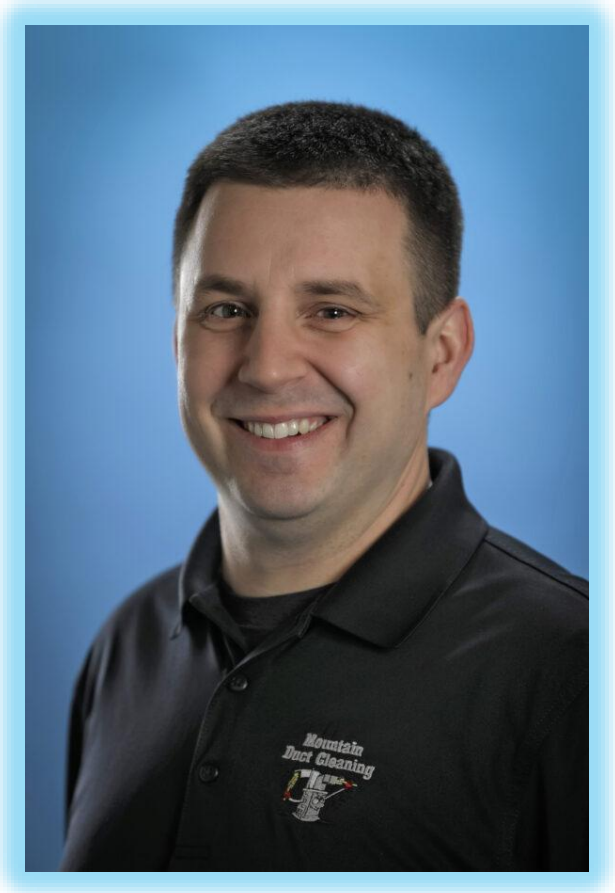
HVAC 101: Residential Systems

Presenter



Matt Mountain, ASCS

Matt Mountain is a 2nd generation duct/HVAC cleaning technician and business owner. Matt cleaned his first duct system at the age of 14. He has been an ASCS since 2010.

Mountain Duct Cleaning provides residential, commercial, and industrial duct and HVAC cleaning services in the Minneapolis/St. Paul MN metro area.

Disclaimer

This presentation is not intended to be a comprehensive program covering all aspects of this topic. All technicians are encouraged to read and follow all applicable standards, codes and regulations related to this topic.

- ✔ It is the responsibility of each individual contractor to follow local building codes and licensing requirements and to work safely in accordance with OSHA guidelines.
- ✔ It is the contractor's responsibility to take proper precautions on each project to prevent cross contamination. Always take the health and safety of the building occupants into consideration before you conduct any cleaning procedures.
- ✔ All of the following tips are only general tips. They do not cover every situation and it is your responsibility to adapt these tips to the individual system you are working on.
- ✔ The Instructor is not responsible in any way for the work you perform after viewing this slide show. You are responsible for your own work.
- ✔ The views and opinions following are the instructors' opinions and not necessarily the official position of the National Air Duct Cleaners Association.

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Supplemental Materials

This session covers key points but not every detail.

The tips and techniques presented are for cleaning and restoration procedures. Procedures are based on 25+ years of experience, but opinions may differ.

For a full understanding of this topic, attendees are encouraged to review additional materials including:

ACR, The NADCA Standard 2021 Edition

What We'll Learn

- Types of HVAC Systems
- Typical Components
- Tips for Cleaning
- Cleaning Requirements

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Section 1
Types of Residential HVAC systems

- Split Systems
  - Up-Flow
  - Down-Flow
- Ductless Mini-Split
- Package Units
- Geothermal
- Multi Zone

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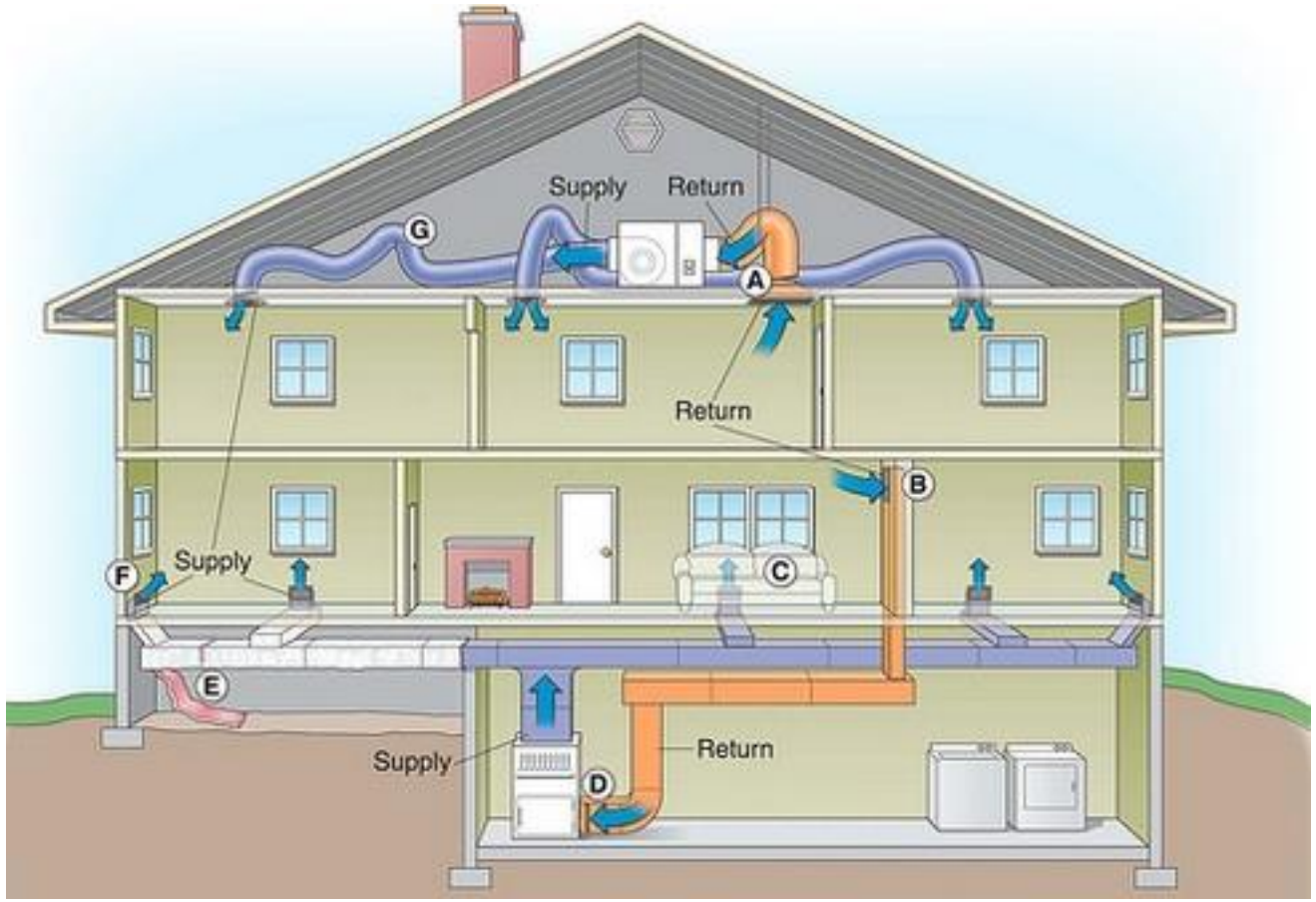
System Types & Locations



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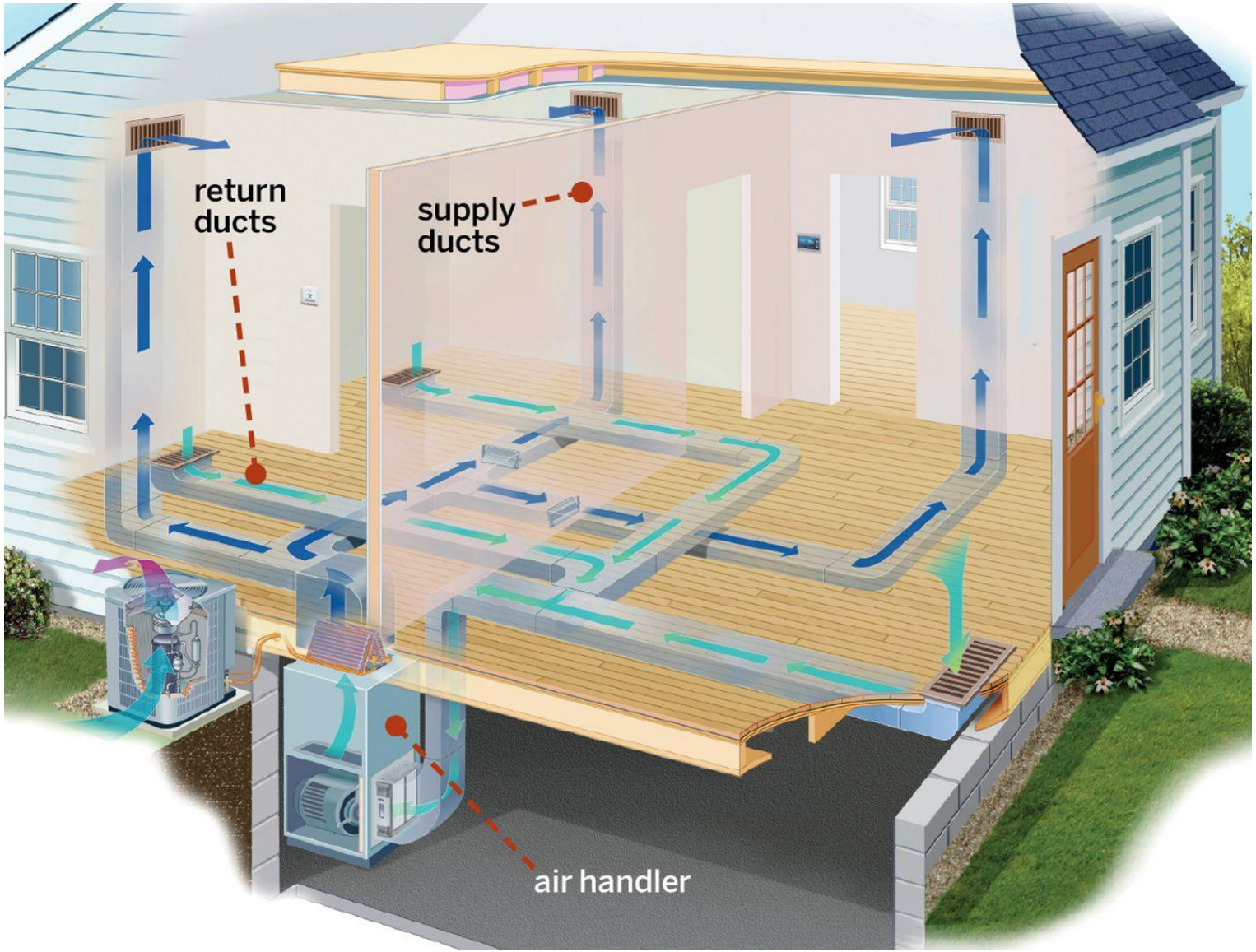
Residential Split Systems



