



Your Guide to Commercial HVAC Maintenance

CLS Facility Services
clsfacilityservices.com

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Introduction: A New Challenge Every Day

As a facility leader, you already know how challenging it is to manage HVAC assets across multiple locations.

Whether you have a few dozen or a few hundred that you and your team oversee, the challenges remain the same:

- Keeping up with maintenance
- Proactively replacing assets
- Reducing energy expenses
- Managing facility budgets
- Managing asset performance
- Managing HVAC service vendors
- Maximizing rebates and incentives
- Budgeting for the future

It's a significant undertaking — one that is compounded by numerous other factors and issues pertinent to today.

- **Rising temperatures**
- Spiking energy costs
- High asset costs and rates
- Sustainability pressures
- Excessive administrative burdens
- Inconsistent vendor performance

And yet, your responsibilities remain clear: maintain HVAC assets and ensure that each location is properly heated, cooled, and ventilated.

To help you maximize results, we've prepared this overview of commercial HVAC maintenance, which includes calculating costs, the importance of preventive maintenance, identifying the right vendors, and more. We've also included a glossary of common HVAC terms that you can refer to as needed.

HVAC is a significant investment in your facilities — both in terms of the assets themselves and their ongoing performance. These assets make a meaningful impact in customer and employee experiences, and impact the financial performance of your organization. Maintenance is critical.

Remember that CLS Facility Services, a nationwide HVAC/R and facility asset maintenance aggregator, is here to support you. **Reach out if we can be of assistance in your strategy.**

Total Cost of Owning and Operating a Rooftop Unit

A commercial building's rooftop HVAC unit (RTU) may reside out of sight for most people. But dollar for dollar, these units take center stage when it comes to making or breaking a facility's operating budget.

HVAC is one of the most important — and energy consuming — building systems in any enclosed structure. Clean and comfortable indoor environments help to keep tenants happy, healthy, and productive. Likewise, **efficient HVAC equipment** helps to keep operating, maintenance, and lifecycle costs in check for building owners.

Purchasing an RTU is expensive, so you want to do all you can to keep it running smoothly over its years of operation. With the high cost of energy, operating expenses can mean the difference between profitability and loss. Knowing the true costs of owning and operating an RTU can help you **manage your facility budget more effectively**. Just as important, you can use that knowledge to build a preventive maintenance plan for your RTU that will cut its operating and maintenance costs, extend its lifespan, and ensure reliability.



The first step is to determine the total cost of owning and operating an RTU. Here's how to do it.

Installed unit cost: \$ _____

Energy cost to operate unit:* \$ _____

Preventive maintenance cost:* \$ _____

Cost for repairs:* \$ _____

**During the total lifetime of the unit.*

The sum total of these four costs represents your total HVAC cost: \$ _____

Take your total HVAC costs and divide that by the number of years that your RTU has been in service (the industry standard for the useful economic life expectancy of an RTU is 12 to 15 years). The result will give you your unit cost per year.

Knowing your RTU's unit cost per year can help you to devise and implement a **comprehensive HVAC preventive maintenance program**. Given an upfront investment of time and forethought, a well conceived and systematically implemented preventive maintenance program that boosts RTU operation, durability, and reliability will pay dividends to your bottom line for years to come.

The Importance of Comprehensive Preventive Maintenance

Three things we know: 1) facility budgets are always tight, 2) happy tenants don't grow on trees, and 3) HVAC preventive maintenance helps facility leaders keep 1 and 2 manageable.

A rooftop HVAC unit is an expensive upfront purchase, and breakdown maintenance on it can cost you in a big way — according to some surveys, three times what a comprehensive maintenance program would otherwise cost to implement and maintain. Add to that disruption to tenants, and the value of a comprehensive preventive maintenance (PM) program becomes clear.

The Benefits of a PM Program

Manufacturers of leading HVAC equipment strongly recommend PM. We do, too. Consider the benefits:



A long and healthy life for your unit or units

Like any piece of equipment, an HVAC unit needs regular care and maintenance. Without it, it won't run at its optimal performance level and components will intricately fail, leading to expensive repairs and replacement costs.



