

Milton

**Boiler Sequence Control System
for Fully Modulating, High/Low & On/Off
Boilers with Optimum Start and Outside
Temperature Compensation**

**Installation, Commissioning
and Servicing Instructions**

IMPORTANT NOTE
**THESE INSTRUCTIONS MUST BE READ
AND UNDERSTOOD BEFORE INSTALLING,
COMMISSIONING, OPERATING OR
SERVICING EQUIPMENT**

Customer Services

Technical Enquiries

 **01202 662527 / 662528**

To supplement the detailed technical brochures, technical advice on the application and use of products in the Hamworthy Heating range is available from our technical team in Poole and our accredited agents.

Site Assembly

 **01202 662555**

Hamworthy offer a service of site assembly for many of our products in instances where plant room area is restricted. Using our trained staff we offer a higher quality of build and assurance of a boiler built and tested by the manufacturer.

Commissioning

 **01202 662555**

Commissioning of equipment by our engineers, accredited agents or specialist sub-contractors will ensure the equipment is operating safely and efficiently.

Maintenance Agreements

 **01202 662555**

Regular routine servicing of equipment by Hamworthy service engineers inspects the safety and integrity of the plant, reducing the risk of failure and improving performance and efficiency. Maintenance agreements enable our customers to plan and budget more efficiently.

Breakdown service, repair, replacement

 **01202 662555**

Hamworthy provide a rapid response breakdown, repair or replacement service through head office at Poole and accredited agents throughout the UK.

Spare Parts

 **01202 662525**

A comprehensive spare parts service is operated from our factory in Poole, providing replacement parts for both current and discontinued products. Delivery of parts and components is normally from stock within seven days. However, a next day delivery service is available for breakdowns and emergencies.

MILTON

BOILER SEQUENCE CONTROL SYSTEM FOR FULLY MODULATING BOILERS WITH OPTIMUM START AND OUTSIDE TEMPERATURE COMPENSATION

INSTALLATION, COMMISSIONING AND SERVICING INSTRUCTIONS

**NOTE: THESE INSTRUCTIONS SHOULD BE READ AND UNDERSTOOD
BEFORE ATTEMPTING TO INSTALL, COMMISSION OR OPERATE THE
MILTON BOILER SEQUENCE CONTROL SYSTEM.**

**THE MILTON BOILER SEQUENCE CONTROL SYSTEM IS INTENDED FOR
USE ONLY IN COMMERCIAL / LIGHT INDUSTRIAL APPLICATIONS.**

**THIS BOILER SEQUENCE CONTROL SYSTEM COMPLIES WITH ALL
RELEVANT EUROPEAN DIRECTIVES**

**PUBLICATION NO. 500001104
ISSUE 'C'
DECEMBER 2003
SOFTWARE VERSION V2.3 ONWARDS**

CONTENTS

	PAGE
1.0 INTRODUCTION	1
2.0 TECHNICAL DATA	3
2.1 Overall Dimensions.....	3
2.2 Technical Data Table.....	3
3.0 DESCRIPTION OF OPERATION	5
3.1 Communication.....	5
3.2 Basic Operation	5
3.3 Remote Modulation Control Operation	8
3.4 Outside Air Temperature Compensation Function Operation	8
3.5 Summer Shutdown Function Operation.....	8
3.6 Optimum Start Function Operation	8
3.7 Daytime Optimisation Function Operation	10
3.8 Night Set-Back Function Operation	10
3.9 Frost Protection Function Operation	10
3.10 Safety Interlock Circuit Operation	10
3.11 Override Function Operation.....	11
3.12 Data Logging Operation.....	11
4.0 INSTALLATION	11
4.1 Control Location.....	11
4.2 Electrical Connections	11
4.3 Boiler Control Connections	13
4.4 Control Input Connections	13
4.5 Temperature Sensors	14
4.6 Completion.....	20
5.0 COMMISSIONING	20
5.1 Pre-commissioning Checks	20
5.2 Programming	20
5.2.1 Program Menu Overview	20
5.2.2 Keypad Operation.....	21
5.2.3 Programming Screen Timeout.....	21
5.2.4 Overview - Enter engineer's settings menu and navigate submenus	21
5.2.5 Overview - Modifying a setting value	22
5.2.6 Master Control Mode Submenu	23
5.2.7 Clock Submenu	24
5.2.8 Compensation Submenu	24
5.2.9 Optimiser Submenu	25
5.2.10 Sequencer Submenu	26
5.2.11 Circulation Pump Submenu	29
5.2.12 Frost Protection Submenu	30
5.2.13 Overrides Submenu.....	30
5.2.14 Security Code Submenu.....	31
5.3 Operation Checks.....	31
6.0 FAULT FINDING	32
7.0 SERVICING	32

FIGURES

2.1	Overall Dimensions	4
2.2	Technical Data	5
3.2.3.1	On/Off Cascade Sequence	6
3.2.3.2	High/Low Cascade Sequence	6
3.2.3.3	Low/Low Cascade Sequence.....	7
3.2.3.4	Modulating Cascade Sequence	7
3.2.3.5	Modulating Unison Sequence	7
3.4	Compensation Function Characteristic Graph	9
4.1	Mounting Holes	11
4.2	Site Wiring Schematic.....	12
4.5.2a	Insertion Type Water Flow Temperature Sensor	15
4.5.2b	Clamp-on Type Water Flow Temperature Sensor.....	16
4.5.3	Outside Air Temperature Sensor	18
4.5.4a	Room Temperature Sensor.....	19
4.5.4b	Multiple Room Temperature Sensor Wiring Configurations	17
5.3.5	Installation Settings.....	38/39
6.0	Fault Finding	33/34/35/36

THIS PAGE BLANK

1.0 INTRODUCTION

1.1 This boiler sequence control system must be installed by a competent person.

All installations must conform to the relevant IEE and Building Regulations as well as any local regulations which apply. HSE requirements must also be taken into account when installing any equipment.

Failure to comply with the above may lead to Prosecution.

1.2 The Milton boiler sequence control system is microprocessor based and designed for use with the Hamworthy fully modulating, high/low and on/off boiler ranges.

An optional Hamworthy 'Sequencing Interface Module' **must** be fitted to each high/low or on/off boiler to enable control of the boiler by the Milton boiler sequence control.

The sequence control is designed to be wall mounted in the boiler house or alternatively, if required, anywhere within the building.

The sequence control provides control of up to 9 fully modulating, high/low or on/off boilers. The sequence control also provides control of the boiler system primary circulation pump.

The boilers are connected in series to the sequence control via a serial data connection. The water flow temperature sensor (available in insertion and clamp-on versions) and optional room temperature and outside air temperature sensors are of the PT1000 type and are individually wired to the sequence control. It is possible to connect a number of room temperature sensors to provide an average room temperature reading. All connections to the sequence control **must** be made using standard conduit cabling, shielded cabling **must not** be used.

1.3 Control Features

1.3.1 Time Clock - 7 day timer with 4 'Active' (on) period settings per day. An external time clock can be connected to override the in-built clock.

1.3.2 Remote Override Facility - A remote switch can be connected to the sequence control, which when closed will cause it to override to 'Active' for the duration that the switch is closed.

1.3.3 Sequencing Options –

1) On/Off Cascade - This option is for sequencing of Hamworthy on/off boilers, and steps each boiler on at full rate, to match the system load.

2) High/Low Cascade - This option is for sequencing of Hamworthy high/low boilers, and steps a boiler on at low fire, then steps the boiler to high fire, repeating for each boiler, to match the system load. The sequence control can also accommodate a combination of on/off and high/low boilers, with the on/off boilers always being last in the sequence. This option is recommended for systems comprising a combination of condensing and non-condensing boilers, such that the condensing boilers are first in the sequence and operate the most to take advantage of their higher efficiency.

3) Low/Low Cascade - This option is for sequencing of Hamworthy high/low boilers, and steps each boiler on at low fire, before stepping each boiler to high fire, to match the system load. The sequence control can also accommodate a combination of on/off and high/low boilers, with the on/off boilers always being last in the sequence. This option is recommended for systems comprising identical boilers, and takes best advantage of the higher boiler efficiency at low fire.

4) Modulating Cascade - This option is for sequencing of Hamworthy fully modulating boilers, and steps an individual boiler on at its lowest rate and then modulates it to its maximum rate, before switching on the next boiler at its lowest rate, to match the system load. This option is recommended for systems comprising a combination of condensing and non-condensing boilers, such that the condensing boilers are first in the sequence and operate the most to take advantage of their higher efficiency.

5) Modulating Unison - This option is for sequencing of Hamworthy fully modulating boilers, and steps each boiler on to its lowest rate in turn before modulating all boilers simultaneously to their maximum rate, to match the system load. This option is recommended for systems comprising identical boilers, and takes best advantage of the higher boiler efficiencies at low firing rates.

1.3.4 Weekly Shift Sequencing - The lead boiler is shifted every 7 days (at midnight on Sunday), to ensure even usage of the boilers. It is also possible to select a number of fixed lead boilers, whilst shifting the firing sequence of the remaining boilers. This is useful in applications where a combination of condensing and high efficiency boilers are installed, and it would be desirable to have maximum use of the condensing boilers. This function can be disabled to maintain a fixed sequence.

1.3.5 Remote Modulation Control - The sequence control incorporates the facility to set the boiler system modulation rate based on the level of a 0 to 10V analogue signal from an external building management system (BMS) control. In this mode of operation the water flow temperature sensor is not required, and all other

Milton functions are disabled. A 'Master' setting is included in the engineers setting menu to select this option.

1.3.6 Outside Temperature Compensation - This function requires an optional outside air temperature sensor. The compensation function adjusts the water flow temperature setting in relation to the outside air temperature. As the outside air temperature falls the heat loss from a building increases, so to compensate for this the sequence control will increase the water flow temperature, thus increasing the heat input to the building and maintaining the desired comfort level. If this function is not utilised, the sequence control will control to a fixed water flow temperature.

1.3.7 Summer Shutdown - This function requires an optional outside air temperature sensor. The function shuts down the boiler system when the measured outside air temperature reaches a programmable set point, preventing unnecessary operation of the heating system.

1.3.8 Optimum Start - This function requires both the optional outside air temperature and room temperature sensors. The function adjusts the heating start time in relation to the outside air and room temperatures. The colder the outside air and room temperatures are, so the earlier the heating is started. In this way the heating is switched on as late as possible to achieve the desired room comfort level at the required time (the time clock settings represent the time at which the desired room comfort level is to be achieved). The optimum start includes a self-learning function to tune the system to each installation. The self-learning function can be disabled. The optimum start function can be disabled and the system will

start at the times specified by the time clock settings.

1.3.9 Daytime Optimisation – This function requires an optional room temperature sensor. When the room temperature reaches the room temperature set point the boilers are switched off immediately, and the circulation pump is switched off after its overrun time. Normal operation resumes if the room temperature subsequently falls below the set point.

1.3.10 Night Set-Back – This function provides an additional room temperature setting for time clock Standby periods, thus preventing the building fabric from falling below this temperature during these periods.

1.3.11 Frost Protection - When the sequence control is in Standby (off/night-setback) mode, this function fires the boilers to maintain a minimum flow water temperature, to prevent freezing of the heating system water. Additionally, if an outside air temperature sensor is connected the circulation pump will be started at an outside air temperature below an adjustable set point, thus providing two stage frost protection.

