Report on the testing of the 'Active' low surface temperature controller on a Belgravia Classic 'A' style fan convector.

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Summary

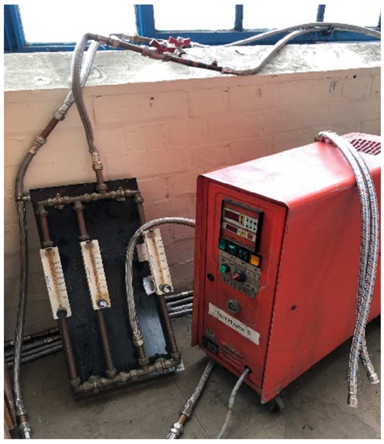
Fan convectors operate with low surface temperature casings, typically around 50 to 55°C compared to conventional radiator systems where surface temperatures can rise above 70°C. The reduced surface temperature results from the heat exchanger surfaces being shrouded in the outer casing of the fan convector rather than being exposed as with a panel or column radiator.

While fan convectors provide low surface temperatures these are not always low enough to comply with the guidelines issued on behalf of the NHS regarding vulnerable room occupants. Should vulnerable occupants be unsupervised and there is a risk that they may fall against the heat emitters or piping then a maximum exposed surface temperature of 43°C is prescribed. The 'Active LST' control is designed to prevent casing temperatures exceeding 43°C by controlling the water flow through the heat exchanger in response to a direct measurement of surface temperature.

Description of the equipment and test apparatus

The fan convector is of the standard design with low front inlet grille and high front outlet grille (designated ‘A’ style by SPC). The unit has no non-standard features other than the ‘Active’ LST control and features the standard fan deck.

Figure 1. SPC Belgravia A style fan convector



Hot waterflow to the test unit is generated by a combined electric heater/pump unit. This is connected via a series of flexible hoses to and from the fan convector heating coil. The control valve is fitted on the return from the coil. Downstream of the valve a rotameter type flow meter is in-line to allow an estimate of the water flowrate to be taken. A restricted bypass leg is included in the pipework to allow flow around the heating unit whenever the control valve is closed.

Figure 2. Water heater/pump unit

The control valve used is fitted with a ‘thermic’ actuator with a 5mm stroke and 3 to 4 minute movement period between being fully open and fully closed. This is a normally closed actuator and is powered open whenever the thermal switch is closed. The thermal switch is mounted directly onto the leaving air grille of the unit and is the break on rise type i.e. when the sensed temperature increases above the threshold value the switch opens and the valve actuator is de-energised acting to close the valve. Using a thermic actuator with an appreciable time to close prevents hunting of the valve and allows the casing sufficient time to cool.

In order to measure casing temperatures, fluid temperatures and room air temperature a number of K type thermocouples were used. The thermocouples were wired back to an 8 channel data logger running Advantech software. This allows real time visualisation and download of data.

Figure 3. Test piece showing thermocouples and valve/actuator

For the purposes of testing the valve and actuator were placed outside the fan convector unit; production units have the valve/actuator factory fitted internally.

Results

Thermocouples were used to measure casing surface temperatures in a number of locations. The casing temperature of the fan convector varies markedly with low temperatures being recorded towards the bottom and sides of the unit and higher temperatures at the top panel and on the upper supply grille. The lower temperatures are well below the safe threshold so are not problematic. The highest temperatures were recorded on the outlet grille and top panel where surface temperatures were almost identical. The thermal switch was fitted in this position for the remainder of the testing.

