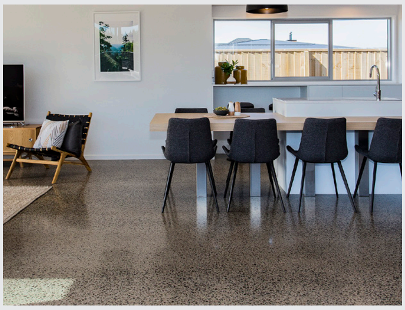
Central Heating NEW ZEALAND

Central Heating New Zealand Cooling Guide



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Cooling Considerations

With changes in the climate, the style of homes, and changes in lifestyles New Zealanders have become much more interested in having solutions integrated into their homes that can provide cooling, and to some this is more important than how the home is heated.

One factor that has a significant impact on this opinion is how warm or cool our bedrooms will be. New Zealand is known for having extremely cold sleeping areas in our homes, but this is an easier problem to solve with the use of additional layers and/or spot heating, but in a lot of newer homes the sleeping areas will also be too warm in the summer months and there is little that we can do to overcome this discomfort at the time. The result of this is that we remember the warm nights where we couldn't sleep and therefore deem the cooling of these spaces to be much more important than heating.

New Zealand has a temperate climate and we need heating for many more hours each year than we need cooling, this varies from North to South but the heating demand throughout New Zealand is 2-4 times greater than the cooling demand. For this reason, it is clear the best cooling solution for your home is one that provides great heating!

From data published by NIWA the table below shows the annual estimated heating and cooling hours for each region:

Regions

Region	Heating Hours	Cooling Hours
Auckland and Northland	1000	600
Waikato and Bay of Plenty	1400	600
Gisborne	1250	610
Hawkes Bay and Taranaki	1500	600
Wanganui	2040	550
Manawatu and Wairarapa	1600	600
Wellington	1420	580
Nelson Bays	1760	570
West Coast	1870	560
Canterbury, Timaru and Oamaru	2100	580
Otago and Southland	2200	590

When we are planning the cooling options for our homes there are a number of aspects to be considered. Some of these considerations relate to the design of the building and so having these in mind from the start of the project is key to a comfortable home.

On the next page we have listed some of these considerations as well as some suggestions for each aspect on how the homes cooling load can be reduced. These should be considered thoroughly prior to researching and selecting the cooling solution for the home.

Window Directions

The sun is the major contributor to the heat gain in our homes in the summer months, the sun provides the earth with around 1kW/m^2 of solar radiation and this heat enters our homes directly through the windows. When planning a new construction project or renovations the direction of windows should be considered and especially for North and West facing glazing the size and shape of the windows should be carefully considered, as these will be the major contributor to the need to cool a home.

Window Shading

The summer sun crosses over at a high angle and is present in the sky for more hours each day, the winter sun conversely crosses over at a lower angle and is present for fewer hours. The depth of eaves and other structures can be used to block the summer sun but allow the winter sun to enter the home, this can have a significant impact on reducing the cooling load of a home while still allowing plenty of winter sun to keep the home warm.

Window Coating & Coverings

The windows of a home allow solar radiation to enter the home, however a proportion is resisted by the window. Windows have a rating for this called the Solar Heat Gain Coefficient (SHGC), the quantity of glass panes and coatings used on the glass can reduce the SHGC and this can reduce the cooling load by around 20% as less of the solar radiation is allowed to enter the home. These coatings also provide the added benefits of keeping more heat inside the home in the winter and reduce the amount of UV rays that enter the home reducing the fading of internal furnishings. Along with choosing the right glazing window furnishings like blinds or curtains can have a significant impact on the amount of solar radiation that enters the home, sheer curtains or mesh blinds can be used on North and West facing glazing to limit the solar gain entering the home but still allow ample light to enter.

Wall & Roof Colours

Similar to windows, the solar radiation that hits the walls and roof of the home causes these surfaces to absorb this heat and increase in temperature. These surfaces warm up throughout the day and then this heat is conducted through the structure of the home eventually causing the internal wall and ceiling linings to warm up and then begin adding heat into the home. One effective way to reduce the amount of solar radiation that these surfaces absorb is to use paint colours that are more reflective. Light colours are the best and will reflect up to 70% of the solar heat, dark colours will absorb more heat and allow up to 80% of the solar heat to be absorbed into the surface and eventually into the home. In New Zealand a dark coloured roof can reach surface temperatures of up to 80°C where as a light coloured roof will only reach 60°C, this factor has a significant impact on the amount of heat that will enter a home. Furthermore this heat is absorbed by the structure of the home and continues to be emitted inside the home long after the sun has set. Roofing supplier will often publish the ratings for different colour options to allow colours that absorb less heat to be selected if desired.

Insulation Levels

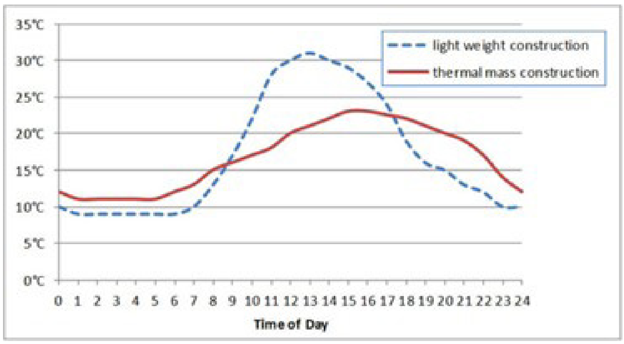
The insulation levels of walls and roofs are key to reducing the amount of heat that is allowed to enter the home through the structure, but also reduce how much heat is absorbed by the structure. Increasing the insulation levels of walls and ceilings will reduce the heat gain in the summer and heat loss in the winter having a significant impact on improving the internal comfort levels and reducing the homes energy consumption. Additionally, the installation techniques should also be considered. Construction techniques and insulation products that reduce thermal bridging will help reduce the impact the heat absorbed by the external surfaces has on the building.

Roof Cavity Ventilation

In the summer the heat that is absorbed by the roofing causes the air in the roof cavity to heat up to extreme temperatures (up to 70-80°C can occur), these spaces are often built with very little to no intentional ventilation and this traps heated air which begins to heat up and penetrate the ceiling insulation then heating up the ceiling in the home. This heat continues to radiate into the home after the sun had dropped until the roof cavity has cooled down. Adding ventilation systems into the design of the roof structure will not only allow the roof space to be cooler but can also reduce the temperature fluctuations and wear on the roof structure. Warm roof systems where the roof cladding includes the insulation are also a good option to achieve cooler roof cavities.