1.3.12 Pump Control – A relay contact is provided to control the system primary circulation pump (see Figure 2.2 p5 for contact rating). A circulation pump overrun timer function is included to make use of the residual boiler heat when the boilers are switched off at the end of an Active period, or when the desired room temperature is achieved (with daytime optimisation function). A pump maintenance function is also included to operate the circulation pump briefly once a week, to prevent seizing during

long periods of heating system inactivity.

1.3.13 Holiday Override – This function overrides the time clock during selected holiday periods, preventing the heating system from operating. Up to 5 holiday periods can be programmed.

1.3.14 Remote Holiday Override – A remote switch can be connected to the sequence control which when closed will put the control into a holiday shutdown mode. Normal operation will resume when the switch is opened.

1.3.15 Safety Interlock Circuit – This function allows the connection of external system safety devices, such as flue exhaust fan proving switch, pressurisation unit safety circuit, etc, to the sequence control. If the circuit is broken by any of the safety devices the boilers are prevented from firing. **Note:** The boilers must also be individually interlocked to the safety devices.

1.3.16 Data Logging – This function enables access to logged information stored on each boiler. Hours run, number of starts and gas consumption are recorded, and any fault conditions such as lockout and overheat are logged with the date and time of occurrence.

Note: This functionality is only available on the Hamworthy Heating range of modulating boilers.

2.0 TECHNICAL DATA

2.1 Overall dimensions, mounting hole positions and cable entry positions for the sequence control are shown in Figure 2.1 (p4).

2.2 Technical specification details are shown in Figure 2.2 (p5).

Figure 2.1 - Overall Dimensions

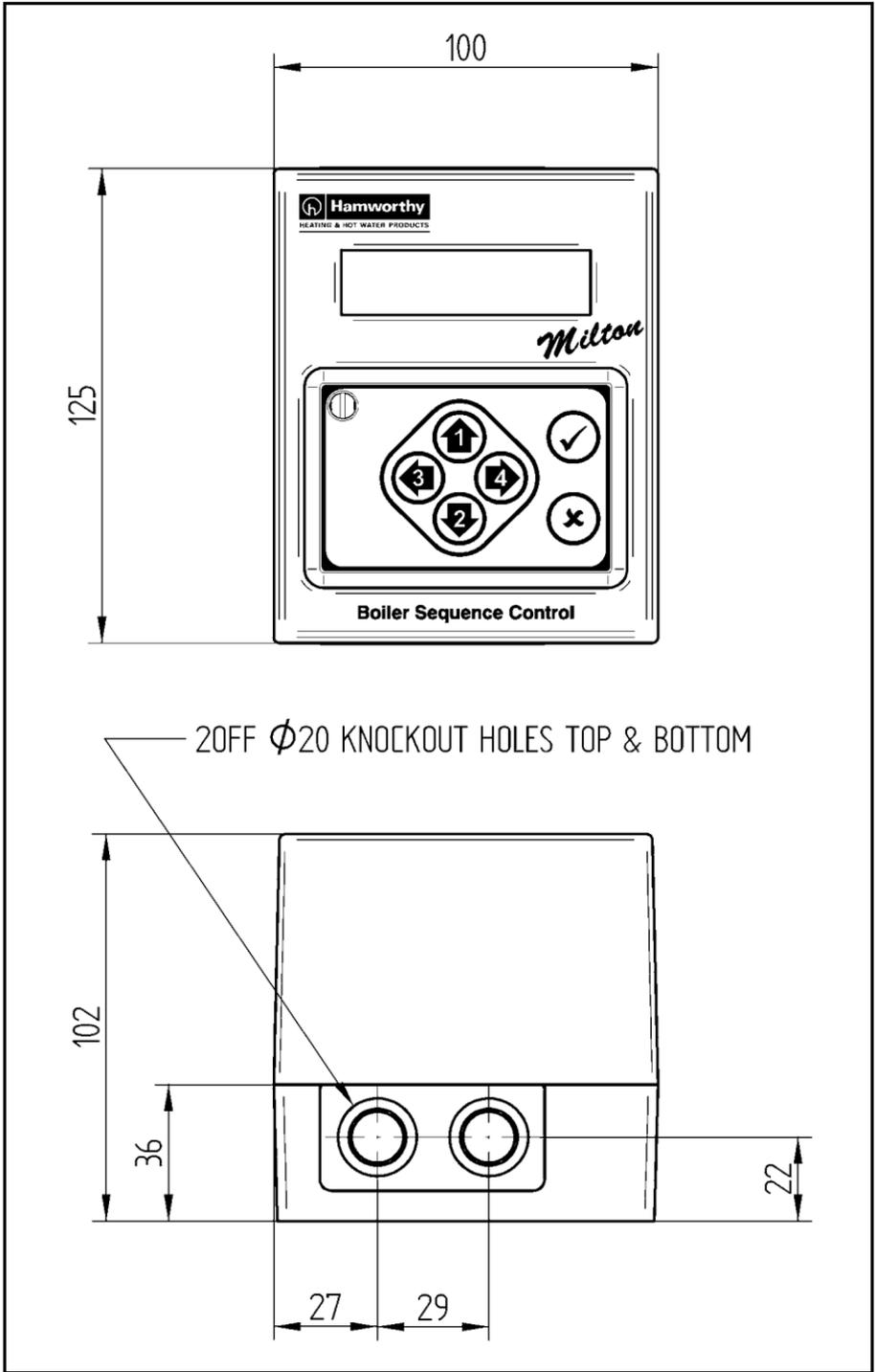


Figure 2.2 - Technical Data

ELECTRICAL DATA	
Supply Voltage	230V ~ 50Hz
Power Consumption	3W max.
Circulation Pump Contact Rating	250V ~ 2A
GENERAL DATA	
Dimensions (including wiring base)	100W x 125H x 104D
Weight	0.45kg
Data Memory and Time-clock Battery Backup	10 years max.
Maximum Boiler Communication Cable Run	50m
TEMPERATURE SENSOR DATA	
Sensor Type	PT1000
Maximum Cable Run	500m

3.0 DESCRIPTION OF OPERATION

3.1 Communication

On application of the electrical supply to the sequence control, it automatically detects the devices connected to it.

Note: The boilers **must be powered and switched on** for the sequence control to detect them.

The control then commences communication with the boilers' main control PCB (modulating boilers) or sequencing interface module (on/off and high/low boilers) via the serial data bus. The sequence control communicates in turn with each device in a continuous sequence.

At each communication the boiler or sequencing interface module is sent details of whether it should be firing or not, and at what rate it should be firing. The red data indicator light (marked 'IOIOIO' on the boiler fascia, and 'Communicating' on the

sequencing interface module fascia) will flash on to indicate that this has occurred.

3.2 Basic Operation (compensation and optimiser functions disabled)

3.2.1 On a call for the boilers to operate, generated either by the sequence control's heating time-clock, an external time-clock or BMS, the sequence control changes from Standby to Active mode. This is indicated on the sequence control display. The heating primary circulation pump will be started, the sequence control will register a 100% boiler system firing rate (indicated on the display), and the lead boiler instructed to fire. The remaining boilers will then be instructed to fire, in sequence, with a delay of 30 seconds between boilers.

3.2.2 The boiler firing order will depend on the 'Firing Order' setting. If 'Fixed Sequence' is selected, then the

lead boiler will always be boiler 1. If 'Lead Boiler Shift' is selected, the lead boiler is rotated on a weekly basis such that, during week 2 boiler 2 is the lead boiler, and during week 3 boiler 3 is the lead boiler. It is also possible to select a number of fixed lead boilers, rotating the remaining boilers, which can be desirable if a combination of condensing and non-condensing boilers are installed. Also if a combination of on/off and high/low boilers are installed, the on/off boilers will be fixed as the last in the sequence, whilst the lead boiler is shifted between the high/low boilers.

3.2.3 As the water flow temperature approaches the desired set point the sequence control will begin to reduce the total boiler firing rate by sequencing the boilers dependent on the boiler type and sequence mode selected.

1) On/Off Cascade

Example - 4 on/off boiler system.

As the required boiler system firing rate determined by the sequence control reduces, the boilers will be switched in the sequence as shown in Figure 3.2.3.1 below.

Figure 3.2.3.1

System Firing Rate	Blr 1	Blr 2	Blr 3	Blr 4
100%	ON	ON	ON	ON
75%	ON	ON	ON	OFF
50%	ON	ON	OFF	OFF
25%	ON	OFF	OFF	OFF
0%	OFF	OFF	OFF	OFF

The sequence control includes a programmable 'switching hysteresis' setting to prevent spurious on/off switching of the boilers. With a setting of '3%', this would (in this example) cause boiler no. 4 to switch off at

boiler system firing rate of 73%, and to switch on again when the boiler system firing rate increased to 76%.

2) High/Low Cascade

Example - 4 high/low boiler system.

As the required boiler system firing rate determined by the sequence control reduces, the boilers will be switched in the sequence as shown in Figure 3.2.3.2 below.

Figure 3.2.3.2

System Firing Rate	Blr 1	Blr 2	Blr 3	Blr 4
100%	HIGH	HIGH	HIGH	HIGH
87%	HIGH	HIGH	HIGH	LOW
75%	HIGH	HIGH	HIGH	OFF
62%	HIGH	HIGH	LOW	OFF
50%	HIGH	HIGH	OFF	OFF
37%	HIGH	LOW	OFF	OFF
25%	HIGH	OFF	OFF	OFF
12%	LOW	OFF	OFF	OFF
0%	OFF	OFF	OFF	OFF

This assumes the boiler low fire rate is 50% of the high fire rate. The sequence control also includes a 'boiler low fire rate' setting to give more accurate boiler system firing rate control. With a setting of 30% for the boiler low fire rate, this would (in this example) cause boiler no. 4 to switch to low fire at a boiler system rate of 82%. The 'switching hysteresis' setting also operates in this mode.

3) Low/Low Cascade

Example - 4 high/low boiler system.

As the required boiler system firing rate determined by the sequence control reduces, the boilers will be switched in the sequence as shown in Figure 3.2.3.3 (p7). The 'switching hysteresis' and 'boiler low fire rate' settings also operate in this mode.

Figure 3.2.3.3

System Firing Rate	Blr 1	Blr 2	Blr 3	Blr 4
100%	HIGH	HIGH	HIGH	HIGH
87%	HIGH	HIGH	HIGH	LOW
75%	HIGH	HIGH	LOW	LOW
62%	HIGH	LOW	LOW	LOW
50%	LOW	LOW	LOW	LOW
37%	LOW	LOW	LOW	OFF
25%	LOW	LOW	OFF	OFF
12%	LOW	OFF	OFF	OFF
0%	OFF	OFF	OFF	OFF

4) Modulating Cascade

Example - 4 modulating boiler system.

As the required boiler system firing rate determined by the sequence control reduces, the boilers will be modulated in the sequence as shown in Figure 3.2.3.4a below.

Figure 3.2.3.4a

System Firing Rate	Blr 1	Blr 2	Blr 3	Blr 4
100%	100%	100%	100%	100%
90%	100%	100%	100%	60%
80%	100%	100%	100%	20%
70%	100%	100%	80%	OFF
50%	100%	100%	OFF	OFF
30%	100%	20%	OFF	OFF
20%	80%	OFF	OFF	OFF
10%	40%	OFF	OFF	OFF
0%	OFF	OFF	OFF	OFF

As the minimum firing rate of the modulating boilers is 20% (5 to 1 turndown) the sequence control incorporates intelligence to ensure smooth linear boiler system modulation at the boiler switch off point as illustrated in Figure 3.2.3.4b above.