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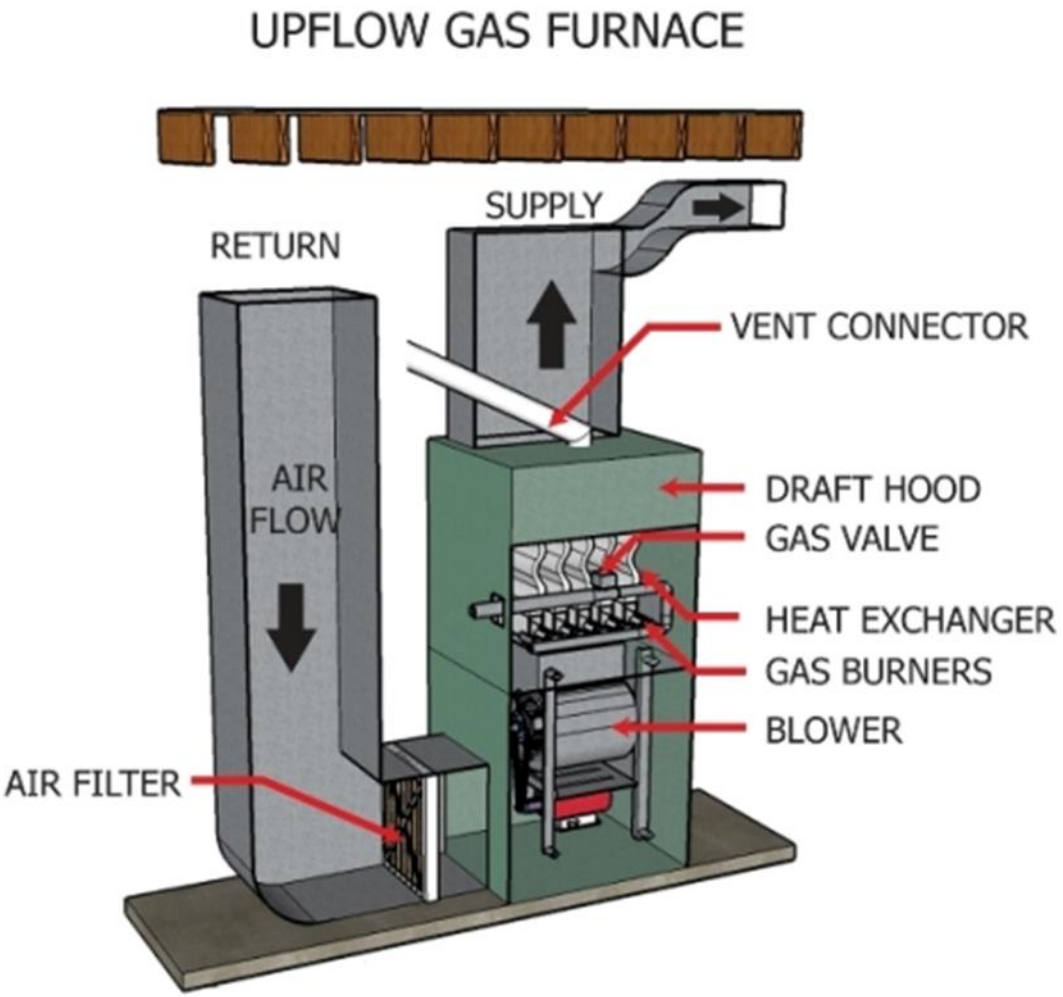
Up Flow System



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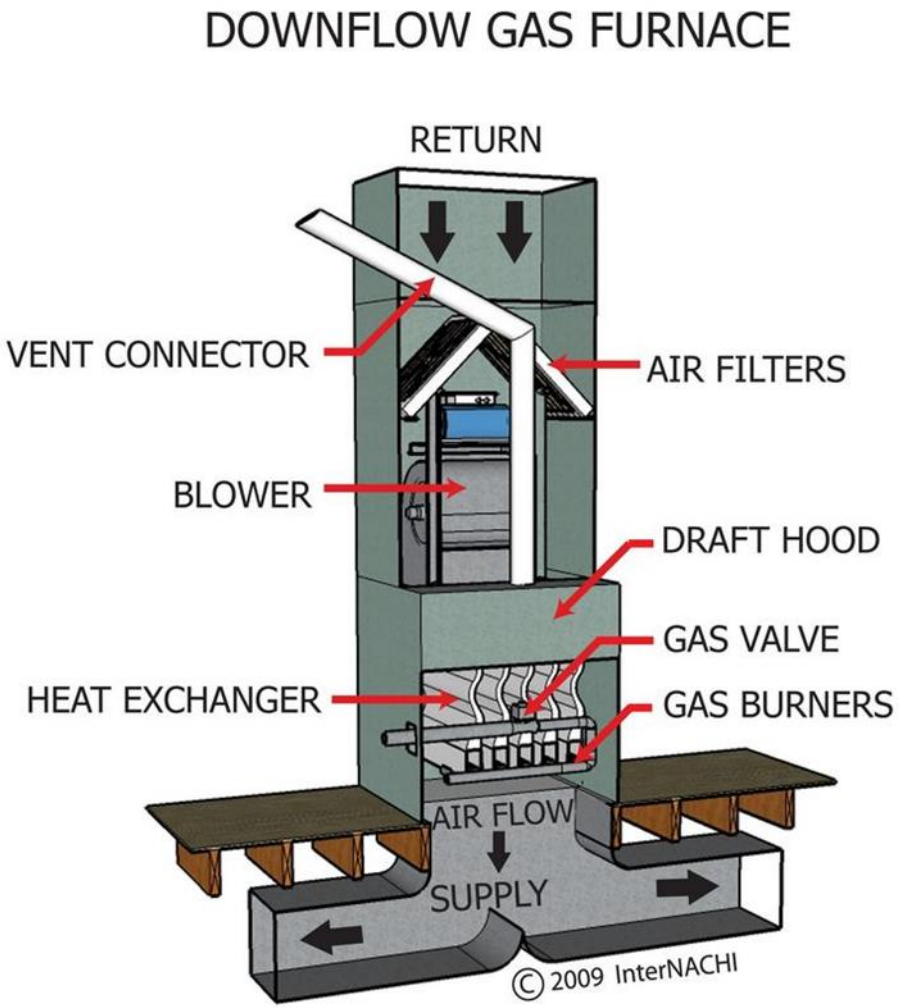
Down Flow System



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Ductless Mini Split System

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Package Units

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Geothermal System

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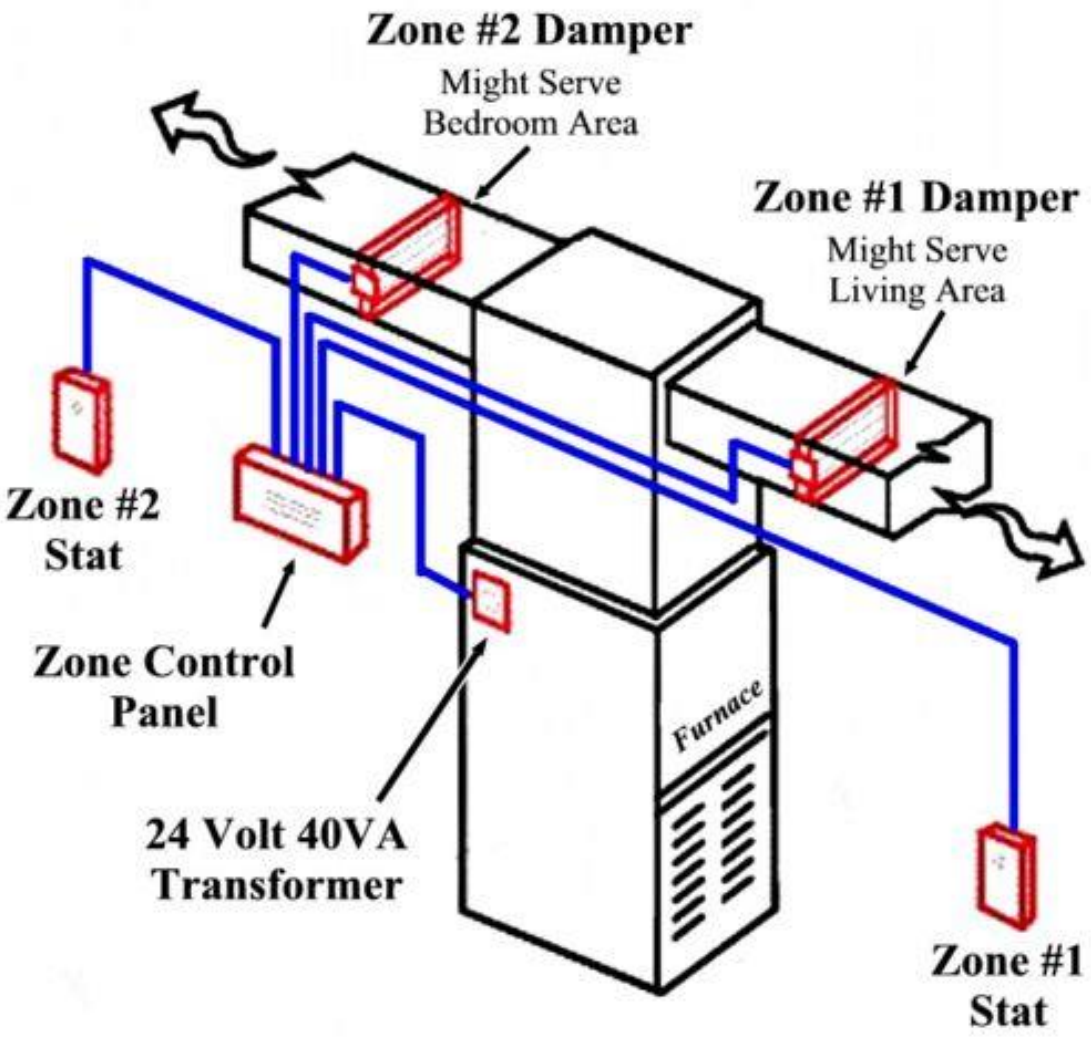
Multi Zone – Multi Damper



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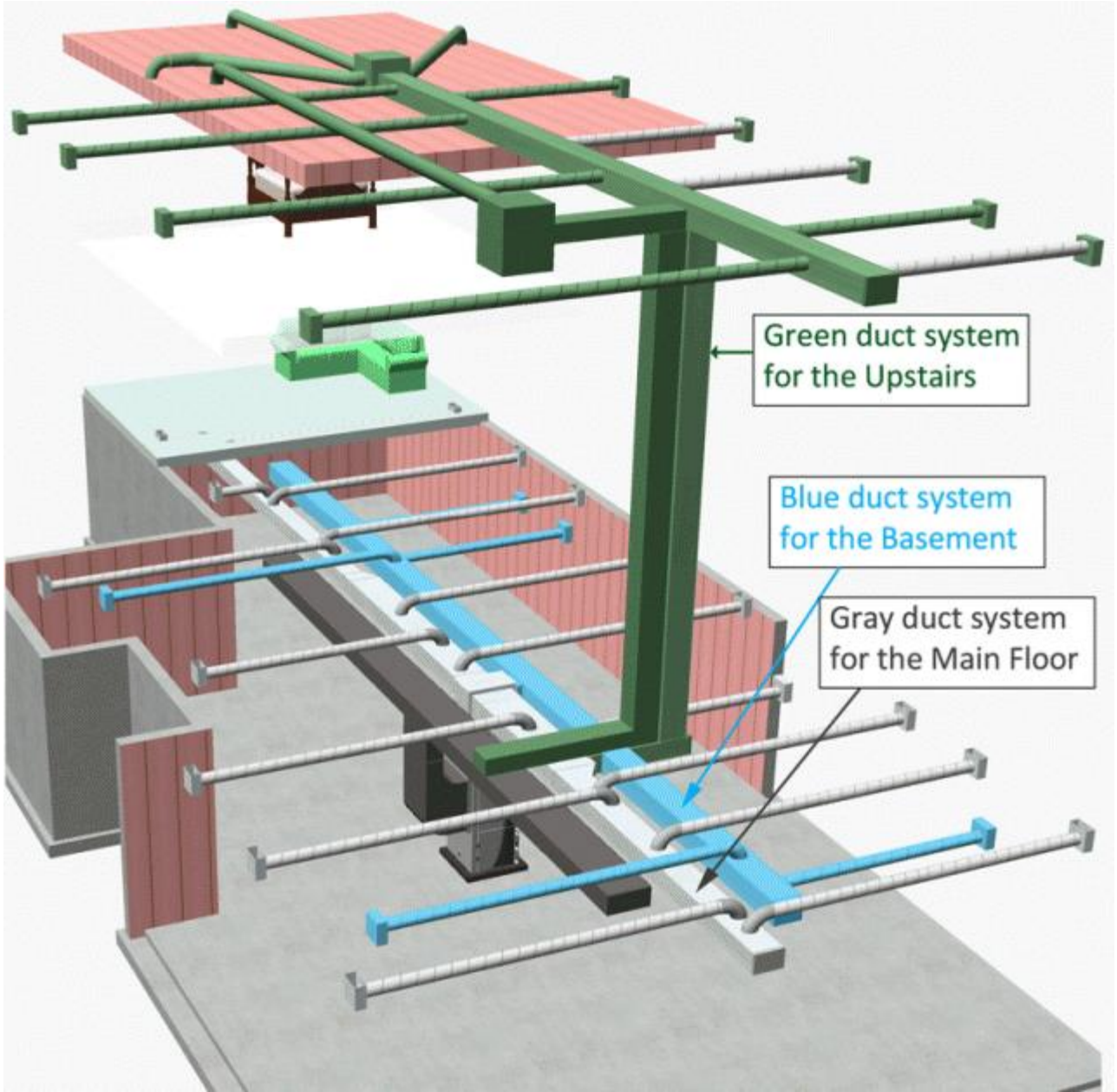
Multi Zone – Multi Damper



