

Good practice guide

Heat pump installation - March 2022

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Good practice guide to heat pump installation

Contents

Index of figures and tables	5
1.0 Introduction	7
2.0 Heat pump systems	8
2.1 Types of heat pump systems	8
2.2 Components of a heat pump	10
2.3 How a heat pump works	12
2.4 Variable-speed (inverter) compressors	12
3.0 Heat pump performance	13
3.1 Heat pump efficiency	13
3.2 Energy rating label	14
3.3 Effects of temperature on efficiency and heating capacity	14
3.4 Impacts of defrost cycle on efficiency and heat output	15
4.0 Designing a heat pump system	16
4.1 Steps for designing a heat pump system	16
4.2 The importance of correct heat pump sizing	16
4.3 Step 1: Determine requirements	17
4.4 Step 2: Calculate heat load requirement	19
4.5 Step 3: Determine design temperature	20
4.6 Step 4: Select a system to meet requirements	21
4.7 Step 5: Locate the units	21
5.0 Toolkit	25
6.0 Installing pipework	26
6.1 Pipework installation	26
6.2 Pipework pre-installation in new buildings	33
7.0 Heat pump installation	35
7.1 Pre-installation checklist	35
7.2 Installing the indoor unit	36
7.3 Installing the outdoor unit	39
7.4 Connecting piping to indoor and outdoor units	41
7.5 Leak/pressure test	44
7.6 Evacuation of the system	44
8.0 Refrigerants	46
8.1 Refrigerant charging	47
8.2 Labelling as record of service	47
9.0 Electrical requirements	48
9.1 Installing electrical wiring	48
9.2 Outdoor unit connections	48
9.3 Nameplate	49

Contents

10.0 Testing, commissioning and customer operating instructions	50
10.1 Pre-commissioning checks	50
10.2 Electrical checks	50
10.3 Prepare the remote control	50
10.4 Testing the new system	51
10.5 Instructions to the owner	51
10.6 Checklist for using a heat pump efficiently	52
10.7 Quality assurance checklist for auditing	53
11.0 Servicing and maintenance	54
11.1 Owner maintenance	54
11.2 Service person maintenance	55

Good practice guide to heat pump installation

Index of figures and tables

Figure 2.1	Split system heat pump	8
Figure 2.2	Multi-split system heat pump	8
Figure 2.3	Ducted heat pump system	8
Figure 2.4	High wall-mounted unit	9
Figure 2.5	Ceiling cassette	9
Figure 2.6	Floor console	9
Table 2.1	Heat pump components	10
Figure 2.7	Schematic diagram of reverse-cycle, air-to-air, split system heat pump operation (heating mode)	10
Figure 2.8	Schematic diagram of reverse-cycle, air-to-air, split system heat pump operation (cooling mode)	11
Figure 2.9	Schematic diagram of heat pump operation (heating)	11
Figure 2.10	Inverter operation	12
Figure 3.1	Schematic of heat pump performance	13
Figure 3.2	Graphic representation of heat pump efficiency	14
Table 3.1	Outdoor ambient temperature rating conditions	15
Table 4.1	Designing a heat pump system	16
Table 4.2	Effects of incorrectly sized systems	16
Figure 4.1	Floor-mounted unit – horizontal and vertical air discharge (heating)	18
Figure 4.2	Ceiling-mounted unit – horizontal air discharge (heating)	18
Figure 4.3	Ceiling-mounted unit – vertical air discharge (heating)	18
Figure 4.4	Wall/high wall-mounted unit – horizontal air discharge (cooling)	18
Table 4.3	External design temperatures by territorial authority (local council) areas	20
Table 4.4	Example of a heat pump performance guide chart	21
Figure 4.5	Outdoor unit clearances	21
Figure 4.6	Service access	22
Figure 4.7	Clearances required between outdoor unit and exchange LPG gas bottles	22
Figure 4.8	Locate the outdoor unit where a solid barrier can block the sound	23
Figure 4.9	Wall-mounted indoor unit clearances	23
Figure 4.10	Pre-install pipework before building claddings are installed	24
Figure 4.11	Permitted notching and drilling of timber framing allowed under NZS 3604	24
Figure 6.1	Twin-insulated and dehydrated pipe	26
Figure 6.2	Step 1: Cleaning the tube end	27
Figure 6.3	Step 2: Roughing the end surface	27
Figure 6.4	Step 3: Fitting insert when required to support pipe	27

Index of figures and tables

Figure 6.5	Step 4: Adding ring	27
Figure 6.6	Step 5: Fitting connector marking stopline	28
Figure 6.7	Step 6: Applying sealant solution	28
Figure 6.8	Step 7: Fitting connector	28
Figure 6.9	Step 8: Compressing one connection end	28
Figure 6.10	Step 9: Completed compression connection	28
Figure 6.11	Pipe opening facing down when cutting	29
Figure 6.12	Cover pipe ends	29
Figure 6.13	Pipe bender	29
Figure 6.14	Cut pipe with tube cutters	30
Figure 6.15	Remove all burrs	30
Figure 6.16	Place the flare nut over the pipe end	30
Figure 6.17	Flare the end of the tube (A)	30
Figure 6.18	Flare the end of the tube (B)	30
Figure 6.19	Flare the end of the tube (C)	30
Figure 6.20	Flare the end of the tube (D)	31
Figure 6.21	Apply oil to the back of the flared pipe and the flare joint	31
Figure 6.22	Connect the pipes (A)	31
Figure 6.23	Connect the pipes (B)	31
Figure 6.24	Tighten connection (A)	31
Figure 6.25	Tighten connection (B)	31
Table 6.1	Fixing spacings for copper tubing	32
Figure 6.26	Run pipe/cable across truss chord/ceiling joist	33
Figure 6.27	Notch the top plate and studs (A)	33
Figure 6.28	Notch the top plate and studs (B)	33
Figure 6.29	Fix galvanised mild steel strap to hold pipe/cable	34
Figure 6.30	Wedge the pipe cable end into the stud	34
Figure 6.31	Braze pipe ends closed	34
Figure 6.32	Fix galvanised mild steel strap to hold pipe/connection cable	34
Figure 6.33	Feed pipe/cables through building wrap	34
Figure 6.34	Seal pipes or sleeve	34
Figure 7.1	Maximum pipe length and height	36
Figure 7.2	Screw-fix installation plate	36
Figure 7.3	Drill a hole through the wall	37
Figure 7.4	Slope of wall penetration	37
Figure 7.5	Release the tubing and drainage hose	37
Figure 7.6	Feed the connecting cable through the wall	37

Index of figures and tables

Figure 7.7	Tape tubing, drainage pipe and connecting cable together	37
Figure 7.8	Feed taped bundle through the hole	37
Figure 7.9	Attach unit to wall bracket (A)	38
Figure 7.10	Attach unit to wall bracket (B)	38
Figure 7.11	Ensure unit is securely seated	38
Figure 7.12	Taped pipes, drainage pipe and connection cable through hole	38
Figure 7.13	Expose flared pipe ends	38
Figure 7.14	Unobstructed gap under outdoor unit fixed on concrete pad cast in place	39
Figure 7.15	Concrete pad construction	39
Figure 7.16	Fixing unit to a timber deck	40
Figure 7.17	Pack with plastic shims to level	40
Figure 7.18	Wall-mounted unit on brackets – masonry wall	40
Figure 7.19	Bind insulation with vinyl tape	41
Figure 7.20	Tape drainage hose to drainage outlet	41
Figure 7.21	Install trunking neatly	42
Figure 7.22	Fit refrigerant piping, drainage pipe and connecting cable into trunking	42
Figure 7.23	Fill hole around piping with sealant	42
Figure 7.24	Seal around cover	42
Figure 7.25	Fit cover over opening	42
Figure 7.26	Apply oil to the back of the flare and the outdoor unit	43
Figure 7.27	Connect pipes and tighten flare nut	43
Figure 7.28	Tighten flare nut connections	43
Figure 7.29	Remove vacuum pump and gauges (A)	44
Figure 7.30	Remove vacuum pump and gauges (B)	45
Figure 7.31	Remove vacuum pump and gauges (C)	45
Figure 7.32	Progressively release the vacuum	45
Figure 7.33	Tighten valve caps	45
Figure 9.1	Connect power supply cable to terminal block	48
Figure 9.2	Install lockable isolating switch (A)	48
Figure 9.3	Install lockable isolating switch (B)	49
Figure 9.4	Install lockable isolating switch (C)	49
Figure 9.5	Replace service cover to outdoor unit	49
Figure 9.6	Example of a nameplate on an outdoor unit	49

1.0 Introduction

Heat pumps have become increasingly popular in New Zealand homes over recent years, as they are an energy efficient and convenient way of heating and cooling.

By using a relatively small amount of electricity, a heat pump can extract heat energy from one location – typically outdoor air – and transfer it to another location to provide heating. The reverse process can provide cooling.

Good design and installation are fundamental to a heat pump system's effectiveness and efficiency. It involves understanding the importance of correct sizing for the ambient conditions, selecting the right unit for the local environment and correctly installing the unit.

This guide provides good practice guidelines for designing and installing the most common type of residential heat pump system – air-to-air single-split heat pump systems (also known as reverse-cycle air conditioners), used primarily for heating.

The guide is aimed at experienced installers of heat pumps, and it gives the process to follow for system design and installation into both new and existing homes.

Note that this guide does not cover:

- multi-split or ducted heat pump systems
- ground-to-air, water-to-air or water heating systems
- DIY installations – EECA recommends heat pump systems are installed by experienced installers
- weathertightness and airtightness of the building envelope and structural integrity (though this must be maintained).

Before you begin

Insulate first

Before installing a heat pump into any home, reduce heat loss as much as possible by:

- adding ceiling and underfloor insulation where practicable
- adding weather stripping to doors and windows
- eliminating draughts.

Ensure you are qualified and prepared

The installation of any heat pump system should be carried out by suitably qualified installers who:

- have the correct toolkit to allow them to carry out the work
- are licensed to carry out the electrical work
- hold an Approved Filler Compliance Certificate for the handling of refrigerants.
- **NOTE: New regulations are underway that will require heat pump installers to have suitable qualification/ certification/ registration from 1 January 2020. Check with your industry association for updates (www.irhace.org.nz).**

Know your standards and regulations

Standards and regulations applicable to a heat pump installation that must be complied with include the following:

- Building Code Clauses B1 Structure, E2 External moisture and G9 Electricity
- Electricity (Safety) Regulations, including the cited edition of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)
- New Zealand electrical codes of practice
- Health and Safety at Work Act (HSWA) 2015
- Australia and New Zealand Refrigerant Handling Code of Practice 2007 and standards
- Consumer Guarantees Act 1993, which places a legal obligation on the installer to install a system that is suitable for the situation it is installed in
- Energy Performance – AS/NZS 3823 units must meet minimum energy performance requirements and have suitable labelling provided.

2.0 Heat pump systems

This section provides a general overview of heat pump types, components and how heat pumps work.

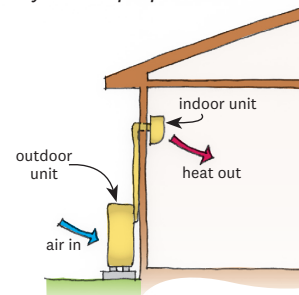
2.1 Types of heat pump systems

Air-to-air, reverse-cycle heat pump configurations are shown below.

The most commonly installed residential heat pump in New Zealand is an air-to-air, single-split system. This guide covers design and installation of this type of system only.

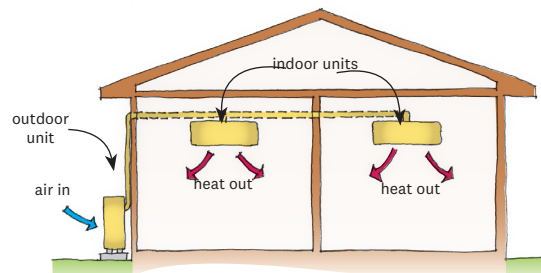
Single-split system – consisting of an outdoor unit and a single indoor unit connected to the coil by pipework containing the refrigerant (Figure 2.1).

Figure 2.1 Split system heat pump



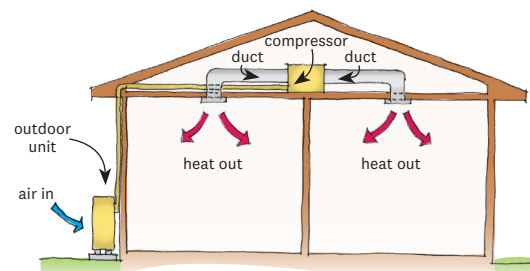
Multi-split system – consisting of an outdoor unit supplying a number of indoor units (Figure 2.2). Not covered by this guide.

Figure 2.2 Multi-split system heat pump



Ducted system – consisting of an outdoor unit and a compressor (located outside or in the roof space) that is connected to a number of air supply outlets in selected rooms or zones in the house. Zones can be controlled individually or by a centrally located controller (Figure 2.3). Not covered by this guide.

Figure 2.3 Ducted heat pump system



Indoor units may be:

- high wall-mounted (Figure 2.4)

Figure 2.4 High wall-mounted unit



- ceiling-mounted cassette (Figure 2.5)

Figure 2.5 Ceiling cassette



- floor console (Figure 2.6)

Figure 2.6 Floor console



More information on positioning of heat pumps can be found in **Section 4.0 Designing a heat pump system.**

2.2 Components of a heat pump

The main components of an air-to-air heat pump and how they operate are described in Table 2.1 and shown in Figures 2.7, 2.8 and 2.9.

Table 2.1 Heat pump components

Component	Description
Evaporator	A heat exchanger that absorbs heat from the surroundings. <ul style="list-style-type: none"> For heating, it is the outdoor unit. For cooling, it is the indoor unit.
Condenser	A heat exchanger that releases heat to the surroundings. <ul style="list-style-type: none"> For heating, it is the indoor unit. For cooling, it is the outdoor unit.
Compressor	Reduces the refrigerant gas volume by compressing it, causing the gas temperature and pressure to rise, and pumps the refrigerant around the pipework/system. The compressor operates as a variable-speed system (see 2.4 Variable Speed (inverter) compressors).
Metering device	Allows the refrigerant condensate (liquid) to expand, lowering the pressure and temperature.
Coil/pipework	Continuous, closed-circuit tubing through which refrigerant flows and heat transfer occurs. The pipes generally have fins to increase the surface area for the heat exchange process (see 6.0 Installing pipework).
Refrigerant	The compound that circulates through the heat pump system in both liquid and gas state, alternately absorbing and releasing heat (see 8.0 Refrigerants).
Reversing valve	Changes the direction of flow of the refrigerant to reverse the heat pump function from heating to cooling or vice versa. Reversing the heat pump function also occurs when the heat pump switches into defrost mode (see 3.4 Impacts of defrost cycle on efficiency and heat output).
Fan	Draws air across the evaporator coil (for heat extraction) and moves air away from the condenser coil (for heat distribution/removal).

