

MINI-SPLIT MAINTENANCE BEST PRACTICES



HVAC School
For Techs by Techs



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Intro

Overview of Mini-Splits

While mini-split or “ductless” systems have been around since the '70s in Asia, many contractors and consumers in North America are just now learning about their advantages, installation and proper maintenance.

Many of us use the terms ductless and mini-split synonymously because the first mini-split units were exclusively small capacity high wall ductless systems. Today, mini-split manufacturers make many options including high wall, ceiling cassette, ducted, ceiling mounted and floor mounted.

Configurations

While ductless started as one condensing unit to one air handler it certainly isn't limited to 1 to 1 nowadays. There are now single phase multi-zone systems for residential and light commercial and larger commercial systems known as VRF (Variable Refrigerant Flow) where a large number of air handlers often called “heads” can be connected to a single condensing unit.

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Advantages

Ductless systems have several key advantages over traditional ducted unitary systems, one of the most distinct is the reduction of materials and labor associated with the installation of ducting.

Typically ductless systems are smaller, lighter and easier to install and they often make use of inverter technology and DC motors to make them quiet and efficient. All of these factors led to the emergence of ductless as a dominant force in the world and the fastest growing equipment segment in the USA.

Ductless and VRF systems can be straight cool or heat pump and most VRF manufacturers offer systems that can provide heat and cooling simultaneously to the conditioned space. Because the compressors are often Variable Frequency Drive (VFD) or "inverter" driven they can vary the refrigerant pumping capacity according to load and often provide strong heating delivery even at low outdoor ambient conditions.

Importance of Maintenance

All systems including ductless and VRF require regular, periodic cleaning and maintenance to stay in top working condition.

One key difference between mini-splits and ducted unitary equipment is that a mini-split generally requires more air handlers to do the same job as a ducted system and those air handlers are often mounted in visible or prominent locations in the building.

This means that cleaning ductless air handlers often requires extra diligence and care to prevent property damage while still accomplishing the task thoroughly.

Another factor is the size and disassembly of ductless systems makes cleaning and servicing using typical processes more challenging and more critical at the same time due to the smaller coils and blower wheel designs common in ductless.

Failure to maintain mini-split equipment or improper practices can result in underperformance, poor air quality and premature failure.



Key Maintenance Results

The old saying "If it ain't broke, don't fix it" doesn't apply to ductless systems. Any professional who works with ductless regularly has seen issues with ductless systems that could have been easily prevented by proper maintenance procedures.

The key to proper maintenance results is to follow procedures that both improve the equipment condition, test for impending issues while doing no harm to the system or space surrounding the system.

Proper Maintenance Procedure Improves:

Energy Efficiency - Clean and well-maintained systems produce more BTUs per input watt. This leads to savings for the customer on their utility bill.

System Performance (Comfort) - On ductless systems, dirt on the coils and blower wheel can quickly lead to poor output, temperature and humidity control.

Breakdown Prevention - Preventing failures of all types through cleaning and observation is the top priority of every successful maintenance. It is also imperative that the technician makes sure that they don't CAUSE any issues in the process.

System Longevity - Proper maintenance can extend system life by catching impending catastrophic issues and dealing with problems that can cause abnormal wear.

Indoor Air Quality - Cleaner air handlers leads to cleaner air by removing dirt and microbial growth before it becomes an IAQ issue.

The goal should be to maintain or improve these outcomes while clearly communicating with the customer about any pre-existing conditions BEFORE you begin the in-depth maintenance when possible.

This process of pre-confirmation, detailed cleaning and maintenance, and post maintenance confirmation ensures that the job is done correctly, the customer understands the process better and there is no harm to the system.

Steps for Proper Ductless Maintenance

1. Pre-Confirm Operation (Make sure the system is functional before starting.)

- Set the system to max cooling or heating
- Check that the air handler runs with no abnormal noises
- Check discharge air temperature from the air handler
- Ensure the condensing unit is running with no unusual noises
- "Feel" test the suction line in cooling mode



2. Protect the Customer's Space

- Wear shoe covers
- Lay down drop cloths in the work area
- Move sensitive objects from the work area with the customer's permission



3. Visually Inspect the Full System

- Ensure you are familiar with the manufacturer's cleaning and disassembly instructions
- Remove access panels inside and outside as needed for testing and cleaning
- Inspect for wire or tubing rubouts
- Check electrical connectors
- Look for signs of oil on tubing and at refrigerant connections
- Inspect for signs of abnormal wear on all moving parts



