Course Structure

Appliance Specific Gas Safety Modules

- **Module 17 Domestic Central Heating and Water Heaters (CENWAT)**
- **Module 18 Domestic Cookers (CKR1)**
- **Module 19 Domestic Space Heaters, Gas Fires and Wall Heaters (HTR1)**
- **Module 20 Domestic Warm Air (DAH1)**

Introduction

All operatives are required to prove their competence in Gas Safety, Installation, Service and Maintenance.

Since 1st August 1998 that proof of competence has been carried out through the Nationally Accredited Certification Scheme (ACS) for Individual Gas Fitting Operatives. Each operative is required to have successfully completed the assessment requirements laid down by an accredited UKAS certification body and then be re-assessed at periods of no more than five years.

The BPEC Services Ltd – CCN1 Initial/Re-assessment Domestic Gas course is intended to provide the training required to support proving competence in this area of work.

Training Objectives

The aim of this open learning/tutor taught training package is to furnish you with the information to enable the **Nationally Accredited Certification Scheme (ACS)** assessments for appropriate appliances to be completed.

Method of Study

You can undertake the study by either self learning:

In which case you are required to study through the manuals at your own time and pace undertaking the questions highlighted in the knowledge question manual when prompted at the end of each module. You will then attend an approved assessment centre to undertake assessment.

NOTE: To undertake assessment you must:

a) Feel that you can completely meet all the knowledge objective requirements, and

b) Feel that you can competently carry out practical tasks covering the full range of modules discussed.

Or alternatively you can attend a training course at a BPEC training centre. You will progress through the course manuals in a structured learning environment. In addition, you will also work through a course practical task manual which links directly to the practical performance requirements identified previously.

If in doubt about completing the practical or knowledge requirements, it is always advisable to go for the BPEC training course option.

Contents

Introduction

The objective of this module is to enable you to successfully complete assessment across the following range of gas fired central heating boilers and instantaneous water heaters:

- Open flued.
- Room sealed (natural and fanned draught).
- Condensing.
- Back boiler units.
- Combination boilers.
- Combination units.
- Flueless – single point (under 12kW heat input).
- Large multipoint heaters – open flued, room sealed natural draught and fan assisted.

You will be required to prove that you can install, disconnect, service, repair, breakdown and commission domestic gas fired central heating/hot water boilers and circulators up to 70kW and domestic gas fired instantaneous water heaters.

Practically, you should be able to ensure the following:

- The appliance assembly is complete and is fit for purpose.
- The gas supply is isolated prior to work commencing.
- The appliance is correctly sealed to the balanced flue set.
- The appliance is correctly sealed to the open flue set.
- The gas supply is re-established.
- The work carried out is gas tight.
- The appliance is correctly located, level and stable.
- The appliance operational gas safety components are dismantled and cleaned, using appropriate cleaning methods and agents (e.g. burners, primary air ports, combustion chambers, ignition devices, thermostat, limit stats, pressure switches and flame supervision).
- The appliance is commissioned as follows:
  - The appliance is purged of air.
  - The working pressure at the appliance is correct.
  - The burner flame pictures, stability and ignition are correct.
  - The user controls are operating correctly.
  - The safety control devices are operating correctly.
  - The temperature controls are operating correctly.
- The flue connections are sound and flues are operating correctly.
- Defects on gas safety components are identified.
- The safe operation and use of the appliance is explained.

Additionally, you should know the following:

- Identification of unsafe conditions.
- Diagnosis of gas safety faults.
- The effects of unsatisfactory appliance case seals.
- Recognition of suitable and unsuitable appliance room/space locations.
- Clearance requirements (proximity of combustible materials) and fire proofing of compartments.
- The operation of mechanical and electrical controls.

Section 1 – Types of Appliances and their Operating Principles

Introduction

In sections 1 to 3 you shall be taking a look at the various types of appliances and the key operating principles of:

- Wet central heating/hot water boilers.
- Circulators.

Part 1 – Wet Central Heating/Hot Water Boilers

For the purposes of this module wet central heating/hot water boilers shall be defined as gas appliances designed to provide heat to wet space heating systems or combined wet space heating and hot water systems.

What types of appliance are available?