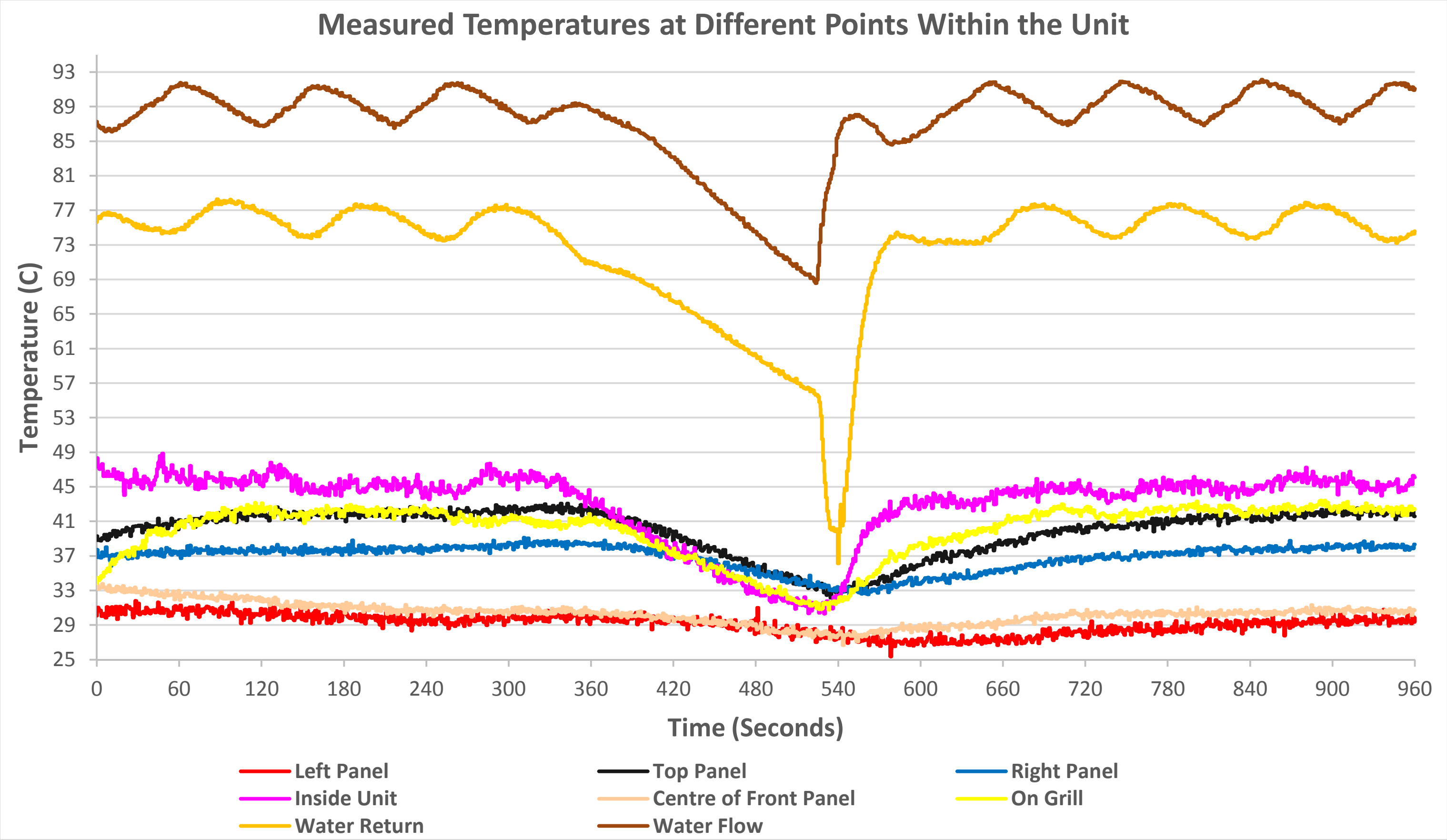


Chart 1. All data

Chart 1 shows a snapshot of all the measured temperatures. The upper plots are for the hot water flow and return temperatures which are controlled at approximately 85°C and 75°C respectively i.e. 80°C mean. This represents the absolute maximum mean water temperature that a fan convector connected to a conventional boiler would operate against.

The choice of fan speed and water flowrate are largely arbitrary as the actual heat output is not of concern and not being measured; it is the operation of the controller than is being monitored and its ability to maintain a maximum surface temperature against the most unfavourable set of conditions. The combination of water flow and air flow selected allows the unit to be capable of providing a leaving air temperature which is capable of raising the surface temperature slightly above the threshold temperature. Selection of other values for these variables would only result in the valve being closed for a longer or shorter period and would not vary the maximum surface temperature; just the time averaged heat output.

