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2nd Edition

Gasfitting

Plumbing Services Series

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Preface

The second edition of *Gasfitting* brings this classic text up to date for the requirements of the modern teaching environment. Written in a clear, accessible style, and with an abundance of illustrations and photographs, it covers all the essential competencies of the gasfitting component of the Plumbing and Services Training Package, and provides a depth of underlying knowledge to help the student towards a thorough understanding of the subject.

The material presented here is able to be applied generally. However, it should be noted that existing local conditions and requirements may differ. Where such a situation occurs, the local regulations must take precedence over the information supplied here. Climatic conditions, for example, vary considerably and may dictate local variations in regulations and practice. Differences between the states and between countries must also be taken into account. The principles, however, remain the same, and the text can therefore be read in conjunction with these requirements.

Although the gas industry in Australia is controlled by companies that vary from large government and public utilities to small councils and private companies, a national standard for the installation and testing of gas appliances issued by the Australian Gas Association is generally followed by all gas companies. A copy of the current code for the installation of gas burning appliances and equipment is considered essential.

The basic hand skills required to carry out an installation and fix gas appliances are very similar to those required to carry out a plumbing installation. Additional knowledge and skills must be acquired by the plumber in order to be capable of installing, commissioning and servicing gas appliances to the standards demanded in the gas industry. The information contained within this volume is aimed, in general, at the basic trade level and therefore is suitable for students seeking registration as gasfitters. The text will also assist the licensed gasfitter to understand and correctly interpret the standards laid down in the current code for the installation of gas burning appliances.

We would like to thank the teachers who generously gave their expert advice on this project, and those who assisted with the editing and production of the manuscript.

CHAPTER **ELEVEN**

Operating and commissioning of appliances

COMMISSIONING OF APPLIANCES

Appliances are commissioned to ensure that they are performing safely and to their design requirements. In general terms commissioning involves the following:

1. Check that the installation complies with the manufacturer's instruction and applicable gas standards and regulations.
2. Test the installation for soundness (bubble leak test, drop test and/or soapy water/leak detection fluid).
3. Purge the gas line to ensure that all air is removed prior to lighting up. This is achieved either through an open burner or by loosening the connection union and waiting until there is an audible change in sound and/or the smell of gas. Retest union after tightening with soapy water/leak detection fluid. *Note:* ***Wait for the gas to dissipate before lighting the appliance (this may take several minutes).***
4. Check that all the burners and accessories are in their correct position.
5. Check appliance pressure with at least 50% of the burners alight. For natural gas appliances attach a manometer to the test point on the appliance regulator or an injector nipple. On LPG appliances attach the manometer to the test point at the cylinder regulator, test point supplied with appliance or injector nipple.
6. Check the gas consumption of the appliance against its rated performance (this can only be done on installations that have a gas meter). See GR formula on p.155.
7. Check operation of thermostats, safety devices and all accessories such as timers.
8. Instruct the customer on the operation of the appliance and leave the instructions with them.

It is advisable to have a record sheet to record the results of the commissioning process. If an appliance is found to be outside of the 10% performance range (check the data plate for consumption) firstly re-do the calculation over a longer period, if still incorrect inform the client and manufacturer. If an appliance pressure is too high it can burn out the combustion chamber, shortening the life of the appliance, or even cause incomplete combustion due to over-gassing. If it is too low then the appliance will not provide the heat required and give poor performance.

The following is an example of appliances commonly installed and commissioned but not an exhaustive list.

COOKERS

Types of cookers

The function of a cooker is to cook food by one of the following methods:

1. boiling or frying on the hotplate
2. grilling
3. baking in the oven.

The main types of cookers are as follows.

1. Upright. This provides combines all three methods of cooking in one appliance by placing the oven, grill and hotplate on top of one another. It has the advantage of providing all three methods of cooking while taking up the minimum of floor space (Fig 11.1).

FIG 11.1 Upright cooker

FIG 11.2 Range

FIG 11.3 Elevated cooker

FIG 11.4 Wall oven and grill

2 Range. This is a wider version of the upright, often with the convenience of a second oven and griddle plate (Fig 11.2).

3 Elevated cooker. The oven is placed by the side of the hotplate and grill instead of underneath. A cabinet must be provided to support the cooker at the correct height. Elevated cookers can be purchased with the oven to the right or left of the hotplate and grill section. The main advantage of this type of cooker is that the oven is situated at a more convenient height (Fig 11.3).

4 Wall oven and grill. Consists of an oven and grill compartment which are either fitted into a cabinet or built into a wall (Fig 11.4).

5 Built-in hotplate. Consists of a hotplate which is fitted into the work top of a cabinet.

PRINCIPLE OF OPERATION

Hotplate

The hotplate consists of an aerated burner and a means of supporting the cooking utensil above the burner (trivet). Heat is transferred from the flame to the utensil by radiation, convection and conduction. Radiation accounts for a very small percentage of the heat transferred to the utensil. Convection in the form of the hot burnt gases leaving the intermediate zone of the flame is the main factor in the transfer of heat to the bottom and sides of the utensil. Conduction is the transfer of heat through the utensil to the food.

The trivet supports the utensil above the flame to ensure maximum efficiency in transferring the heat to the utensil. Flame contact should be made after the gases have completely burnt in the intermediate zone. The trivet must be robust and capable of supporting small and large utensils but not too bulky or it will absorb too much energy. Cookers usually have deep spillage bowls which fit tightly around the burner; secondary air for combustion is drawn from the space between the top of the trivet and the bottom of the spillage bowl (Fig 11.5).