Figure 2.7 Schematic diagram of reverse-cycle, air-to-air, split system heat pump operation (heating mode)

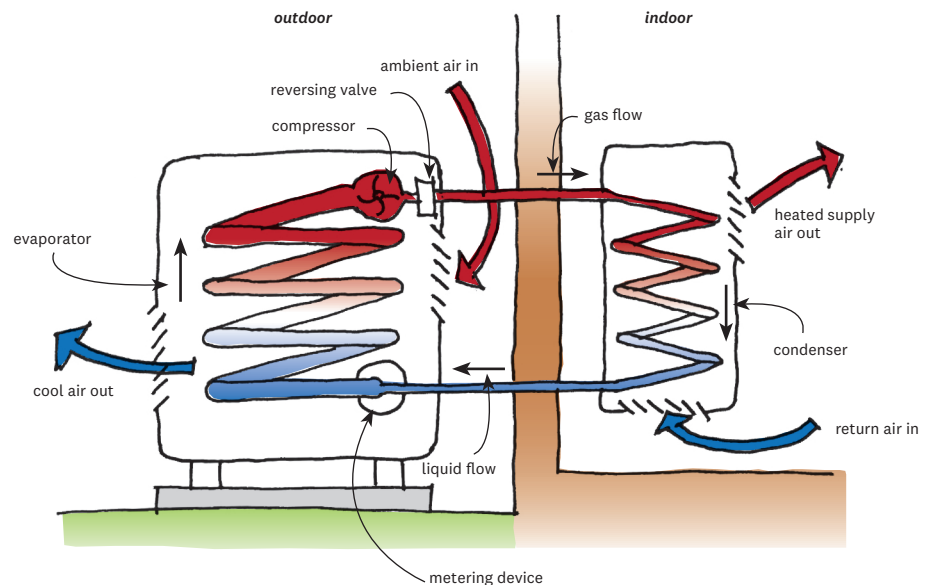


Figure 2.8 Schematic diagram of reverse-cycle, air-to-air, split system heat pump operation (cooling mode)

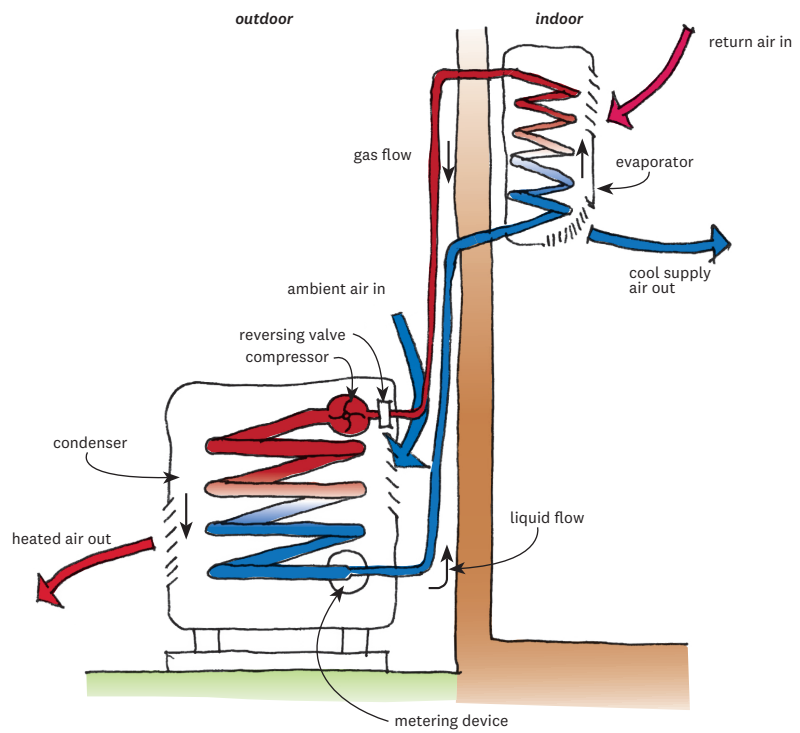
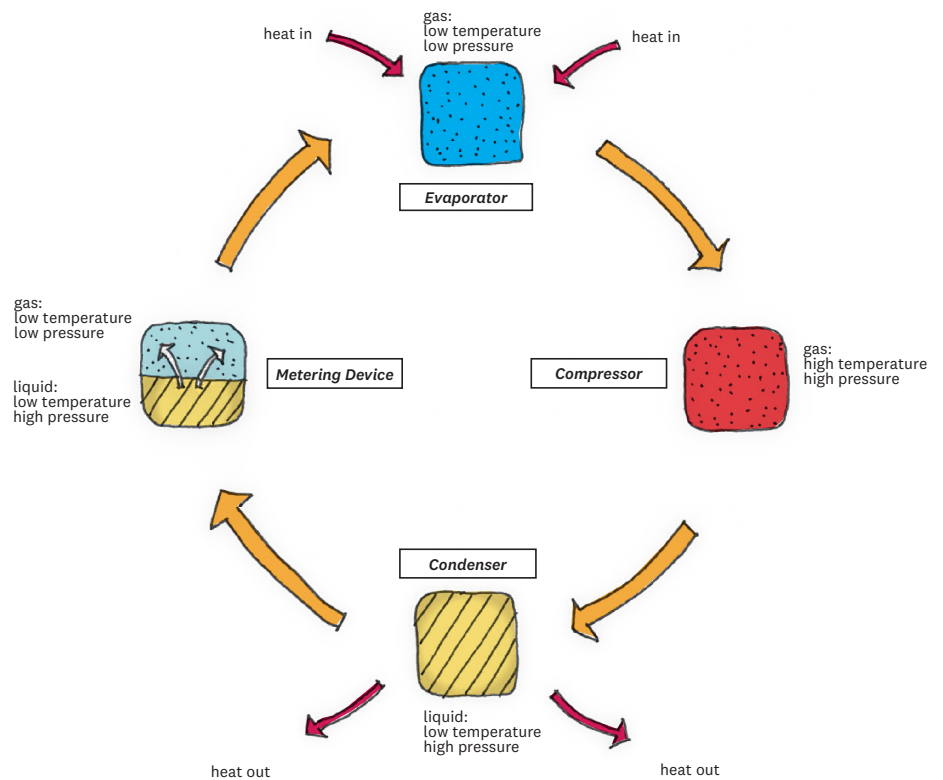


Figure 2.9 Schematic diagram of heat pump operation (heating)



2.3 How a heat pump works

In broad terms, air-to-air heat pumps work by using electrical energy to extract energy from the outside air and transfer it inside as heat, which makes it an efficient way of heating. Reversing the process enables indoor heat to be removed to provide cooling. A more detailed illustration of how a heat pump operates in heating mode can be seen in Figure 2.9. There are five main processes in the cycle:

1. In the evaporator (outdoor unit), low-pressure, low-temperature liquid refrigerant absorbs heat from its surroundings and evaporates, converting to a gas state and absorbing energy as it does so (latent heat of evaporation).
2. It passes through the compressor, where the low temperature gas is reduced in volume, resulting in a rise in both temperature and pressure.
3. As a heated and high-pressure gas, it passes through the condenser (indoor unit), where the gas condenses (latent heat of condensation) with a release of heat into the air surrounding the coil. A fan moves the warmed air away from the coil to distribute it throughout the indoor space.
4. Still under pressure, the cooled refrigerant, now in liquid state, passes through the metering device, where rapid expansion results in a reduction in pressure.
5. In the low-pressure, low-temperature state, the refrigerant flows back into the evaporator, and the cycle is repeated.

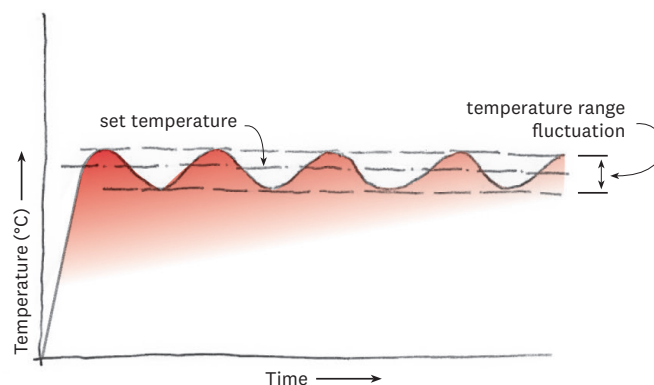
2.4 Variable-speed (inverter) compressors

The compressor of a modern heat pump is commonly a variable-speed compressor – also known as an inverter compressor. Heat pumps with variable speed (inverter) compressors are more efficient than heat pumps with fixed speed compressors.

An inverter or variable-speed compressor has a number of advantages over fixed-speed units which are no longer common.

They have a ‘soft start’ and run at variable speed, decreasing as the temperature approaches set point and increasing as the temperature begins to fall. The varying speed delivers heating or cooling as required and maintains a more constant temperature that has smaller fluctuations (Figure 2.10). This results in improved efficiency, reduced vibration and quieter operation.

Figure 2.10 Inverter operation

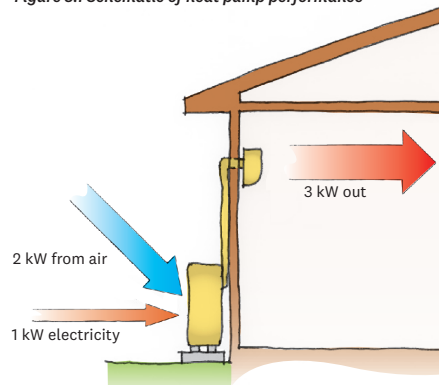


3.0 Heat pump performance

This section covers the different factors that influence the efficiency and performance of heat pumps.

Understanding heat pump performance is essential when it comes to selecting a heat pump (which is covered in Section 4.0 of this guide).

Figure 3.1 Schematic of heat pump performance



In theory, the total heat that could be available for heating is the sum of the heat extracted from the source plus the energy required to drive the heat pump. Thus, if 1 kWh of electricity is required to drive a heat pump and 2 kWh of energy can be extracted from the heat source, the total energy delivered could theoretically be 3 kWh, giving an efficiency of 300% (Figure 3.1).

In practice, other factors influence the actual efficiency of a heat pump:

- climate
- heating and cooling demands
- source and supply temperatures
- auxiliary energy consumption (pumps, fans)
- heat pump size to meet heating/cooling demand
- operating characteristics.

3.1 Heat pump efficiency

Heat pump efficiency is the ratio of the heating or cooling delivered, compared to the electrical energy required to operate the system.

The ratios are given in two ways:

- coefficient of performance (COP) – the ratio of heating delivered, compared to the electrical energy input
- energy efficiency ratio (EER) – the ratio of cooling delivered, compared to the electrical energy input.

The higher the COP or EER, the greater is the efficiency of the heating or cooling system.

You can calculate the COP by taking the heating output (in kW) and dividing it by the electrical input (in kW).

These values can be found on the energy rating label (see Section 3.2) or manufacturer's information.

An acceptable level of COP should be at least 3, and better products may well have a COP of 4 or more.

NOTE: Heat pump efficiency ratios are sometimes presented as ACOP and AEER, which are annualised figures that includes standby power in the calculation.

3.2 Energy rating label

The energy rating label gives information on how much energy a product uses so you can compare models. Every heat pump sold in New Zealand must display this label. The number of stars tells you how well the product performs – the more stars the better.

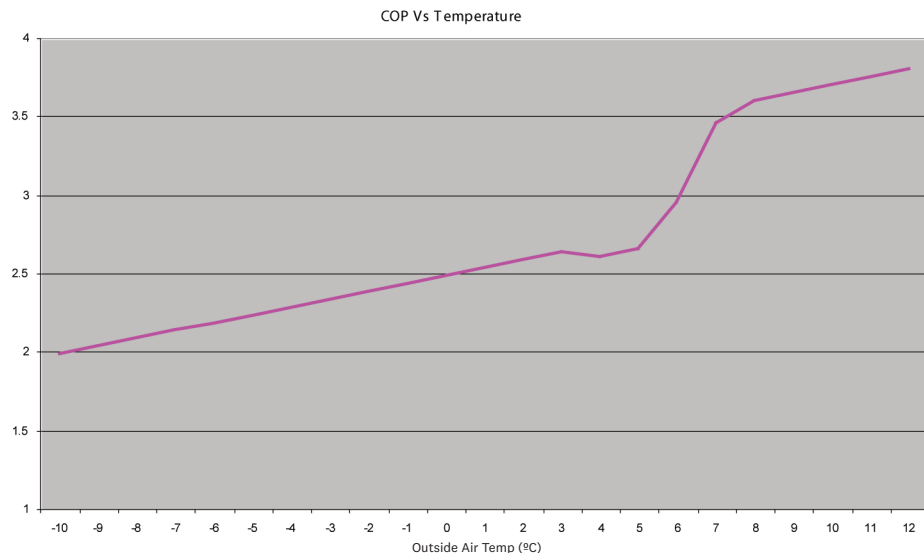
3.3 Effects of temperature on efficiency and heating capacity

Efficiency and heating capacity of a heat pump system are not constant – they vary along with the temperature differential between indoor and outdoor air. A heat pump's rated efficiency and heating capacity are for particular outdoor temperatures and heating/cooling loads. When designing a system it is important to understand how it will perform at lower temperatures.

As the difference between outdoor temperature and desired indoor temperature increases, the efficiency of a heat pump system decreases. This is illustrated in Figure 3.2, which shows the efficiency of a heat pump in heating mode reducing as the outdoor temperature decreases.

Different heat pumps will perform very differently at sub-zero temperatures – some may keep performing down to -20 °C while others will struggle at temperatures below freezing.

Figure 3.2 Graphic representation of heat pump efficiency



Another temperature-related factor that affects heating efficiency is the extra energy required for defrosting at low temperatures. At temperatures up to around +7 degrees Celsius, any water vapour in the air may start to condense and freeze onto the evaporator (outdoor heat exchanger) coils. This will disrupt the heat flow, and the coils must be de-iced for heating to be able to continue (see Section **3.4 Impacts of defrost cycle on efficiency**).

Heat pumps are rated for efficiency and capacity output under laboratory conditions at a particular ambient outdoor temperature. However, actual mid-winter temperatures in some parts of New Zealand, particularly in the central North Island and in the South Island, will give significantly different performance.

For this reason, standardised testing of heat pumps can be done at three levels of specific temperature and humidity. These are called H1, H2 and H3 and are shown in Table 3.1.

Table 3.1 Outdoor ambient temperature rating conditions

Rating	Outdoor ambient temperature (°C) rating conditions
	Dry bulb (DB)
H1	7 °C
H2	2 °C
H3	-7 °C

These ratings allow you to use a range of design temperatures to select heat pumps for areas where the temperature may often be below 0 °C. This is important to ensure that the heat pump will be able to provide the required heating capacity at low outdoor temperatures relevant for the local climate of the home or building (see **4.5 Step 3: Calculate heat load requirement**).

Manufacturers will also often test their product at other temperatures (e.g. -5, 0, 5, 10 °C etc).

3.4 Impacts of defrost cycle on efficiency and heat output

For optimal heat pump efficiency and performance, you must size a system correctly to minimise the energy losses and disruptions to heating delivery that occur during the defrost cycle.

The defrost cycle is necessary to remove ice build-up on evaporator coils. Ice build-up occurs from below 7 °C (especially in high humidity), when any water vapour in the air will start to condense and freeze onto the evaporator (outdoor heat exchanger) coils.