Boilers generally fall into one of three categories, related to possible positions where they may be sited:

- Floor standing.
- Wall mounted.
- Back boilers (behind a fire) GFBB (gas fired back boilers).

These categories can be manufactured as open flued room sealed or fanned draught models with the exception of back boilers, which are only available as open flued appliances.

Boilers can, however, be categorised further:

- Open flued or fanned draught.
- Room sealed – natural draught or fanned draught.
- System boilers.
- Combination boilers.
- Combination units.
- Condensing boilers.

By understanding the operating principles of these six appliance types, you should be able to describe how the mechanical and electrical controls operate within the majority of appliances which you may have to install or maintain.

Natural draught room sealed

Figure 1 is an exploded diagram of a typical room sealed natural draught gas boiler. The casing and control panel (including the boiler thermostat) have been omitted from the diagram for the purposes of clarity.

Legend

1. Heat exchanger
2. Flue baffles
3. Hook bolt kit assembly
4.1 Pipe – RH flow
4.2 Pipe – LH flow
4.3 Pipe – Return
5. Pipe – Return assembly
6. Collector hood
7. Combustion chamber
12. Main burner
18.1 Detection electrode
22. Thermostat pocket
25. Boiler thermostat
26. Control thermostat knob
34. Balanced flue terminal
47. Gasket, grommet and bush kit
53. Wall mounting plate

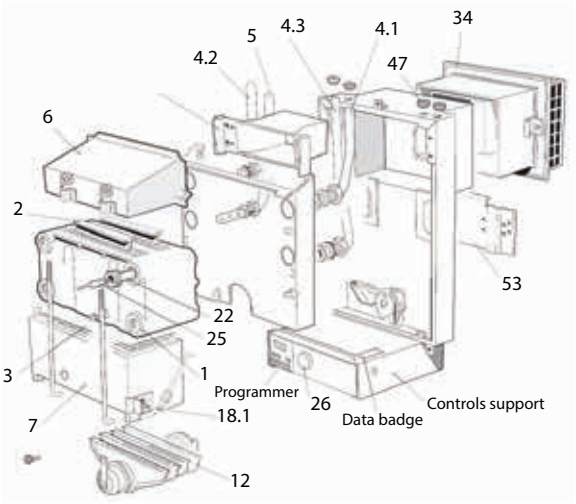

Figure 1: Typical room sealed natural draught floor standing boiler

Legend

10. Burner manifold
11. Air box and pilot assembly
12. Main burner
13. Main burner injector
16. Pilot shield
17. Gas control valve
42. Gas service cock

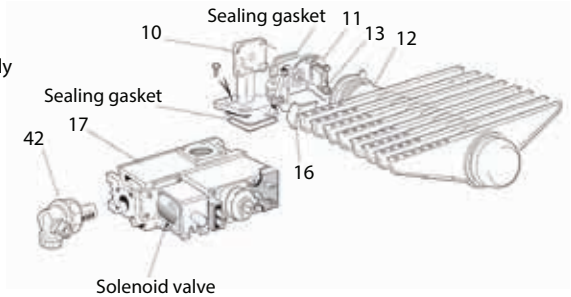

Figure 2: Burner and controls

How does the appliance work?

The boiler shown incorporates a combination of both mechanical and electrical gas control devices. It uses a permanent pilot as its source of main burner ignition.

Gas is supplied via the service cock (the main point of appliance gas isolation) to the inlet of the multifunctional control valve, which incorporates:

- Constant pressure governor.
- Flame supervision device (in this case working on the thermo-electric principle, using a thermocouple).
- Solenoid valve.

A pilot pipe and thermocouple lead connect the multifunctional control valve to the pilot assembly, which is situated adjacent to the main burner. The function of the pilot is to light the main burner. The pilot assembly incorporates:

- Pilot burner (incorporating pilot injector).
- Thermocouple.
- Spark electrode.

The spark electrode is connected via a lead to the piezo unit; its function is to light the pilot burner.

The purpose of the flame supervision section of the multifunctional control valve and its associated thermocouple is to only permit a flow of gas to the main burner when the presence of a pilot flame has been detected. The gas governor section of the control valve allows for adjustment of gas flow through to the main burner. The electric solenoid valve section provides for on/off operation of the main burner.