Lower energy costs

HVAC accounts for a significant portion of a building's energy usage. Ensuring that units are well-maintained means that they run efficiently — and use less energy.



Fewer breakdown repair costs

It's simple math: Fewer breakdowns means less breakdown repair costs.



Tenant satisfaction

That includes better health, productivity, efficiency and even profit. A well-functioning HVAC unit helps to provide a comfortable, clean indoor working environment. Indoor air quality is of great importance for both employees and customers. For retail space, introducing outside or fresh air into a space flushes the VOC (Volatile Organic Compounds) present in new merchandise, carpeting, and packaging.

Likewise, if air filters are changed regularly and the proper amount of outside or fresh air is introduced into your office, factory, warehouse, or store, employees will be healthier and more productive.

Employee turnover also can be reduced by providing a comfortable workplace. **In the retail realm**, many stores have installed incandescent lighting to make merchandise more appealing. But, designers don't always calculate the additional heat load that this lighting places on a cooling system. If an employee feels uncomfortable on the job, he or she may begin looking for better working conditions.

Finally, customers, and even visiting clients, who feel more comfortable in your space may also feel more inclined to do business with you — today or in the future.

Building a PM Program

Here are some starting points for establishing a PM program:



Consistent Checks

Rooftop HVAC units should have a minimum of four PM checks each year, which include one cooling startup and one heating startup. This includes one belt replacement, if applicable, and four filter changes. If your air conditioning unit and duct system will allow higher efficiency pleated filters, consider installing them. Usually, you can use a two-inch pleated filter in rooftop units under 30 tons. The pleated filter will provide additional rigidity that will protect the filter if it gets wet.



Component Cleaning

Once per year, clean both coils, the condenser, and the evaporator with a low-cost hand sprayer. To do this, first “brush clean” the coil, if necessary. Then, using a low-suds detergent such as Simple Green at the proper dilution strength, clean both coils, and rinse. An evaporator tends to be “self-rinsing” in the cooling mode. Cleaning the coils with a hand sprayer should be sufficient if other preventive maintenance has been performed at recommended intervals.



Deep Cleaning as Needed

Know that there are coils that are eight rows deep that can only be cleaned properly by a power or pressure washer. Pressure washing has its place in cases when a piece of equipment has been neglected, or for cleaning after longer time intervals. But pressure washing takes more time to set up on a roof and uses more chemicals. As a result, it's a more expensive alternative.



Annual Readings

At least once a year, take a megohmmeter reading of the unit's motors and compressors. This is a quick, non-invasive procedure that will give you a good indication of the condition of the compressor windings and refrigerant. If you get low readings, then you can change either or all of the following: filter-driers, refrigerant, and compressor oil. Doing this will extend the life of the compressor.

