Wet

# HETAS

# Solid Fuel & Wood

# Engineers Training Manual

HETAS

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# Contents

Acknowledgements

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Thanks are extended to all contributors to this Manual, both the original version and the 2006 revisions.

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## *Chapter 1E*

# Approved Document L1A and L1B

ADL 1A and 1B came into effect on 6th April 2005 and deal specifically with Conservation of Heat and Power in domestic dwellings, new and existing. There are also companion Documents L2A and L2B covering buildings other than dwellings but these do not apply to the HETAS Registration Scheme which relates to domestic properties only

The overriding purpose of these regulations is to reduce levels of carbon dioxide emitted into the atmosphere in order to meet the UK commitment to the Kyoto agreement, the purpose of which is to limit the impact of climate change. By reducing energy consumption through greater insulation and the fitting of high efficiency/low carbon impact appliances, the Government hopes to meet these targets.

The requirements to meet these regulations have been incorporated at appropriate points in the earlier chapters of this manual. The 2006 amendments contained in the domestic section of ADL read as follows.

**ADL1A & ADL1B**

*Reasonable provision shall be made for the conservation of fuel and power in buildings by:*

a. *Limiting-*
   i. *heat losses through the fabric of the building*
   ii. *excessive solar gains*
   iii. *heat gains and losses from pipes, ducts and vessels used for space heating, space cooling and hot water storage*

b. *providing energy efficient and properly commissioned fixed building services with effective controls*
c. *providing the owner sufficient information about the building and its building services so that the building can be operated and maintained in such a manner as to use no more fuel and power than is reasonable in the circumstances.*

*Limits on application*

*With respect to the provision of services or fittings in* ***existing dwellings,*** *this Part applies only to:*

a. *the provision of a window, roof-light etc...*
b. *the provision of space heating or hot water service boiler,*

*but this limit does not apply to the provision of any service or fittings in an extension to an existing dwelling.*

In practice the demands of ADL1A place a heavy burden upon the Architect and Builder in meeting the CO2 emission targets for the property taking into consideration

air permeability, appliance efficiency, insulation, solar gain, controls and quality of construction.

To some extent installation of appliances and heating systems into existing properties is less exacting. As the construction of the building is beyond the control of the installer, every reasonable step must be taken to ensure the system is as efficient as practicably possible and thereby consume no more energy than is necessary for the comfort of the occupants.

Heating appliances and their associated systems are classified as 'Controlled Services'. ADL1B requires the following be complied with.

Where a heating or hot water system or part thereof is to be provided or replaced, reasonable provision would be

a) *The installation of an appliance with an efficiency*
   i) *not less than that recommended for its type in the Domestic Heating Compliance Guide*
   ii) *where the appliance is the primary heating service, an efficiency that it is not more than two percentage point lower than that of the controlled service being replaced. If the new service uses a different fuel, then the efficiency of the new service should be multiplied by the ratio of the CO2 emission factor of the fuel used in the service being replaced to that of the fuel used in the new service before making this check. The CO2 emission factors should be taken from Table 12 of SAP 2005. In the absence of specific information, efficiency values may be taken from Table 4a or 4b of SAP 2005. This will prevent an existing appliance being replaced by a significantly less carbon efficient one.*
b) *The provision of controls that meet the minimum control requirements as given in the Domestic Heating Compliance Guide for the particular appliance and heat distribution system.*
c) *The heating and hot water system should be commissioned so that at completion, the system and its controls are left in good working order and can operate efficiently for the purposes of the conservation of fuel and power. In order to demonstrate that appliances and systems have been adequately commissioned, the person carrying out the work shall... provide the local authority a notice confirming all fixed services have been properly commissioned. The procedure is set out in the Domestic Heating Compliance Guide.*
d) *A notice shall be given to the local authority , including a declaration signed by a suitably qualified person that the manufacturers commissioning procedures have been completed satisfactorily.*
e) *Membership of an appropriate Competent Persons Scheme should be a way of showing suitable qualification. This declaration will eventually form part of the Home Information Pack.*

Much of the detail of how to achieve the above requirements is contained in a second tier draft document known as the Domestic Heating Compliance Guide, referred to above. This document includes Table 16, Solid Fuel Appliance Categories and Minimum Efficiencies and Table 17, CO2 Emission Factors for Generic Types of Solid Fuel & Wood. This will provide data for the calculation shown in *a(ii)* above.

ADL1B gives the following example for clarity.

*When fuel switching, if an old oil boiler with an efficiency of 72% is to be replaced by a dual solid fuel boiler with an efficiency of 65%, the equivalent efficiency of the dual solid fuel boiler would be 65%*(0.265/0.187)=92.1%, and so test (ii) would be satisfied. 0.265 and 0.187 kgCO2/kWh are the emission factors for oil and dual solid fuel appliances respectively.*

This document is divided into 9 sections covering all the various types of heating types on the market today. Section 4 covers Solid Fuel & Wood heating systems for both primary and secondary heating and is reproduced in the supplement to this Manual.

As part of the provision of a heating or hot water service, reasonable provision would be demonstrated by insulating pipes and ducts and vessels to standards that are not less than those set out in the Domestic Heating Compliance Guide.

Also contained in this document is reference to Notification of Building Work procedures. It highlights the existence of the requirement to notify Local Authority Building Control Dept. of work to be undertaken involving Controlled Services or employ the services of an installer who is registered under a recognised Competent Persons Scheme.

HETAS Registration Category 1 (Full Systems) only covers the installation of work as outlined above. If electrical work or installation of a sealed system is required the relevant Building Regulation such as Part P and Part G should be consulted together with the requirements of an appropriate Competent Persons Scheme.

# *Chapter 2E* Specific Design Requirements

## Introduction

The Hetas Guide to Approved Solid Fuel Products and Services provides details of the thermal performance of the various appliances listed. The figures quoted are determined by testing in an approved laboratory using a standard test fuel and are independent of the manufacturer's claims. The test regime will vary depending on the appliance type i.e. open fire, roomheater, etc. but in all cases the relevant British or European Standard Testing Procedure is followed.

The HETAS test procedures described in the various standards are designed to reflect how the appliance is typically operated when installed in someone's home. The manufacturer's operating instructions also mirror the requirements laid down in the relevant British or European Standard.

As a result of the above the designing engineer can be confident that any particular approved appliance will, when operated according to the manufacturer's instructions, burning a suitable fuel and correctly installed, achieve the thermal performance listed in the Guide.

This chapter should be read in conjunction with two further publications:

- The Domestic Heating Compliance Guide, which is a second tier part of Building Regulations Document L1A and L1B, providing explicit guidance for installers to ensure compliance with the regulations. A copy of the relevant section of this document is provided.

- The Energy Efficiency Best Practice in Housing. Domestic Heating: Solid Fuel Systems Guide for Installers and Specifiers, produced by the Energy Savings Trust. Provides Minimum and Best Practice Standards for the selection of controls.

The installer should be satisfied the appliance selected has an efficiency equal to or exceeding those specified in Table 16 of Section 5 in the Domestic Heating Compliance Guide. The minimum efficiencies for solid fuel & wood appliances are published in the Official Guide to Approved Solid Fuel Products and Services and on the website www.HETAS.co.uk. HETAS also certify and publish actual appliance efficiencies following type testing in a notified laboratory to a harmonised European Standard to enable an installer/specifier to meet these regulations. Details of certified output and efficiencies also appear on the HETAS website.

