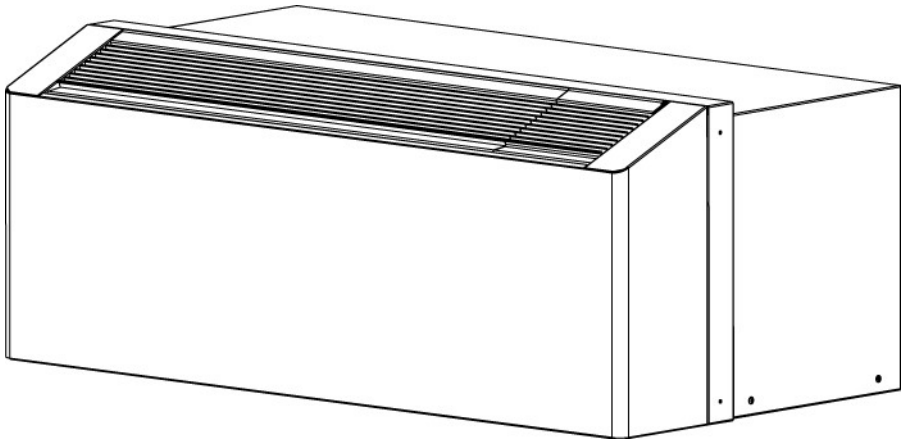
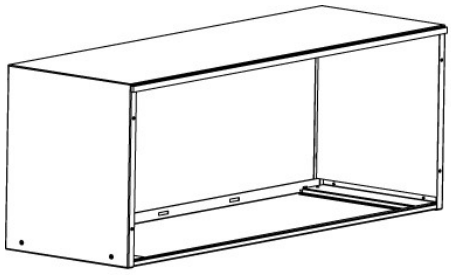
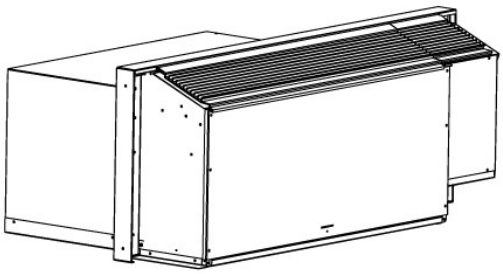
NAHWE SERIES UPFLOW PACKAGED TERMINAL HEAT PUMP (PTHP)

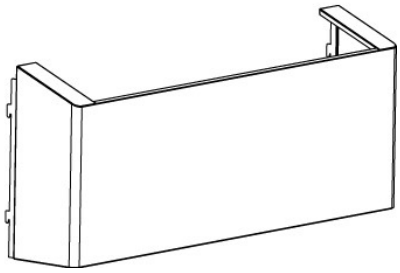
Heat Pump with Back-up Hot Water or Steam Heating

INSTALLATION & OPERATION MANUAL









IMPORTANT:

READ AND SAVE THESE INSTRUCTIONS. INSTALLATION AND WIRING MUST BE IN ACCORDANCE WITH CEC, NEC AND LOCAL ELECTRICAL CODES.

GENERAL INFORMATION

This Applied Comfort PTHP is designed and built for through-the-wall installation in either new or existing buildings. The self-contained compressor and refrigerant system delivers cooling, and also reverse-cycle heating as the primary heat source when the outdoor temperature is moderately cool.
In cold weather, when the unit must switch from reverse-cycle heat to the back-up heat source, so the hot water or steam must be available to the unit for the room to be heated. Failure to do so will cause the indoor blower to blow cold air and provide no heat to the space.

WARNING: To avoid property damage, bodily injury or death, ensure power is disconnected before any service is attempted. Repairs should be made by qualified service personnel only. The chassis must be installed in accordance with the Authority Having Jurisdiction, and all Local and National Codes, including the National Electrical Code, and the Canadian Electrical Code, as applicable.

FOR EFFICIENT OPERATION

Air Filter

The washable air filter is not shipped with the chassis – it is shipped installed in the heating sub-base. Operating the unit without an air filter will void the warranty. Keep air filter clean. The air filter can be removed and cleaned with soap and water. Inspect and clean the filter a least once a month or more often as conditions dictate. Replace as necessary. A dirty, clogged filter reduces the efficiency of the system. It can also cause erratic performance of controls and can result in damage to the motor and compressor.

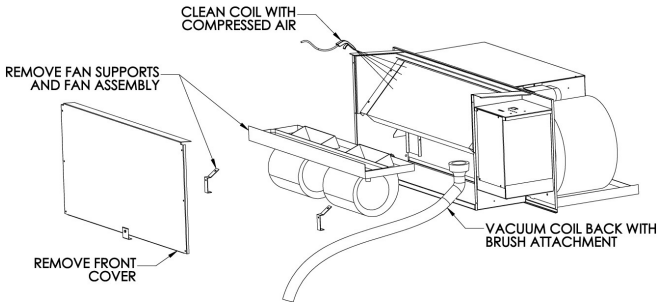
ATTENTION: An improperly maintained air filter or not using an air filter at all will void the warranty. The unit must not be used for temporary heating or cooling during the building's construction stage.