4. Cleaning

- Wear PPE as needed
- Remove and clean the air filters
- Clean and sanitize the blower wheel
- Clean and sanitize the evaporator coil
- Wash the condenser coil
- Remove debris from around the condenser base and wash the coil
- Clean the drain line and condensate pump (if applicable)



5. Run Test and Observe

- Carefully reassemble the equipment
- Leave the bib in place and run the blower to dry
- Check for rubbing or unusual noises
- Test both modes for operation on heat pump systems
- Run the system at full cool if possible



6. Take Key Measurements

- Measure Compressor, Blower and CFM Amps
- Check applied voltage
- Measure outlet air temperature & delta T
- Check suction pressure and superheat at full cooling



Cleaning Tools & Materials for Ductless

Proper PPE

When working with HVAC equipment, wearing proper PPE is always required. When cleaning it's smart to wear safety goggles and gloves to keep cleaner out of your eyes and off your skin ESPECIALLY when using more caustic cleaners (which aren't recommended).

Drop Cloth(s) & Towel

Make sure to protect the work area around the ductless air handler by laying down a clean drop cloth below the system.

A large towel handy by the air handler while cleaning can be useful for accidental spills.

Rags

Have several microfiber or terry cloth rags nearby for wiping down the cabinet and drain pan and catching stray droplets of water.

Soft Bristle Brushes

An assortment of soft bristle brushes can be useful for removing heavier soil from the coils and small brushes can help to clean tight spots.

Mini-Split Bib® Kit

Ductless air handlers can be challenging to disassemble which can lead to time-consuming cleaning and costly damage. The **Mini-Split Bib® Kit** allows a technician to clean a ductless blower wheel and evaporator coil while it remains in place on the wall with minimal disassembly. The Mini-Split Bib® Kit protects the area around the unit and drains the cleaner, dirt, and water away into a bucket where it can be disposed of without damage to the surrounding surfaces. The kit comes with everything you need – bib with tightening system, wall bracket, wall deflector, adhesive tape and 5 gallon bucket.



MSB-KIT

CoilJet® Coil Cleaner

Because ductless systems are often in tight areas near surfaces that cannot be damaged it's important to have a cleaning system that can provide water and cleaner at appropriate pressure and flow rates for ductless systems. The **CoilJet®** is a self-contained system that allows you to add the water and liquid cleaner before you enter the work area. It contains enough of each to fully clean the system without a need to refill.



CJ-125



Wet/Dry Vacuum

A good, clean wet/dry vacuum can be used to clean out the drain as well as clean up dirt and debris from inside and around the condenser base. It is also a good backup plan should you ever accidentally spill water inside the space.

Safe Cleaners

Using a safe, non-caustic, alkaline foaming cleaner/degreaser like **SpeedyFoam®** Coil Cleaner is the best bet for cleaning both the evaporator and condenser coils on most ductless systems.



SC-FCC-1



Contact Cleaner

When insect nests or corrosion are present on circuit boards or other controls, it is good to have some contact cleaner handy to clean them. Take care not to spray contact cleaner on plastic parts as it can result in damage.

Dry Steam Coil & Surface Cleaner

Some applications and customers require water only for cleaning due to chemical sensitivities. The **Dry Steam Coil & Surface Cleaner** from SpeedClean® does an incredible job of cleaning and sanitizing with high-temperature dry steam which uses minimal water stored in the onboard tank.



SC-VSC-7000



Step by Step Process

Discuss how the system has been functioning with the customer and review the maintenance process with them.

Review the work area and lay down drop cloths as needed. Remove fragile or sensitive items from the work area with the customer's permission and as allowed by the policies of your company.

Set up a ladder or step stool in the work area as needed in a safe manner.

Run the equipment in maximum cooling if ambient conditions allow and observe the air handler outlet air dry bulb temperature. Most of ductless systems will have an outlet air temperature between 40° to 50°F after a few minutes of operation at maximum cooling during normal indoor temperatures. This helps you ensure that the system doesn't have major operational issues before starting the maintenance.

WARNING: BE CAREFUL NOT TO INSERT A TEMPERATURE PROBE INTO THE SPINNING BLOWER WHEEL, OR YOU WILL END UP WITH A SHREDDED PROBE AND WHEEL.

Use a temperature clamp or a simple "feel" test of the suction line near the condenser to ensure that the suction line temperature is dropping below 55°F, as another quick operation confirmation before disassembly.

Listen for abnormal sounds while reviewing the condensing unit and air handler(s) and setting up your tools and work areas.