FIG 11.5 Typical natural gas hotplate burner, spillage bowl and trivet

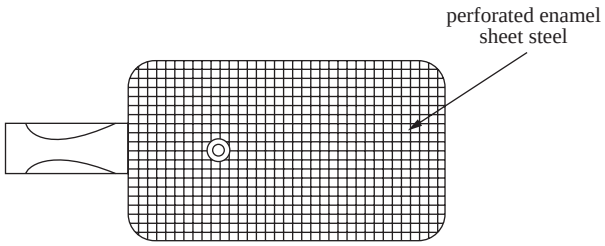
Under no circumstances must the inner cone of the flame come into contact with the utensil as this will cause incomplete combustion to take place. The trivet is designed to keep the utensil well clear of the inner cone.

Grill (Fig 11.6)

Food cooked with a griller is heated from above with radiant heat.

The surface combustion burner used by grills has the advantage of having an even heat over the whole grilling surface and consists of an aerated burner with an enlarged burner head which forms the complete area of the grilling surface. The burner head is made from either a perforated enamelled sheet steel or a fine steel mesh. Gas passes through the perforated surface with combustion taking place on the surface. The perforated enamel sheet steel type does not glow a bright red but the food is cooked by direct flame radiation and high flame temperature. The fine steel mesh burners glow a bright red which radiates heat onto the food. Surface combustion grillers use a very high percentage of primary air. If burnt with insufficient primary air the flame tends to float over the surface and lap around the side of the burner.

FIG 11.6 Surface combustion grill burner



Oven

The oven consists of a box and a burner with provisions made to draw in air for combustion and an outlet for discharge of the products of combustion. The food is cooked by convection currents created by the circulation of the products of combustion and by radiant heat from the sides and top of the oven.

Development of the oven

There are five main stages of development.

Stage 1 Refer to Figure 11.7.

This early type of oven had no insulation or thermostat. The convection currents from the hot gas had very little work to do before being vented at the top of the oven, making the oven very inefficient. The food cooked very unevenly with a tendency to overcook on the bottom. To counteract this, a metal plate was sometimes placed above the food and when the metal plate got hot, it radiated heat onto the top of the food.

Stage 2 Refer to Figure 11.8.

A slight improvement in design. Some of the ovens were insulated and thermostats were starting to be used. The convection currents from the hot gases had a little more work to do which improved efficiency slightly. Although this design improved the cooking performance, the metal plate was still placed above to radiate heat onto the top of the food.

FIG 11.7 Oven design

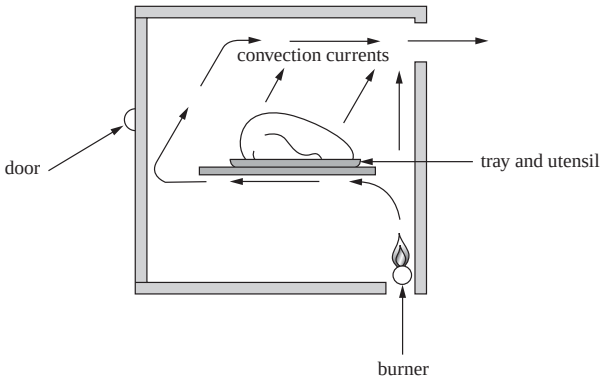
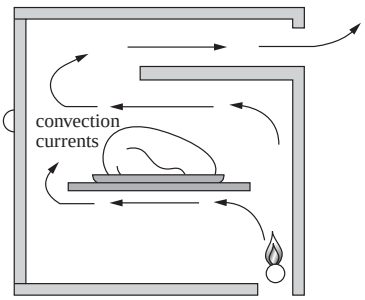


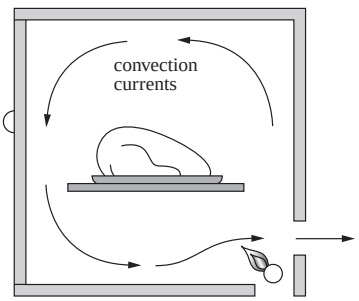
FIG 11.8 Oven design



Stage 3 Refer to Figure 11.9.

These ovens were well insulated and thermostatically controlled. The hot gases had to circulate, giving off much of their heat before passing out of the oven. Because hot gases rise and then fall when cooling, the top of the oven was approximately 25°C hotter than the bottom. This type of oven was called a zoned heat oven and allowed several dishes to be cooked at slightly different temperatures at the

FIG 11.9 Oven design

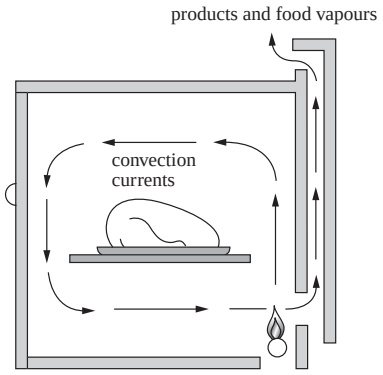


same time. It also made it necessary for the cook to locate the food on the correct shelf. The cooking results from this type of oven are excellent.

Stage 4 Refer to Figure 11.10.

This design is used on the majority of modern cookers. It functions in the same way as that described in Figure 11.9 except that it carries the products and food vapour away from the wall immediately behind the cooker and vents them into the room from the top of the cooker. All modern ovens have a safety device to ensure the gas supply is shut off in the event of flame failure. The modern oven is available as a manual oven or it can have the added convenience of being fully programmed.

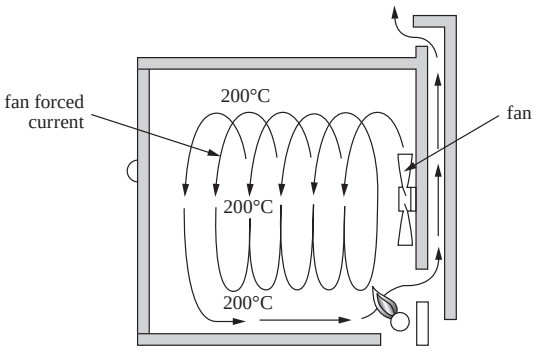
FIG 11.10 Oven design



Stage 5 Refer to Figure 11.11.