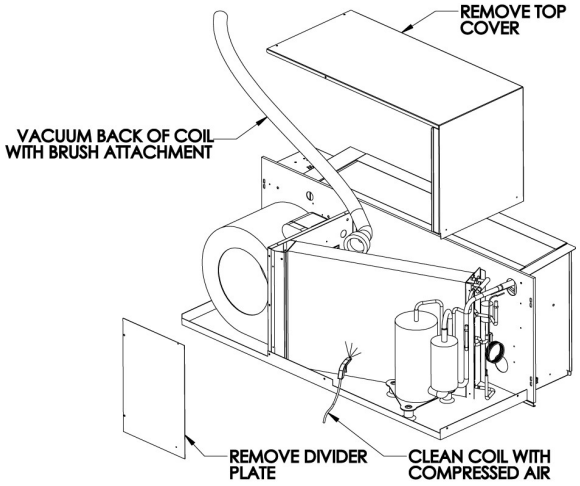
To access the air filter, first remove the grille cover from the heating subbase by rotating the two ¼ turn finger and thumb fasteners until the grille cover releases. The unit front panel need not be removed. The air filter is located directly below the heat exchange coil and slides out freely. Always replace the grille cover after re-inserting the filter.

CAUTION: Risk of bodily injury. Be aware that the heating coil, valve, and piping may be extremely hot and can potentially cause burns even if the unit is not in operation, due to residual heat. Always replace the grille cover after re-inserting the filter before operating the unit.

Clean Coils

As part of regular servicing, clean the condenser coil, and evaporator coil at least annually, or more often as dictated by the severity of the particulates and pollutants circulating in the outdoor and indoor operating environments. One suggested method is as follows:





Unimpeded Outdoor Airflow

Do not block off the outside air flow to the unit. The condenser air inlet and outlet must be free of obstructions and of any external influence that would cause the hot discharged condenser air to be re-circulated back into the outdoor blower intake. Outdoor air is drawn into the outdoor blower on the left side of

the rear grill (viewing grille). Hot condenser air is forced sideways out of the right hand portion of the rear grill, minimizing air re-circulation back into the blower intake. Paper, leaves, dirt, or other material blocking airflow, or fouling the condenser coil surface, can impair efficiency and cause serious damage to the compressor.

Oiling

The motors are permanently lubricated; no re-oiling.

Unimpeded Indoor Airflow

Ensure that drapes, bed, bedspread, and furniture etc. do not block the indoor air discharge and intake air openings, causing a restricted air flow through the indoor air handling section of the unit. Do not place articles on discharge grille – especially liquids.

Reducing Load

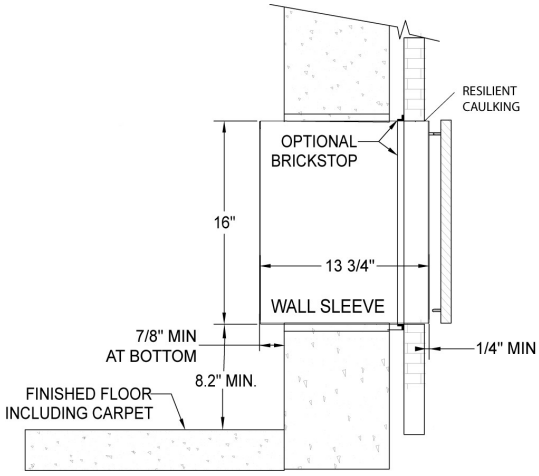
To reduce the cooling load, draw drapes or blinds in the summer, to reflect direct rays from the sun.

To reduce the cooling and heating load, keep windows and doors closed when operating the unit.

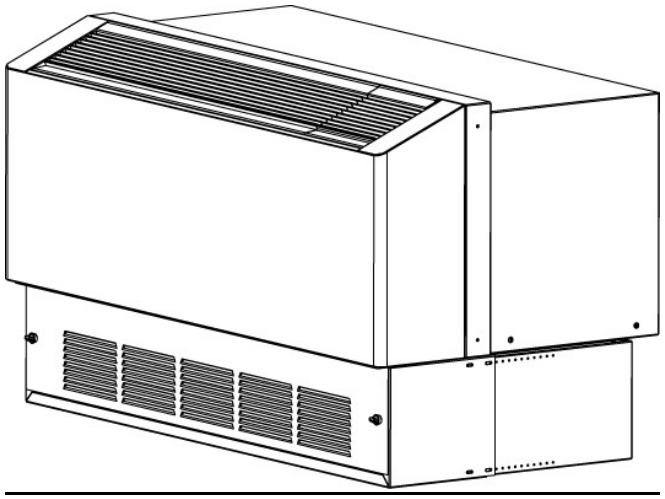
WALL SLEEVE CONSIDERATIONS:

The wall sleeve must be installed in strict accordance with the wall sleeve installation instructions, supplied with the wall sleeve. For compatibility with the heating sub-base, the bottom front edge of the wall sleeve must penetrate into the room by at least 0.875 inches past the finished wall surface, and the bottom of the sleeve must be between 8.2 and 9.2 inches off the finished floor.

IMPORTANT: The wall sleeve must be installed so that the bottom of the sleeve has a 1/8" per foot slope downward toward the outside to ensure proper water drainage out the back edge of the sleeve during overflow conditions. The specified slope corresponds to a 1/8 bubble on a carpenter's level. The wall sleeve must also be level from side-to-side.