This will disrupt the heat flow, and the coils must be de-iced for heating to be able to continue.

To remove ice build-up on the coils, most heat pumps have a defrost cycle where the system switches into cooling mode (taking some heat from inside the home), which effectively cools the room slightly.

Some systems have a closed-loop cycle to use waste heat from the motor/compressor to defrost the coils.

During defrosting, no heat is supplied to indoors.

Undersized heat pumps will need to defrost frequently in low ambient temperatures, reducing the system's efficiency and ability to provide sufficient heating.

The defrost cycle control is either:

- a time-temperature defrost, starting and stopping at preset times (30-, 60- or 90-minute intervals); or
- on-demand defrost, which is generally more efficient because it operates only when it detects frost build-up on the outdoor coil by monitoring air and coil temperature, outdoor airflow, pressure differential across the coil and refrigerant pressure.

Note: If a heat pump goes into multiple defrosts over a short time frame (1-2 hours), the unit should be serviced. This issue could also occur where the heat pump is undersized and struggling to heat the space.

Systems that include a dry-coil defrost cycle briefly run the outdoor fan at maximum speed before the system starts to heat again, to remove any water that may still be on the coil fins and would immediately refreeze. This operation can be seen by water vapour blowing from the outdoor unit before the heating cycle resumes.

4.0 Designing a heat pump system

This section describes the steps for designing a heat pump system that will perform as efficiently as possible to meet the customer's needs.

4.1 Steps for designing a heat pump system

For a well-designed heat pump follow the four steps shown in Table 4.1. Each step is described in detail in Sections 4.3 to 4.7.

Table 4.1 Designing a heat pump system

Step	Action
1	Determine requirements (Section 4.3): <ul style="list-style-type: none"> • for heating/cooling • for the building • for the environment (e.g. protection for system components in coastal/geothermal regions) • for the type of unit suited to the room.
2	Determine heating capacity (kW) requirement and external design temperature (Sections 4.4 and 4.5).
3	Select the system/model to suit the design requirements and occupant preferences (Section 4.6).
4	Select the locations of the indoor and outdoor units (Section 4.7).

4.2 The importance of correct heat pump sizing

Correct heat pump sizing is critical to efficiency and performance. Select a unit that can provide the required heating capacity at the external design temperature relevant for the location of the home or building.

If the heat pump capacity is too low, the system will use more energy than necessary (increasing running costs), will likely need to defrost more frequently during heating operation, and may not be able to provide sufficient heating/cooling to achieve the indoor temperatures required for occupant comfort (Table 4.2).

The extra running costs of an undersized heat pump generally outweigh the additional cost of installing a unit that is the next size up.

Selecting a slightly oversized heat pump provides a safety margin to ensure that heating/cooling requirements will be met. It may also result in improved energy efficiency.

However, significant oversizing should be avoided.

Table 4.2 Effects of incorrectly sized systems

If unit is:	Performance	Effects
Undersized	Operation may be in defrost mode too often (see 3.4 Impacts of defrost cycle on efficiency and heat output).	<ul style="list-style-type: none"> • System is not delivering heat. • System may be blowing out cold air.
	Operation may be at full capacity too often.	<ul style="list-style-type: none"> • Increased running costs. • Reduced efficiency. • Undue wear and tear, premature failure of equipment
Oversized significantly	Increased start-up power use.	<ul style="list-style-type: none"> • Increased running costs. • Reduced efficiency.
	Short cycling because output exceeds demand.	<ul style="list-style-type: none"> • Too much air movement (draught) even at low fan speed. • Increased noise. • Undue wear and tear.
	Runs at low load too often.	<ul style="list-style-type: none"> • Reduced efficiency.

Where the space being heated is large, installing two smaller units or a multi-split system may give better heat distribution within the space and better control than a large-capacity single unit.

4.3 Step 1: Determine requirements

As a first step, gather the information that you will need to determine what the most appropriate heat pump option is for a particular home. Use the checklists below to determine requirements for the system.

4.3.1 Checklist of heating/cooling requirements

- ☐ What is required? For example, is it mainly heating or cooling?
- ☐ What is the region and location of the building?
- ☐ Are there specific local conditions, such as microclimates within the climatic zones, which may influence selection?
- ☐ What are the seasonal high and low ambient temperatures?
- ☐ What type of home is the system for? For example, old, new, insulated.
- ☐ Is it for a typical single room or a large or open plan room/hallway (where more than one unit may be required)?
- ☐ What is the owner preference for the type of indoor unit? For example, a floor-mounted unit may be better for an older user to give more direct heat flow and allow easier access for maintenance. A high wall-mounted or ceiling-mounted unit can provide more effective cooling and allows occupants more flexibility with arranging furniture in the room.
- ☐ Does the owner prefer a unit that can be controlled remotely (e.g. a Wi-Fi enabled unit)?

4.3.2 Checklist of building conditions

- ☐ Building orientation.
- ☐ Window orientation and solar gain, particularly in summer.
- ☐ Areas of walls, ceilings, windows and floors.
- ☐ Building envelope; for example, air infiltration/heat loss around doors/windows.
- ☐ Insulation levels of walls, ceilings and floors.
- ☐ Single/double glazing.

4.3.3 Environmental requirements

Select a unit that is **suitable for the environment** it is being installed in.

For example, geothermal regions require the indoor and/or outdoor units, coil and pipework to be protected against atmospheric sulphur-containing gases that will cause corrosion of the coil.

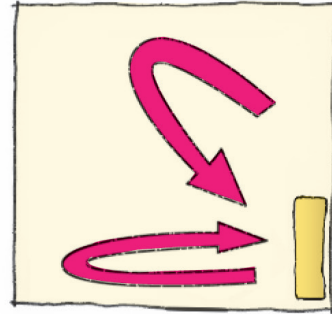
Coastal regions also require protection against corrosion for both the outdoor cabinet and the coils. Use a proprietary coil protectant available to installers in those areas.

4.3.4 Type of unit suited to room

Consider the options for airflow patterns in relation to room or space layout (Figures 4.1 – 4.4). All three types of unit can be used for heating or cooling. Different types may suit different people based on their own personal choice.

Floor console units are primarily designed for heating, as warm air rises and cold air falls (Figure 4.1). Consider the location of objects such as furniture that may interfere with airflow and cause short circuiting of the air back to the unit, reducing efficiency and performance.

Figure 4.1 Floor-mounted unit – horizontal and vertical air discharge (heating)



Ceiling-mounted units blow air down or out from the unit to circulate the warmed air within the room (Figures 4.2 and 4.3).

Figure 4.2 Ceiling-mounted unit – horizontal air discharge (heating)

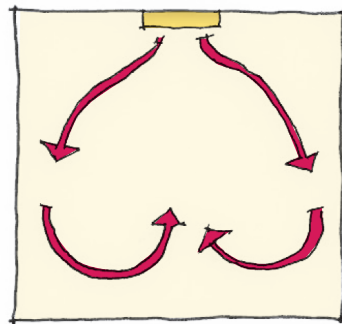
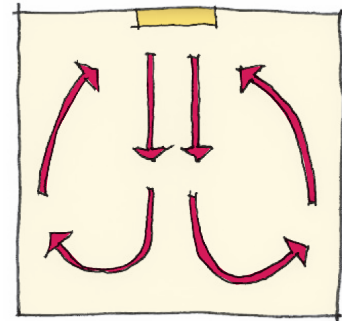
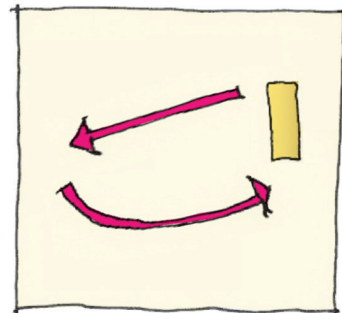


Figure 4.3 Ceiling-mounted unit – vertical air discharge (heating)



High wall-mounted units blow hot or cool air to mix with room air before dropping to the level of occupants (Figure 4.4).

Figure 4.4 Wall/high wall-mounted unit – horizontal air discharge (cooling)



4.4 Step 2: Calculate heat load requirement

Using the information from Step 1, you can now calculate the required heating capacity for the heat pump.

For rental homes, the Residential Tenancies (Healthy Homes Standards) Regulations 2019 include minimum requirements for heaters in the main living room. From 1 July 2019, a heat pump newly installed in the main living room of a rental home should at least have the heating capacity required by these regulations.

To determine the minimum heating capacity required by the Residential Tenancies (Healthy Homes Standards) Regulations 2019 you can either:

- use the heating assessment tool available on the Tenancy Services website, or
- do a manual calculation in accordance with Schedule 2 of the Residential Tenancies (Healthy Homes Standards) Regulations 2019.

Use these heater sizing methods for heat pumps installed in the living room of any home, not just rental homes. This will ensure the heat pump can meet the requirements if the home was to become a rental home.

These heater sizing methods are also suitable for rooms other than the main living room, for example a secondary living room or a bedroom.

4.4.1 Heating assessment tool on Tenancy Services website

Tenancy Services is part of the Ministry of Business, Information and Employment (MBIE). Its website provides information to residential landlords and tenants and includes an online heating assessment tool.

The online heating assessment tool aims to help landlords determine what type and capacity heater rental homes require in the main living room to comply with the Residential Tenancies (Healthy Homes Standards) Regulations 2019.

Whilst these regulations only apply to rental homes, the heating assessment tool is suitable for determining the required heating capacity for any room in both rental and owner-occupied homes in New Zealand.

The Tenancy Services heating assessment tool is available on:

www.tenancy.govt.nz/heating-tool

4.4.2 Manual calculation of required heating capacity

You can also calculate the required heating capacity manually. For details, refer to Schedule 2 of the Residential Tenancies (Healthy Homes Standards) Regulations 2019.

This calculation method is suitable for determining the required heating capacity for any room in both rental and owner-occupied homes in New Zealand.

The Residential Tenancies (Healthy Homes Standards) Regulations 2019 are available on: **www.legislation.govt.nz/regulation/public/2019/0088/latest/whole.html**

4.5 Step 3: Determine external design temperature

Because the heating capacity of a heat pump reduces with outdoor temperature, a unit must be selected that can provide the required heating capacity at the lowest winter outdoor temperature relevant to the local climate where the heat pump is being installed. The heat pump's capacity at that temperature will likely be different to the rated heating output capacity.

Table 4.3 lists external design temperatures for all territorial authority (local council) areas of New Zealand, as provided in Schedule 2 of the Residential Tenancies (Healthy Homes Standards) Regulations 2019.

Note that there may be some variation within each area. If the location where the heat pump is being installed has a particularly severe climate or microclimate (for example, a sunless or damp valley), this needs to be taken into consideration. In this case, the design temperature may be one or two degrees lower.

Table 4.3 External design temperatures by territorial authority (local council) areas

Territorial authority	Outdoor (°C)	Territorial authority	Outdoor (°C)
Ashburton District Council	-5	Otorohanga District Council	-3
Auckland Council	1	Palmerston North City Council	-3
Buller District Council	-3	Porirua City Council	0
Carterton District Council	-4	Queenstown Lakes District Council	-6
Central Hawke's Bay District Council	-3	Rangitikei District Council	-4
Central Otago District Council	-8	Rotorua Lakes Council	-3
Chatham Islands Council	-1	Ruapehu District Council	-5
Christchurch City Council	-4	Selwyn District Council	-4
Clutha District Council	-4	South Taranaki District Council	-1
Dunedin City Council	-4	South Waikato District Council	-3
Far North District Council	2	South Wairarapa District Council	-4
Gisborne District Council	0	Southland District Council	-6
Gore District Council	-4	Stratford District Council	-2
Grey District Council	-2	Tararua District Council	-3
Hamilton City Council	-3	Tasman District Council	-4
Hastings District Council	-2	Taupo District Council	-5
Hauraki District Council	-2	Tauranga City Council	0
Horowhenua District Council	-3	Thames-Coromandel District Council	-1
Hurunui District Council	-5	Timaru District Council	-5
Hutt City Council	-1	Upper Hutt City Council	-3
Invercargill City Council	-4	Waikato District Council	-2
Kaikoura District Council	1	Waimakariri District Council	-4
Kaipara District Council	1	Waimate District Council	-5
Kapiti Coast District Council	-3	Waipa District Council	-3
Kawerau District Council	-2	Wairoa District Council	0
Mackenzie District Council	-10	Waitaki District Council	-5
Manawatu District Council	-2	Waitomo District Council	-3
Marlborough District Council	-3	Wellington City Council	2
Masterton District Council	-4	Western Bay of Plenty District Council	-1
Matamata-Piako District Council	-3	Westland District Council	-2
Napier City Council	-2	Whakatane District Council	-2
Nelson City Council	-3	Whanganui District Council	-1
New Plymouth District Council	0	Whangarei District Council	2
Opotiki District Council	-2		

4.6 Step 4: Select a system to meet requirements

You should now have all the information needed to select the right heat pump system for the home's needs. Things to keep in mind:

- Inverter type units are recommended in most cases for their increased efficiency.
- Consider suitability for the environment (i.e. sea spray, sulphur from geothermal activity).

Some manufacturers provide performance guide charts for selecting a heat pump system similar to Table 4.4. You should use products with this information available, particularly in colder climates.

Where heating capacity data is not available for the precise external design temperature relevant to the installation site, use the heating capacity information for the nearest outdoor temperature available below the external design temperature.

Table 4.4: Example of a heat pump performance guide chart

Model A: Capacity 4.0 kW rated output															
Indoor (°C)	Outdoor (°C)														
20	-10			-5			0			2			7		
	Output	Input	COP	Output	Input	COP	Output	Input	COP	Output	Input	COP	Output	Input	COP
	2.4	0.77	3.12	2.88	0.91	3.15	3.7	1.1	3.31	3.8	1.12	3.4	4.1	1.18	3.5
Model B: Capacity 6.0 kW rated output															
Indoor (°C)	Outdoor (°C)														
20	-10			-5			0			2			7		
	Output	Input	COP	Output	Input	COP	Output	Input	COP	Output	Input	COP	Output	Input	COP
	3.6	1.3	2.76	4.32	1.54	2.8	5.1	1.71	2.98	5.2	1.75	3.0	6.1	1.9	3.2
Model C: Capacity 8.0 kW rated output															
Indoor (°C)	Outdoor (°C)														
20	-10			-5			0			2			7		
	Output	Input	COP	Output	Input	COP	Output	Input	COP	Output	Input	COP	Output	Input	COP
	4.8	1.85	2.59	5.65	2.05	2.75	6.2	2.25	2.8	6.4	2.4	2.7	8.1	2.6	3.1

As an example, for a required heating capacity of 5.6 kW and an external design temperature of +1°C, by referring to the example performance guide chart in Table 4.4, an 8 kW rated capacity heat pump should be selected as it is able to deliver 6.2 kW output at 0°C (nearest temperature below +1°C with data available), which will meet the heating capacity requirement. The 6 kW rated capacity heat pump model only provides 5.1 kW output at 0°C which is less than the required 5.6 kW and therefore insufficient.