5) Modulating Unison

Example - 4 modulating boiler system.

As the required boiler system firing

Figure 3.2.3.4b

System Firing Rate	Blr 1	Blr 2	Blr 3	Blr 4
80%	100%	100%	100%	20%
79%	100%	100%	80%	36%
78%	100%	100%	80%	32%
77%	100%	100%	80%	28%
76%	100%	100%	80%	24%
75%	100%	100%	80%	20%
74%	100%	100%	76%	OFF

rate determined by the sequence control reduces, the boilers will be modulated in the sequence as shown in Figure 3.2.3.5 below.

Figure 3.2.3.5

System Firing Rate	Blr 1	Blr 2	Blr 3	Blr 4
100%	100%	100%	100%	100%
90%	90%	90%	90%	90%
80%	80%	80%	80%	80%
70%	70%	70%	70%	70%
50%	50%	50%	50%	50%
30%	30%	30%	30%	30%
20%	20%	20%	20%	20%
15%	20%	20%	20%	OFF
10%	20%	20%	OFF	OFF
5%	20%	OFF	OFF	OFF
0%	OFF	OFF	OFF	OFF

Note: As the required system firing rate falls below 20%, the boilers are stepped off in turn. The 'switching hysteresis' setting also operates in this mode.

3.2.4 Should the system load subsequently increase, the sequence control will instruct the boilers to step on / modulate upwards to match the new higher load.

3.2.5 During operation should a boiler fault occur (ignition lockout) preventing its operation, the sequence control will automatically adjust the

boiler sequencing to compensate for the non-operational boiler.

Note: This is applicable only to Hamworthy Heating modulating boilers.

3.2.6 At the end of the time-clock period the sequence control will instruct all of the boilers to switch off. The circulation pump will continue to run for an overrun period, to remove residual heat from the boilers, and then shut down.

3.3 Remote Modulation Control Operation

The sequence control software includes a 'Master' setting which enables the boiler system firing rate to be controlled by a remote BMS control via a 0 to 10V analogue signal. Refer to **Section 5.2.6** (p23) for setting details. In this operating mode all other Milton functions are disabled.

Note: As the boiler firing rate is determined by an external control the Milton water temperature sensor is not required.

In this mode of operation the sequence control remains 'Active' constantly (with circulation pump output on). The sequence control constantly monitors the level of the 0 to 10V analogue signal from the BMS control. At a level of the signal of 0.0V the sequence control will instruct all boilers to be off. Between signal 0.1V and 10.0V the sequence control will vary the boiler system firing rate linearly between 1 and 100%, controlling the boilers as described in **Section 3.2** (p5).

3.4 Outside Air Temperature Compensation Function Operation

The sequence control can automatically adjust the water flow temperature set point in relation to the outside air temperature, between maximum and minimum flow

temperature settings. The relationship between the outside air temperature and the water flow temperature is determined by a temperature ratio setting and an offset setting (see Figure 3.4 (p9)). The sequence control automatically adjusts the boiler firing rates to match the flow temperature set point as it changes.

3.5 Summer Shutdown Function Operation

The sequence control can automatically shut down the heating system when the outside air temperature reaches a programmable set point. Operation of this function is indicated on the display.

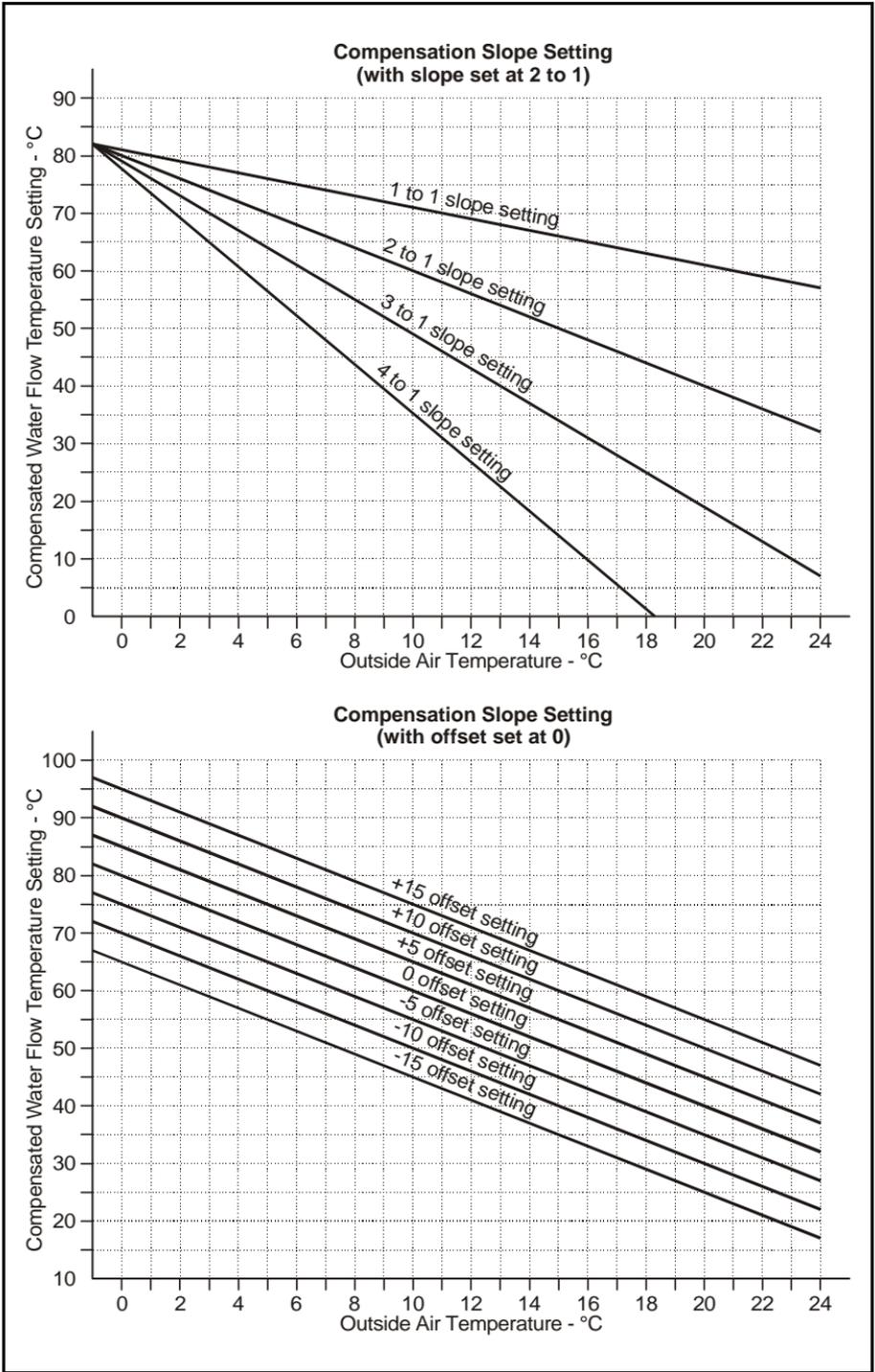
3.6 Optimum Start Function Operation

3.6.1 When the optimum start function is utilised the heating time-clock settings become the times at which the desired room temperature set point is to be achieved, rather than the times at which the heating is to start.

In the time prior to the start of the building occupancy period, the sequence control continuously monitors the outside air and room temperatures. Based on these and the desired occupancy room temperature set point, the sequence control determines the duration of the preheat period required to raise the room temperature to the desired level. The heating system is started when the required preheat time equals the remaining time prior to the start of the occupancy period.

2 settings are provided to adjust the preheat duration - F_r , a factor relating to the room temperature, and F_a , a factor relating to the outside air temperature. The factory settings for these factors are $F_r = 10$, and $F_a = 1$. These settings will allow 66 minutes of preheat to raise the room temperature

Figure 3.4 - Compensation Function Characteristic Graph



from 0 to 20°C with an outside air temperature of 0°C. That is 3 minutes per °C rise of room temperature and 0.3 minutes per °C difference between the outside air temperature and desired room temperature.

The preheat duration can be limited by a 'Maximum Preheat' setting.

3.6.2 The optimum start function includes a self-learning facility to tune the system to each installation. This works by adjusting the F_a factor based on how much too early or too late the desired temperature was actually achieved.

The self-learning facility can be disabled to fix the F_a factor.

3.6.3 The optimum start function **cannot** be used in conjunction with an external time-clock control.

3.7 Daytime Optimisation Function Operation

3.7.1 This function provides control of the room temperature during occupancy periods. When the desired room temperature set point is achieved the sequence control instructs the boilers to switch off, and the circulation pump is switched off after its overrun period.

Should the room temperature subsequently fall below the set point during the occupancy period, the heating system is restarted to maintain the room temperature set point.

3.7.2 This function can be disabled to allow the boilers to remain in operation when the room temperature set point is achieved.

3.8 Night Set-Back Function Operation

This function provides control of the room temperature during non occupancy periods. A night set-back

room temperature set point is provided. The heating system is operated should the room temperature fall below the set point. When the night set-back room temperature is achieved the boilers are switched off and the pump switched off after the overrun time.

The night set-back function can be disabled.

3.9 Frost Protection Function Operation

3.9.1 A frost protection outside air temperature setting is provided, which should the outside air temperature fall below it, during a non occupancy period, will cause the sequence control to operate the circulation pump to ensure that remote sections of the heating pipework do not freeze. An outside air temperature sensor is required for this function.

3.9.2 A frost protection water flow temperature setting is also provided, which should the water temperature fall below it, during a non occupancy period, will cause the sequence control to fire the boilers, to maintain the water temperature 20°C above the set point. Once the required water temperature is achieved the boilers are shut down.

3.9.3 It is possible to disable the outside air temperature based action or both of the frost protection actions.

3.10 Safety Interlock Circuit Operation

If any of the devices connected to the safety interlock circuit break the circuit, the sequence control will immediately instruct the boilers to shut down. On rectification of the fault condition and remaking of the safety interlock circuit, the sequence control will automatically instruct the boilers to restart.

3.11 Override Functions Operation

Refer to section 2.0 Of the Milton boiler sequence control user's instruction manual for details of the operation of the override functions:

Remote override switch

Remote holiday override switch

3.12 Data Logging Operation

Refer to section 3.2.7 Of the Milton boiler sequence control user's instruction manual for details of the operation of the data logging function.

4.0 INSTALLATION

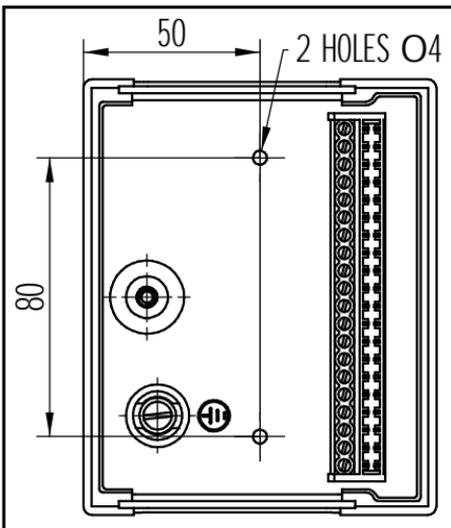
NOTE! IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN.