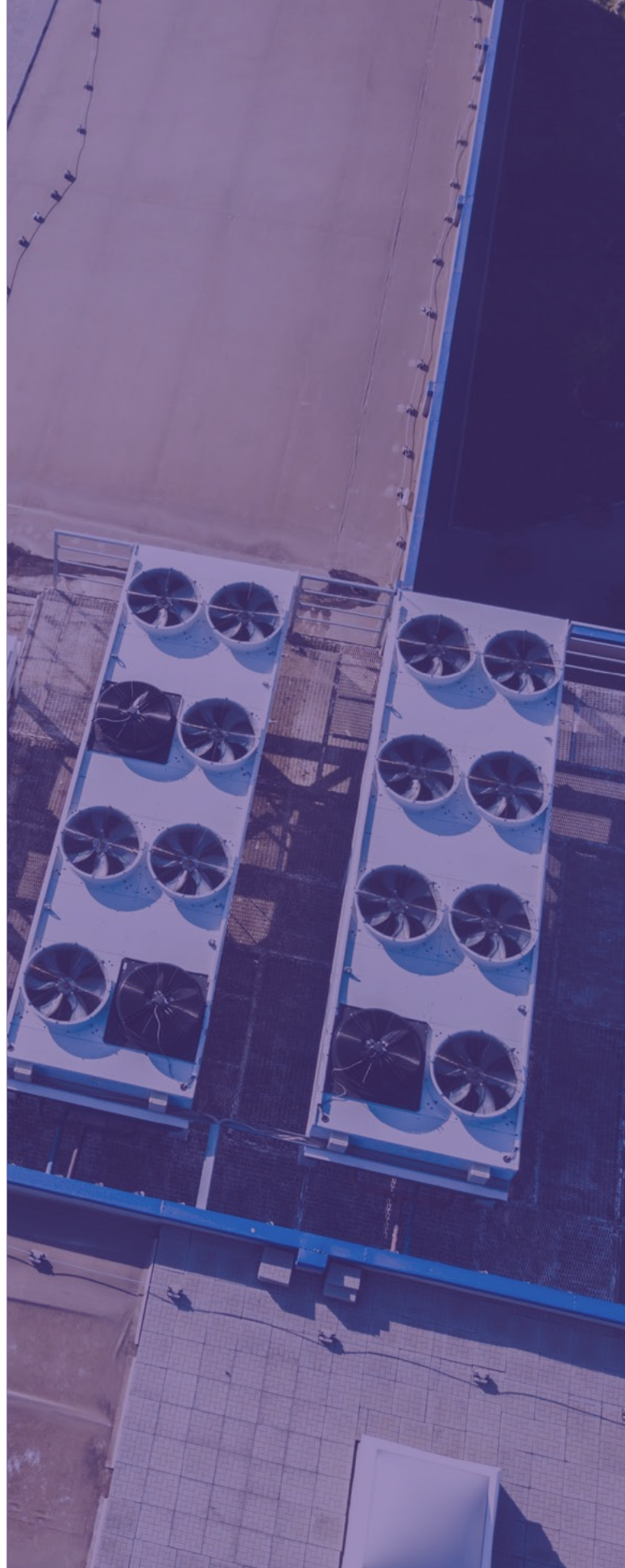


Comprehensive Preventive Maintenance Checklist

Now that we've explained the benefits of a comprehensive preventive maintenance (PM) program for your HVAC unit and outlined some basic steps, we want to give you a more detailed PM checklist to include as part of this program. Note that this checklist is consistent with recommendations provided by several of today's leading HVAC manufacturers.

Two (2) Mid-Season Inspections (February and August)

- Replace all air filters (preferably pleated)
- Inspect and adjust belts and blower
- Inspect and lubricate blower bearings
- Clean heating, evaporator, and condenser coils
- Verify that heating/cooling systems are operable
- Clean condensate drain, trap, and pan
- Check thermostat calibration
- Verify that economizer dampers are set and operable



Cooling Start-Up (April and May)

- Replace all air filters (preferably pleated)
- Replace blower belt(s)
- Inspect and lubricate blower bearings
- Clean heating, evaporator, and condenser coils
- Verify that heating/cooling systems are operable
- Check refrigerant and compressor oil levels on compressors with sight glass
- Check and adjust all operating and safety controls
- Megohmmeter check compressor(s) and motor(s)
- Clean condensate drain, trap, and pan
- Verify that economizer dampers are set and operable

Heat Start-Up (October and November)

- Replace all air filters (preferably pleated)
- Inspect blower and belts
- Inspect and lubricate blower bearings and motor
- Clean heating, evaporator, and condenser coils
- Test the operation of heating systems
- Verify that heating/cooling systems are operable
- Check and adjust all operating and safety controls
- Clean condensate drain, trap, and pan
- Verify that economizer dampers are set and operational

Remember, these are recommendations only, so they're not necessarily applicable for every PM program. You should build your own PM program based on the specifications of your system and its unique needs, the needs of your facility, and those of your tenants.



Choosing the Right Preventive Maintenance Program

A good appreciation for the ways that preventive maintenance (PM) can help you reduce HVAC repair costs and increase unit lifespan can give you a better sense of what a baseline PM program entails. We even provided a more thorough checklist of specific PM components that can help to form the foundation of a solid PM plan.