Internal Floor Finishings

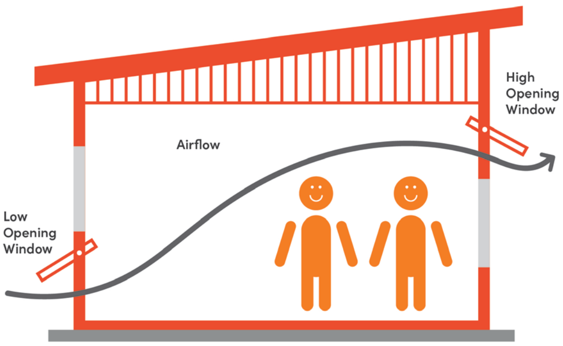
For homes that use concrete floors the heat that shines through the windows during the day can be absorbed by the floors to reduce the overheating of the home and maintain a more stable temperature throughout the day, but then this heat can also be radiated out into the home during the evenings. Using the thermal mass of the floors can help keep a home more comfortable year-round and when compared to a lightweight construction home will allow less cooling and heating to be needed:



To maximise the heat that is absorbed by the floors, the floor coverings need to allow the heat to enter and the best floor coverings for this are to leave it exposed/polished or a stone tile. Floor coverings like thin vinyl and engineered timbers (<14mm thick) will also allow a reasonable amount of heat to be absorbed by the floor too. It is recommended to avoid using floor coverings like carpet or thick timber in areas with high solar gain. If these materials aren't suitable for the entire room, consider using tiles or polished concrete in front of large North/North West facing windows as an alternative.

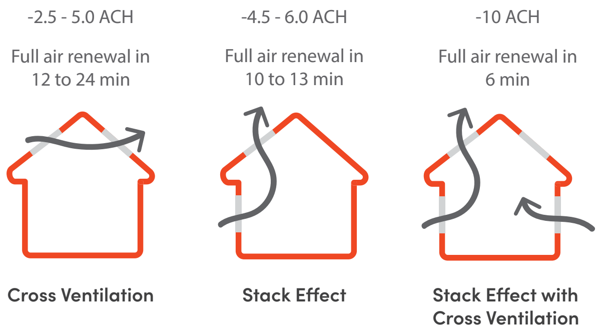
Natural Ventilation

In most areas of New Zealand on the days where cooling is needed inside the home, the air temperatures outside are still very comfortable, by using the positioning of windows and/or skylights substantial amounts of natural ventilation in the home can be achieved. When designing a home, ensure that rooms that are likely to overheat have openable windows on opposite sides to enable crossflow ventilation. Ideally, these windows should include smaller openable elements with stays that can be left open throughout the day. To maximise the 'stack effect,' these openings should ideally be positioned at a low level on one side of the home and at a high level on the opposite side, allowing warm air to rise and escape, creating a higher rate of natural ventilation:



Where windows cannot be positioned on opposite sides of a room, skylights can provide substantial natural ventilation. Ideally, skylights should be placed on the south side of the roof to minimise additional solar gain.

Using cross flow ventilation, stack effect ventilation, or a combination of both can achieve very high air change rates allowing fresh, cooler outside air to naturally cool the home and improve the homes air quality:



By considering these factors during the design process, the home's cooling load can be reduced before any active/radiant cooling solutions are needed. These design considerations not only reduce cooling demands but also enhance year-round comfort while lowering energy use for both heating and cooling.

For more information on these building considerations, additional details are available from MBIE website, along with many other resources. Your designer is also likely to be able to provide you with guidance in these decisions.

Reference: www.building.govt.nz/getting-started/smarter-homes-guides/design/passive-cooling

CHNZ—Cooling System Design Conditions

When we calculate the heating load for a home this is calculated based on heat losses through the walls, floors, ceilings, and windows when the outside and inside air temperature is at the design conditions. This peak heating load for a home occurs in the early hours of the morning or evening when the sun is not out, so it is simply a relationship between the outside and inside air temperatures that is considered.

A home's cooling load depends on several factors. While the temperature difference between indoor and outdoor air is important, the most significant factor is the sun and its solar radiation absorbed by the structure & entering through the glazing. As the sun moves throughout the day, solar gain shifts between rooms. A room with a low cooling load in the morning may experience a high cooling load in the afternoon, and vice versa. Because of this, cooling load calculations must carefully account for the home's orientation.

Where a heating load is calculated from a 2D analysis of the home in 1 to 2 hours the process to calculate a cooling load accurately will take a lot longer. The best solution to calculate the cooling load of a home is to generate a 3D model and simulate the effect of the sun throughout the year, but this process takes many hours or even days to complete.

To allow Central Heating New Zealand to complete a cooling load analysis as part of our free design process, we have developed a tool that allows us to estimate the hourly cooling load with minimal additional effort beyond a standard heating load calculation, while ensuring that we can continue to offer a free and timely design service.

As part of our cooling design process, certain factors are predefined, and assumptions are made to establish realistic expectations for the outcomes.

External Design Conditions

The external air temperature used for cooling designs varies depending on the location of the home but is generally 29°C throughout NZ. The actual air temperature has minimal impact on the cooling load as the major part of the cooling load is the solar radiation.

The solar gain through windows and on the structure is based on typical figures for New Zealand, and It is modelled as an hourly cooling load, calculated for each hour of the day, depending on the direction that the external surfaces of the room face.

No allowance is made for shading from eaves, external structures, or planting. In most cases this means the actual cooling load will be less than the calculated load, but that the performance of the cooling system is not dependent on these factors.

Internal Design Conditions

The internal design temperature for Central Heating New Zealand cooling systems will be dependent on the type of cooling system that is being designed.

Typically, active cooling systems that use fan coils for cooling will need to achieve a space temperature of 25°C to achieve comfort. On a warm summer day, a space temperature of 25°C is pleasant and this is the target temperature for our active cooling designs. Standard refrigeration type air conditioning systems are typically selected and designed based on their nominal performance at a space temperature of 27°C, but a good system design will allow for the reduced capacity of these units to achieve 25°C or similar.

Radiant cooling systems achieve occupant comfort at higher space temperatures than fan coil type systems. This is due to our bodies managing our heat loss primarily through radiating heat to the environment and a radiant cooling system working in harmony with this. Radiant cooling systems will typically be designed based on achieving a space temperature of 27°C, this design set point will still achieve a reasonable level of comfort while significantly reducing operating costs of the cooling system.

