

Biddle Forceflow - LST Fan Convectors

Installation, Servicing and Maintenance Instructions

(Issue 4 – 01/01/2014 onwards)

Description

The Low Surface Temperature (LST) Forceflow Fan Convectors use patented LST active control to maintain the surface temperatures of the unit within the 43°C limit indicated by NHS Estates document "Health Guidance Note – 'Safe' hot water and surface temperatures".

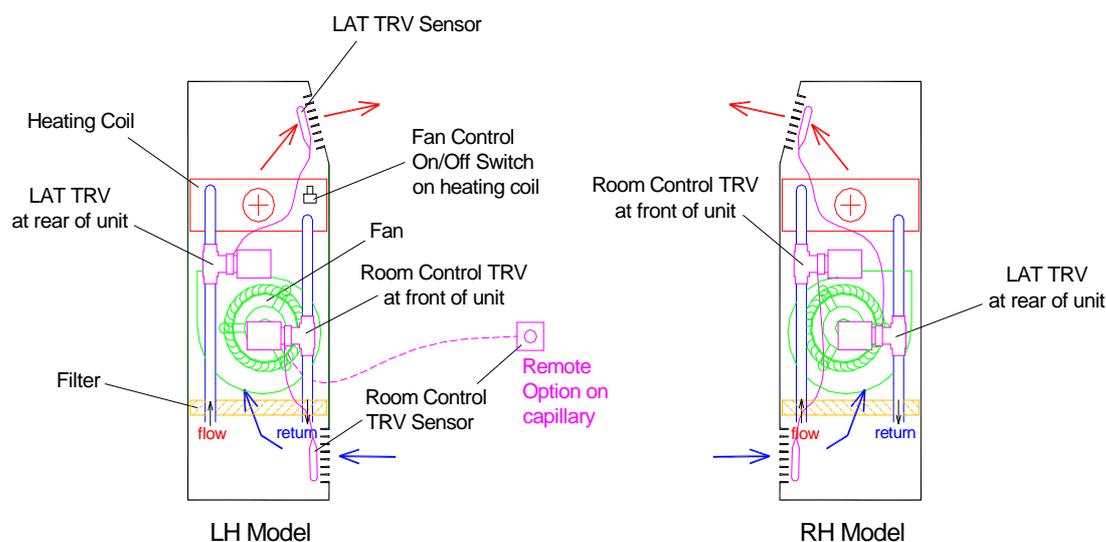


Figure 1 – Forceflow LST Fan Convectors

In common with a typical fan convectors the unit has a fan with motor, heating coil and air filter housed within a painted sheet steel casing. Room air enters through the bottom return grille and heated air is discharged out from the top grille to heat the conditioned space. The discharge grille and surrounding metalwork on a standard fan convectors can have surface temperatures higher than 43°C which would cause burns to vulnerable persons. The Biddle, Forceflow LST Fan Convectors incorporate patented LST active control technology so the casing will not go above 43°C.

Figure 1 shows the basic components of the unit. There is a Leaving Air Temperature, Thermostatic Radiator Valve (LAT TRV) fitted in the heating coil pipework with temperature sensor located in the air discharge of the unit. This automatically adjusts the temperature of the air that blows out of the unit so the casing will not go above 43°C. The control head of this LAT TRV is pre-set by Biddle in its factory and locked so it is non-adjustable by the end user or persons on site.

There is also a Room Control, Thermostatic Radiator Valve (Room Control TRV) fitted in the heating coil pipework that controls the temperature of the room space. The Room Control TRV automatically controls the temperature of the air in the room to achieve a satisfactory room air temperature for comfort heating. The Room Control TRV does not compromise the action of the LAT TRV in maintaining LST surface temperatures.

In the standard unit the Room Control TRV has a temperature sensor located inside the bottom air return grille of the unit, controlling the room temperature against the return air entering the unit. The adjustable control head of the standard Room Control TRV is also fitted inside the unit casing (see Figure 2, Page 6) and the temperature set-point is set at commissioning to, say 21°C. The access panel of the fan convector is then closed, secured with screws and the unit left at this fixed temperature setting.