## Design Considerations

### The standard of heating being provided - definitions of heating

ie. Full or Whole House, Background, Partial, etc.

### Balancing the types of heat outputs

Solid fuel appliances (except independent boilers and cookers) with high output boilers and thermostatic control give their heat output in two forms:

**Direct room heating via Radiation and Convection**

**Hot water for domestic use and radiators**

Some open fires and roomheaters are fitted with a boiler flue damper which varies the proportion of space heating output to water heating output. In these cases outputs are given under the alternative conditions of the boiler damper setting. Other appliances have optional boiler reduction bricks which result in different outputs to both the boiler and the room

When designing a central heating system the following have to be considered:

1. **The design temperature (*required by the customer) for the individual rooms to be heated. This is known as the space heating requirement and calculated in the normal way by calculating the heat losses through the structure and ventilation, to provide a boiler load and radiator size (these may not be the same when factors are considered).**

   ***Some individual customers may wish to have a level of heating over and above that specified in BS5449. In such cases it is important to record this requirement in writing to avoid later complaints.**

2. **The domestic hot water requirement. This will vary considerably from customer to customer depending on the number of occupants. Again it is recommended that any excessive demands from an individual customer are recorded in writing. The Minimum requirement, for a 117 litre hot water cylinder, is 1.2 kW as specified in the HETAS guide. If greater than the minimum is likely to be required use the recommendations specified in BS 5449.**

3. **The appliance type and an appropriate flow temperature i.e. open fire back-boiler - 60°C, roomheater/stove with boiler - 70°C and automatic boiler - 75°C. These will give different room to radiator temperature differentials to those specified in the radiator catalogues and so the following factors should be used.**

| Appliance Type | Flow Temperature | Room Temperature | Temp. Difference | Factor |
|---|---|---|---|---|
| Open Fire HOBB | 60° | 21° | 39° | 0.57 |
| | " | 18° | 42° | 0.63 |
| | " | 16° | 44° | 0.67 |
| Roomheater HOBB | 70° | 21° | 49° | 0.77 |
| | " | 18° | 52° | 0.83 |
| | " | 16° | 54° | 0.87 |
| Automatic Boiler | 75° | 21° | 54° | 0.87 |
| | " | 18° | 57° | 0.94 |
| | " | 16° | 59° | 0.98 |

Note: Other issues such as paint finish, under shelves or window sills and tapping location will all affect the output and heating load of the radiator circuit. Check with radiator the manufacturer for further details.

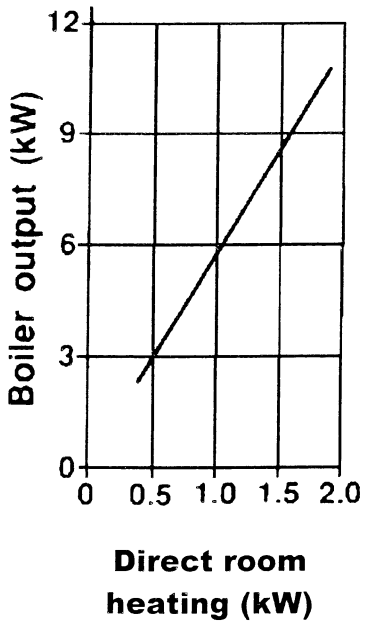
Having calculated the *"Total Connected Heat Load"* of the system i.e. the space heating requirements plus the domestic hot water requirement plus an allowance for "uncontrolled" losses from the pipework (in normal designs this is considered to be 10% of the space/hot water load unless this takes you up to the next boiler size), particular attention is required to the room in which the appliance is to be installed. If this is a room that is to be heated, then consideration should be given to the direct heat output from the appliance. If this is in a boiler house situation or other non-heated area, the need for cooling may need consideration should the boiler not be fully insulated.

The HETAS Guide to Solid Fuel Products and Services provides details of the thermal output for approved appliances as outlined in the Introduction above.

In the case of a roomheater with high output boiler and water temperature thermostat, careful consideration has to be given to the effect on direct room heating output when the total connected "heat load" is below the rated output of the appliance as specified in the Hetas Guide or manufacturers literature.

It can be assumed that the ratio between direct room heating and boiler output is proportional.

For example, a roomheater with a rated output of say 2kW direct room heating and 11kW boiler output would not produce 2kW to the room if the "total connected heat load" was only 8kW. The boiler thermostat would react when an output of 8kW was achieved thus reducing the direct room heating output by 25% to a figure of 1.5kW.




Many manufacturers provide details of the ratio of direct room heating output and boiler output at different total connect heat loads (see graph opposite).

As a result of the interaction between roomheating output and boiler output (due to the influence of the thermostat) the heat requirement of the room in which the appliance is installed has to be carefully considered.

For example a calculation to determine the Total Connected Heat Load carried out on a "typical domestic dwelling" (using the procedures described in BS5449) indicates that the room in which the appliance is to be installed requires an input of 2.0kW. The other rooms to be heated and the domestic hot water (including pipework losses) require an input of 8.0kW.

(Boiler load / boiler maximum) x Room Maximum = actual room output

i.e. (8 kW / 11kW) x 2kW = 1.5 kW

Reference to the HETAS Guide and manufacturer's literature suggests that there is a range of appliances from various manufacturers thermally suitable for this.

If a range cooker is used for central heating purposes and this has a water sensing thermostat, the same care has to be taken or the cooker may never reach working temperature.

***Note:*** *The customer will obviously play an important role in the final choice of appliance i.e. appearance, colour etc. However, it is important to ensure that any appliance chosen is thermally suitable for the dwelling.*

Having arrived at the final choice of appliance that meets both the customers and systems needs, a simple calculation to determine the maximum heat output (convection and radiation) from the appliance can be determined.

From the example given above, an appliance with a rated output of 2kW direct room heating and 11kW boiler output has been chosen. Should the roomheater incorporate a boiler damper the *minimum* space heating output should be used.

Using the calculated total connected heat load of 8kW the maximum room heating output from the appliance will be 1.5kW, leaving a deficit of 0.5kW. The shortfall of 0.5kW will need to be made up if normal comfort levels are to be achieved. A radiator of this output should therefore be installed and this should have a thermostatic radiator valve attached.

Document L requires the inclusion of space heating controls and one method given in the DHCG is to fit thermostatic radiator valves to all but the heat leak radiator. This is not the most appropriate method for solid fuel & wood but is the easiest way to update an existing system.

## Hot water cylinder

The domestic hot water cylinder used on a solid fuel & wood installation should always be of the fully insulated double feed indirect type, to BS 1566:2002 and should have a minimum capacity of 117 litres (unless otherwise stated in the appliance manufacturers installation instructions). Note the fitting of a new cylinder and the replacement of an existing one comes under section G of the Building Regulations and requires Building Control consent if the installer is not registered as a Competent Person for this type of work.

HETAS recommend a minimum allowance of 1.2kW load on the system for this size of cylinder when working on boiler load calculations.

### Gravity Circuit

Unlike other fuels many solid fuel & wood fired appliances are continuous burning. As a result (in the case of appliances with boilers) heat energy is transferred to the hot water system whenever the appliance is alight.

This fact means that in most cases it will be more economical to use gravity circulation to the cylinder or hot water storage than to use a fully pumped system and is allowed for in the Domestic Heating Compliance Guide. Where this method is used the gravity circulation should be used to derive as much useful heat as possible rather than dissipating to a location where it is of no advantage.