The old axiom 'one size doesn't fit all' applies to so many things in life, and HVAC PM is no exception. PM for one unit may not be well-suited for another unit, especially when you account for critical variables such as location and usage.

While we've provided some good general recommendations and specific checklist components, the right PM program for your HVAC unit is dependent on factors that are unique to your unit and your facility. Consider:



Age and Condition

Is your equipment one year old or 10 years old? Is it used regularly, or sparingly? New equipment may only require a few PM sessions annually, while older units may likely need more. Then again, some new units may actually require more PM than older units, if you take into account some of the additional variables below...



Geography

Where is your unit located? In Maine? Arizona? Florida? Ohio? Different parts of the country experience characteristically different climates. Heat, or lack thereof, humidity, sunshine, and even wind and rainfall all play important roles in determining the specific components in a PM program, as well as the frequency of PM within a given calendar year.



Other Locations Considerations

Is your equipment located in an enclosed retail space such as a mall? Do other nearby businesses emit fumes, chemicals, or odors that encroach on your space and affect your HVAC filtering — potentially even every day? Is your unit within the accepted boundaries of what is considered a "bad" HVAC environment — i.e., near an airport, a construction zone, or the ocean?



Environmental Considerations

In the Southeast U.S., for example, cottonwood trees emit seeds covered with a cottony substance in late spring. This material clogs HVAC filters — sometimes daily — and necessitates a robust PM program for units that are affected. Other units not in close proximity to such trees may only need a handful of PM programs annually. We use these trees as an illustration of the types of materials in various environments that can directly impact HVAC performance and health — and therefore must be accounted for in a PM program.

The point is, choosing the right PM program for your unit means gathering a lot of useful information, processing it thoughtfully (sometimes even through mathematical or statistical analysis), and building a sensible program that keeps it running smoothly ensures a long lifecycle to protect your investment — and strengthens your bottom line.

About CLS Facility Services

CLS Facility Services is a nationwide facility asset management organization that partners with service providers across multiple disciplines and industries.

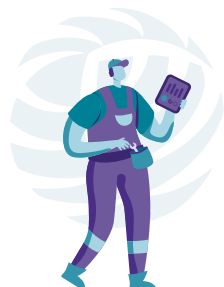
We pride ourselves on the technical expertise of our service professionals, many of whom have been with us for more than a decade. Our team has a comprehensive knowledge of **commercial HVAC preventive maintenance** and **other related HVAC solutions** that can help you get the very best performance out of your assets.

As an aggregator, we do not self-perform our maintenance services. Instead, **we partner with commercial service vendors** across the country to ensure you have the right support exactly where your facilities are located. This helps consolidate service vendors for your team and reduces your administrative workload. **Every vendor has been rigorously vetted** and has an average relationship length of 12.5 years — giving you peace of mind in knowing that your HVAC assets are in good hands.

Here's why you should work with us for your HVAC preventive maintenance program:

- Complete maintenance coverage across the U.S.
- Asset maintenance support for 50 to 500 locations
- Experienced and service-focused account team
- Ability to work on multiple work order systems
- Accessible online asset management portal
- We build a complete list of all HVAC assets
- CapEx budgeting and strategic planning support
- Your account manager is your emergency contact
- Extensive capabilities beyond HVAC maintenance
- Relentless focus on customer service at all times

Connect with us today to learn more about building an HVAC preventive maintenance program for your organization.



Commercial HVAC Maintenance Glossary

For those who are new to the world of commercial HVAC maintenance, there are several terms that you'll encounter on a regular basis. Here, we'll take a look at some of these terms that describe various HVAC system types.

Accumulator — A shell device installed in the suction line of a HVAC system to prevent liquids from entering the compressor.

Acrolein — An agent added to methyl chloride to make you aware of refrigerant leaks.

Activated Alumina — A type of aluminum oxide that absorbs moisture (used in refrigerant driers).

Activated Carbon — A processed carbon used in filter driers and commonly used in air filters to clean the air.

Active Cooling — HVAC term for compressor driven air conditioning.