The convection oven uses a fan to give an even distribution of heat throughout the oven. Food can be placed on any shelf in the oven. Some convection ovens can be used as ordinary zoned heat ovens in the event of an electrical breakdown. Convection ovens which can only be used with the fan generally use the fan to circulate the hot gases and increase the pressure within the oven, thus reducing the cooking time by up to one-third. For example, a cooking time of 60 minutes in a normal cooker would be reduced to 40 minutes in this type of convection oven.

FIG 11.11 Fan forced oven



OVEN VITIATION

Oven vitiation (flame suffocation) is caused through inadequate secondary air being available from around the burner, usually due to the products of combustion not passing, or only partially passing, up the flue, or being recirculated around the burner.

Causes of oven vitiation

1. The oven flue is blocked.
2. The gas rate is too high.
3. The angle of the burner is wrong or the burner is wrongly adjusted. If the burner is not fitted and adjusted correctly, the products of combustion may be projected forward onto the bottom of a utensil or the solid section of the oven shelf which some ovens have. This will cause some of the products to recirculate around the burner and thus exclude secondary air.
4. An oversized cooking utensil is used. The cooking utensil must have adequate space around it to allow the convection currents to circulate correctly or they will recirculate around the burner and exclude secondary air. This problem can also be identified by the food being overcooked on the bottom.

Self-clean oven

A catalyst material is mixed with the porcelain before it is sprayed onto the oven linings. The catalyst decomposes grease and cooking vapours during the cooking cycle. The decomposed matter changes to a fine ash. The catalytic effect takes place between temperatures of 150–350°C, and between these temperatures a continuous cleaning process takes place. Problems with grease and food vapour build-up will occur if the cooker is used often at low temperatures or excessive spillage of fats takes place. Because the bottom of the oven is the coolest spot, some manufacturers provide a tray to catch excessive spillage. Self-clean oven linings must only be wiped with a soft rag. Under no circumstances must abrasives or cleaning agents be used. If a build-up of grease occurs, set the oven to a high temperature and leave on until clean.

Rotisseries

The rotisserie is an additional feature of many ovens. It provides a means of barbecuing or broiling the food. This is done by passing a spit through the meat, securing one end to a support and locating the other end into a motor so that the meat can be rotated slowly while cooking. Other accessories include timers, clocks and various electronic ignition devices.

COMMISSIONING COOKERS

Installation check

1. Check that appliance installation complies with the manufacturer's instructions, the AS 5601 code and any special local authority's requirements.

2 Check that cooker is level and firm.

3 Check that wall ovens are secured to the cabinet.

Light up and check

1 Attach manometer to a suitable point on the outlet side of the appliance regulator.

2 Check badge plate for correct working pressure of appliance, and set pressure correctly with at least 50% of the burners full on.

3 Check and adjust the oven burner, and leave oven set at 150°C or equivalent.

4 Adjust hotplate burners and grill.

5 Check operation of ignition device/s.

6 When oven is hot, turn thermostat setting back to 120°C—burner should be at minimum bypass rate.

7 Carry out oven door slam test to ensure normal opening and closing of the door will not cause flame outage.

8 Check appliance performance by checking whether the actual gas consumption is within 10% of the data plate rating (all burners must be on high).

9 Check flame failure device is operating in the advent of flame failure.

10 Check operation of rotisserie, programmers and lights.

Instructions for customer

1 Instruct customer on correct lighting and operating procedures.

2 Be sure customers understand by getting them to demonstrate the lighting and operating procedures.

3 Draw attention to the manufacturer's written instructions.

INSTANTANEOUS HOT WATER SERVICES

Instantaneous hot water services do not store water; the water is heated as it flows through the hot water service. The capacity of the instantaneous hot water service is measured in litres per minute for water flow and degree centigrade for the temperature rise. An instantaneous hot water service is very compact and is available as an inside wall model with a conventional flue, or as an outside wall model using an inbuilt balanced flue system.

PRINCIPLE OF OPERATION

When a hot tap is turned on, the flow of water through the water section of the heater lifts the gas valve, allowing the gas to the burner to heat the water. When the hot tap is turned off, the gas also goes off. As the water flow increases the temperature of the water decreases and conversely as the water flow decreases the temperature increases as the burner flame size and resultant energy is constant.

Operation of the instantaneous hot water service

1 When no water is being used, the pressure on the bottom and top side of the diaphragm is equal.

2 When water is flowing through the water section, it increases its velocity when passing through the venturi.

3 The velocity of the water passing through the venturi sucks the water out from the top side of the diaphragm, thus creating a differential pressure between the top and bottom side of the diaphragm.

4 The higher pressure on the bottom side of the diaphragm causes the diaphragm, bearing plate and water spindle to rise, and the water spindle pushes the gas valve up, allowing gas to flow to the burner.