Gravity circulation works on the principle of hot water in the flow pipe having a lower density (lighter) than cold water in the return pipe. To be able to maintain this differential there has to be a heat source at the base of the circuit to reheat the cooler return water and some heat loss on the system to create the temperature difference. This process will provide a continuous circulation. See Fig SDR-1

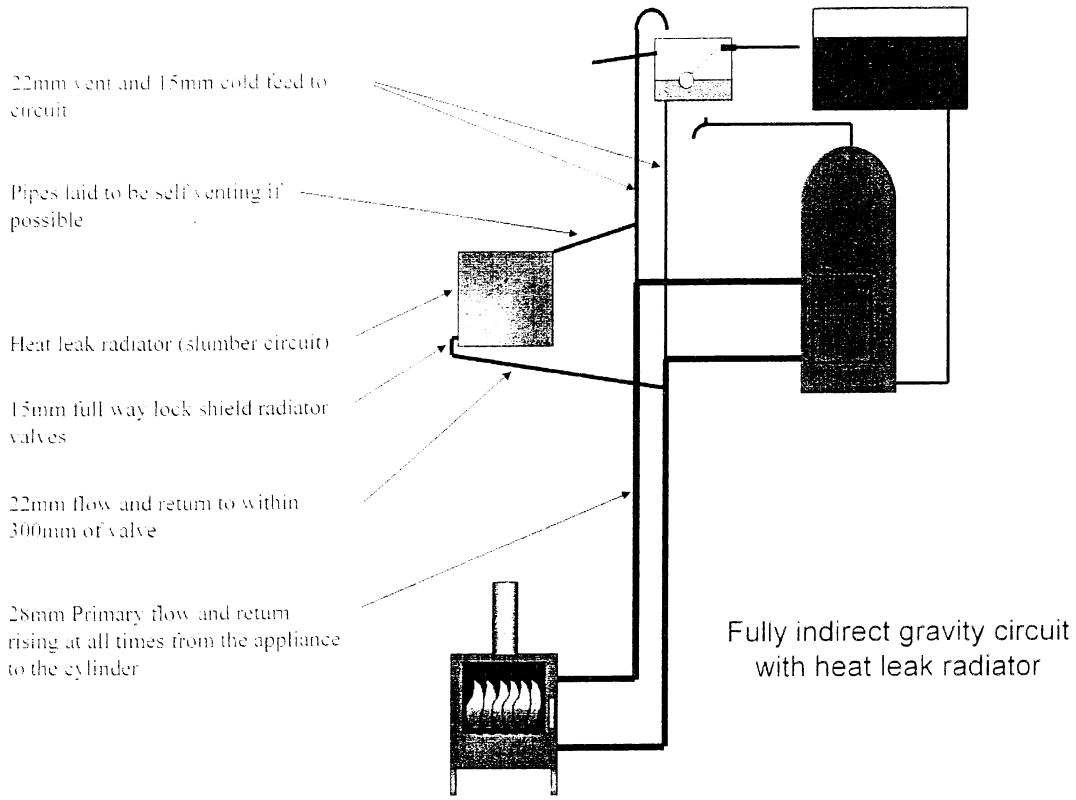



**Fig. SDR-1**

Gravity circulation uses only a small amount of motive force therefore can only overcome limited frictional resistance. As a consequence, pipe sizes need to be large (28mm or more) and the circuit as short and direct as possible.

In order to prevent the risk of localised boiling, it is necessary to position the hot water cylinder or a radiator to enable gravity circulation to take place when the circulating pump is off or the power supply interrupted.

Some control packages require the installation of a motorised valve/s within the gravity circuit. If this is the case the valve *must* return to the *fully open* position when the power is switched off or interrupted and positioned to ensure they do not interfere with the open feed and vent pipes.

Even though the system will be safe if an open vent is provided (see next paragraph) the provision of a gravity circuit will avoid the inconvenience of the system boiling and allow some use of the system in the event of a power failure.

## Separate open vent and cold feed

BS 5449 along with all recognised Codes of Good Practice specify that a separate cold feed and open vent pipe be fitted to systems heated by solid fuel & wood. (Unless the appliance is designed to be operated on a sealed system, in which case appliance manufacturer's installation instructions must be followed). The open vent should be a minimum of 22mm and discharge into a 'heat resistant' feed and expansion tank. The tank and its components must comply with BS 4213 and be able to withstand water at 110°C, including the ball valve and overflow. It is essential the tank is a high temperature type, fitted onto a board which supports the whole base and has a lid with a lip to provide added strength for the sides. It is good practice to provide a copper float, or at least one which will withstand 110°C.

*It is essential the overflow is 22mm copper and is adequately supported throughout its length. The outlet from the overflow must be positioned so that any boiling water from the tank is not discharged over a door, onto a path or in any area where scalding to persons may occur.*

Both the cold feed and open vent pipe must enter the system separately and *should not* incorporate any valves, either manual or automatic that may obstruct the feed or vent pipes.

A proprietary air separator correctly fitted can be used.

**Particular attention should be given to HSE Safety Alert on Scalding Risk from Domestic Hot Water Systems.**

## Heat Leak Radiator

The continuous combustion of solid fuel & wood and the heat this produces, even at a minimum level, demands some means of dissipating the heat from the boiler. Traditionally this has been achieved by supplying the domestic hot water cylinder via a gravity primary circuit.

However, due to the high efficiency of modern solid fuel & wood fired appliances and cylinder insulation, roomheaters and boilers with high outputs require the installation of a heat leak radiator. The appliance manufacturers will specify the size of radiator required.

The function of the heat leak radiator is two fold, thus:-

1. **To dissipate the heat output from the boiler during slumbering conditions once the domestic hot water cylinder has been satisfied. This will help prevent the overheating of the domestic hot water supply.**

2. **In order to maintain combustion the appliance requires an adequate supply of air. Once the hot water cylinder (during slumbering periods) has been satisfied the appliance thermostat will remain closed or combustion air fan off. Under these conditions there is a risk the fire will "go out" due to lack of combustion air. The heat leak radiator ensures the appliance thermostat is stimulated from time to time during any slumbering period to prevent this.**

The heat leak radiator is traditionally a part of the gravity primary circuit and sized according to the manufacturer's recommendations. The connections should be at least 22mm reducing to 15mm for no more than the last 300mm before the radiator valves.

The radiator should be installed in a bathroom acting as a towel rail as well as heating the room, or in another area where the heat is useful. Two full way lockshield valves set in the fully open position should be fitted and if possible the connecting pipe work should be laid to vent naturally. If this is not possible, the flow to the heat leak should be taken off the primary flow or vent where it travels vertically to avoid the radiator collecting air and risk air locking.

It is recommended that in any installation with or without a heat leak radiator, a high temperature limit thermostat be fitted to the primary flow pipe (set at 85°C). The "limit stat" should be connected to switch on the circulating pump and so reduce the risk of overheating.

## Pump assisted primaries

Traditionally designed solid fuel & wood heating and hot water systems normally incorporate a pumped heating and gravity hot water circuit. However it is sometimes difficult to ensure the correct balance between the two circuits. When the pump is operating, the gravity circuit can be starved. This cools the heat leak radiator and increases the recovery time of the domestic hot water.