Air Balance — HVAC term for distributing air through a system to precisely match the required amount.

Air Cleaning — In HVAC, an IAQ control strategy to remove various airborne particulates and/or gasses from the air. The three types of air cleaning most commonly used are particulate filtration, electrostatic precipitation, and gas sorption.

Air Conditioner — A device used to control temperature and humidity of the air.

Air Conditioning — In HVAC, the control of the quality, quantity, and temperature-humidity of the air in an interior space.

Air Diffuser — HVAC term for an air distribution outlet, typically located in the ceiling, which mixes conditioned air with room air.

Air Exchange Rate — In HVAC, the rate at which outside air replaces indoor air in a space, expressed in one of two ways: the number of changes of outside air per unit of time — air changes per hour (ACH); or the rate at which a volume of outside air enters per unit of time — cubic feet per minute (CFM).

Air Handler — HVAC term for a fan-blower, heat transfer coil, and housing parts of a system.

Air Handling Unit (AHU) — In HVAC, this refers to equipment that includes a blower or fan, heating and/or cooling coils, and related equipment such as controls, condensate drain pans, and air filters. It does not include ductwork, registers, grilles, boilers, or chillers.

Air Infiltration — The unwanted entrance of air due to leakage, temperature difference, or wind.

Ambient Air — The air external to a building or device.

Blower — In HVAC, the device inside an air conditioner that distributes the filtered air from the return duct over the coil/heat exchanger. This circulated air is cooled/heated and then sent through the supply duct, past dampers, and through supply diffusers to the living/working space.

Boiler — A vessel or tank where heat produced from the combustion of fuels such as natural gas, fuel oil, or coal is used to generate hot water or steam for applications ranging from building space heating to electric power production or industrial process heat.

Boiler Pressure — The pressure of the steam or water in a boiler as measured, usually expressed in pounds per square inch gauge (psig).

Boiler Rating — The heating capacity of a steam boiler expressed in BTU per hour (BTU/H), horsepower, or pounds of steam per hour.

British Thermal Unit (BTU) — The amount of heat required to raise the temperature of one pound of water one degree Fahrenheit, equal to 252 calories.

Building Envelope — Elements of the building, including all external building materials, windows, and walls, that enclose the internal space.

Burner Capacity — The maximum heat output (in BTU per hour) released by a burner with a stable flame and satisfactory combustion.

Carbon Monoxide (CO) — A colorless, odorless but poisonous, combustible gas with the formula CO. Carbon monoxide is produced in the incomplete combustion of carbon and carbon compounds such as fossil fuels (i.e. coal, petroleum) and their products (e.g. liquefied petroleum gas, gasoline), and biomass.

Ceiling Plenum — Space below the flooring and above the suspended ceiling that accommodates the mechanical and electrical equipment that is used as part of the air distribution system. The space is kept under negative pressure.

Central Heating System — In HVAC, a system where heat is supplied to areas of a building from a single appliance through a network of ducts or pipes.

Cubic Feet per Minute (CFM) — HVAC term for the amount of air, in cubic feet, that flows through a given space in one minute. One CFM equals approximately two liters per second (l/s).

Compressor — A device used to compress air for mechanical or electrical power production, air conditioners, heat pumps and refrigerators, to pressurize the refrigerant and enable it to flow through the system.

Condenser — The device in an air conditioner or heat pump in which the refrigerant condenses from a gas to a liquid when it is depressurized or cooled.

Condenser Coil — The device in an air conditioner or heat pump through which the refrigerant is circulated and releases heat to the surroundings when a fan blows outside air over the coils. This will return the hot vapor that entered the coil into a hot liquid upon exiting the coil.

Condensing Unit — The component of a central air conditioner that is designed to remove heat absorbed by the refrigerant and transfer it outside the conditioned space.

Conditioned Air — Air that has been heated, cooled, humidified, or dehumidified to maintain an interior space within the "comfort zone." (Sometimes referred to as "tempered" air.)

Constant Air Volume Systems — Air handling system that provides a constant air flow while varying the temperature to meet heating and cooling needs.