Types of Systems

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Section 2

Typical Components of Residential Systems

- duct work
- registers
- furnace fan/blower
- evaporator coils & drain
- heat exchanger
  - secondary heat exchanger (90%)
- humidifier/dehumidifier
- air exchanger / ERV / HRV
- filter(s)

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Typical Components: Supply & Return Air Duct Work

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Typical Components: Supply & Return Air Duct Work

Return Panning

Flex Duct (not my install)

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Typical Components: Supply & Return Air Duct Work

Duct Board

Internally lined

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Typical Components: Registers & Vent Covers

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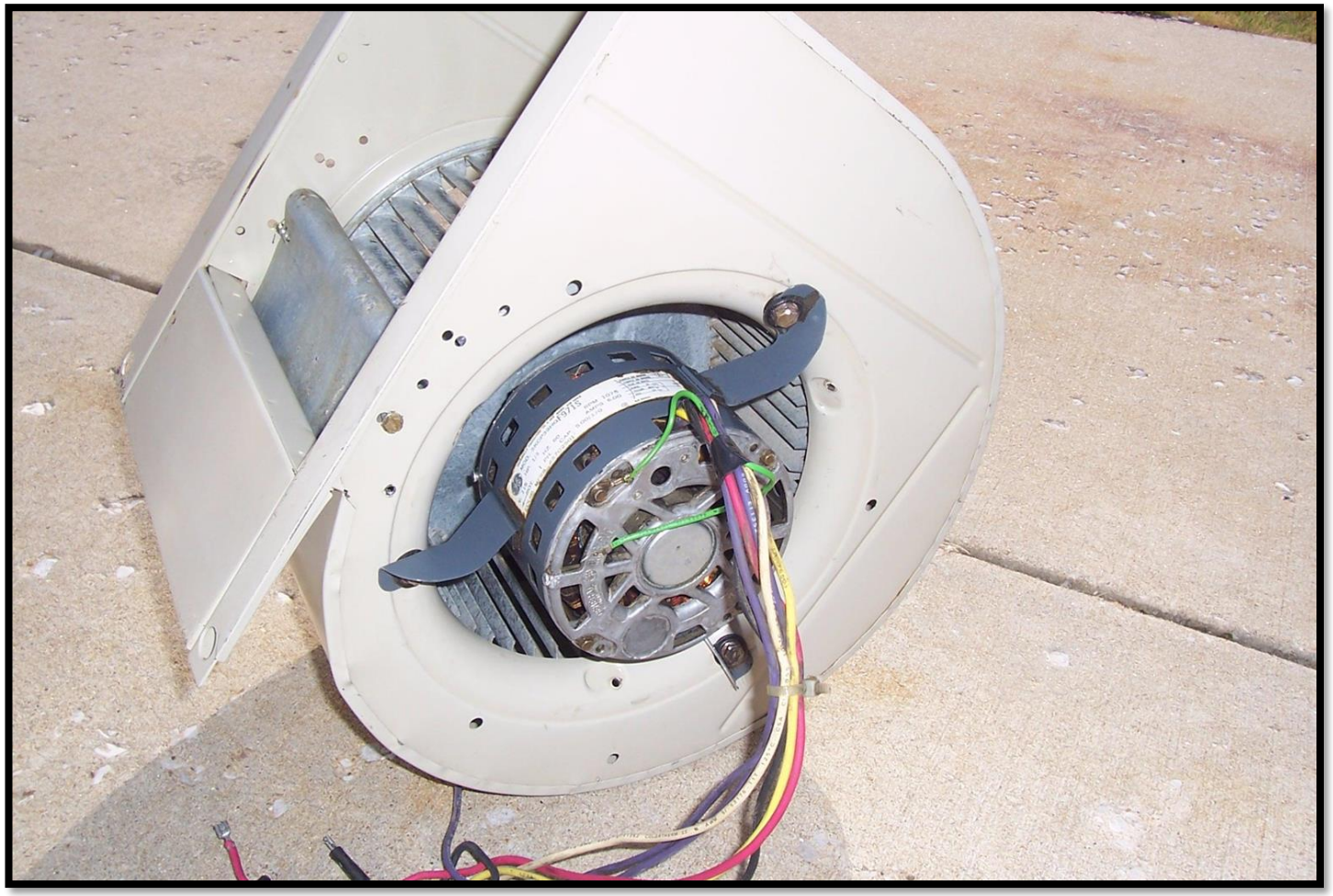
Typical Components: Furnace Fan



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Typical Components: Evaporator Coil & Drain pan

Typical Components: Humidifier

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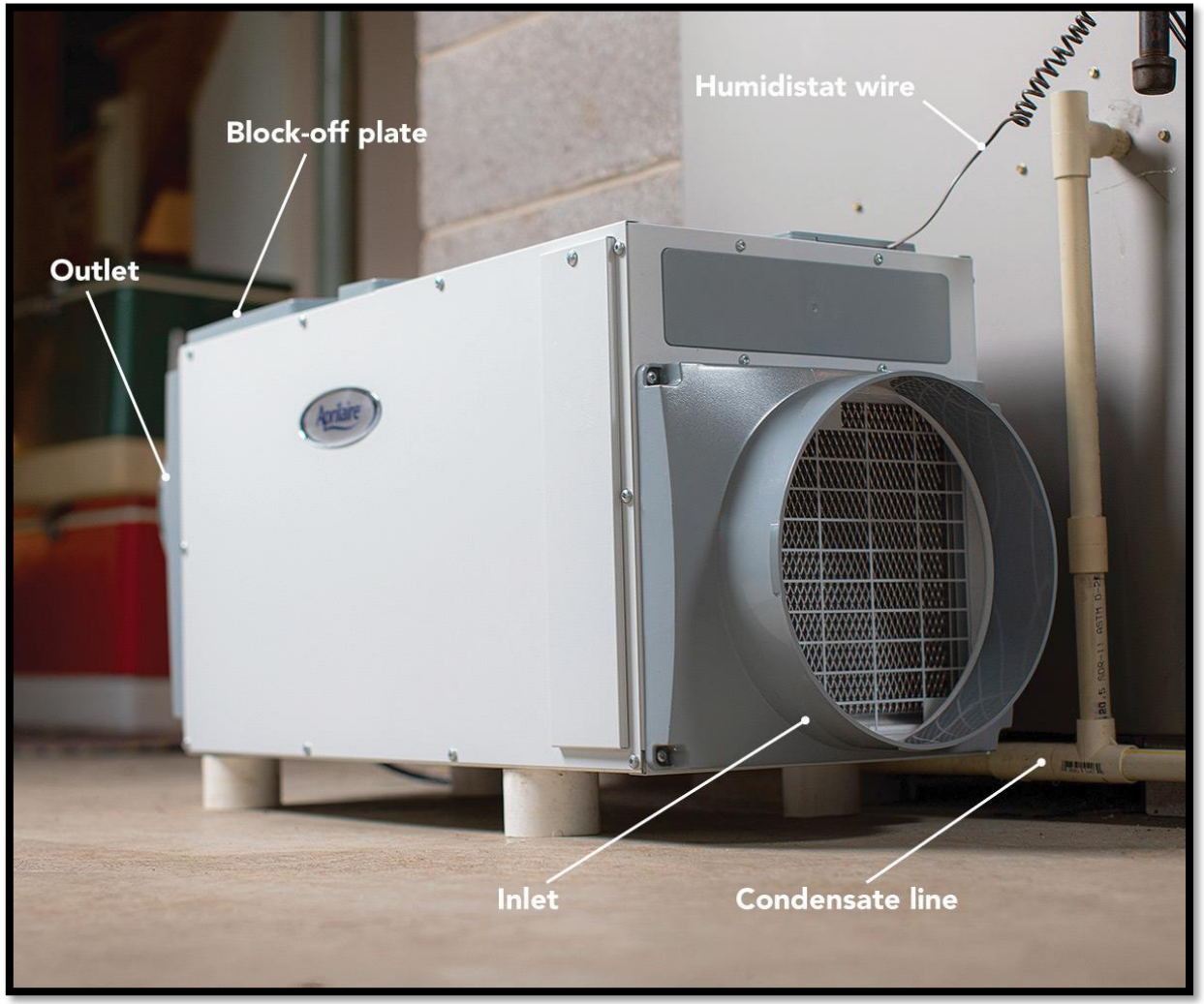
Typical Components: Dehumidifier



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Typical Components: Air Exchanger / ERV / HRV

Typical Components:
Air Exchanger / ERV / HRV

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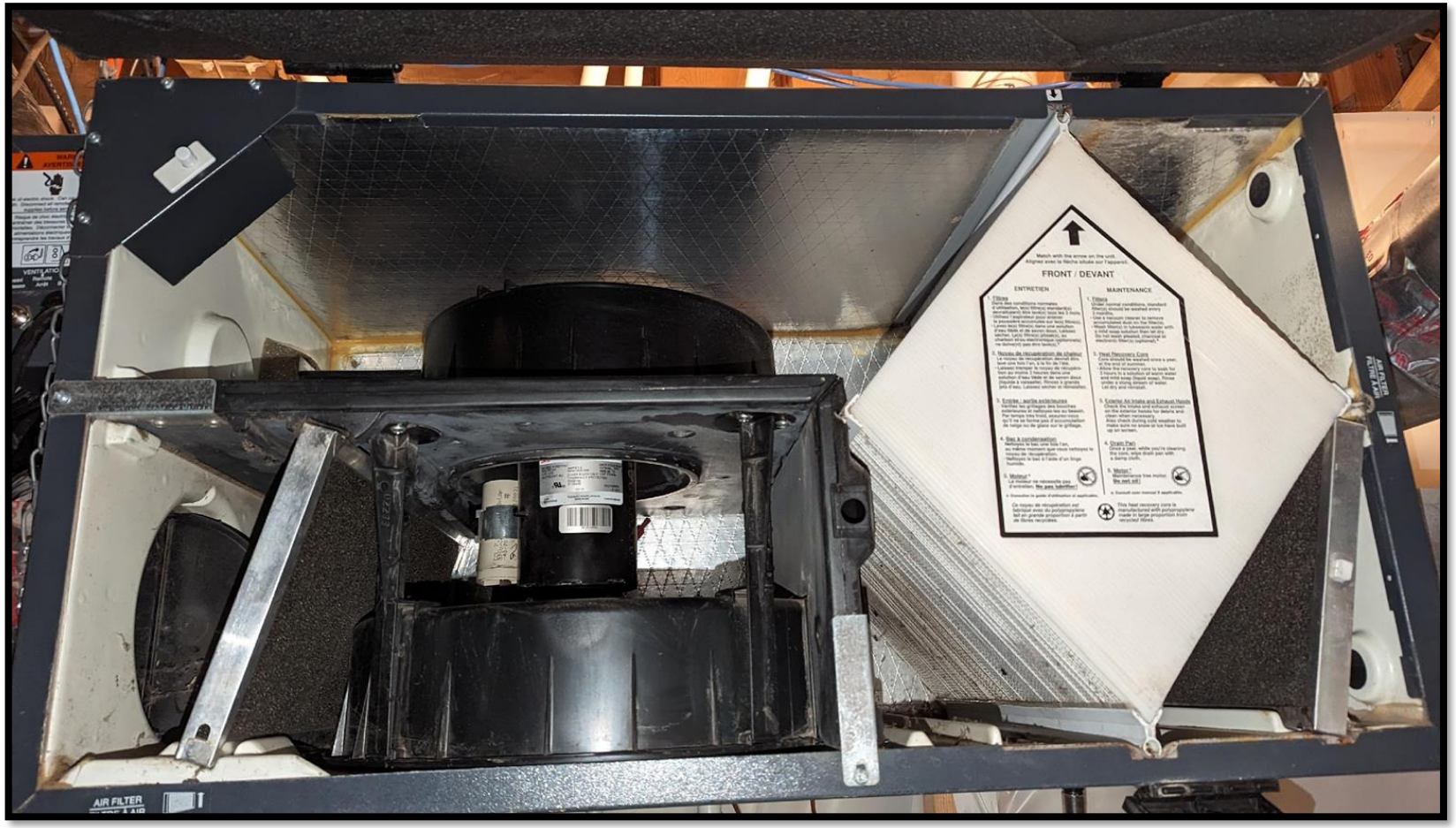

