

Ventilation, Heating and Air Conditioning Systems Operation

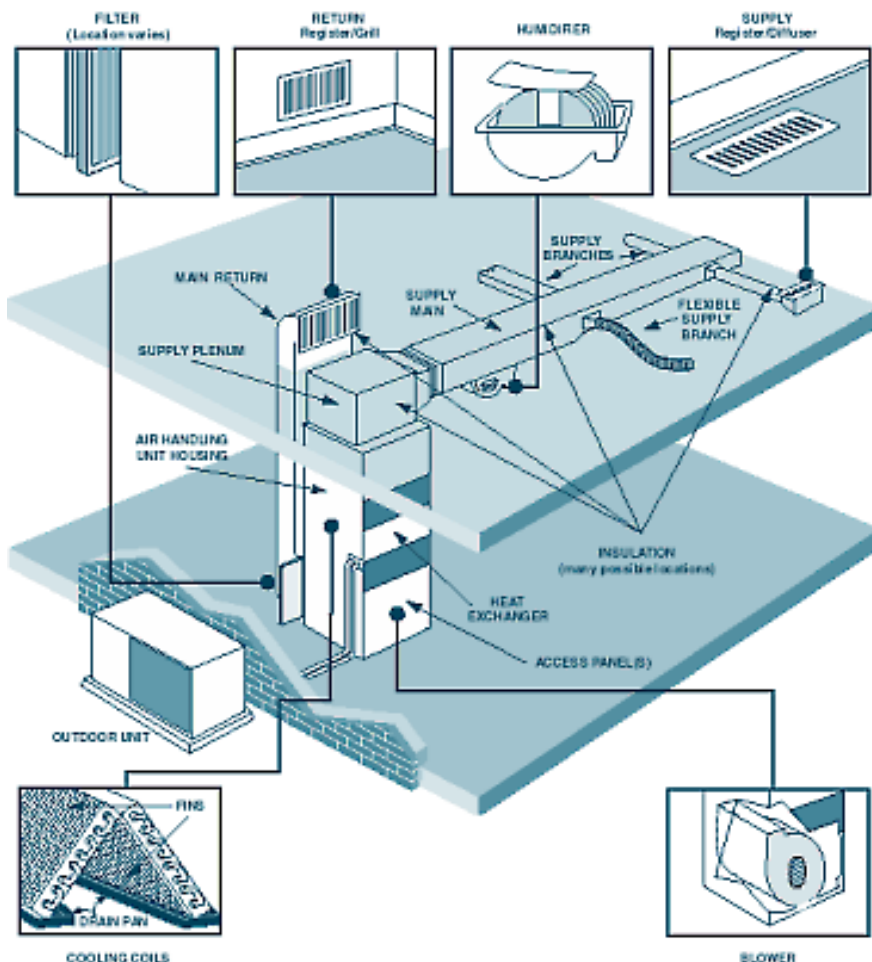
HVAC System and how it operates can be helpful in understanding the critical role AC Filters and Furnace Filters play in the efficient operation of the HVAC system and how it impacts your indoor air.

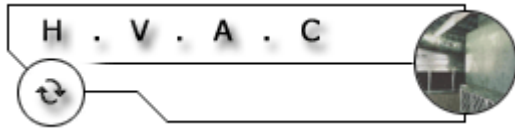
Below is a drawing of the typical central heating and/or air conditioning system used in a home or small office. Often referred to as a "loop system", the air passes through the HVAC system and is circulated in an endless "loop".

The loop begins when air comes into the system through the return air ducts located throughout the building and into the ductwork. Air then passes through the ductwork and the ac filter or furnace filter and then into the actual HVAC system where it is forced out into the ductwork and through the register vents into each room of the dwelling. The AC Filter or Furnace Filter, as well as [Air Vent Filters](#) (added to the home or office) are the only way to regulate the quality of the indoor air in a dwelling.

Each component of the HVAC system is designed for a specific function. All of the components except the ac filter and/or furnace filter are fixed. Consequently, the only way to significantly improve the quality of the air that passes through the HVAC system is through improving the quality of the ac filter and/or furnace filter.

It is important to note that proper maintenance is crucial, including routine cleaning of the coils and other parts of the HVAC system and occasional ductwork cleaning. Be advised, this work should be performed by a licensed HVAC technician.





The majority of systems installed in residences today are single speed, gas or electric heating and electric air conditioning, covering about 60 percent of the market. However, heat pumps are becoming increasingly popular as efficiencies and reliability have improved. Heat pumps now make up almost 30 percent of the market. Two speed or two stage systems make up the remaining 10 percent.

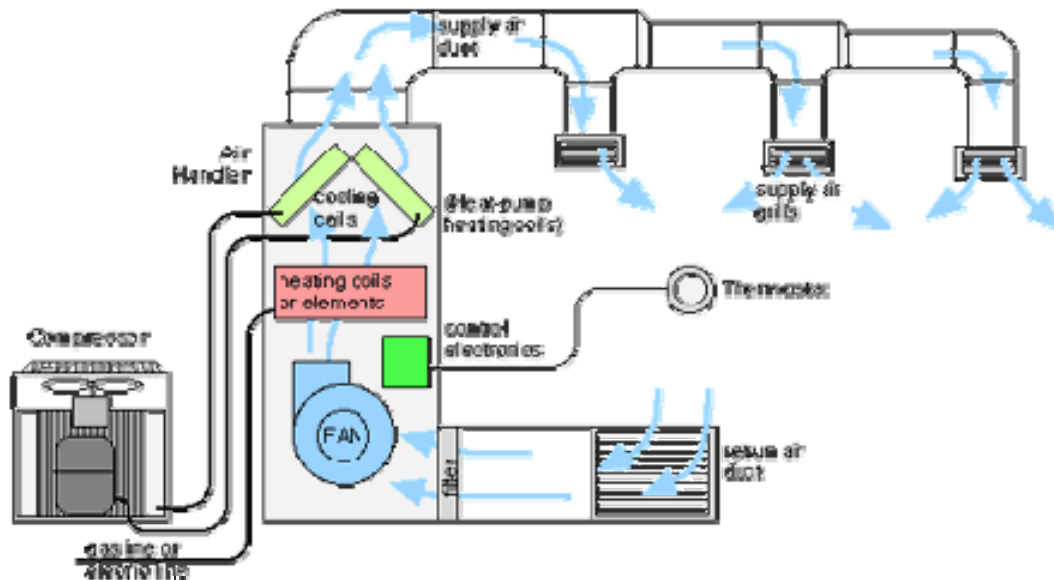
This section of the Guide will cover heating, ventilating, and air-conditioning (HVAC) subsystem automation. Since the 1950's when forced air heating and cooling systems first began to be installed in homes, heating and air-conditioning systems have changed very little. While the basic system operation is the same, there have been significant improvements in operating efficiency.



Home H.V.A.C

If there is one system in the house that can benefit the most from automation, the HVAC system is it. Almost all systems rely on a simple, often mechanical thermostat that simply turns the system on or off. Almost anything you do can improve its ability to provide increased comfort more efficiently.

Like lighting, HVAC subsystem automation can be implemented as a stand alone system or as part of a whole-house automation system. Almost any type of heating, cooling, or ventilation equipment can be part of an automated HVAC system. Since the heating and cooling system consumes about 50% of the energy costs and is responsible for most of the occupant's comfort, an automation system can enhance comfort and reduce energy costs by setting the thermostat properly based on whether the owner is home, asleep or away. In addition, sensors used for security purposes can be used to adjust the HVAC system for maximum efficiency, (for example, setting back the heat when there is no one in a room). Finally, most automation systems offer access by telephone or Internet, allowing the thermostat(s) to be adjusted remotely.

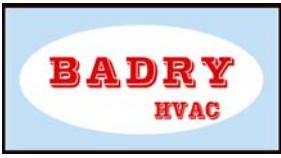


Typical conventional heating/cooling system

Terms and Definitions

HVAC products and systems have their own unique set of terms. The following terms are used throughout this section of the Guide and will also be found in HVAC and HVAC control system documentation and literature.

HVAC equipment - Heating, Ventilating and Air-Conditioning equipment - A generic term for any equipment that provides heating or cooling for the home as well as the ventilation and air handling equipment.



HVAC Zone (or Environmental Zone) - An area of a home whose environmental conditions (temperature, humidity, airflow, etc.) are individually controllable. A home always has one or more zones.

HVAC System (or Environmental System) - A group of one or more environmental zones operated by a single source of heating/cooling/air-handling equipment. A system may have multiple control devices. If there is only one zone in a home, the zone and system are the same. There may also be more than one system in a home.

Hydronic System - A type of heating system that uses hot water instead of air, either in tubing in the floor, walls, or ceiling, or in room radiators. A Hydronic system usually relies on heat radiation or air convection rather than forced air movement.

Stages - heating and cooling systems are said to have stages of heating and cooling to mean more than one source of heating or cooling in the same system. For example, a heat pump compressor provides the first stage of heat and a gas heating element provides the second stage.

SEER - (Season Energy Efficiency Ratio) a measure of cooling efficiency for air conditioning products.. The higher the SEER rating number, the more energy efficient the unit. The minimum standard rating established by the government for air conditioning is 10. The technical definition is the total cooling of a central unitary air conditioner or unitary heat pump in BTU's during its normal annual usage period for cooling divided by the total electric energy input in watt-hours during the same period.

BTU - (British Thermal Unit) is the amount of heat that will raise or lower one pound of water by one degree Fahrenheit. A BTU is how many BTUs are used per hour. The amount of heat added or removed by a heating or air-conditioning system is measured in BTUs.

Ton - Heat pumps and air conditioners are generally sized in tons. Typical sizes for single family residences are between two and five tons. Each ton equals 12,000 BTU.

Hysteresis - used in HVAC control devices such as thermostats to mean how much the actual temperature is allowed to vary around the desired set point temperature. For example, a thermostat with a 2 degree hysteresis that is set to 72 degrees for cooling will call for cooling when the temperature rises to 73, and stop calling for cooling when the temperature drops to 71. Too small a hysteresis can cause the HVAC system to cycle on and off too quickly, and to large a hysteresis can cause the temperature to vary too greatly. Hysteresis is set based on each individual installations size and load.

MRT (Mean Radiant Temperature) is a measure of the radiation temperatures from all the surfaces in a room or space arriving at an occupant. MRT is independent from the air temperature in a room and usually is more influential in determining if a room "feels" warm or cool. It is a more accurate measure of the perception of temperature than the air temperature. For example, if a room has a several large glass windows and it's very cold outside, this can cause the room to feel cold even though its air temperature is warm. Likewise, radiant floor heating will make a room feel warm long before the air temperature in the room is warm. Unfortunately, conventional thermostats only measure air temperature.

HVAC System Concepts

Heating, ventilating and air-conditioning equipment is designed to provide a relatively constant and comfortable temperature in the home. Secondary goals are to provide fresh and filtered air, and a comfortable humidity level.

While there are many different types of equipment that provide heating and cooling from forced air systems, to in-floor radiant heating, they all work on the same basic principles. There is a source of heat or cold, and a way to distribute it throughout the home.

The control of HVAC systems hasn't changed much over the last half century. When the temperature is below a desired temperature (for heating), a control device (thermostat) "calls" for heating. Heat is applied to the area where the control device is located until the temperature is reached, then the control device turns off the heat. Control equipment does not, in general, make a distinction about the source of heating or cooling energy (electric, gas, oil, etc.) or type of equipment in the home.