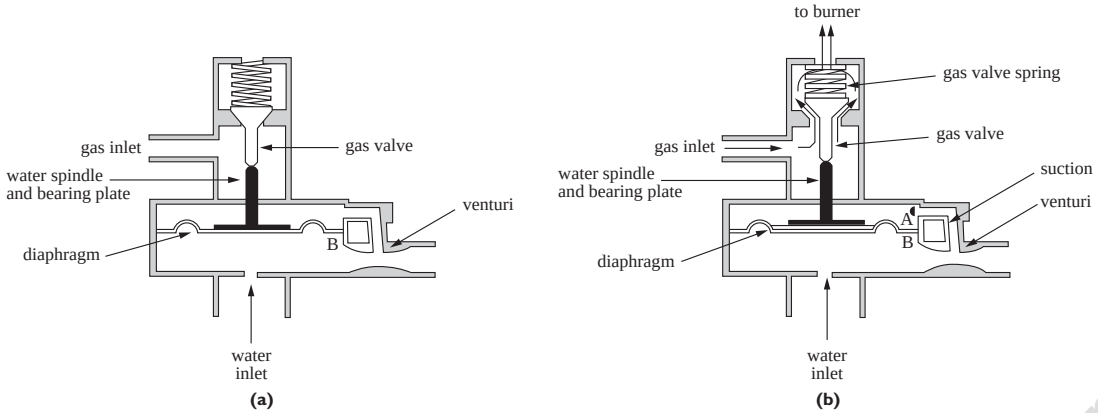
5 When the hot tap is turned off, water flows back into the top section of the diaphragm and this equalises the pressure between the top and bottom sides of the diaphragm.

6 A spring, which is usually placed on top of the gas valve, reacts to shut the gas off.

Two-stage ignition

It is essential that the gas lights in two stages. Stage one allows sufficient gas to pass to the burner to establish

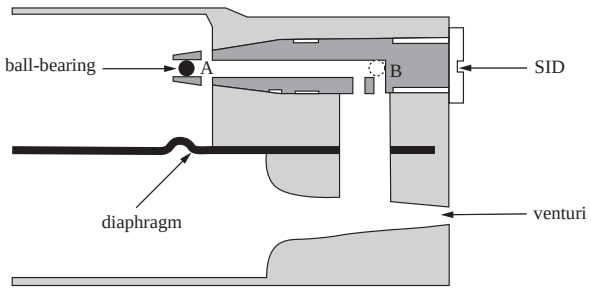
FIG 11.12 Operation of the instantaneous hot water service: (a) No water flowing. Pressure at A and B equal. (b) Water flowing. Pressure at B greater than A



a small stable flame on the whole of the burner. Stage two allows the gas rate to increase gradually to the full gas rate. If two-stage ignition is not achieved and the full gas rate is allowed to the burner in one lift, flash ignition will take place. This type of ignition will overheat the combustion chamber and heat exchanger. If flash ignition is not corrected, the working life of the combustion chamber and heat exchanger will be considerably shortened.

Operation of the slow ignition device (SID)

FIG 11.13 Slow ignition device. (Detail of Fig 11.12.)



1. When the water is turned off, the water that pushes up into the section on top of the diaphragm also pushes the ball bearing to position A on the SID.
2. When the water is being used and therefore sucked out of the top section, sufficient water will pass through the two openings behind the ball bearing, allowing water to be drawn out of the top section to give a slight lift of the diaphragm. This slight movement of the diaphragm will be sufficient for the first stage of ignition.
3. As the ball bearing is sucked along the tube, it will shut off the withdrawal of water from the section on top of the diaphragm until it reaches position B.
4. When it reaches position B, the rest of the water will be sucked through the small opening allowing a full lift of the diaphragm and gas valve.

   Note: The two-stage ignition described in points 1 to 4 will take approximately 2 seconds.
5. When the water is turned off, the flow of water back into the section on top of the diaphragm quickly pushes the ball bearing to position A.
6. When the ball is in position A, water rushes into the top section, restoring equilibrium above and below the diaphragm, which allows the gas to shut off quickly.
   Note: If the gas does not go off quickly when the water is turned off, the small amount of water in the heat exchanger will increase in temperature rapidly. Therefore, it is essential that this is checked and corrected if the gas is not going off quickly.

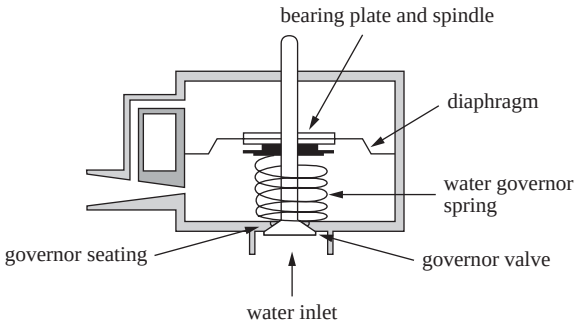
Operation of the temperature selector

The temperature selector increases or decreases the volume of water flowing through the heater without affecting the gas rate.

Operation of the water governor

Once the temperature selector has been set, the water governor will ensure a constant water flow and temperature under varying inlet water pressures.

FIG 11.14 Water section instantaneous hot water service



1. The water governor does not operate until the diaphragm has lifted and full gas is established at the burner. This is because the valve is so far away from the seating that it does not create sufficient resistance to water flow until the diaphragm has lifted.
2. The water governor spring ensures the governor valve follows the movement of the diaphragm.
3. When the diaphragm lifts, the position of the governor valve in relation to the valve seating will determine water flow.
4. Any increase or decrease in water pressure will cause the diaphragm and the water governor valve to move and therefore maintain a constant flow of water.

Additional control of ignition gas

To ensure the correct amount of gas is supplied for the first stage ignition, the gas is passed through a cross ignition bolt containing a fixed orifice.

When the diaphragm lifts and pushes up the gas valve stem, the stem passes through the small bottom valve but lifts the top valve. Gas must pass through the cross ignition bolt to get to the burner. This ensures the correct volume of gas is allowed to the burner for first stage ignition. The circlip on the gas valve stem pushes the bottom valve off its seating, allowing full gas to the burner when the diaphragm lifts fully in the second stage ignition cycle.

Installation check

1. Check that appliance installation complies with the manufacturer's instructions, the AS 5601 code and any special local gas or water authority requirements.
2. Check all hot water draw-off points for water flow.