4.1 Control Location

The Milton boiler sequence control is designed for wall mounting on its wiring base. It should be positioned at a point of easy access at an approximate height of 1.5m.

To mount the sequence control, unfasten the screw accessible from the front of the control to separate it from its wiring base. The wiring base

Figure 4.1 - Mounting Holes



can then be fixed in position using suitable fixings for the type of construction of the wall to which it is to be mounted.

2off mounting holes are provided in the wiring base (refer to Figure 4.1 for hole details).

The wiring base is supplied complete with 2off removable gland plates, each having 2off 20mm dia. knockout holes for cable conduit connection.

4.2 Electrical Connections

All wiring to the sequence control must be in accordance with the IEE Regulations, and any local regulations which apply.

NOTE! IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN.

The site wiring connection terminals are shown in Figure 4.2 (p12).

4.2.1 Electrical Supply

The electrical mains connection must be via a double pole, fused isolator with a contact separation of at least 3mm in all poles, positioned adjacent to the sequence control.

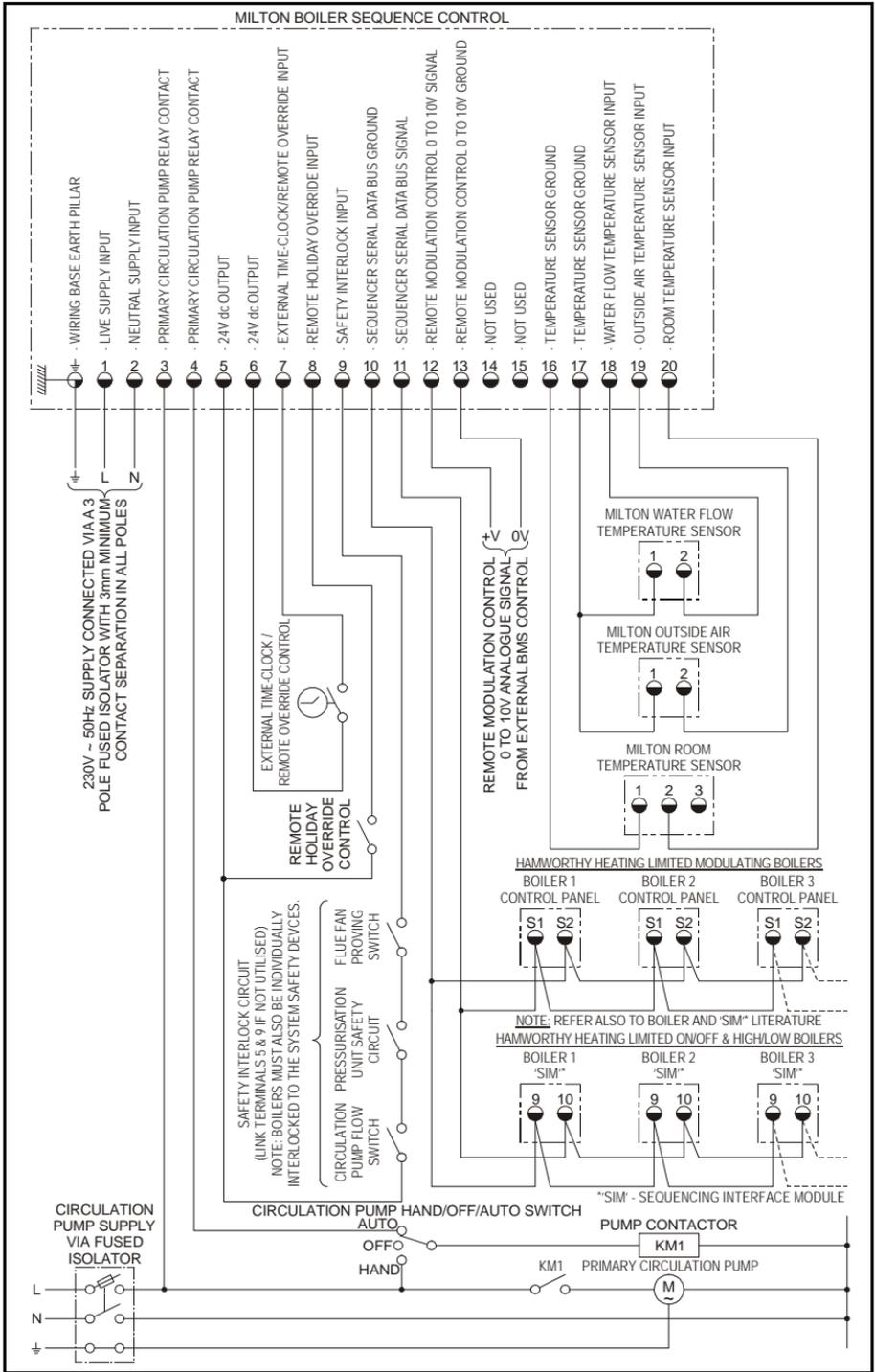
Note! The supply to the sequence control must not be interrupted by any other controls, such as external time-clocks or building management systems.

4.2.2 Primary Circulation Pump

The primary circulation pump must be connected to the electrical supply via a fused isolator with a minimum contact separation of 3mm in all poles.

The sequence control provides a relay contact to control operation of the circulation pump. This relay contact should be used to operate the circulation pump contactor. A hand/off/auto switch should also be incorporated into this control circuit. Refer to Figure 4.2 (p12) for details.

Figure 4.2 - Site Wiring Schematic



Note! The sequence control relay contact must **NOT** be used to directly switch the electrical supply to the circulation pump.

4.3 Boiler Control Connections

The boilers are connected to the sequence control via a 2 wire serial data bus link. Shielded cabling **must not** be used for these connections.

4.3.1 On/Off and High/Low Boilers

Hamworthy Heating Limited on/off and high/low boilers will be supplied with optional 'sequencing interface modules', which must be fitted to the boiler control panels. Refer to the installation instructions supplied with the interface module for details.

Having installed the interface modules and made the wiring connections between the interface modules and boiler control PCBs, the 'bus' control connections can be made.

Wire the lead boiler interface module to the sequence control boiler control output terminals (terminal '10' on Milton to '9' on interface module, terminal '11' on Milton to '10' on interface module - refer to Figure 4.2 p12). Wire the second boiler interface module to the lead boiler interface module terminals ('9' to '9' and '10' to '10'). Continue this until all of the boilers are wired together.

4.3.2 Modulating Boilers

All Hamworthy Heating Limited modulating boilers are fitted with dedicated Milton communication input terminals, labelled 'S1' and 'S2'. Refer also to the specific boiler's installation manual for terminal details.

Wire the lead boiler to the sequence control boiler control output terminals (terminal '10' on Milton to 'S2' on boiler, terminal '11' on Milton to 'S1' on boiler - refer to Figure 4.2 p12).

Wire the second boiler to the lead boiler terminals ('S1' to 'S1' and 'S2' to 'S2'). Continue this until all of the boilers are wired together.

4.4 Control Input Connections

The sequence control provides the facility for a number of control inputs from external devices including time-clocks, building management systems and system safety devices. Refer to Figure 4.2 (p12) for details.

4.4.1 0 to 10V Remote Modulation Control Input

This is a low voltage signal input and must only be connected to a suitable 0 to 10V signal.

Connect the 2 wire analogue signal to terminal '12' and ground to terminal '13'. Refer to Figure 4.2 (p12) for details.

4.4.2 Safety Interlock Circuit

This circuit operates at 24V dc and must only be connected to volt free switching devices.

Connect the safety devices in series across terminals '5' and '9'.

The boilers must also be individually interlocked, via their remote on/off control terminals, to any system safety devices required for their safe operation. Refer to individual boiler installation manuals for details.

Note! If no safety devices are to be connected a setting is provided to disable this function. Failure to disable the function will prevent the boilers from operating.

4.4.3 External Time-clock (Optional)

This circuit operates at 24V dc and must only be connected to volt free switching devices.

Connect the time-clock control across terminals '6' and '7'.

4.4.4 Remote Override Switch (Optional)

The remote override function is not available when an external time-clock is connected to the Milton control, it is intended for use in conjunction with the sequence control internal time-clock function.

The remote override switch is connected across terminals '6' and '7'.

Note! This circuit operates at 24V dc, mains voltages MUST NOT be fed onto these terminals.

4.4.5 Remote Holiday Override Switch (Optional)

This switch is connected across terminals '5' and '8'.

Note! This circuit operates at 24V dc, mains voltages MUST NOT be fed onto these terminals.

4.5 Temperature Sensors

4.5.1 General

Note: No temperature sensors are required to be connected to the sequence control if the 'Master Control' setting is set to 'BMS' for remote modulation control via a 0-10V signal from an external building management control system.

The Milton system temperature sensors are of the PT1000 platinum resistance type. Standard conduit cabling is suitable for connecting the sensors, special shielded cabling **must not** be used.

4 types of sensor are available - Insertion water sensor complete with pocket, clamp-on water sensor, room sensor and outside air sensor.

4.5.2 Water Flow Temperature Sensor

Either the insertion type or clamp-on type can be used, however Hamworthy Heating Limited recommend the use of the insertion

type which will provide more accurate temperature control in most applications.

The water flow temperature sensor must be installed at the outlet of the flow header from the boiler system. There must be no connections taken from the flow header between the boilers and the sensor position.

The insertion type sensor consists of a brass probe mounted to a plastic housing, supplied with a brass pocket with a R½ thread (refer to Figure 4.5.2a p15). Fit the sensor pocket to a ½" BSP socket welded to the flow header, allowing an insertion depth to the centre line of the pipe. Alternatively, the sensor can be installed at a pipe bend as shown in Figure 4.5.2a (p15). Insert the sensor probe into the pocket and fix in place with the locking screw on the side of the pocket.

The clamp-on type sensor consists of a spring loaded surface temperature probe mounted to a plastic housing, supplied with a clamping strap device suitable for clamping up to 4inch pipes maximum (refer to Figure 4.5.2b p16). Position the sensor on the pipe and pass the strap through the rectangular hole in the sensor and around the pipe. Assemble the clamping mechanism as shown in Figure 4.5.2b (p16) and fasten the sensor in place by tightening the clamping strap nut. Do not over tighten.

The water sensor housings incorporate an M20 threaded conduit / gland connection for cable entry. Remove the housing cover by unfastening the 2 screws and wire the water sensor to terminals '17' and '18' on the sequence control. Replace the housing cover.

