SPEAKER –
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20 YEARS EXPERIENCE.

HEATING VENTILATION AIR CONDITIONING

AGENDA

- Types of HVAC systems
- Application of HVAC
- Limitations/Advantages
- Life cycle duration
- Replacement and repair costs
- Maintenance considerations

TYPES OF HVAC SYSTEMS

DUCTED SPLIT SYSTEMS

- Are split into 2 main sections.
  - An indoor section.
    - This section will have a blower also called an Air Handling Unit (AHU) or Furnace to which the ductwork will be attached. May include fresh air intake.
    - If air conditioning is required on a furnace heating system a coil, usually cased, will be placed on top of the furnace.
    - The furnace can also be stand alone for heating only situations.
    - A thermostat will also be mounted inside the space to be conditioned.

DUCTED SPLIT SYSTEMS

- And an outdoor section.
    - This section will have a Condensing Unit in which is the compressor.
    - If the unit only provides cooling it is a straight A/C
    - If it provides heating and cooling it is referred to as a Heat Pump
    - This unit either extracts heat from the air or rejects it to the air.

MINI-SPLIT SYSTEMS

- Indoor section.
- This can be a miniature “hidden” or “concealed” air handler with ductwork attached.
- More often a ductless indoor section is used.
- These ductless sections can be mounted to the wall high up or at floor level.
- Or can be “recessed” unit in the ceiling. These units are often called “cassettes”

MINI-SPLIT SYSTEMS

- And an outdoor section.
    - This section will have a Condensing Unit in which is the compressor.
    - The outdoor section can be connected to multiple indoor units if it is equipped to do so. (usually max of 5)
    - If the unit only provides cooling it is a straight A/C
    - If it provides heating and cooling it is referred to as a Heat Pump

PACKAGED SYSTEMS

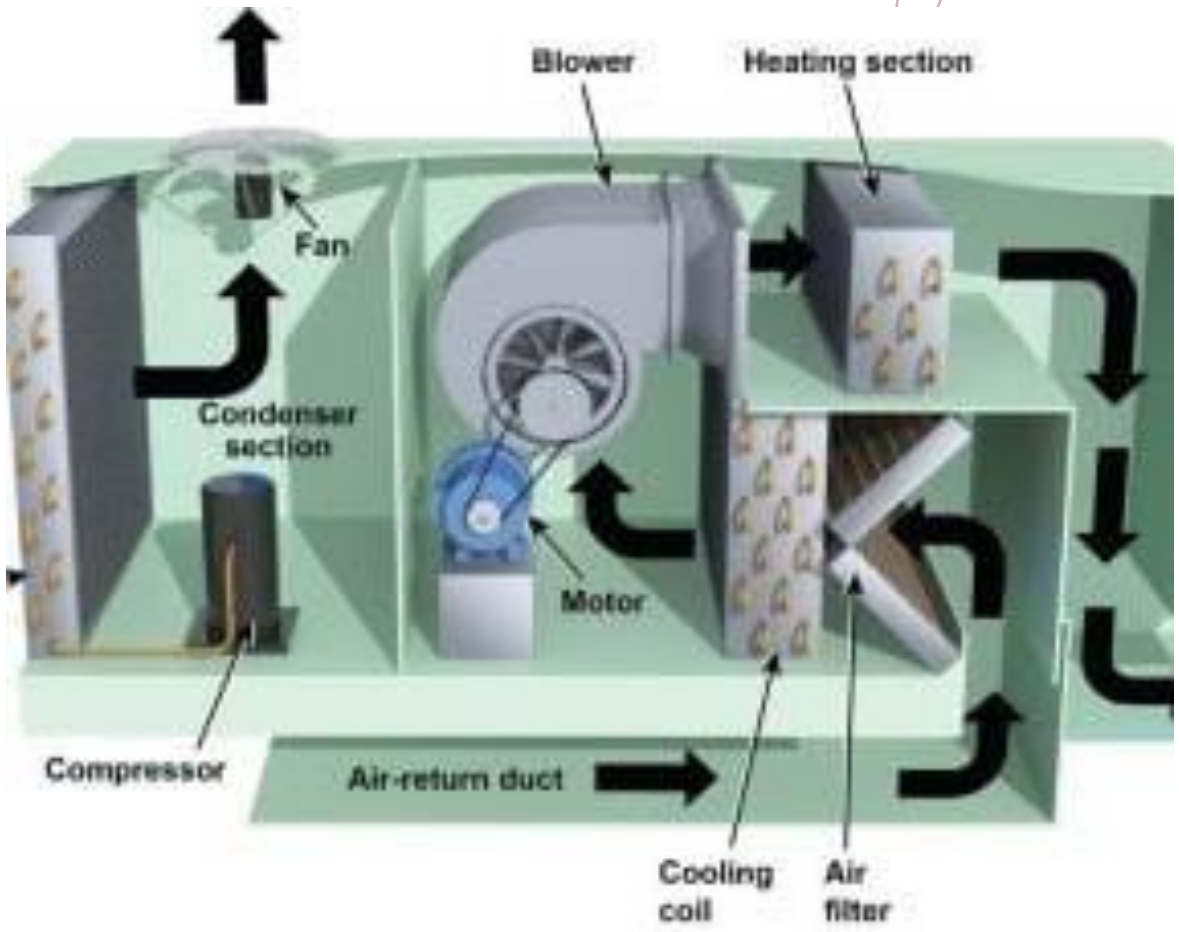
Package sometimes called rooftop HVAC systems, commonly referred to as rooftop units (RTUs), are self-contained.

They typically provide heating, ventilation, and air conditioning typically situated on the roofs of buildings. They can be on the ground if need/desired.

These units are designed to house all the necessary components for conditioning air within a single, weatherproof enclosure or package.