A boiler (control) thermostat, which can usually be adjusted in terms of water temperature, is electrically connected to the solenoid section of the multifunctional valve. The thermostat, includes a thermostat phial and lead. The phial is placed inside the thermostat pocket, which projects into the heat exchanger waterways. The thermostat electrically activates the solenoid valve in response to water temperature fluctuations.

The outlet of the multifunctional control valve connects directly to the main burner via connecting pipework. The gas itself is discharged into the main burner through an injector.

In the case of room sealed appliances, the air supply is entrained from the outside of the building via the air duct assembly directly into the combustion chamber of the appliance.

Flue gases are discharged through the heat exchanger (which may include a series of flue baffles) into the collector hood, discharging to outside air via the flue duct assembly.

Contents

Introduction

The objective of this module is to enable you to successfully complete assessment across the following range of ducted air heaters:

- Open flue natural draught.
- Open flue fan draught.
- Up flow models.
- Down flow models.
- Horizontal flow models.

You will be required to prove that you can install, disconnect, service, repair, breakdown and commission domestic gas fired ducted air heaters up to 60kW.

Practically, you should be able to ensure the following:

- The compartment construction and ventilation meets current requirements.
- The appliance assembly is complete and is fit for use and purpose.
- The gas supply is isolated prior to work commencing.
- The existing heater is disconnected and removed.
- The replacement heater is positioned in the compartment.
- The plenum base is sized, located and adapted to fit replacement appliance.
- The return air duct is sized, located and adapted to fit replacement appliance.
- A suitable rigid connection is made between the gas point and the appliance.
- The open flue is connected to the appliance.
- The gas supply is re-established.
- The work carried out is gas tight.
- The appliance is correctly located, level and stable.
- The appliance operational gas safety components are dismantled and cleaned, using appropriate cleaning methods and agents (e.g. burners, primary air ports, combustion chambers, ignition devices, thermostats, limit switch and flame supervision).
- The appliance is commissioned as follows:
  - The appliance is purged of air.
  - The working pressure at the appliance is correct.
  - The burner flame picture, stability and ignition are correct.
  - The user controls are operating correctly.
  - The safety control devices are operating correctly.
  - The temperature controls are operating correctly.
  - The plenum/return air ducts are adequately sealed.
  - The flue is correctly clearing products of combustion.

- The connections are gas tight and flues are operating correctly.
- Defects on gas safety components are identified.
- The safe operation and use of the appliance is explained.

Additionally, you should know the following:

- Identification of unsafe conditions.
- Diagnosis of gas safety faults.
- The causes and effects of split heat exchangers.
- Suitable and unsuitable locations/compartments – fire proofing.
- Air filters and their effects on the appliance.
- Requirements where combustion air is supplied by the heaters circulating fan.
- Clearance requirements (proximity of combustible materials) and fire proofing of compartments.
- The operation of mechanical and electrical controls.

Section 1 – Types of Appliances and their Operating Principles: Ducted Air heaters

Introduction

In this module we shall be taking a look at the various types of appliances and the key operating principles of:

- Up flow models.
- Down flow models.
- Horizontal flow models.

Part 1 – Ducted Air Heaters

For the purposes of this training course we shall define ducted air heaters as gas appliances designed to provide heat for space heating.

What types of appliances are available?

Ducted air heaters fall into one of three categories:

- Up flow models.
- Down flow models.
- Horizontal flow models.

These categories can be manufactured as open flued, natural convection or open flued fitted with a flue boost.

However, ducted air heaters can be categorised further:

- Natural draught and fanned draught.
- Traditional control models.
- Modairflow models.

By understanding the operating principles of these appliance types, we should be able to describe how the mechanical and electrical controls operate within the majority of appliances that we may have to install or maintain.

The operation of a traditional control

When the room thermostat calls for heat, it will operate the gas valve, which in turn will switch on the burner.

Once the temperature in the heat exchanger has reached approximately 58°C, the fan thermostat will operate the fan unit, thus distributing warm air via the register. When the temperature in the heat exchanger falls to approximately 38°C, the fan thermostat will switch off the fan unit.