4.5.3 Outside Air Temperature Sensor (Optional)

The optional outside air temperature sensor is required for the outside air

Figure 4.5.2a - Insertion Type Water Flow Temperature Sensor

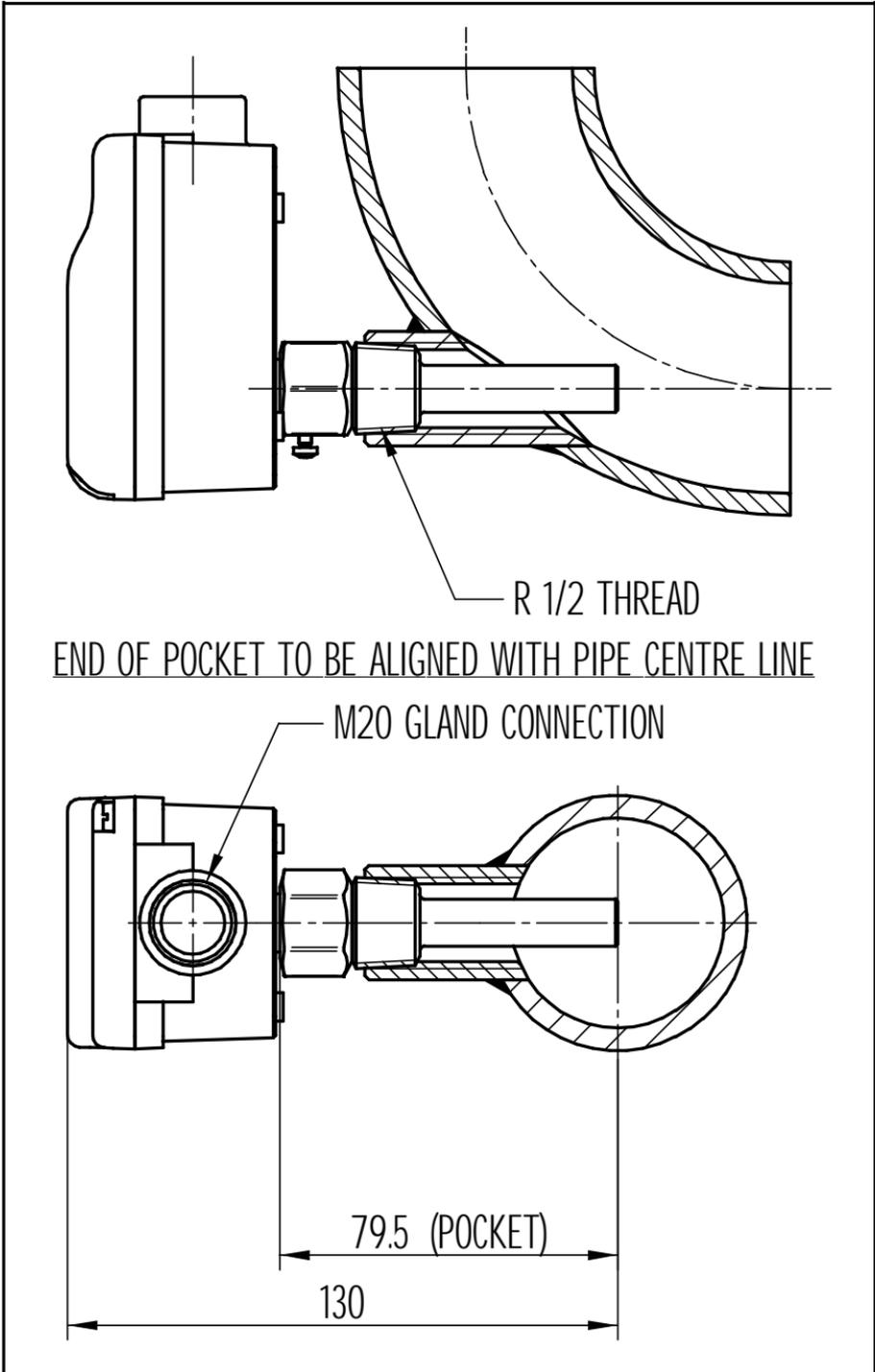
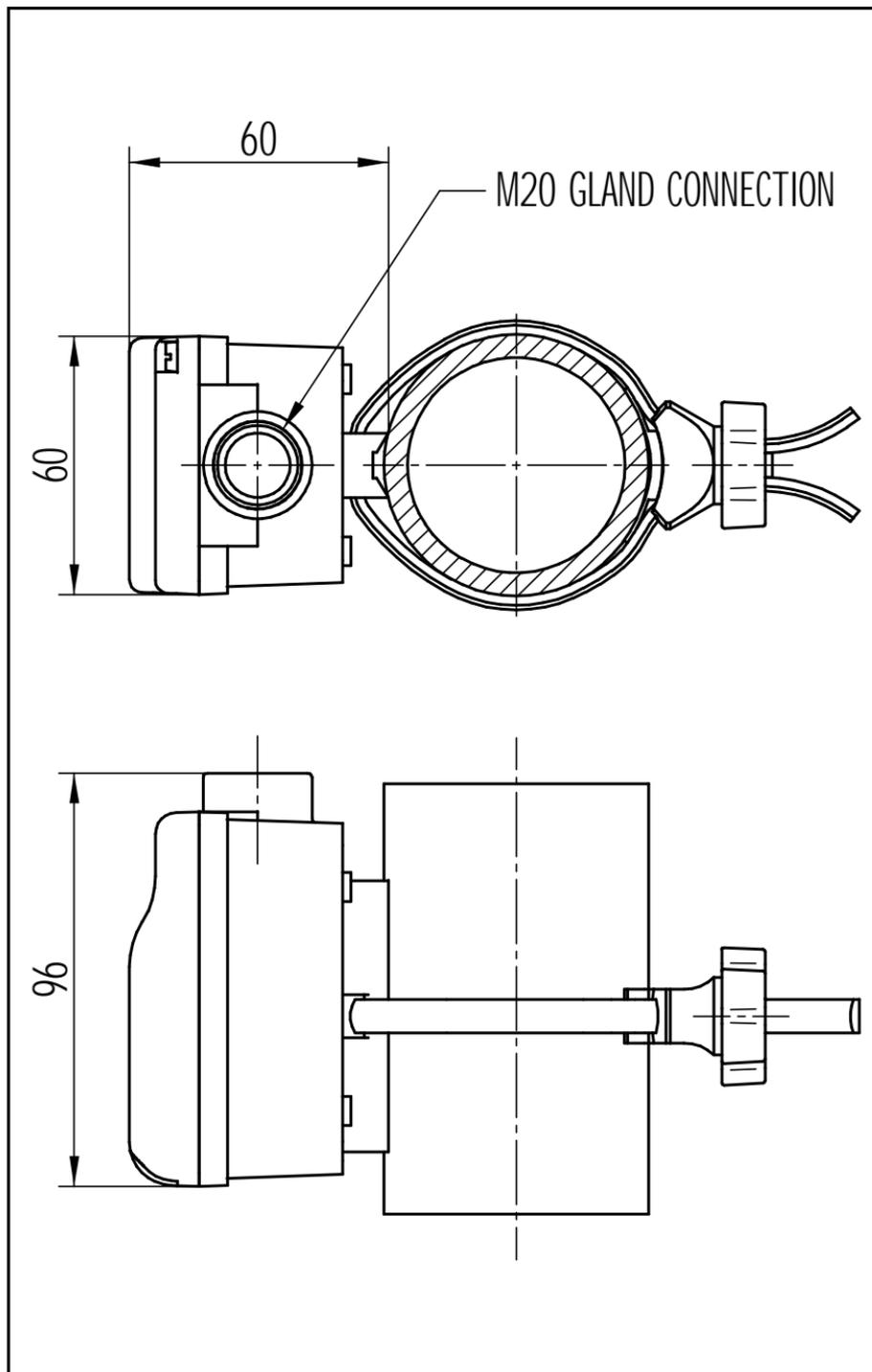


Figure 4.5.2b - Clamp-on Type Water Flow Temperature Sensor



temperature compensation, optimum start and 2 stage frost protection functions.

The outside air sensor consists of a plastic housing with integral mounting flange. The housing incorporates an M20 threaded conduit / gland connection, which when used in conjunction with a suitable conduit or gland connector provides IP65 protection.

The sensor must be installed on an outside, north facing wall, away from any air vents, pipes, illuminated signs or any other device that could affect the ambient temperature local the sensor.

Note! Exposure of the sensor to direct sunlight at any time during the day will severely affect the performance of the compensation and optimum start functions.

The sensor can be fixed to the wall using the mounting holes in its plastic housing, or held in place by the cable conduit (see Figure 4.5.3 p18).

Remove the housing cover by unfastening the 2 screws and wire the outside air sensor to terminals '17' and '19' on the sequence control. Replace the housing cover.

4.5.4 Room Temperature Sensor (Optional)

The optional room temperature sensor is required for the optimum start, daytime optimisation and night set-back functions.

The room temperature sensor consists of a plastic housing supplied with a surface mounting back box. The sensor housing can also be mounted to any standard flush or surface mounting back box. See Figure 4.5.4a (p19).

The sensor should be mounted on an internal wall at a point where it will not

be subject to draughts from outside and where it will not be exposed to direct sunlight in order to ensure that the sensor reading is representative of the actual ambient room temperature. The sensor should be mounted at a height of approximately 1.5m above floor level.

Remove the housing from the back box by unfastening the 2 screws. Fix the supplied back box to the wall using suitable countersunk head screws, or discard if a suitable back box is already installed. Wire the room sensor to terminals '16' and '20' on the Milton control. Fasten the housing to the back box using the 2 screws supplied.

It may be desirable for some installations to install sensors in a number of positions to obtain an average room temperature reading. This can provide more accurate operation of the optimum start and

Figure 4.5.4b - Multiple Room Temp. Sensor Wiring Configurations

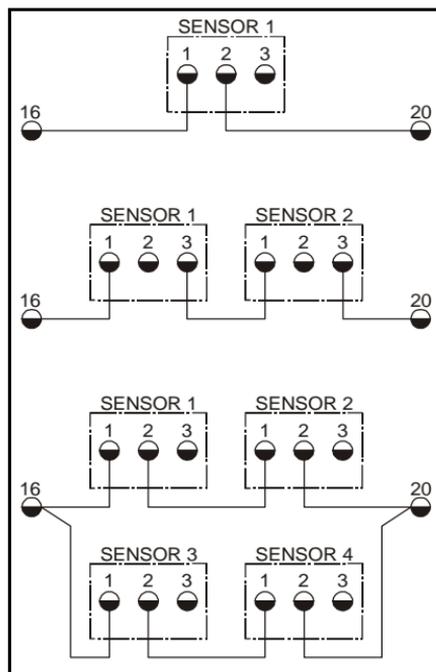
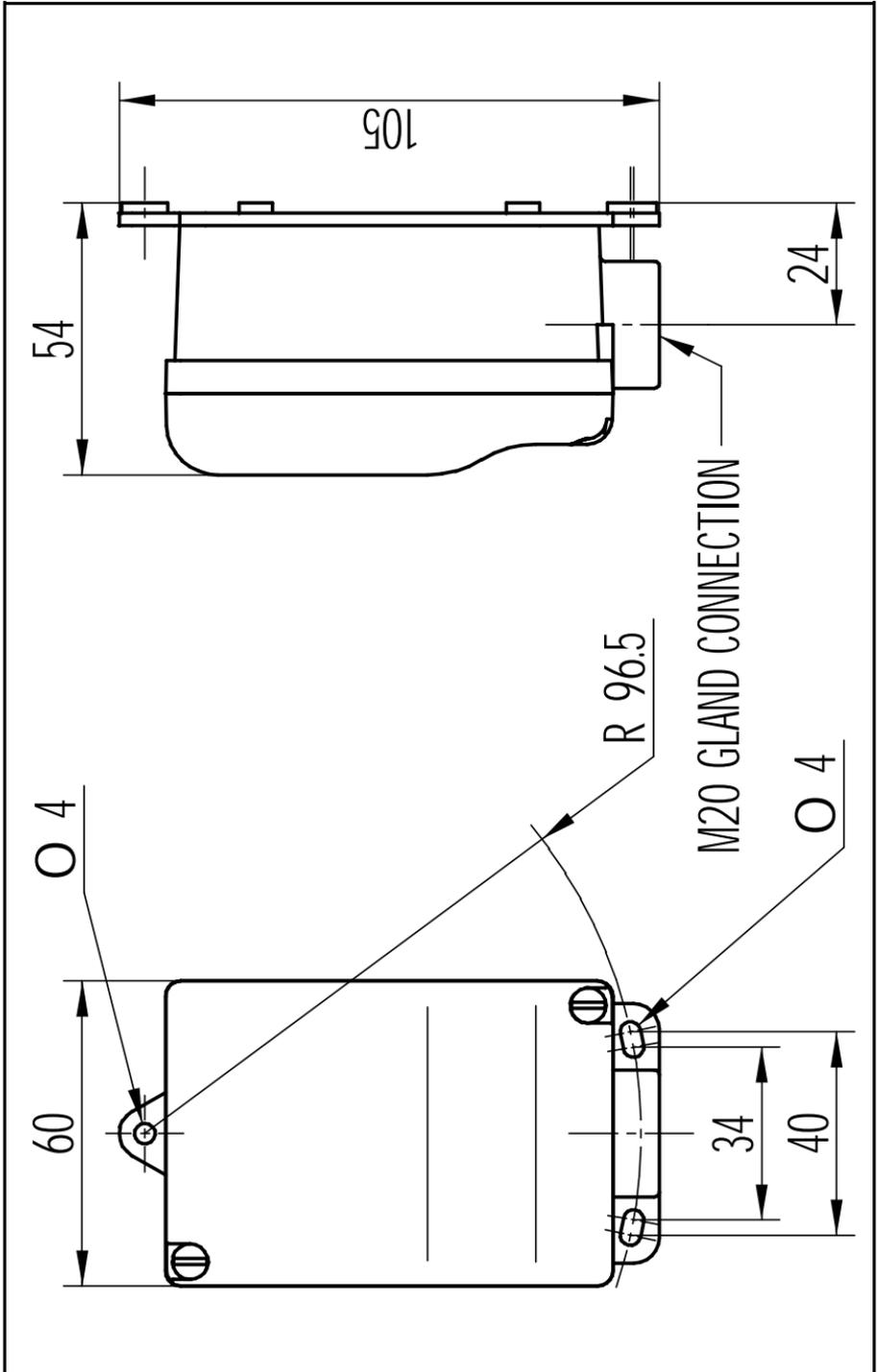