PACKAGED SYSTEMS

- This integration can include
- Dampers that regulate airflow, also can introduce outside air for ventilation and free cooling.
- Cooling and heating coils responsible for temperature adjustment. Water systems will have 2 coils while normal system (DX) will have one that satisfies both modes.
- Heat exchangers for gas fueled heating.
- Fans that circulate the conditioned air distributed throughout the building via a network of ductwork.



PACKAGED SYSTEMS

- Very large package system, most often roof mounted, can be attached to a specialty induct system called Variable Air Volume (VAV).
- This include VAV “boxes” that regulate the air supplied to a given space based on thermostat or BMS/BAS input.
- Some will have fans built into them to give proper airflow in heating.
- These use electric heaters or hot water or steam coils to provide heat above what the main unit can provide.

VRF/V SYSTEMS (VARIABLE REFRIGERANT FLOW/VOLUME)

- Variable Refrigerant Flow (VRF) systems represent a sophisticated and increasingly chosen system type.
- These systems function as heat pumps usually with 1 to 8 outdoor condensing units and a network of multiple indoor air terminal units.
- This design allows for the simultaneous provision of heating and cooling to different zones (if properly configured) within a building, offering a high degree of flexibility and granular control over the indoor climate.

VRF/V SYSTEMS (VARIABLE REFRIGERANT FLOW/VOLUME)

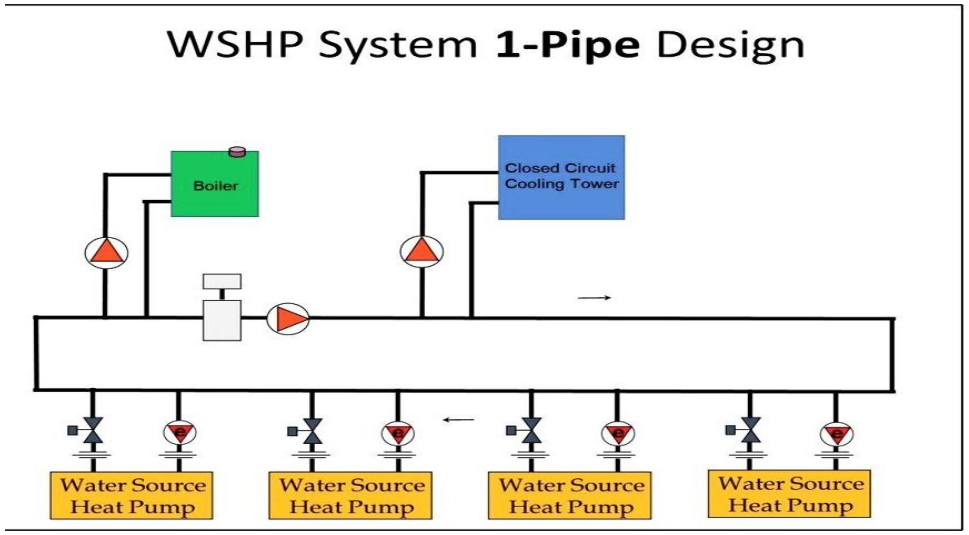
- Indoor (often called Terminal) units are often the same as mini-split units.
- Wall hanging or floor standing units.
- Concealed miniature air handlers.
- Cassettes especially in drop/grid ceiling configurations.
- And they add the ability to use normal size air handling units.

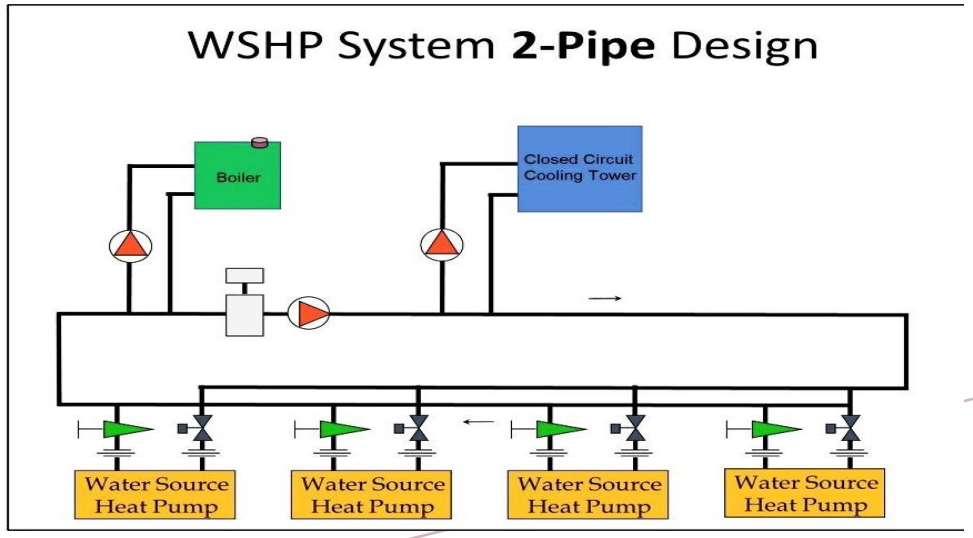
HVRF/V SYSTEMS (HYBRID VARIABLE REFRIGERANT FLOW/VOLUME)

- The new kid on the block!
- Essentially this is the same technology as the conventional VRF/V system except it uses water to do heat transfer to the indoor systems.
- It often incorporates a large buffer tank to provide extra capacity for high load periods.
- All indoor systems can be the same as conventional VRF.
- Has advantages in retrofits from a conventional 2 pipe system.

WATER BASED SYSTEMS
1 OR 2 PIPE WATER SOURCE HEAT PUMP (WSHP)

- An extremely popular system type in the 80s.
- Has a 2-pipe water system, one supply and on return, that goes to space conditioning units.
- The space units are Water Source Heat Pumps as the remove heat from or reject heat to the circulated water.