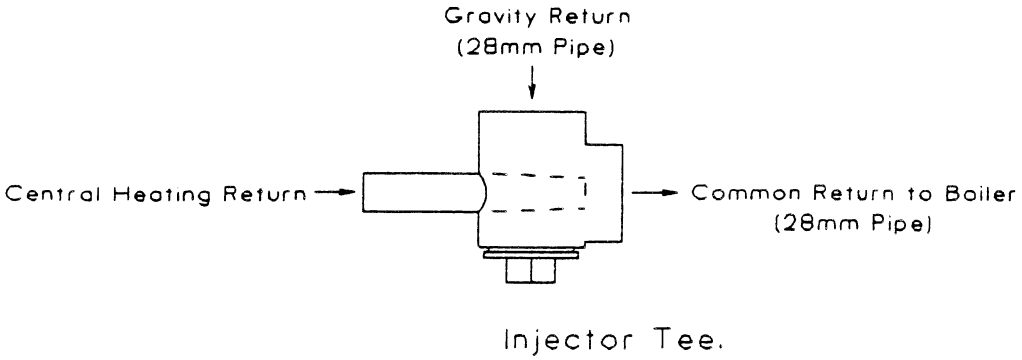



**Fig SDR – 2**

To reduce this effect it is common practice to "inject" the heating return into the gravity return in order to assist circulation through the gravity circuit when the heating is on. This assistance is created by a vortex exerting a drag on the primary gravity circuit, thus inducing a much increased flow to the hot water cylinder and/or the heat leak radiator (See Fig. SDR – 2 and SDR-3)

The use of a proprietary brand of injector tee is recommended as these are specifically designed and manufactured to ensure that the injection of the pumped water creates the maximum drag available. "Home-made" units should not be used. Two problems may occur if the location of the injector in the tee is not correct:-

1) If the injector protrudes too far into the tee it will reduce the area for flow and so interfere with the gravity circulation when the pump is off.

2) If the injector does not protrude into the tee far enough the pump will force water the wrong way around the gravity circuit causing a loss of stored domestic hot water. This is known as reverse circulation and must be prevented.

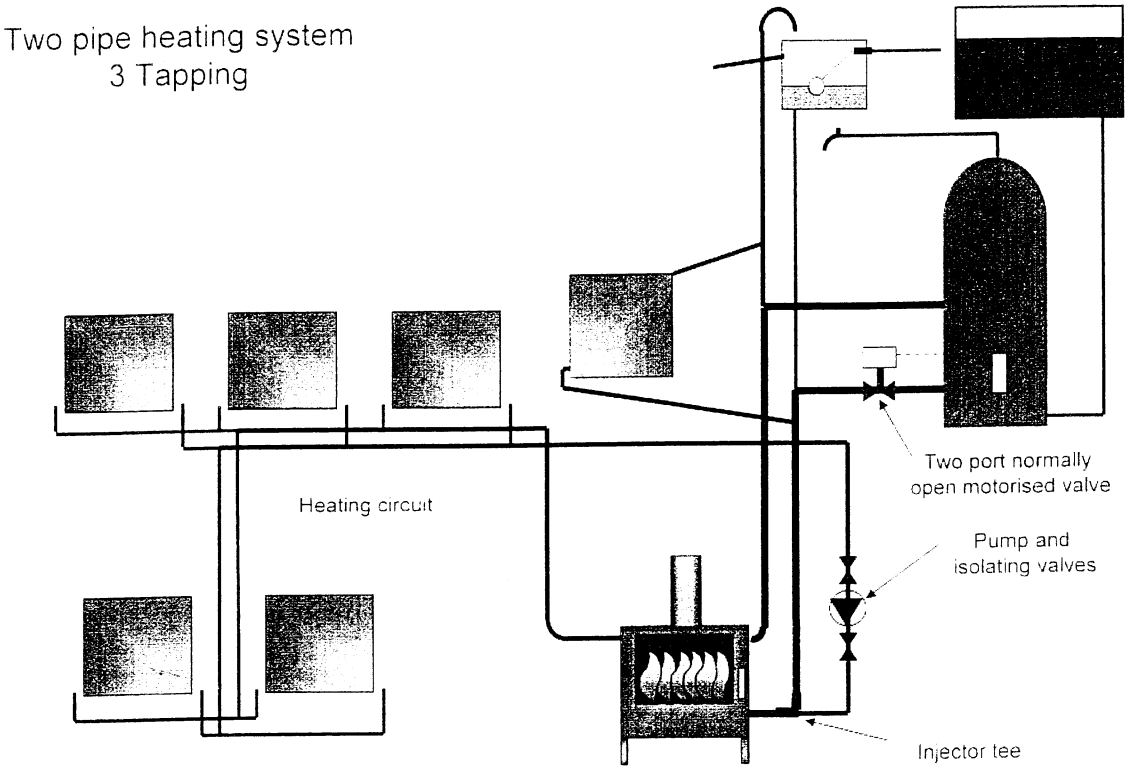



Fig. SDR – 3

## Heating system controls

Many consumers believe a solid fuel & wood heating system cannot be controlled. However, like any other energy source the heat provided by a solid fuel & wood boiler can be directed around the heating system according to the wishes of the user.

It should be noted that all new installations must include heating controls as appropriate in order to minimise energy consumption and carbon dioxide emissions in accordance with ADL and The Domestic Heating Compliance Guide.

The heat generated within the boiler is controlled by the appliance thermostat. This thermostat controls the oxygen available for combustion, and hence the burning rate of the fire and the heat generated. The higher the setting of the thermostat the higher the water temperature in the system will be before the air supply is cut or reduced, this means the surface temperature of the radiator circuit can be controlled. The lower the temperature set the more often the air supply will be cut therefore burning less fuel. To achieve full output when outside temperatures are freezing will require the thermostat to be set at maximum. Customers may well take some time (using trial and error) to establish the ideal thermostat setting that meets their needs in any given season or weather condition..

Hot water leaving the boiler at the desired temperature enters the heating/hot water system and can be controlled in a similar way to other fuel types.

Controls for solid fuel & wood heating systems fulfil three separate functions:

1) **In the event of misuse or mechanical failure the controls provide additional safety.**

2) **To control the comfort level within the dwelling.**

3) **To reduce energy consumption.**

The first safety function includes

a) High limit thermostats to bring the pump on if the system gets close to boiling during idle and a low limit thermostat which turns the pump off to avoid low temperature corrosion within the appliance (sometimes required by the appliance manufacturer).

b) Control of the temperature of stored hot water or the water leaving the store.

The second and third functions are closely related and are often considered together

With current Regulations, system controls must comply with Approved Document L. This document is divided into four sections, two for domestic dwellings and two for non-domestic. The domestic parts are split into new properties and existing ones and further details are contained in the Domestic Heating Compliance Guide. The section below should be read in conjunction with the DHCG as it gives information on various circumstances.

*The section in the DHCG dealing with Solid Fuel & Wood installations is provided in the Building Regulations supplement to this manual for reference.*

In nearly all cases the following should be considered –

a) The temperature of the water distributed around the system

b) Control of the temperature of the stored hot water and/or the temperature of the water leaving the hot taps

c) Time control for the operation of the heating system

d) The temperature of the space that is heated

e) Zoning of the heating system for larger properties.

Below we consider these items independently and look at appropriate methods of achieving the required control.

**The temperature of the water distributed around the system**

In most cases this will be provided by the appliance combustion control, especially if it is thermostatic. If the appliance does not have thermostatic combustion control then consideration should be given to thermal store type heating systems as they can have a mixing valve included to regulate the water temperature at point of consumption.