Figure 4.5.3 - Outside Air Temperature Sensor



daytime optimisation functions. Figure 4.5.4b gives wiring connection details for combinations of 1, 2 and 4 sensors (a 3 sensor combination is not possible). Note the different terminal connections for the 2 sensor combination.

4.6 Completion

When all of the required connections have been made to the wiring base, fit the sequence control to the wiring base, taking care to align the PCB edge connector into the terminal strip in the base, and push firmly into place. Fasten the screw in the front of the control to fix it in place.

5.0 COMMISSIONING

5.1 Pre-Commissioning Checks

5.1.1 Carry out the electrical and gas installation and water circulation system checks as detailed in the commissioning section of the boiler's installation manual.

5.1.2 Ensure that the electrical supplies to the sequence control and all of the equipment connected to it are isolated. Remove the sequence control from its wiring base, and check that the wiring connections are correct and soundly made.

Note! Wiring **MUST** be checked by a suitably competent person.

Replace the sequence control on its wiring base and fasten in position.

5.1.3 Ensure that the system circulation pump(s) are running by setting them to their 'hand' control positions.

The boilers can now be commissioned as detailed in their installation manuals.

Once boiler commissioning is complete isolate the electrical supply to all of the boilers and ensure that the rotary switch (marked 'SW1') on the main PCB of each modulating boiler, or on the sequencing interface module

is set to the correct position. Switch 'SW1' should be set to position '1' on the lead boiler, position '2' on the second boiler and so on up to a maximum of 9 boilers. Refer also to the boiler's installation manual for further details.

Set the boiler control thermostat to a temperature 10°C above the intended mixed flow temperature setting in the flow header, up to the maximum setting of the control thermostat. This will prevent the boilers' own temperature controls from interfering with the sequence control's temperature control action.

Switch on the electrical supply to all of the devices connected to the sequence control and ensure that the boilers are switched on (amber power on indicator on boiler fascia illuminated).

Switch on the electrical supply to the sequence control. The sequence control will initiate and automatically detect all of the connected devices and initiate communication with them.

Note! The sequence control will fail to detect and initiate communication with the boilers if they are not powered and switched on.

The Milton boiler sequence control is now ready to be programmed.

5.2 Programming

5.2.1 Program Menu Overview

The Milton boiler sequence control program settings are separated into 2 sections - the engineer's settings and user's settings. The engineer's settings determine how the system operates and which functions are to be used. The user's settings include time-clock, holiday period and room temperature settings. Both are protected by 4 digit numerical security codes.

The engineer's settings security code

is factory set to '1805' and cannot be changed. It is advisable that 'casual' users do not have access to this security code.

The user's settings security code is factory set to '1000', but can be changed from within the user's settings, or if forgotten, from within the engineer's settings.

Refer to the Milton boiler sequence control user's instruction manual (HHL pt. no. 500001105) for further details of the user's settings.

The engineer's settings consist of a main menu, with a numbered list of options, each of which lead to a sub menu.

The submenus consist of a number of screens with various settings relevant to the particular submenu.

In order to simplify programming of the Milton control, submenus and settings which are not relevant to a particular

installation are automatically hidden.

5.2.2 Keypad Operation

The '▲' and '▼' keys are used to scroll up and down through the menu lists and also to change setting values.

The '◀' and '▶' keys are used to move the flashing cursor position on individual screens.

The '✓' key is used to access the engineer's settings menu, select menu items and to enter modified setting values.

The '✕' key is used to access the user's settings menu, return to the previous menu level or to exit the program settings.

5.2.3 Programming Screen Timeout

If no keys are pressed for 1 minute the sequence control will automatically return from the programming screens to the run mode screens.

5.2.4 Overview - Enter engineer's settings menu and navigate submenus	
a) To enter the engineer's settings menu press and hold the '✓' key for 5 seconds until the security code screen is displayed. Note that the left hand code digit is flashing to indicate the cursor position.	Enter MENU CODE: 0000
b) Use the '▲' and '▼' keys to enter the first digit of the code. Use the '◀' and '▶' keys to move the cursor position to enter the remaining digits.	Enter MENU CODE: 1805
c) To enter the code press the '✓' key. If the code entered was incorrect the control will give the option to try again. If the code entered was correct the main menu screen will be displayed.	1 Set MASTER 2 Set CLOCK
d) Use the '▲' and '▼' keys to scroll up and down through the main menu list. The '▶' symbol on the left of the screen indicates the currently selected menu item. Note: There are more than 2 menu items. The screen displays 2 at a time.	4 Set OPTIMISER ▶5 Set SEQUENCER

5.2.4 Overview - Enter engineer's settings menu and navigate submenus (continued)

e) The full menu list is as shown. Note that depending on various setting values some of the submenus may be hidden.

```

1 Set MASTER
2 Set CLOCK
3 Set COMPENSAT
4 Set OPTIMISER
#5 Set SEQUENCER
6 Set CIRCULATN
7 Set FROST PRT
8 Set OVERRIDES
9 Set MENU CODE
    
```

f) To select a menu item press the '✓' key. The submenu will be displayed. Note that the submenu setting title flashes to indicate the cursor position.

```

FLOW TEMPS (°C)
Max 090 Min 015✓
    
```

g) With the cursor on the setting title, use the '↑' and '↓' keys to scroll through the submenu screens.

```

FIRING ORDER
Fixed Sequence ✓
    
```

h) To return to the main menu press the 'x' key.

```

4 Set OPTIMISER
#5 Set SEQUENCER
    
```

h) To exit from the engineer's settings menu press the 'x' key. The run mode screen will be displayed.

```

Fri 07-Mar-2003
15:31 Air: 12°C
    
```

5.2.5 Overview - Modifying a setting value

a) Enter the engineer's settings menu and select the sequencer settings submenu as described above. Select the flow temperature limits setting screen.

```

FLOW TEMPS (°C)
Max 090 Min 015✓
    
```

b) Use the '←' and '→' keys to move the flashing cursor position from the setting title to the setting value. The cursor can be positioned on each individual digit of a numerical setting. Use the '↑' and '↓' keys to modify the value of each digit of a setting.

```

FLOW TEMPS (°C)
Max 080 Min 015?
    
```

Note that when a setting is changed the '✓' symbol on the right of the screen changes to a '?' to indicate that the displayed value is not the current value programmed in memory.

```

FLOW TEMPS (°C)
Max 082 Min 015?
    
```

```

FLOW TEMPS (°C)
Max 082 Min 065?
    
```

5.2.5 Overview - Modifying a setting value (continued)

c) The sequence control will not allow a setting value outside the allowable range for each setting to be displayed. In this example the allowable setting range is 0 to 120°C. The control will not allow the first digit to be set to '1' until the last 2 digits are set to '20' or lower.

```
FLOW TEMPS (°C)
Max 010 Min 065?
```

```
FLOW TEMPS (°C)
Max 110 Min 015?
```

d) To enter the new setting value(s) into the program memory, press the '✓' key. The '?' symbol on the right of the screen will change to a '✓'. The flashing cursor position will automatically return to the setting title.

```
FLOW TEMPS (°C)
Max 110 Min 065✓
```

e) Ensure that the cursor position is on the setting title before using the '↑' and '↓' keys to scroll to the other setting screens in the submenu. Note that some settings are control options rather than numerical values, as in this case.

```
FIRING ORDER
Fixed Sequence ✓
```

f) Positioning the cursor on the setting value in this case will cause the whole setting option description to flash. Use the '↑' and '↓' keys to select between the various options available.

```
FIRING ORDER
Lead Blr Shift ?
```

g) When all of the required settings in the submenu have been modified, use the 'x' key to return to the main menu and then exit to the run mode screen.

```
Fri 07-Mar-2003
15:35 Air: 12°C
```

5.2.6 Master Control Mode Submenu

a) Master Control Setting

This screen is used to determine the modulation control source, and has 2 available options. The first is 'Milton' whereby the boiler system firing rate is determined internally by the Milton sequence control based on its water temperature sensor reading. The second is 'BMS' whereby the boiler system modulation rate is determined by an external building management control system and is transmitted to the Milton sequence control via a 0-10V analogue signal (refer to **Section 3.3** p8 for further details).

```
CONTROL MASTER
Milton ✓
```

5.2.6 Master Control Mode Submenu (continued)	
Note: When the 'BMS' setting is selected, the majority of other functions are disabled. Only the 'Sequencing' and 'Menu Code' submenus are available.	
5.2.7 Clock Submenu	
Note: If the master control setting is 'BMS' this submenu is not available.	CLOCK SOURCE internal ✓
a) Clock Source Setting This screen has 2 available options, 'internal' whereby the heating system is started based on the sequence control's own time-clock, or 'external' whereby the heating system is started based on the external time-clock input.	
5.2.8 Compensation Submenu	
Note: If the master control setting is 'BMS' this submenu is not available.	COMP MODE Compensated ✓
a) Compensation Mode Setting This setting has 2 available options, 'Fixed Temp' whereby the outside air temperature compensation function is disabled and the sequence control will control to a single fixed water flow temperature, or 'Compensated' whereby the compensation function is enabled.	
b) Compensation Slope Setting Note: If the compensation mode setting is 'Fixed Temp' this setting is not available. This setting represents the amount by which the water flow temperature set point is reduced per °C outside air temperature rise. It can be set between 0.5 and 4.0 °C/°C in 0.5 steps. Refer to Section 3.4 (p8) for further details.	COMP SLOPE 2.0°C/°C ✓
c) Compensation Slope Offset Setting Note: If the compensation mode setting is 'Fixed Temp' this setting is not available. The reference point for the compensation slope is 82°C water flow temp. at -1°C outside air temp. This setting represents	SLOPE OFFSET +00°C ✓