The problem with the simplistic control system is that the on-off switching of the fan unit creates a feeling of coldness to the room occupants during an off period.

The operation of a modairflow control

A time control in the air heater allows the user to pre-select times of heating system operation.

A thermista-stat on the wall allows selection of comfort level; it senses heat requirement and continuously informs the electronic controls in the air heater of the rate of warm air delivery required. The air heater controls automatically adjust the operation of both gas burner and air circulation fan. Figure 1 shows a typical operating sequence of a modairflow control.

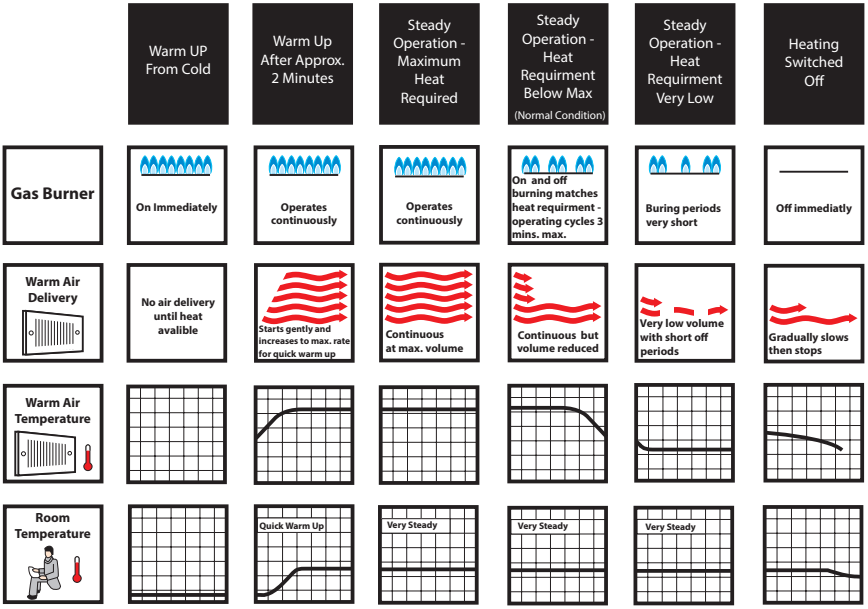

Figure 1: Operating sequence

How does the appliance work?

There are three variations in flow direction:

- **Downflow:**

Where the fan is positioned above the heat exchanger, directing the heat downwards through the unit, with the air distributed from the bottom (see Figure 2).

These are suitable for most dwellings.

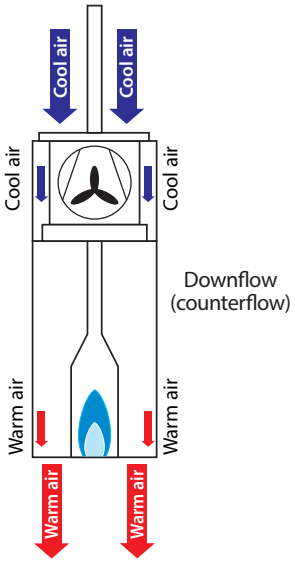

Figure 2: Downflow

- **Upflow:**

  Where the fan is positioned below the heat exchanger delivering air upwards for distribution (see Figure 3).

  These are suitable for installations in basement, but can be installed at other levels within a dwelling.

- **Horizontal flow:**

  Has the fan and heat exchanger located side by side and discharges air for distribution horizontally (see Figure 4).

  These are suitable for wall mounting.

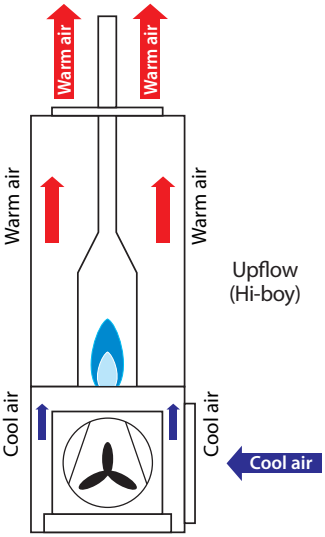

Figure 3: Upflow

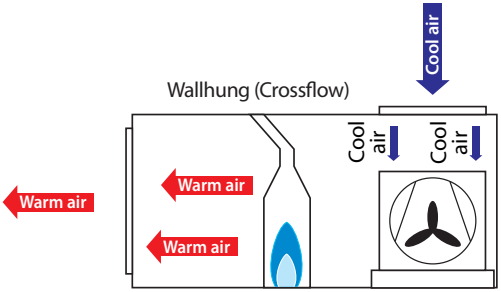

Figure 4: Horizontal flow

The working components

The centrifugal fan has an integral motor with sealed bearings designed to give trouble-free running.

