

A heat pump uses the same process a refrigerator uses to chill food - only in reverse. The heat pump takes heat extracted from outdoor air and delivers it to the living space inside a home.

A split system has an exterior compressor unit connected to an interior ceiling or wall mounted unit. Pipes carry refrigerant to the indoor unit.

There are other types but the commonest associated with domestic noise problems is the split unit and the noise problems commonly arise from the exterior unit.

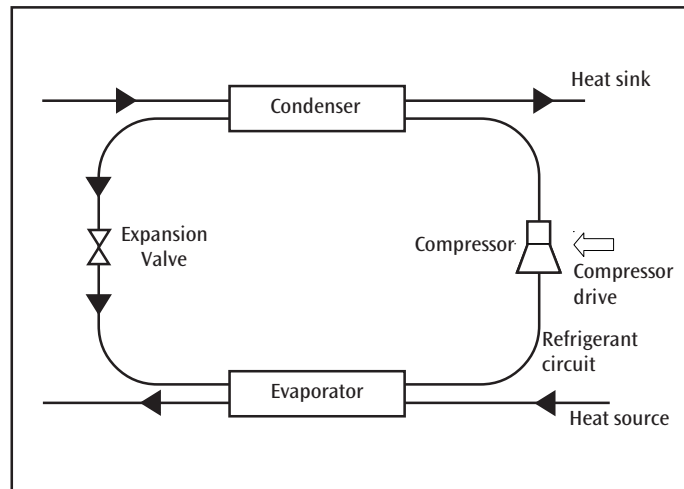


Figure 1: Heat pump schematic

Units are either constant speed types which cycle on and off or the more modern inverter type with a variable speed electric motor which speeds up or slows down to maintain temperature indoors.

Heat pumps are very similar to air conditioners. An evaporator fan and compressor operate with “on” and “off” cycles throughout the day and night, especially in winter. Reverse cycle types are used for cooling in summer.

Noise problems

Care must be taken to locate the heat pump so that the noise produced during its operation does not interfere with sensitive areas - either in the house being heated, or the neighbour’s house. Most noise problems occur between mid-evening and sunrise when ambient sound levels in the neighbourhood are lower because of cessation of outdoor activity and less traffic sounds. Tonal type sounds are common from rotating parts in units such as fans and motors and can greatly increase if there is no preventative maintenance to replace worn bearings or limited-life parts before they fail. Loose screws in a metal casing are a common source of buzzing or rattling noises.

In urban neighbourhoods there is usually insufficient space between residences for exterior heat pump units to be installed without causing noise problems for the occupants or the neighbours. Noise is directly propagated to a neighbour’s house wall or indirectly from reflection off the wall of the house being heated, or a combination of both. Higher frequency sounds are readily attenuated by structure, but lower frequency sounds penetrate structure unless attenuated at source.

Noise reduction

If locating the unit away from the vicinity of neighbours rooms is impractical, some degree of noise control will usually be necessary. The following notes describe some of the principles of noise control that can be employed to reduce noise from the external heat pump unit becoming a problem. A home handyman can easily utilise the design concepts to fabricate a simple enclosure.

Case-specific design can be obtained through the services of an acoustical engineer.

Typical operating sound levels from heat pumps will often exceed boundary noise limits which apply at night-time in most New Zealand urban areas unless sighted to avoid exposing neighbouring properties to noise from the exterior mounted heat exchanger unit.

Isolation Mounts

Isolation mounts are one-piece moulded neoprene, often with non-skid ribs on the bottom load surfaces. Each isolator incorporates bolt-down holes on the bottom load surface and a tapped steel top load plate for attachment to the supported equipment. Isolators are designed for up to about 4mm deflection and are available in a range of sizes, and load capacities. Mounts can be fixed with masonry anchors to concrete pads under heat pumps.



Figure 2: Isolation mounts

Isolation Pads

Isolation Pads are single-ribbed or double-ribbed high quality elastomer, used singularly or in multiple layers, separated with steel shims. Pads are available with rated deflections from 1- 5 mm.



Figure 3: Isolation pads

Pads are available in sheets and may be easily cut or drilled to meet mounting conditions. Pads are generally inferior to mounts because of restraint fixings which transmit vibration.

Barriers to sound propagation

Fences or barriers can be effective in interrupting the propagation of sound towards a neighbour. Beware of reflected sound of building walls and eaves. 20mm thick timber or materials with an equivalent surface density will be effective as barriers as long as there are no gaps. Barriers rely on mass and blocking line-of sight between the source and receiver of sound. Barriers are best when combined with absorptive materials to reduce reflections and absorb sound.

Sound absorption

Sound absorption relies on flow resistivity in materials at a microscopic level and lack of reflection from materials' surface area. However few absorbent materials are weather/sunlight resistant and most therefore require protection from direct sunlight and rain. Suitable commercial products include fibreglass batts/sheets, and polyethylene foams. Polystyrene foam is useless.

Enclosures

Enclosures for heat pumps could be partial enclosures or full-enclosures. It is critical that adequate airflow around the unit be maintained. Enclosures should incorporate the following key design features to maximise sound reduction.