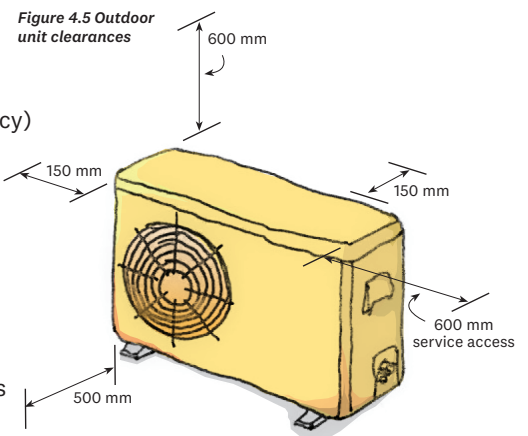
4.7 Step 5: Locate the units

Correct location of both outdoor and indoor units is essential for optimum performance. Many problems with poorly performing heat pumps are due to poor location of units.

4.7.1 Outdoor units

Locate outdoor units:

- to allow unimpeded air flow around the unit (to avoid the creation of a microclimate that reduces heat pump performance and efficiency)
- in a position that gets full sun in winter
- in accordance with the manufacturer's recommendations for distances to obstructions. If the manufacturer's recommendations are not given, provide the following minimum distances from obstructions:
 - 500 mm between air inlet and outlet faces
 - 600 mm above the unit
 - 150 mm to other faces (Figure 4.5).



Locate the units:

- to minimise refrigerant pipe run lengths and bends
- to give minimum pipe runs in accordance with the unit manufacturer's instructions
- where condensate can easily be drained away
- to allow access for service (minimum 600 mm) (Figure 4.6)
- where any blockage (such as from leaves or snow) is quickly seen and can be cleared away.

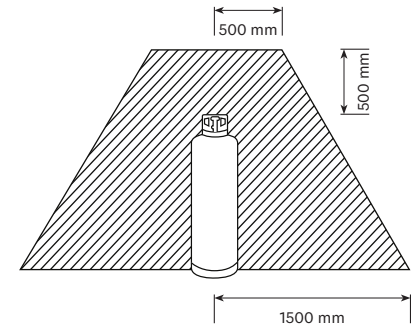
Figure 4.6 Service access




Locate the units:

- to be **protected from the sea spray in coastal areas**, sheltered from frost and strong wind (strong wind can cause the condenser fan to spin in reverse and burn out the motor, which is a particular problem when a unit is located on a roof)
- where condensation can be appropriately drained away (see **6.1.8 Positioning and connecting the condensate drainage pipe**) condensation will always be produced during heating and must be able to be drained safely
- in a well ventilated area, and at a safe distance from any gas sources or appliances:
 - 1.5 m clearance from an exchange LPG bottle (i.e. gas cylinders that get swapped and refilled offsite).
 - 3.5m clearance from an in-situ fill LPG bottle (i.e. gas cylinders that get refilled by tanker onsite)
 - 0.5 m clearance from a gas water heater.

Figure 4.7 Clearances required between outdoor unit and exchange LPG gas bottles



Within space 0.5 m above and 0.5 m laterally from any cylinder valve, extending 1.5 m laterally at the base of the cylinder.

 = Zone 2

NOTE:

- **DO NOT** locate where noise can cause a disturbance to home occupants or to neighbours (see Section 4.7.1.1 for more information)
- **DO NOT** locate under the house or a deck, or any location that may impede airflow, only install where there is ample space and clearance
- **DO NOT** locate below a window where the unit has a vertical discharge
- **DO NOT** locate so that multiple units are competing against each other for air flow
- **DO NOT** locate where the air outlet is directed to where people pass, such as across an accessway or path
- **DO NOT** locate the outdoor unit on a balcony or deck that is more than 1 m above a surface below in a way that facilitates climbing over the balustrades or railings. Any screen around the outdoor unit must not facilitate climbing and must not include toe holes.

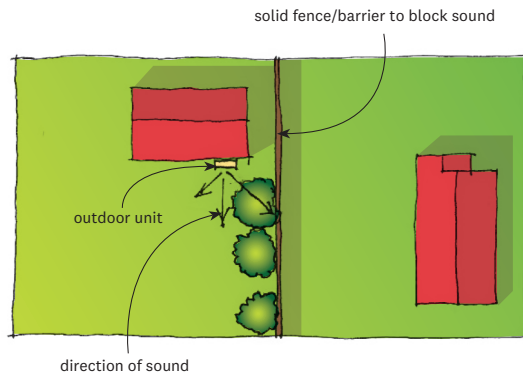
4.7.1.1 Avoid noise disturbance

Locate outdoor units where noise from the unit cannot transmit to and disturb the home occupant or adjacent properties. Do not install the outdoor unit under or close to bedroom windows. Comply with council bylaws regarding permitted noise levels at the property boundary.

There are several ways to reduce sound transmission:

- Locate the unit where a fence or solid barrier can block sound so that the line of sight between source and receiver is blocked (Figure 4.8).

Figure 4.8 Locate the outdoor unit where a solid barrier can block the sound



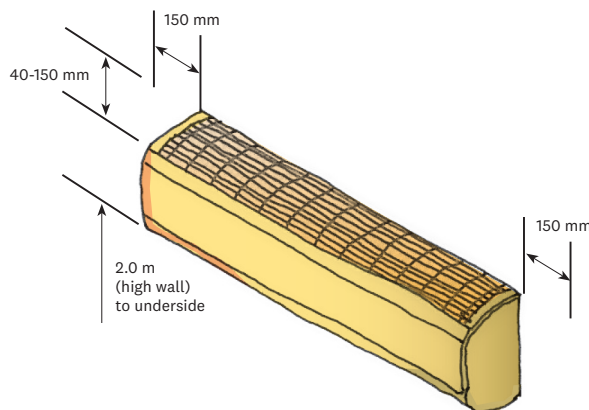
- At the same time avoid reflected sound transmission – consider the reverberation effects of lightweight materials such as corrugated iron fencing.
- Mount the unit on isolation mounting blocks or pads to absorb vibration.
- Ensure the owner is aware of the need to carry out regular maintenance to have worn bearings or other noisy parts replaced.
- Refer to the manufacturer's mounting instructions for recommended clearances to ensure airflow around the unit.

4.7.2 Indoor units

Locate indoor units:

- according to the type of unit, i.e. high wall, under-ceiling, floor-mounted
- on an external wall if possible
- to avoid directing airflow onto seating locations or electronic equipment
- to direct airflow to the coldest point in the room (but not towards a window)
- appropriately for room layout and airflow patterns
- in accordance with the manufacturer's recommendations for minimum clearances.

Figure 4.9 Wall-mounted indoor unit clearances



Otherwise allow:

- 40-150 mm minimum above and 150 mm minimum on either side of a wall-mounted unit
- 2.0 m minimum (measured to the bottom of the unit) above floor for a high wall or ceiling-mounted unit
- 50 mm minimum to each side for a floor console (Figure 4.9)
- so that a clear airflow path is maintained
- to minimise refrigerant pipe run lengths and bends (for each 90° bend, deduct 1% from the heat pump heating/cooling capacity)
- so that the condensate drainage pipe can drain to outside without the need for a condensate pump.

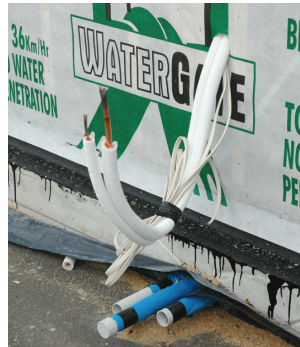
NOTE:

- **DO NOT** locate in a tight corner or space
- **DO NOT** locate behind a grille
- **DO NOT** locate so it directs air to a primary source of heat gain or loss, such as windows
- **DO NOT** locate where there may be any steam
- **DO NOT** locate within a kitchen or near an automatic insect repellent dispenser
- **DO NOT** locate above or close to any heat source, including electrical appliances, which could affect the performance or act as an ignition point.

4.7.3 Building work

4.7.3.1 New building

Figure 4.10 Pre-install pipework before building claddings are installed



The best time to install pipework and cables in a new building is when it is still under construction. Co-ordinate with the other trades and plan the layout and location of the system early in the building design stage so that penetrations through the building envelope can be made before the cladding is installed (Figure 4.10)

- Note that the penetration through the wall underlay has not incorporated a sleeve and has not yet been taped off with flexible flashing tape.
- Protect pipework and cables from being damaged by other trades. Sleeving or plastic inserts can be used to prevent pipes from being kinked.

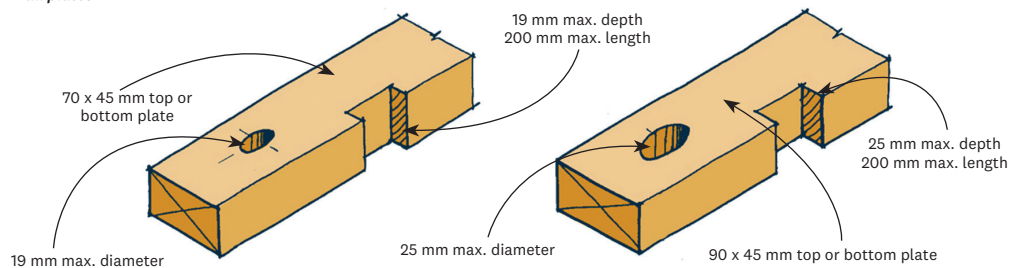
Building Code acceptable solution E2/AS1 gives guidance on making penetrations through the wall cladding and wall underlay – a copy is available for download from the building.govt.nz website.

If you make the penetration through the wall cladding system, then you are responsible for the weathertight performance of the penetration made. You will be liable for any non-performance due to your work.

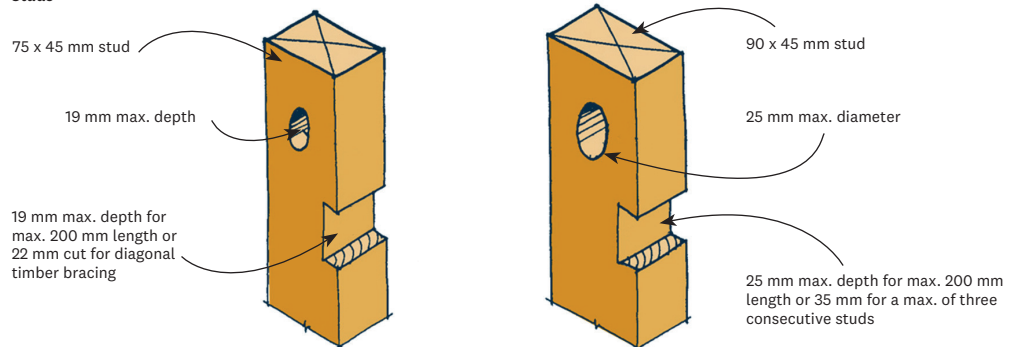
Any drilling, notching or cutting of load-bearing and support walls to fit pipes must be within the limits specified by NZS 3604:2011 Timber framed buildings. Figure 4.11 outlines the maximum permitted allowances for drilling and notching a top plate may be required.

Figure 4.11 Permitted notching and drilling of timber framing allowed under NZS 3604

Wall plates



Studs



NOTE: Notches in studs to be spaced at a min. of 600 mm apart.

4.7.3.2 Existing building

When installing units into an existing building:

- Identify the location of existing pipework, studs and cables before drilling holes or making penetrations in the building.
- Ensure any drilling, notching or cutting of load-bearing and support walls to fit pipes is within the limits specified by NZS 3604:2011 Timber framed buildings (shown in Figure 4.11).

5.0 Toolkit

Use the correct tools and equipment as per the following list.

Equipment

- ☐ Brazing equipment
- ☐ Set of standard hand tools
- ☐ Pipe benders
- ☐ De-burring tool
- ☐ Swaging set
- ☐ Flaring tools
- ☐ Wrenches
- ☐ Torque wrenches
- ☐ Pipe cutters
- ☐ Electronic scales
- ☐ Digital thermometer
- ☐ Oxygen free nitrogen gas cylinder with pressure gauge and manifold valve and flexible clear hose
- ☐ Leak testing equipment
- ☐ Electronic leak tester
- ☐ Vacuum pump with backflow prevention device
- ☐ Manifold set
- ☐ Hose adaptors
- ☐ Auto ignition gas torch
- ☐ Digital vacuum gauge
- ☐ Refrigerant specific valve core removal tool
- ☐ Tape measure
- ☐ Charge valve
- ☐ Compression or locked-ring jointing tool
- ☐ Recovery cylinder
- ☐ Charge hose and connector
- ☐ Stud finder
- ☐ Safety glasses, gloves, ear protection, safety boots, hard hats and other PPE

Materials

- ☐ Copper pipe (hard/soft drawn, twin-insulated, dehydrated)
- ☐ Pipe protection
- ☐ Pipe insulation
- ☐ Electrical cable
- ☐ Oil for flared joints (refrigerant compatible)
- ☐ Galvanised mild steel straps 120 x 25 x 0.5mm
- ☐ Galvanised pipe brackets 65mm diameter
- ☐ Galvanised nails 30mm
- ☐ Condensate drainage pipe, either smooth, hard PVC pipe (best practice option) or flexible, ribbed pipe
- ☐ Vinyl tape
- ☐ Electrical conduit
- ☐ Gas cylinder with refrigerant that is compatible with heat pump

6.0 Installing pipework

Good pipework gives a safe, efficient and reliable installation necessary for the heat pump system to perform properly. Too many joints, bends and long lengths can increase the risk of leaks and reduce efficiency, as it requires more energy for the compressor to pump the refrigerant around the system.

Many system failures occur due to poor workmanship of pipework installation. To reduce the likelihood of problems:

- pipes must be clean and moisture-free
- use pipe sizes recommended by the manufacturer
- design pipelines for the shortest runs and minimum number of bends to limit internal friction:
 - floor consoles may not have a minimum pipe run and can be installed back to back
 - high wall units have a minimum pipe run, typically 3.0-5.0m – check the manufacturer's instructions for this information
- insulate and protect all pipework with a rated UV capping
- slope pipes towards the compressor to allow any oil that gets into the pipes to drain back to the compressor sump (some compressor oil will likely get into the pipeline in any system, and if it remains there it will de-rate the system's pressure and hence its efficiency)
- install pipelines to allow for seismic, wind and thermal movement
- pipes must be rated for the refrigerant pressure being used in the system.

6.1 Pipework installation

Good-quality pipework involves the following steps:

1. Selecting suitable pipework and jointing (see Sections 6.1.1 and 6.1.2).
2. Ensuring pipework is clean (see Section 6.1.3).
3. Making bends properly (see Section 6.1.4).
4. Creating flared joints properly (see Section 6.1.5).
5. Ensuring pipework is well-supported (see Section 6.1.6).
6. Insulating refrigerant pipework (see Section 6.1.7).
7. Positioning and connecting the condensate drainage pipe properly (see Section 6.1.8).

6.1.1 Types of pipework

Figure 6.1 Twin-insulated and dehydrated pipe



Copper pipework forms the closed-coil system through which refrigerant flows. Copper may be hard-drawn or soft-drawn.

Hard-drawn is recommended as best practice for pipe diameters of 20 mm and more, but soft-drawn is commonly used because it is easier to work with.

Use UV-rated twin-insulated and dehydrated pipe, which is easier to install in trunking and in ceiling spaces (Figure 6.1).