5.2.8 Compensation Submenu (continued)	
<p>an offset for the reference point, eg. with an offset of +5°C the water flow temp. will be 87°C at -1°C outside air temp. It can be set between -15°C and +15°C in 1°C steps. Refer to Section 3.4 (p8) for further details.</p>	
<p>d) Summer Shutdown Temperature Setting</p> <p>This setting represents the outside air temperature at which the heating is switched off. It can be set between 0 and 30°C in 1°C steps. Also included on the screen is a setting which enables the function to be enabled/disabled - 'off' disables the function, 'on' enables the function.</p>	<p>SUMMER SHUTDOWN off 20°C ✓</p>
5.2.9 Optimiser Submenu	
<p>Note: If the master control setting is 'BMS' this submenu is not available.</p> <p>a) Optimum Start Mode Setting</p> <p>Note: If the time-clock source setting is 'external' this setting is not available and optimum start is automatically disabled.</p> <p>This setting has 3 available options. The first is 'Enabled (adapt)' whereby the optimum start is enabled with self learning. The second is 'Enabled (fixed)' whereby the optimum start is enabled without self learning. The third is 'Disabled' whereby the optimum start is disabled and the heating starts at the times dictated by the sequence control internal time-clock.</p>	<p>OPT START MODE Enabled (fixed) ✓</p>
<p>b) Optimum Start Parameter Setting</p> <p>Note: If the time-clock source setting is 'external' or the optimum start mode setting is 'disabled' this setting is not available.</p> <p>These 2 settings are used by the sequence control to calculate the optimum start preheat time. The factory settings shown above, will allow a preheat time of 66 minutes to raise the room temperature</p>	<p>OPT START PARS Fr 010 Fa 001 ✓</p>

5.2.9 Optimiser Submenu (continued)	
from 0 to 20°C with an outside temperature of 0°C. Refer to Section 3.5 (p8) for further details. Both settings can be set between 1 and 100 in steps of 1.	
c) Maximum Preheat Time Setting Note: If the time-clock source setting is 'external' or the optimum start mode setting is 'disabled' this setting is not available. This setting is used to limit the duration of the optimum start preheat time. It can be set between 1 and 9 hours in 1 hour steps.	MAX PREHEAT TIME 9hrs ✓
d) Room Temperature Control Mode Setting This setting is used to enable or disable the daytime optimisation function to control the room temperature during occupancy periods. The setting options are 'Daytime Optim' or 'Disabled'.	ROOM T CTL MODE Disabled ✓
e) Night Set-Back Mode Setting This setting is used to enable or disable the night set-back function to control the room temperature during non-occupancy periods. The setting options are 'Enabled' or 'Disabled'.	NIGHT S/BK MODE Disabled ✓
5.2.10 Sequencer Submenu	
a) Water Flow Temperature Set Point Limits Setting This setting represents the limits of water flow temperature set point for the compensation function. If the compensation mode setting is set to 'Fixed Temp' then the fixed water flow temperature set point is set to the maximum value. When non-condensing boilers are installed, the minimum value must be at least 65°C to prevent condensate forming in the boilers. The values can be set between 0 and 117°C in 1°C steps. Do not set the minimum value higher than the maximum value.	FLOW TEMPS (°C) Max 082 Min 065 ✓

5.2.10 Sequencer Submenu (continued)

b) Temperature Control Proportional and Integral Gains Settings

These settings determine the response of the sequence control water temperature control action. The factory settings are proportional gain PG = 50, and integral gain IG = 5. For the majority of installations these settings will provide acceptable performance. However, if the boiler system response is observed to be very fast, for example where the full boiler heat input is significantly greater than the actual heating system load, it may be advisable to reduce the gain settings. This will cause the modulation action to start reducing the boiler firing rate at a lower water temperature and also slow down the rate of change of boiler firing rate. If the settings are adjusted it is advisable to limit the change to steps of '5' for the proportional gain and steps of '1' for the integral gain. Observe the effect of the new settings before making further changes.

P & I GAINS
PG 050 IG 005 ✓

c) Sequencing Mode Setting

This setting has 5 available options to match the type of boilers to be controlled. Refer to **Section 3.2.3** (p6) for detailed description of each of the available options.

Setting options as follows:

- a) 'On/Off Cascade'
- b) 'Hi/Lo Cascade'
- c) 'Lo/Lo' Cascade'
- d) 'Modltn Cascade'
- e) 'Modltn Unison'

SEQUENCING MODE
On/Off Cascade ✓

d) Firing Order Setting

This setting has 2 available options, 'Lead Blr Shift' whereby the lead boiler is rotated on a weekly basis, or 'Fixed Sequence' whereby the lead boiler is always boiler 1.

FIRING ORDER
Lead Blr Shift ✓

5.2.10 Sequencer Submenu (continued)

e) Number of Fixed Lead Boilers Setting

Note: If the firing order setting is 'Fixed Sequence' this setting is not available.

This setting allows a number of boilers to be fixed as the first in the firing sequence when the lead boiler shift option is used. This is desirable when a combination of condensing and non-condensing boilers are installed, in order to fix the condensing boilers as the lead boilers to benefit from their higher efficiency at lower water flow temperatures. The fixed lead boilers **must** be boiler nos. 1, 2, 3 etc. The firing sequence of the remaining boilers will be rotated. The setting can be adjusted between 0 and the total number of boilers installed.

NO. FIXED LEAD
1 ✓

f) Switching Hysteresis Setting

Note: If the sequencing mode setting is 'Modltn Cascade' or 'Modltn Unison' this setting is not available.

This setting represents the switching hysteresis in % at the on/off switching point for on/off and high/low boilers. It can be set between 1 and 5%, recommended setting is 3%. Increasing the setting may help reduce fast on/off cycling of the boilers if this is observed.

SET HYSTERESIS
3% ✓

g) Low Fire Rate Setting

Note: This setting is only available if the sequencing mode setting is 'hi/lo cascade' or 'lo/lo cascade'.

This setting represents the low fire rate of high/low boilers as a percentage of the high fire rate. It can be set between 10 and 90 % in 10% steps. The chart overpage gives correct settings for the HHL high/low ranges of boilers.

LOW FIRE RATE
50% ✓

5.2.10 Sequencer Submenu (continued)

Boiler Model	Low Fire Rate
Purewell PC40	80%
Purewell PC50	60%
Purewell PC60	50%
Purewell PC70	40%
Purewell PC80	40%
Purewell PC95	40%
Purewell PC105	40%
Purewell PC120	30%
Warmwell W60	60%
Warmwell W95	40%
Warmwell W120	40%
Warmwell W140	30%
Wessex 100 M	50%

h) Number of On/Off Boilers Setting

Note: This setting is only available if the sequencing mode setting is 'hi/lo cascade' or 'lo/lo cascade'.

If a combination of on/off and high/low boilers are installed this setting is used to identify the number on/off boilers. It can be set between 0 and the total number of installed boilers.

Note: The on/off boilers must always be the last in the sequence.

No. ON/OFF BLRS
0 ✓

5.2.11 Circulation Pump Submenu

Note: If the master control setting is 'BMS' this submenu is not available.

a) Circulation Pump Maintenance Setting

This setting enables or disables the circulation pump maintenance function whereby the primary circulation pump is run briefly at midnight each week on Sunday, to prevent seizing during heating system non-operational periods.

PUMP MAINTENANCE
Enabled ✓

b) Circulation Pump Overrun Time Setting

This setting represents the duration of the circulation pump overrun time. It can be set between 0 and 90 minutes in 1 minute steps.

PUMP OVERRUN TIME
20 mins ✓

5.2.12 Frost Protection Submenu Settings

Note: If the master control setting is 'BMS' this submenu is not available.

FROST PROT MODE
2 stage ✓

a) Frost Protection Mode Setting

There are 3 available options for this setting. The first is 'Disabled' which disables the frost protection function. The second is '1 stage' whereby frost protection based on the reading of the water flow temperature sensor is enabled. The third is '2 stage' whereby frost protection based on both the water flow and outside air temperature sensors is enabled. Refer to **Section 3.8** (p10) for further details.

b) Minimum Water Temperature Setting

Note: If the frost protection mode setting is 'Disabled' this setting is not available.

MIN WATER TEMP
68°C ✓

This setting represents the minimum water temperature at which the boiler system is operated to prevent freezing of the system. It can be set between 0 and 30°C in 1°C steps.

c) Minimum Outside Air Temperature Setting

Note: If the frost protection mode setting is 'Disabled' or '1 stage' this setting is not available.

MIN OS AIR TEMP
+82°C ✓

This setting represents the minimum outside air temperature at which the circulation pump is operated to prevent freezing of remote parts of the heating system. It can be set between -10 and +10°C in 1°C steps.

5.2.13 Overrides Submenu

Note: If the master control setting is 'BMS' this submenu is not available.

SAFETY INTLOCK
Enabled ✓

a) Safety Interlock Circuit Setting

This setting enables or disables the operation of the safety interlock circuit function. If no system safety devices are connected to the circuit, then the setting must be set to 'disabled' to allow boiler operation.

5.2.13 Overrides Submenu (continued)	
b) Remote Time-Clock Override Setting Note: If the time-clock source setting is 'external' this setting is not available. This setting enables or disables the remote time-clock override function. Refer to section 2.2 of the sequence control user's operating instructions for further details.	REM CLOCK ORIDE Enabled ✓
c) Remote Holiday Override Setting This setting enables or disables the remote holiday override function. Refer to section 2.3 of the sequence control user's operating instructions for further details.	REM HOLIDAY ORIDE Enabled ✓
5.2.14 Security Code Submenu	
a) User's Security Code Setting This screen allows the current user's setting menu security code to be viewed and adjusted should it be forgotten or unavailable to the engineer.	USER MENU CODE 1000 ✓

5.2.15 User's Settings

Once the engineer's settings have been completed, enter the user's settings referring to section 3.0 of the Milton sequence control user's instruction manual (HHL pt. no. 500001105) for details.

5.3 Milton Operation Checks

5.3.1 On completion of programming the control, if the time-clock is calling for system operation the sequence control will switch on the primary circulation pump and instruct the boilers to operate.

5.3.2 Temperature Sensor Operation

The temperature sensor(s) fitted to the sequence control do not require calibration, however it is advisable to check their operation using a suitable digital thermometer.

A suspect sensor can be checked by

disconnecting the wires from the sensor (**isolate the electrical supply to the sequence control first**) and measuring the resistance across terminals 1 & 2 using a digital ohmmeter. The resistance will be 1000Ω at 0°C, and increases by 3.85Ω per °C above 0°C.

5.3.3 Boiler Communication

Check that the sequence control has detected all of the boilers by observing the boiler status screen (refer to section 1.0 of the user's instructions), and observing the communication indicators on the boiler fascias. If a boiler has not been detected, ensure that is powered and switched on, then reset the power to the sequence control.