**Control of stored water temperature and/or temperature of water at point of use.**

**See fig SDR-4**

In some cases the temperature of the stored water in a cylinder supplied by a solid fuel & wood boiler can reach excessive, even dangerous, levels – particularly overnight. There is a risk of scalding, particularly with elderly, infirm and children. Therefore there are two issues to consider

a) to keep the temperature below that which is likely to scald at the point of consumption

b) to keep the temperature high enough to avoid the risk of legionnaires disease

It is considered the best compromise to hold the cylinder temperature at approx 65°C, to avoid both a) and b) above, although this may still be too hot for the most vulnerable. In such instances it is recommended to fit thermostatic mixing valves either on the cylinder or at point of use.

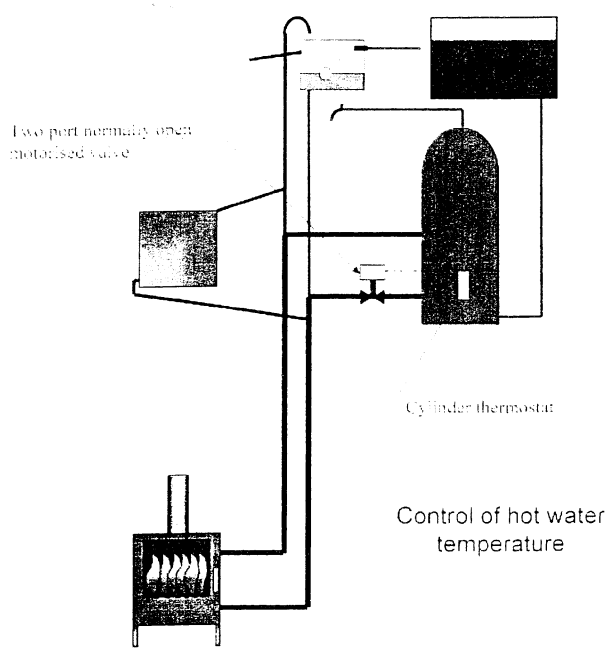



**Fig. SDR-4**

If thermostatic mixing valves are fitted, the water storage temperature can be higher, such as 80°C allowing for more surplus heat to be stored overnight and removing the need for larger heat leak radiators

A mixing valve at the draw-off point on the cylinder can be fed with cold water from the cold water storage tank at the same pressure as the cylinder. Alternatively, the mixing valves can be sited at the point of use ie bath or sink, allowing hotter water to be available for washing machines and the kitchen sink, where higher temperatures may be desired.

**Time control for heating system**

The simplest form of control is a time clock. This may be wired to the pump to control the on/off periods for central heating. Often the time clock may be linked to some form of temperature sensor to control levels of comfort. There are two main ways to control room heating temperature.

Thermostatic radiator valves

This is the easiest way to modify an existing system to provide zoning and different temperatures in each room. It is important to fit a thermostatic valve to any radiator that is in the same room as a heating appliance to prevent the room overheating.

It is also important not to fit thermostatic valves to any heat leak radiator as it must be able to operate whenever the appliance is alight. It is recommended that at least one other radiator on the system is not fitted with a TRV to allow heat dissipation should a high limit thermostat switch on the pump in an overheat situation.

Room Thermostat

This will be wired to control the central heating pump so that when the room reaches the set temperature the pump will switch off. The appliance thermostat will automatically reduce the burning rate and result in fuel saving and increased comfort.

One of the most effective controls for solid fuel & wood heating systems (particularly an independent boiler) is a programmable room thermostat such as the Honeywell CM67. This combines the control of a time clock with the temperature control of a room thermostat. As the appliance is continually burning and producing heat it is impractical to allow the property to cool down before the time clock calls for heat again. The programmable room thermostat does not turn the heating 'off' but alters the temperature allowing the pump to switch off the heating when the desired temperature has been reached. On very cold days this will bring on the heating, rather than allowing the property to cool down,

## Fully Pumped Systems

Many new gas and oil systems today are designed to operate on fully pumped principles incorporating a boiler interlock to prevent burners from firing when heating controls dictate that heating and hot water circuits should be off.

Where new solid fuel & wood systems are being installed and the customer requires a high level of control it is often believed a fully pumped system is desirable. However, this type of system is not as efficient as a traditional pumped and gravity system. When motorised valves have cut heat distribution to the hot water cylinder, there may still be surplus heat to dissipate through the heat leak radiator, therefore the pump will continue to run to cool the system, instead of allowing the cylinder to take the surplus heat and store it for later use.

Fully pumped systems work ideally with fully automatic appliances which have the facility to self extinguish and auto-ignite such as wood pellet stoves. Where it is difficult to get the required hot water recovery times with gravity circulation for example because of long pipe runs, fully pumped systems are to be recommended.

Despite the system being fully pumped it is still necessary to ensure gravity circulation can occur, especially in the event of a power failure. Circulation to the cylinder is required, allowing a flow of hot water to the sensors thereby activating the pump and controls when power is available and provide some heat loss during power failure. Under these circumstances some heat and hot water can also be obtained.

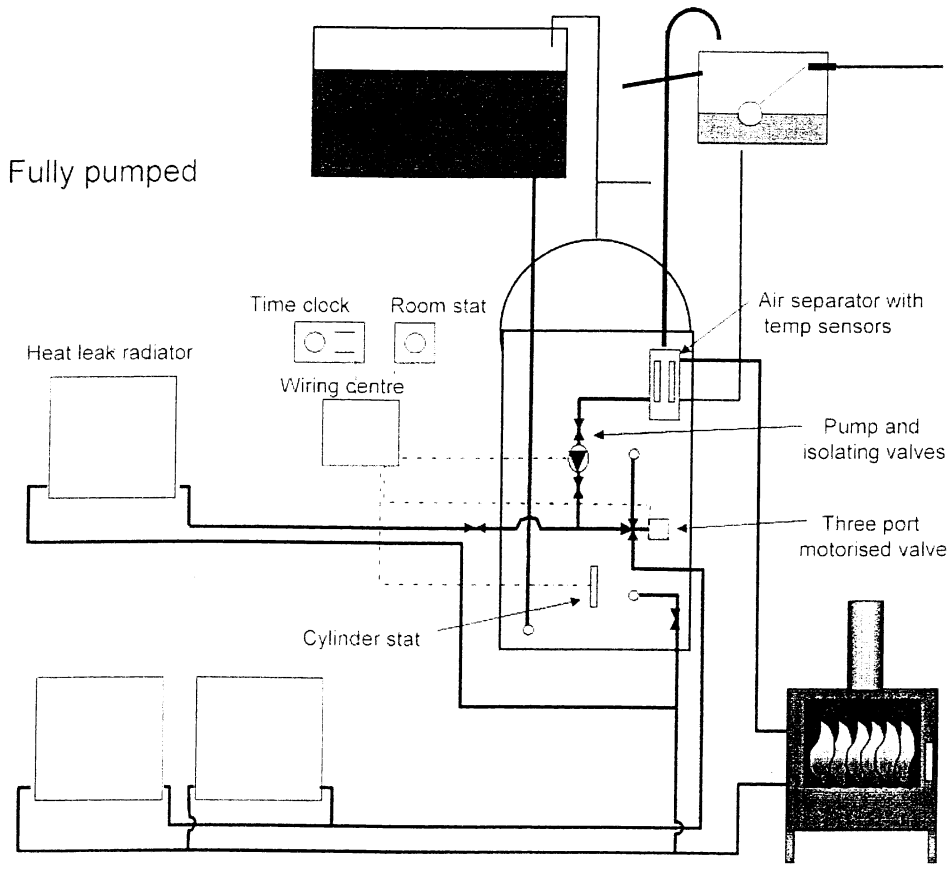



**Fig. SDR - 5**

**Authors Note:**

To design and install a fully pumped system requires a full understanding of solid fuel & wood heating systems. However, at least two companies provide fully constructed and pre-wired kits with full fitting instructions to make the installation more straight forward and efficient.