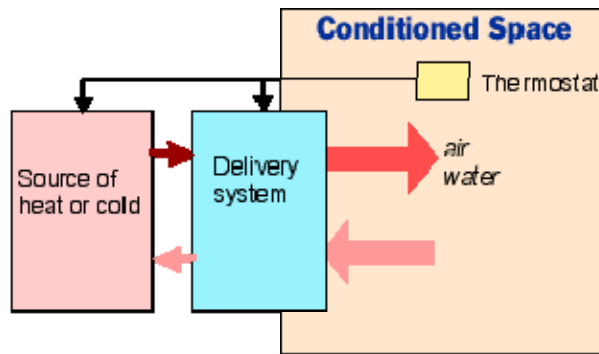
The term "call" for heating or cooling simply means that the thermostat does something to turn the heat source or cooling source on, usually closing a contact in a relay circuit.

In homes up to about 2500 sq. ft. there is usually only a single zone serviced by a single heating or cooling device. In this case the heating and/or air conditioning equipment comprise a single zone system. In larger homes, especially homes over 4000 sq. ft., it is common to have multiple zones. A multi-zone home may have each zone serviced by a single heating or cooling device, or two or more zones may be serviced by a single heating or cooling device. The equipment services different zones by means of dampers, mixing boxes, or other devices to individually heat or cool the zones independently.

In many parts of the country where humidity levels reach extremes (over 90% or less than 20%) it is common for the HVAC system to include humidification or dehumidification equipment. Humidification equipment, like other HVAC equipment, can also be zoned. Humidification zones may not be the same as environmental (heating/cooling) zones. There may, for example, be several heating/cooling zones but only one humidification zone (the whole house).

HVAC systems

The HVAC house subsystem consists of one or more HVAC systems. HVAC systems consist of a source of heat generation such as electric resistive heating, gas, or oil, optionally a source of cooling, almost always a freon gas compressor, and a way to deliver it to the conditioned space. In the case of heating, this is usually done by forced air, but can be hot water through in-floor tubing or in radiators. For cooling, delivery is almost always forced air through an air handling system. Combinations of different types of delivery for heating and cooling are possible.



Basic HVAC system design

All systems are controlled by a thermostat. A thermostat measures the air temperature in the conditioned space and turns heating or cooling on or off based on the measured vs. the desired temperature. This forms a simple feedback system. The comfort and efficiency of the system is determined by the efficiency of the heating and cooling source, how well the delivery system distributes the heat or cool, and to a great extent, how well the thermostat operates. Better thermostats can make a significant difference in how well the overall system operates.

Typical Systems

While there are many different types of heating and cooling, some more popular in different parts of the country, this Section will concentrate on forced air heating and cooling systems either from separate sources or via a heat-pump. It will also assume the equipment operates by on/off control of one or more stages of heating or cooling.

Heating only

Heating only systems, prevalent in northern climates, have a single source of heat generation such as gas, oil, or electricity and typically used force air to deliver the heat to the conditioned space although hydronic systems (radiator and in-floor coils) are popular. They use a simple on/off thermostat.

Heating/Cooling (conventional)

A conventional heating/cooling system is just a heating only system usually with the addition of a compressor unit located on the outside and a cooling coil in an air-handler (Figure 4.2.2). Cooling systems rely exclusively on forced air to deliver cooling to a zone. Therefore the heating part of the system also uses forced air. Some homes are equipped with forced air cooling and radiator or floor hot water heating. The two systems operate independently.

A blower motor circulates air from the return air duct and filter through the heating coils or element, then through a set of cooling coils (if equipped for cooling), then out the supply air ducts to each room. An outside compressor is used for cooling. The compressor compresses a freon (or equivalent) gas that passes through a set of heat exchanger coils where a fan draws outside air over the coils to cool the gas. The gas then goes to the cooling coils inside the air-handler where it expands, cools, and cools the air passing through the coils.

Two Stage Heating and Cooling systems

Some higher-end furnaces now have two stage gas valves, allowing a low setting appropriate for most weather conditions, and a high setting that can boost output for the coldest weather. A multi-speed blower is also used. This may be used with a two speed or dual compressor air conditioner, to provide two stages of cooling as well.



Heating/Cooling Single-stage Heat Pump

A single stage heat pump provides cooling in the conventional way by using a compressor and an air handler, but they heat by reversing the flow of Freon using a reversing valve, causing it to "pump" heat from outside to inside. The role of the inside coils in the air handler is also reversed, providing heat by cooling the compressed gas. Since the compressor only has one speed, it is referred to as a single-stage heat pump.

Because the heat generated in these systems may not be adequate for the coldest part of the year, they are usually equipped with some form of auxiliary heat, typically a gas or electric heating element in the air handler. When the compressor is not able to maintain a constant temperature, the thermostat will call for auxiliary heat as well.

Heating/Cooling Multi-stage Heat Pump

A multi-stage heat pump is the same as a single-stage heat pump with either a dual-speed compressor or two compressors. Since the compressor can run at two speeds it can cool at two rates and heat at three rates (including the auxiliary heat).

Ventilation Equipment

With the ever increasing air-tightness of new homes, some means of ventilating the air of the home is usually required, especially in the winter when the homes tend to be kept "tight" by the occupants. In many parts of the country, building codes mandate some form of outside air exchange. This usually takes the form of a small duct from the outside to one of the return air ducts. The low pressure in the return air ducts will draw in a small amount of outside air as inside air is lost from open doors or windows.

Using outside air for heating and cooling can be a big energy saver when it is cooler than inside air when the system is calling for cooling, and warmer than the inside air when calling for heating. This requires an HVAC controller capable of measuring both inside and outside air temperatures and controlling a damper from the outside to the return air duct of the air blower.

Humidification and Dehumidification Equipment

Humidification and/or dehumidification equipment may be added to any forced air heating or cooling system. In the summer in humid climates, central cooling equipment (conventional or heat-pump) provides its own dehumidification of the air. In the winter, dehumidification is usually not needed. It can be accomplished in more sophisticated systems by running the cooling equipment to condense the moisture then reheating the air to the desired temperature (this is how many car A/C systems operate in the defrost/defog mode). The cooling coils must be placed before the heating elements.

Some cooling systems have a humidistat input designed to increase moisture removal in periods of high humidity. It slows the indoor blower during operation of the air conditioner. This allows the indoor coil to operate at a colder temperature for a longer period of time, thus removing more moisture.

Humidification equipment is typically used in the winter and summer in dry climates. The humidifier is attached to a forced air heating system to provide added moisture to the air passing through the air handler. The equipment is usually attached to the main air handler. A fine water mist is injected into the air as it leaves the heating element.

Humidification is controlled by a hydrostat or humidistat; a type of humidity level thermostat. It is set for a desired humidity level and works independently from any thermostat. In a multi-zone forced air heating/cooling system, there is usually only one humidifier serving all zones. In a zoned system serviced by separate equipment there may be humidifiers on each system.

It is possible to measure humidity electronically and use the value to control humidification equipment from a home automation system.

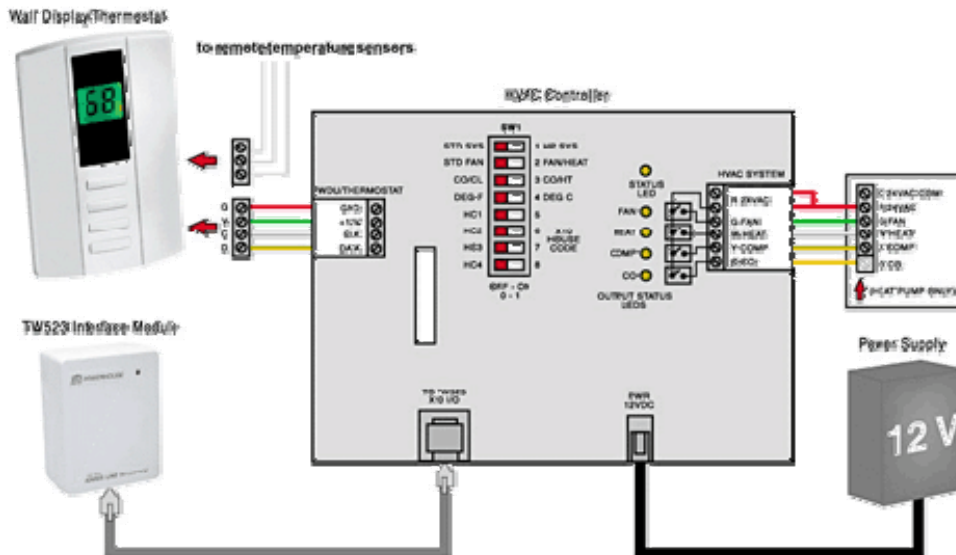
Zoning

The best way to achieve better temperature control throughout a home is by zoning the HVAC system. Multiple zones may be incorporated into a home HVAC system in one of two ways. In some systems, a single set of heating/cooling equipment can service more than one zone in the home by using dampers to adjust airflow, or other means to regulate the amount of heating or cooling in each zone. A zone may be a house, a floor, part of a floor, or a room. Each zone must have its own thermostat or equivalent control device. In other systems, each zone has its own heating/cooling source equipment, and is operated independently. Again, each zone has its own thermostat. Combinations of these two approaches are also possible.

Depending on the home's room configuration, homes under 3000 square feet can generally be properly air conditioned using two or three zones. Homes between 3000 and 5000 square feet can generally be properly conditioned with 4 to 6 zones. Larger homes generally use separate HVAC systems to divide the home (main living area, guest quarters, master suite, etc.)

In order to maintain the rooms of a zone within 1 degree of each other, a supply and return air balance is required in each room so they will receive the proper air flow rate (in cubic feet of air/min or CFM) when the control damper is positioned open.

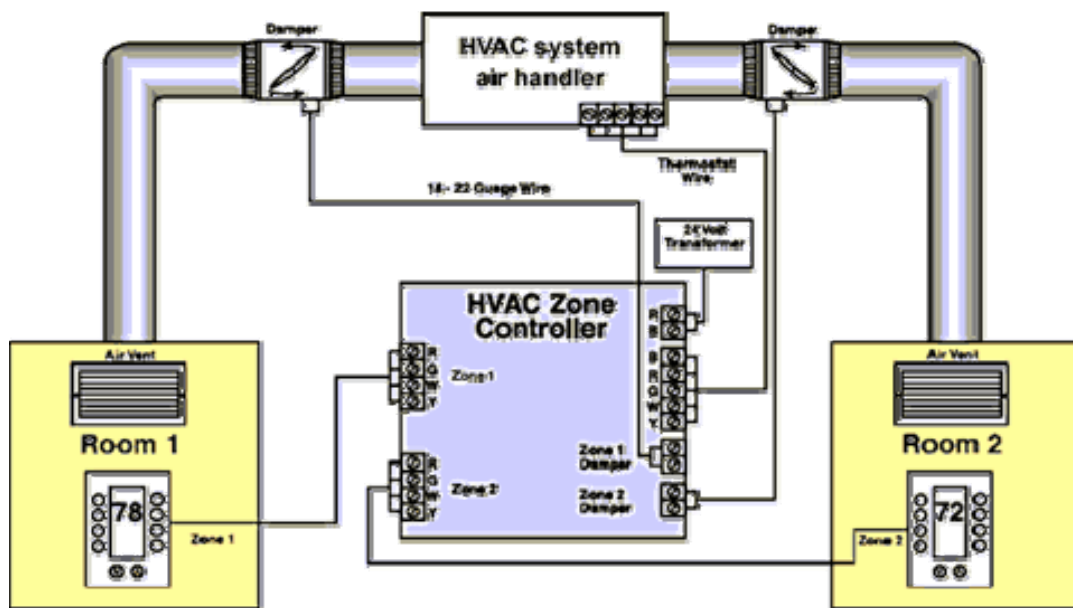
RCS Communicating Thermostats function as standard thermostats and in addition allow remote commands to set specific temperature set points and HVAC modes. Models control standard gas/electric, single stage heat and cool, heat pump, 2-stage heat and single-stage cool.