5.3.4 Safety Interlock and Remote Overrides Operation

Check the operation of the safety interlock circuit by simulating a fault on

each of the safety devices. Ensure that the safety interlock screen on the sequence control registers the fault (refer to section 1.0 of the user's instructions), and that the boilers are shut down.

Check the operation of the remote time-clock and holiday override inputs by switching the respective remote devices and observing the relevant override screen on the sequence control (refer to section 1.0 of the user's instructions).

5.3.5 Completion

Finally, enter the engineer's program settings in the tables shown in Figure 5.3.5 on pages 38 & 39 for future reference.

6.0 FAULT FINDING

General fault finding is shown in Figure 6.0 on pages 33 - 36. If the Milton boiler sequence control system still cannot be operated satisfactorily after following the chart, consult your local office of Hamworthy Heating for assistance.

Note! Before carrying out any work ensure that the boiler is electrically isolated.

IF IN ANY DOUBT CONSULT A QUALIFIED ELECTRICIAN.

7.0 SERVICING

7.1 The Milton boiler sequence control system requires no regular servicing. However, an annual check of the systems operation can be useful to highlight any possible problems.

7.2 To allow servicing of on/off and high/low boilers, a hand/auto switch is included on the boiler's main control PCB, which should be set to the hand position to override control by the Milton boiler sequence control. To allow servicing of modulating boilers, use of rotary switch 'SW1' on the boiler's control PCB should be made to override control of the boiler by the Milton boiler sequence control. Refer to the boiler's installation manual for further details.

Note! The electrical supply to the boiler must be isolated prior to changing the setting of the rotary switch.

When overriding the sequence controls operation of the boilers ensure that the primary circulating pump is operational by setting it to its 'hand' control position.

Return the hand/auto switch / rotary switch to its original position on completion of boiler servicing operations.

Refer also to the boiler's installation and servicing manual for details.

Figure 6.0 - Fault Finding Part 1

Fault	Symptom	Cause	Remedy
The heating system does not operate	Milton sequence control display not operating	Mains power is not supplied to the Milton sequence control	Checks mains supply wiring, fuse and isolator
	Milton water temperature sensor reading shows '____',	Faulty Milton sequence control	Replace sequence control
	Milton room temperature sensor reading shows '____'. This will only prevent heating system operation if the 'daytime optimisation' function is utilised	Faulty wiring to water temperature sensor	Check and remedy wiring fault
	Safety interlock circuit status showing 'fault detected'	Faulty water temperature sensor	Check and replace water temperature sensor
	Remote time-clock override status showing 'none' and an external time-clock is being utilised	System safety device has operated	Check and remedy system safety device fault
		Faulty wiring to safety circuit	Check and remedy wiring fault
		No system safety devices connected	Set safety interlock circuit setting to 'Disabled' (refer to section 5.2.9)
		External time-clock control is switched off	Check operation of external time-clock device
		Faulty wiring to external time-clock device	Check and remedy wiring fault

Figure 6.0 - Fault Finding Part 2

Fault	Symptom	Cause	Remedy
The heating system does not operate (cont)	Remote modulation control is being used and system firing rate is 0%	No demand from external BMS control (0V signal from BMS)	Generate demand on external BMS control
		Faulty wiring between Milton and external BMS control	Check and remedy wiring fault
	Remote holiday override status shows 'active'	Remote holiday override control is activated	Switch off remote holiday override control
	Heating status shows 'standby' during time-clock on period	Holiday period has been programmed	Delete holiday period in user's settings (refer to section 3.2.4 of user's instructions)
	Heating status shows 'Sumr SD' during time-clock on period	The outside air temperature has exceeded the summer shutdown temperature set point	Disable summer shutdown function or increase the set point temperature
	Individual boiler(s) do not operate	Boiler number does not appear on boiler status screen, communication indicator on boiler fascia not operating	Sequence control has failed to detect boiler
Rotary switch 'SW1' on boiler main control PCB or Sequencing Interface Module PCB set incorrectly			Check and set rotary switch correctly (refer to section 5.1.3 and also to boiler installation manual)
Faulty boiler main control PCB or Sequencing Interface Module			Replace boiler main control PCB

Figure 6.0 - Fault Finding Part 3

Fault	Symptom	Cause	Remedy
Individual boiler(s) do not operate (cont)	Boiler number does appear on sequence control boiler status screen, communication indicator on boiler fascia operating	Other boiler fault	Refer to fault finding instructions in boiler installation manual
The boiler firing sequence is incorrect	Boilers firing in order different to that shown on sequence control boiler status screen	Rotary switch 'SW1' on boiler main control PCBs set incorrectly	Check and set rotary switch correctly (refer to section 5.1.3 and also to boiler installation manual)
The boilers' temperature limiters repeatedly operate	Overheat indicator on boiler fascias illuminated	The primary circuit circulation pump is not operating	Check the pump and pump control circuit
		Pump overrun time too short	Increase pump overrun time setting (refer to section 5.2.8)
		A clamp-on water temperature sensor fitted to a large diameter header pipe is causing a high lag in sensor response	A clamp-on water temperature sensor fitted to a large diameter header pipe is causing a high lag in sensor response
The heating system is unable to achieve the desired room temperature set point	Room temperature low	Incorrect positioning of the room temperature sensor is causing an elevated temperature reading, causing the daytime optimisation function to operate prematurely	Reposition the room sensor correctly as described in section 4.5.4
		Incorrect positioning of the outside air temperature sensor is causing an elevated temperature reading, causing a low compensated water temperature set point	Reposition the outside air temperature sensor correctly as described in section 4.5.3

Figure 6.0 - Fault Finding Part 4

Fault	Symptom	Cause	Remedy
The heating system is unable to achieve the desired room temperature set point	Room temperature low	Compensated water flow temperature too low due to incorrect compensation settings	Reduce compensation slope setting and/or increase compensation slope offset setting (refer to section 5.2.5)
		The maximum water flow temperature setting is too low limiting the maximum heat input into the building	Increase the maximum water temperature set point setting (refer to section 5.2.6)
The heating system exceeds the desired room temperature set point	Room temperature high	Incorrect positioning of the room temperature sensor is causing a depressed temperature reading, preventing the daytime optimisation function operating	Reposition the room temperature sensor correctly as described in section 4.5.4
		Compensated water flow temperature too high due to incorrect compensation settings	Increase compensation slope setting and/or decrease compensation slope offset setting (refer to section 5.2.5)
		The minimum water flow temperature setting is too high limiting the minimum heat input into the building	Decrease the minimum water temperature set point setting (refer to section 5.2.6)
			Enable the daytime optimisation function to switch off the heating when the room temperature set point is reached

THIS PAGE BLANK

Figure 5.3.5 - Installation Settings Part 1

ENGINEER'S SETTINGS		
1) Master Control Mode Submenu Settings		
a) Master Control Mode		Milton
		BMS
2) Clock Submenu Settings		
a) Clock Source		Internal
		External
2) Compensation Submenu Settings		
a) Compensation Mode		Fixed Temp
		Compensated
b) Compensation Slope		°C/°C
c) Compensation Slope Offset		°C
d) Summer Shutdown Temperature	on / off	°C
3) Optimiser Submenu Settings		
a) Optimum Start Mode		Enabled (adapt)
		Enabled (fixed)
		Disabled
b) Optimum Start 'Fr' Parameter		
c) Optimum Start 'Fa' Parameter		
d) Maximum Preheat Time		hours
e) Room Temperature Control Mode		Daytime Optim
		Disabled
f) Night Set-Back Mode		Enabled
		Disabled
4) Sequencer Submenu Settings		
a) Water Flow Temperature Set Point - Max		°C
b) Water Flow Temperature Set Point - Min		°C
c) P & I Control Gains - PG		
d) P & I Control Gains - IG		

Figure 5.3.5 - Installation Settings Part 2

ENGINEER'S SETTINGS		
4) Sequencer Submenu Settings (continued)		
e) Modulation Mode		On/Off Cascade
		High/Low Cascade
		Low/Low Cascade
		Modulating Cascade
		Modulating Unison
f) Firing Order		Fixed
		Lead Blr Shift
g) Number of Fixed Lead Boilers		
h) Switching Hysteresis		%
i) Low Fire Rate		%
j) Number of On/Off Boilers		
5) Circulation Pump Submenu Settings		
a) Circulation Pump Maintenance Mode		Enabled
		Disabled
b) Circulation Pump Overrun Time		minutes
6) Frost Protection Submenu Settings		
a) Frost Protection Mode		2 stage
		1 stage
		Disabled
b) Minimum Water Temperature		°C
c) Minimum Outside Air Temperature		°C
7) Overrides Submenu Settings		
a) Safety Interlock Circuit Operation		Enabled
		Disabled
b) Remote Time-Clock Override		Enabled
		Disabled
c) Remote Holiday Override		Enabled
		Disabled
8) Security Code Submenu Settings		
a) User's Security Code		

USEFUL USER INFORMATION

INSTALLER	SITE ADDRESS

DATE OF COMMISSIONING:

MILTON SERIAL NUMBER*		
MILTON SOFTWARE VERSION*		
TEMPERATURE SENSORS FITTED	INSERTION FLOW	
	CLAMP-ON FLOW	
	OUTSIDE AIR	
	ROOM	
BOILER MODEL CONTROLLED		
NUMBER OF BOILERS		

* PRINTED ON REAR OF MILTON UNIT

NOTES:

Notes

A large empty rectangular box with a black border, intended for taking notes. It has small black squares in the top-right and bottom-left corners.

Connect direct

Direct Dial Telephone and Fax Numbers



- boilers
- controllers
- water heaters
- pressurisation sets

Poole Office

Hamworthy Heating Limited
Fleets Corner, Poole, Dorset BH17 0HH England
Main switchboard tel: **01202 662500**

Technical enquiries  **01202 662527/28**  **01202 665111**
Spare parts  **01202 662525**  **01202 665111**
Service department  **01202 662555**  **01202 662522**



- flue components
- packaged fan dilution systems
- bespoke flue components
- bespoke flue systems
- design and installation

Birmingham Office

Hamworthy Heating Limited
Shady Lane, Great Barr, Birmingham B44 9ER
Main switchboard tel: **0121 360 7000** fax: **0121 325 2309**

General enquiries  **0121 360 7000**

Direct Email Addresses

Customer Services spares@hamworthy-heating.com
service@hamworthy-heating.com
technical@hamworthy-heating.com
sales.flues@hamworthy-heating.com

Hamworthy Heating Accredited Agents

North West England

Gillies Modular Services
210-218 New Chester Road, Birkenhead, Merseyside L41 9BG
tel: **0151 666 1030** fax: **0151 647 8101**

Southern Ireland

HEVAC Limited
Naas Road, Dublin 12, Ireland
tel: **00 3531 141 91919** fax: **00 3531 145 84806**

Northern Ireland

HVAC Supplies Limited
Unit 2, Antrim Line Business Park, Sentry Lane, Newtownabbey BT36 8XX
tel: **02890 849826** fax: **02890 847443**

Scotland

McDowall Modular Services
14-46 Lomond Street, Glasgow, Scotland G22 6JD
tel: **0151 666 1030** fax: **0151 647 8101**

North East England

Allison Heating Products
17 Beech Road, South Shields, Tyne & Wear NE33 2QH
tel: **0191 455 7898** fax: **0191 455 7899**

Website

www.hamworthy-heating.com

Associate Companies, Offices and Agents throughout the World.

Hamworthy reserves the right to make changes and improvements which may necessitate alteration to the specification without prior notice.