For either of the cooling options, a Central Heating New Zealand cooling design will include a cooling summary on the equipment layout drawing. This cooling summary is provided in the form of a table, which shows, for each room and each hour of the day, the percentage of the room's calculated cooling load that has been achieved. These tables are colour-coded with a red-to-blue gradient to visually highlight the areas of the home that will be warmer throughout the day. An example of this table is shown below:

	Average	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
Master Bedroom	54%	70%	63%	56%	49%	46%	46%	46%	50%	58%	60%	71%
Ensuite	92%	100%	100%	100%	79%	68%	64%	69%	82%	100%	100%	100%
Lounge	100%	100%	100%	100%	100%	100%	100%	100%	77%	63%	50%	61%
Laundry	35%	76%	69%	64%	60%	58%	55%	39%	26%	21%	17%	21%
Hall & WC	99%	100%	100%	100%	90%	81%	79%	82%	92%	100%	100%	100%
Living Dining Kitchen	86%	100%	100%	94%	74%	64%	61%	64%	76%	99%	100%	100%
Scullery	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Bedroom 2	44%	40%	37%	35%	34%	36%	38%	40%	48%	63%	77%	89%
Ensuite 2	86%	100%	100%	95%	73%	62%	59%	63%	76%	100%	100%	100%
Bedroom 3	62%	34%	33%	36%	46%	71%	100%	100%	100%	100%	100%	100%
Bathroom	52%	39%	38%	40%	48%	63%	69%	60%	55%	55%	58%	68%
Bedroom 4	78%	82%	89%	81%	75%	72%	71%	72%	76%	82%	88%	79%
Hall 2	100%	100%	100%	100%	97%	93%	92%	94%	98%	100%	100%	100%
Total	**71%**	**69%**	**68%**	**67%**	**62%**	**60%**	**60%**	**62%**	**67%**	**76%**	**74%**	**80%**

Radiant Cooling Expectations

Radiant cooling systems utilise active surfaces of the home, floors, walls, and/or ceilings. By pumping chilled water through one or many of these elements the surface temperature is cooled to 17-22°C and is then much cooler than the room and the occupants. Through radiant heat transfer, heat from the occupants, other surfaces, and furnishings is absorbed by the cooled surfaces, allowing the room to become more comfortable.

Radiant cooling typically achieves a cooling rate of 40-80W/m^2 of room floor area, whereas the peak solar gain can be around 100-150W/m^2. This means that the radiant cooling system needs to be operating before and after the period of peak solar gain to compensate the shortfall during the peak period.

As radiant cooling systems operate by cooling surfaces and likely don't achieve the performance required in the peak period, it is recommended that the systems are run on a programmed schedule throughout the cooling season. This is typically from early December until late February the radiant cooling should be turned on with the time and temperature schedule set to permit cooling as required throughout the day.

The set point of the thermostat for a radiant cooling system should be viewed more as the temperature from which cooling is required. Throughout the cooling season there will be days where cooling is not needed, and the set point should be high enough to reduce/eliminate cooling operation on these days. A suggested set point for radiant cooling control is 23°C. Once the room has exceeded this set point, the active surface will be cooled and be able to remove some of the excess heat from the space. Throughout the day the internal space temperature is likely to climb above this set point and internal temperatures as high as 28-32°C will be achieved depending on the design of the system and home. The radiant cooling system will continue to remove heat from the home until the internal space temperature has dropped below the set point of 23°C and will make the space more comfortable throughout this period.

As radiant cooling systems achieve most of their cooling performance by cooling of the surface and occupants directly, having windows and doors open to ventilate the home will not significantly increase operating costs. The use of natural ventilation with radiant cooling is recommended to achieve a healthy and comfortable home.

Radiant Cooling Functional Limitations

Radiant cooling systems are a slow response and low output system and should not be expected to respond quickly or be able to rapidly cool a home to a low set point.

These systems will achieve a background level of cooling that when combined with natural ventilation, can create a low operating cost cooling solution.

Radiant cooling systems are modulated based on the internal humidity levels in the home, the performance of these systems will reduce as the internal humidity levels increase.

Radiant cooling can be combined with active cooling where more specific cooling levels are required.

Active Cooling Expectations

Active cooling systems use fans to blow air over a heat exchanger that has chilled water pumped through it. This process allows the air to be cooled to very low temperatures (12-15°C) and pumped out into the room to gradually cool down the room air as it passes through the fan coil. The air flow rate of the fan coil will be 6-12x the volume of the room each hour allowing the rooms air to be well conditioned.

- Fan coil systems can be selected to have a high cooling performance, and if required, match the peak cooling load of the room. These systems can be used to more quickly cool the room and used intermittently as cooling is required rather than being left on throughout the cooling season.
- As active cooling systems are more responsive to the space cooling needs, using these systems with a set point closer to the designed internal temperature of 25°C is more appropriate. For an active cooling system that achieved 100% of the cooling load, the internal space temperatures can be expected to be controlled to within a few degrees of the design temperature/set point (23-27°C).
- Where active cooling systems have not been able to achieve 100% of the calculated cooling load, these systems may need to have lower cooling set points, and/or the internal temperatures may be higher than the ideal temperature.
- As active cooling systems work to cool the air inside the room to achieve occupant comfort, the building needs to remain closed up while the cooling systems are operating. Opening windows and doors for prolonged periods will ventilate the cooled air and result in higher operating costs and/or lower comfort levels.
- The performance of radiant cooling systems is limited by the internal humidity levels, in regions of high internal humidity levels active cooling systems will provide more consistent performance.

Active Cooling Functional Limitations

An adequately sized active cooling system (cooling performance >80% of cooling load) will be able to be turned on and off as required and will have a relatively quick impact on improving the internal comfort levels. Systems that are undersized due to limitations in the equipment sizing/budget may take longer to achieve comfort after they are switched on.

Active cooling systems should only be used while all windows and doors are closed, and any ventilation systems should be a heat recovery type with a high efficiency.

Active cooling systems will have higher operating costs than radiant cooling systems but, it is also possible to combined these two systems to achieve higher comfort and lower running costs than an active cooling system can on its own.