An alternative to controlling the room temperature against a fixed return air set point is to have a Remote Room Control which is a combined temperature sensor and set-point adjuster fitted on the wall of the room. This has a 15m capillary which is run back to the valve body of the Room Control TRV inside the fan convector unit and connected to the TRV valve with a threaded connector, see Figure 5 & 6, Page 8. Whilst the capillary is only 2mm diameter the threaded connector on the end of the capillary has a 34mm diameter knurled nut so allowance needs to be made to run this back the unit.

The temperature of the water from the boiler heating system is used to switch the fans on and off in the fan convector. There is an integral pipe switch fitted inside the unit which switches the fans on when water temperature rises above 45°C and switches the fans off when water temperature cools below 35°C. This provides "global" switching via the heating system for all the LST fan convectors in the building. The LST Fan Convector must not be switched on and off at the electrical supply as this will compromise the LST operation of the unit. On/Off must be done as explained above with water temperature from the boiler heating system.

As the Room Control TRV controls the temperature of the room the fans will switch off and on when the room temperature is close to the temperature set-point. This is quite normal and avoids fans blowing air at an ambient temperature out of the discharge grille which could be felt as a draft to vulnerable persons.

There is a 3-speed fan switch located inside the fan convector which can be set to High, Medium or Low fan speed during commissioning or servicing. The access panel of the fan convector is then closed, secured with screws and the unit left at this fixed fan speed. It is not possible to have user remote fan speed switching as this can compromise the LST operation.

AC or EC fans can be fitted in the LST Fan Convector. With AC fans the High, Medium and Low fan speeds can be connected to 6 available motor speed tapplings at the fan motor terminal block (see Figure 7 - Wiring Diagram, AC Fans on Page 9). With EC fans the High, Medium and Low fan speeds can be individually adjusted to suit the site conditions via speed potentiometers on a pcb fitted within the integral control panel (see Figure 8 - Wiring Diagram EC Fans on Page 10).

Design Considerations

Higher grade LPHW water flow temperatures can vary between 70°C and 90°C and the patented Biddle LST Active Control will maintain safe casing surface temperatures and provide the maximum heat outputs as given in Table 1 below. Water flow temperatures below 70°C will provide reduced heat outputs to those given in Table 1.

NB. If using the LST Forceflow on compensated water circuits this should not present a problem as lower heat output during mild weather is then desirable.

A water flow temperature of 60°C will provide c.65% of Table 1 heat output.

A water flow temperature of 50°C will provide c.45% of Table 1 heat output.

A permanent electrical supply must be made to the unit via a local isolator with 3mm contact separation on both live and neutral poles. The unit must be earthed. The unit must not be controlled on and off via a timed or manual switched electrical supply as this will start and stop the unit unnecessarily and result in non-LST operation. Fan On/Off must only be via the integral fan control switch when it detects hot water at above approximately 45°C. The electrical supply to the unit must be left permanently energised except in the case of an emergency or when servicing the unit. To this end, it is recommended that a notice with the wording "To be left on during normal operation" be affixed to the local electrical isolator by the installer. It is not possible to have user remote fan speed switching as this can compromise the LST operation.

Maximum heat outputs and corresponding water flow rates for 80°C water flow temperature are shown in Table 1, these are for when the Room Control TRV is fully open, i.e. the design day condition. Higher water flow rates will not produce higher heat outputs, just higher pressure drops. This is because the leaving air temperature is fixed by the LAT TRV to achieve a safe low surface temperature. Only an increase in fan speed and/or a decrease in return air temperature to the unit below 20°C will produce higher heat outputs to those shown in Table 1.

Size	Fan Speed	Air Volume (l/s)	Max. Heat Output @ Flow/Return temp. and 20°C EAT (kW)	Water Flow Rate @ 80°C flow temp. (l/s)	Hydraulic Pressure Drop (kPa)
915	high	118	2.83 @ 80/63°C	0.041	1.6
	medium	87	2.09 @ 80/62°C	0.028	0.8
	low	59	1.42 @ 80/61°C	0.018	0.3
930	high	190	4.56 @ 80/59°C	0.051	2.4
	medium	176	4.22 @ 80/60°C	0.047	2.2
	low	104	2.50 @ 80/60°C	0.028	0.8
935	high	254	6.40 @ 80/57°C	0.068	4.5
	medium	202	5.10 @ 80/58°C	0.057	3.2
	low	136	3.43 @ 80/59°C	0.040	1.6
940	high	318	8.01 @ 80/52°C	0.070	5.0
	medium	249	6.28 @ 80/54°C	0.059	3.4
	low	164	4.13 @ 80/56°C	0.042	1.8
975	high	465	11.72 @ 80/55°C	0.114	9.8
	medium	408	10.28 @ 80/55°C	0.100	7.7
	low	250	6.30 @ 80/55°C	0.062	3.0