WATER BASED SYSTEMS
1 OR 2 PIPE WATER SOURCE HEAT PUMP (WSHP)

- There are 2 main options for getting the heat out of the water for cooling. Or putting heat into the water for heating.
    - Geothermal wells – this is by far the most efficient and planet conscious method. Water is pulled from the wells at a consistent temperature is sent to the WSHPs and the water is returned to the well system after either losing or gaining heat.

WATER BASED SYSTEMS
1 OR 2 PIPE WATER SOURCE HEAT PUMP (WSHP)

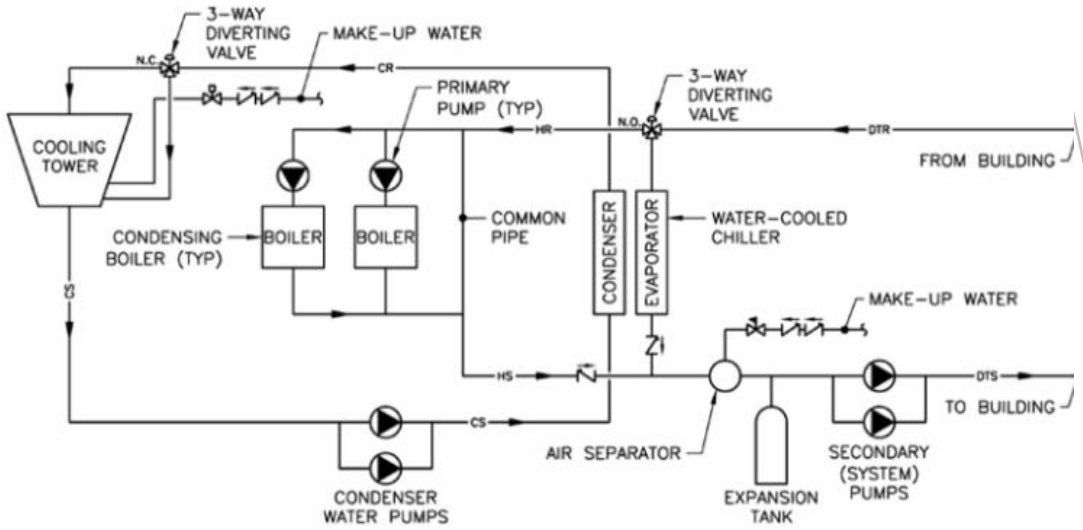
There are 2 main options for getting the heat out of the water for cooling. Or putting heat into the water for heating.

Cooling tower with boiler if needed – Most cost-effective option for initial cost. Utilizes either a cooling tower or a boiler to heat or cool the supply loop to the WSHPs.

A cooling tower uses either direct or indirect evaporative cooling to reject heat outside the building during cooling demand. The boiler provides heat to the supply if needed during heating demand.

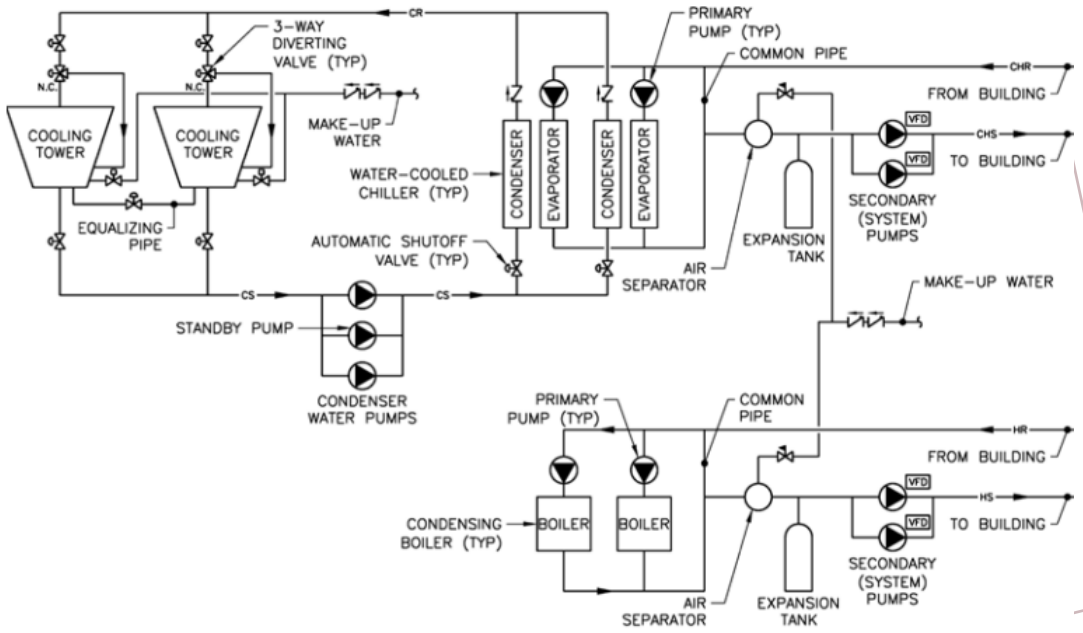
WATER BASED SYSTEMS -2 PIPE WATER WITH FAN COIL UNITS

- Another form of 2 pipe system is water only.
- This system use a supply and return piping configuration like the WSHP setup.
- But it utilizes fan coil units FCU's to provide air to each space. The FCU receives either cooled (often referred to as chilled) water or heated water and the fan distributes it into the space.
- These systems can utilize many types of FCU including VRF looking wall, floor mount, and recessed units as well as conventional ducted models.