With a basic heater, the fan switch (a bi-metal blade) controls the fan and ensures that it does not blow cold air on starting and that it dissipates warm air before stopping. The fan runs at a single speed.

With a modulating output heater, the airflow sensor (a thermistor) has a similar task to the fan switch, but the fan speed varies automatically. With the system ET (even temperature controls), the thermista stat controls the fan speed as well as the burner.

The heat exchanger – transfers heat from combustion chamber to circulation air without them mixing. It is shaped like a clam and made up of one or more sections. Most are constructed from stainless steel.

The burner – natural gas burners have a single injector, gas and air are mixed before burning. Each heat exchanger clam has its own burner bar.

The flue – takes combustion products from the heater to atmosphere and can be of different types. Mostly open flues are used, where combustion air is drawn in through the front of the heater. The flue products pass through a draught diverter and then to atmosphere via a flue pipe. Fan assisted open flues are also used.

Balanced flues – are used on individual heaters and the flue box induces combustion air and disposes of flue products.

The controls – All heaters use a multi functional gas valve. This allows gas to pass to the burner and is controlled by the limit switch.

The limit switch – performs the same function as a boiler stat and controls the temperature of air distributed to the grilles and registers.

Fan switch control (thermistor) – controls the speed of the fan according to the current temperature, or on basic models shuts the fan off.

Time control – allows the gas valve to open at pre-selected times.

Room stat – This will bring the burner into operation when calling for heat. The gas valve allows gas to permanent pilot, which will ignite the burner when the main gas is supplied.

The thermocouple – is a device to prevent gas being supplied to the burner when the pilot is not alight. Its probe is heated by the pilot, which produces a small electric current of 10-30 Mv, opening the gas valve.

The pilot – can be lit by pushing the gas valve button in (which allows gas to the pilot) and igniting the pilot by the piezo ignition. The button is held in long enough for the thermocouple to operate. Piezo means "pressure electric" and is a crystal which, when pressure is applied, becomes compressed and produces a spark.

Basic control ducted air heaters

These heaters are operated by a 24 volt thermostat which, when calling for heat, brings on the burner at a pre-selected rate via an electrical panel. The fan switch will consequently bring on the fan at a pre-selected speed. Warm air will then be delivered via the system until the thermostat is satisfied; the heater will then shut down.

On short ducted systems this can give fairly large temperature differences, both across rooms and from off and on. Draughts and noises can also be a problem.

Modairflow control ducted air heaters

These heaters are operated by a thermista-stat, which is a heat sensitive resistor sending a continuous signal to the heater. This brings on the burner, which cycles at approximately two minute intervals, with on periods always matching the heat requirement. The fan speed is then matched to the heat output.

This provides a heater with modulating output working almost continuously to match the heat requirement. Continuous output at lower fan speeds mean very stable temperatures, all round comfort and vastly reduced noises and draughts.

The filter contained within the heater can be a passive filter or with modern technology, an extremely efficient electronic air cleaner. Basic air heaters can also have electronic air cleaners fitted.

Task 2

Visually check the existing pipework system and note any defects below, and any remedial actions necessary, e.g. pipework fixings, pipe size, materials etc.

Task 3

Check to ensure that the gas supply has been effectively isolated prior to the work commencing.

Has the gas supply been effectively isolated? Yes No

If no, what remedial action is necessary?

Task 4

Carry out a gas tightness test of the existing pipework installation prior to the work commencing.

Does the tightness test indicate that the pipework system is leak free or within permissible tolerances?

Yes No

If no, what remedial actions are necessary?