6.0 Installing pipework

Good pipework gives a safe, efficient and reliable installation that will help the heat pump system perform properly. Too many joints, bends and long lengths can 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 2.5-3.0 m – check the manufacturer's instructions for specific run lengths
- insulate and protect all pipework
- 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 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 – while hard-drawn is recommended as best practice for pipe diameters of 20 mm and more, soft-drawn is commonly used because it is easier to work with.

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

6.1.2 Types of jointing

Pipes can be jointed by brazing, compression or lock-ring jointing.

Brazed joints are considered to 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.

Compression or lock-ring joints are a recent addition to the options for jointing copper pipe; however, space is needed to allow access to install and compress the jointer onto the pipe. Joints must be made with the supplier's recommended fittings and using the correct compression/locking tool. Fittings must be suitable for the pipe diameters and be rated for the refrigerant pressures present in the system.

Do not use screwed or flanged pipe connections.

6.1.3 Maintaining cleanliness of pipework

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

Figure 6.2 Pipe opening facing down when cutting

- Holding the pipe opening facing down when cutting (Figure 6.2).
- Removing metal filings from inside pipework after cutting.

Figure 6.3 Cover pipe ends

- Always keeping pipe ends covered with caps, by brazing or taping (Figure 6.3) – covering pipe ends prevents moisture, dirt or foreign matter getting into the pipes, particularly when pushing or pulling through wall cavities.

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 6.4) – handmade bends may kink or have a reduced internal pipe dimension, which will reduce refrigerant flow.

Figure 6.4 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 are required where connecting the pipe to the units. Flared joints must be done by an experienced installer as the joints have a higher risk of the refrigerant leaking due to poor installation. They can also be easily modified by unqualified persons.

Flaring of joints is not a simple task and requires the correct tool to be used for the refrigerant gas being used and the pipe wall thickness. The correct steps must be followed to create a sound connection.

Units using R14A refrigerant require a specific flaring tool to cope with the pressure the refrigerant is installed at.

There are several steps for forming a flared joint.

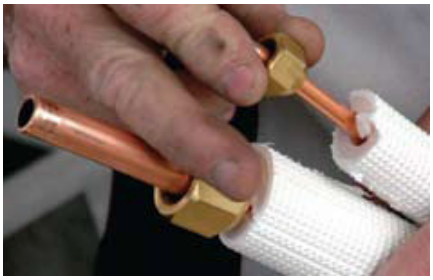
Figure 6.5 Cut pipe with tube cutters

- Cut pipe with tube cutters to give a cut that is straight across (Figure 6.5) – use a sharp blade and cut slightly longer than measured length.

Figure 6.6 Remove all burrs

- Remove all burrs with a de-burr tool (Figure 6.6).
- Remove any metal filings that may have fallen into the pipe.

Figure 6.7 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 6.7) – it is not possible to put it on after flaring the pipe.

Figure 6.8 Flare the end of the tube (A)

- Flare the end of the tube using the correctly-sized flare tool (Figures 6.8 – 6.11).

Figure 6.9 Flare the end of the tube (B)

Figure 6.10 Flare the end of the tube (C)

Figure 6.11 Flare the end of the tube (D)

Figure 6.12 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 using oil compatible with the refrigerant before connecting pipes, i.e. use polyolester oil (POE) with R-410A refrigerant (Figure 6.12) – oil reduces the possibility of tearing the flare when the nut is tightened. Oil must not be allowed to contaminate the refrigerant.

Figure 6.13 Connect the pipes (A)

Figure 6.14 Connect the pipes (B)

- Hand-fasten the flare nut to connect the pipes (Figures 6.13 and 6.14).

Figure 6.15 Tighten connection (A)

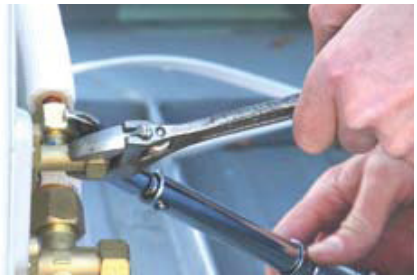


Figure 6.16 Tighten connection (B)

- Tighten the connection using two spanners to the torque recommended by the manufacturer (Figures 6.15 and 6.16) – use a torque spanner to achieve the correct torque. Torque against the second spanner (to secure the load while tightening). Never tighten the connection against the joint.

Do not:

- **mix polyolester oil and mineral-based oil**
- **use leak lock or PTFE tape – these are not plumbing joints.**

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 due to sagging
- eliminating vibration
- eliminating a hammer effect or damage from fluid movement
- resulting in better fluid handling characteristics.

As good practice, copper tubing should be fixed 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

Insulating all refrigerant pipework will help improve the efficiency of the heat pump system.

Use pre-split, polyurethane foam insulation that is a minimum of 12 mm thick (10 mm for 6 mm or ¼ inch pipe), and is heat-resistant up to 100°C.

To install:

- open insulation tube and wrap moulded section around pipe
- remove self-adhesive strip to seal-join long joint
- butt-join section lengths and tape seal around circumference.

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.
- 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 to be drained 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.
- The condensate outlet pipe should never be allowed to be immersed in water as this can cause an air lock and prevent water drainage under gravity.

Do not:

- **use flexible drainage piping in internal wall spaces**
- **use flexible ribbed drainage piping for lateral pipe runs, as water may sit in the ribs or low points may occur in the pipe**
- **use electrical conduit.**

Internal units should be located to avoid the need to install a condensate pump. Where unavoidable, install in accordance with the manufacturer's specification and advise the owner of the maintenance requirements of the pump.

6.1.8.2 From the outdoor unit

Discharge condensate:

- onto a grassed or planted area
- into a stormwater gulley trap
- through timber decking to ground below.

Do not discharge where it can run over a footpath as it may become slippery or freeze in the winter.

6.2 Pipework pre-installation in new buildings

When installing pipework in a new building, it is easiest to do it 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 6.17).
- Fix with galvanised mild steel pipe brackets.

Figure 6.17 Run pipe/cable across truss chord/ceiling joist

Indoor unit location

- Notch the top plate and studs (90 x 45 mm) to a maximum depth of 25 mm to insert pipe/cable (Figures 6.18 and 6.19).

Figure 6.18 Notch the top plate and studs (A)

Figure 6.19 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 6.20). Notching and drilling must not exceed the limits given in NZS 3604 – see Figure 4.11.

Figure 6.20 Fix galvanised mild steel strap to hold pipe/cable

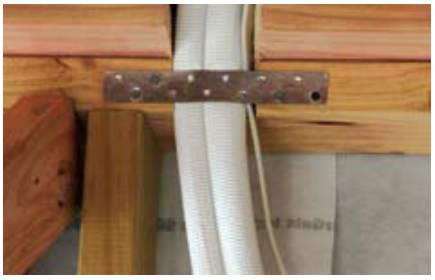


Figure 6.21 Wedge the pipe cable end into the stud

- Wedge the pipe cable end into the stud in readiness for connection to the indoor unit (Figure 6.21) – 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 6.22).

Figure 6.22 Braze pipe ends closed

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

Do not cut out more timber than necessary.

Outdoor unit location

- Notch the top plate and studs sufficiently to insert pipe/cable. See Figure 4.12 (page 25) 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 6.23).

Figure 6.23 Fix galvanised mild steel strap to hold pipe/connection cable

Figure 6.24 Feed pipe/cables through building wrap

Figure 6.25 Seal pipes or sleeve

- Feed pipe/cables for connection to outdoor unit through a hole cut in building wrap (Figure 6.24). 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 6.25).
- 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 this figure nor has a sleeve been used as shown in Figure 7.4.