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Typical Components: Washable Media Air Filters

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Typical Components: Bypass HEPA Filters

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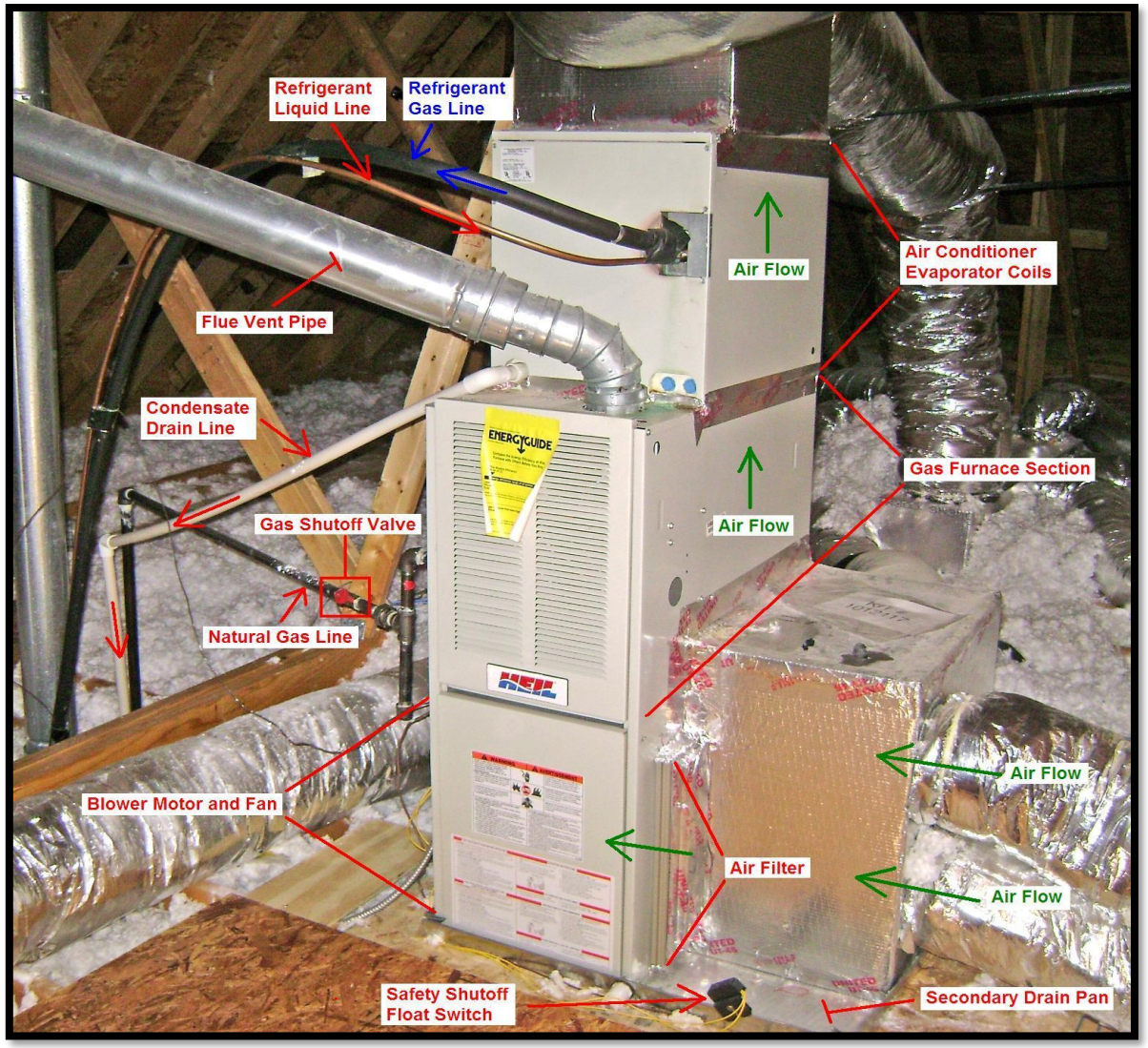
Typical Components: Real Life Install



Typical Components

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Section 3
Cleaning Methods

NADCA does not endorse or recommend any single method of cleaning or type of equipment.

NADCA recommends the use of source removal methods and equipment designed to clean HVAC systems to the cleanliness levels specified in NADCA Standard ACR.

Each cleaning method has its advantages and disadvantages

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Section 3
Cleaning Methods

Adaptability

[*uh*-dap-t*uh*-**bil**-i-tee]

Noun

1. the ability to adjust to different conditions or circumstances

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Section 3
Cleaning Methods

1. Assess the system:

- HVAC system type and location
- additional system components
- duct layout
- duct materials
- accessibility to components
- type of contamination
- environmental factors
- homeowner's belongings

2. THEN make your plan

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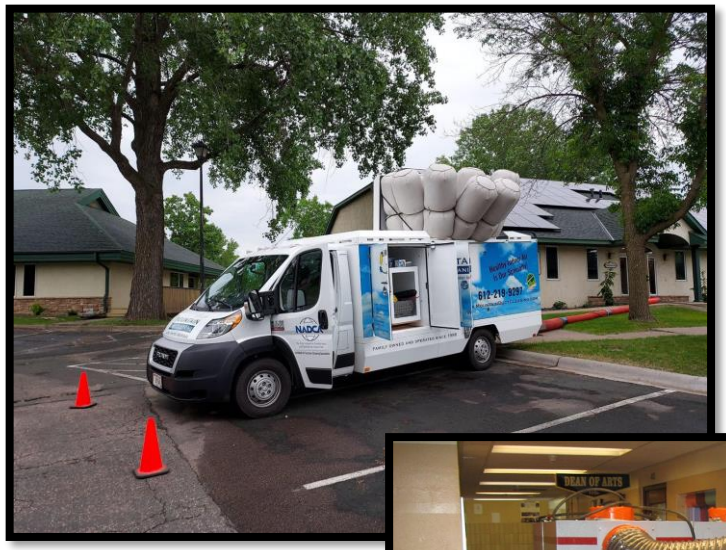
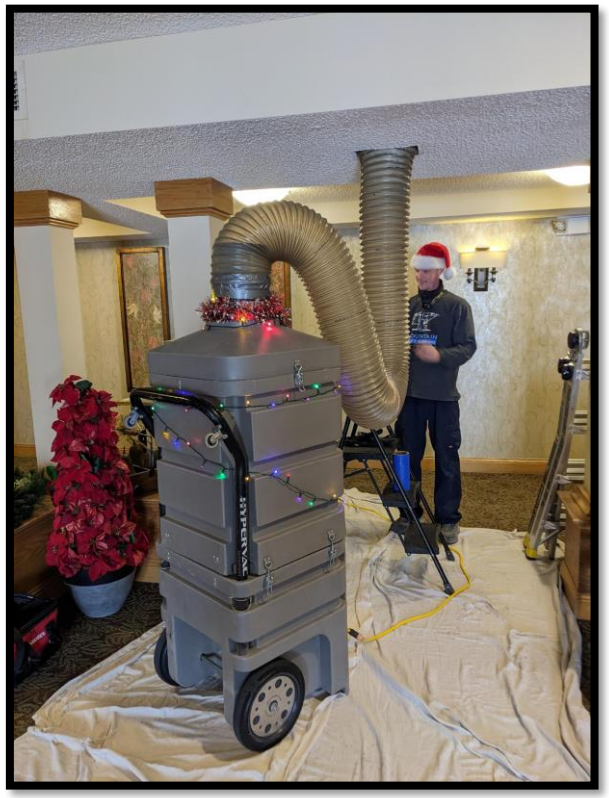
Section 3
Cleaning Methods: Vacuum Collection



Good negative air (suction) is a must for capturing particulate and for protecting the indoor environment.



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Section 3
Cleaning Methods: Vacuum Collection

ACR, The NADCA Standard, 2021 edition

4.1 Negative Duct Pressurization: Prior to and throughout the duration of the cleaning process, the HVAC system components and associated air ducts ***shall*** be kept at an appropriate negative pressure differential relative to the indoor non-work area. This negative pressure differential ***shall*** be maintained between the portion of the HVAC duct system components being cleaned and surrounding indoor occupant spaces.

4.1.1 Verifying Negative Pressure Differential: Under all circumstances, you ***shall*** verify pressurization differential during the project.

4.1.2 Equipment Exhausting Indoors: Vacuum collection equipment exhausting indoors ***shall*** be HEPA-filtered and be capable of retaining dislodged debris.

4.1.3 Equipment Exhausting Outdoors: All equipment used to create negative duct pressurization that does not have HEPA filtration ***shall*** be exhausted outdoors.

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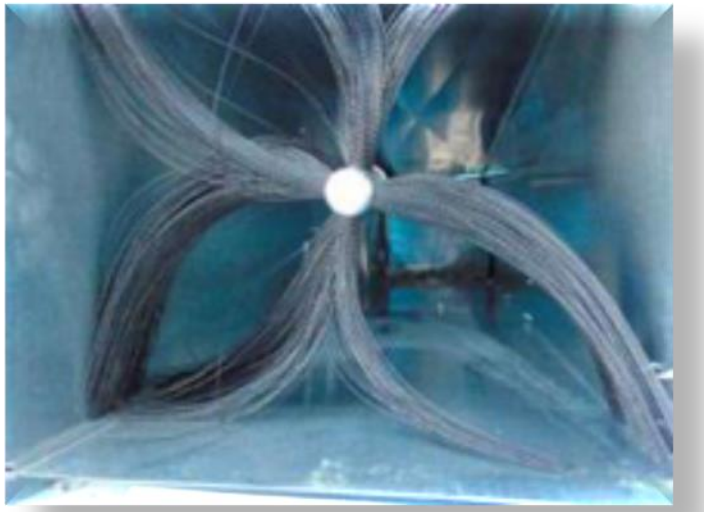
Section 3
Cleaning Methods: Vacuum Collection

A vacuum collection device alone will <u>not</u> get an HVAC system clean.

Methods and tools designed to agitate debris adhered to surfaces along with use of vacuum collection device(s), is required.