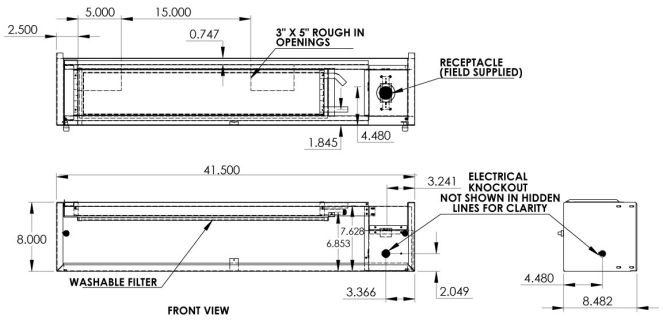


HEATING SUB-BASE



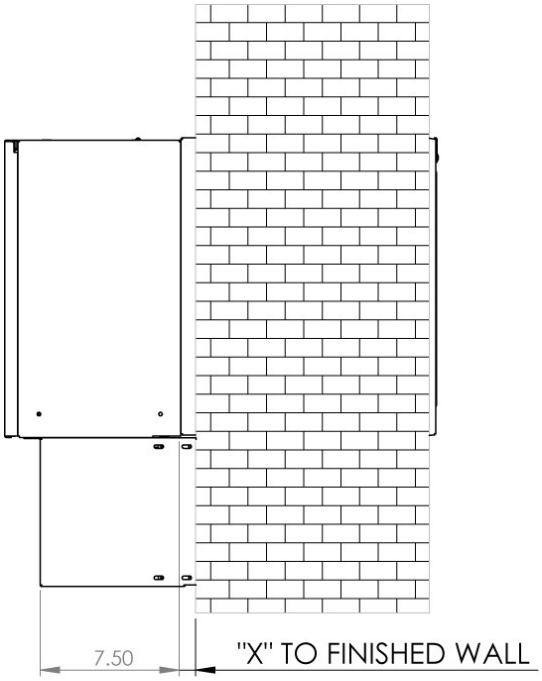
The heating subbase contains a tube-and-fin heat exchanger that is configured for the use with hot water or steam as the heating medium. The subbase also houses the field-supplied electrical receptacle and provides mechanical protection for the cord and plug. The subbase measures 8" high without leveling feet, and with the leveling feet allows adjustability from 8.2 to 9.2" high off the finished floor surface.

Electrical and plumbing rough-in can be done either through the back of the heating sub-base or through the openings provided in the bottom of the sub-base.



Telescoping Side Channels

Telescoping side channels close in the gap between the subbase and the wall. The further the wall sleeve penetrates into the room, the larger the gap to fill will be. The side channels have slotted holes and are reversible to enable practically infinite adjustability within the range from zero to 10.75 inches of gap fill, without having to cut or break off any sections.
Adjust the side flanges as follows:
Measure the penetration of the **bottom** of the wall sleeve into the room relative to the finished wall surface, and record as "x". Remove the grille cover from the heating subbase by rotating the two ¼ turn finger and thumb fasteners until the grille cover releases. The total side length of the heating subbase (cover removed) plus side channel closure is calculated as 7.5 + "x". Insert the side channels and secure with the screws provided, set at the total side length calculated. Center the subbase under the wall sleeve opening and adjust the levelling feet to the anticipated correct height. Final height adjustment can be made after the wall sleeve is permanently installed. At that point, the flanges of the side channels can be screwed to the finished wall from inside the sub-base if desired, to anchor the entire heating sub-base assembly in place. The bottom of the wall sleeve will end up overlapping the sub-base by about 0.875 inches.



Plumbing Connections:

The heating coil is supplied with 5/8" O.D. (actual diameter) copper tubing connections. Hot water heating typically requires a Normally Open (NO) water valve, and steam usually requires a Normally Closed (NC) steam valve. The NFWC unit 24 VAC control output to the valve is factory set for NC but can be field-converted to NO duty as described in Section *Heating/Cooling Chassis Installation.*

Remove the cover plate on the right hand side of the heating coil to provide better access to the copper connection tubes. Always pipe the valve to the supply connection. If the heating medium is hot water, connect the valve "outlet" (Supply) to the lower connection and the Return water to the upper connection. If the heating medium is steam, connect the valve "outlet" (Supply) to the upper connection and the Return to the lower connection. Route the steam or water source to the valve's "inlet" connection.

Install the piping, valve, and accessories (as specified by the design engineer) in the space available under the heating coil.

ELECTRICAL WIRING AND RECEPTACLE

Wire Sizing

A single outlet branch circuit from the main electrical panel to the receptacle in the subbase should be used. Wire sizing shall be in accordance with the minimum circuit ampacity as declared on the unit Rating Plate for the specific chassis. Wire sizing must also take into account any distance from fuse box or breaker panel to receptacle to prevent excessive voltage drop in undersized wires.

IMPORTANT: Low voltage to the unit will cause compressor starting problems and decrease the performance and reliability of the compressor.

Branch Circuit Protection

The Current Rating of branch circuit protection using a Time Delay Fuse or HACR circuit breaker should also be as declared on the unit Rating Plate for the specific chassis being installed.