Light up and check

1. Attach manometer, check and set working pressure with main burner full on.

2 With main burner off, check pilot flame size and position. This is to ensure it will light the gas on first stage ignition and heat up the flame failure device.

3 Turn on the check for two-stage ignition.

4 Observe main burner shuts off quickly when flow of water is stopped.

5 Turn on and check temperature of water at all outlet points.

6 After heater has been on for at least 5 minutes, check operation of flue.

Instructions for customer

1 Instruct customer on correct lighting and operating procedures.

2 Be certain the customers understand—have them demonstrate the lighting and operating procedures to you.

3 Leave the manufacturer's operating instructions with the customer.

CONTINUOUS FLOW HOT WATER SERVICES

Continuous flow hot water services do not store water; the water is heated as it flows through the hot water service. The capacity of the continuous flow hot water service is measured in litres per minute for water flow and the temperature can be adjusted to suit the application. With continuous flow hot water heaters the temperature of the water remains constant even if the water flow changes as its computer panel increases or decreases the flame size to match the water flow and thus maintain a constant temperature.

PRINCIPLE OF OPERATION

As water passes through the heater it is heated by the burner to a predetermined temperature. The gas flow and water flow are matched by the control panel in the heater so the temperature of the water is not affected by variances in flow.

Operation of the continuous flow hot water service

The flow of water through the water section of the heater activates a switch which in turn opens the gas valve and allows gas to enter the burner. The burner is then lit by an electronic igniter. Prior to ignition though the fan purges the combustion chamber of any residual gas. The control panel within the heater senses the rate of water flow and matches the flame size to this rate to deliver water at the pre-set or selected temperature. If the water flow changes e.g. another tap is turned on, the heater will adjust the

FIG 11.15 (a) Continuous flow hot water service (interior) and (b) exterior

flame to accommodate for this. Temperature control panels can be added to the system so the temperature of the water can be selected by the user remotely at the source of usage. Where more than one temperature control panel is fitted the one fitted in the bathroom and/or ensuite will be dominant.

Operation of the temperature control

The temperature panel (where optioned and installed) allows the user to select the temperature of the water up to 50°C. The control panel sends a signal to the computer panel in the heater indicating the temperature required. Where not fitted the unit is usually pre-set to 50°C. The control panel sends a signal to the computer panel in the heater indicating the temperature required.

Installation check

1. Check that appliance installation complies with the manufacturer's instructions, the AS 5601 Code and any special local gas or water authority requirements. (In particular check that the gas supply is adequate for the rating of the appliance).
2. Check all hot water draw-off points for water flow.
3. Check flue terminal distance from openings. (This distance can be a significant amount where the appliance rating is high (i.e. over 150 Mj/h)).

Light up and check

1. Attach manometer, check and set working pressure with main burner full on.
2. Check for efficient ignition.
4. Observe main burner shuts off quickly when flow of water is stopped.
5. Turn check temperature of water at all outlet points.
6. After heater has been on for at least 5 minutes, check operation of flue.

Instructions for customer

1. Instruct customer on correct lighting and operating procedures.
2. Be certain the customers understand by having them demonstrate the lighting and operating procedures to you.
3. Leave the manufacturer's operating instructions with the customer.

STORAGE HOT WATER SERVICES

The storage hot water service consists of an insulated cylinder which stores the water at a preset temperature ready for use. Storage heaters are thermostatically controlled and when hot water is drawn off from the top of the cylinder, cold water replaces it at the bottom. The incoming cold water enters close to the thermostat sensor so the thermostat will react and bring on the gas to replace the hot water drawn off.

PRINCIPLE OF OPERATION

Water becomes less dense when heated and therefore rises and is replaced by cooler denser water from within the heater. This circulation (hot rises, cold falls) is referred to as convection currents and results in the hottest water settling at the top and the cooler water at the bottom. This is known as 'stratification'. The thermostat is usually located close to the bottom of the cylinder and the cold water inlet. When the water around the thermostat has reached the set temperature, the gas is switched off and when the water around the thermostat has cooled sufficiently, full gas is restored to reheat. Because of this, an automatic permanent source of ignition is required to reignite the burner. The temperature differential between gas off at present temperature and gas back on for reheating is between 5 and 11°C, e.g. if gas is off at 55°C then it will come back on between 44 and 50°C.

Stacking

If all the water is drawn off and the total capacity of the unit is heated from scratch, the temperature differential between the top and bottom of the cylinder is small, often no more than 3°C. If small amounts are drawn off, the incoming cold water will cool the thermostat sensor allowing the gas to come on to reheat the replacement water. The thermostat may over-react and replace more energy than was drawn off.

If the heater is subjected to continuous small draw-offs, a considerable temperature differential between the top and bottom of the cylinder may occur. This is known as 'stacking'. To minimise stacking, some manufacturers have inserted a plastic dissipater into the cold water inlet. This spreads the cold water entering the unit and minimises the over-reaction of the thermostat.

Heat transfer

Refer to Figures 11.16(a), (b) and (c).

Figure 11.16(a) shows the traditional method of transferring heat from the hot gases leaving the flame into the water. Although it is an efficient method of transferring heat into the water, it also accounts for most of the heat losses when the water is up to temperature and the gas is off.

This method shown in Figure 11.16(b) creates a high turbulence inside the central flue, causing the products of combustion to recirculate repeatedly, so that more heat is transferred to the water. Heat losses are also less than those of heaters using the standard baffle.

There is no central flue in the method shown in Figure 11.16(c); the products of combustion transfer their heat into the water through the base and sides of the unit. The products have to push up the side of the cylinder and then down, before they escape through the balanced flue terminal. Because this takes longer and they are in contact with a larger area, more heat is transferred into the water. When the water is up to temperature and the burner is off, heat losses are minimised, because a trap is formed as the hot air from the cylinder has to push down against the cold air which forms in the down section of the heat exchanger.