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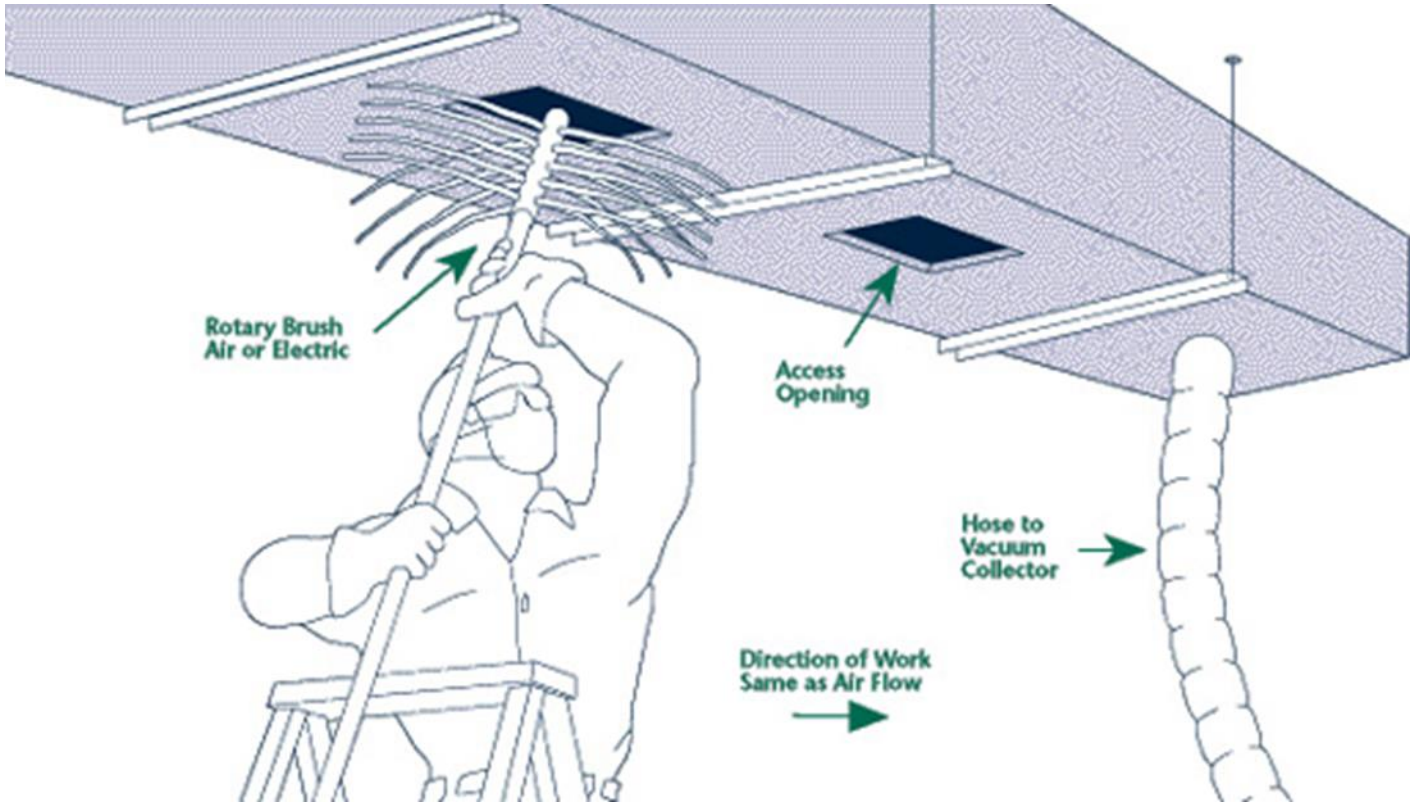
Section 3
Cleaning Methods: Brushing



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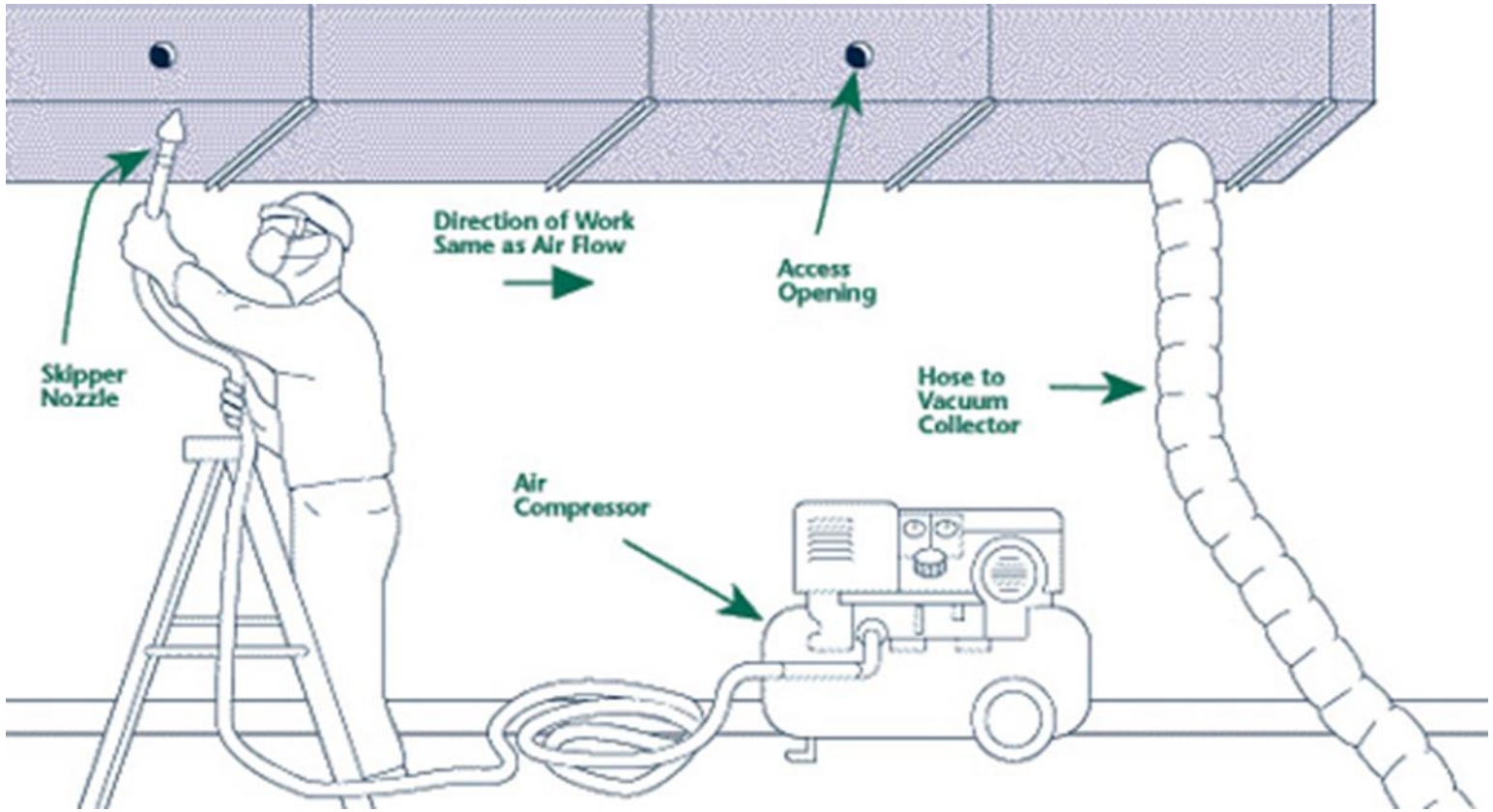
Section 3
Cleaning Methods: Air Washing



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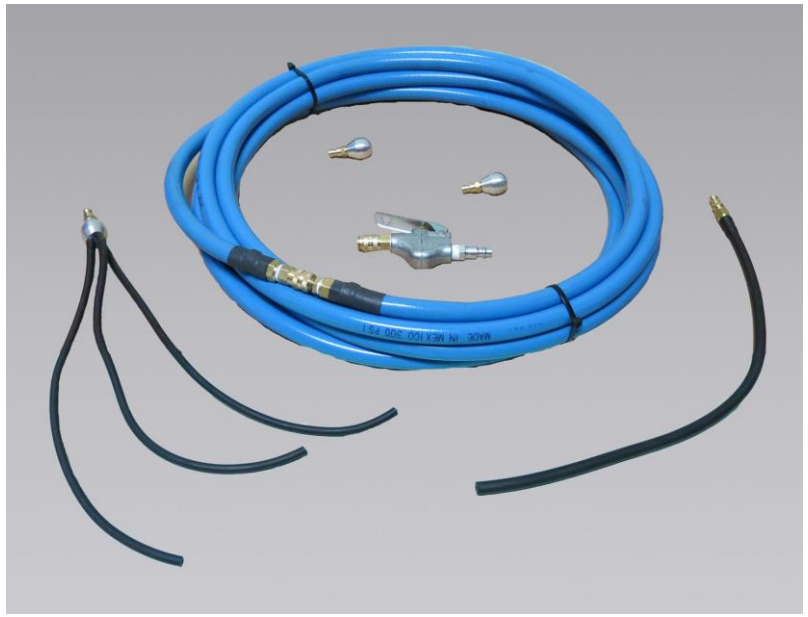
Section 3
Cleaning Methods: Air Washing

Whips, Rods, Blast Nozzles



Section 3
Cleaning Methods: Contact Vacuuming

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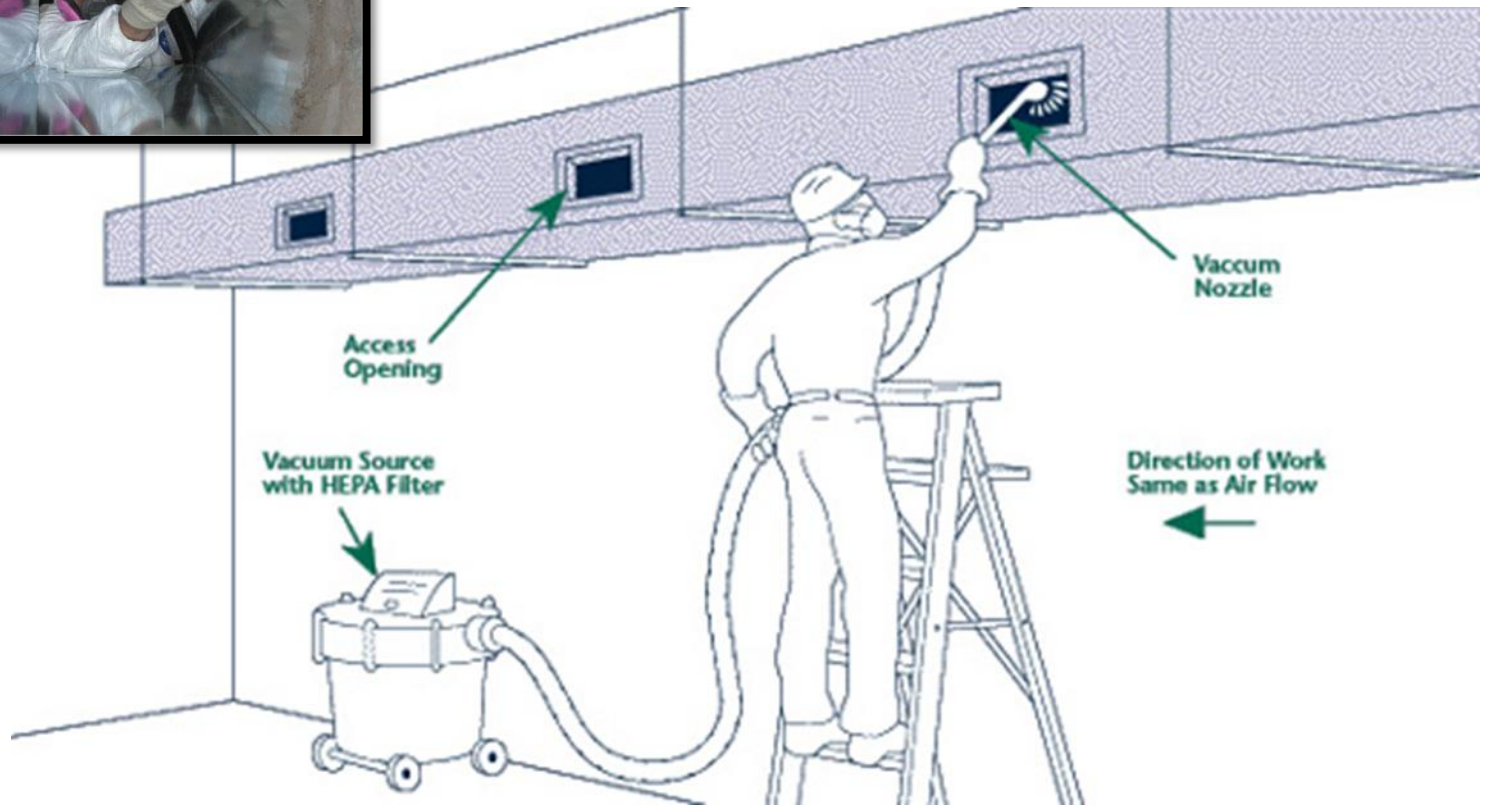

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Section 3
Cleaning Methods: Hand Washing

This procedure is just what its name implies- washing components by hand.