6.1.2 Types of jointing

You can joint pipes by brazing or compression (lock-ring) jointing.

6.1.2.1 Brazed connections

Brazed joints provide the best resistance to pressure, temperature and stress vibrations, and using this type of jointing is recommended as good practice. Pipe joints behind the indoor unit and in wall spaces must be brazed, as brazed pipe connections reduce the likelihood of leaks and take up less space. Carry out all brazing with oxygen-free nitrogen (OFN) circulating through the pipework – this will avoid a build-up of carbon in the pipe, which will cause oil sludging, filter blockage and eventual system failure.

6.1.2.2 Compression connections

Compression connections are an alternative to brazed connections and are far more reliable than flare joint connections. Compression connections, as shown below, have become more popular in recent years for a variety of reasons:

1. 100% leak free, unlike flare connections (provided the correct assembly procedure is followed).
2. Clean, efficient and reliable.
3. No need for heavy brazing gear and associated flame, especially where there is a special fire hazard.
4. Able to be installed indoors while building occupants are around.
5. Suitable for HC, HFC, HFO and CO2 refrigerants.
6. UL, TUV, and EN/ISO approved.
7. Max. 75 bar operating pressure, so suitable for high pressure refrigerants.
8. No requirement for nitrogen for brazing or purging.
9. Ability to connect differing pipe materials together.
10. Available from 6mm (1/4") to 42mm (1 5/8").

Figures 6.2 - 6.10 show an example of assembling a compression connection.

Figure 6.2 Step 1: Cleaning the tube end



Figure 6.3 Step 2: Roughing the end surface

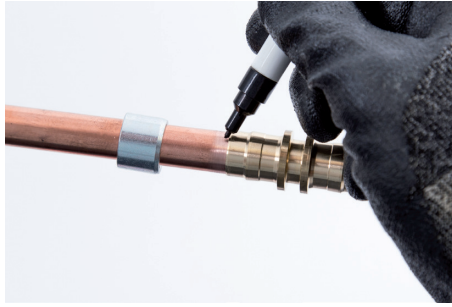
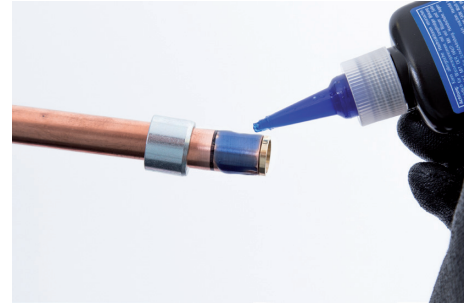
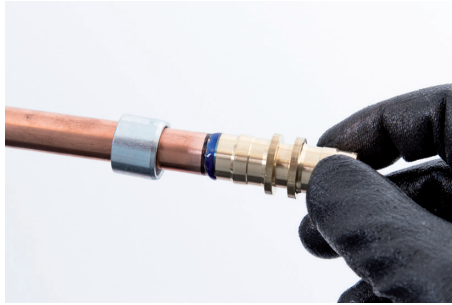
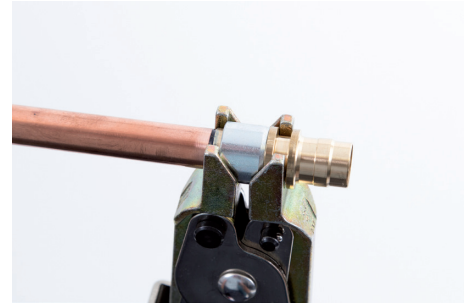
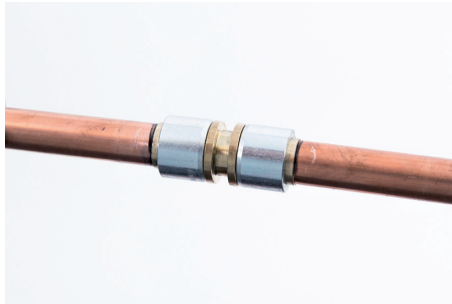


Figure 6.4 Step 3: Fitting insert when required to support pipe



Figure 6.5 Step 4: Adding ring



Figure 6.6 Step 5: Fitting connector marking stopline*Figure 6.7 Step 6: Applying sealant solution**Figure 6.8 Step 7: Fitting connector**Figure 6.9 Step 8: Compressing one connection end**Figure 6.10 Step 9: Completed compression connection*

6.1.2.3 Flared joints

Flared joints have a higher risk of the refrigerant leaking but may be required where connecting the pipe to the outdoor unit.

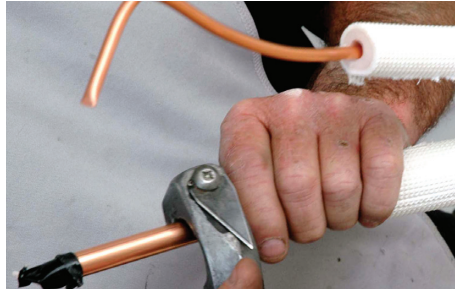
If poorly installed, flared joints have a high risk of the refrigerant leaking. They can also be easily modified by unqualified persons. Flared joints may be suitable if installed correctly and in accordance with the manufacturer's installation instructions.

See **6.1.5 Creating flared joints** for further information.

6.1.3 Maintaining cleanliness of pipework

Ensure that all pipework is clean and suitable for the system by:

Figure 6.11 Pipe opening facing down when cutting



- Holding the pipe opening facing down when cutting (Figure 6.11).
- Removing metal filings from inside pipework after cutting.

Figure 6.12 Cover pipe ends



- Always keeping pipe ends covered with caps, by brazing or taping (Figure 6.12)
 - covering pipe ends prevents moisture, dirt or foreign matter getting into the pipes, particularly when pushing or pulling through wall cavities.

NOTE: DO NOT let uncapped ends of pipe touch the ground.

6.1.4 Making bends

Bend all copper pipes over 9.5 mm or 3/8" diameter with the correct-sized pipe bender (Figure 6.13) – handmade bends may kink or have a reduced internal pipe dimension, which reduces refrigerant flow and performance.

Figure 6.13 Pipe bender



When pre-insulated pipe is used:

- Split the insulation and cut away from around the pipe.
- Bend the pipe using the correct-sized bender.
- Replace the insulation and tape together using vinyl tape or insert a copper bend using brazed connections, then insulate.

6.1.5 Creating flared joints

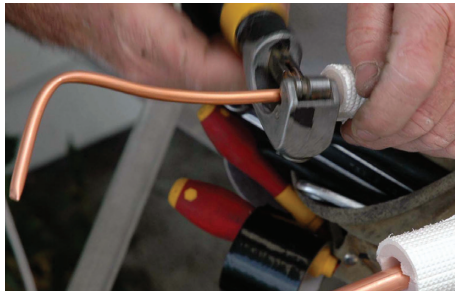
Flared joints must be formed by an experienced installer, as the joints have a high risk of the refrigerant leaking.

Flaring of joints is not a simple task and requires the correct tool for the refrigerant gas being used and the pipe wall thickness.

Units using R410A, R32 or other high pressure refrigerants require a specific flaring tool to cope with the refrigerant pressure and the pipe thickness.

Follow the correct steps to create a sound flared joint.

Figure 6.14 Cut pipe with tube cutters



- Cut pipe with tube cutters to give a cut that is straight across and clean (Figure 6.14) – use a sharp blade and cut slightly longer than measured length.

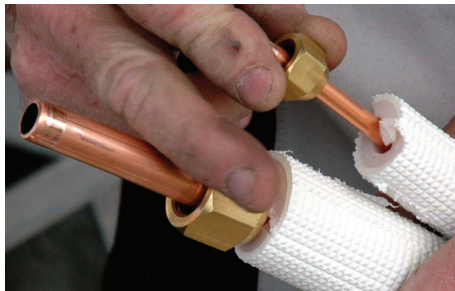
Figure 6.15 Remove all burrs



- Remove all burrs with a de-burr tool (Figure 6.15).
- Remove any metal filings that may have fallen into the pipe.

DO NOT use a saw blade to cut the pipe.

Figure 6.16 Place the flare nut over the pipe end



- Remember to remove the flare nut from the unit and put it over the pipe end (Figure 6.16) – it is not possible to put it on after flaring the pipe.

Insufficient tube protrusion could lead to a joint that will come apart with vibration and is more likely to leak.

Figure 6.17 Flare the end of the tube (A)



- Flare the end of the tube using the correctly-sized flare tool and ensure that the correct amount of pipe protrudes (Figures 6.17 – 6.20).

Excess tube protrusion could stop the flare connection sealing properly when the nut is tightened.

Figure 6.18 Flare the end of the tube (B)

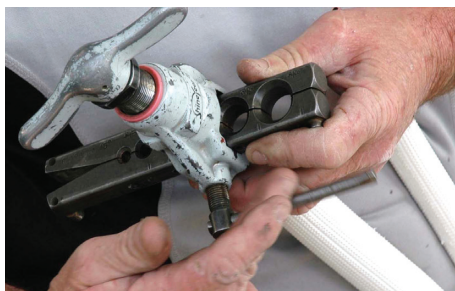


Figure 6.19 Flare the end of the tube (C)



Figure 6.20 Flare the end of the tube (D)

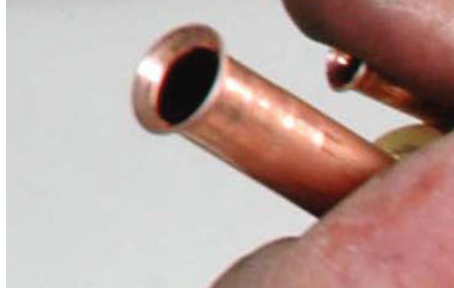


Figure 6.21 Apply oil to the back of the flared pipe and the flare joint



- Apply oil to the back of the flared pipe and the flare joint. Use oil compatible with the refrigerant before connecting pipes, i.e. use polyolester oil (POE) with R-410A or R32 refrigerant (Figure 6.21). Oil reduces the possibility of tearing the flare when the nut is tightened. Oil must not be allowed to contaminate the refrigerant.

Figure 6.22 Connect the pipes (A)



Figure 6.23 Connect the pipes (B)



- Hand-fasten the flare nut to connect the pipes (Figures 6.22 and 6.23).

Figure 6.24 Tighten connection (A)



Figure 6.25 Tighten connection (B)



- Tighten the connection using two spanners to the torque recommended by the manufacturer (Figures 6.24 and 6.25) – use a torque spanner to achieve the correct torque. Torque against the second spanner (to secure the load while tightening). Never tighten the connection just against the joint.

NOTE:

- **DO NOT** mix polyolester oil and mineral-based oil
- **DO NOT** use leak lock or PTFE tape – these are not plumbing joints
- **DO NOT** cross thread the fittings, as you may damage them.

6.1.6 Ensuring pipework is well-supported

Well-supported pipes help ensure the durability and performance of the system by:

- reducing the possibility of cracking or oil traps due to sagging
- eliminating vibration
- eliminating a liquid hammer effect or damage from fluid movement
- resulting in better fluid handling characteristics.

As good practice, fix copper tubing at the spacings given in Table 6.1.

Table 6.1 Fixing spacings for copper tubing

Tubing diameter (mm)	Maximum fixing spacing (m)
< 6.5	1.0
6.5 – 20	1.5
25	2.0
32 – 40	2.5
> 50	3.0

Source: Australia and New Zealand Refrigerant Handling Code of Practice 2007 clause 5.18.

6.1.7 Insulating refrigerant pipework

- Insulate all refrigerant pipework to improve the efficiency of the heat pump system.
- Use a proprietary insulated pair coil, which is heat resistant up to 100oC.

6.1.8 Positioning and connecting the condensate drainage pipe

6.1.8.1 From the indoor unit

Position and connect the condensate drainage pipe from the indoor unit.

- Connect the drainage pipe to the drainage pipe outlet from the unit – if there are two drainage outlets in the condensate tray (indoor unit), connect the drainage pipe to the appropriate side, i.e. to suit the wall outlet location, and insert a rubber bung into the other outlet.
- Wrap the indoor and through wall section of the drainage pipe in polyurethane foam insulation (see **6.1.7 Insulating refrigerant pipework**).
- Use smooth, hard PVC-U drainage pipe if drainage pipe runs laterally – flexible, ribbed drainage pipe can be used for vertical drainage.
- Provide sufficient fall for condensate to drain away.
- Run the condensate hose beneath the refrigerant line when going through the wall, to ensure a free flow of condensate.
- Connect sections of pipe with pipe solvent – where pipe sizes must be stepped down, connect sections with silicone sealant internally, then tape around join with vinyl tape.
- Run the indoor drainage pipe:
 - to the outdoor unit and drain away to the same location as the outdoor unit condensate
 - outdoors to drain onto lawn or garden – discharge into the stormwater system is permitted in some areas (do not discharge into a gully trap).
- Where pipe traps are recommended by the manufacturer to reduce negative pressure, install in accordance with the manufacturer's specifications.
- Do not allow the condensate outlet pipe to be immersed in water, as this can cause an air lock and prevent water drainage under gravity.
- Use mechanical connectors (jubilee clips) to connect the hoses
- Locate indoor units suitably to avoid the need for a condensate pump. Where unavoidable, install a condensate pump in accordance with the manufacturer's specification. Advise the owner of the maintenance requirements of the pump and that it may make noise. Failure to do so will void any claim for water damage.

NOTE:

- **DO NOT use flexible drainage piping in internal wall spaces**
- **DO NOT use flexible ribbed drainage piping for lateral pipe runs, as water may sit in the ribs or low points may occur in the pipe**
- **DO NOT use electrical conduit as a drainage pipe.**

6.1.8.2 From the outdoor unit

Discharge condensate:

- into a suitable drain connection
- onto a grassed or planted area
- into a stormwater drain (where permitted by local council regulations).

NOTE: DO NOT discharge where it can run over a footpath as it may become slippery or freeze in winter.

6.2 Pipework pre-installation in new buildings

In a new building, install pipework before wall linings and claddings are put on.

Procedure

- Unroll and lay out pipe and connection cable to connect indoor and outdoor units.
- Tape pipe and connection cable together with vinyl tape at 1-1.5 m spacings.
- Establish the location and centre of the indoor unit.
- Establish the location of the outdoor unit.
- Run taped pipe/cable across the top of the bottom truss chord/ceiling joist between the unit locations (Figure 6.26).
- Fix with galvanised mild steel pipe brackets.

Figure 6.26 Run pipe/cable across truss chord/ceiling joist



Indoor unit location

- Notch the top plate and studs to a maximum depth of 25 mm (for 90 x 45 mm timber) or 19mm (for 70 x 45 mm timber) to insert pipe/cable (Figures 6.27 and 6.28).

Figure 6.27 Notch the top plate and studs (A)



Figure 6.28 Notch the top plate and studs (B)

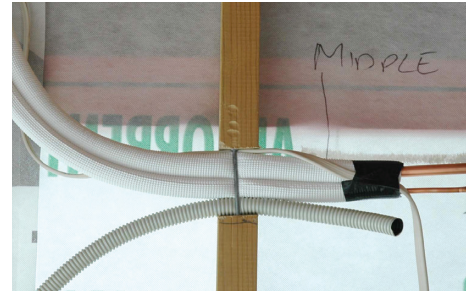


- Insert pipe/cable into notch and fix galvanised mild steel strap over to hold securely in position (Figure 6.29). Notching and drilling must not exceed the limits given in NZS 3604: 2011– see Figure 4.11. Protect pipe against damage caused by other trades.