- locate unit to minimise reflections and maximise separation from noise-sensitive buildings
- maintain air gaps and circulation space around unit
- mount the heat pump chassis on neoprene isolation mounts (best) or isolation pads
- enclosure casing should act as a barrier - the higher the mass the better
- the enclosure interior should incorporate some absorptive material which is protected from weather damage
- ensure heat pump casing screws are not loose (rattling)
- allow access for servicing

The figure illustrates a simple three sided enclosure incorporating these principles.

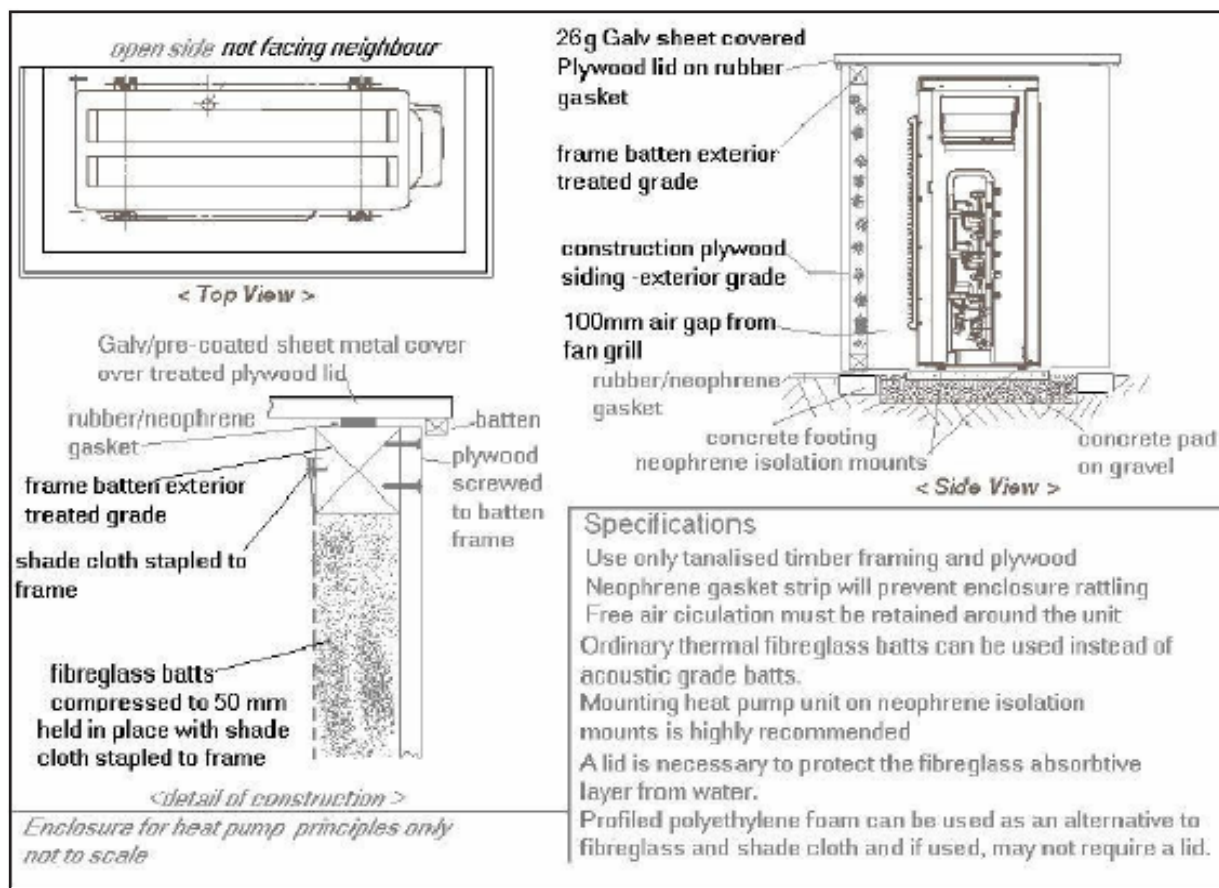


Figure 4: A three-sided heat pump enclosure

Preventive maintenance

In addition to annual preventive maintenance recommended for most heat pumps to maintain efficiency, owners should expect to replace bearings and seals every five years. If fans or other electrical/mechanical parts become noisy, they should be serviced or replaced.

Metal casing rattling can be reduced by gluing elastomeric sheets to the inside of the casing. Screw / bolt attachments can be damped by fitting neoprene washers. (Elastomer products are commonly available as panel dampening sheets from automotive accessory retailers). Para Rubber stocks neoprene gasket strips and a small range of isolation mounts and pads. A standard hot water cylinder insulation pack will supply enough foil-backed fibreglass insulation for an enclosure to insulate a standard domestic heat pump in the manner illustrated above.

Where to get help

Look in the yellow pages for acoustical consultants or noise control engineers.

Legal requirements

Section 16 of the Resource Management Act 1991 is the key legislation and makes every occupier of land responsible to adopt the best practicable option of limiting noise emissions from their property to a reasonable level. There is no decibel limit set and the obligation applies regardless of whether the Council noise limits are complied with, so tonality and other special characteristics of heat pump sounds must also be controlled.

Noise problems between neighbours are solved by spending money on simple noise control engineering solutions - not by spending money on lawyers trying to avoid responsibilities.

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