FIG 11.16 (a), (b) Heat transfer

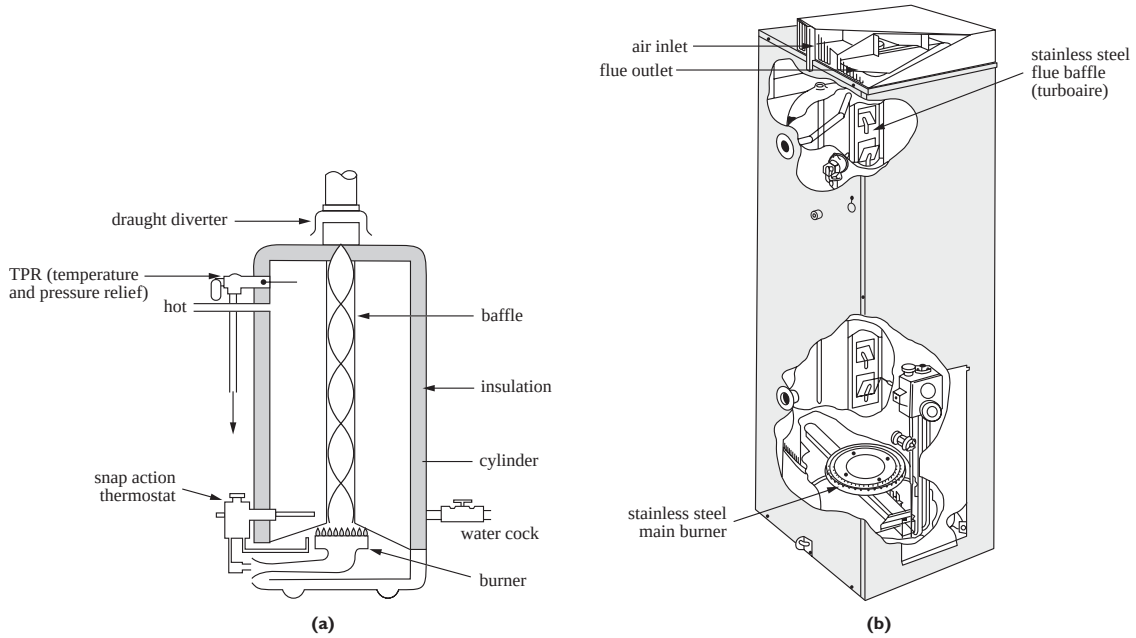
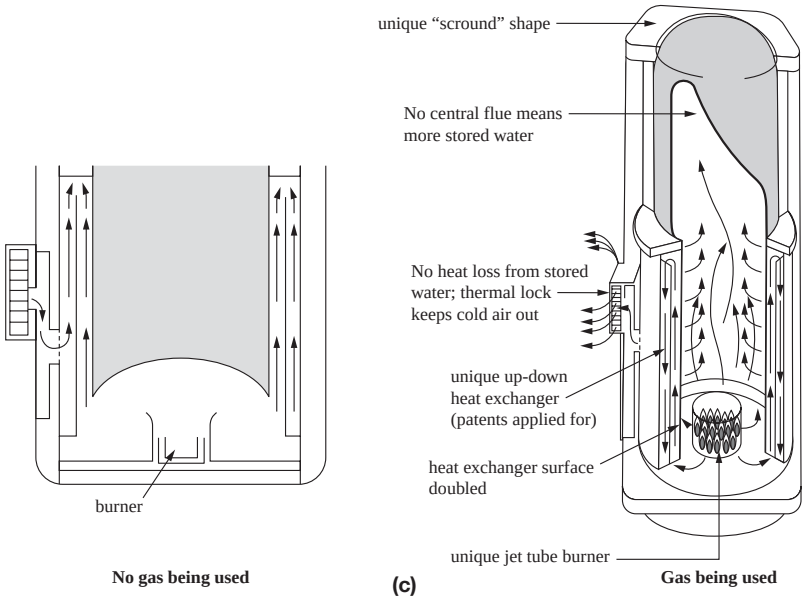


FIG 11.16 (c) Heat transfer



Capacity and recovery rates

It is important with gas storage heaters that both the capacity of the cylinder and the number of litres which can be reheated per hour is taken into consideration when sizing the unit. Slow recovery units usually have a large storage capacity to compensate for the slow recovery rate. Domestic hot water services with a fast recovery usually store a minimum of 45 L and a maximum of 135 L with a recovery rate of 90–145 L/ h.

TYPES OF HOT WATER SERVICES

Mains pressure fast recovery

This type of heater is usually connected direct to the domestic cold water service and is constructed of steel with a vitreous enamel coating which is referred to as a 'glass-lined' cylinder (Fig 11.17(a)).

FIG 11.17 (a) Exterior fast recovery hot water services (foreground)

Glass-lined cylinders

The vitreous enamelled surface is slowly soluble in water, and the solubility increases with the temperature of the stored water. To protect the steel from any imperfections in the coating, a sacrificial anode is used, which is colour coded for the specific water conditions of the geographical area it is to be installed in. It is important that the correct one for the area is used. These units must have a pressure and temperature relief valve fitted in the top 150 mm of water or in the top 20% of water capacity of the heater, whichever is the higher. The pressure and temperature relief valve can be combined and will relieve any pressure in excess of its set capacity, whether it is excess cold water service inlet pressure or thermal expansion. When the heater is in its heating cycle, thermal expansion will cause a steady drip of water from the pressure relief section of the valve. This will reseal when the heating cycle stops. Thermal relief takes place if the temperature of the water reaches 99°C. The water around the relief valve will have to drop considerably before it will reseal. In areas where the water supply contains a high calcium content, a cold water pressure relief valve should be fitted on the cold water inlet between the cylinder and the check valve. The fitting of a cold water pressure relief valve is compulsory in some areas.