Figure 6.29 Fix galvanised mild steel strap to hold pipe/cable



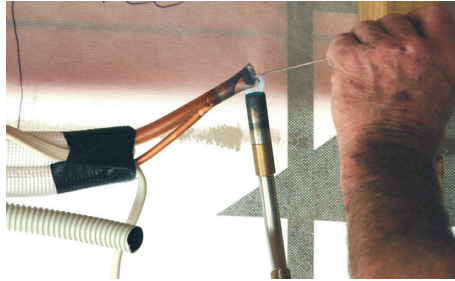
Figure 6.30 Wedge the pipe cable end into the stud



- Wedge the pipe cable end into the stud in readiness for connection to the indoor unit (Figure 6.30) – use a lightly-fixed and wedged nail that can easily be removed to hold the pipe/cable flat for interior lining fixing.
- Braze pipe ends closed to keep moisture and debris out (Figure 6.31).

Once brazed, pressurize pipework with dry nitrogen. If the pipes get damaged, the gas escapes, alerting other tradespeople to the fact that they have damaged the pipe. If you return and find the gas is gone, then you know pipes have been damaged.

Figure 6.31 Braze pipe ends closed



- For floor-mounted units on internal walls:
 - fix pipe/cable in notched dwangs
 - drill holes and feed the pipes through
- Feed pipes through a hole in the building wrap to outside and seal to weatherproof around pipe.

NOTE: DO NOT CUT OUT MORE TIMBER THAN NECESSARY.

Outdoor unit location

- Notch the top plate and studs sufficiently to insert pipe/cable. See Figure 4.11 for limits on notching and drilling framing.
- Insert pipe/connection cable and power cable (run from meter board) into notches and fix galvanised mild steel strap over to hold securely in position (Figure 6.32).

Figure 6.32 Fix galvanised mild steel strap to hold pipe/connection cable



Figure 6.33 Feed pipe/cables through building wrap



Figure 6.34 Seal pipes or sleeve



- Feed pipe/cables for connection to outdoor unit through a hole cut in building wrap (Figure 6.33). Installing a sleeve is recommended as shown in Figure 7.4.
- Seal pipes or sleeve with flexible flashing tape to weatherproof around pipework and cables (Figure 6.34).
- Braze pipe ends closed to keep moisture and debris out.
- Leave pipe/cable neatly coiled and taped. Note that the taping off has not been completed in Figure 6.34, nor has a sleeve been used as shown in Figure 7.4.

7.0 Heat pump installation

This section covers good-quality and safe installation of the indoor and outdoor heat pump units, connecting the units to pipework, testing the system for pressure/leaks and evacuation of the system (which must occur after pressure testing).

Some general rules for installing heat pump units are:

- follow the manufacturer's instructions
- use tools and equipment appropriate for the task and in a well-maintained condition
- ensure components are compatible
- keep the entire system clean and dry.

7.1 Pre-installation checklist

Before installing the heat pump units, check the following:

Unit components

- ☐ Check that the unit is what was specified and that model numbers match.
- ☐ Remove the unit from the packaging and check that all components are supplied.
- ☐ Check for any damaged components.
- ☐ Ensure that installation and owner manuals are supplied.

Trade co-ordination

- ☐ Confirm on-site trade co-ordination between the installer, builder (for new construction) and the electrician (only a registered electrician can hard wire the heat pump units).

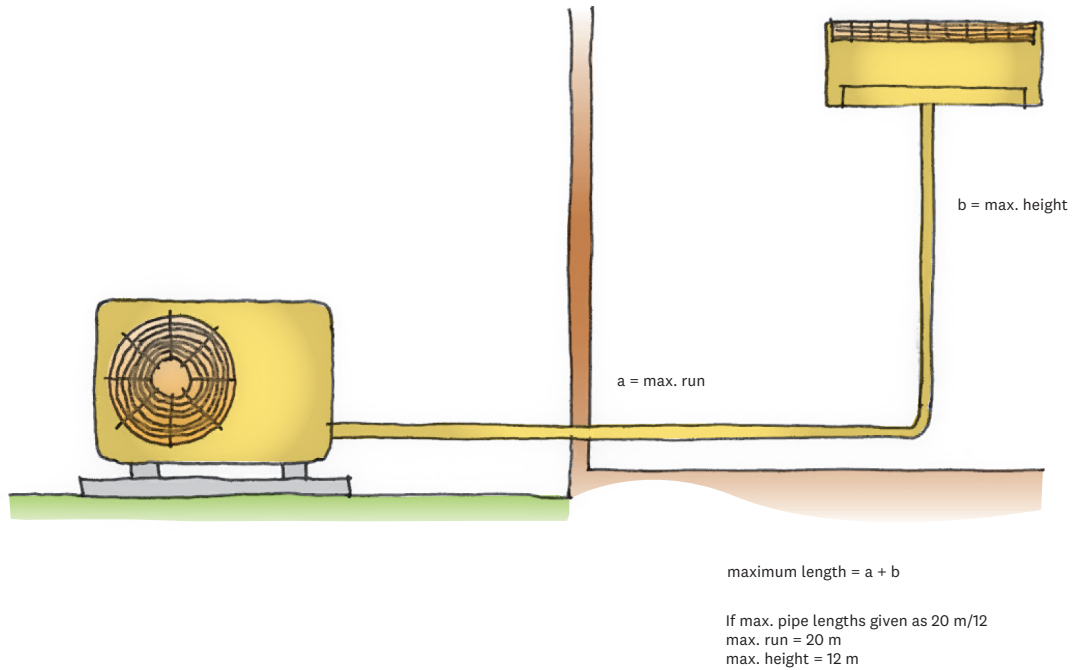
Health and safety

- ☐ Ensure appropriate health and safety procedures are in place and implemented to comply with the Health and Safety at Work Act 2015 and any other applicable legislation or standards (e.g. electrical safety requirements, flammable refrigerant handling requirements).
- ☐ Appropriately plan the installation including considering the health and safety risks relevant to the installation works, and what steps are required to control those risks before work commences.

Install location

- ☐ Check and measure indoor and outdoor locations for available space, access and required clearances for installation and servicing (see 4.7 Step 5: Locate the units).
- ☐ Check the system pipe run does not exceed maximum length and differential height recommended by the manufacturer (Figure 7.1).
- ☐ Confirm the walls are able to provide fixing and support.
- ☐ Identify the location of a suitable power source (see 9.0 Electrical requirements).

Figure 7.1 Maximum pipe length and height



7.2 Installing the indoor unit

Check the manufacturer's instructions for minimum clearances – otherwise allow clearances as given in **4.7 Step 5: Locate the units.**

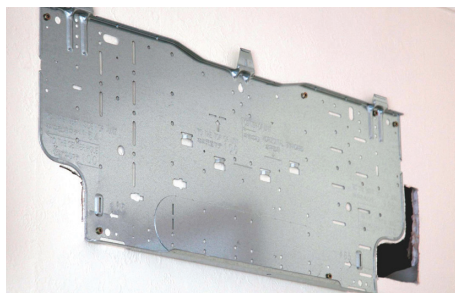
- **New building:**

- Locate the pre-installed pipework.
- Have any required dswanging added.

- **Existing building:**

- Locate studs/framing on which to fix the installation plate. Plate should be located to span across two stud positions.
- Check the structural integrity of the wall.
- Insert dswanging between studs for fixing support if two studs in suitable positions are not available.

Figure 7.2 Screw-fix installation plate



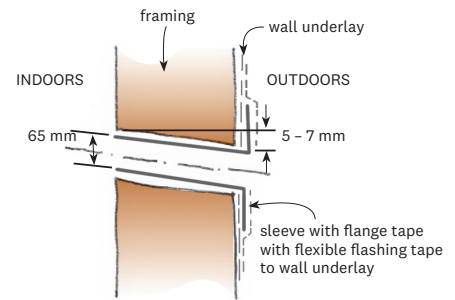
- Use a level to check that the installation plate is horizontal before fixing.
- Do not bend the back plate during fixing – if necessary, pack behind.
- For framed walls, screw-fix the installation plate through the wall into the framing behind (Figure 7.2).
- For concrete/concrete masonry walls, bolt-fix the installation plate using anchor or screw bolts.

Figure 7.3 Drill a hole through the wall



- Drill a hole in the wall: Using a 65 mm diameter core drill, drill a hole through the wall to the right or left of the installation plate as required (Figure 7.3). Drill the hole with a slight slope to the outside for drainage (Figure 7.4).

Figure 7.4 Slope of wall penetration



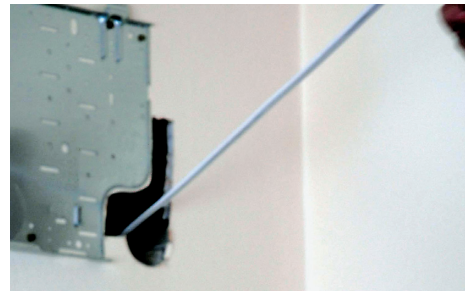
- Check that the wall space is free from electrical cables, plumbing and cross bracings before drilling holes.

Figure 7.5 Release the tubing and drainage hose



- Attach the indoor unit: Release the tubing and drainage hose from the back of the indoor unit ready for connection to the pipework (Figure 7.5).

Figure 7.6 Feed the connecting cable through the wall



- Feed the connecting cable from the outdoor unit through the hole in the wall and connect to the indoor unit (Figure 7.6).

Figure 7.7 Tape tubing, drainage pipe and connecting cable together



- Tape the tubing, drainage hose and the connecting cable together, ensuring that the drainage hose is on the low side of the bundle (Figure 7.7). If you route the drainage hose inside the room, insulate it to prevent condensation forming that may damage furniture or fittings.

Figure 7.8 Feed taped bundle through the hole



- Lift the unit into position and feed the taped bundle through the hole (Figure 7.8).

Figure 7.9 Attach unit to wall bracket (A)



Figure 7.10 Attach unit to wall bracket (B)



- Attach the unit to the wall bracket (Figures 7.9 and 7.10).

Figure 7.11 Ensure unit is securely seated



Figure 7.12 Taped pipes, drainage pipe and connection cable through hole



- Ensure that the unit is securely seated (Figure 7.11).
- Fill gaps around the pipe work in the opening formed using a proprietary seal.
- Install cover and face plate to unit. Check that all holes through the wall lining are hidden by the installed unit.
- Feed taped pipes, drainage pipe and connection cable through the hole to the outside (Figure 7.12). Ensure that the condensate drain is at the bottom of the grouped pipes and that there are no kinks in it.

Figure 7.13 Expose flared pipe ends



- Remove tape and expose flared pipe ends for connection to copper piping (Figure 7.13) – see **7.4 Connecting piping to indoor and outdoor units.**

NOTE: DO NOT use flexible drainage hose inside existing walls unless fully accessible – if it becomes kinked, it may block and cause leakage inside the wall.

7.3 Installing the outdoor unit

Figure 7.14 Unobstructed gap under outdoor unit fixed on concrete pad cast in place



Install the outdoor unit so that:

- it sits level
- it cannot fall over
- the weight is fully supported to prevent sagging
- it has an unobstructed gap under it (Figure 7.14)
- it creates no vibration
- there is a suitable clearance (about 100mm) underneath to allow for hosing and clearing of leaves and dirt
- fixings used are corrosion-resistant – typically requires stainless steel.

The outdoor unit can be fixed on:

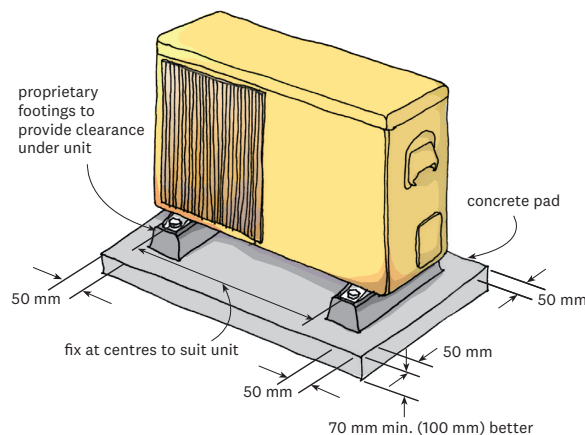
- a concrete pad cast in place or a single piece pre-cast slab at least 40 mm thick (see Section 7.3.1)
- a concrete patio or balcony (see Section 7.3.2)
- a timber slatted deck with anti-vibration mounts (see Section 7.3.3)
- brackets fixed to a foundation or wall (see Section 7.3.4)
- the roof where the installation has been specifically designed (engineered) to accommodate live loads and wind forces acting on the roof, and it incorporates anti-vibration mounts (see Section 7.3.5)
- a specified base in accordance with manufacturer's instructions.

Proprietary mounting systems for roofs and walls are available and should be installed in accordance with the supplier's instructions.

NOTE: DO NOT fix the unit onto a waterproof deck or a membrane roofing system, as the fixings will penetrate and compromise the waterproofing.

7.3.1 Installing an outdoor unit on a concrete pad

Figure 7.15 Concrete pad construction



- Construct the pad as shown in Figure 7.15 (check construction if done by others) or place and level a single unit 950 x 450 x 50 mm thick pre-cast concrete slab.
- Fix proprietary mounting rails, where supplied, or hot-dip, galvanised mounting rails at centres to suit the unit.
- Securely fix the mounting rails to the concrete with Grade 316 stainless steel masonry anchors or screw bolts, using two fixings per rail.
- Check that rails are level before tightening – pack with plastic shims as necessary to level.
- Fix the unit to the rails and tighten fixing bolts/anchors.

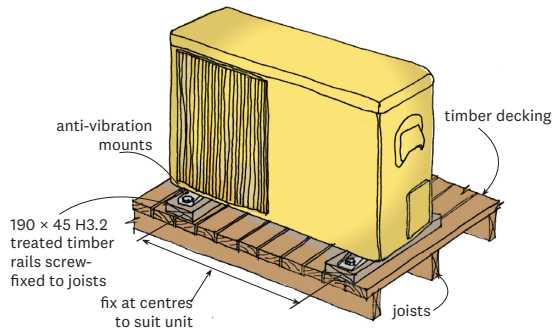
7.3.2 Installing an outdoor unit on a concrete balcony or patio

- Fix proprietary mounting rails (where supplied) or hot-dip galvanised mounting rails over anti-vibration mounts, at centres to suit the unit.
- Securely fix the mounting rails to the concrete with Grade 316 stainless steel masonry anchors or screw bolts, with two fixings per rail.
- Check that rails are level before tightening – pack with plastic shims as necessary to level.
- Fix the unit to the rails and tighten fixing bolts.

NOTE: DO NOT fix units to waterproof concrete or timber-framed decks.

7.3.3 Installing an outdoor unit on a timber deck

Figure 7.16 Fixing unit to a timber deck



- Fix hot-dip galvanised mounting rails into the joists with 75 mm long stainless steel screws. Alternatively, fix the mounting rails to 190 x 45 H3.2 treated timber rails laid on flat that are screw-fixed to the decking joists with 115 mm long stainless steel screws (Figure 7.16). Provide anti-vibration mounts or pads. Fix hot-dip galvanised mounting rails through the rails and joists with 75 mm long stainless steel screws.