Table 1

Please note that the water flow rates, water return temperatures and hydraulic pressure drops given in Table 1 are for a water flow temperature of 80°C. This is with the unit operating at maximum output (i.e. with the Room Control TRV fully open). Design water flow rates, water return temperatures and hydraulic pressure drops will be different for other water flow temperatures, i.e. 70°C or 90°C. Contact the Biddle Sales office for details.

To explain this it must be understood that the maximum heat output is determined solely by the airside heat output equation with the Room Control TRV fully open and the LAT TRV controlling the Leaving Air Temperature (LAT) to 40°C so that maximum case temperatures are 43°C, i.e.

$$\text{Air Volume} \times 1.2 \times \text{Increase in Air Temperature} = \text{Heat Output}$$

For a 930 size unit at medium fan speed this would be :-

$$0.176 \times 1.2 \times (40^\circ\text{C LAT} - 20^\circ\text{C EAT}) = 4.22 \text{ kW}$$

Where 40°C LAT is the mean off coil temperature to ensure that no part of the casework of the unit is hotter than 43°C and 20°C EAT is the entering air temperature of room air back into the unit.

The hydraulic pressure drop in column 6 of Table 1 refers to the pressure drop across all the components within the unit, i.e. LAT TRV + Heating Coil + Room Control TRV at the water flow rate given in column 5.

To achieve this maximum heat output with 80°C water flow temperature the flow rate of the water has to be set as per that shown in Table 1 and this results in the water return temperatures shown in column 4. Whilst these water temperature differentials are somewhat higher than normally seen they should not present a problem to the designer, on the contrary it can be argued that they benefit boiler efficiency.

Do not use a pump more powerful than is required to achieve the design water flow rates with the hydraulic pressure drops given. The differential pressure over the thermostatic valves must not exceed 20kPa (0.2 bar) even if the valves have shut down or the valve seat will lift compromising the LST performance of the unit. If it is believed that high differential pressures will occur in the partial load condition (i.e. TRV head throttling down) a suitable differential pressure regulating device must be fitted across the flow and return pipework to each unit.

For design of the electrical installation the full load current and starting current for the unit are as shown in Table 2.

Size	Full Load Current (Amps)		Start Current (Amps)	
	AC Fans	EC Fans	AC Fans	EC Fans
915	0.2	0.1	0.3	N/A *
930	0.35	0.19	0.45	N/A *
935	0.4	0.2	0.55	N/A *
940	0.7	0.3	0.9	N/A *
975	0.9	0.65	1.2	N/A *

Table 2

* EC fans have "soft-start" so will not see a starting current higher than full load current.

It is important to note that the unit may not operate as a LST heat emitter until approximately 30 minutes after first turning on from cold with LPHW from the boiler operating the integral fan control switch. An over temperature of up to 10°C could occur during this initial warm-up period, which would usually be when the building is unoccupied. If the unit is operated continuously, such as is typical in hospitals, retirement homes, etc. it will remain LST as demonstrated during its trials at the BSRIA Test House.

Installation

Decide on the best location for the fan convector. This is often adjacent to a cold zone in the room such as under a window or against an external wall.

Remove protective cardboard outer packaging and any polystyrene padding. You should have received the fan convector in perfect condition. Please advise us within 5 days of receipt if it is damaged in any way whatsoever.

Remove the front access panel (2 screws or 2 key locks) and offer the unit up to its intended location and mark where the flow and return water pipes will enter the unit through the rectangular entry hole in the base of the casing. Electrical connection is made to the unit at the opposite end of the casing to the pipe connections. This can be done via the cable entry point at the bottom of the side panel, using the cable gland supplied, or the rectangular hole in the base of the unit
NB. The unit can be manufactured with RH or LH pipe connections at the factory to suit the installation. It is not possible to change pipework handing once the unit is on site.