Involves hand tools such as brushes, sponges or damp cloths to wipe clean a designated area.

Liquids cannot be applied to porous components such as fibrous glass. Make sure that no chemical residues are left in the system during hand washing.

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Cleaning Methods:
Duct Board and Internal Duct Liner

Duct Board

Internally Lined

Cleaning Methods:
Duct Board and Internal Duct Liner

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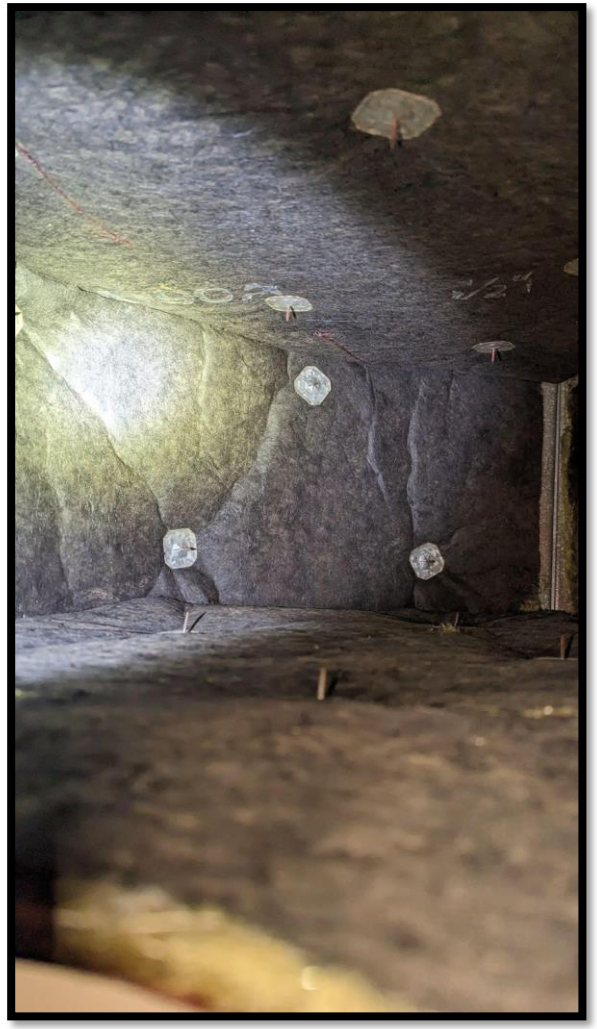

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Cleaning Methods: Duct Board and Internal Duct Liner

ACR, The NADCA Standard, 2021 Edition

4.17 Cleaning Fibrous Glass Duct System Components: The cleaning of fibrous glass duct liner or duct board present in equipment or air ducts *shall* be performed in accordance with Section 4.7 of this Standard.

4.17.1 The mechanical cleaning methods selected for duct liner or fibrous glass duct board *shall* not create abrasions, breaks, or tears to fibrous glass liner or duct board surfaces.

Sections 4.18 - 4.20 discuss coating and/or replacement of duct liner.

Cleaning Methods

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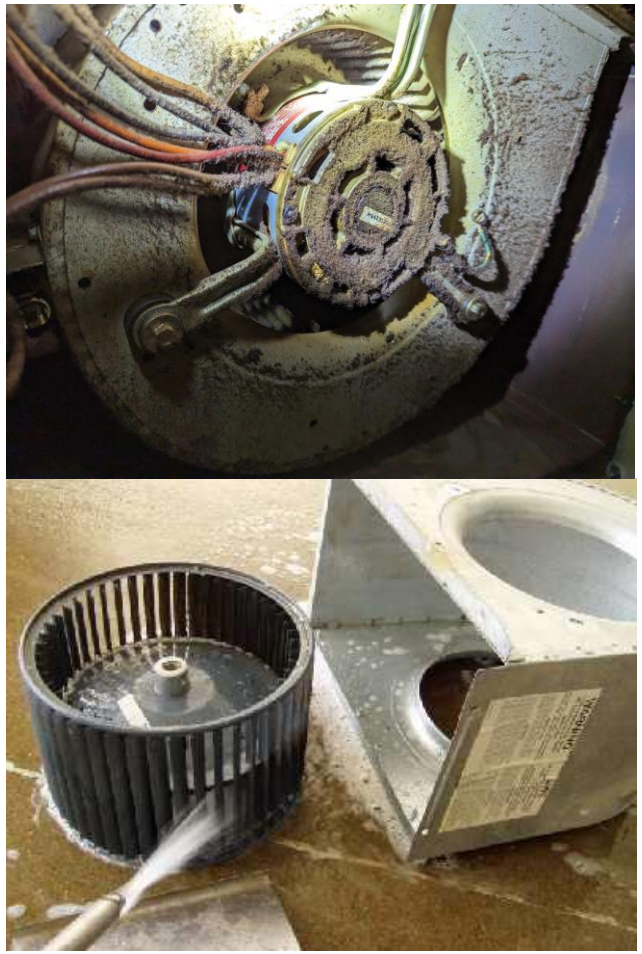
Section 3
Component Cleaning - Fans



Fan Compartment
Fan Housing
Fan Blades or Vanes
Motor/ Drive Assemblies

Section 3
Component Cleaning - Fans

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Section 3
Component Cleaning - Fans

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Section 3
Component Cleaning – Evaporator Coils

ACR, The NADCA Standard – 2021 edition

4.11.2 Type 1 Coil Cleaning (Dry)
- Contact Vacuum (Gently!)
- Brush (Lightly!)
- Compressed air (Carefully!)

4.11.4 Type 2 Coil Cleaning (Wet)
- Aerosol or Pump Sprayer
- Pressure Washing
- Steam Cleaning
- Water Washing
  - Some say “Water Only”

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Section 3
Component Cleaning – Evaporator Coils

- Access is going to be the hard part.
- Containment – Separate coil from furnace with sheet metal, cardboard, or poly.
- Verify the drain line from the pan is actually flowing before starting!
- Capture water during cleaning with a wet vac, vacuum out the drain pan as needed
- Go slowly- the pan is small and only holds a small amount; it's easy to overflow.

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Section 3
Component Cleaning – Drain Lines

The condensate drain pan and line should be flushed.

Verify operation before cleaning.

Blow out with compressed air first to remove large buildup but be careful.

Usually, a **drain pan** and **line** have the **highest amounts of contamination** when compared to all other system components.

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Section 3
Secondary Heat Exchanger

What is it and more importantly… WHERE is it?

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Section 3

Component Cleaning – Duct System Tips

It’s faster to cut an access opening and vacuum large debris out of the ducts instead of trying to use air to push it towards the collection unit.

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Section 3

Component Cleaning – Duct System Tips

Sometimes a 5-gallon bucket is a necessary cleaning tool!

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Section 3

Component Cleaning – Duct System Tips

- Standardize your access holes – 2 sizes. One for your vac hose and a smaller one for cleaning/camera access holes.
- Try to minimize your trips to the truck – steps cost money.
- One toolbox for the furnace room, one to leave by the front door for upstairs work.
- Its quicker (and cheaper) to lay down a drop-cloth and pick it up again than it is to clean someone's furniture or carpet.
- Establish negative air before you remove vent covers - this helps to minimize mess. Contact vac vent cover before removing.
- If you can, run negative pressure on supply and return at the same time.
  - Must have enough vac. Split truck/gas portable or 2 electrics.
- Remember: Efficiency and Speed are two different things.

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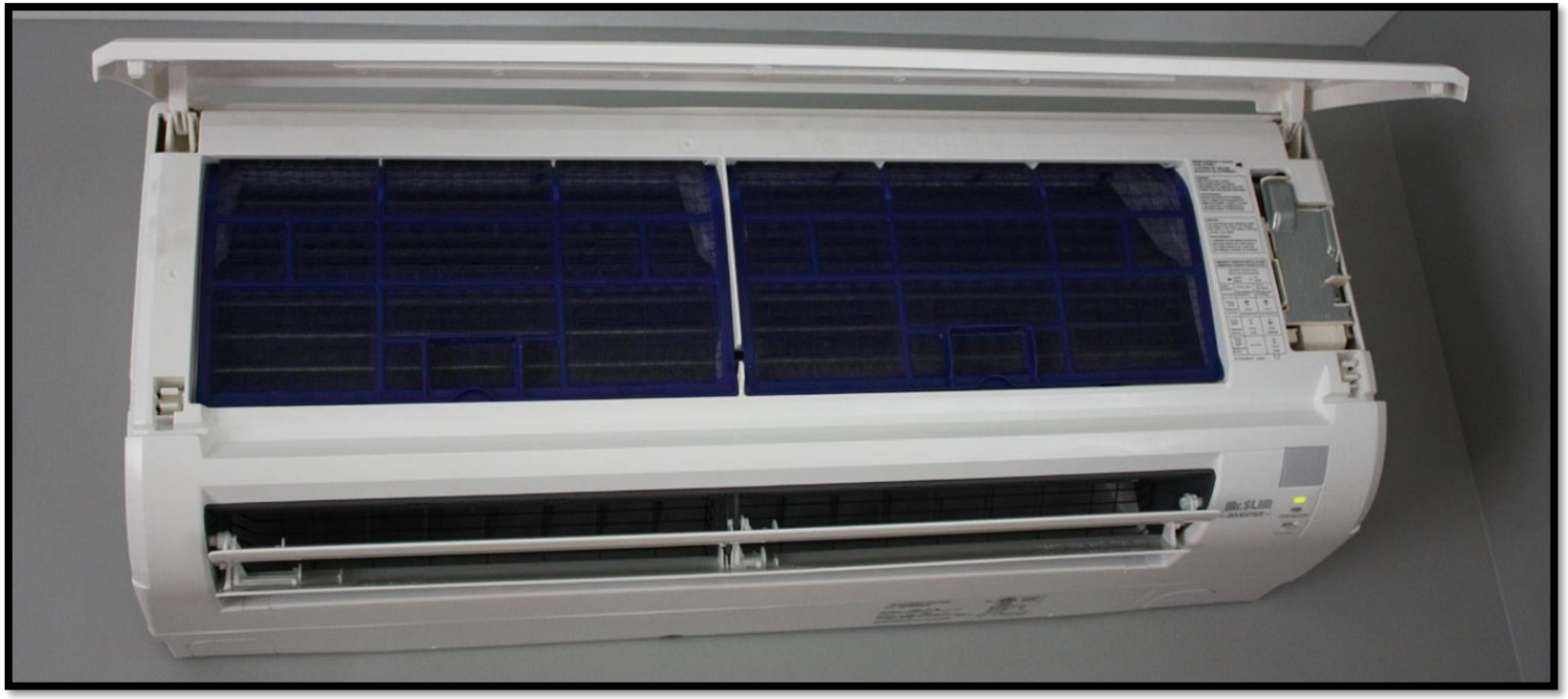
Component Cleaning: Ductless Mini Split



Same components of a standard furnace, just compact.
Contains a fan, filter, evaporator coil, and drain pan.

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Component Cleaning: Ductless Mini Split

Remove covers, vacuum fan and coils.
Compressed air can be used to blow items out.

Purchase or create a containment to capture the water overflow to wet clean the coils.

Here's a Tip...

Component Cleaning: Geothermal Air Handler

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Mysterious looking?

Component Cleaning: Geothermal Air Handler

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Same components as normal furnaces, fan, coils, drain pan.

Be aware of coil placement, usually on return air side of the system.

Tightly spaced coils, don’t tolerate aggressive cleaning agents.