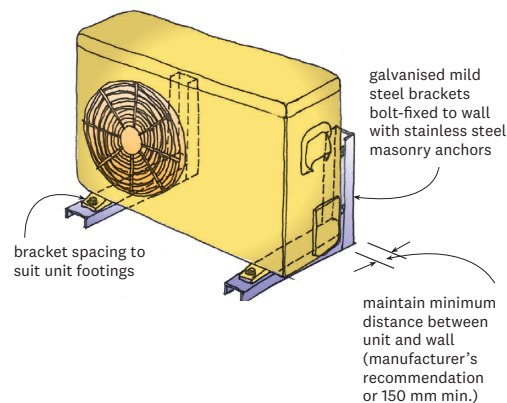
Figure 7.17 Pack with plastic shims to level



- Check that rails are level before tightening – pack with plastic shims as necessary to level (Figure 7.17).
- Fix the unit to the rails and tighten fixing bolts.

7.3.4 Installing an outdoor unit on a foundation or wall (concrete/concrete masonry only)

Figure 7.18 Wall-mounted unit on brackets – masonry wall



- Check the structural integrity of the wall or foundation.
- Bolt-fix hot-dip, galvanised brackets or proprietary brackets to the wall or foundation using stainless steel masonry anchors or screw bolts (Figure 7.18).
- Check that the brackets are level before tightening.
- Waterproof around fixings according to the material.
- Fix the unit to the brackets.
- Anti-vibration pads may be used.
- Ensure the ground underneath is stable, compact and level
- Ensure clearance to ground is sufficient and as per manufacturer's instructions.

NOTE: Outdoor units may be able to be wall-mounted to some lightweight claddings but the connections and weatherproofing details must be specifically designed to maintain the integrity of the weatherproofing.

7.3.4.1 Installing an outdoor unit onto the roof

It is not recommended to install a heat pump onto a roof, due to noise vibration transfer, service accessibility, exposure to elements and moisture ingress.

However, if you do, adhere to the following:

- Roof installations must be specifically designed.
- Always check and follow the instructions of the roofing system manufacturer.
- Screw-fix hot-dip, galvanised brackets or a proprietary mounting system into the roof framing. If mounting on timber base, use painted H3.2 treated timber.
- Use anti-vibration mounts.
- Insert ethylene propylene diene M-class (EPDM) rubber washers between the bracket and the roofing.
- Check that the brackets are level before tightening.
- Seal all fixings as for the rest of the roof fixing; for example, use EPDM or neoprene.
- Fix the unit to the base.

NOTE:

- **DO NOT mount units on concrete or clay tile roofs (tiles are not strong enough to allow mounting and the weight of the installers working on the roof)**
- **DO NOT mount directly onto metal roofing, as roofing can act as a sound amplifier and direct fixing may cause corrosion of the roofing**
- **DO NOT let CCA treated (tanalised) timber come into direct contact with galvanized steel roofing as it is not compatible.**

7.4 Connecting piping to indoor and outdoor units

Connection of piping to indoor and outdoor units must be done in the following order:

1. Connect the piping to the indoor unit (see Section 7.4.1).
2. Fix trunking (see Section 7.4.2).
3. Connect the piping to the outdoor unit (see Section 7.4.3).

7.4.1 Connect the piping to the indoor unit

Figure 7.19 Bind insulation with vinyl tape



- Use twin-insulated and dehydrated copper piping.
- Cut and flare the copper pipes for connection to the indoor unit (see **6.1.5 Creating flared joints**).
- Apply oil to both the flare and the indoor unit, ensuring that the oil is compatible with the refrigerant.
- Align and connect the pipes and tighten the flare nut by hand.
- Tighten the flare nut connections using two spanners to the correct torque.
- Overlap the connection pipe and indoor pipe insulation.
- Bind the insulation with foam insulation tape, then follow with vinyl tape (Figure 7.19).

Figure 7.20 Tape drainage hose to drainage outlet



- Connect and tape the drainage hose to the drainage outlet (Figure 7.20).

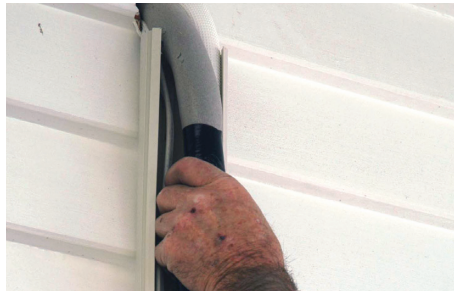
7.4.2 Fix trunking

Figure 7.21 Install trunking neatly



- Screw-fix proprietary trunking to the exterior wall from the outlet to the outdoor unit.
- Use stainless steel screws.
- Install trunking neatly in straight runs with 90° angles, tight weather seals and waterproof flashings (Figure 7.21).
- Run horizontal trunking with a slight downhill slope if it contains the condensate drainage pipe.

Figure 7.22 Fit refrigerant piping, drainage pipe and connecting cable into trunking



- Fit refrigerant piping, drainage pipe and connecting cable into trunking (Figure 7.22).
- Attach trunking cover.

Figure 7.23 Fill hole around piping with sealant



- Fill hole around piping with sealant compatible with the trunking and the cladding system (Figure 7.23).

Figure 7.24 Seal around cover



- Seal around and fit cover over opening (Figures 7.24 and 7.25).

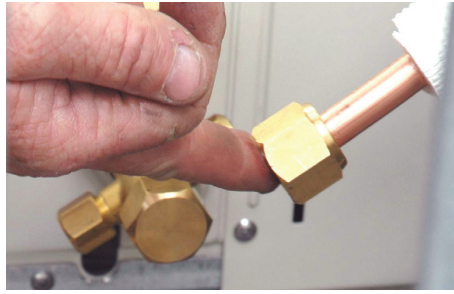
Figure 7.25 Fit cover over opening



NOTE: For aesthetic reasons, minimize the use of trunking indoors.

7.4.3 Connect the piping to the outdoor unit

Figure 7.26 Apply oil to the back of the flare and the outdoor unit



- Cut both pipes to the correct length.
- Flare the pipe ends for connection to the outdoor unit (see **6.1.5 Creating flared joints**).
- Purge the system by blowing oxygen-free nitrogen (OFN) into the pipes before making final flare connection. Note: Hard-drawn copper pipe must be annealed before bending and therefore also requires purging with nitrogen.
- Apply oil to the front and back face of the flare and the outdoor unit, ensuring that the oil is compatible with the refrigerant (Figure 7.26).

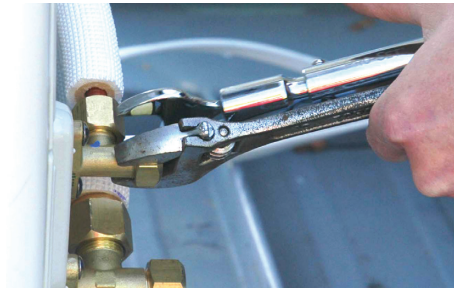
NOTE: DO NOT use adhesive threadlocker or thread sealant.

Figure 7.27 Connect pipes and tighten flare nut



- Align and connect the pipes and tighten the flare nut by hand (Figure 7.27).

Figure 7.28 Tighten flare nut connections



- Tighten the flare nut connections using two spanners and to the correct torque (Figure 7.28).
- Check all mechanical joints for tightness on completion.
- Remove all rubbish from the installation.
- Clean any marks from the area around the units.

7.5 Leak/pressure test

It is good practice to pressure test the system for leaks after completion of pipework installation. Test in accordance with the methods specified in the Australia and New Zealand Refrigerant Handling Code of Practice 2007, Part 1: paragraphs 3.2.1 and 3.2.2.

Procedure

- Remove the service port valve cap from the gas valve on the outdoor unit (the isolation valve must be kept closed).
- Use oxygen-free dry nitrogen (OFN). Any oxygen introduced into a system during pressure testing can be extremely dangerous and can cause a large explosion.
- Connect the nitrogen gas cylinder to the service port valve.
- Pressurise the system to maximum 500 psi/3.45 MPa and allow to hold for 5 minutes.
- Watch the pressure gauge for any drop-off in pressure.
- Test joints by using a bubble test solution. If using electronic testing, a trace gas must be added to the nitrogen. Electronic testing can be unreliable in windy conditions – if a leak is found with an electronic tester, it must be verified using a bubble test solution.
- Release the nitrogen pressure to discharge.
- Disconnect the cylinder when the pressure has returned to normal.
- Wipe the bubble test solution off the joints after testing.

7.6 Evacuation of the system

It is essential that you evacuate the system to remove air, moisture and any nitrogen remaining from the pressure testing. Any air, moisture or foreign matter remaining in the system may cause:

- the pressure in the system to rise, resulting in compressor malfunction
- the operating current to rise, resulting in performance loss
- moisture to freeze and block pipework and valves
- oil sludge build-up
- corrosion of parts of the system.

Always use an electronic digital vacuum gauge to monitor the evacuation.

Ensure as a minimum, that the vacuum pump is in good working order, is serviced regularly and has clean oil. Vacuum pump oil should be replaced after 25 uses or every 6 weeks. Ensure the vacuum pump is equipped with a backflow prevention device to prevent the oil in the pump flowing backwards into the refrigerant pipes (should power fail during the test) as this could cause major damage to the system.

Procedure

Carry out the evacuation according to:

- the manufacturer's instructions, or
- the methods specified in the Australia and New Zealand Refrigerant Handling Code of Practice 2007, Section 6.

Figure 7.29 Remove vacuum pump and gauges (A)



- Connect the vacuum pump hose to the service port valve on the gas valve.
- Start the pump.
- Evacuate to 200 microns measure with an electronic vacuum gauge. The evacuation time will vary according to the pump capacity and the length of the tubing. Moisture removal will occur in the evacuation process when the pressure is 500 microns or less. Read the gauge for a pressure reading to check evacuation – do not time.

Figure 7.30 Remove vacuum pump and gauges (B)

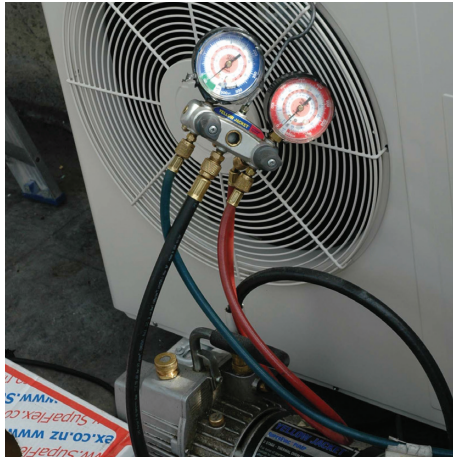


Figure 7.31 Remove vacuum pump and gauges (C)

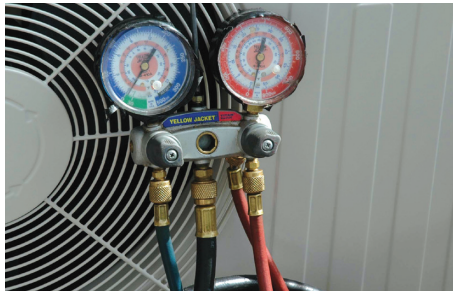


Figure 7.32 Progressively release the vacuum



Figure 7.33 Tighten valve caps



- When the required level of evacuation has been reached, close the manifold valve and stop the pump.
- Allow to hold for minimum 10 minutes – refer back to **7.5 Leak/pressure test** if pressure not held.
- Remove the vacuum pump and gauges (Figures 7.29 – 7.31).

- Progressively release the vacuum by opening both the liquid and gas side isolation valves. Use the valve core removal tool and turn it counter-clockwise a $\frac{1}{4}$ turn (Figure 7.32) so that air is not introduced into the system.

- Replace both liquid and gas valve caps and gas service port valve caps and tighten using an adjustable wrench (Figure 7.33). If a valve cap cannot be finger-tightened first, do not force-tighten it, as this may strip the thread. Instead, remove and refit the cap. Securely fasten the caps to prevent refrigerant leakage from the system.
 - Leak test with bubble solution to confirm.

8.0 Refrigerants

A number of different refrigerants have been used over the years and all have some degree of impact to the environment.

It is important to minimise refrigerant leaks because they can damage the ozone layer, increase greenhouse gases or present health and safety risks.

Early refrigerants used were chlorofluorocarbons (CFCs), but the ozone-depleting nature of these compounds has led to them being phased out and replaced with hydrochlorofluorocarbon (HCFC) compounds such as R-22. For environmental reasons HCFCs have also been phased out and replaced with blended hydrofluorocarbon (HFC) compounds.

Hydrofluorocarbons (HFCs) such as R410A and R32 are currently widely used in refrigeration and air conditioning systems. However, HFCs are greenhouse gases with high global warming potential. A worldwide phase down of HFCs is being implemented from 2019.

The switch from HFCs to more environmentally acceptable alternatives will help combat climate change, but will also present increased risks to health and safety in some circumstances because of the higher toxicity, flammability or pressure of common alternatives.

When purchasing a heat pump, ensure you understand which refrigerant is suitable for the system. The installation and technical guide supplied by the manufacturer will provide this information and must be observed at all times.

NOTE: DO NOT use the incorrect refrigerant in a heat pump as this could void the warranty and can create the risk of an accident.

Australia and New Zealand Refrigerant Handling Code of Practice

Fluorocarbon Refrigerants

Compliance with the Australia and New Zealand Refrigerant Handling Code of Practice 2007 is mandatory for the handling of fluorocarbon refrigerants by anyone holding a refrigerant handling license or refrigerant trading authorisation. The Code of Practice is in two parts:

- Part 1 covers self-contained low charge systems that do not require any work on the refrigeration circuit to install and contain less than 2 kilograms of fluorocarbon refrigerant.
- Part 2 covers all other stationary and transport refrigeration and air conditioning systems.

Essential requirements of the code are that:

- heat pump systems must be able to be installed, operated, serviced and decommissioned without loss of refrigerant
- heat pump systems must be installed by an appropriately qualified person with Approved Filler Compliance Certificate for refrigerant handling.
- refrigerant must not be intentionally released into the atmosphere. Releasing refrigerants into the atmosphere can incur hefty fines.

NOTE:

- **ALWAYS check with the manufacturer for the correct refrigerant to be used**
- **ALWAYS confirm with your local authority, industry association, or the manufacturer to ensure the installer is suitably qualified**
- **DO NOT use an unqualified, uncertified installer.**

8.1 Refrigerant charging

The outdoor unit is factory-charged with sufficient refrigerant to allow for the indoor unit and a specific pipe run. Refer to the manufacturer's installation instructions for the pre-charge pipe length.

You will need to add extra refrigerant where pipe runs exceed the manufacturer's parameters for the factory-charged amount of refrigerant.

You must carry out refrigerant charging in accordance with AS/NZS 5149:2016 Part 4 Operation, maintenance, repair and recovery.