Plug and Receptacle

All 230-208 Volt units are normally furnished with a NEMA 6-20P, 20 Amp non-locking plug, and hence will require a NEMA 6-20R receptacle to be installed in the heating subbase.

All 115 Volt units are furnished with a NEMA 5-15P, or 5-20P non-locking plug as applicable. The respective plug will require a NEMA 5-15R or combination 5-20R receptacle to be installed in the heating subbase.

All 277 Volt units are furnished with a NEMA 7-20P, 20 Amp non-locking plug, and hence will require a NEMA 7-20R receptacle to be installed in the heating subbase.

NOTE: These installations are not "cord connected" units; they are permanently connected per the National Electrical Code. The plug and cord are considered to be a "connector of convenience" in order to facilitate easy removal of the chassis for servicing. The plug and cord are suitably protected when using the hydronic sub-base (Part No. ACCNSUBBASE_HYDRONIC).

WARNING: To avoid property damage, bodily injury or death, the unit must be used on a grounded power supply only. The unit will be grounded through the service cord plug and matching receptacle as long as the branch circuit remains grounded.

DO NOT:

- Change the length of the cord.
- Bend the connector blades or otherwise alter service cord plug configuration.
- Use extension cords.

Wiring to Subbase

Remove the junction box cover plate. Punch out the appropriate knock-out and anchor the electrical supply conduit to the junction box. Connect the power supply wires to the receptacle. Be sure to properly ground the electrical supply to the subbase and the receptacle using the two *Green with Yellow Stripe* ground leads provided. Mount the receptacle with the designated screws and re-install the junction box cover plate.

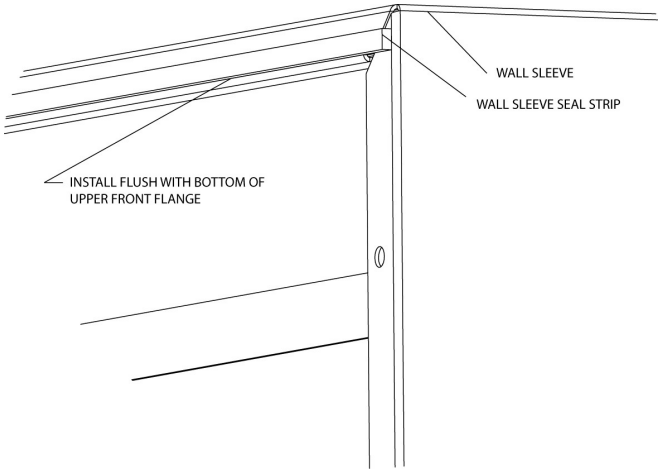
CHASSIS INSTALLATION

Unpack heat/cool chassis from shipping carton. Check for any shipping damage. Spin the fan wheels manually to confirm free rotation. Inspect refrigerant piping to ensure there is no damage or potential chafing. Report any shipping damage to the carrier immediately.

Check the interior of the installed wall sleeve. Clean out any dirt or debris that may have accumulated. Replace any air seals that are damaged or missing, if applicable.

Heating/Cooling Chassis Installation

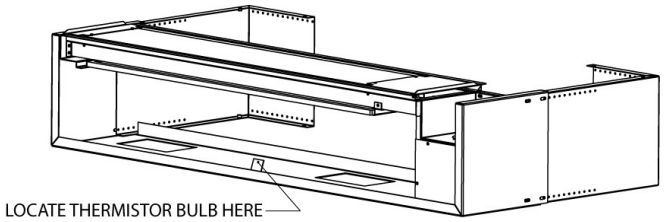
1. **Locate the wall sleeve seal shipped with the unit and apply it to the top front flange of the wall sleeve, running even with the bottom edge of the flange (see illustration).**



2. The chassis must be level from side-to-side and sloped toward the outdoors from front-to-rear in the order of 1/8 inch per foot, once the chassis side flanges are drawn up tight to the wall sleeve using the four flange screws. A chassis slope downward (backward toward the room) from outdoor-to-indoor side is not permissible and must be corrected before the unit is operated.
3. There are vertical air seals at the rear of the unit that surround the condenser outlet that will engage and "seal" against the rear grille. However, in some cases, such as when an extra deep wall sleeve is used, or some other variation is encountered that prevents the air deflectors from sealing against the outdoor grille, then steps must be taken to add anti-recirculation baffles to prevent hot condenser air from short-circuiting back into the air intake/outdoor blower inlet via the void space created in behind the outdoor grill.
4. With the front panel removed, position the chassis in the wall sleeve cabinet and slide into place. Keep the chassis level, square, and centered to prevent binding. Push from the ends of the front cover where they attach to the coils support, DO NOT push from the electrical box cover or the middle of the front cover. The chassis must be pushed into the wall sleeve until the side flange seals of the chassis engage the sleeve. Alternately tighten each of the four draw screws until the chassis is drawn snugly into the sleeve. Do not over-tighten the draw screws.
5. Locate the 24 Volt wiring harness either coiled beneath the control box or shipped loose with the unit. The harness is used to make connections to the aquastat. It is also employed if a remote 24 Volt AC wall thermostat will be used. Connect the multi-wire 24 volt wiring harness to the mating plug protruding beneath the control box, as applicable, and follow the detailed instructions on the wiring diagram affixed to the specific unit being installed. Insulated crimp-on connectors are provided at the end of every connection lead to facilitate connections/insulation except for the Blue and Orange Aquastat wires which are connected together by default. **If an aquastat will be used, <u>you must cut the Blue and Orange leads</u> free at the splice connection and wire them to an field-provided aquastat switch suitable for a 24VAC Class 2 circuit to permit proper operation of the aquastat.**
6. A 24 VAC water or steam valve output connector is also provided under the control box. A mating connector and 3 feet of wire leads are supplied to connect to a 24 VAC valve. The units can accommodate a normally-open NO or a normally-closed NC valve. The NO/NC switch is located in the high voltage wiring compartment as a DIP switch on the electronic control board, and is factory set to NC. The setting can be changed to NO in the field by qualified service personnel.