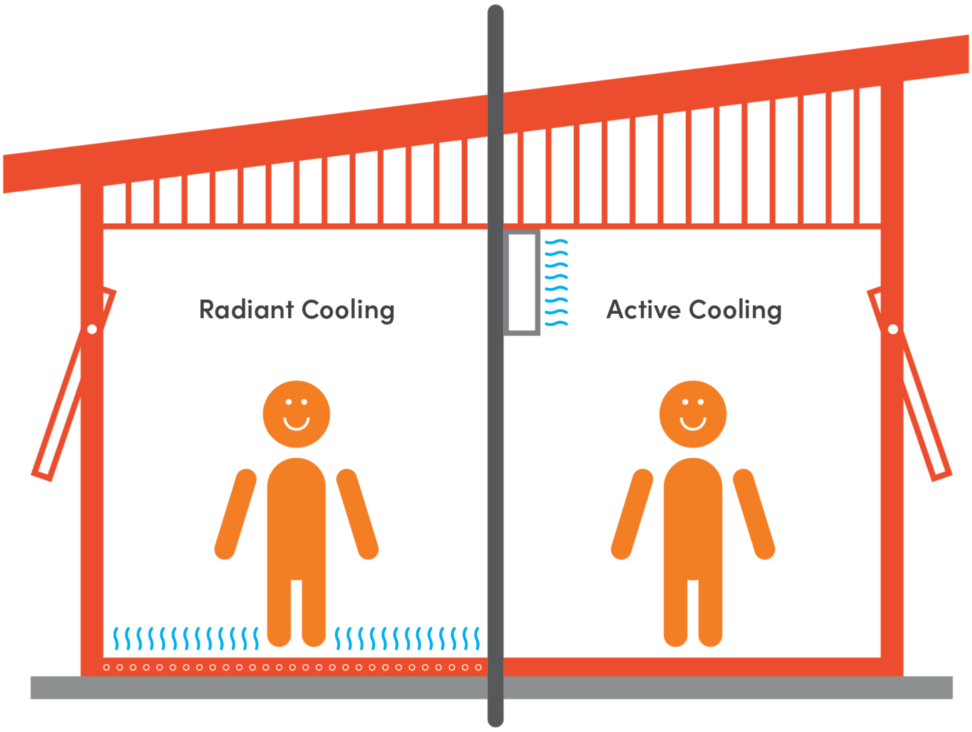
Active Cooling

Radiant Cooling

CHNZ Cooling Options

Central Heating New Zealand have several different product options that can be included in our systems to provide home cooling. These cooling options are sorted into two categories:

1. **Radiant Cooling:** these are systems that used chilled water to cool the surface of floors, walls, or ceilings to provide direct radiant cooling of the occupants and space.
2. **Active Cooling:** these are systems that used chilled water to cool the rooms air via fan coil units that are mounted directly within or ducted into the room.

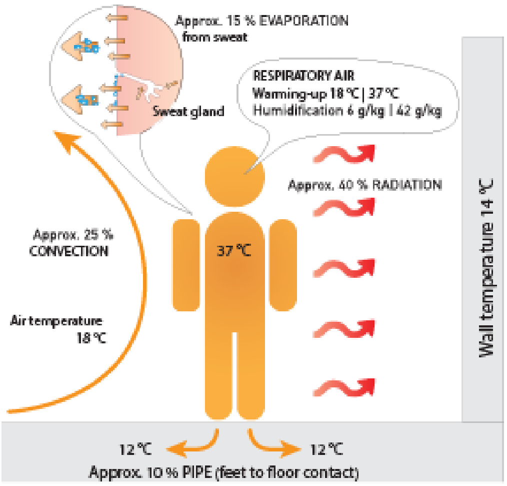


Both cooling options can be integrated into our heat pump powered systems and as part of a total home heating and cooling system. Where the homes heating is provided from a radiant heating system (pipes embedded in the floor, walls, or ceilings, or wall mounted radiators) these systems achieve the goal at the start of this guide of providing a great heating solution while also providing the additional function of some cooling of the home in the warmer months.

For each cooling product category, we have provided some further information on the various product options available in the following sections.

Radiant Cooling Options

Radiant cooling systems exploit the human bodies temperature regulation mechanisms to provide our bodies with a surface where heat can be radiated away from it. To maintain our internal body temperature, our body loses heat to the environment around us and uses 5 heat transfer methods to achieve this (Conduction, Convection, Radiation, Evaporation, & Respiration). When the rate of heat loss from each of these methods is balanced at the rates shown in the graphic below, we feel most comfortable:



▲ Human heat balance

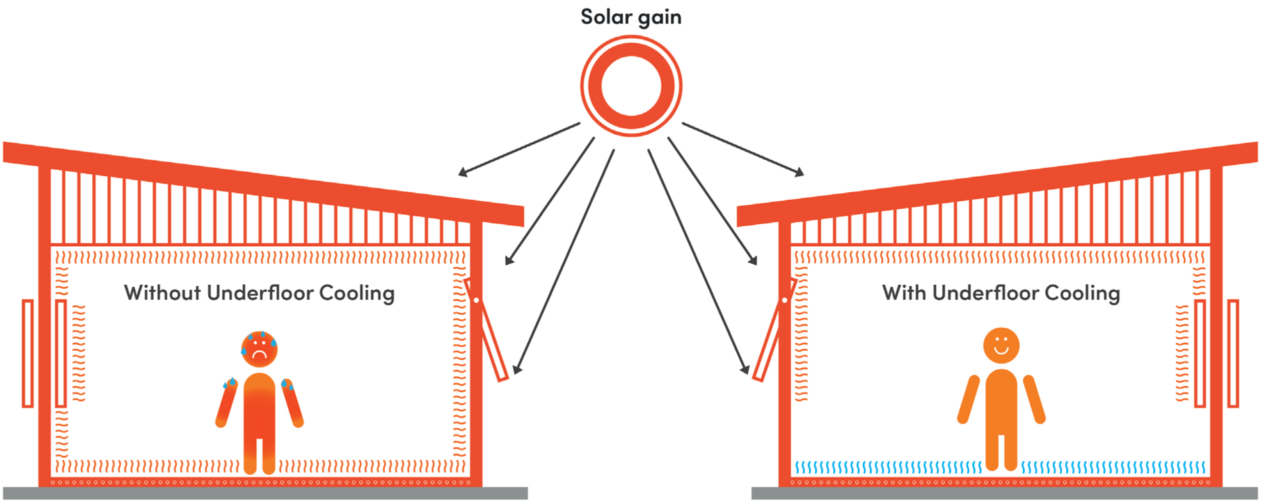
Understanding this factor allows us to realise that comfort is not only created through the air temperature in the room, but the temperature of the surfaces enclosing the room is of equal importance. Cooling surfaces offers the advantage of gentle radiation exchange between the cooled surface and the human body. Other warmer objects in the room (floor, furnishings, etc) also radiate heat to this cooled surface, and since thermal radiation always flows from the warmer to colder objects, this loss of heat reduces the surface temperatures providing gentle cooling within the room.

These systems allow occupants to feel more comfortable at much higher room air temperatures with comfort being achieved at space temperatures of 25-27°C, we feel more comfortable at these higher air temperatures as our body is still able to self-regulate its internal temperatures by radiating heating away to the cooled surfaces.

Radiant Cooling Considerations

Pros		Cons	
✓	Radiant cooling is more comfortable	✗	Lower performance than active cooling systems
✓	No noises, draughts, or visible elements	✗	Longer response times, needs to be on and ready
✓	Can be effective with doors and windows open	✗	Not able to achieve specific temperatures
✓	Provides excellent heating	✗	Can be more expensive to install than active cooling options
✓	Most efficient cooling system	✗	Can be more difficult to retrofit

Inslab Underfloor Cooling



Underfloor heating is well known for its high comfort during winter. But underfloor cooling is a new phenomenon being offered in our market and Central Heating New Zealand have been developing and offering this solution to the market since 2017.