Fix the unit to the wall using four suitable fixings via the keyhole slots in the rear panel and connect water and electrical connections. The flow (inlet) and return (outlet) water connections must be connected the right way around so the direction of water flow through the unit is correct or the unit will be non-LST and unsafe.

For units with LH pipe connections (viewed from the front) the flow pipe is at the rear.
For units with RH pipe connections (viewed from the front) the flow pipe is at the front.
See Figure 1, Page 1 which shows the Flow and Return connections for LH and RH units and Figure 2, below, which shows the Flow and Return connections for a LH unit.

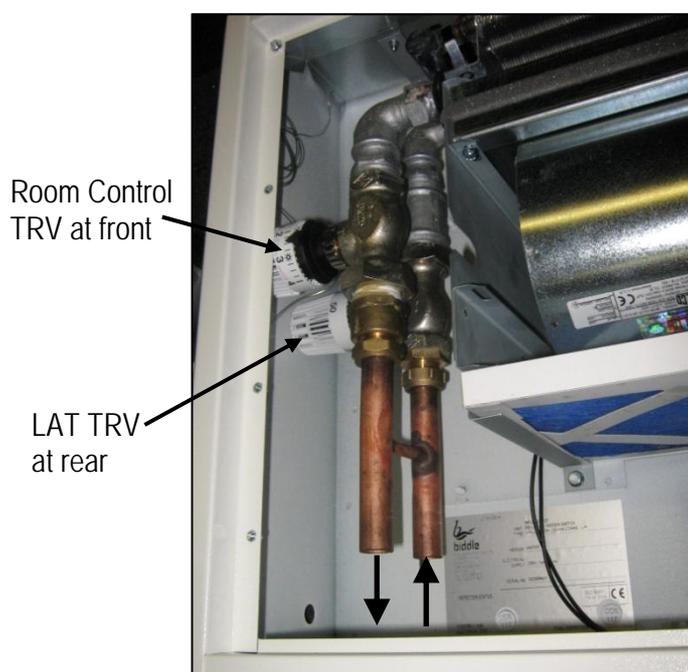


Figure 2
(LH pipe connections shown)

Note also the positions of the Room Control TRV (at the front) and the LAT TRV (at the back) inside the unit.

A double check on water flow direction should be carried out using the direction of flow arrows engraved on the TRV Valve bodies, see Figure 3 below.

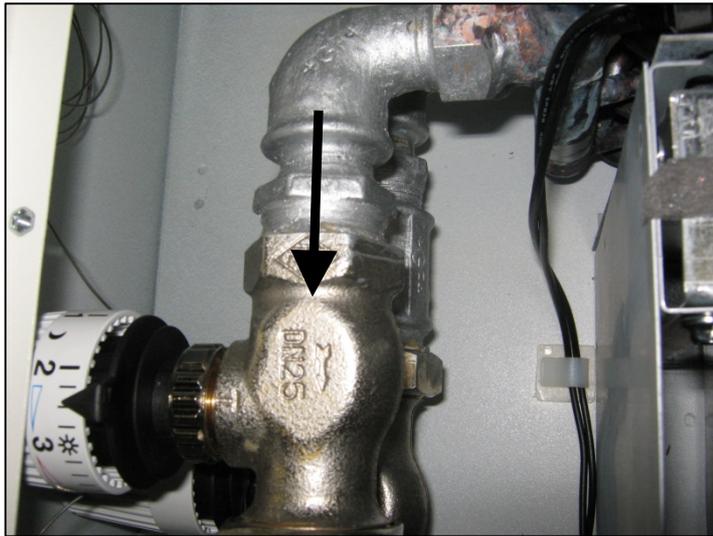


Figure 3

Ensure the large chrome knurled fixing nut that holds the sensor capillary head to the valve body is tight, see Figure 4 below. Using pump pliers, or equivalent, "nip up" the fixing nut just past hand tight, no tighter.