The charts show the valve closing as temperatures slowly rise. The closure is not instant and the surface temperature reduces slowly until it falls below the differential of the actuator which then starts to move the valve in an opening direction and the temperatures increase to their previous level.

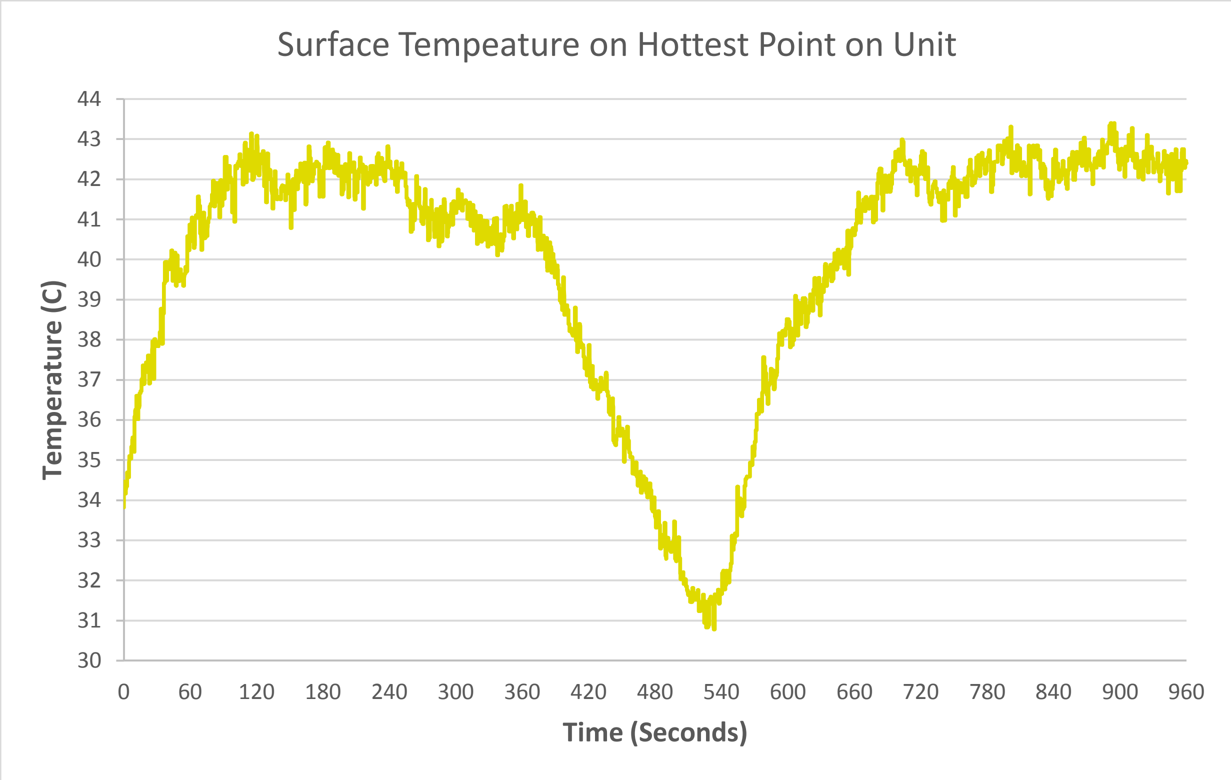


Chart 2. Controlled temperature

Chart 2 is an extract from the main data showing the surface temperature plot at the measured and hottest point on the surface.

Discussion/Conclusions

Worst case conditions in terms of hot water temperatures have been used for the test and the control devices have been shown to be capable of maintaining the maximum surface temperature at the prescribed level against such conditions. As the control reacts directly to the change in surface temperature rather than via indirect measurements of air/water temperature then it is suitable for use against any set of conditions while maintaining the same maximum surface temperature. Heat up times and outputs will vary at different conditions but not the controlled variable (maximum surface temperature).

The controller functions correctly against the worst case set of conditions and can therefore be confidently used whenever specifications call for units with built-in, active surface temperature protection. This will be afforded even if water/air conditions vary from design.