Typical remote controlled thermostat connection. This shows the interface on the HVAC controller, but several thermostats are available with the interface electronics built in.

Zone Control Systems

A zone control system allows a single HVAC system to independently control the heating and cooling in more than one zone serviced by the system. It allows multiple thermostats to be connected for each zone. The most common residential zone control systems operate a series of motor controlled air dampers to regulate the flow of air into a zone, thus controlling the temperature in that zone.

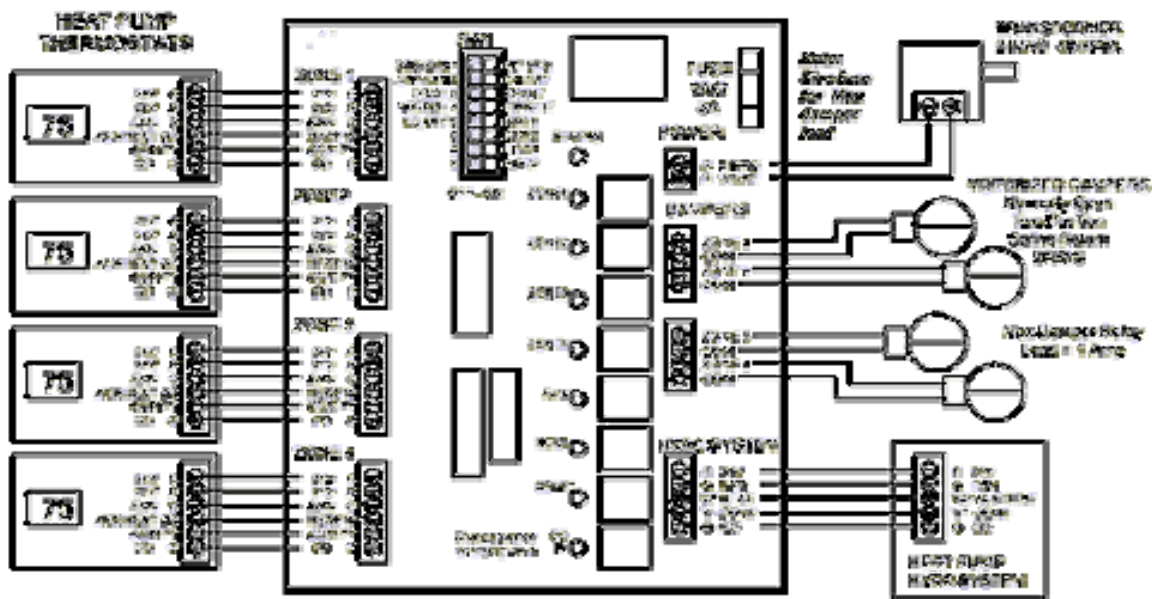


example of the components of a typical zoned control system

Controllers

Controllers are typically housed in a stand-alone box usually attached to the side of the HVAC air handler. While the operation of the controller is straightforward, its firmware operation can get complex. It must take into account the varying demands of each zone and make sure the system is operated correctly. It must make sure that airflow is not blocked and may need to bleed air into zones that are not calling for heating or cooling to maintain a minimum airflow.

If any zone calls for heat, it turns the heating system on and opens the damper to that zone. If additional zones call for heat, the system opens their dampers as well. When no zone is calling for heat, the controller turns the system off. If one or more zones call for heat and another zone calls for cooling, the controller must decide based on the temperature in each zone as well as the outside temperature—what function to perform (ignore the call for cooling, or shut off the heating zones and operate cooling only in the zone calling for cooling). Some controllers have an optimization function when one or more zones are divided between an upstairs and downstairs. Since hot air rises and cool air falls it is more difficult to balance upstairs and downstairs temperatures. For example, more airflow is usually needed in a downstairs zone when heating and in an upstairs zone when cooling.



typical wiring diagram of a 4 zone controller for a heat-pump HVAC system. Connections are provided for each zone thermostat, four dampers, and connection to the HVAC equipment.

Designing a Zoned HVAC system

Designing a zoned HVAC system in new construction should be done with coordination with the HVAC contractor. He will need to help you determine how many HVAC systems will be needed versus zoning of each system. He will also need to help determine duct sizes and placement.

Determine how the home will be zoned and the total number of zones. A multistory dwelling will normally be zoned by stories. Make each zone handle approximately the same heating/cooling load (the HVAC contractor can help determine this). Avoid zones that have a small physical area.

Zones should bear some relationship to living patterns. Make guest quarters, the master suite, living areas, and areas that are seldom used into separate zones.

Have the HVAC contractor plan the ducting that connects each zone to a separate branch of the main supply duct. Duct branching usually occurs near the air handler but some branching may occur in distant parts of the house or floors. Dampers are placed at the branch point to each zone.

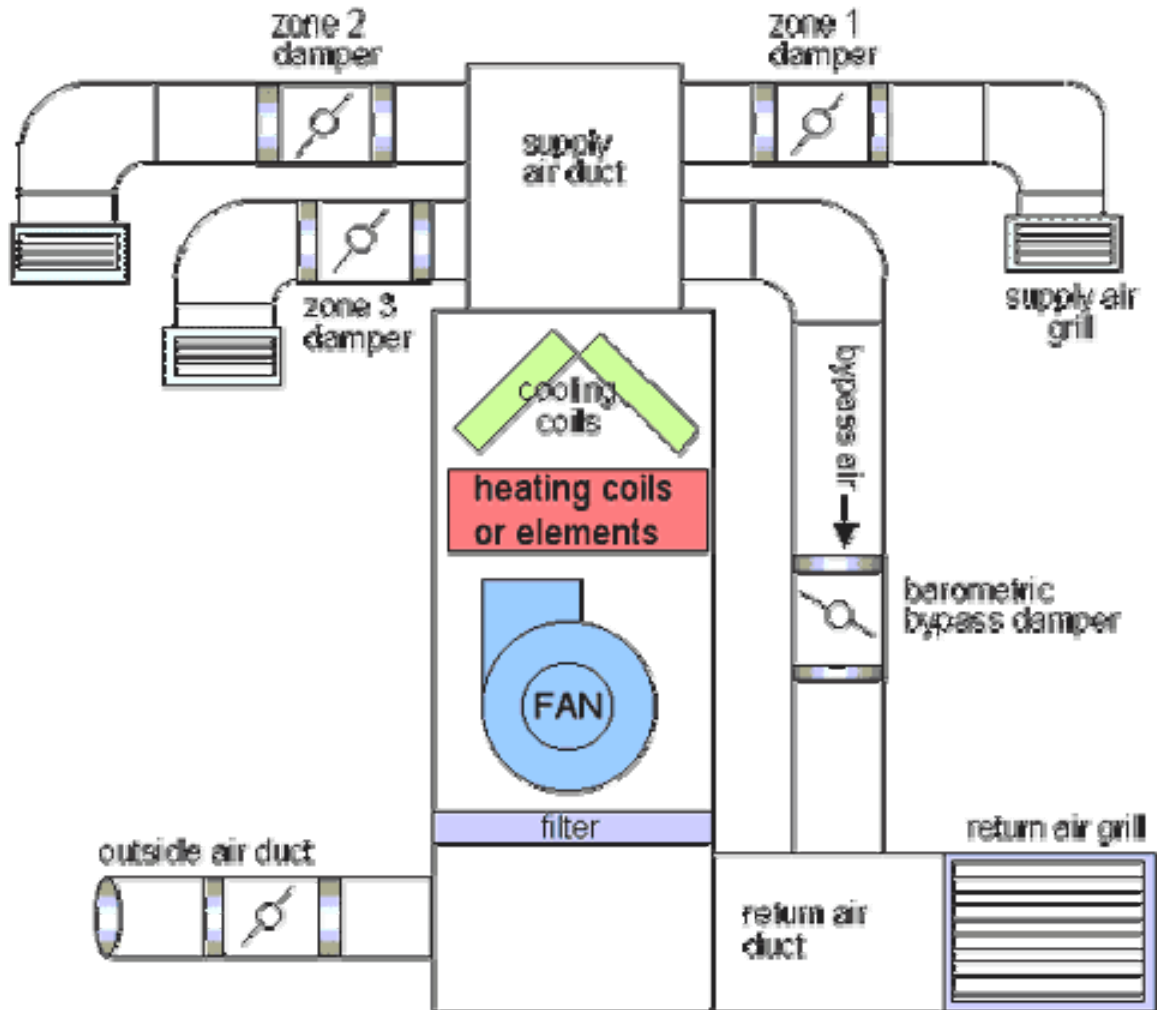
The ducting will usually be larger than for non-zoned systems to handle the extra airflow in the zone ducts due to the fact that some ducts will be closed. When the zone controller closes one or more dampers, the back pressure should not increase so much as to damage the HVAC system.

Select the type of controller that will handle the number of zones and has the features needed for the home, then select appropriate thermostats for the controller.

Plan the location of each thermostat in each zone (see below) and run the necessary cable from the location to the controller.

Run the necessary cable from the controller to the damper locations and to the HVAC equipment.

Once the HVAC contractor has the system installed, he can test the airflow (since the dampers are normally open) by just connecting a regular thermostat to the HVAC system. Once air flow is working correctly, the zone controller can be installed.



Typical ducting design for a zoned forced air HVAC system. Dampers are installed in the supply air ducts for each zone.

A zoned HVAC will usually contain not only dampers for each zone air duct, but unless the system can modulate the damper positions to prevent excessive supply side air pressure, it will need to be equipped with a bypass air duct from the supply side to the return side. This is equipped with a barometric bypass damper that opens when sufficient pressure builds up on the supply side. An outside air duct can also be installed to utilize outside air to save energy. The outside air duct damper can be controlled by some zone controllers.