Visually Inspect the system prior to disassembly for -

- Signs of condensate leakage or staining at or below the air handler
- Proper pitch of the drain when visible

- Electrical routing, strapping and installation
- Safe installation and mounting of the condenser and air handler
- Proper breaker sizes and disconnects
- Visible oil on or around the condensing unit or ports which can indicate possible refrigerant leak points
- Damage to covers or louvers
- Damage to the blower wheel or condensing fan blade
- Missing screws or port caps
- Damaged tubing insulation
- Microbial growth and smell for signs of its presence

If you do notice anything out of the ordinary, bring it to the customer's attention so they have the option to have you address it before you begin the maintenance.

Safely disconnect power and test from leg to leg and hot to ground on each high voltage leg to ensure that there is no electrical potential present.

WARNING: INVERTER DRIVEN DUCTLESS SYSTEMS CONTAIN LARGE CAPACITORS THAT CAN HOLD A CHARGE FOR QUITE SOME TIME AFTER THEY HAVE BEEN DISCONNECTED FROM POWER. USE CAUTION AND FOLLOW MANUFACTURERS RECOMMENDATIONS AND SAFETY PRECAUTIONS

Always review manufacturer recommended disassembly and maintenance guidelines before working on a new type of system for the first time. Most manufacturers have online portals where you can find service guides and even videos to help you with disassembly and service.



Continued – Step by Step Process

ALWAYS WEAR PROPER SAFETY PPE WHEN CLEANING AND SERVICING ANY HVAC EQUIPMENT

Cleaning the condenser coil is a critical part of every HVAC/R maintenance but especially on ductless systems because they often have tightly spaced fins that can be easily blocked.

It's important to use mild cleaners and controlled water pressure to keep from damaging the coils and the electrical components.

The majority of ductless systems discharge air to the side and can be cleaned against the airflow by removing the front grille or top.

It's a good idea to cover motors and controls with plastic bags or the adhesive wrap included (see *image A*) with the **Mini-Split Bib® Kit** if they are exposed in the cleaning area. If any electrical components do accidentally get wet you can carefully use nitrogen or compressed air to dry them off completely before proceeding.

NOTE: Many technicians opt to clean ductless condensers from the outside/in and this may be the best option especially when access is difficult and the soil is light.

When cleaning with the flow of air be careful not to force soil deeper into the coil. When cleaning the condenser this is the method we have found most effective -

1. Pre-rinse the coil with water working from top to bottom and against the flow of air, inside out.
2. Foam the entire coil with properly mixed, mild foaming cleaner like **SpeedyFoam®** on both sides, building the foam from bottom to top.
3. Allow the cleaner to work for 5 to 10 minutes.
4. Rinse well from top to bottom from inside out if possible. A product like the **SpeedClean® CoilJet®** offers extension wands to easily clean from the inside out.

Clean any debris or dirt from around the base of the condenser and from inside the base pan if there is any using water and a wet/dry vacuum as required.



Remove and clean the air filters outside with water and allow them to dry.

When cleaning the evaporator and blower wheel do not use compressed air or nitrogen. This can embed soil deeper into the coil and spread microbes and grime through the system. Instead, use the **Mini-Split Bib® Kit** to clean the evaporator coil, blower wheel, and the internal shroud.

1. Remove the outer filter cover(s), louvers and shroud as required to gain access to the coil and blower.
2. Attach the bib system with the adjustable brackets.
3. Protect the wall with the included deflector plates.
4. Protect electronics with included adhesive wrap.
5. Clean the coils, fans and more with the **CoilJet®** and the flexible wand adapter for great results even in tight spaces.
6. Rinse with water.
7. Use a quality, safe anti-microbial treatment on the evaporator surface such as **BBJ Mold Control**.
8. Leave the bib in place for the unit to dry.

In some cases, when the blower wheel is very dirty, it may be easier to remove the wheel and clean it outside. Even in these cases it still makes sense to use the **Mini-Split Bib® Kit** to get the evaporator coil completely clean.

If the customer has chemical sensitivities, using the **Dry Steam Coil & Surface Cleaner** will be a superior solution for cleaning the coil.

If the system has a gravity drain it is a good practice to run several gallons of water through the drain with the wet/dry vacuum attached to the outlet. Some technicians run the vacuum during the entire coil cleaning

process so the cleaners are pulling through the drain and working to remove buildup.

Always clean out all sludge from the drain pan and from under the coil using rags or brushes.

If the system has a condensate pump, the pump reservoir should be removed and cleaned. Make sure to clean the float and screen if the pump uses them. Then use nitrogen or CO₂ to blow out the condensate discharge line. Make sure to keep harsh cleaners out of the pump and refill and test the pump completely before finishing.

Inspect all of the wiring and tubing inside the air handler and condensing units for signs of chafing or rubouts.

Inspect and check electrical connectors, lugs, and terminals for tightness.