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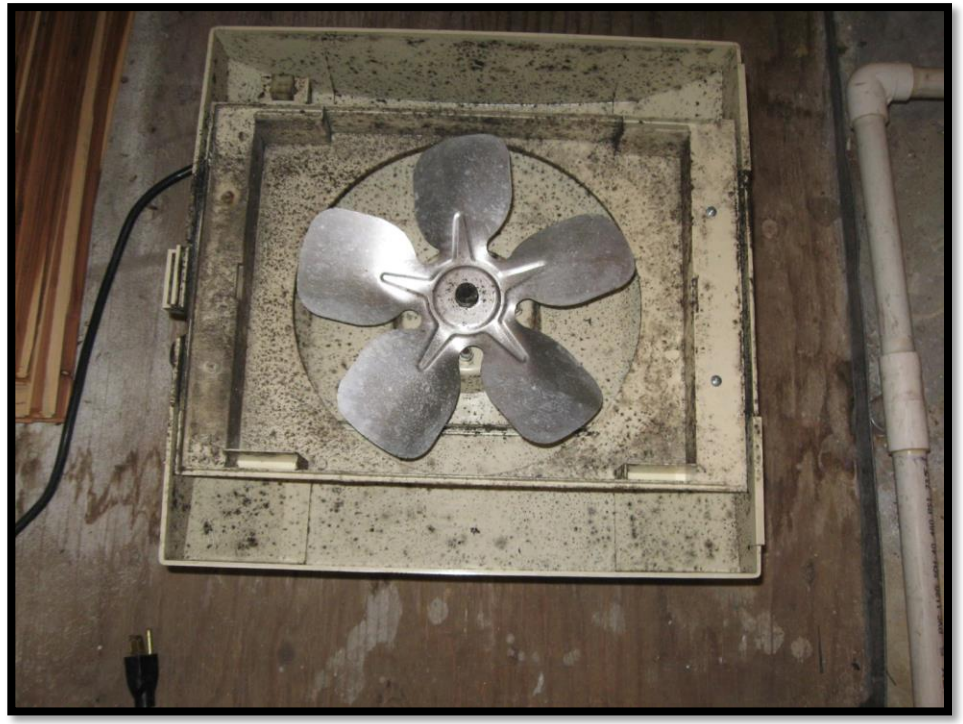
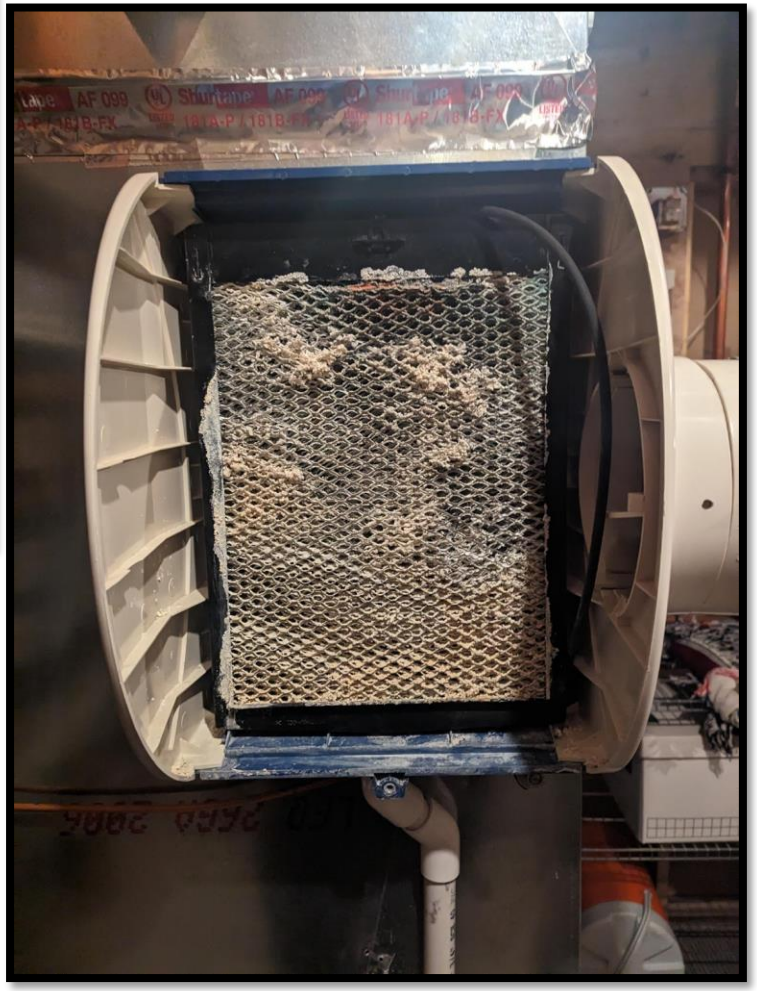
Component Cleaning: Humidifiers





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Component Cleaning: Humidifiers

- Disassemble and wash components
- Pad can be replaced and sometimes washed.
- Verify that drain is working.
- Residential HVAC microbial issues often start with the humidifier and evaporator coils.

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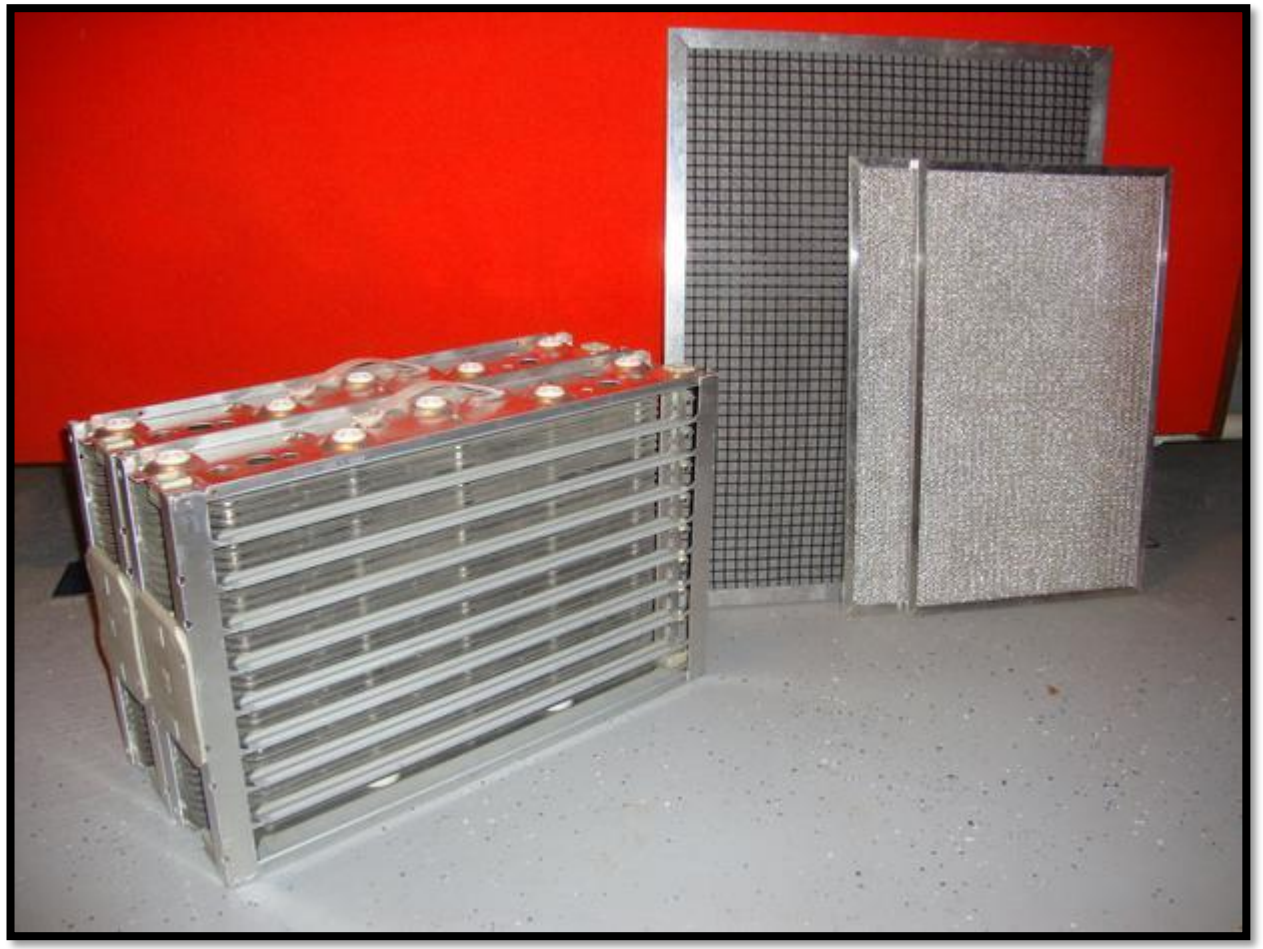
Component Cleaning: Washable Media Air Filters



Wash with mild detergent, coil cleaner or degreaser

Section 4:
Cleaning Requirements & Standards

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HVAC System Cleaning Requirements

- Visibly Clean
- Source Removal
- Negative Duct Pressurization
- Service Openings
- Containment

Section 4:
Cleaning Requirements & Standards

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Cleaning Methods

- Vacuum Collection
- Brushing
- Air Washing
- Hand or Contact Vacuuming
- Hand Washing
- Power Washing

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Section 4:
Cleaning Requirements & Standards

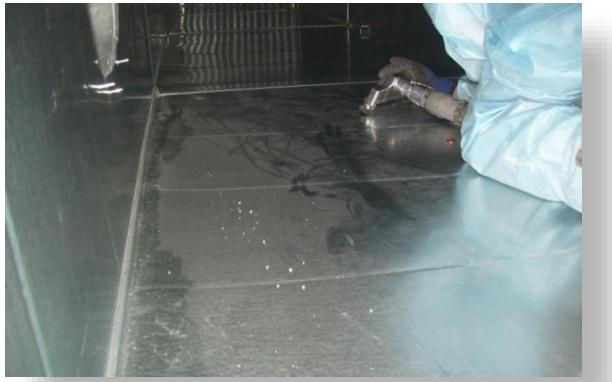
Visibly Clean Standard

ACR, The NADCA Standard – 2021 Edition

5.2 Description of Method 1 - Visual Inspection: A visual inspection of porous and non-porous HVAC system components *shall* be conducted to assess if the HVAC system components are visibly clean. An interior surface is considered visibly clean when it is free from non-adhered substances and debris. If a component is visibly clean, then no further cleanliness verification methods are necessary.

Definition: What does non-adhered mean?

Non-Adhered Substance: Any material not intended or designed to be present in the HVAC system, and which can be removed by cleaning and restoration procedures as described in Section 4 of ACR, The NADCA Standard.



Section 4:
Cleaning Requirements & Standards

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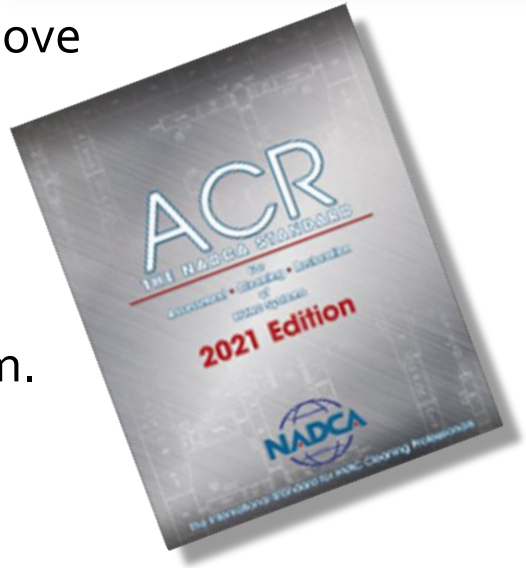
Source Removal

Key Terms

Source Removal
The mechanical cleaning of system components to remove dirt and debris.