WATER BASED SYSTEMS - 4 PIPE WATER WITH FAN COIL UNITS

- Another form of water only system is the 4-pipe system.
- This system use separate supply and return piping for heating and cooling. Allowing for heating and cooling simultaneously.
- It utilizes fan coil units FCU's to provide air to each space. The FCU receives cooled water to one coil. And heated water to another coil and the fan distributes it into the space.
- These systems can utilize many types of FCU including VRF looking wall, floor mount, and recessed units as well as conventional ducted models.



WHICH ONE, WHICH ONE?

Each of these systems has unique properties that can make it ideal or a disaster depending on if it is applied properly.

For replacement, the main limiting factor is usually the previous system type. If you have splits systems, it would be difficult to move to a water system. It is more plausible to move to VRF/V or Mini splits if not retaining the split system.

Next is cost what system has the best upfront cost.

But true long-term planning the long-term maintenance and repair costs need to be considered.

LIMITATIONS/ ADVANTAGES

Split systems – Limitations

- Takes up more space than some options both in the conditioned space and outside. The one outdoor to one indoor make space and esthetics an issue if you have more that 20 separate spaces
- More limited that some as to distance from outdoor unit to indoor unit.
- Coil cleaning at indoor can be challenging.
- Most often is the least efficient.
- Tend to be less robust due to mostly residential use.
- Zoning of individual rooms adds cost and complexity.

LIMITATIONS/ ADVANTAGES

Split systems – Advantages

- Easiest to maintain overall with customizable filter placement and outdoor coil cleaning the main items.
- Easiest to find qualified Technicians to maintain and service.
- Replacement of indoor or outdoor separately is possible in some cases.
- Due to less and smaller parts the repair costs tend to be less.
- Can choose level of filtration and add air cleaning easily.

LIMITATIONS/ ADVANTAGES

Mini-Split – Limitations

- Depending on indoor unit can have more technician deep cleaning needed. And filtration is limited.
- Durability is often the lowest of all systems.
- Sensitive to surges to the use of many PCB boards.
- Tend to leak more often due to flare style joining system.
- Zones must either be all cooling or all heating.

LIMITATIONS/ ADVANTAGES

Mini-Split – Advantages

- Lowest install cost. This applies to non-ducted models.
- Easy to clean filters.
- Easy to use and can have individual zones inside with a single outdoor unit.
- Can have extremely high efficiency rating in both heat and cool modes.
- Easy to use controls and convenient. Usually, a remote.

LIMITATIONS/ ADVANTAGES

Package Systems – Limitations

- If on ground exposed duct work.
- Least efficient in most cases.
- If not, the original system can need engineering and structural to place on roof.
- Larger units more expensive repairs.
- Filtration is set and is hard to upgrade.

LIMITATIONS/ ADVANTAGES

Package Systems – Advantages

- When on roof does not take up ground space.
- Easiest for overall maintenance due to all items to be checked are in one place.
- More durable than most systems.
- Can handle design flaws better.
- Best unit for large spaces. In fact, it can cover entire buildings especially when paired with VAVs.
- Easiest to add economizers to get outside air and “free cooling” when it is cool enough outside.

LIMITATIONS/ ADVANTAGES

VRV/F Systems – Limitations

- High initial cost also high retrofit cost.
- Failures are more expensive than most systems.
- Can be harder to find qualified technician or companies to install and repair. Specialty tools and sometimes training.
- Lots of piping and refrigerant often in hard-to-reach areas so leaks and leak checking is expensive.
- In many cases in room leak detection is required if space is closed off.
- Some indoor units require technician deep cleaning

LIMITATIONS/ ADVANTAGES

VRV/F Systems – Advantages

- One of the most efficient systems.
- Very flexible as a retrofit option due to indoor options.
- If properly configured (3 and 4 pipe) can heat one space and cool another at the same time. Also, can do hot water heating.
- When paired with proper system controller can be remotely monitored and managed and diagnostic alerts can be supplied.
- Per space heating and cooling so load need is closely matched by the system.

LIMITATIONS/ ADVANTAGES

HVRV/F Systems – Limitations

- High initial cost also high retrofit cost.
- Failures are more expensive than most systems.
- Can be harder to find qualified technician or companies to install and repair. Specialty tools and sometimes training.
- Some indoor units require technician deep cleaning
- Less Manufacturer choice.

LIMITATIONS/ ADVANTAGES

HVRV/F Systems – Advantages

- Very flexible as a retrofit option due to indoor options. And the ability to replace boiler and chiller in water systems.
- If properly configured can heat one space and cool another at the same time. Also, can do hot water heating.
- When paired with proper system controller can be remotely monitored and managed and diagnostic alerts can be supplied.
- Per space heating and cooling so load need is closely matched by the system.
- Little to no refrigerant in building. Leaks are less costly, and no refrigerant monitors needed.

LIMITATIONS/ ADVANTAGES

WSHP 2 Pipe Systems – Limitations

- Initial cost is highest.
- Maintenance cost can be high due to 3 separate sections to maintain.
- Repairs can be costly compared to RTUs or split systems.
- May require refrigerant monitoring due to new refrigerants on new installations.

LIMITATIONS/ ADVANTAGES

WSHP 2 Pipe Systems – Advantages

- Longevity – WSHP often last 20 years with main systems lasting 30 to 50 years depending on maintenance.
- Efficiency one of the most efficient system can be enhanced by using geothermal.
- Easier to reconfigure the layout of spaces. Moving just duct work instead of entire indoor units.
- Better filtration than wall mounted units for VRV and mini-split systems. Same Indoor Air Quality options as split systems.
- Lower outdoor space requirements than most systems.
- Better dehumidification on average than VRF or Mini-split.

SHOW ME THE MONEY! CAPITAL AND REPLACEMENT COSTS.

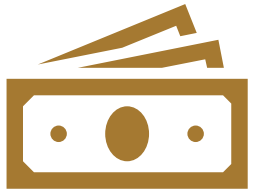
SHOW ME THE MONEY! CAPITAL AND REPLACEMENT COSTS.