Reassemble the units as much as possible while leaving the **Mini-Split Bib® Kit** in place to catch any residual water.

When reassembling the units ensure that no wires or sensors have moved out of place or become pinched and that no electrical components have gotten wet.

Perform a quick run test of the inside unit by turning the power back on and setting the control to fan (blower) only operation. This will allow you to listen to the operation and make sure there are no abnormal sounds and it will allow any excess water to blow off of the coil. Once the unit stops dripping water you can shut off power once again and remove the **Mini-Split Bib® Kit**.

If you are not familiar with the manufacturer's testing guidelines, now would be a good time to review the service manual so you are aware of the specific test procedures the manufacturer recommends. While there are some good general test procedures to follow, nothing beats the manufacturer's guidelines, especially for complex ductless systems.



Now is the time to perform minimally invasive run testing.

Allow the system to run 10+ minutes to stabilize and for coils to dry before performing any tests. Ductless systems have critical charges that are weighed in based on line length at startup. Because of this, it generally isn't recommended to connect refrigerant gauges to the system during testing. If you must connect to the refrigerant circuit a hoseless test probe or gauge is often the best choice. Here are some tests to perform:

- Measure compressor and condenser fan amperage at high cool
- Measure the applied voltage
- Test the suction line temperature at the condenser
- Take the indoor air outlet and inlet temperature

For more advanced testing in cases where system performance is in question, you can measure suction pressure which will often equate to a 35° to 45° saturation, and superheat which should generally be quite low (around 5°F).

You can also confirm delivered capacity, which is the amount of BTUs of heat being actively removed from the air.

Use two thermo-hygrometer (a.k.a humidity) probes — one in the intake and one in the discharge air — to calculate input and output wet bulb and dry bulb temps. Many wireless probes will automatically calculate the delivered capacity that can then be checked against manufacturer data.

If you don't have an app-based humidity probe, you simply convert wet bulb temperature to enthalpy (h), subtract the lower enthalpy from the higher enthalpy, and then use this calculation:

$\Delta h \times \text{cfm} \times 4.5 = \text{Operating Btuh transfer}$

By utilizing manufacturer data compared to actual delivered capacity, you can confirm whether or not the system is delivering the desired capacity.

For advanced testing, it is always best to rely on manufacturer's recommendations. In some cases, it will be best to weigh out and re-weigh in the charge to manufacturers specs if the charge appears to be off.

If the ambient conditions allow for it, run the system long enough to confirm condensate production and proper drainage. Ensure there are no drips or leaks of condensate at the air handler.

Test both modes of operation if the system is a heat pump.

Make sure to clean up everything both inside and outside and do a final walk through to ensure that the system is running properly with no abnormal sounds. Ensure that all screws and caps are back in place, disconnects are in place and closed and all tools and materials are put away.

Make the customer aware that you are complete and discuss what tasks you performed. Ask the customer what setting they would like you to leave the system at and reset the control.



Dos and Don'ts

Do	Don't
Prepare the cleaning area carefully	Damage surfaces around the system
Perform a detailed cleaning	Believe "if it ain't broke don't fix it"
Protect electronics	Compromise electronics with water
Use safe and gentle cleaners	Damage the coils with harsh chemicals
Make use of safe water pressure for cleaning	Use pressurized air or nitrogen on coils
Use non-invasive test methods	Treat ductless like a typical system
Communicate with the customer	Leave the customer wondering what you did



Types of Mini-Split Air Handlers

High Wall

Highwall units are the type we've covered in this process and are the most common type of ductless systems by far.



Cassette

Ceiling cassette units are recessed up into the ceiling rather than being mounted on the wall. Consider using the special **Mini-Split Cassette Bib® Kit** which works similar to versions for high wall units.



Vertical Ducted

Many traditionally ductless manufacturers have begun manufacturing vertical ducted systems that are configured very similarly to traditional split systems but, with ductless style controls and components. They can be cleaned like a typical split but, take care to protect the electronics contained in them.



Horizontal Ducted

Many horizontal ducted air handlers are concealed above ceilings and are designed to be on very short, low static duct systems. In some cases, the **Mini-Split Cassette Bib® Kit** can be used under these systems to assist with cleaning.



Floor Mounted

Floor mounted ductless systems are very similar to highwall but, are mounted on the floor. Usually, a combination of plastic sheeting over the drop cloth can be used to protect the flooring in conjunction with a wet/dry vacuum and the **CoilJet® Coil Cleaner System** will be an effective strategy. This is a great application for the **Dry Steam Coil & Surface Cleaner** due to the lower water output combined with powerful cleaning.



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