Procedure

- Only use the refrigerant specified by the manufacturer for charging.
- Measure the additional pipe run length.
- Accurately calculate the amount of refrigerant required according to the manufacturer's instructions.
- Measure the required amount of refrigerant (where additional charge is required) by mass, using electronic scales.
- Keep the charge lines as short as possible.
- Leak test the pipework before charging, by partially opening, then closing the cylinder valve to pressurise the connecting pipework.
- Charge using liquid refrigerant from the cylinder.
- Check for leaks using the bubble test solution.
- Ensure that the cylinder and unit are at the same height to prevent gravity transfer of the refrigerant.

NOTE:

- **DO NOT release refrigerant into the atmosphere. Releasing refrigerants into the atmosphere can incur hefty fines**
- **DO NOT use ultraviolet dye**
- **DO NOT use reclaimed refrigerant to add additional charge.**

8.2 Labelling as record of service

You must label any system that is charged with refrigerant or lubricant. Label compressors, systems and liquid refrigerant pumps in accordance with AS/NZS 5149.2: 2016 clause 4.5 marking and documentation.

Place a permanent label on the outer side of unit that identifies:

- refrigerant type
- date of service
- lubricant type
- refrigerant charge (total including any additional charge).

9.0 Electrical requirements

This section covers electrical requirements for heat pump installations.

All electrical work must be carried out by a registered electrician. An Electrical Certificate of Compliance (CoC) must be issued on completion.

Electrical work must be carried out in accordance with the Electricity Act, Electricity (Safety) Regulations, including the cited edition of AS/NZS 3000 Electrical installations (known as the Australian/New Zealand Wiring Rules).

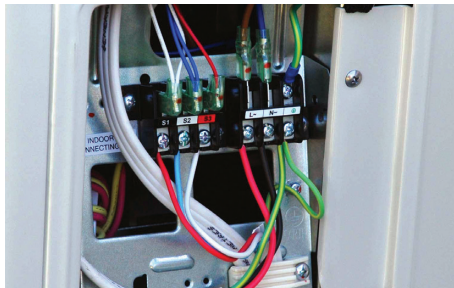
9.1 Installing electrical wiring

Depending on the heat pump's power input rating and the building's existing electrical installation, the heat pump may either be connected to an existing electrical circuit with sufficient spare capacity (e.g. looped off an existing power socket), or to a separate dedicated circuit (wired back to the main switchboard).

- Select a circuit for the main power supply.
- For installations in new buildings, use a dedicated circuit.
- Refer to the manufacturer's specifications for:
 - rated voltage
 - input capacity/fuse size
 - electrical cable size
 - wiring diagram for electrical installation.
- All hard wiring must be carried out by a registered electrician.

9.2 Outdoor unit connections

Figure 9.1 Connect power supply cable to terminal block



- Remove service cover from outdoor unit.
- Fix indoor/outdoor connecting cable correctly to the terminal block in the outdoor unit.
- Tighten terminal screws to ensure that wires are firmly secured.
- Connect power supply cable to terminal block in outdoor unit (Figure 9.1).

Figure 9.2 Install lockable isolating switch (A)



- Install a lockable isolating switch (Figures 9.2 – 9.4).
- Install the switch so that it can be reached for servicing
- Attach the isolating switch to the house
 - not the outdoor unit.

NOTE: It is an offence to mount a switch on the unit.

Figure 9.3 Install lockable isolating switch (B)



Figure 9.4 Install lockable isolating switch (C)



Figure 9.5 Replace service cover to outdoor unit



- Provide waterproof protection to the connection as required, such as:
 - cable gland
 - lexible conduit.
- Replace service cover to outdoor unit when all connections are completed (Figure 9.5).

NOTE:

- **DO NOT connect the isolating switch to the outdoor unit. Otherwise the unit cannot be isolated from power**
- **DO NOT allow contact between wiring and refrigerant pipework**
- **DO NOT run the main power cable and heat pump system power cable together**
- **DO NOT allow electrical work to be carried out by an unlicensed tradesperson or without an Electrical Certificate of Compliance (CoC). Otherwise, the owner's house insurance may be voided.**

9.3 Nameplate

Figure 9.6 Example of a nameplate on an outdoor unit



Ensure nameplate (Figure 9.6) is visible in an accessible location displaying:

- manufacturer's name and/or trademark
- type or model designation and serial number
- rated voltage
- rated frequency
- cooling capacity
- heating capacity
- refrigerant type (designation) and charge.

10.0 Testing, commissioning and customer operating instructions

This section covers what you need to do once a heat pump system is installed. It includes what to check before it is commissioned, testing the system, briefing the homeowner on the new system and carrying out a quality assurance check once everything is completed.

For testing and commissioning, follow manufacturer's instructions where provided; otherwise follow the Australia and New Zealand Refrigerant Handling Code of Practice 2007.

10.1 Pre-commissioning checks

Outdoor unit – check:

- ☐ The unit is secure and correctly mounted.
- ☐ There is a clear air movement path.
- ☐ Ensure the valves are fully opened and valve caps have been replaced and securely tightened.

Indoor unit – check:

- ☐ Unit mounting is level and secure.
- ☐ Remote control base is securely screwed to wall.

Pipework – check:

- ☐ Pipework has been correctly installed and secured.
- ☐ Pipework is correctly insulated.

Indoor unit drainage – check:

- ☐ Pour some water into the indoor unit drainage pan. Ensure that the water flows through the outlet and drainage hose without leaking.
- ☐ If a condensate pump has been used, test this is working correctly, that it is not siphoning, and that the float switch is working correctly.

10.2 Electrical checks

Wiring:

- ☐ Carry out tests required under the Electricity (Safety) Regulations, including the cited edition of AS/NZS 3000 Electrical installations (known as the Australian/ New Zealand Wiring Rules).
- ☐ Electrical code compliance certificate is obtained and a copy handed to the owner.

Labelling:

- ☐ Ensure Switchboard fuse has been labelled appropriately

10.3 Prepare the remote control

- ☐ Remove the battery cover.
- ☐ Insert new batteries.
- ☐ Replace cover.

10.4 Testing the new system

- ☐ Switch the system on.
- ☐ Ensure that no LED lights are on. If LED lights are on or blinking, the installation is faulty. Refer to unit handbook to identify fault as indicated by flashing LEDs. Then disconnect the power supply and locate and fix the fault.
- ☐ Check the emergency operation by pressing the emergency operation on/off switch and holding down for 3-5 seconds. This will start a test run (continuous operation for a set period) during which the thermostat does not work.
- ☐ Press the emergency operation on/off switch again to turn off.
- ☐ Test unit in heating and cooling mode, as described below.

Indoor unit – check:

- ☐ The fan operates at all speeds.
- ☐ There is no vibration of the unit.
- ☐ Vertical and horizontal air direction controls are operating.
- ☐ Air circulation mode (circulating air without heating/cooling) is operating.
- ☐ The unit operates to the correct heat command – use a thermometer. With an indoor ambient air temperature of 21°C:
 - for heating, an air-off coil temperature of 45-50°C or higher should be achieved
 - for cooling, an air-off coil temperature of 8-12°C or lower should be achieved.
- ☐ The manual operation (using the switches on the indoor unit) is functioning – for situations when the remote cannot be used.
- ☐ The auto start is functioning.
- ☐ An electronic sound can be heard by pressing the on/off button of the remote control.
- ☐ The condensate pump (if installed) works.

10.5 Instructions to the owner

Checklist of instructions to the owner on the use of the system:

- ☐ Demonstrate how to set the controls/different modes correctly.
- ☐ Demonstrate how to use the remote control.
- ☐ Demonstrate how to remove and clean air filters.
- Advise:
 - on what to expect in extremely hot or cold conditions
 - that the system will take a few minutes to warm up
 - consider turning the heat pump off late at night if the noise bothers the neighbours.
- ☐ Advise of service requirements.
- ☐ Recommend reading the operating instructions manual.
- ☐ Provide a service checklist.
- ☐ Provide the warranty.

Before the installer leaves

- ☐ Electrician to provide an electrical Certificate of Compliance (CoC).
- ☐ Provide a record of the system commissioning data.
- ☐ Provide contact names and numbers for after sales support.

10.6 Checklist for using a heat pump efficiently

Understanding how to use a heat pump efficiently is important information for users.

- Only heat when you need it - don't leave your heat pump on all day if you're not there. Use the timer to turn on the heat pump shortly before you get home and turn it off when you don't need it.
- Set the thermostat to a healthy temperature - aim for 18°C to 21°C. High thermostat settings cause high electricity use. Inadequate heating can lead to mould growth and dampness.
- Avoid using the 'Auto' mode - use the 'Heating' mode. In 'Auto' mode, the heat pump tries to maintain the set temperature by constantly changing between heating and cooling, as the room temperature fluctuates. This can waste a lot of energy.
- Avoid the 'Low' and 'Quiet' Fan settings during very cold weather. To get the full heating power out of your heat pump, choose the 'Auto' Fan setting.
- It is normal for the heat pump to sometimes stop heating or blow out cold air during very cold weather, while the outdoor unit defrosts. This usually only takes a few minutes. Contact the manufacturer if you have any concerns.
- Clean the filter regularly (as often as monthly) - this is a quick, easy job you can do yourself. Clogged heat pump filters mean the heater uses more power to run.
- Avoid using it as an air conditioner when you can - try opening windows and doors on either side of the house to create a through-breeze. Close curtains on hot, sunny days to keep your home cool and shady.

More information is available on www.eeca.govt.nz

10.7 Quality assurance checklist

Carry out a quality assurance check on completion of the heat pump installation pump system.

Outdoor unit

- ☐ Is the outdoor unit secure with no likelihood of falling over?
- ☐ Is there any vibration or noise disturbance to owners and/or adjacent properties?
- ☐ Is the area around the unit clear so there is no likelihood that the air supply routes will become blocked?
- ☐ Has the unit been installed to provide future servicing access?
- ☐ Is all the exterior ducting neat and tidy, with all flashing and waterproofing completed?
- ☐ Have all service covers been replaced?
- ☐ Is the unit clearly labelled?
- ☐ Have the installer's checklists been sighted?

Indoor unit

- ☐ Is the indoor unit secure and does it not vibrate?
- ☐ Has the test run been carried out?
- ☐ Is the unit neatly installed with no pipework or ducting visible?
- ☐ Have the installer's checklists been sighted?

Pipework

- ☐ Is the pipework appropriate for the refrigerant used in the system?
- ☐ Has a leak test been carried out?
- ☐ Was the system evacuated?
- ☐ Is the system charged to a level appropriate for the pipe length?
- ☐ Are the stop valves fully open?
- ☐ Have the installer's checklists been sighted?

Drainage

- ☐ Is the drain hose from the indoor unit properly installed?
- ☐ Has the indoor unit drainage been tested by pouring water into the tray?
- ☐ Has the outdoor drainage pipe been directed away appropriately?

Electrical

- ☐ Does the electrical work have an electrical Certificate of Compliance?
- ☐ Has a copy of the electrical Certificate of Compliance been given to the owner?
- ☐ Is the unit connected to a separate circuit, hard wired back to the mains distribution board (or if connected to existing circuit, does it have sufficient spare capacity)?
- ☐ Is there a circuit breaker in the system and has the circuit been properly labelled on the distribution board?
- ☐ Is the energy rating label on the unit or available for viewing?

Instructions to the owner

- ☐ Has the operation of the system been explained to the owner?
- ☐ Does the owner have the operating manual?
- ☐ Has the owner been advised of maintenance and servicing requirements?
- ☐ Does the indoor unit have the energy rating label applied, or available?
- ☐ Has the owner been given a copy of the warranty?

11.0 Servicing and maintenance

In addition to regular maintenance by the owner, it is recommended that a routine maintenance agreement is put in place with a licensed service person or organisation. In addition, users should monitor their heat pump and call a service person immediately if any abnormal operation is found.

11.1 Owner maintenance

Follow manufacturer's instructions. Most manufacturers provide copies of their manuals on their website.

Indoor unit

- ☐ Check air filters of the indoor unit every 3 months' use and clean or replace as necessary (some units will identify when filters need cleaning or be self-cleaning).
If they can be cleaned:
 - remove and vacuum clean using a brush attachment then replace, or
 - wash gently with a mild detergent and warm water, and dry before replacing.
- ☐ Check the indoor coils (if accessible) – dust gently with a soft brush to clean.
- ☐ Check and clean condensate pan, drain and trap.
- ☐ Clean the unit cover with a damp cloth and mild detergent as required.
- ☐ Recognise the operational sound of the heat pump – if the sound changes, have the system checked.
- ☐ Ensure that air vents are not blocked by furniture or objects.
- ☐ Check operation of condensate pump every 6 months (if fitted).

NOTE: DO NOT vacuum the indoor coil fins as they are easily damaged.

Outdoor unit

- ☐ Keep the area around the outdoor unit clear of garden waste and dirt.
- ☐ Remove any growth around or into the unit.
- ☐ Make sure the unit is off when cleaning. Follow manufacturer's instructions when turning off the power.
- ☐ Check and clean the outdoor coils as per manufacturer's instructions when they are dirty. In a corrosive environment cleaning may be required as regularly as every 3 months. Do not spray the fan motor or wires with water.
- ☐ Contact a service person at any sign of unusual sounds or operation.
- ☐ It is recommended to have an annual servicing agreement with your installer. Failure to maintain your heat pump to the manufacturer's instruction may void the warranty.

NOTE: DO NOT spray the fan motor or wires with water.

11.2 Service person maintenance

The system should be serviced by a qualified person every 12 months, depending on use. Before servicing, establish the type of refrigerant used in the system.

Indoor unit

- ☐ Inspect the filters, blower and indoor coil for dirt or obstructions. Clean these parts with a biodegradable cleaner.
- ☐ Check the airflow.

Outdoor unit

- ☐ Clean the condenser coils as follows:
 - Clear the outside of the coil of debris.
 - Vacuum the coil fins using a soft bristle brush attachment – take care to avoid bending the fins.
 - Spray water from the inside to the outside of the coils to remove stuck debris using a hose and spray gun. Do not spray the fan motor or wires with water.
 - Vacuum or remove by hand any debris remaining in the unit.
- ☐ Check coil fins for damage – if coil fins are bent, straighten using a proprietary tool.
- ☐ Lubricate fan bearings if required – sealed bearing units do not require lubricating.
- ☐ Inspect fan for damage and repair as required.
- ☐ Replace grille covers.
- ☐ Check that the condenser unit is secure and level in both directions. If necessary, adjust the levelling feet, or make level with timber/plastic shims. If the unit is seriously out of level, repair or replace the base the unit sits on.

NOTE: DO NOT spray the fan motor or wires with water. Refrigerant

Refrigerant

- ☐ Check the indoor unit output temperature with a digital thermometer. At an indoor ambient air temperature of 21°C:
 - for heating, an air-off coil temperature of 45-50°C or higher should be achieved
 - for cooling, an air-off coil temperature of 8-12°C or lower should be achieved.
- ☐ Check pipe joints for refrigerant leakage with bubble solution.

Electrical

- ☐ Check terminals and connections – clean and tighten if necessary.
- ☐ Check fan motors for lubrication.
- ☐ Check that all controls are operating correctly.
- ☐ Check that the thermostat is operating correctly.
- ☐ Check the voltage.

Service checklist

- ☐ Provide the owner with a service checklist after each service.

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