WARNING: The NO/NC conversion procedure involves exposure to high voltage electrical circuits in the control box in order to make the necessary change to the DIP switch, and must be performed by qualified service personnel. Failure to do so could result in property damage, personal injury or death. Disconnect electric power to the unit before servicing.

7. Locate the indoor air thermistor bulb at the end of the black thermistor wire with clamp coiled beneath the control box. The bulb and clamp must be relocated to the thermistor holder in the bottom of the heating subbase so it is sure to sense true return air temperature, and not air that has been heated by the heating coil. Use the clamp provided to secure the bulb in place.



IMPORTANT: To avoid damaging the indoor thermistor wire, always remove the thermistor from the clamp holder before removing the chassis for service.

IMPORTANT: Operating the unit without the filter in place can damage the unit, and void the warranty. Always remember to re-install the filter after servicing the chassis, or replacing/cleaning the filters.

8. Wipe unit cabinet/wall sleeve to remove dirt, etc.
9. Lock the front panel on by inserting the tabs into the corresponding slot and sliding the front cover down until it seats.
10. The unit is now ready for operation, when supplied with power from the distribution panel and wired to a remote thermostat (if applicable).

START-UP CHECKLIST

Note: Once the unit is installed, it should be checked for proper function by qualified service personnel before turning it over to the User.

- Circuit breakers, wire size, and electrical connections tight and correct
- Filter clean and properly in place
- Condenser air inlet and outlet free of obstructions and no short-circuiting of condenser air
- Unit operated for 20 minutes to prove stability
- Controls operation OK
- Unit installed in compliance with all codes and ordinances
- All panels in place and secured with required fasteners
- Mylar overlay applied to cover up touch pad for 24 Volt Remote Thermostat installations.
- Work area clean and free of debris
- Owner or operator instructed on control operation and routine maintenance.

USER CONTROLS - GENERAL

NAWE series is available with advanced-function electronic controls with membrane switch type keypad.

ELECTRONIC CONTROLS

The chassis incorporating electronic controls is factory-shipped with an active keypad control and display mounted directly to the control panel. The unit functions are controlled by the user by pressing the keys on the keypad, and reading the display. However, the unit also has the latent ability to be field-converted by qualified service personnel for use with a field-supplied 24 volt AC wall thermostat. These instructions will address both unit-mounted control operation, and remote 24 volt AC wall thermostat operation.

CONTROL AT THE UNIT, KEYPAD/DISPLAY

THE KEYPAD CONTROL

Become familiar with the keypad keys as shown in Figure 1.

Display
Red light emitting diodes (LEDs) display the actual temperature of the air entering the unit at floor level. The display can also be used to indicate the desired set point temperature for room comfort. It is important to remember that the temperature displayed is the temperature sensed at the unit's indoor air inlet and can be significantly different from the bulk room temperature at a distance from the unit.

On/Off Key
Each press of the key toggles the unit from an OFF state to an ON state or from an ON state to an OFF state. Heating and cooling functions, as well as the display, and all indicating LEDs except for the fan indicators, are enabled or disabled with this key. When toggled OFF, the control preserves only two modes active; fan-only, and room freeze protection.

Fan Key
Each press of the Fan Key cycles the fan through three modes of operation; Low Speed, High Speed and Auto. Small green LEDs will indicate the mode. The On/Off key need not be ON to operate the fan and set fan speeds. Auto Mode will cycle the fan on and off, and determine the fan speed, in conjunction with the heating or cooling demand.

Warmer Key
Pressing the Warmer Key will cause the display to show the set point temperature for 3 seconds, and then increases room temperature by 1 degree for every subsequent press of the key.

Cooler Key
Pressing the Cooler Key will cause the display to show set point temperature for 3 seconds, and then decreases room temperature by 1 degree for every subsequent press of the key

°F/°C Key
This key toggles the display between Fahrenheit and Celsius temperature modes, and affects all displayed temperatures.

Heat Key
The Heat Key toggles the unit in and out of heating mode for every press of the key, provided the On/Off Key is ON.

Cool Key
The Cool Key toggles the unit in and out of cooling mode for every press of the key, provided the On/Off Key is ON.