Due to the great variations in scope and environment the following are merely general guidelines.

Due to the unique nature of each project a professional should be consulted for a “true” or “real world” cost estimate.

CAPITAL COSTS

All system types



Factors effecting costs

CAPITAL COSTS

Size of system – is it a 2-ton unit or a 5-ton unit.

Efficiency or the system – more efficient = more cost.

Local rates – The labor cost is significantly different across the country.

Accessibility – Indoor in a mechanical room with space or in a confined space or needs an access cut in wall or ceiling. Is the outdoor on a roof or is it in the open on the ground.

Changes needed if replacement – Modify the ductwork connections. Changing the drain pan or any piping and vent changes. New outdoor pad or placement due to larger size of the new condensing units.

Sizing/Load – Never assume that the system in place is correctly sized. Always have load calculations run.

CAPITAL COSTS

Ducted Split Systems

1.5-to-5-ton size has been chosen due to common use. Ducted splits can exceed 100-ton capacity. Systems in the 7.5-to-100-ton range will run 33 to 350 thousand dollars new system and 18 to 200 thousand replacement.

New system cost 1.5-to-5-ton – Per system the cost including duct work and electrical 17 thousand to 28 thousand dollars per system.

This could come down to 14 to 25 thousand if a large quantity was installed at the same time in the same space.

Replacements 1.5-to-5-tonshould replace both indoor and outdoor when switching manufactures, refrigerants, or when system age is over 10 years. Split system rated lifespan is 12 to 17 years for HP units, 15 to 20 years for straight AC units, and 18 to 25 years for furnaces.

Replacement cost for 1.5-to-5-ton systems is 7 to 20 thousand.

CAPITAL COSTS

Ducted Split Systems

Repair cost factors – Labor rate varies by locality. Unit type and efficiency. Unit manufacturer. Accessibility to systems. Refrigerant type. How well the job is done – compressor replaced but same drier and refrigerant used less than if these are replaced.

Cost are for 1.5-to-5-ton systems

Compressor replacement – 1,200 to 3,500 dollars

Blower motor replacement – 500 to 1,200 dollars – with wheel or assembly 800 to 1,800.

Condenser fan replacement motor and blade – 400 to 1,000 dollars

CAPITAL COSTS

Mini Split Systems

New system cost .75-to-5-ton – Per system the cost including electrical 3,400 thousand to 20 thousand dollars per system. The higher prices will have 2 to 5 indoor units and so will have individual control.

This could come down to 3,200 to 18 thousand if a large quantity was installed at the same time in the same space.

Replacements .75-to-5-ton - Must replace both indoor and outdoor when switching manufactures, refrigerants, or when system age is over 7 years. Mini split system rated lifespan is 10 to 15 years for HP units.

Replacement cost for .75-to-5-ton systems is 2,000 to 12,000 thousand.

CAPITAL COSTS

Mini Split Systems

Repair cost factors – Labor rate varies by locality. Unit type and efficiency. Unit manufacturer. Accessibility to systems. Refrigerant type. How well the job is done – compressor replaced but same drier and refrigerant used less than if these are replaced.

Cost are for .75-to-5-ton systems

Compressor replacement – 800 to 2,800 dollars

Main board – 800 – 2,800 dollars

Inverter board – 800 – 3,500 dollars

Blower motor replacement – 500 to 1,200 dollars

Condenser fan replacement motor and blade – 400 to 1,000 dollars

CAPITAL COSTS

Package (RTU) Systems

5-to-25-ton size has been chosen due to common use. Package systems can exceed 150-ton capacity. Systems in the 30-to-150-ton range will run 65 thousand to 1.5+ million dollars new system and 40 to 750 thousand replacement.

New system cost 5-to-25-ton – With duct and electrical. 20 thousand to 85 thousand dollars. High variation due to electrical run length, type and amount of duct work and add on components (economizer etc.)

Reduction to 8 to 65 thousand dollars if more than one done at a time. This is due to the ability to coordinate better.

Replacement cost 5-to-25-ton – 13 thousand to 50 thousand dollars. Since the system is a package, the whole unit is replaced. Curb adapters often needed for generation or manufacturer change. Life span ranges from 10 to 30 years with a rated life of 15 years. (ASHRAE)

CAPITAL COSTS

Package (RTU) Systems

Repair cost factors – Labor rate varies by locality. Unit type and efficiency. Unit manufacturer. Accessibility to systems. Refrigerant type. How well the job is done – compressor replaced but same drier and refrigerant used less than if these are replaced.

Cost are for cost 5-to-25-ton systems

Compressor replacement – 2,500 to 17,000 dollars

Main board – 250 – 2,500 dollars

Blower motor replacement – 1,000 to 5,000 dollars

Condenser fan replacement motor and blade – 400 to 2,500 dollars

CAPITAL COSTS

VRV/F and HVRV/F System

5-to-25-ton size has been chosen due to common use. VRV/F systems can exceed 150-ton capacity. Systems in the 30-to-150-ton range will run 100 thousand to 1.25+ million dollars new system and 40 to 750 thousand replacement. Usually have to replace indoor and outdoor and distribution boxes, if new series and always if new manufacturer. May also have to change the communication wire.

New system cost 5-to-25-ton – With electrical. 20 thousand to 150 thousand dollars. High variation due to electrical run length, type and amount of duct work and add on components (economizer etc.)

Reduction to 16 thousand dollars if more than one done at a time for small systems . This is due to the ability to coordinate better. Since larger systems, 10 ton or more, are usually accomplished by adding condensers and indoor units there is little to no savings larger systems

Replacement cost 5-to-25-ton – 13 thousand to 85 thousand dollars. Replacement costs are high due to needing to replace the majority of the components. Life span ranges from 10 to 20 years with a rated life of 15 years.