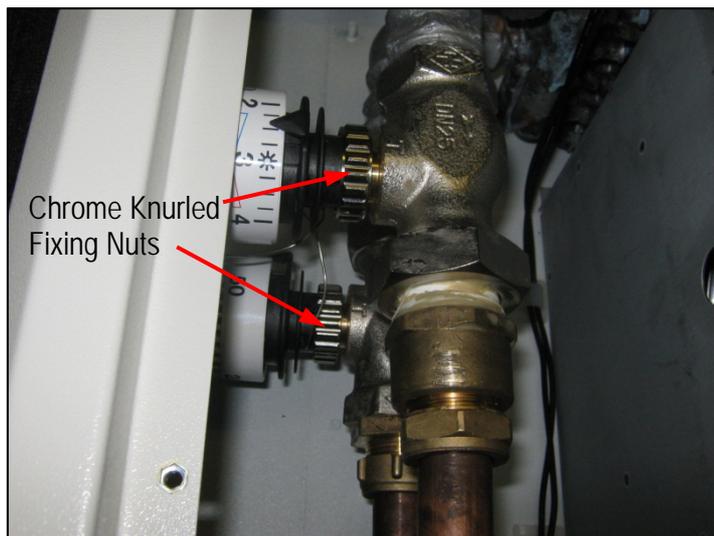


Figure 4

Size 22mm compression fittings should be used to connect to the flow and return connections. Do not use heat in this area when connecting pipework.

A permanent electrical supply must be made to the unit via a local isolator with 3mm contact separation on both live and neutral poles. The unit must be earthed. See Wiring Diagrams – Figure 7 or 8. It is recommended that a notice with the wording "To be left on during normal operation" be affixed to the local electrical isolator by the installer.

If a Remote Room Control TRV, Sensor Head is being used the sensor head should be positioned on the wall in a suitable position within the room in accordance with the instructions that come with the sensor head. The capillary from the Sensor Head should then be fed back to the fan convector entering the unit via the square entry hole in the base of the casing (see Figure 5 below) and connected onto the Room Control TRV (see Figure 6 below). Ensure the large chrome knurled fixing nut that holds the sensor capillary head to the valve body is tight, see Figure 6. Using pump pliers, or equivalent, "nip up" the fixing nut just past hand tight, no tighter.



