can be used to provide a non-intrusive retrofit option.

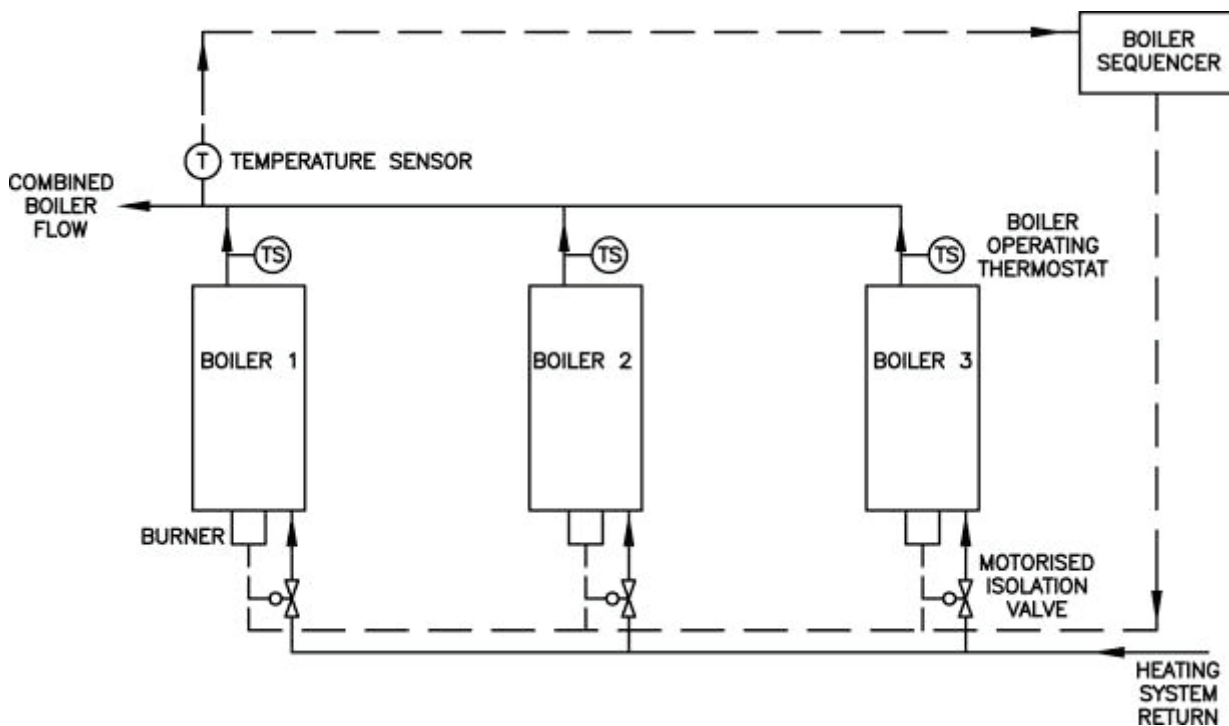
Boiler sequence controllers can either be purchased as stand-alone devices or the same functionality can often be provided by an existing Building Energy Management System (BEMS), if available.

Most usually, the output from the boiler sequence controller will simply turn the boiler plant on or off (electrically). Whilst this prevents the boiler from firing, hot water will still circulate through the off-line plant meaning that there will continue to be some standing heat losses.



On larger hot water heating boilers (typically above 500 kW output), it can therefore be cost effective to supplement the boiler sequence controller with a motorised isolation valve fitted to the return water connection on each boiler. Following a predetermined period after a boiler has been switched off by the sequence controller, the valve will automatically close thereby allowing the boiler to go cold. There are, however, potential safety and boiler longevity issues associated with this approach. Advice should be sought from a specialist controls contractor.

The following figure illustrates the application of boiler sequencing control.



Application

A boiler sequence controller should be applied to any boiler house that has two or more boilers connected to a common heating system.

They are particularly useful in installations where one or more very high efficiency boiler has been provided (for example a condensing boiler or CHP unit), where it is important to ensure that the maximum load is taken by the most efficient plant at all times.

Specification checklist

The following table lists the key parameters that you should define through discussions with your supplier, in order to specify a boiler sequence control.

Item No.	Parameter	Comments
1	Number of boilers/firing stages to be controlled	Be aware that an excessive number of control stages (say more than 5), can lead to problems with low flow temperatures at times of full heat load – your supplier will be able to advise you on this.
2	Immersion or clamp-on sensor	See Technology section
3	BEMS compatibility	See Technology section
4	Requirement for motorised isolation valves	See Technology section.

Commissioning procedures

A specialist controls contractor should be used to specify and install boiler sequence controls. As part of their commissioning procedures they should demonstrate that the controller delivers the functionality required of it.

Following the commissioning of the controls, it is prudent for the operator of the boiler plant to perform regular visual checks to confirm that the controller continues to operate satisfactorily. Unsatisfactory performance can be readily detected by the tell-tale sign of multiple boilers cycling rapidly on and off.



Common problems

Poorly performing boiler sequence controllers are relatively common and most usually the cause is incorrect adjustment of the sequence controller set-point relative to the individual boiler operating thermostats.

Prior to installing a boiler sequence controller, boiler firing will have been controlled by each boiler's own operating thermostat.

When a sequence controller is installed, however, this must be allowed to take over the control of boiler firing. To allow this to happen, the individual boiler thermostats must be set at a temperature **higher** than the set point of the boiler sequence controller.

As an example, for a typical low temperature hot water boiler installation the combined flow temperature set point on the sequence controller may be 80°C, while the individual boiler thermostats would be set at 90°C.

Special arrangements are made when boilers are equipped with high/low or modulating burners and your supplier should be consulted in these applications.

Finding a supplier

Boiler sequence controls are one of the technologies supported by the Government's Enhanced Capital Allowances Scheme and a list of ECA approved sequence controls can be found at www.eca.gov.uk.

Specification and installation should be carried out by a specialist controls contractor.

If you do not already employ a controls specialist, you could consider:

- Contacting the original installer of your boilerhouse control system (their contact details will normally be listed on the existing control panel or on supporting documentation).
- Contacting the Building Controls Industry Association (BCIA) – www.bcia.co.uk.

The business case

Typically, a boiler sequence controller would cost around £600 to install.

The savings will depend on the size and number of boilers being controlled.

As an example, three, 200 kW boilers will have combined standing heat losses of around 6 kW. The installation of a sequence controller could typically save around half of this giving an annual saving of 6,000 kWh (assuming 2,000 hours/year operation).

At a gas price of 2.5p/kWh (including CCL), this would give a financial saving of £150, representing a payback period of 4 years.



The Carbon Trust is funded by the Department for Environment, Food and Rural Affairs (Defra), the Department for Business, Enterprise and Regulatory Reform, the Scottish Government, the Welsh Assembly Government and Invest Northern Ireland.

Whilst reasonable steps have been taken to ensure that the information contained within this publication is correct, the authors, the Carbon Trust, its agents, contractors and sub-contractors give no warranty and make no representation as to its accuracy and accept no liability for any errors or omissions.

Carbon Trust trademarks, service marks or logos used in this publication, and copyright in it, are the property of the Carbon Trust. Nothing in this publication shall be construed as granting any licence or right to use or reproduce Carbon Trust trademarks, service marks, logos, copyright or any proprietary information in any way without the Carbon Trust's prior written permission. The Carbon Trust enforces infringements of its intellectual property rights to the full extent permitted by law.

The Carbon Trust is a company limited by guarantee and registered in England and Wales under Company number 4190230 with its Registered Office at: 8th Floor, 3 Clement's Inn, London WC2A 2AZ.