CAPITAL COSTS

VRV/F and HVRV/F System

Repair cost factors – Labor rate varies by locality. Unit type and efficiency. Unit manufacturer. Accessibility to systems. Refrigerant type. How well the job is done – compressor replaced but same drier and refrigerant used less than if these are replaced.

Cost are for cost 5-to-25-ton systems

Compressor replacement – 2,500 to 17,000 dollars

Main board – 800 – 5,000 dollars

Compressor drive board – 800 – 3,000 dollars

Blower motor replacement – 700 to 2,500 dollars

Condenser fan replacement motor and blade – 1,200 to 2,500 dollars

CAPITAL COSTS

2-pipe Water Source Heat Pump

30-to-100-ton size has been chosen due to common use. 2-pipe WSHP systems can exceed 150-ton capacity. Systems in the 150+ ton range will run 1.75 million dollars minimum new system. For all 2-pipe WSHP system replacement is component based.

New system cost 30-to-100-ton – With electrical. 190 thousand to 1.2 million dollars. High variation due to electrical run length, type and amount of duct work and add on components (economizer etc.)

As these are whole building system there is little to no discount for multiple buildings and costs and logistics remain mostly unaffected.

Replacements or component based. Ranging from 6,000 dollars to replace a small easy access WSHP to 800 thousand dollars to replace a 100-ton roof mounted cooling tower in a city.

CAPITAL COSTS

2-pipe Water Source Heat Pump

Repair cost factors – Labor rate varies by locality. Unit type and efficiency. Unit manufacturer. Accessibility to systems. Refrigerant type. How well the job is done – compressor replaced but same drier and refrigerant used less than if these are replaced.

Repair costs are per system component. Each part of the system can be repaired individually.

Compressor replacement – 2,500 to 6,000 dollars

Main board – 600 – 2,000 dollars

Blower motor replacement – 700 to 1,000 dollars

Pump replacement – 3,500 to 25,000 dollars

Cooling tower distributor or baffle repairs – 5,000 to 40,000 dollars

PROTECTING THE INVESTMENT. MAINTENANCE – BEST PRACTICE AND COSTS

MAINTENANCE FREQUENCY AND COST FACTORS

Maintenance cost factors – Labor rate varies by locality. Unit type and efficiency as this affects filter type and size and outdoor coil size. Unit manufacturer. Accessibility to systems. And number of times per year system is serviced.

Most Preventative Maintenance is broken into 2 groups - major and minor PM visits. I will be addressing PM needs specifically later.

A major PM consists of in-depth checks and require a qualified technician to perform them. Thes have all the items in the all-system types list and tasks specific to the different systems and/or seasons. These are usually done in spring and fall.

A minor PM consists of tasks that can be performed by site maintenance or occupants most of the time – filter changes, drain check, vent checks, and visual checks for refrigerant leaks and electrical problems. Some specialty add on can be done by technicians only.

BEWARE not all maintenance is equal be sure to ask for PM punch lists and pictures. It will cost more but long-term you should see benefits.

COMMON MAINTENANCE

All system types

Air Filter Replacement:

- This is the most critical task.
- Replace or clean the filter every 1-3 months in general use.
- A dirty filter restricts airflow, reducing efficiency and potentially damaging the system.

Vent and Register Checks:

- Ensure vents and registers are not blocked by furniture or other obstructions.

Electrical Connection Checks:

- Regular examination and tightening of all electrical connections.
- Loose or corroded connections can lead to increased electrical resistance, causing components to overheat and potentially fail prematurely, or even create fire hazards.
- Measuring the voltage and current on motors can help identify potential electrical issues before they escalate.

COMMON MAINTENANCE

All system types

Evaporator coil inspection and cleaning

- Frequency: At least annually, or more often in dusty environments.
- Importance: Clean coils ensure efficient heat transfer. Dirty coils can lead to: Reduced cooling capacity. Loss of Heating. Increased energy consumption. Frozen coils. Mold growth.

Condenser coil check and clean

- This could be an air coil or a water coil depending on the system.
- Both if dirty or restricted by debris may lead to:
- Efficiency loss. Reduced cooling capacity. Early compressor failure. Corrosion or condenser heat exchanger.

COMMON MAINTENANCE

All system types

Drainage System Maintenance:

- HVAC systems produce condensate, especially during the cooling season.
- Ensure that the condensate drains are clear of any obstructions to prevent water from backing up into the unit or leaking into space.
- Regular clearing of these drains helps to avoid water damage to the unit and the building structure, as well as preventing mold growth.
- Drain pans should also be inspected for any blockages or leaks.

COMMON MAINTENANCE

All system types

Refrigerant Charge and Leak Checks:

- Maintaining the correct refrigerant charge is essential for the unit to operate efficiently and effectively.
- Refrigerant levels should be checked regularly, and adjustments made if necessary.
- It is also important to inspect the system for any refrigerant leaks, which can not only impact the unit's cooling capacity but also pose environmental hazards .
- Any detected leaks should be promptly repaired by a qualified professional, and the system recharged to the appropriate level.
- New mildly flammable **(A2L)** refrigerants have made leak detection and ventilation a feature of new systems but, it does not detect small leaks and only for sections exposed to occupied spaces. Therefore, technician leak detection is key.

DUCTED SPLIT SYSTEMS

Furnace Maintenance

Inspection and Cleaning of Burners:

- Ensures proper combustion.

Heat Exchanger Inspection:

- Checks for cracks or damage, which can lead to carbon monoxide leaks.
- Can lead to failure of system to run. And overheating of the burner area and fires.

Combustion testing.

- Furnace performance and safety is tested and if needed tuned to match manufacturer specifications.

DUCTED SPLIT SYSTEMS

Furnace Maintenance

Gas Line and Connection Checks:

- Detects and repairs gas leaks.