Residential HVAC

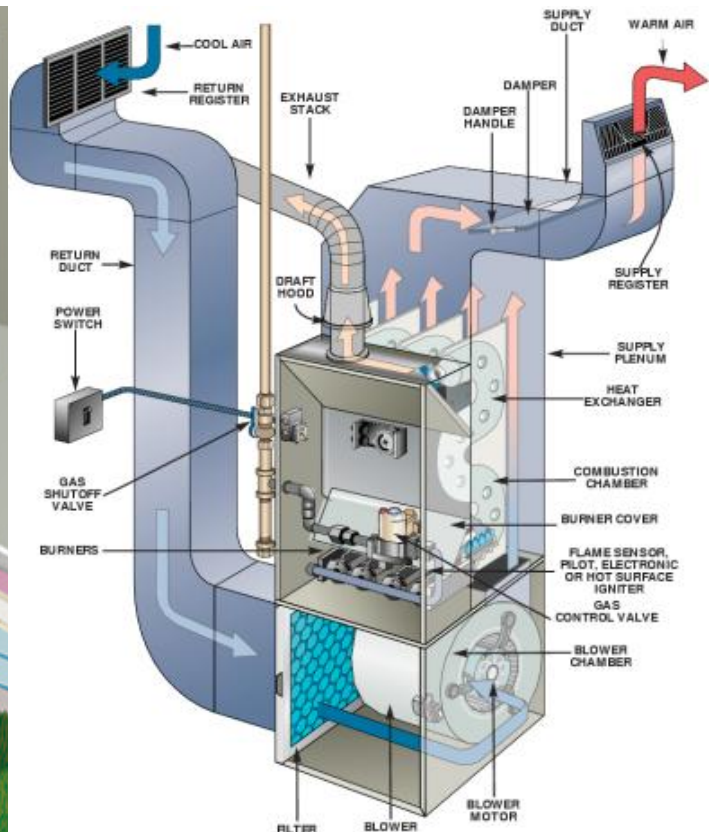
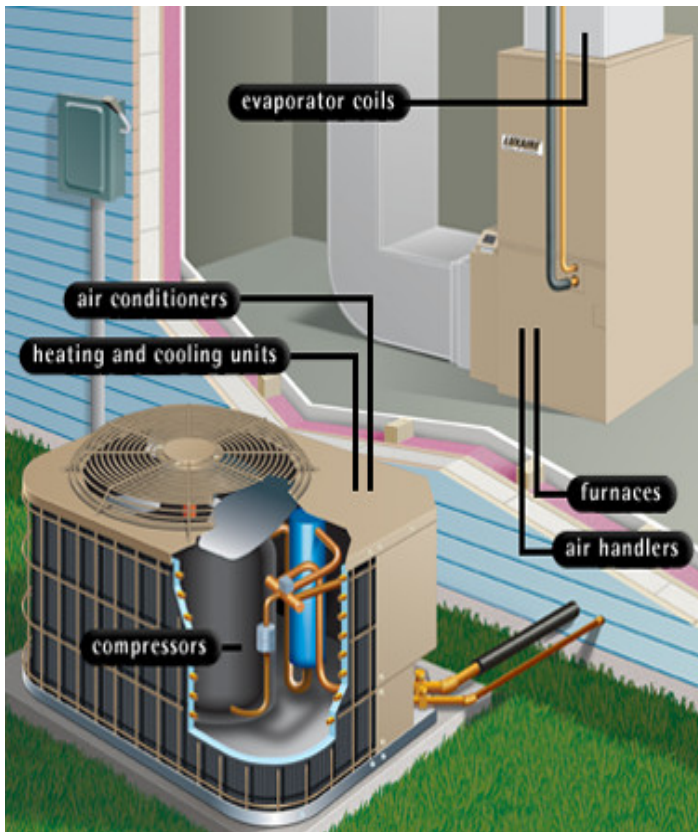
Air Conditioning Systems

We can help you maintain and repair the system you have, or replace it completely. As factory-trained technicians, we can provide routine periodic inspections, licensed warranty and post-warranty repairs, and immediate emergency response.

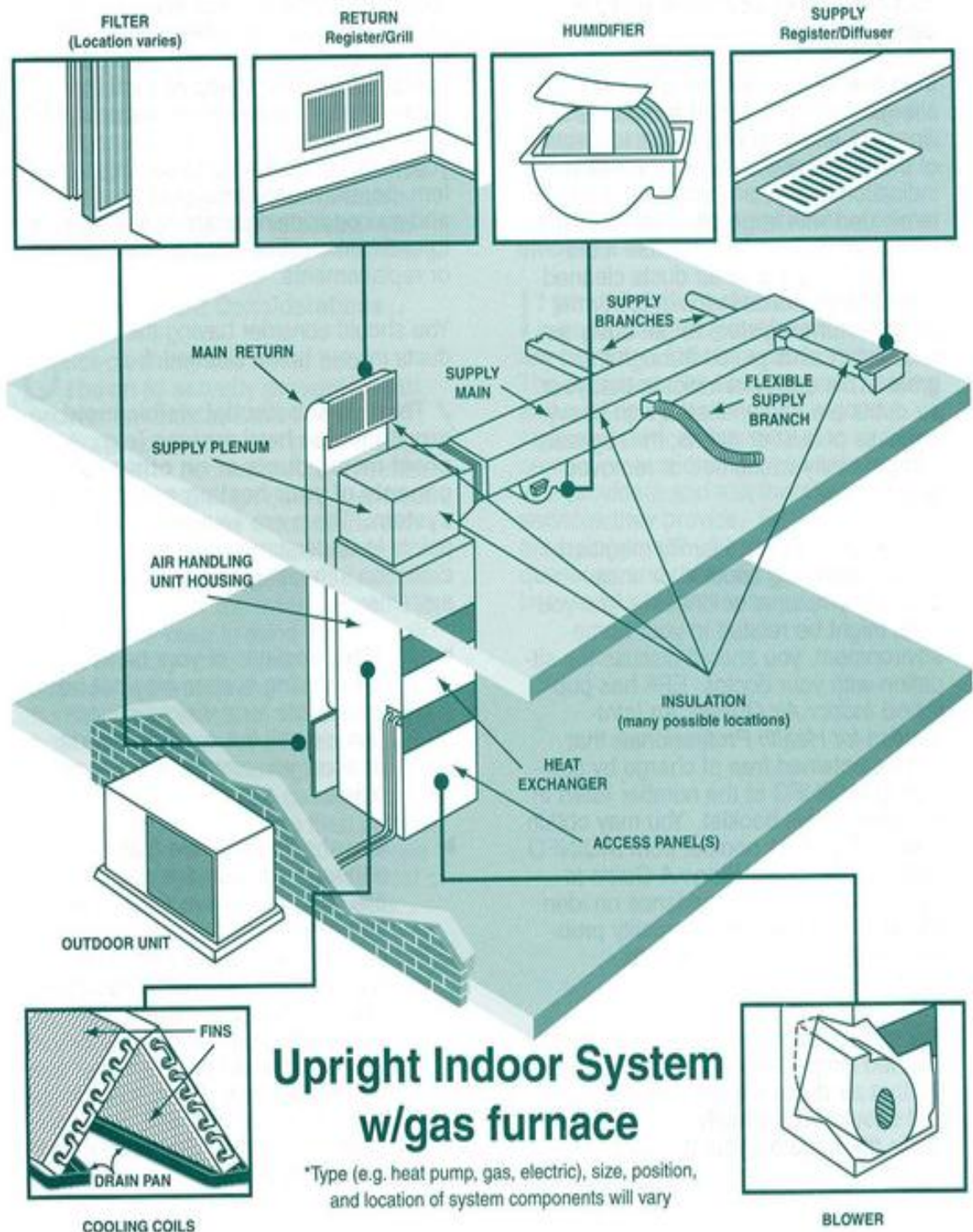
Skill Areas

Our skill areas include all of the following:

- AC and Refrigeration
- Air Filtration
- Rooftop Units
- System Maintenance
- System Replacement
- System Installation
- Air Duct Cleaning
- Air-Conditioning Maintenance
- Programmable Thermostats
- Duct Sealing
- Pressurizing for Duct Testing



Components of a Typical* Residential Heating and Cooling System





Commercial HVAC-R

Tempe Mechanical has the expertise available to successfully complete even the most difficult and challenging HVAC projects. We provide superior HVAC services to our customers. HVAC employees are trained and certified in the areas of refrigerant handling and welding, as well as all of the major brands of equipment.

HVAC Services Include:

- HVAC
- Heating
- Ventilation
- Air Conditioning
- Air Conditioning and Ventilation Equipment and Supplies
- Compressors
- Condensing Units
- Dehumidifiers
- Dust Collecting Equipment
- Air Balance
- Refrigerant evacuation
- Leak Testing

Refrigeration

From an under-counter fridge to a refrigerated warehouse to a 30-ton-per-day ice machine, we provide full-service maintenance. Our staff is equally knowledgeable in such areas as cooling scientific test chambers and medical refrigeration.

Multi-Zone HVAC Management & Installation: 2-Zone System Example

HVAC automation has progressed rapidly in the last few years. It is now *relatively* straightforward to RETROFIT an existing construction single-zone heating and cooling system with a high-tech, *energy saving* multi-zone system. The main elements of a multi-zone system are: HVAC Controller, Smart Thermostats (wireless & wired), and electronically controlled Dampers. You will also likely need to install a Barometric Pressure Relief Bypass Duct.

For serious DIY-ers -- with medium electronic/electrical skills -- it is possible to do most of the installation, wiring, and Thermostat programming that is required. However, the mechanical work of installing the sheet-metal dampers is only for the mechanically adept and so motivated.

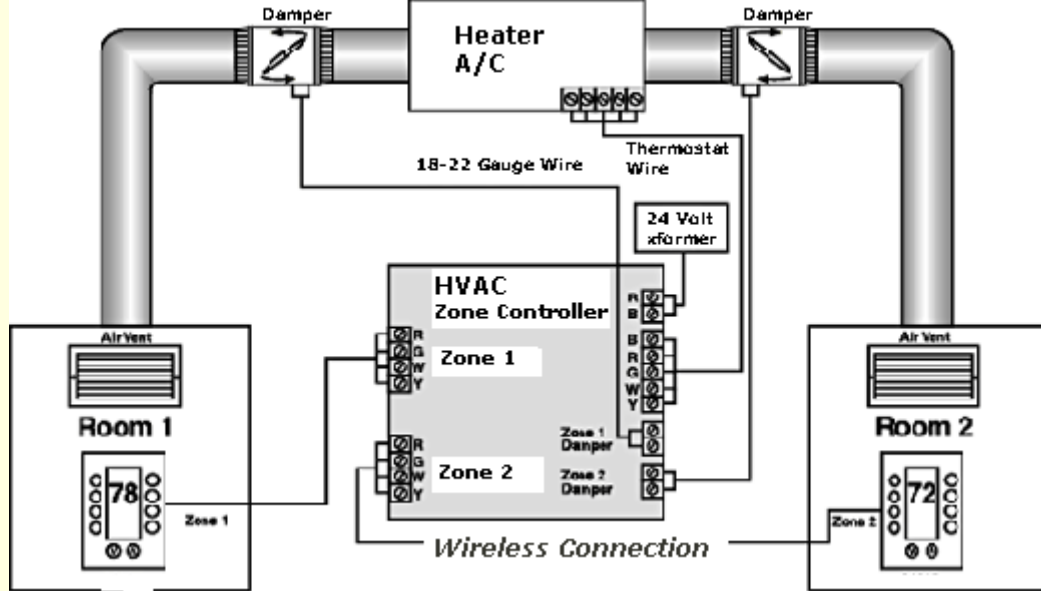
At any rate, we recommend that -- before undertaking a retrofit -- you consult with a local HVAC professional about the retrofit, in order to make sure that you'll have a good plan and that you'll follow local building codes and inspection requirements.

Please also NOTE, that Netropolis does NOT help you plan, install, nor provide consultation services for your installation. Netropolis only sells products and only provides relevant website resources.

Here are the installation steps **we've** performed when we upgraded OUR single-zone forced air, oil HVAC system to a 2-zone system with 2 smart Thermostats. We've replaced our original thermostat (Room 1) with a wired 7-day Programmable remote-control (via the Internet) thermostat. We've also added a Wireless Thermostat system (Room 2), that now controls the temperature in our upstairs master bedroom.

We've added a 2-Zone HVAC controller, and installed 2 whisper-quiet Electronic Dampers.

The following diagram and installation steps are for **ILLUSTRATION PURPOSES ONLY**.