While it seems an unusual prospect, it works very well if the system is designed and controlled correctly, and the homes design and layout reduces the cooling load and maximises the cooling potential of the underfloor cooling system.

The same system that is used to heat the floors in the winter is utilised to allow the floors to be cooled in the summer. Very few changes to the heating system are required to allow this functionality to be added;

- A suitable thermostat for managing floor cooling (SmartOne).
- Some additional insulation of pipe, fittings, and the underfloor manifold to ensure condensation does not occur.

Underfloor cooling systems are often only able to provide a portion of the buildings peak cooling load and during the day, the internal temperatures can be expected to be 25-28°C. However, the radiant cooling effect will still allow the space to feel more comfortable than without any cooling. Windows and doors can be opened to naturally ventilate the home.

Where underfloor cooling performs the best is in helping the home cool down more quickly in the evenings. As the floor cooling system has been running all day, it has been removing some of the heat that the sun blasts in through the windows and onto the walls and roof. The underfloor cooling system absorbs some of this heat so when the outside air temperatures fall, and the sun goes down, the home cools down more quickly.

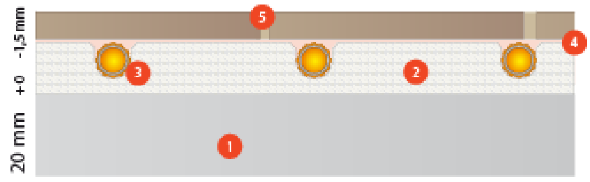
There are some limitations with in-slab cooling systems that will impact its effectiveness;

1. Due to the high thermal mass of the system, it is not able to respond quickly to a cooling demand and must be on in advance of a cooling need.
2. The impact of floor coverings is significant, and radiant cooling is best suited to areas with hard flooring and a low thermal resistance. Polished concrete, tiles, vinyl, and thin engineered timber floors are best. Some cooling performance through carpet is possible it is generally only effective in rooms with very low cooling loads (typically those on the South side of the home).

VarioComp Underfloor Cooling

The Variotherm VarioComp floor system has been used in New Zealand for many years now and we have received excellent feedback from the market on the effectiveness and efficiency of this system. The floor system (similar to the Variotherm wall & ceiling systems) uses a 18mm Fibre Gypsum panel as the distribution medium resulting in a very fast reaction time allowing the system to be turned up and down or on and off as required to suit the comfort levels required in the space.

The super-slim, light-weight VarioComp floor panel system with a total construction height of 20-30mm and system weight of only 25kg/m² has been an appealing feature for retrofit applications. The system has also been popular for timber structured new build projects as its light-weight design makes it suitable to use without requiring a re-engineered floor.



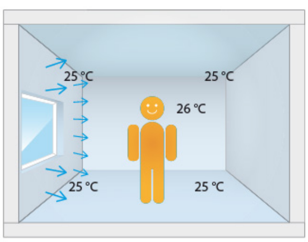
VARIOCOMP
1 Substructure
2 VaroComp panel 600 x 1000 mm
3 VarioProFile pipe 11.6 x 1.5 Laser
4 VaroComp filling compound
5 Floor covering

When used in cooling mode, the Variocomp system provides a similar cooling effect to the in-slab cooling systems with the added benefit of being more responsive due to the lower thermal mass of this system.

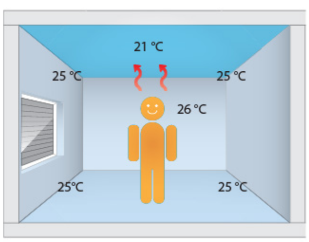
Module Panel Wall & Ceiling Cooling

Variotherm's ceiling and wall panels are great for smaller applications but excel at maximising efficiency where large heated or cooled surfaces are required. The increased levels of comfort that this radiant cooling system provides at higher room temperatures also result in significantly reducing running costs.

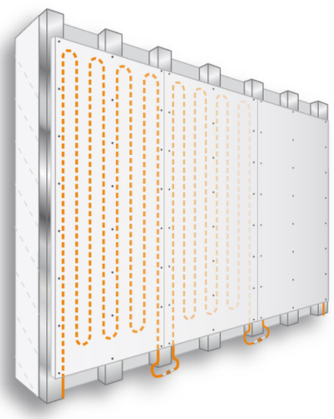
The Variotherm ModuleWall & ModuleCeiling systems achieve higher levels of radiant cooling than a floor cooling system with the ModuleCeiling system providing around twice the cooling effect per m² than a floor cooling system.



▲ Comfort with wall cooling

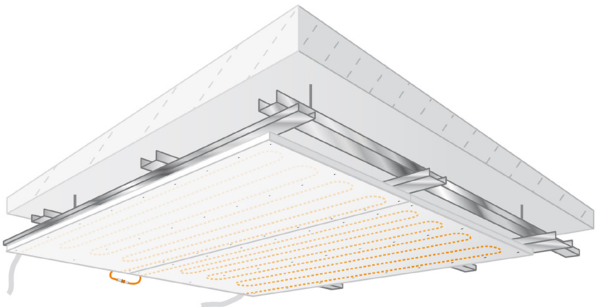


▲ Comfort with cooling



These systems use a fibre gypsum panel with integrated pipe work that when plastered and painted blends into the remaining wall and ceiling areas to create an invisible heating and cooling element.

The Variotherm ModulePanel system can be combined with other radiant cooling options. A typical design approach is to use this system combined with a floor cooling system to increase the cooling power in high cooling load rooms. With this approach only some of the wall or ceiling area needs to be fitted with the ModulePanel system.



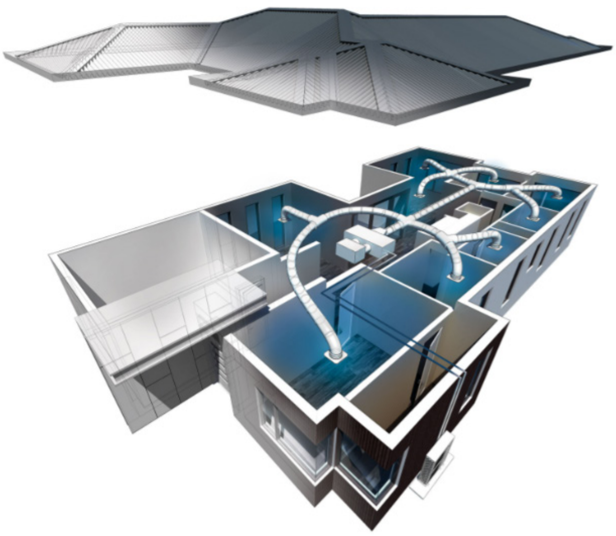
Similar to the floor cooling systems, the ModulePanel system can be effortlessly added to any central heating system. Individual panels are grouped into loops and connected back to a manifold in the same way underfloor heating systems are configured. The pipes running from the manifold to the panel groups are run through the ceiling structure in pre-insulated pipe. A SmartOne thermostat is used to manage the panels and using a probe fixed to the pipe leaving the panels will ensure that condensation does not form on the walls or ceilings.