Checking of all safety controls.

Inspection of the flue and venting system.

Looking for separated vent pipes and holes or rust.

In some cases, proper damper operation.

MAINTENANCE COSTS

Split Systems

1.5-to-5-ton

Below assumes standard Merv 8 -10 filters and outdoor coil cleaning once per year, and indoor cleaning once per year. If system has a furnace combustion check is assumed. Variation is due to depth of PM work done and cost factors.

Major PM visits run – 250 to 700 dollars per system serviced.

Minor PM visits run – 100 to 300 dollars per system serviced.

An average 2 time per year/per system basic maintenance plan would therefore be 500 to 1,400 dollars. It would consist of 2 major PM visits.

The 4 time per year/per system basic maintenance plan would be 700 to 2,000 dollars. It would consist of 2 major and 2 minor PM visits.

MAINTENANCE COSTS

Mini-Split Systems

.75-to-5-ton

Below assumes standard Merv 8 to 11 filters if they are used.

Major PM visits run – 250 to 500 dollars per system serviced. Some wall mounted units will require a deep cleaning. This can be 250 to 450 per wall unit more.

Minor PM visits run – 75 to 300 dollars per system serviced.

An average 2 time per year/per system basic maintenance plan would therefore be 500 to 1,000 dollars. It would consist of 2 major PM visits. If deep clean in need on wall units 750 to 1,450 dollars if one wall unit.

The 4 time per year/per system basic maintenance plan would be 650 to 1,600 dollars. It would consist of 2 major and 2 minor PM visits. If deep clean in need on wall units 900 to 2,050 dollars if one wall unit.

MAINTENANCE COSTS

Package (RTU) Systems

5-to-25-ton

Below assumes standard Merv 8 to 11 filters if they are used.

Major PM visits run – 250 to 1,200 dollars per system serviced.

Minor PM visits run – 150 to 500 dollars per system serviced.

An average 2 time per year/per system basic maintenance plan would therefore be 500 to 2,400 dollars. It would consist of 2 major PM visits

The 4 time per year/per system basic maintenance plan would be 800 to 3,400 dollars. It would consist of 2 major and 2 minor PM visits.

MAINTENANCE COSTS

VRV/F and HVRV/F Systems

5-to-25-ton

To properly check the refrigeration and communication systems on many of these units a special tool needs to be used, or the correct user interface controller needs to be used.

Some brands only allow certified companies to use this tool. Costs for this service range from 1,500 to 6,000 dollars depending on system and companies.

It is often cheaper long term to get a user interface that allows for these check to be done through it.

MAINTENANCE COSTS

VRF/V Systems

5-to-25-ton

Leak detection systems are often installed with and in some areas, code requires that they be installed. They must monitor any spaces with units supplying them that can be closed off such as offices or dorm rooms.

These systems are to supply a visual or audible alarm in the space. And can be setup to send alarms to fire or alarm systems.

The new A2L (mildly flammable) refrigerant systems have leak detection and arrest systems at each indoor unit.

Leak checking all refrigerant types is critical as there will be many areas not monitored, and leaks will degrade system function quickly.

MAINTENANCE COSTS

- HVRV/F Systems

- 5-to-25-ton

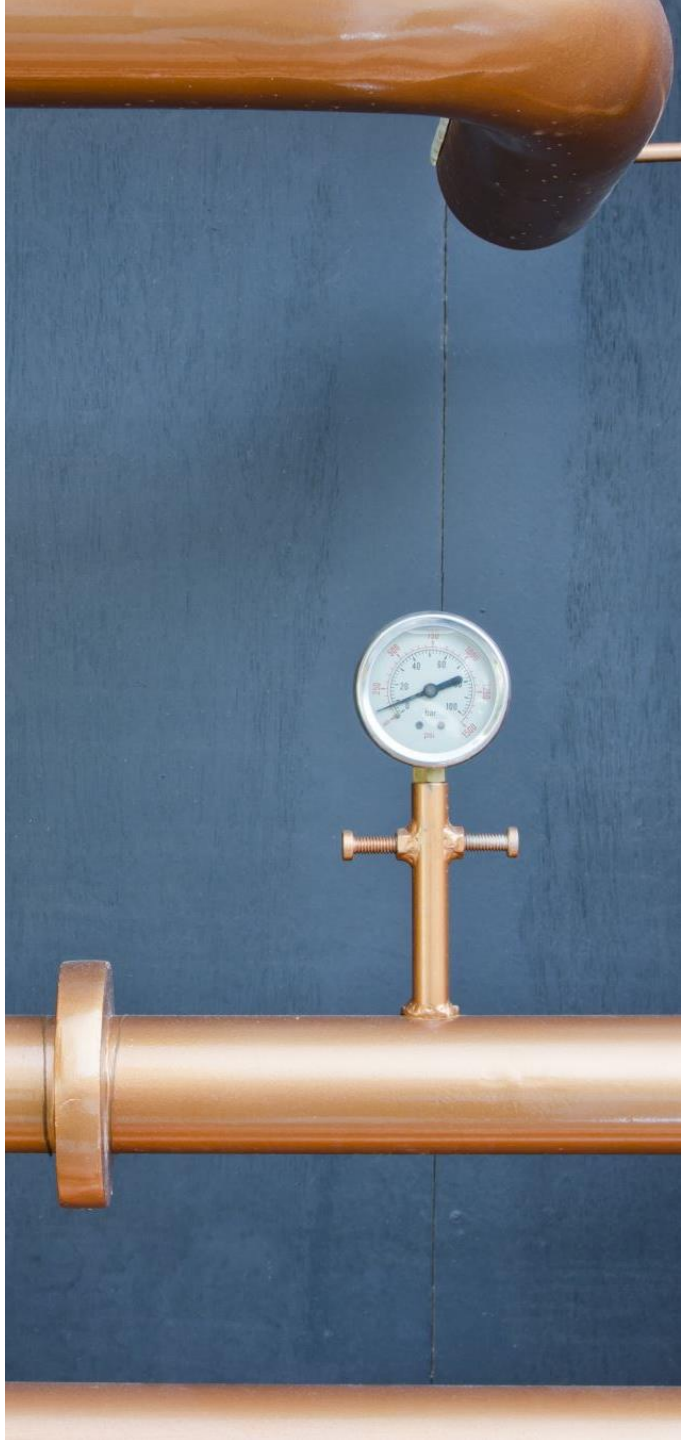
- These systems have a water system in addition to the refrigeration system. This leads to the need for water side maintenance.