- Disconnect the power to your heating system by turning its circuit breaker OFF.
- Mount the HVAC 2-Zone Controller close to the Heater/AC system. Disconnect the 18 - 22 GA Thermostat wires from the Heater/AC and reconnect these wires to Zone 1 of the HVAC Zone Controller. Make sure that you have a C (common) wire if you are replacing your current thermostat with our 7-day Programmable Thermostat (most often you'll have an extra wire in your thermostat cable -- if not you'll have to run one. If you want to use the thermostat's humidity control module you'll run another wire (that connects to the whole-house Humidifier unit.)
- If you have a 2 story home, Thermostat 1, replaces in Room 1, your current hard-wired Thermostat. This thermostat can be controlled from at-home, as well as away-from-home. **Note: replacement of your existing Thermostat is *not* necessary if you're happy with it.**
- Upstairs (Room 2), mount on a wall the Thermostat part of the wireless Thermostat System. Mount the Receiver part of the wireless Thermostat System next to the HVAC Zone Controller. Connect, via 18 - 22 GA Thermostat wire, the Receiver terminals to the corresponding Zone 2 terminals of the HVAC 2-Zone Controller. Connect, via 18 - 22 GA Thermostat wire, the HVAC Zone Controller's "HVAC System" terminals to the Thermostat terminals of your Heater/AC system.
- Program your Thermostats for the proper heating and cooling temps. Turn Thermostats OFF.
- Connect the Red & Black terminal wires of the Low-Voltage 24V Power supply to the corresponding Red & Black terminals of the HVAC Zone Controller. Double check ALL of your connections. Plug 24 V Power supply into a 110V outlet. Turn your heating system's circuit breaker ON.
- Turn on the Zone 1 Thermostat and check your Heating/AC system for proper functioning. Repeat with the Zone 2 Thermostat.
- When everything works so far, install the electronic Duct Dampers into the appropriate Zone 1 and Zone 2 branch feeds. Our Zone 1 Thermostat is located in the Living room, thus we've put a Damper into its branch pipe. We've also put a second Damper into the Upstairs bedroom (Zone 2) branch feed.
- Disconnect the 24V Power supply from the HVAC Zone Controller. Run 18 - 24 GA wires from each Damper to the HVAC Controller. Connect the living room damper wires to the Zone 1 Damper terminals of the Zone Controller. Connect the bedroom damper wires to the Zone 2 Damper terminals of the Zone Controller. Plug back the 24V Power supply. Run thru Zone 1 and Zone 2 Thermostat controlled heating and cooling cycles to verify proper damper operation.

NOTE: In a multi-zone system, you'll also need to install a **Barometric Pressure Relief Bypass Duct** duct to prevent over pressure buildup that may damage the system. This duct is installed just ahead of the blower. It opens and redirects some of the airflow back into the blower intake when pressure builds up due to many dampers being closed. This mechanical bypass duct is continuously variable, and the pressure relief level is easily adjustable. Consult a HVAC professional for the proper sizing of the Barometric Pressure Relief Bypass Duct.

It is always a good idea to allow for future expansion: So, instead of initially installing a 2-Zone HVAC controller, you could install a **4-Zone HVAC controller** for not that much more money. Just as with a 2-Zone HVAC controller, you can attach up to two (2) Dampers/zone. So, a 4-Zone HVAC controller allows you to attach up to eight (8) electronic Dampers. The wireless Thermostat *Receiver* -- that you've purchased for your 2-zone installation -- can accommodate up to three (3) **additional wireless Thermostats** (to be placed in various rooms for even better zone control).

Single-Zone HVAC Management & Installation:

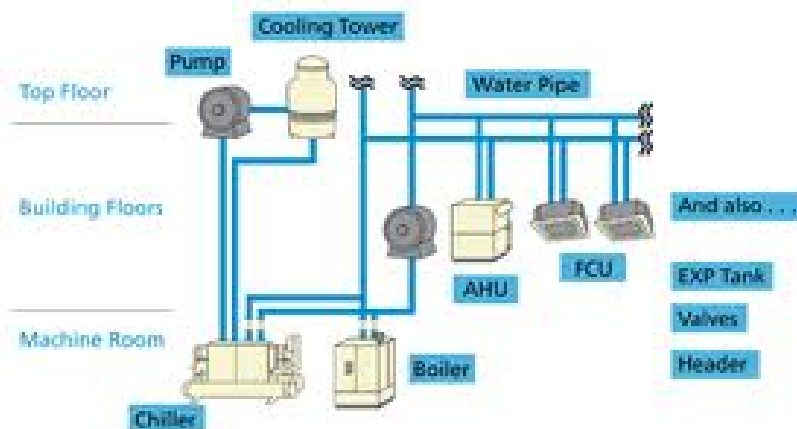
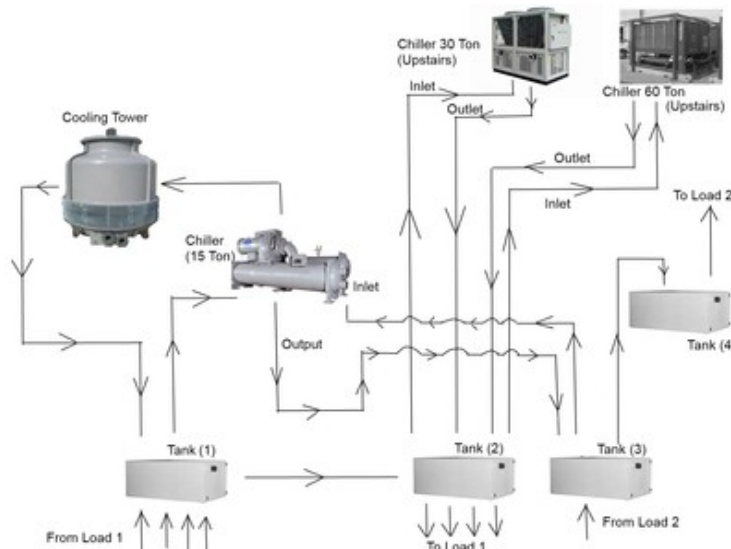
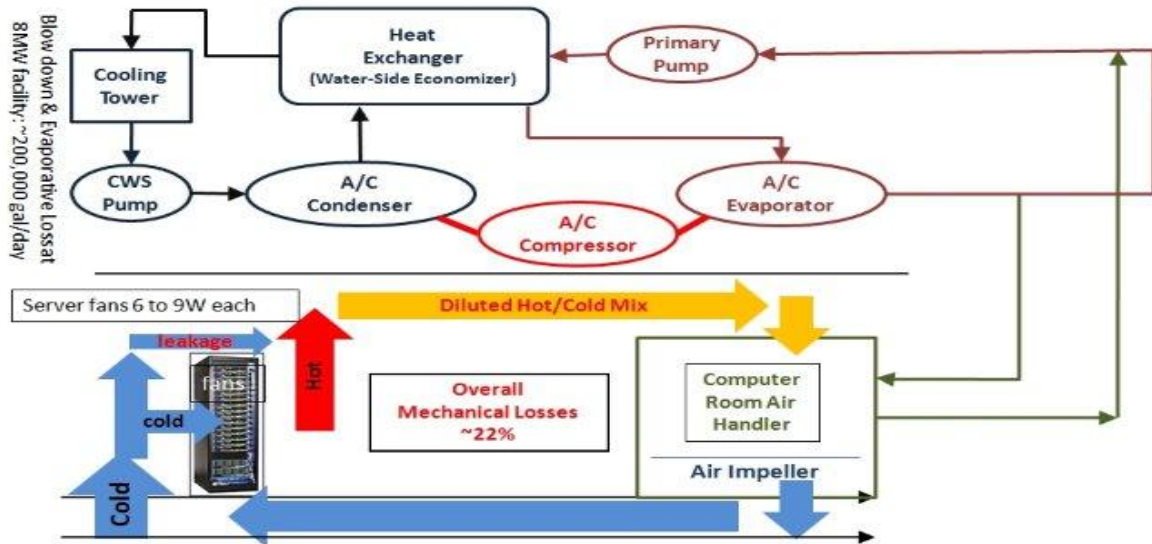
A really elegant way to address the problem of one or more rooms that need to be heated/cooled differently from the rest of the house is to use a single zone **Smart Damper** system. Purchase a **Premium Whisper-quiet smart Damper** -- *bundled* with a wireless Thermostat and a wireless receiver. The smart Dampers are available in seven (7) sizes. When the thermostat calls for heating or cooling, the damper remains closed until a sensor in the damper determines whether the air in the duct is warmer or cooler than called for. If the room needs heat but the duct air is cold, the damper remains closed. Conversely, if the room needs cooling but the duct air is warm, it remains closed. Powered by your HVAC system's 24VAC circuit (or, a 24V power supply.)



- The battery powered, auto-changeover thermostat communicates via an RF wireless data link to the damper control module located on the damper.
- The automatic changeover duct sensor located on the damper senses whether there is warm air or cool air in the branch supply duct. If the wireless thermostat is calling for cooling and the duct sensor determines there is cool air in the duct, the damper will power open; otherwise, the damper will remain closed. If the thermostat is calling for heating and the duct sensor determines there is warm air in the duct, the damper will power open; otherwise, the damper will remain closed.
- The thermostat is to be located in the area being controlled by the zone damper and away from the HVAC unit thermostat. Do not install the thermostat in an area where drafts are present, near the floor, behind doors or on an external wall. Avoid placing the thermostat in areas where the air movement is limited, affected by direct sunlight or other areas not typical of the temperature in the space.