Active Cooling Options

Active cooling systems are those that use fans to blow room air over a heat exchanger that the chilled water is pumped through. Active cooling systems achieve high levels of cooling performance by removing heat and humidity from the rooms air to bring down the internal air temperature.

Fan coils are used with active cooling systems, and are similar to the fan coils that are used with refrigerant type heat pump systems that are more typical in New Zealand.

Fan coils are available in a wide range of shapes and sizes. This allows a fan coil solution to be possible for every project. Each fan coil will have a flow and return pipe connection into the system allowing heated or cooled water to be pumped through the heat exchanger and the fan coil to then heat or cool a space.



Active Cooling Considerations

Pros		Cons	
✓	High cooling performance available	✗	Creates draughts which some find uncomfortable
✓	Reacts quickly to demand and can cool/heat a space quickly	✗	Fan noise will be noticeable in all systems when operating
✓	Can achieve lower and more specific room temperatures in cooling mode	✗	Requires the home to be closed up to be effective
✓	Can be more cost effective to install than radiant cooling options	✗	The heating provided from fan coils is not as comfortable as radiant heating
✓	Easier to retrofit to existing buildings	✗	Requires chilled water to be cooled to lower temperatures resulting in lower system efficiencies than radiant cooling

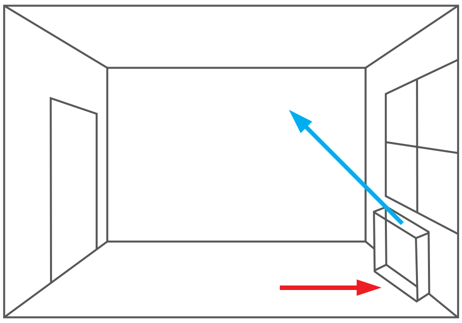
Surface Mounted Fan Coils

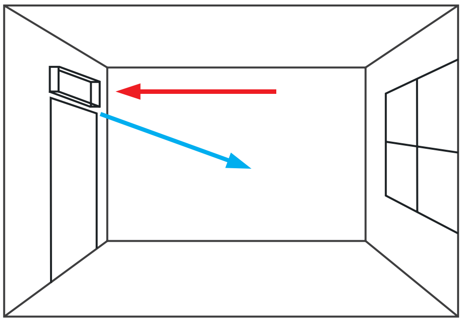
Surface mounted fan coils are mounted on the wall or ceiling of a home and provide spot heating and/or cooling to the room they are installed in only. Surface mounted fan coils units have relatively low fan power compared to ducted or built-in units, this is due to these units only being intended to condition the room that they are installed into and provide minimal heating or cooling of other rooms.

When considering these units, each room where heating and/or cooling is required should have its own unit installed. The air flow from these units is intended to extend 2-4m into the room depending on the selected model. For rooms larger than this, it is advisable to install multiple units to ensure all areas of the room are conditioned.

Surface mounted fan coils are available in both low level and high-level wall mounted options, and ceiling mounted options are also available as required:

High level units are best for cooling performance and low-level units are best for heating performance:





Surface mounted fan coils can be more easily installed in retro-fit projects with the need to find pathways for pipe work, electrical connections, and condensate drainage to each unit being easier to achieve compared to built-in or ducted fan coils.

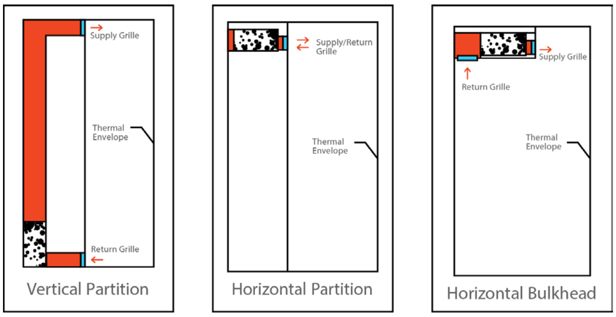
Often these units are controlled with an on-board or remote controller and operate as a sub control zone to the main system working in whatever operating mode the main system controller is set to.

Built-In Fan Coils

Built-in fan coils are mounted within the wall or ceiling of a home and provide heating and/or cooling to the room they are installed in with only the supply and return grilles being visible in the space.

Built-in fan coils are used to provide heating and/or cooling directly into the space they are installed into, or may be installed in an adjoining space. Through careful planning and coordination between the installer and builder the fan coil units are hidden within the structure or a joinery unit and only the supply and return grilles are visible in the room.

Below are some examples of the installation options for a built-in fan coil to enclose this within the building or a joinery unit:



These units typically provide more heating or cooling performance than surface-mounted units, with additional fan power to achieve the required airflow through a small amount of ducting, grilles, and filters.

In some cases, ducting from the built-in fan coil will be connected into multiple rooms, or the return air grill will be located in a different room/area from the supply grille to also heat or cool this space.

Built-in fan coils require more project coordination with the builder and/or joinery manufacturers to ensure these units are integrated correctly. Provision for access to the units for maintenance and future replacement must also be carefully considered.

The built-in fan coils will be controlled from a wall mounted controller for each fan coil. The controller will manage the set point and fan speed of the fan coil. For most systems the operating mode (heating or cooling), will be managed from a single controller and all other controls will operate as a sub-zone to this controller.

Ducted Fan Coils

Ducted fan coils are mounted within the wall or ceiling of a home and provide heating or cooling to multiple rooms through insulated ducting, feeding grilles in the ceilings and/or walls of each room.

Typically, Ducted fan coils are mounted in the ceiling space of the home and through multiple flexible insulated supply and return ducts, with only the ceiling or wall return and supply grilles being visible in the home.

Ducted fan coils are used to provide heating and/or cooling to multiple rooms with each conditioned room having at least one supply grille. Larger rooms may have multiple supply grilles. The return air is drawn through common return grilles, often connecting multiple supply areas together drawing air through open doors between spaces.