- The water itself will need to be treated. Hard or acidic water will cause piping or fittings to deteriorate. A water treatment system is often needed, and even if that is not needed filtration is a must.

- Pumps will need to be checked annually or bi-annually. Depending on size they may need oiling and motors greased.

- Water pressure reducing valve to keep water side pressure down in some systems.

- Relief valves will need to have operation verified.



MAINTENANCE COSTS

VRV/F and HVRV/F Systems

5-to-25-ton

Below assumes standard Merv 8 to 11 filters if they are used.

Major PM visits run – 800 to 2,800 dollars per system serviced (assumes max of 2 outdoor and 15 indoor units. Some wall mounted units will require a deep cleaning. This can be 250 to 450 per wall unit more.

Minor PM visits run – 250 to 1,600 dollars per system serviced.

An average 2 time per year/per system basic maintenance plan would therefore be 1,600 to 5,600 dollars. It would consist of 2 major PM visits

The 4 time per year/per system basic maintenance plan would be 1,300 to 8,800 dollars. It would consist of 2 major and 2 minor PM visits. Assuming all 15 units were wall units and needed deep cleaning this would add 3,750 to 6,750 yearly.

MAINTENANCE COSTS

2-pipe WSHP Systems

30-to-100-ton

These systems have a water system in addition to the refrigeration system. This leads to the need for water side maintenance.

A water treatment system is often needed, and even if that is not needed filtration is a must. Water should be checked no less than bi-annually.

Pumps will need to be checked annually or bi-annually. Depending on size they may need oiling and motors greased.

WSHP units should have a strainer on the in let to the condenser. This should be flushed annually.

MAINTENANCE COSTS

2-pipe WSHP Systems

30-to-100-ton

Water pressure reducing valve to keep water side pressure down in some systems.

Relief valves will need to have operation verified.

In colder climates a boiler is used in these systems.

The boiler will need to have combustion and safety checks done.

The venting should be checked, and the heat exchanger should be checked and may need periodic cleaning.

MAINTENANCE COSTS

2-pipe WSHP Systems

30-to-100-ton

Most of these systems will have a cooling tower.

The cooling tower will need yearly basin cleaning.

Checking of the distributions system including nozzles, distribution basin, pumps, sump basin, drift eliminators, motor(s), blade(s)/Wheel(s), bearings, shafts, float valve, air louvre(s), and possibly gear boxes.

Some colder areas will need the tower drained or winterized. And will need Glycol in the building water loop.

MAINTENANCE COSTS

2-pipe WSHP Systems

WSHP Units

Below assumes standard Merv 8 to 11 filters if they are used.

Major PM visits run – 150 to 300 dollars per system serviced.

Minor PM visits run – 75 to 150 dollars per system serviced.

An average 2 time per year/per system basic maintenance plan would therefore be 300 to 600 dollars. It would consist of 2 major PM visits

The 4 time per year/per system basic maintenance plan would be 450 to 900 dollars. It would consist of 2 major and 2 minor PM visits.

MAINTENANCE COSTS

2-pipe WSHP Systems

Boilers

Major PM 1 per year visit run – 450 to 2,000 dollars per boiler serviced. Should replace ignitor and flame sensor.

Minor PM visits run – 150 to 300 dollars per boiler serviced.

An average 2 time per year/per system basic maintenance plan would therefore be 600 to 2,000 dollars. It would consist of 1 major PM and one minor PM visit.

The 4 time per year/per system basic maintenance plan would be 900 to 2,900 dollars. It would consist of 1 major and 3 minor PM visits.

MAINTENANCE COSTS

2-pipe WSHP Systems
Cooling tower
Major PM 1 per year visit run – 1,000 to 8,000 dollars per tower serviced. Should clean basins, check all components.
Minor PM visits run – 400 to 1,200 dollars per tower serviced. Inspection and pump service and electrical checks.
An average 2 time per year/per system basic maintenance plan would therefore be 1,400 to 9,200 dollars. It would consist of 1 major PM and one minor PM visit.
The 4 time per year/per system basic maintenance plan would be 2,600 to 11,600 dollars. It would consist of 1 major and 3 minor PM visits.
Winterization of a tower runs 800 to 5,000 dollars for the whole tower system.

MAINTENANCE COSTS

2-pipe WSHP Systems

Water system and pumps

Major PM 1 per year visit run – 450 to 2,500 dollars per system serviced assumes 2 pumps. Should oil/grease pumps, check electrical, perform water testing, and check alignment of pumps where applicable.

Minor PM visits run – 300 to 800 dollars per tower serviced. Water testing and pump inspection.

An average 2 time per year/per system basic maintenance plan would therefore be 750 to 3,300 dollars. It would consist of 1 major PM and one minor PM visit.

The 4 time per year/per system basic maintenance plan would be 1,350 to 4,900 dollars. It would consist of 1 major and 3 minor PM visits.

Additional cost of water treatment chemical/media and a fill plan runs 1,200 to 6,000.

QUESTIONS & ANSWERS