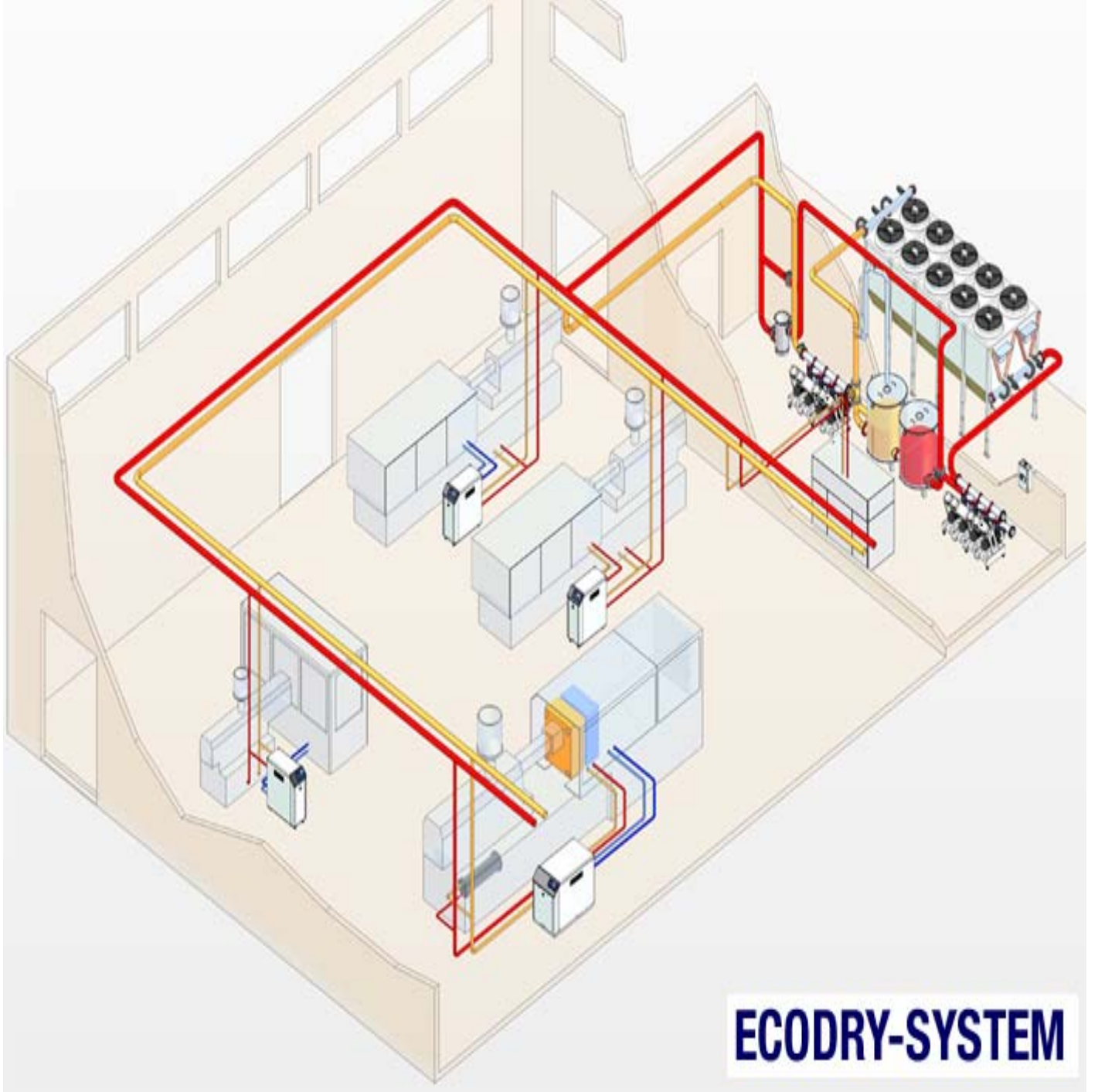
Chilled Water Network

Mechanical Systems



Ecody System: the ideal solution for Industrial Applications

Tailor Made Cooling Solution

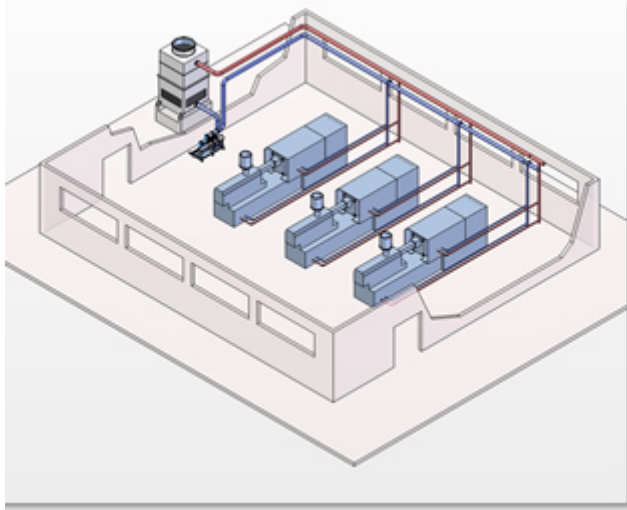


an integrated Cooling System designed to optimize the advantages of the adiabatic cooler Ecodyrgel and the Point-to-Point Process Chillers/TCU Microgel/Turbogel.

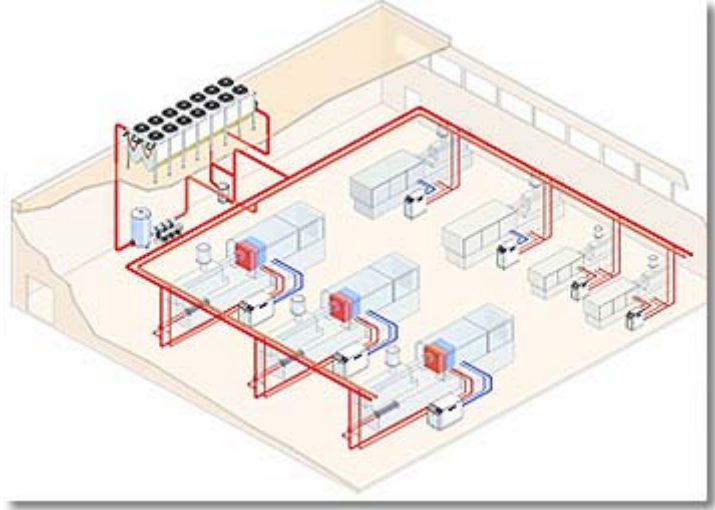
Ecody System is the best Cooling System and wins all Comparisons with other common Cooling Systems. Learn more clicking on links beside

Comparison with Cooling Tower

Cooling Tower Circuit



Ecodry System



COOLING TOWER

Open System
Max Temperature: 28/30°C (82/86°F)
for both Oil and Moulds

Method of Heat Rejection:
Water Evaporation

ECODRY SYSTEM

Close System (**Ecodrygel + Microgel + Turbogel**)
Main Circuit Temp: 32/35°C (90/95°F)

Point-to-Point Process Cooling Units
One or Two Flexible and Precise Temperatures
to each Mould from -5 to 90°C (25 to 195 °F)
and one or Two Customized Pumps for each Mould

Method of Heat Rejection:
Dry Air Convection for Main Circuit and
Compressor for Moulds (when required)

DISADVANTAGES

Water Quality

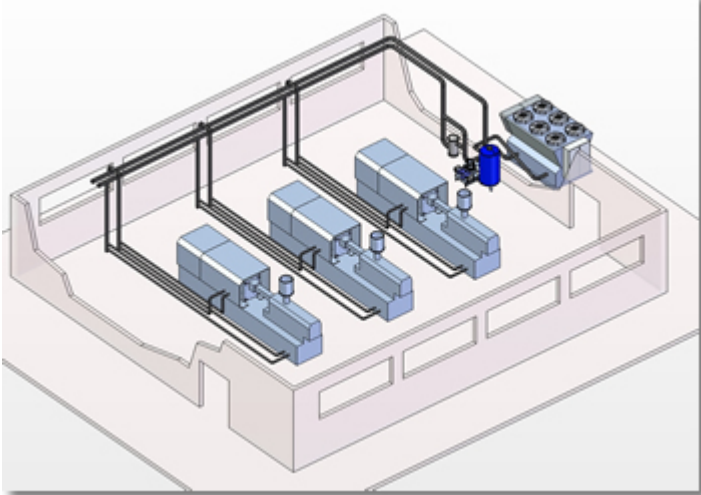
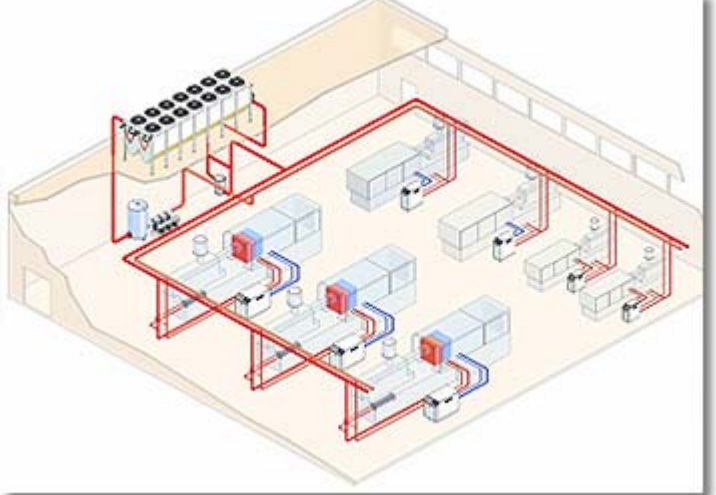
- **Poor Quality** of Water to Process
- Permanent **Contamination**
- Solids, Gases, Algae
- High risk of Bacterial contamination
(i.e. **Legionella**)
- **Scale** Accumulation
- Permanent **Oxidation**
- **Reduced** Heat Transfer **Efficiency** and **Performance** due to Fouling and scaling

ADVANTAGES

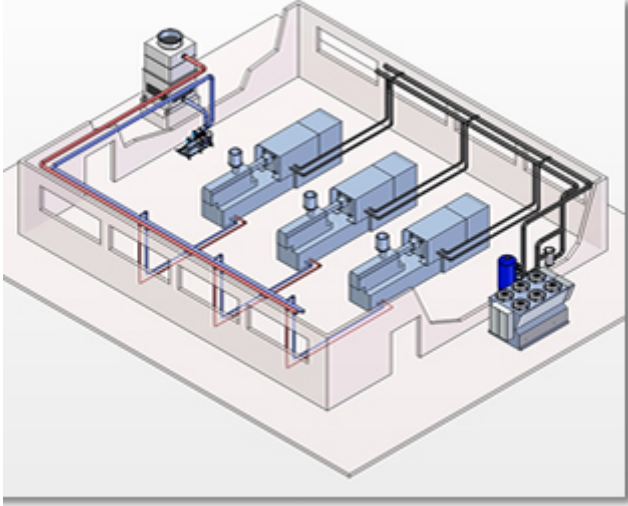
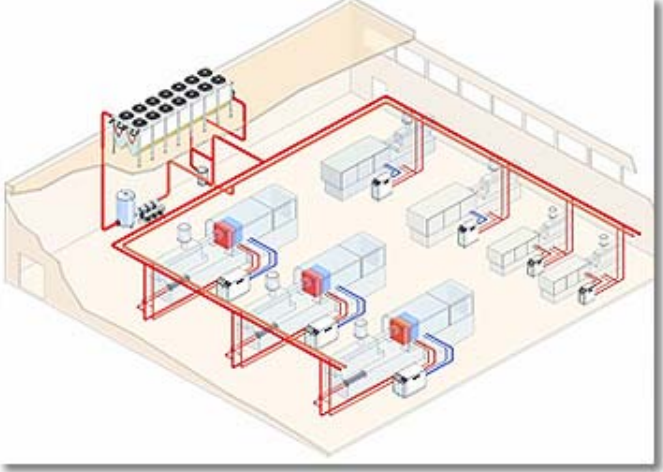
Water Quality

- Excellent **quality of water**, almost maintenance-free.
- **No scale accumulation** on heat-exchangers and circuits – constant efficiency
- **No chemicals consumption** and/or disposal.
- **No risks of bacterial infections** or contamination
- Available in “Self Draining” configuration, that can work in ANY climate with **no use of Glycol**