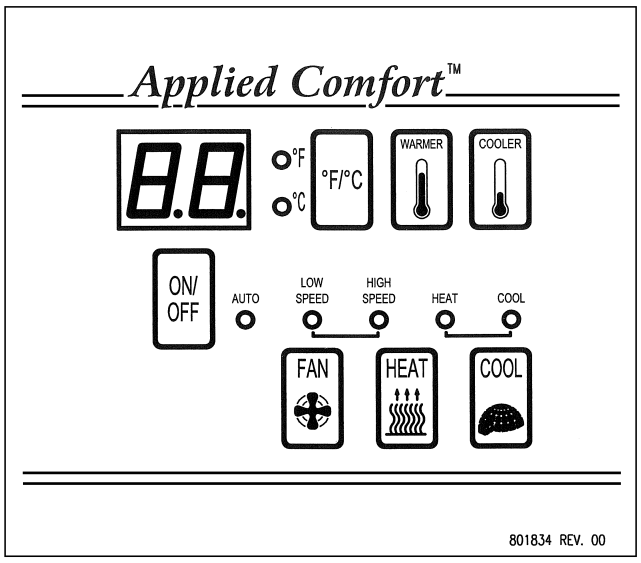


Figure 1

OPERATION USING KEYPAD

When the unit is first plugged in, or when recovering from a power outage, there will be a random 5 to 15 second delay before the electronic control powers up. This minimizes the large electrical surge that would otherwise occur if all units in a building started up at the same time.

To Initiate Heating or Cooling Mode
Press On/Off Key to turn on the LED display and commence full functionality. Push the °F/°C Key to obtain the desired temperature scale. Press the Heat or Cool key as applicable, and the current indoor temperature will be shown on the display.

Set Desired Temperature
Press Cooler or Warmer key as applicable. Each push of the key increases or decreases the set point temperature by 1 degree, as applicable.

Set Fan Mode
Press Fan key to cycle through the fan settings as indicated by the small green circular LEDs. Select continuous High Speed fan, continuous Low Speed fan, or Intermittent Fan by selecting Auto. Auto cycles the fan on and off with the calls for heating or cooling. Auto also sets fan speed according to the amount of heating or cooling demanded. In Auto mode, the fan will start up periodically to establish airflow; air temperature will be sampled, and then the fan will shut off again if there is no demand.

Disable Heating or Cooling, but Initiate Fan-Only
Press On/Off key to turn off LED display. Press Fan key to cycle through the fan settings as indicated by the small circular LEDs. Select continuous High or Low speed. Do not select Auto, as it will turn the fan off.

CONTROL AT THE WALL THERMOSTAT

CONVERSION TO 24V REMOTE THERMOSTAT

Except for the wall thermostat and thermostat cable, everything is included with the unit to field convert a keypad-operated unit to 24 Volt AC wall thermostat operation by qualified service personnel. Specific conversion instructions are detailed on the wiring diagram affixed to each particular unit to be converted. Conversion involves accessing the high voltage wiring compartment and changing a DIP switch setting on the electronic board. Once the DIP switch setting has been changed, operation will be in remote thermostat mode as soon as power is restored to the control.

WARNING: The conversion procedure involves exposure to high voltage electrical circuits in the control box in order to make the necessary change to the DIP switch, and must be performed by qualified service personnel. Failure to do so could result in property damage, personal injury or death. Disconnect electric power to the unit before servicing.

A factory-supplied 24 Volt wiring harness is provided with every unit to facilitate connection to the wall thermostat wiring. One end has a multi-pin connector which mates with a connector exiting the unit. The other end has preinstalled butt splice connectors, which play a dual role in insulating any unused connectors, and can also be used to make the wire connections for wires that are used.

The final step is to apply the masking label provided, to cover up the keypad. The keypad and display will be disabled and no longer be available for control. The masking label markings instruct the user to go to the wall thermostat for controlling the unit.

COMPATIBLE THERMOSTATS

The features of the 24 VAC wall thermostat chosen will dictate the extent of the features available from the unit.
Electric Heat / Cool units can accommodate the following thermostats in either manual or automatic changeover:

- Single Stage Heat/Cool, Single Speed Fan
- Single Stage Heat/Cool, Two Speed Fan

Note: The thermostat selection must be verified to ensure its control logic will always energize a Fan output (G) on a call for heat – also known as an Electric Heat Type Thermostat.

General:

All the above can have single speed or two speed fan control.

The wiring diagrams affixed to the units will guide the specific connection strategies for the particular thermostats used.

THERMOSTAT LOCATION:

Proper functioning of the thermostat depends on accurate room temperature sensing. Be conscious of locating the thermostat where temperatures near the thermostat are not representative of room temperature. For example, do not install the thermostat where it is subjected to direct sunlight, other sources of heat, or to cold drafts, including air discharged from a supply air register. A common error is forgetting to seal the hole in the wall where the thermostat cable passes through, directly behind the thermostat body. Air bleeding from behind the wall can drastically affect the temperature sensed by the thermostat.

REMOTE THERMOSTAT OPERATION

When the unit is first plugged in, or when recovering from a power outage, there will be a random 5 to 15 second delay before the electronic control powers up. The keypad will be totally disabled once the DIP switch has been set for remote mode. The unit will obey the commands from the thermostat only.