Ducted fan coils can typically be used to provide all of a home's cooling needs from 1 or 2 units (very large homes may need more). Each unit being able to provide much higher levels of cooling and air flow than the built-in fan coils. Ducted fan coil systems are better suited for homes with ample roof space and access, allowing for cost-effective methods of routing ductwork and providing easy access for future maintenance or replacement.

Ducted fan coils are controlled via a wall-mounted controller, which manages the set point and fan speed. The controller often also acts as the master unit for setting the system's operating mode, with all other system aspects functioning as sub-zones to the ducted fan coil controller.

Fan Coil Grille Options

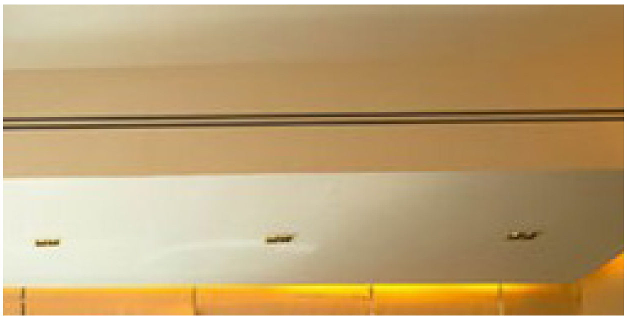
Both Built-In & Ducted Fan coils will use a collection of ceiling, wall, or floor grilles to supply and extract air from each of the conditioned rooms. While there are some standard grille options used in most applications for each type of fan coil, designer grille options are available for projects with more specific aesthetic requirements. Below, we have included examples of the typical and designer grille options for each fan coil type.

Built-In Fan Coil Grille

The typical grilles used with built-in fan coils are a linear bar grille for both the supply and return grilles:

These grilles have a removable core and can include an integrated filter, a single longer grille can be used for both the supply and return air to a room.

For designer applications other types of bar grilles are possible including frameless grilles. A popular designer option is to use slot diffusers which can also be built into the wall linings or joinery resulting in only 1, 2 or 3 slot openings being visible:



Ducted Fan Coil Grille

The typical grilles used with ducted fan coils are round ceiling diffusers for the supply and eggcrate filter grilles for the return:

These supply grilles allow for easy balancing of the supply air flows to each room.

For designer applications other types of round ceiling diffusers are possible including metal options. For more architectural options, ducted systems can use the bar and slot type grilles from the built-in fan coil options with these mounted in the ceilings or walls and ducted back to the unit:

The grilles used for built-in and ducted fan coil solutions provided by Central Heating New Zealand are sourced from local suppliers Smooth-Air and Holyoake. If there are grille options other than those suggested above, or grilles from other suppliers, are preferred, our engineering team can adapt our designs to suit, provided the technical specifications of these grilles are available.

Cooling System Comparisons

The cooling systems explained in this guide each have their unique pro's and con's, and the best solution will be dependent on the occupant and projects specific requirements.

The table below provides a comparison of each cooling option offered by Central Heating New Zealand, evaluating performance, response time, installation costs, and operating costs:

Comparisons

Type of Cooling	Cooling Performance	Heating Performance	Response Time	Installation Cost	Operating Cost
Radiant: Underfloor Inslab	★	★★★		$	$$
Radiant: Underfloor VarioComp	★	★★★		$$$	$
Radiant: ModuleWall	★	★★★		$$$	$
Radiant: Module-Ceiling	★	★★		$$$	$
Active: Surface Mounted Fan Coils	★★★	★		$$	$$$
Active: Built-In Fan Coils	★★★	★		$$	$$$
Active: Ducted Fan Coils	★★★	★		$$	$$$

The best cooling solution for each project will depend on the cooling load, construction type of the home, and the client's expectations for performance and budget. Central Heating New Zealand's experienced sales and engineering teams will help ensure that each project is provided with the cooling options that best suit its specific needs.

Cooling System Install Considerations

Cooling systems are installed in a very similar way to the water-based heating systems that we have supplied since 2002. Our installers are experienced in the installation and commissioning of these systems, and installing them for chilled water and cooling requires very few additional steps. Below the specific installation requirements for cooling systems are outlined.

Condensate Removal

When fan coils are provided with chilled water the surface temperature of the heat exchange surface is lower than the dew point of the air that is being cooled. This causes water vapour in the air to condense on the coil surface.

Fan coils that are designed for cooling have the heat exchanger configured in a way where the condensation that forms on the heat exchanger, can be collected in a tray that is located under the coil.

When a fan coil installation is being planned, the location and installation of drains are required to allow the condensate from the fan coil to be connected back to a suitable drain.

Condensate pipes are generally run in PVC/Pressure pipe with glued joints and a flexible connection made onto the fan coil. These drains are then typically run independently outside or to a suitable trapped waste water drain inside.

More information on the requirements for condensate removal and drains can be found in our Fan Coil Condensate Guide.

Pipe Insulation

Pipes that carry chilled water must be insulated. Not only to prevent unwanted heat gain, but to also prevent condensation forming and potentially damaging the building and/or causing mould growth.

It is generally recommended that all pipes, fittings, and valves that carry chiller water are insulated with at least 13mm thick insulation. This not only ensures condensation is not formed but, significantly limits the heat gain of the pipes increasing the efficiency of the system.

Pipes that carry chilled water should generally remain insulated even when passing through structural members. To assist with retaining the structural integrity of the elements, it may be possible to reduce the thickness of the insulation by up to half. But a minimum insulation thickness of at least 9mm is recommended.

Where pipes, fittings, and valves are exposed inside or outside, they should also generally be insulated with at least 13mm thick insulation. In some situations, to allow the correct functionality of a valve or sufficient access for maintenance, this may not possible. In these situations, it is suitable to reduce the insulation thickness to 9mm. If 9mm insulation is not possible, at least a layer of 3mm thick insulation is required and any valves or fittings with 3mm insulation must be installed in a way where condensation forming and dripping will cause limited damage to the building.

Radiant cooling systems generally operate with higher chilled water flow temperatures than Active cooling systems. For radiant cooling systems with flow temperatures no less than 10°C, an insulation thickness of 9mm provides a good level of protection against condensation.

More information for chilled water pipe insulation requirements check out Chilled Water Pipe Insulation Guide.

Cooling Controls

Controllers for central heating systems are often not suitable for control of cooling systems. Specific cooling controllers are required and these need to be able to manage some additional functions from a standard central heating thermostat.