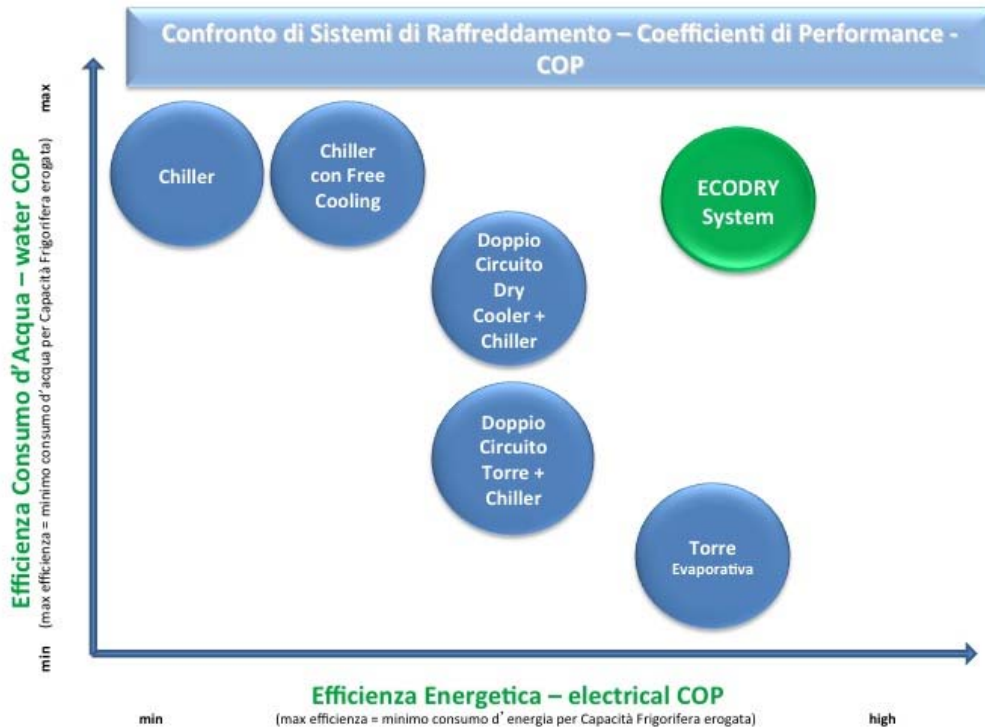
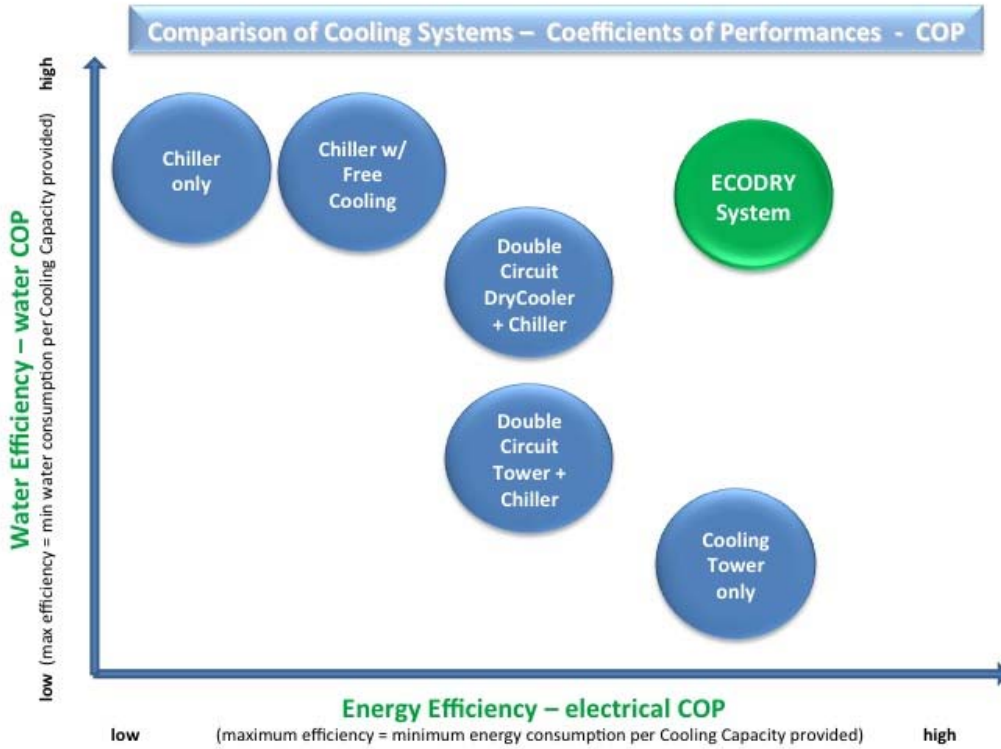
Comparison with Central Chiller

<p style="text-align: center;">Central Chiller</p> 	<p style="text-align: center;">Ecodry System</p> 
<p style="text-align: center;">CENTRAL CHILLER</p> <p>One Water Chiller System for Multiple Users</p> <p>One Temperature to All Users: 10/15°C (50/60°F)</p> <p>One centralized Pumping group</p> <p>Method of Heat Rejection: Compressor Cooling</p>	<p style="text-align: center;">ECODRY SYSTEM</p> <p>Close System (ECODRYGEL + MICROGEL/TURBOGEL) Main Circuit Temp: 32/35°C (90/95°F)</p> <p>Point-to-Point Process Cooling Units One or Two Flexible and Precise Temperatures to each Mould from -5 to 90°C (25 to 195 °F) and one or Two Customized Pumps for each Mould</p> <p>Method of Heat Rejection: Dry Air Convection for Main Circuit and Compressor for Moulds (when required)</p>
<p style="text-align: center;">DISADVANTAGES</p> <p>Productivity</p> <ul style="list-style-type: none"> • Lack of flexibility in temperature control. • Variable water flow to moulds, Highly affected by the other users • Higher cooling cycle time due to High and Variable delta T on moulds. • No possibility of communication with processing machines. 	<p style="text-align: center;">ADVANTAGES</p> <p>Productivity</p> <ul style="list-style-type: none"> • Possibility of searching and repeating the optimum cooling conditions for each mould. Complete independence of setting. • Precise automatic control of the mould temperature. • Cooling conditions (temperature AND flow) permanently stable and under control for each mould. • High cooling efficiency with low delta T of the

Comparison with Double Circuit

<p style="text-align: center;">Double Circuit</p> 	<p style="text-align: center;">Ecodry System</p> 
<p style="text-align: center;">DOUBLE CIRCUIT</p> <p>System composed by two separate circuits:</p> <ul style="list-style-type: none"> a Cooling Tower circuit for Hydraulics at 28-30°C (82/86°F) a Chilled Water Circuit for Moulds at 10-15°C (50/60°F) <p>Method of Heat Rejection: Oil Circuit: Water Evaporation Moulds Circuit: Refrigeration with Compressors</p>	<p style="text-align: center;">ECODRY SYSTEM</p> <p>Close System (ECODRYGEL + MICROGEL/TURBOGEL) Main Circuit Temp: 32/35°C (90/95°F)</p> <p>Point-to-Point Process Cooling Units One or Two Flexible and Precise Temperatures to each Mould from -5 to 90°C (25 to 195 °F) and one or Two Customized Pumps for each Mould</p> <p>Method of Heat Rejection: Dry Air Convection for Main Circuit and Compressor for Moulds (when required)</p>
<p style="text-align: center;">DISADVANTAGES</p> <p>Water Quality</p> <ul style="list-style-type: none"> Permanent Contamination, Scale Accumulation and Oxidation (on Tower Circuit) High risk of Bacterial contamination, i.e. Legionella (on Tower Circuit) Reduced Heat Transfer Efficiency and Performance due to Fouling and scaling (on Tower Circuit) Winter Icing (on Tower Circuit) 	<p style="text-align: center;">ADVANTAGES</p> <p>Water Quality</p> <ul style="list-style-type: none"> Excellent quality of water, almost maintenance-free. No scale accumulation on heat-exchangers and circuits – constant efficiency No chemicals consumption and/or disposal. No risks of bacterial infections or contamination Available in “Self Draining” configuration

Matrix of comparison of different Cooling Systems



The Basic HVAC System and Ductwork Installation

Tempe Mechanical houses one of the largest and most technically advanced sheet metal fabrication facilities in the Southwest. Computerized systems support production equipment in the shop as well as interface between CAD services and the equipment.

Sheet Metal Duct (SMD) Fabrication Services Include:

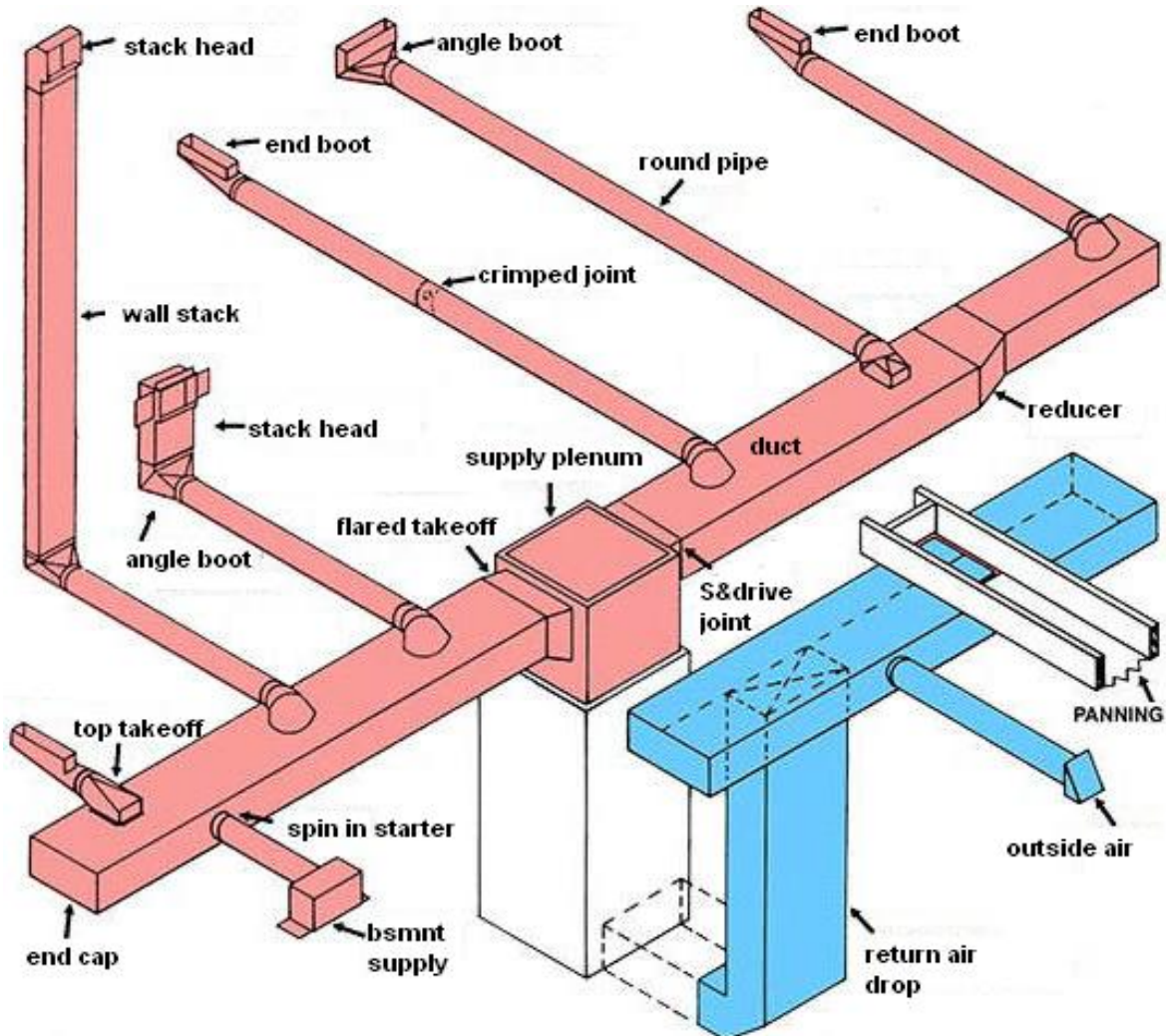
- Architectural sheet metal work (including roof flashing, fascia trim, gutters and downspouts)
- HVAC sheet metal—any size or pressure class to SMACNA standards; insulated or not insulated
- Letters, stencils, etc. The plasma machine can cut anything that can be drawn.
- Grease duct systems - Custom roof curbs any size or pitch - Fabrication of angle iron and bars
- Welding of galvanized metal, stainless, grease duct - Chilled water pipe fabrication

SMD fabrication facility contains:

- Double-table plasma cutter - Complete coil line including insulation - Power brakes and hand brakes
- Customized collar machine - Damper machines - Groove Lock machine
- Welding machines for every application (galvanized, stainless, grease) - Chilled water pipe fabricating and welding equipment

Step-by-step ductwork installation

We will use this single level rambler as our example system for this page.