Figure 5

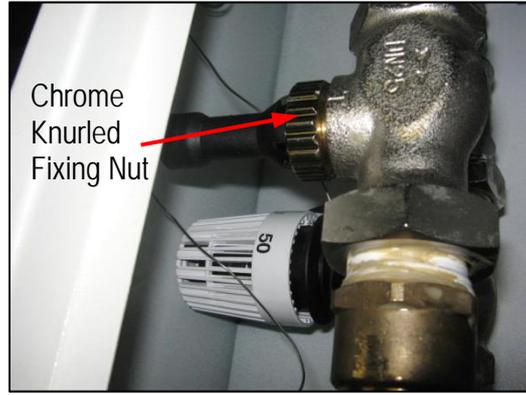


Figure 6

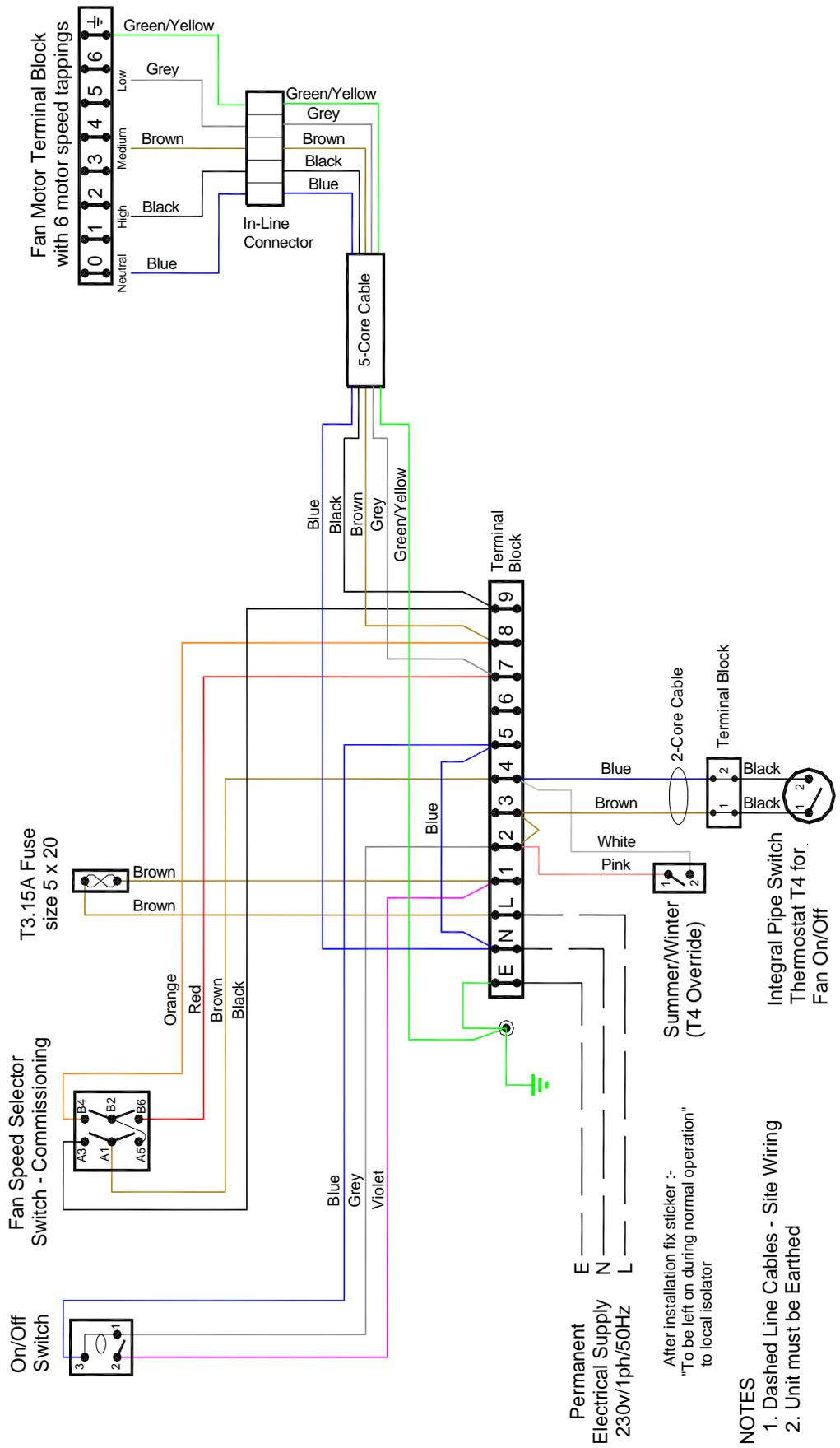


Figure 7 – Wiring Diagram, AC Fans

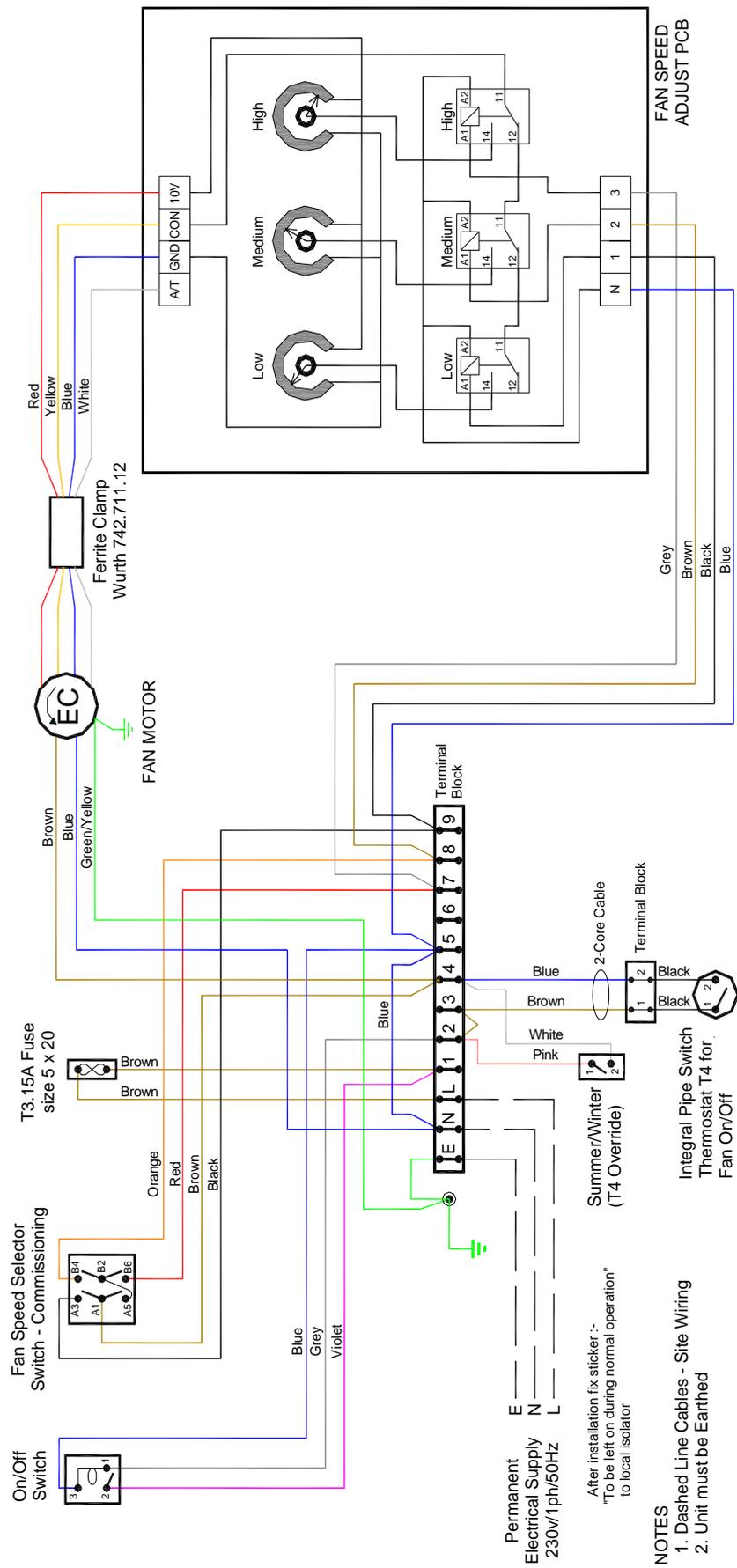


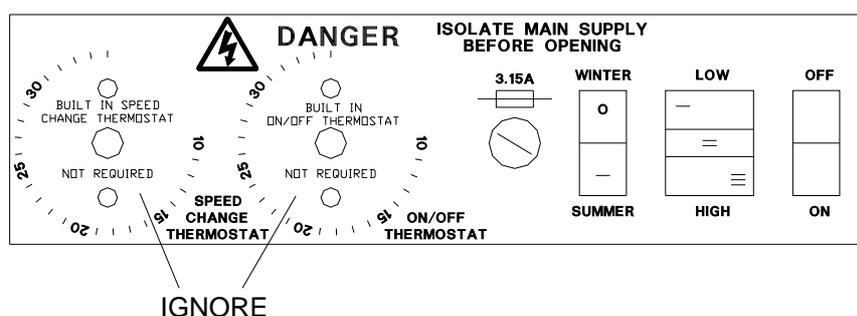
Figure 8 – Wiring Diagram, EC Fans

Commissioning

Remove front access panel (2 screws or 2 key locks). Switch on electrical power to unit.

On the integral control panel (See Figure 9) set the Summer/Winter Switch to summer and the On/Off Switch to On and the fan should operate. Switch the fan through all three speeds with the fan speed selector switch (High, Medium and Low) and check fan speeds correspond. Set the fan speed to Low or Medium or High, this will be the speed the unit is then permanently set to run on.

Figure 9 – Integral Control Panel



With AC fans the High, Medium and Low fan speeds can be connected to 6 available motor speed tappings at the fan motor terminal block (see Figure 7 - Wiring Diagram, AC Fans on Page 9).

With EC fans the High, Medium and Low fan speeds can be individually adjusted to suit the site conditions via speed potentiometers on a pcb fitted within the integral control panel (see Figure 8 - Wiring Diagram, EC Fans on Page 10).

Adjust the set point adjuster of the Room Control TRV to the required temperature setting, see Table 3. The set point adjuster is fitted inside the casing on standard units or on the wall in the room if the Room Control is remotely fitted. Check that the large chrome knurled fixing nut that holds the sensor head to the valve body is still tight. Using pump pliers, or equivalent, check the fixing nut is "nipped up" just past hand tight, no tighter.