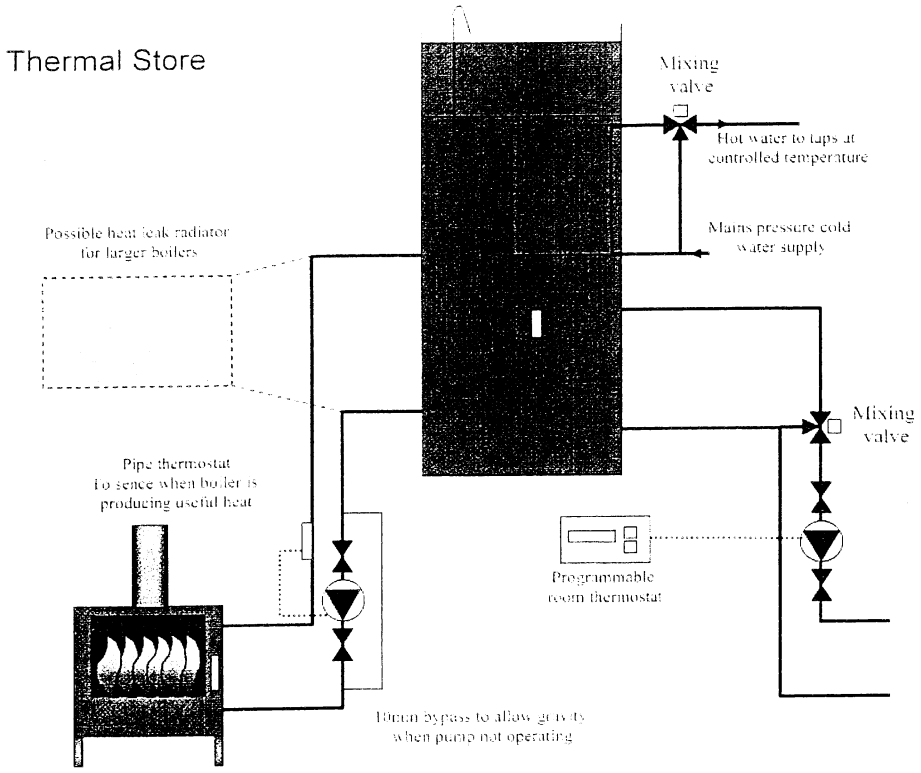
Fig. SDR - 5 shows a typical installation incorporating a manufacturers control "kit".

## Thermal Storage Systems

This is a development in the solid fuel & wood heating market which can offer a high degree of control, mains pressure hot water for showers, improved energy efficiency and allow more than one appliance to power a heating system without the need for additional equipment.

As solid fuel & wood systems are continuous burning, heat is generated during periods when it is not required. As shown in previous sections this heat is commonly stored in hot water cylinders and any surplus is dissipated through heat leak radiators.

In a thermal storage system all the heat from the boiler is captured and stored to provide heating and hot water as required at a later time. This is particularly beneficial where appliances, such as wood burners are fitted, designed to operate at high burning rates with maximum efficiency for short periods of time. This will also reduce the incidence of condensation in the flue.




**SDR - 6**

The above diagram shows a typical layout for a thermal store system. There are at least two companies producing systems suitable for use with solid fuel & wood appliances.

The advantages of thermal storage are as follows:

- Heat can be stored for later use at a higher temperature and greater capacity than a standard hot water cylinder.
- Mains pressure hot water can be provided for showers and taps, reduced to a safer temperature by thermostatic mixing valves.
- Instantaneous heat available for radiator circuits whilst the appliance is at reduced output during refuelling etc.
- Electric immersion heaters can provide hot water during summer periods by only warming the top section of the store. Alternatively, solar heated hot water can be incorporated to supply the store.
- In an emergency, electric immersion heating can provide a level of electric central heating by heating the whole store.
- Frost protection can be provided by the electric immersion heater.
- Link-up of two solid fuel & wood boilers or solid fuel and a gas or oil fired boiler can be easily achieved.
- Different temperature zones can be created with mixing valves controlling parts of the circuit. Eg. 40°C for under-floor heating and 60°C for radiators.
- System design requiring pressurisation of the circuit are possible.

In nearly all cases the thermal store system should be open vented and should be sized to suit the appliance minimum output figure and the heating system load. If it is not possible to accommodate a store of sufficient size to collect all the heat from a large boiler, a heat leak radiator can be added although this may be smaller than traditionally needed.

More specific qualifications are required for engineers working with mains pressure systems.

## Pressurised systems.

In accordance with BS 5449, HETAS do not recommend the fitting of conventional solid fuel & wood appliances to a sealed system. In the event of an overheat situation the controls on the system cannot prevent the continued production of heat. Although there are pressure relief valves fitted to such systems, the incidence of them being brought into play may be far too regular to make them suitable for domestic use.

It should be noted however that the manufacturers of some automated wood pellet or chip boilers state their equipment can safely operate with sealed / pressurised systems. Whilst such installations would not comply with BS 5449, any installations of this type must comply with manufacturer's installation instructions and the requirements of Part G of the Building Regulations.

## Mechanical Extract Ventilation

The Building Regulation Part J Heat Producing Appliances 2002 (England and Wales*) specify that a suitable system for extract ventilation must be installed in any living space** where excessive condensation or odour can be produced. Additionally within the same document there is a clause that specifies the use of mechanical extract ventilation in the same room*** as any open flued appliance is not permitted. The reason for this contradiction which often gives rise to problems is outlined below.

Any domestic solid fuel & wood fired appliance will only work efficiently when connected to a chimney system capable of generating adequate up-draught to induce sufficient air supply for complete combustion and to overcome any frictional resistance association with the system. The natural up-draught on a chimney will depend on a number of factors.

The use of mechanical extract ventilation in any room will create air depression. If this depression is greater than the up-draught generated by any open flued appliance installed in the same room, the products of combustion will be drawn into the room.

Long term experience backed up by work carried out by the Building Research Establishment confirms the above risks.

Additionally, research has indicated that the "natural ventilation" created by a continuous burning open flued appliance will greatly reduce the risk of condensation occurring within the room in which the appliance is installed. **Therefore the use of mechanical ventilation in the same room as any solid fuel & wood fired appliance must be avoided.**

If a client requires a cooker hood in a kitchen containing a solid fuel & wood appliance this can be done provided it is a re-circulating type, this can contain a charcoal filter to remove grease and smells.

*Building Regulations for Scotland & Northern Ireland are written in a different form but the Regulation still applies.

**Usually a kitchen, bathroom or WC etc.

***This covers all solid fuel appliances

## Link-Up

Any solid fuel & wood appliance with a boiler can be linked to an existing or new central heating system fired by another fuel or a second solid fuel & wood appliance. This means that the central heating can be heated by one or both boilers in tandem, depending on the heat required.

Link-up can be achieved in a number of ways depending on appliance type and usage. Whichever method is used it is essential the solid fuel & wood appliance has an unrestricted open vent and separate cold feed. Also any motorised valves fitted to the circuit must be of the powered closed type to allow circulation of surplus hot water in the event of a power failure.