OUR SERVICES



HVAC/R SERVICE and INSTALLATION

We cover it all! Air Conditioning and Heating, Gas, Oil, Electric, Heat Pumps, Boilers - Steam/Hot Water, Computer and Clean Rooms, Energy Management Systems, High Efficiency Heating & Cooling Systems, Pool Heaters, Radiant Floor Heating Systems.



COMMERCIAL and INDUSTRIAL HVAC

Our years of Commercial and Industrial experience consists of work performed on all types of HVAC/R equipment from smaller light commercial units to equipment consisting of hundreds of tons of cooling capacity and millions of BTU's of heating capacity.



RESIDENTIAL HVAC

Our years of experience in the heating, air conditioning and indoor quality fields have given us the expertise needed when it comes to your needs as a homeowner. We can provide service, repair and maintenance for all your HVAC needs for your home.



INDOOR AIR QUALITY

At BADRY we offer a number of Indoor Air Quality products that will make your home healthier, more comfortable and save you money on your heating and cooling needs.



REFRIGERATION

BADRY can help you with all of your refrigeration needs. Cooler Repair, Freezer Repair, Refrigerated Display Cases, Walk-In Coolers & Freezers, Heat Reclaim Systems, Refrigerated Food Warehousing.



MECHANICAL PIPING

We provide heating, ventilation and air conditioning (HVAC) services suitable for all areas. We can help you with all HVAC applications and guarantee successful results to all of our customers. If you are building a hospital or just replacing a chiller, BADRY can help you achieve your goal.



SHEET METAL DESIGN, FABRICATION and INSTALLATION

We have our own in-house sheet metal fabrication facility. In addition to our qualified fabrication mechanics our field personnel have extensive experience when it comes to field fabrication and installation.

We are currently servicing all over Egypt and Africa & Arabian Countries. If you need more information about how we can help you call us at 02-229-58 530.



HVAC/R SERVICE AND INSTALLATION

BADRY provides service and repair for all your HVAC/R needs. We are specialists in system design, planning, installation and service for all types and brands. BADRY also offers **preventive maintenance** and **service contracts** for all HVAC and refrigeration equipment and systems.



- Air Conditioning and Heating
- Gas, Oil, Electric, Heat Pumps
- Air Filtration
- Boilers - Steam/Hot Water
- Chillers
- Cooling Towers
- Water Heaters
- Computer Room HVAC
- Clean Room HVAC
- Dehumidification Systems
- Design/Build HVAC Services
- DDC Controls
- Energy Management Systems
- Exhaust Systems
- Geothermal Heat Pumps
- High Efficiency Heating and Cooling Systems
- Humidification Systems
- Make-up Air & Ventilation Systems
- Pool Heaters
- Pneumatic Controls
- Preventive Maintenance Programs
- Radiant Floor Heating Systems
- Refrigerant Piping
- Roof Top Units and Split Systems
- Snow Melt Systems
- Environmental Temperature Control





COMMERCIAL AND INDUSTRIAL HVAC

Our years of Commercial and Industrial experience consists of work performed on all types of HVAC/R equipment from smaller light commercial units to equipment consisting of hundreds of tons of cooling capacity and millions of BTU's of heating capacity.

Our large commercial/industrial customer base affords us the opportunity to perform **service installation** and **preventative maintenance** work on a vast array of equipment such as:

- Chillers
- Roof Top Equipment and Package Units
- Heat Pumps
- Geothermal Equipment
- Ventilation Equipment
- V.A.V. (variable air volume systems)
- Multi Zone Systems
- Energy Management Systems and Building Automation
- Gas and Oil Heating Systems
- Clean Rooms
- Hydronic and Steam Heating Systems
- Hot Air Heating Systems
- Radiant Floor heating Systems
- Infrared Heating Systems
- Ductless Split Systems
- Refrigeration Rack Systems
- Walk-in Coolers and Freezers
- Ice Machines
- Reach in Coolers & Freezers
- Refrigerated Display Cases
- Indoor Air Quality
- Variable Volume Refrigerant Systems
- Humidification Systems
- Dehumidification Systems
- Computer Room Air Conditioning Systems
- Multi Zone Ductless and Ducted Split Systems
- Process Piping for Chemical and Food Grade Applications
- Air Curtains





RESIDENTIAL HVAC

Our years of experience in the heating, air conditioning and indoor air quality have given us the expertise needed when it comes to your needs as a homeowner. We can provide service, repair and maintenance for all your HVAC needs including:

- Air Conditioning Systems
- Heat Pumps
- Geothermal Systems
- Radiant Heating
- Ductless Split Systems
- Multi Zone Systems
- Standard & High Efficiency Boilers
- Standard & High Efficiency Furnaces
- Standard & High Efficiency
- Air Conditioning Systems
- Standard & High Efficiency Heat Pump Systems
- Indoor Air Quality Systems
- Humidification Systems
- Dehumidification Systems



Our design specialist will provide you a FREE estimate!

A note to our customers:

When it comes to residential air conditioning and heating systems we at BADRY play by different rules than our competitors! Unlike them, our service techs ARE NOT paid on a commission basis for what they "sell" the customer. Unlike most of our competitors whose technicians base their salary on that fact, we believe that system is flawed and could lead to inappropriate billing and sales practices. Also, we do not base our billing on so called "book pricing" which lumps all costs whether or not they are associated with your particular service repair issue into your bill. For example: Maybe your gas valve only took an hour to replace but you would get billed for what it would cost for an average replacement of 2.5 hours using the "book pricing" system.

We bill a standard service charge for the first hour of service then in 15 minutes increments (not 1/2 hour increments, always rounded up) there after plus the parts if needed. Also, we will provide you with a prompt written estimate for repairs before any work is performed. You will never see a pushy sales person trying to sell you something that you don't need when using us. We want you as our customer and I believe through fair and honest business practices that goal is obtainable.



INDOOR AIR QUALITY

At BADRY we offer a number of **Indoor Air Quality** products that will make your home healthier, more comfortable and save you money on your heating and cooling needs.



Whole House Humidifiers

- Humidity makes you feel warmer at a lower temperature saving on your heating costs.
- Prevents sinuses from drying out - less sinus infections, colds and nosebleeds.
- Wood floors, doors and cabinets won't dry, shrink or crack.



Air Filtration Systems

- Effectively removes particles from your home's air ordinary filters can't.
- Alleviate allergy symptoms, household dust and odors.



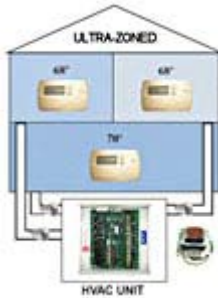
Germicidal Lights

- Kills air borne bacteria, mold, viruses and fungi.
- Prevents their growth on your heating and cooling system.



Heat Recovery Ventilators

- Removes stale air, odors and chemicals, such as formaldehyde, that are used in many building materials. ie: carpet and plywood.
- Puts fresh, filtered air into your home.



Zoning Systems

- Gives you greater control over your heating and cooling system.
- Enhances comfort and efficiency.
- Perfect for bonus rooms and finished basements.

Call us for the perfect indoor environment!



REFRIGERATION SERVICE

BADRY is the area's premier provider of commercial and industrial refrigeration service and installations. We provide service and repairs on walk-in coolers, walk-in freezers, reach-in coolers and freezers, ice machines, refrigerated display cases and all other commercial refrigeration equipment ranging from a single door cooler to large supermarket rack systems. In addition to providing terrific refrigeration service and repair, we offer a complete range of maintenance on all commercial and industrial refrigeration equipment and systems.

All of our technicians are licensed, insured and factory trained.

- Walk-in Coolers
- Walk-in Freezers
- Reach-in Coolers
- Reach-in Freezers
- Ice Machines
- Refrigerated Display Cases
- Ultra Low Temp Systems
- Refrigerated Process Systems
- Refrigerated Food Warehousing
- Supermarket Rack Systems
- Preventive Maintenance Programs
- Refrigerant Retrofits
- Refrigeration Systems Planning, Design, and Evaluation



MECHANICAL PIPING

At BADRY we provide mechanical piping for chilled water systems, hot water systems, commercial food grade systems, steam piping, condenser fluid piping, medical gas piping, process piping and radiant heat systems. We have completed jobs ranging from one thousand EGP up to multi-million EGP piping projects.

- Gas Service Piping
- Tankless Water Heaters
- Welded Pipe
- Victaulic Piping
- Stainless Steel Piping
- PVC, ABS, Teflon, Glue and Weld Piping
- Refrigerant Piping
- Chilled Water Systems
- Hot Water Systems
- Commercial Food Grade Systems
- Steam Piping
- Condenser Fluid Piping
- Medical Gas Piping
- Process Piping
- Radiant Heat Systems

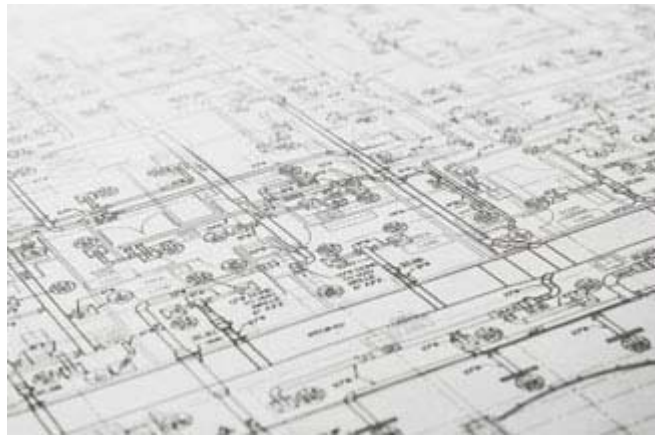


SHEET METAL DESIGN, FABRICATION AND INSTALLATION

We have our own in-house sheet metal fabrication facility. In addition to our qualified fabrication mechanics our field personnel have extensive experience when it comes to field fabrication and installation.



- Sheet Metal Design
- Duct System Design
- Sheet Metal Fabrication
- Exhaust Systems
- Variable Air Volume Systems
- Spiral Duct Systems
- Interior and Exterior Ducting
- Kitchen Hoods and Exhaust Systems





شركة البدرى لأعمال التبريد والتكييف والتدفئة
إحدى شركات مجموعة البدرى للتنمية والاستثمار

BADRY HVAC Works Co.

6B, 60 October st., Menshiat El-Sad ElAley - El Salam, Cairo, Egypt.

Tel.: (+202) 22958530 - 22955487 Fax: (+202) 22995860

٦ب شارع ٦ أكتوبر منشيه السد العالى - السلام - القاهرة.

تليفون : ٢٢٩٥٨٥٣٠ - ٢٢٩٥٥٤٨٧ (+٢٠٢) فاكس : ٢٢٩٩٥٨٦٠ (+٢٠٢)