Setting Position	1		2		3		4	5
Approx. Room Temperature	12	14	16	18	20	22	24	28

Table 3 – Room Control TRV settings

The LAT TRV (rear TRV, see Figures 1 & 2) is factory set and locked at the correct setting. It must not be tampered with under any circumstances. The valve head should be fixed tight onto the valve body at the factory. Check that the large chrome knurled fixing nut that holds the valve head to the valve body is still tight. Using pump pliers, or equivalent, check the fixing nut is "nipped up" just past hand tight, no tighter.

Set the Summer/Winter Switch to the winter position and the fan should turn off if the heating system is cold.

With the heating system operating ensure the flow pipe gets hot and the fan operates after a delay. If the fan does not operate check that the integral pipe switch fitted inside the unit is correctly fitted to the heating coil, see Figure 10 below. Replace the front access panel.



Figure 10

Servicing

Before carrying out any service work isolate the unit from the power supply and ensure it cannot be accidentally restored by unauthorised personnel. Remove front access panel (2 screws or 2 key locks).

The standard cardboard frame panel filter is not designed to be cleaned and should be replaced at appropriate intervals, which will vary from site to site. Clean the heating coil and fans by vacuuming. Carry out the checks as described above in "Commissioning" and replace the front access panel.

Repair and Maintenance

Short list of spare parts relevant to the Forceflow LST Fan Convector is shown in Table 4 :-

Part Name	Biddle Part No.
Room Control TRV or LAT TRV – Valve Body 1 in.	0308101
Room Control TRV – Head	0308102
optional Remote Room Control TRV - Head	0308104
LAT TRV – Head	0308103
Fan On/Off Pipe Switch – T4 Thermostat	0307001

Table 4

Because of the critical nature of the unit operating within LST constraints it is very important that if components should fail they are replaced correctly. We therefore recommend that Biddle Air Systems carry out such work unless a fully qualified Heating Technician is available.

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The name Biddle is a registered trademark.

Guarantee

The guarantee conditions form part of the terms of delivery.

Delivery of Units

If any items of the delivery have sustained damage through transit or otherwise please contact us at the address below within 5 days

Liability for the contents of this guide:

Care has been taken in compiling these instructions to ensure they are correct, although Biddle disclaims all liability for damage resulting from any inaccuracies and/or deficiencies in this documentation.

Should you find any errors or ambiguities in these instructions we would be pleased to hear from you as it helps us to improve our documentation further.

Biddle retains the right to change the specifications stated in these instructions.

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EC DECLARATION OF CONFORMITY
as defined by the EC Council Directive on Machinery 2006/42/EC, the Low Voltage Directive 2006/95/EC, Electromagnetic Compatibility Directive 2004/108/EC, the Pressure Equipment Directive 97/23/EC, the Energy related Products Directive 2009/125/EC

Herewith we declare that the air movement equipment designated below, on the basis of its design and construction in the form brought onto the market by us in accordance with the relevant safety, health and performance requirements of the Machinery.

If alterations are made to the machinery without prior consultations with us, this declaration becomes invalid.

Designation of Equipment : Forceflow LST Fan Convector

Series Type : Size 915, 930, 935, 940, 975

Relevant EC Council Directives : the Machinery Directive (2006/42/EC)
the Low Voltage Directive (2006/95/EC)
the Electromagnetic Compatibility Directive (2004/108/EC)
the Energy related Products Directive (2009/125/EC)

Applied Harmonised Standards : Machinery - EN ISO 14121-1:2007, EN 294:1992, EN 414:2000, BS EN 442-2:1997
LVD - EN 60335-1:2002, +A14 incorporating A1, A2, A11, A12 & A13, EN 60335-2-30:2009, EN 60335-2-40:2003
EMC - EN 61000-6-1:2007, EN 61000-6-3:2007 + A1:2011, EN 61000-3-2:2006 + A2:2009, EN 61000-3-3:2008
ErP - ISO 5801:2007, ISO 12759:2010

Basis of Self Attestation : Quality Assurance to BS EN ISO 9001 : 2008
B.S.I. Registered Firm Certificate Number FM 85224
BSRIA Test Report 19313/1
Wemtech Test Reports 6661 and 6765
ELCOLAB Test Report TR001943EMC02/01

Responsible Person : Mr. P.Casey, Site Managing Director, Thermoscreens Ltd.

Date : 1st January 2014

Signed : 