There are three ways to link two appliances:

Simple Link-up

Electronically Controlled Link-up

Use of Neutral point technology such as Neutralizer or open vented thermal store

Simple Link-up may be regarded as the most straight forward in principle. It can involve connecting the hot water circuits through the hot water cylinder, either by direct connections from a glass lined boiler or a twin coil indirect cylinder. Whilst simple in design it provides limited potential due to the size of solid fuel & wood boiler which can be employed. Additionally, you can directly connect heating circuits from two appliances but this will result in loss of heat through the unlit appliance, loss of stored hot water when the heating is on and a lack of control.

Electronically Controlled Link-up allows greater flexibility with the opportunity to connect central heating boilers employing programmers, thermostatic controls and motorised valves to regulate the distribution of heat around the system.

Neutralizers are a simplified method to connect two appliances at a neutral point in order that there is no hydraulic interaction between them. This means that the pumped circuit from a second appliance will not induce flow through the solid fuel & wood boiler. An open vented thermal store will often be able to act as the neutral point in a link system without the need for any additional devices.

More information can be obtained from:

SFA leaflet 'The Guide to Link-Up'

Heating Innovations Ltd. 01354 653854

Dunsley Heat Ltd. 01484 682635

*It should be noted that Combi and Condensing boilers normally operate with pressurised systems and without the use of cold feed and expansion tanks with hot water storage cylinders. It is therefore not possible to link an open vented boiler to a pressurised appliance without some form of interface where the solid fuel system can remain open vented. It is worth noting however there are Condensing 'system' boilers available which can be connected to conventional open vented systems. More information should be sought from the boiler manufacturer.*

# *Chapter 3E* Commissioning

## Introduction

The previous chapters of this manual have dealt with the correct installation of the various appliance types featured along with the importance of using the correct fuel as recommended by the appliance manufacturer.

This chapter deals with the important issue of how to commission the appliance on completion of the works. Typical lighting methods are described, however in all cases the manufacturer's specific instructions should be followed.

In cases where a new heating/hot water system has been installed along with a new appliance details on how to balance the system is provided. This is an extremely important operation and needs to be carried out correctly if the consumer is to achieve a high level of comfort and maximum economy. On completion of the work, the system should be thoroughly flushed out and fully treated as required in Building Regulations before starting the circulating pump, then filled and checked for leaks prior to lighting.

It is essential to record details of the installation in order to comply with the new requirement J4 of the Building Regulations Part J for the provision of information by way of a durable notice. Appendix A on pages 58 and 59 of ADJ gives a checklist which could be used for recording the details of the installation for this purpose.

***Special Note**: - As a final step, before leaving the site, attach the 'Notice Plate' containing all the appropriate details of the installation. A recommended place is next to the electricity consumer unit, next to the chimney or hearth described, or next to the water supply stop-cock (see clause 1.57 on page 23 of ADJ)*

## Lighting the appliance

The Clean Air Act prevents the use of unauthorised fuels in smoke control areas. The commissioning engineer should contact the Local Authority Environment Health Department to determine if the installation address is covered by a Smoke Control Order. If such an order is in place only an authorised manufactured or naturally occurring smokeless fuel should be used unless the appliance has an exemption certificate which will state the types of fuel for which the exemption applies. See the HETAS Official Guide to Approved Solid Fuel Products and Services for details. The Official Guide also lists Firelighters which have been tested and found suitable for the purpose.

### The simple open fire (dryback)

The combustion rate on the majority of simple fires is controlled by adjusting the amount of air entering the ashpan area. Some achieve this by using a spin wheel, others a sliding plate or an adjustable cam. Maximum burning rate (and therefore thermal output) is achieved when the various controls referred to above are fully open and minimum rate when fully closed.

### Lighting

Place some paper and dry kindling wood or two to three firelighters on the grate and cover with a small amount of fuel. Open the air control to maximum and light the paper or firelighters. Allow

the fire to burn until the fuel is well ignited. Additional fuel can now be added to a level recommended by the manufacturer's operating instructions.

***Note:*** *If the installation incorporates an adjustable throat restrictor this should be in the fully open position during the ignition period. Once the fire has become well established a smoke draw test should be carried out as described in the Service and Maintenance section of this Manual. This test should be carried out with all the doors and windows closed in the room in which the appliance is installed.*

## Open fires with boilers

The majority of open fires with boilers incorporate a damper. The damper is designed to control the direction of the flue gases around the boiler flueways. For maximum direct roomheating the boiler damper should be fully closed i.e. pushed to the rear. For maximum boiler output the damper should be pulled fully forward. In addition, the burning rate can also be controlled using a spin-wheel, sliding plate or adjustable cam as on the simple open fire.

## Lighting

The appliance should be lit in the same manner as described for the simple open fire ensuring that the boiler damper is in the fully closed position. Once the fire has become fully established the boiler damper should be fully opened and a smoke draw test should be carried out with all the doors and windows closed in the room in which the appliance is installed. If this is successful, the test should be repeated with the damper in the fully closed position.

## Roomheaters / Stoves

For solid mineral fuels the burning rate of the fuel is controlled by the amount of air entering the ashpit region. On some models the ashpit cover is opened and closed by an adjustable cam, others have a sliding plate or spin wheel providing manual control over the rate of combustion. Some models incorporate a body sensitive thermostat which responds to the convection air temperature. The majority of high output roomheaters incorporating a boiler are controlled by a water sensitive thermostat. On all appliances incorporating a thermostat this should be adjusted to the manufacturer's instructions prior to lighting.

Some roomheaters with boilers incorporate a damper which controls the ratio of the water heating to space heating. With the damper in the closed position the roomheating output will be at a maximum and when fully opened maximum boiler output is achieved.

For wood burning appliances any air entering the firebox will increase the combustion rate, this can be from the primary air control, secondary or air wash control plus the tertiary air inlet. Some of these are fixed and cannot be adjusted as they are provided to avoid condensation and subsequent tarring of the flue.

## Lighting

On appliances incorporating a flue damper this should be in the closed (high room output) position during the ignition period. The air control in the ashpit area should be fully open or any thermostat set to a maximum. Paper and kindling wood or two to three firelighters should be placed on the grate and covered with a thin layer of fuel. The paper or firelighters should be lit and the firedoor closed. When the fire is well alight add more fuel up to the front fire bars, sloping it up towards the

back of the firebox. Set the combustion control system (and boiler damper where fitted) to the desired setting. Finally, the flue draught should be checked after about 30 – 40 minutes by inserting the metal probe of a draught gauge into the aperture recommended by the appliance manufacturer and ensure the draught is within the range required. This check test should be carried out with all the doors and windows closed in the room in which the appliance is installed. Open a window or closable vent, if the draught gauge shows an increase this indicates more permanent ventilation is required for the fire to operate at optimum efficiency.

***Note** : On initial lighting the appliance may give off an odour, normally caused by lubricants on the metal burning off, which will cease after a short time. During this period the room should be well ventilated.*

## Independent Boilers (Gravity Feed)

Gravity feed boilers are designed to burn small anthracite i.e. grains or beans. They all incorporate a forced draught fan controlled by a water sensitive thermostat which switches on or off the combustion air and a flue draught stabiliser which controls the draught to reduce the risk of over-burning or inefficiency during idling periods. With the fan off the burning rate will be at a minimum. The natural draught of the chimney system induces the ingress of combustion air through the fan blast control flap at its idle setting. The idle and blast settings should be checked to ensure they are as stated in the appliance manufacturer's instructions. A suitable electrical supply must be provided to the appliance in accordance with Building Regulations Part P and the connection to the boiler must utilize heat resisting cable.