Cooling Capacity — The quantity of heat that a cooling appliance is capable of removing from a room in one hour.

Dampers — HVAC term for controls that vary airflow through an air outlet, inlet, or duct. A damper position may be immovable, manually adjustable, or part of an automated control system.

Diffusers and Grilles — Components of the ventilation system that distribute and return air to promote air circulation in the occupied space. As used in this document, supply air enters a space through a diffuser or vent and return air leaves a space through a grille.

Dual Duct System — An air conditioning system that has two ducts, one is heated and the other is cooled, so that air of the correct temperature is provided by mixing varying amounts of air from each duct.

Duct Fan — HVAC term for an axial flow fan mounted in a section of duct to move conditioned air.

Duct(s) — The round or rectangular tube(s), generally constructed of sheet metal, fiberglass board, or a flexible plastic-and-wire composite, located within a wall, floor, or ceiling that distributes heated or cooled air in buildings.

Environmental Agents — Conditions other than indoor air contaminants that cause stress, comfort, and/or health problems (e.g., humidity extremes, drafts, lack of air circulation, noise, and overcrowding).

Filter (Air) — A device that removes contaminants, by mechanical filtration, from the fresh air stream before the air enters the living space. Filters can be installed as part of a heating/cooling system through which air flows for the purpose of removing particulates before or after the air enters the mechanical components.

Forced Air System or Furnace — HVAC term for a type of heating system in which heated air is blown by a fan through air channels or ducts to rooms.

Freon — A registered trademark for a chlorofluorocarbon (CFC) gas that is highly stable and that has been historically used as a refrigerant.



Heat — A form of thermal energy resulting from combustion, chemical reaction, friction, or movement of electricity. As a thermodynamic condition, heat, at a constant pressure, is equal to internal or intrinsic energy plus pressure times volume.

Heat Loss — The heat that flows from the building interior, through the building envelope, to the outside environment.

Heating Capacity (Also Specific Heat) — The quantity of heat necessary to raise the temperature of a specific mass of a substance by one degree.

Heating Load — The rate of heat flow required to maintain a specific indoor temperature; usually measured in BTU per hour.

Humidity — A measure of the moisture content of air; may be expressed as absolute, mixing ratio, saturation deficit, relative, or specific.

HVAC — HVAC is an acronym for heating, ventilation, and air-conditioning system.

IAP — Indoor air pollution.

IAQ — Indoor air quality.

Indoor Air — The air that people breathe inside a built environment.

Indoor Air Pollutant — Particles and dust, fibers, mists, bio-aerosols, and gasses or vapors.

Infiltration — Air leakage inward through cracks, ceilings, floors, and walls of a space or building.

Integrated Heating Systems — HVAC term for a type of heating appliance that performs more than one function, for example space and water heating.

Ion — An electrically charged atom or group of atoms that has lost or gained electrons; a loss makes the resulting particle positively charged; a gain makes the particle negatively charged.



Ionizer — A device that removes airborne particles from breathable air. Negative ions are produced and give up their negative charge to the particles. These new negative particles are then attracted to the positive particles surrounding them. This accumulation process continues until the particles become heavy enough to fall to the ground.

Natural Ventilation — In HVAC, the movement of outdoor air into a space through intentionally provided openings, such as windows and doors, or through non-powered ventilators, or by infiltration.

Negative Pressure — Condition that exists when less air is supplied to a space than is exhausted from the space, so the air pressure within that space is less than that in surrounding areas. Under this condition, if an opening exists, air will flow from surrounding areas into the negatively pressurized space.

Outdoor Air — Air taken from the external atmosphere and, therefore, not previously circulated through the system.

Outdoor Air Supply — HVAC term for air brought into a building from the outdoors (often through the ventilation system) that has not been previously circulated through the system. Also known as “make-up air.”

R-Value — A measure of the capacity of a material to resist heat transfer. The R-Value is the reciprocal of the conductivity of a material (U-Value). The larger the R-Value of a material, the greater its insulating properties.