The control requirements for managing a Radiant cooling system are very different from the control requirements for managing an Active cooling system. The key requirements for managing each of the cooling options are outlined below:

Radiant Cooling Control

Radiant cooling systems need to be carefully managed to ensure condensation does not form on the surface of the cooled elements. The thermostat used for managing a radiant cooling system can achieve this in one of two ways:

1. The preferred Radiant cooling control logic is where the thermostat in the home measures the internal humidity and provides this to the heat pumps in the form of a 0-10V output (i.e. 55% RH = 5.5V). The heat pumps are then configured to allow the flow temperature to be increased as the humidity increases to prevent condensation while still allowing some cooling performance to be provided.
2. The minimum control requirement for managing a Radiant cooling system is for the thermostat to monitor the surface temperature of the active elements and stop operation of the system/zone if this probe reaches the dew point to prevent condensation. This functionality can be achieved with a single thermostat, or by the use of additional condensation sensors. This option does not allow permanent operation of the Radiant cooling system and results in lower cooling performance than option 1.

Active Cooling Control

- The main requirement of a controller that manages an active cooling system is that it can manage the fan speed of the fan coil.
- The fan speed should be able to be automatically regulated based on the rooms heating or cooling need. This results in the fan speeding up when the room is further away from set point and slowing down as the temperature nears the room set point.
- The ability to manually set the fan speed and/or limit the maximum fan speed is also critical and is needed in areas where the noise created by the fan coil will be a disturbance.

SmartOne Thermostat

Central Heating New Zealand developed and delivered the SmartOne thermostat to the NZ market in 2020 and this controller was specifically designed to manage Radiant cooling systems.

For radiant cooling systems, the SmartOne thermostat can provide a 0-10V humidity output to allow the CHOFU heat pumps chilled water flow temperature to be regulated to prevent condensation. But this thermostat can also be set with dew point protection to stop operation if condensation is likely allowing this controller to also be used in cooling systems where the 0-10V humidity output can not be used.

The SmartOne thermostat is the worlds first and to this date only controller specifically designed for managing radiant cooling systems with a wide range of flexibility in its operation.

To support our active cooling systems, a new control mode has been developed for the SmartOne thermostat now allowing these controllers to manage 0-10V controlled fan coils. This new fan coil control mode for these thermostats includes a wide range of functions that Central Heating New Zealand included to provide a high level of end user control, these are;

1. **Automatic and Manual Fan Speed Control:** from the main user interface the fan speed can be allowed to change automatically or the preferred fan speed selected. The output voltage and range of outputs for all of the fan speed modes can also be adjusted in the advanced parameters to allow exact project specific fan speed limits to be set.
2. **Constant Fan Mode:** in rooms where the fan stopping and starting could be disturbing (i.e. bedrooms) this setting ensures that the fan runs continuously at a selected speed even when heating or cooling is not active.
3. **Temp Check Mode:** in systems where the delivery of hot or chilled water to the fan coil could take some time, this mode prevents the fan from starting (or increasing in speed if Constant Fan mode enabled) until the water temperature at the coil is sufficiently cool or warm.

The SmartOne thermostat is the perfect solution for managing any central heating system and now can manage any Radiant or Active cooling system.

Cooling System Maintenance

All central heating systems need to be maintained to ensure they operate effectively and efficiently and have a long operational life, most of these maintenance requirements pertain to the cleanliness and filtration of the system water and the cleanliness of the heat source heat exchangers.

Central heating systems that also provide cooling to a home will require a number of additional maintenance tasks that are completed by the home owner and/or service agent.

All Cooling Systems:

Any type of hydronic cooling system will use pipe work to transfer chilled water to the various emission systems throughout the building. All pipe work, fittings and valves must be insulated to eliminate/minimise the formation of condensate and any damage that could be caused by this condensation building up within/on elements of the building.

As part of the servicing of these systems, the service agent should review the state of all exposed insulation making sure there are no gaps and making any required repairs to ensure the system is well insulated. They should also check for any signs of dampness or water damage around any wall, floor, or ceiling penetrations and if found investigate and resolve the source of water, the pipe should be insulated through a penetration, not just have insulation applied on each side of this.

Radiant Cooling Systems:

A radiant cooling system is generally designed to operate above the dew point. After the primary delivery pipework and any manifolds, the remaining system components (floor, ceiling, and wall) should not have any condensation formation. This should be visually inspected, and the occupants should be asked if they have noticed any condensation.

If there is any evidence that the radiant system has caused condensation to form on the active surfaces, the system controls should be checked to confirm they are programmed suitably to prevent condensation – if this is the case this issue should be referred to the Central Heating New Zealand Aftersales team to investigate further.

All other maintenance components of these systems should be the same as a radiant heating system with a review and confirmation of flow rates and control operation.

Active Cooling Systems:

An active cooling system using fan coils to cool the home has several additional maintenance considerations compared to a traditional heating-only central heating system. There are two key differences between these systems and radiant heating/cooling systems, and each requires additional maintenance steps;

1. These systems move large volumes of air around the home, and as part of this process, any particles in the air needs to be filtered out to prevent these building up in the systems and to also improve the air quality.
2. These systems remove moisture from the air that is circulated in cooling mode. This moisture forms as condensation on the heat exchanger and is drained from the unit with a suitable drainage system.

These two main functional differences require a number of additional system maintenance requirements, and these are listed below:

- **Cleaning of Filters:** removable filters are installed on the return air systems and these filters must be thoroughly cleaned to maintain correct system performance.
- **Unit Cleanliness:** additional to the filters the machine where accessible should also be cleaned on an annual basis.

- **Condensate Drain:** the drain pan, and drain pipes of the condensate system should be checked for water tightness and any signs of leaks inspected and repaired.
- **Fan Group:** Where fans can be inspected, isolate the unit and check the fan blades for cleanliness and as required clean using a soft brush. Run the fan and ensure that it operates with no abnormal noises or vibrations.
- **General Checks:** check that any electrical enclosures and connections are sealed and tight. Check the tightness of any nuts, bolts, and fixings to ensure these have not been loosened from vibrations. Ensure that all ducting is securely fastened, there is no kinks or crushed sections in the duct work and that insulation is in good condition and covering all ducting.

More details on the maintenance requirements of cooling systems including a suggested maintenance schedule can be found in our Cooling System Maintenance Guide.

Your Cooling Solution

For you project's cooling solution, the team at Central Heating New Zealand offers a free, personalised system design that delivers efficient heating and cooling to suit your home and budget.

With a nationwide network of installers and sales representatives in every main centre, we make it easy to find the perfect fit.

Enjoy year-round comfort with a system tailored to your lifestyle and built to last. Contact us today to create the ideal balance of warmth in winter and cool relief in summer.

Working with us

- Support from start to finish
- Bespoke heating and cooling designs from in-house Engineers
- Marketing material and support
- Expert knowledge with more than 13,000 central heating installations New Zealand wide
- Invisible, silent, healthy and efficient solutions

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BAXI DēLonghi FAR FIREBIRD multitubo systems FERNOX MAKES WATER WORK VARIOTHERM CHOFU KORADO Rinnai