COMMISSIONING STORAGE HOT WATER SERVICES

Installation check

1. Check that appliance installation complies with the manufacturer's instructions, the AS 5601 code and any local gas or water authorities' codes.
2. Check all hot water draw-off points for water flow.

Light up and check

1. Attach manometer, and check and set working pressure with main burner full on.
2. Check and adjust main burner aeration.
3. With main burner off, check and adjust pilot.
4. Check operation of thermostat and set to suitable temperature.
5. Check the appliance consumption against the data plate.
6. After heater has been on for at least 5 minutes, check operation of flue.
7. Check operation of pressure and temperature relief valve.
8. Check and time the operation of the safety device.

Instructions for customer

1 Instruct customer on correct lighting and operating instructions.

2 Be sure the customers understand by getting them to demonstrate the lighting and operating instructions to you.

ROOM HEATERS

The function of a room heater is to heat a room or area to a comfortable temperature and maintain comfortable conditions within that room or area.

Comfort conditions in a room

Comfort in a room depends upon the following factors:

1 Temperature. The temperature required for comfort in a lounge room varies from person to person, but a temperature of 22–23°C is generally accepted as being comfortable in Australia. For people to be comfortable, they must lose a small amount of heat. The temperature of exposed clothing and skin is usually 24–25°C; a room temperature of 1–2°C below this temperature will ensure people lose a small amount of heat to the room. There should not be excessive variation in temperature between floor and ceiling.

2 Ventilation. Sufficient ventilation to ensure an adequate supply of fresh air to the room is essential. Air movement without creating draughts is also necessary if the room is to be ideally comfortable.

3 Humidity. The relative humidity should not exceed 70%.

Method of heating a room

When heating a room or space either radiant or convection heat is used.

Radiant heat

Radiant heat travels in straight lines and does not give off its heat until it strikes a solid object (e.g. people, walls or furniture).

The air between the room heater and the solid objects is not heated by radiant heat, but when walls and furniture become warm, the air that comes into contact with them is heated, which gradually warms the air in the room (Fig 11.18(a)).

Advantages of radiant heat

1 It is not affected by draughts.

2 It can be directed where it is wanted.

3 It warms the furniture.

4 It has a warm red glow which has a psychological effect.

Disadvantages of radiant heat

1 Temperature is uneven in the room.

2 It is slow to bring the air temperature up to an even, comfortable level.

Convection heat

Air when it is heated becomes lighter; the lighter heated air rises and is replaced by cooler air. This movement sets up a continuous circulating cycle. A more efficient circulation of these air currents can be achieved by using a fan (Fig 11.18(b)).

Advantages of convection heat

1 It heats the room quickly and evenly.

2 There is continuous air movement.

Disadvantage of convection heat

It is affected by draughts.

TYPES OF ROOM HEATERS

Radiant forced convection heaters

This is a very popular type of heater which has all the advantages of both radiant and convection heat to ensure maximum comfort conditions in the space being heated. This style of heater is available with swank surface combustion radiant blocks, which ensure a high temperature radiant surface at all times. These surface combustion heaters are not thermostatically controlled but have available a manual control which allows a quick heating up cycle and a variety of turn down rates to ensure a comfortable temperature is maintained. The alternative is the type of heater that

FIG 11.18 (a) Radiant heat, (b) Convection heat, (c) Combination of radiant and convection heat

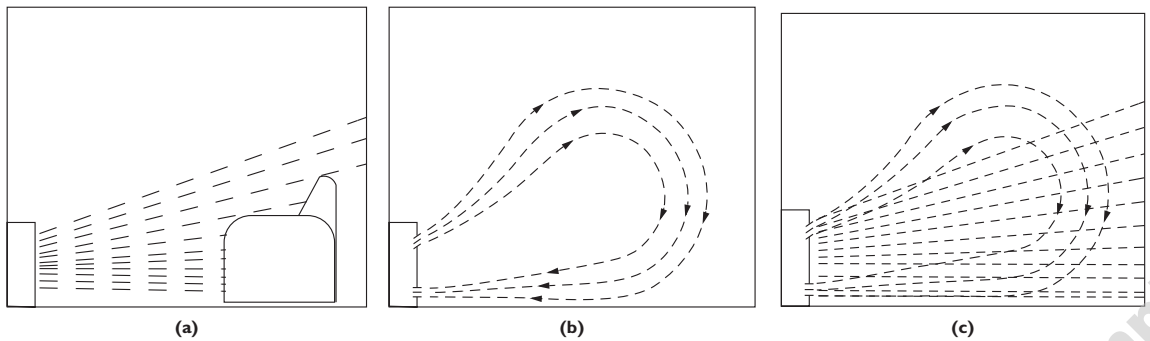
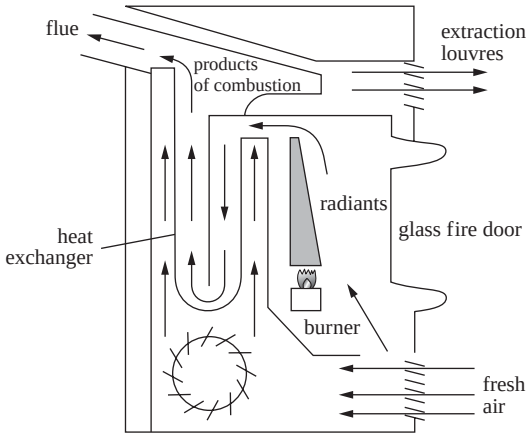


FIG 11.19 (a) Radiant forced convection space heater. (b) Console radiant force convection space heater. (c) Showing rating labels



(a)

(b)

(c)

uses fire clay radiants which are heated to a high temperature for radiant heat. These units are normally thermostatically controlled and when the room reaches the required temperature, the flame is reduced to the rate needed to maintain the temperature of the room. Radiant forced convection heaters are available as console models or as inbuilt models (Fig 11.19(a), (b) and (c)).