Re-circulated Air — Air removed from the conditioned space and used for ventilation, heating, cooling, humidification, or dehumidification.

Refrigerant — The compound (working fluid) used in air conditioners, heat pumps, and refrigerators to transfer heat into or out of an interior space. This fluid boils at a very low temperature enabling it to evaporate and absorb heat.

Refrigeration — The process of the absorption of heat from one location and its transfer to another for rejection or recuperation.

Relative Humidity — A measure of the percent of moisture actually in the air compared with what would be in it if it were fully saturated at that temperature. When the air is fully saturated, its relative humidity is 100 percent.

Return Air — Air that is returned to a heating or cooling appliance from a heated or cooled space.

Return Duct — The central heating or cooling system contains a fan that gets its air supply through these ducts, which ideally should be installed in every room of the house. The air from a room will move towards the lower pressure of the return duct.

Seasonal Energy Efficiency Ratio (SEER) — A measure of seasonal or annual efficiency of a central air conditioner or air conditioning heat pump. It takes into account the variations in temperature that can occur within a season and is the average number of BTU of cooling delivered for every watt-hour of electricity used by the heat pump over a cooling season.

Setback Thermostat — A thermostat that can be set to automatically lower temperatures in an unoccupied area and raise them again before the occupant returns.

Split System Air Conditioner — HVAC term for an air conditioning system that comes in two to five pieces: one piece contains the compressor, condenser, and a fan; the others have an evaporator and a fan. The condenser, installed outside the building, connects to several evaporators, one in each room to be cooled, mounted inside the building. Each evaporator is individually controlled, allowing different rooms or zones to be cooled to varying degrees.

Static Pressure — Condition that exists when an equal amount of air is supplied to and exhausted from a space. At static pressure, equilibrium has been reached.

Supply Duct — HVAC term for the duct(s) of a forced air heating/cooling system through which heated or cooled air is supplied to rooms by the action of the fan of the central heating or cooling unit.

Temperature Zone — In HVAC, individual rooms or zones in a building where temperature is controlled separately from other rooms or zones.

Therm — A unit of heat containing 100,000 British thermal units (BTU).

Ton (Air Conditioning) — A unit of air cooling capacity; 12,000 BTU per hour.

Unit Ventilator — HVAC term for a fan-coil unit package device for applications in which the use of outdoor- and return air mixing is intended to satisfy tempering requirements and ventilation needs.

Variable Air Volume System (VAV) — Air handling system that conditions the air to constant temperature and varies the outside airflow to ensure thermal comfort.

Vent — A component of a heating or ventilation appliance used to conduct fresh air into, or waste air or combustion gasses out of, an interior space.

Vent Damper — An HVAC term for a device mounted in the vent connector that closes the vent when the heating unit is not firing. This traps heat inside the heating system and house rather than letting it draft up and out of the vent system.

Vent Pipe — A tube in which combustion gasses from a combustion appliance are vented out of the appliance to the outdoors.

Ventilation — The process of moving air (changing) into and out of an interior space either by natural or mechanically induced (forced) means.

Ventilation Air — Defined as the total air, which is a combination of the air brought inside from outdoors and the air that is being re-circulated within the building. Sometimes, however, used in reference only to the air brought into the system from the outdoors; this document defines this air as "outdoor air ventilation."

Ventilation Rate — The rate at which indoor air enters and leaves a building. Expressed in one of two ways: 1) the number of changes of outdoor air per unit of time (air changes per hour, or "ACH") or the rate at which a volume of outdoor air enters per unit of time (cubic feet per minute, or "CFM").

Weatherization — In HVAC, caulking and weather-stripping to reduce air infiltration and exfiltration into/out of a building.

Weather-Stripping — A material used to seal gaps around windows and exterior doors.

Zone — In HVAC, an area within the interior space of a building, such as an individual room(s), to be cooled, heated, or ventilated. A zone has its own thermostat to control the flow of conditioned air into the space.

Zoning — The combining of rooms in a structure according to similar heating and cooling patterns. Zoning requires using more than one thermostat to control heating, cooling, and ventilation equipment.