The thermostat will automatically maintain the temperature in the room, based on the setting pre-set by the user. If the thermostat has only single fan speed capability, a decision will need to be made as to whether the fan will always run in high speed or low speed, and then the appropriate fan speed wiring connection can be made at the unit.

All the internal control features of the electronic board remain active, except for keyboard and display interface functions and room temperature sampling. Room temperature is detected at the location of the wall thermostat, and is usually a much more accurate representation of bulk room temperature. The thermostat used may have advanced features beyond the basic functions described below. Consult your thermostat Installation and Operating Instructions for further information.

In addition to controlling room temperature, the room thermostat is also used to select whether the unit is to be in heating mode, or cooling mode, or in automatic changeover between the modes. It also determines whether the system is to be ON or OFF, and whether the fan is to run continuously, or to cycle with heating or cooling demand.

WALL THERMOSTAT OPERATION	
Heat	Sets the unit into heating mode. Initiates heating when room temperature falls below set point.
Off	Disables heating and cooling modes, but allows control of fan.
Cool	Sets the unit into cooling mode. Initiates cooling when room temperature rises above set point.
Auto (not shown)	Found on automatic changeover thermostats only. Allows the thermostat to decide whether it should be in the heating or cooling mode. Usually a 4 F° differential or "deadband" will exist between heating and cooling set points to prevent inadvertent rapid switching between modes.
Temperature Setting	Establishes the "set point", or desired room temperature.
Fan On	Synonymous with "Fan Continuous". Fan will continue to run after the heating and cooling function has cycled off. Fan will continue to run even when mode switch is in Off position.
Fan Auto	Synonymous with "Fan Intermittent". Fan will cycle on and off with the heating cycle or cooling cycle, and will not operate between cycles.

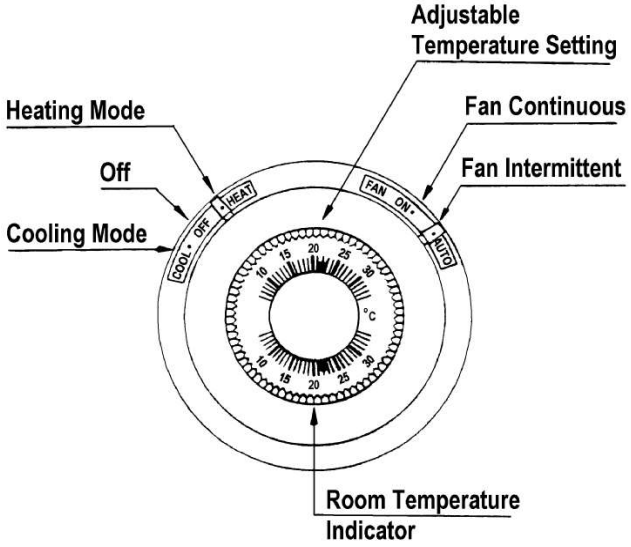


Figure 2

Once a comfortable temperature setting is established, no other adjustments are necessary, except for fan speed, which may or may not be adjustable on your particular thermostat.

CAUTION: One side of the unit's 24-volt control system is grounded. When wiring the thermostat, care must be taken not to ground the wires, or drive a nail through the thermostat wire bundle, thereby potentially burning out the transformer.

ADDITIONAL FEATURES:

Some additional features of the Electronic Control units are as follows:

Room Freeze Protection
This feature is enabled when the unit is shipped from the factory. The feature can be disabled by qualified service personnel. If power is available to the unit, and regardless of whether it is turned ON or OFF, the unit will automatically supply heat to the room with the fan running at low fan speed if the room temperature falls to 50°F (10ºC). The heat will turn off when the room temperature reaches 55°F (13ºC). For the feature to work, the unit must be configured with an electric heater. The feature is enabled whether the unit is configured for keypad or remote thermostat. The protection remains active when the unit is OFF, for either keypad or remote thermostat application, as long as the unit is plugged in, power is available, **and a heat source (hot water or steam) is available.**

Compressor Short-Cycle Protection
If the electronic control shuts the compressor down for any reason, a 3 minute time delay will elapse before the compressor is allowed to re-start. This prevents

compressor overload during re-start due to unequal system refrigerant pressures.

Indoor Coil Freeze Protection
Control of frost on the evaporator coil due to low indoor loads, or cold outdoor ambient temperatures, is provided.

Low Outdoor Temperature Lock-out
If the outdoor temperature is too low for proper compressor operation, cooling operation will be suspended until the outdoor temperature rises to an acceptable point, depending on the application.

Indoor Temperature Limiting (Keypad Control Only)
Using the keypad control and display, high and low temperature limits can be established to prevent the user from entering set point temperatures colder or warmer than what the property manager or hotel operator may desire. The temperature limit choices are as follows:

Configuration Code	Low Limit °F (ºC)		High Limit °F (ºC)	
R1	63	(17)	86	(30)
R2	65	(18)	86	(30)
R3	65	(18)	90	(32)
R4	67	(19)	88	(31)
R5	67	(19)	92	(33)
R6	69	(20)	90	(32)
R7	69	(20)	72	(22)

The procedure to set the limits is as follows: Depress the On/Off key, the °F/°C key, and the Warmer key simultaneously for 5 seconds to enter the limit setup mode. The Warmer and Cooler keys will scroll through the R-values indicated in the above table. Once the desired R-value has been obtained on the display, press the On/Off key to accept the change, and then press it again to effect the change and restore the normal display.