Radiant natural convection heaters (flued type)

Radiant convector room heaters are radiant heaters which have the fire frames designed with air passages to permit air from the room to be drawn in through openings at the base of the fire frame. This air is passed over a heat exchanger and discharged back into the room. The convected air does not come into contact with the products of combustion. These heaters are not quite as efficient as fan forced convection heaters but are ideal for heating small rooms (Fig 11.20(a) and (b)).

Flueless heaters (domestic type)

These room heaters are normally a combination of radiant and convection heat. The flame and the products of combustion heat the radiant block and then the products of combustion are mixed with comparatively large volumes of air drawn in at the base of the heater, which are then discharged into the room through a grille at the top of the heater. Because of the amount of dilution that takes place, the products of combustion return to the room at a much lower temperature. Flueless heaters designed and approved for use with LPG incorporate an oxygen depletion device, which shuts off the supply of gas to the burner if the oxygen content of the room is affected by the products of combustion. Flueless heaters for installation in domestic homes using natural gas are not approved by all local authorities. When heaters have been approved for installation, the AS 5601 ventilation code must be strictly adhered to.

Forced convection heaters (flued type)

Forced convection heaters use a fan to draw air into the bottom of the unit. This air is then passed over a heat exchanger and then pushed out the top grill section. The

FIG 11.20 (a) Radiant natural convector: cross-section (b) radiant natural convector

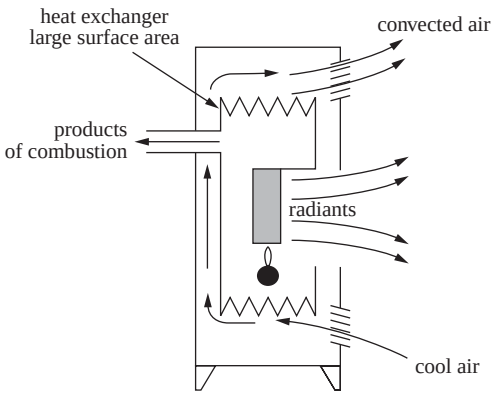


FIG 11.21 Wall furnace forced convection heater.

air which is drawn into the unit by the fan does not mix with the products of combustion. This type of unit gives a rapid build-up of air temperature in the room and an even distribution of heat throughout the room. These units are available as a console or inbuilt unit or as a wall furnace. Some units are available with a balanced flue system See Chapter 9 fluing and ventilation'.

BALANCED FLUE SYSTEMS

Commissioning room heaters

Light up and check

1. Check room ventilation.
2. Purge supply line and pilot supply.
3. Check for leaks.
4. Attach manometer-check and set working pressure of appliance with main burner full on.
5. Check and adjust aeration of main burner.
6. With main burner off, check and adjust pilot.
7. When applicable, check operation of the thermostat.
8. Check the appliance consumption against the data plate.
9. Check and time operation of flame failure device.

Installation check

1. Check that the flue is fitted according to the AS 5601 code and local authority codes.
2. Check operation of the flue.
3. Inbuilt room heaters must be secured and sealed to the room as per manufacturer's instructions.
4. Check operation of the fan.
5. Check that the approved double pole isolation switch is fitted or check that there is an accessible three pin plug and switch to isolate electrical power to the unit.

Instructions for customer

1. Instruct customer on correct lighting procedure.
2. Ensure customers understand and have them demonstrate to you the lighting procedure.

MAINTENANCE OF APPLIANCES

To ensure that appliances perform to their maximum capability and efficiency they need to be maintained at regular intervals. By analysing the flue gases you can gain an indication as to the health of the appliance. If it is producing carbon monoxide then you know that there is a serious problem with combustion which must be rectified immediately or the appliance shut down.

Maintenance includes items such as cleaning the combustion chamber, grills and filters, and checking the appliance operation by re-commissioning it as previously discussed. A maintenance schedule should be filled out to record the results of the maintenance with a copy given to the client and one kept by the gasfitter. This is your record of the health of the appliance.

Individual appliances will have specific requirements, and you need to refer to the manufacturer's instruction as well as observing the general guidelines above.

Index length = _____ metres

Section	MJ loading (MJ/Hr)	Pipe size (mm)
A-B		
B-C		
B-F		
C-D		
C-E		

chapter eleven

1 With the aid of a sketch describe the operation of a fan forced oven.

2 (a) What is meant by the term 'oven vitiation?'

(b) State three causes of oven vitiation.

1 _____

2 _____

3 _____

3 Give the reasons why it is essential that an instantaneous hot water service must light up in two stages.

4 List the commissioning procedure for an upright stove.

Installation check

1 _____

2 _____

Light up and check

1
2
3
4
5
6
7
8
9
10

Instructions for customer

1
2
3

5 Where and when would you check the water temperature to determine whether or not the thermostat of a storage hot water service needed recalibrating?

6 (a) What are the advantages of radiant heat when used to heat a room?

(b) What are the advantages of convection heat when used to heat a room?

7 Why is an oxygen depletion device fitted to flueless LPG room heaters?

8 How is the temperature maintained on a continuous flow water heater if the water flow rate changes?

9 If after checking the appliance performance against the rating on the data plate it was found to be outside the 10% range what would you do?

10 Describe what maintenance procedures you would perform when servicing a natural gas storage hot water service.

11 List and describe the three methods of heat transfer.

1

2

3

12 Why is it important to instruct the customer on the operation of the appliance and leave the instructions with them?