Within the boiler hopper is a fuel regulator plate which controls the depth of the firebed. The plate is adjustable to accommodate the size of the fuel being used which should be checked to ensure the plate is secure and in the correct location for the choice of fuel to be burned.

## Lighting

These boilers are designed to be continuous burning appliances and should only require lighting once or twice a year.

The fuel regulator plate should be positioned to suit the size of the fuel being used and fuel placed in the hopper sufficient to at least cover the fuel regulator plate. The electrical supply should be switched on and the boiler thermostat set to minimum.

The chimney should be warmed by burning two or three firelighters in the boiler flue outlet.

The ashpit door should be opened and three to four firelighters positioned in the middle and well up into the fuel bed. The firelighters should be lit and left to burn for a few minutes after which the ashpit door should be closed and the thermostat turned up to start the fan. The fire should be well established after 15 minutes but check to make sure the flames have not been extinguished, then set the thermostat to the desired setting. Once the appliance has achieved the water temperature determined by the thermostat setting the combustion air fan will switch off.

After a short period of time the flue draught should be measured at the boiler outlet and, unless factory set, the draught stabiliser adjusted according to the manufacturer's instructions.

A flue draught of 1 – 1.5mm wg (0.03 – 0.05 in wg) is required over the firebed when the boiler is running at its reduced rated output. To measure the draught, without the built-in draught stabilizer

affecting the reading, it is necessary to insert a metal tube through the tapping on the top of the boiler and down one of the flue-ways by about 25mm.

Once this has been checked and found to be within manufacturer's tolerances, the hopper can be fully filled with fuel.

***Note :*** *On initial lighting the appliance may give off an odour, normally caused by burning of the lubricants on the metal surfaces burning off. This will cease after a short time and during this period the room should be well ventilated.*

### Cookers

The design and operation of solid fuel & wood fired cookers vary from model to model. Some appliances are refuelled from the top and others through a fire door at the front. Some models incorporate flue dampers which direct the hot flue gases around the oven(s). The combustion rate on the majority of models is achieved by controlling the amount of air entering the ashpit area in conjunction with an adjustable flue damper to control the chimney draught. As a result of the above it is important to follow the individual manufacturer's instructions for commissioning the appliance.

### Lighting

Generally speaking when lighting a solid fuel & wood fired cooker the flue damper should be in the fully open position. If the appliance incorporates a damper which diverts the flue gases around the oven this also should be in the fully open position. The air control in the ashpit area should be fully open. Paper and kindling wood or two to three firelighters should be placed on the grate and covered by a thin layer of fuel. The paper or firelighters should be lit and the ashpit door closed. Once the fire has been established the fuel compartment can be fully charged.

*Note : On initial lighting the appliance may give off an odour, normally caused by burning of the lubricants on the metal surfaces. This will cease after a short time and during this period the room should be well ventilated.*

**Finally, in all cases the commissioning engineer should check that any controls associated with the appliance or heating system are working correctly. The consumer should be advised on the correct operation of the appliance and any control system. The manufacturer's operating instructions should be handed over to the consumer.**

## Balancing the System

### Introduction

As mentioned at the start of this chapter the need to ensure that the heating system is correctly "balanced" is very important. Generally speaking the thermal output of most radiators is based on a water flow temperature of around 80°C and a room temperature of 20°C. Good design practice recommends a 10°C difference between the flow and return pipe from the boiler making an average temperature in the centre of the radiator of 75°C. As discussed in the Specific Design Requirements Section this is often not achievable with a solid fuel appliance and therefore radiator factors are used when selecting the size of radiator needed to achieve this required amount of energy to heat the room.

The flow temperatures recommended for the various types of solid fuel appliance are given below:

Open Fire Back-boiler - 65°C,

Roomheater / Stove / Cooker (with boiler) - 70°C,

Automatic Boiler - 75°C.

To achieve this requirement and ensure that all radiators are receiving the correct amount of energy to heat the room, the amount of hot water circulating through the system needs to be controlled. The circulating pump must be able to overcome the frictional resistance of the heating system and must avoid pushing water through the boiler too quickly such that it cannot collect the amount of heat needed to power the system. However, individual radiators or loops need different water flow rates to ensure the correct heat outputs. The process of balancing is to achieve the following objectives.

## The Need for Balancing

### The basic aims in balancing a system are:-

a) **To achieve the temperature drop across the boiler for which the system was designed. This is very commonly 10°C for a pumped system, and means that the temperature of the return pipe near the boiler should be 10°C lower than that of the flow pipe, when the boiler is operating at its design temperature given above.**

b) **To ensure the temperature in the centre of each radiator is the same, it is sufficiently accurate to make adjustments, to within approximately +/- one degree Celsius.**

### Things to understand in achieving these aims

a) **The lock-shield valves on each radiator are used to adjust the flow of water through the radiator, the more nearly closed such a valve is the less water will flow through it, therefore the water will flow more slowly and cool down within the radiator. Thus to reduce the temperature at the centre of the radiator, the valve is closed down and to increase the temperature at the outlet the valve is opened up. With modern valves they rarely open fully and once a valve has been opened two turns there is no appreciable increase in flow thereafter.**

b) **If the pump speed is set too high the flow of water through the boiler will be excessive and will travel too quickly through the boiler to pick up the available heat. This will lower the efficiency of the system. In this case it is possible to reduce the speed setting of the pump. It is worthless trying to balance a system until the performance of the pump has been checked.**

### How to set about balancing the system

Having understood what has to be aimed at, a procedure can be laid down. The equipment needed is simply a lockshield valve key, an air vent key and an electronic or infra red thermometer.

## Method

Light the appliance and carry out the appropriate tests as described earlier in this section. Ensure the water in the domestic hot water cylinder is cold.

Leave central heating controls set to off and allow gravity circulation to become established; this should occur before the flow temperature reaches 45°C and will become apparent once the temperature of the return water has risen at least 5°C above room temperature.

Turn on the central heating and any controls to ensure there is demand for heat throughout the pumped circuit.

The flow temperature from the boiler will fall as a result of the cool return water entering the boiler.

Set the appliance thermostat at its mid setting and whilst the boiler is building up temperature close all the lock-shield valves in the system and then open each one ½ a turn.

When the appliance air control closes / switches off measure the temperature difference between the heating flow and return pipes at the boiler to ensure at least a10°C increase has been achieved. It is likely the pump will need to be set at minimum speed to achieve this. If the lowest pump speed still results in a temperature difference of below 10°C it may be necessary to reduce the flow through the boiler by partially closing the isolation valve on the outlet from the pump.

Once the correct flow through the boiler has been achieved, measure the temperature at the centre of each radiator. Note the temperature of the hottest radiator as this will be the target temperature for all the others.

Open the lock-shield valves of the cooler radiators by a further ¼ turn and recheck the temperature after 10 minutes. This process is repeated until each radiator reaches the target temperature.

If any radiator requires the lock-shield valve to be opened more than 1½ turns it is likely the pipe sizing of the system is incorrect and will require further investigation. Increasing the pump speed may be considered a possible solution but this will reduce the temperature difference between the flow and return pipes and lead to a fall in appliance efficiency.

If the hottest radiator surface temperature falls below the target figure it may be necessary to de-ash and refuel the fire, waiting at least 15 minutes before continuing the operation. If this does not achieve the required temperature it is likely the boiler output is insufficient for the system installed.