Automatic Powered Damper

NAWE models are available with or without provision for fresh air. However, if the units are configured to bring in fresh air, they must have an automatic powered fresh air damper that opens the fresh air door to bring outdoor air into the room only when the indoor blower is running. If the indoor fan shuts off, the damper automatically closes and interrupts the heating coil's potential exposure to possible extremely cold air when there is no blended air flow over the coil and/or no flow of the heating medium inside the coil. The factory default is fresh air with high speed fan operation only, but it can be changed to open with low speed fan operation only by having qualified service personnel re-wire the unit as shown on the specific wiring diagram affixed to the unit.

WARNING: The speed conversion procedure involves exposure to high voltage electrical circuits in the control box in order to make the necessary change to the damper action tied to motor speed, and must be performed by qualified service personnel. Failure to do so could result in property damage, personal injury or death. Disconnect electric power to the unit before servicing.

SERVICE/REPAIR INFORMATION:

Service and repairs shall be completed by authorized service personnel.

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimized.

Work shall be undertaken under a controlled procedure to minimize the risk of a flammable gas or vapour being present while the work is being performed.

All maintenance staff and others working in the local area shall be instructed on the nature of the work being carried out. Work in confined spaces shall be avoided.

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO, fire extinguisher adjacent to the charging area.

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing

any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. "No Smoking" signs shall be displayed.

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance. The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

- The actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed.
- The ventilation machinery and outlets are operating adequately and are not obstructed.
- If an indirect refrigerating circuit is being used, the secondary circuit shall be checked for the presence of refrigerant.
- marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected.
- Refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.

Initial safety checks shall include:

- that capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking.
- that no live electrical components and wiring are exposed while charging, recovering or purging the system.

that there is continuity of earth bonding.

Ventilated Areas

Ensure that the area is open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

Repairs

During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is necessary to have an electrical supply to equipment during servicing, then a permanent operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatus is mounted securely.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.
Do not apply any permanent inductive or capacitance loads to the circuit without ensuring that this will not exceed the permissible voltage and current permitted for the equipment in use. Intrinsically safe components are the only types that can be worked on while live in

the presence of a flammable atmosphere. The test apparatus shall be at the correct rating.
Replace components only with parts specified by the manufacturer. Other parts may result in the ignition of refrigerant in the atmosphere from a leak.
NOTE: The use of silicon sealant can inhibit the effectiveness of some types of leak detection equipment. Intrinsically safe components do not have to be isolated prior to working on them.

Cabling
Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also consider the effects of aging or continual vibration from sources such as compressors or fans.

Detection
Under no circumstances shall potentially sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used. The following leak detection methods are deemed acceptable for all refrigerant systems. Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity may not be adequate or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed. Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipework.
NOTE Examples of leak detection fluids are:
- bubble method,
- fluorescent method agents.

If a leak is suspected, all naked flames shall be removed/extinguished. If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

Removal / Evacuation of Refrigerant
When breaking into the refrigerant circuit to make repairs - or for any other purpose - conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration. The following procedure shall be adhered to:

a) safely remove refrigerant following local and national regulations.
b) purge the circuit with inert gas.
c) evacuate (optional for A2L).
d) purge with inert gas (optional for A2L).
e) open the circuit by cutting or brazing.
f) The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems. For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place. Ensure that the outlet for the vacuum pump is not close to any potential ignition sources and that ventilation is available.

Charging Procedure
In addition to conventional charging procedures, the following requirements shall be followed:
• Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
• Cylinders shall be kept in an appropriate position according to the instructions.
• Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
• Label the system when charging is complete (if not already).
• Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.
Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior

to commissioning. A follow up leak test shall be carried out prior to leaving the site.

Decommissioning / Recovery

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its details. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task commences.

a) Become familiar with the equipment and its operation.

b) Isolate the system electrically.

c) Before attempting the procedure, ensure that:

- Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
- All personal protective equipment is available and being used correctly.
- The recovery process is always supervised by a competent person.
- recovery equipment and cylinders conform to the appropriate standards.

d) Pump down the refrigerant system, if possible.

e) If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

f) Make sure that cylinder is situated on the scales before recovery takes place.

g) Start the recovery machine and operate in accordance with instructions.

h) Do not overfill cylinders (no more than 80 % volume liquid charge).

i) Do not exceed the maximum working pressure of the cylinder, even temporarily.

j) When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

k) Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely. When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e. special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs. The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of all appropriate refrigerants including, when applicable, FLAMMABLE REFRIGERANTS. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition. Before using the recovery machine, check that it is in satisfactory working order, has been properly maintained and that any associated electrical components are sealed to prevent ignition in the event of a refrigerant release. Consult manufacturer if in doubt. The recovered refrigerant shall be returned to the refrigerant supplier in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders. If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that FLAMMABLE REFRIGERANT does not remain within the lubricant. The
evacuation process shall be carried out prior to returning the compressor to the suppliers. Only electric heating to the compressor body shall be employed to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Labelling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.