Requires two key elements to be effective:

1. ***Agitation*** of dust and debris within the HVAC system.
2. ***Extraction*** of contaminants from the HVAC system

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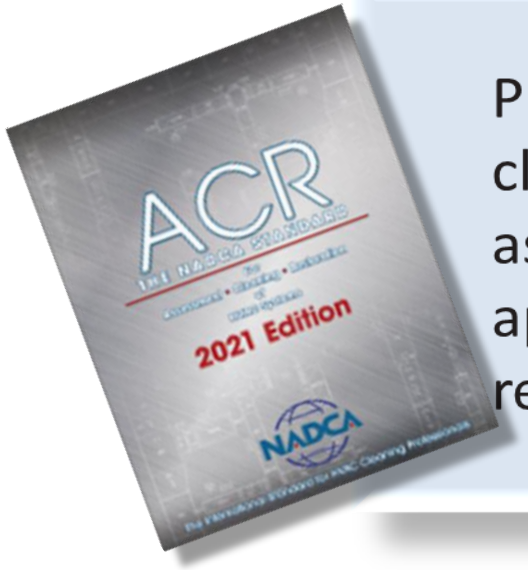
Section 4: Cleaning Requirements & Standards

Negative Duct Pressurization

Key Terms

Negative Pressure
Used to prevent debris from entering the occupied space or leaving the contained area.



Prior to and throughout the duration of the cleaning process, the HVAC system and associated air duct *shall* be kept at an appropriate negative pressure differential relative to the indoor non-work area.

Section 4:
Cleaning Requirements & Standards

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Effective negative pressure containment requires:

- Physical barrier around work area
- Sealing off HVAC return air grills
- Continuously pulling air through a HEPA filtration device to reduce airborne particles.
- Exhausting more cubic feet per minute of clean, HEPA-filtered air out of the space than is supplied into it.

Section 4:
Cleaning Requirements & Standards

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Service Openings

Minimum Requirements for Service Openings

Service openings shall:

not degrade the structural, thermal, or functional integrity of the system;

not hinder, restrict, or alter the airflow within the air duct;

not be made in flexible ductwork;

be created in a manner that allows for proper closure;

comply with applicable UL, SMACNA and NFPA standards, as well as local, regional, state and federal codes.

Section 4:
Cleaning Requirements & Standards

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Service Openings

Service Panels

- *Shall* be of an equivalent gauge or heavier
- *Shall* be mechanically fastened (screwed or riveted) at minimum every 4" on center.
- *Shall* overlap the ductwork surfaces by a minimum of 1" on all sides.
- *Recommended to* be sealed with gaskets, duct sealants, mastic or tape.

Section 4:
Cleaning Requirements & Standards

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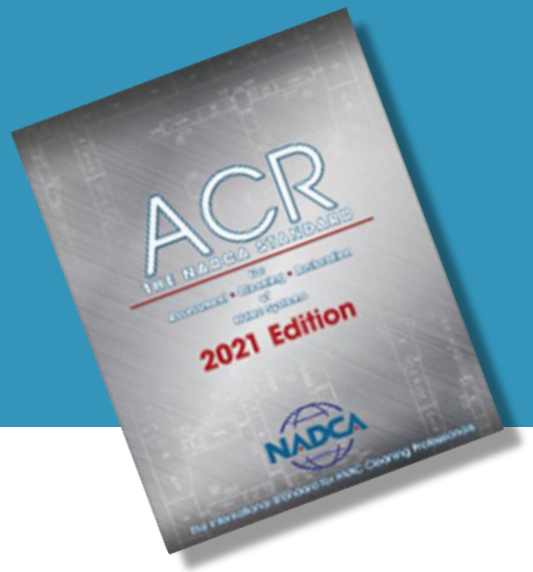
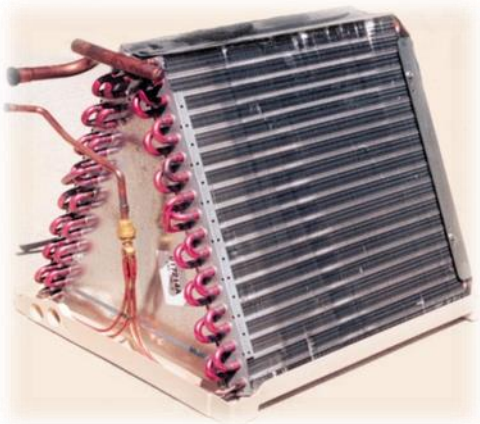


Evaporator Coils

All portions of each coil assembly <u>must be cleaned</u>.

- Both upstream and downstream sides of each coil section *shall* be accessed for cleaning.
- When both sides of a coil are not accessible for cleaning then removal and/or replacement *may* be required.
- Visual inspection of the coil and drain pan will determine whether Type 1 or Type 2 cleaning is required.



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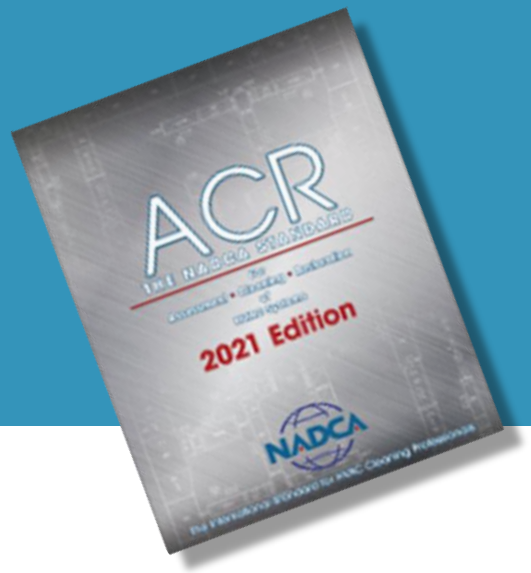

Section 4: Cleaning Requirements & Standards

Evaporator Coils

The substances impacted on the evaporator coil help determine the initial cleaning protocol. Evaporator coil cleaning is broken into two (2) categories known as **Types**. Evaporator coil reconditioning will utilize **Type-1** or **Type-2** cleaning methods.

Type 1 (Dry Cleaning)

Type 2 (Wet Cleaning)

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Section 4: Cleaning Requirements & Standards

Pop Quiz Does this coil require Type 1 or Type 2 cleaning?

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Section 4:
Cleaning Requirements & Standards

Answer:

Perform a Type 1 cleaning.

After performing Type 1 cleaning determine whether you need to proceed to Type 2 cleaning.

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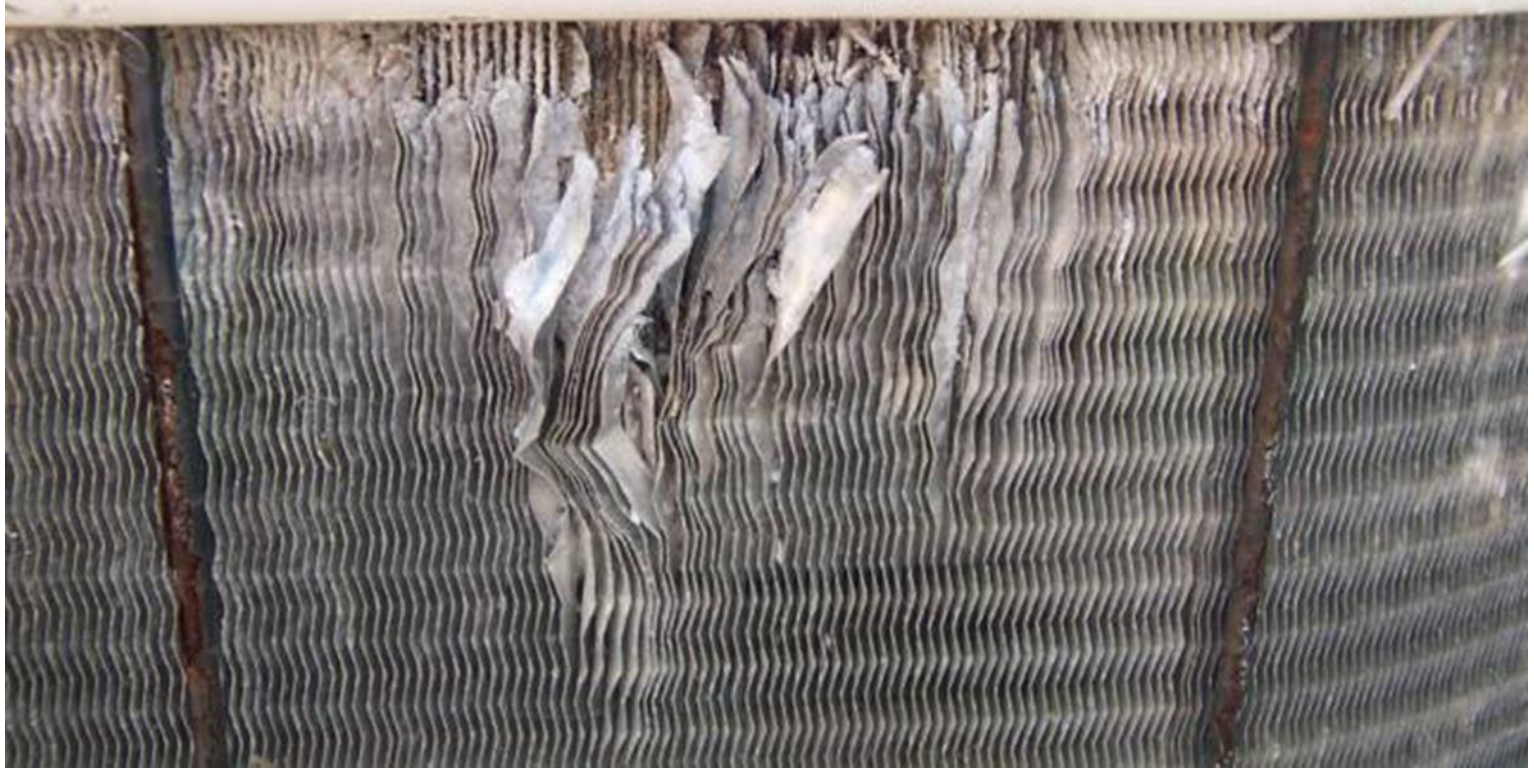
Section 4: Cleaning Requirements & Standards

Participant Poll Question:

Recommend Cleaning or Replacement?



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Section 4:
Cleaning Requirements & Standards

Containment

Be prepared to cover everything in your work area if needed.

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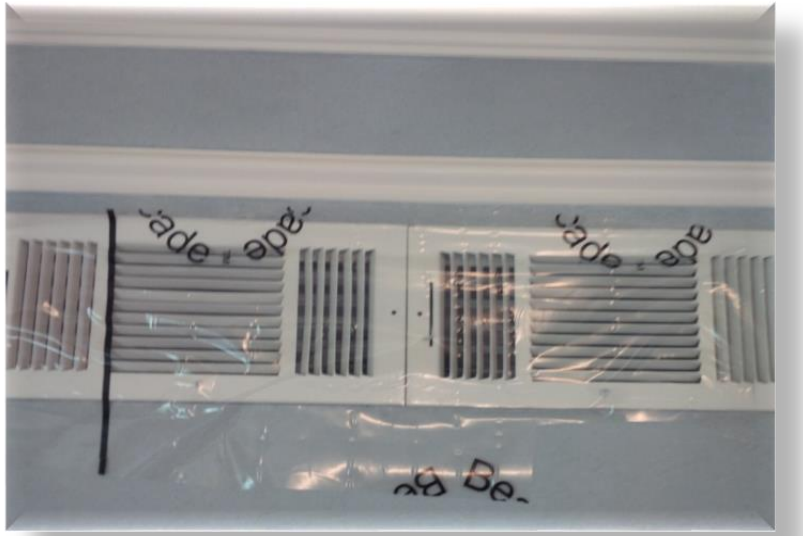
Section 4:
Cleaning Requirements & Standards

Containment



Simple critical barriers

Residential HVAC 101

Section 4:
Cleaning Requirements & Standards

Containment

Coils covered by cardboard, keeps debris from damaging coils

Residential HVAC 101

Section 4: Cleaning Requirements & Standards

Containment

Replace filter with cardboard, sheet metal etc. to section furnace from duct system

Residential HVAC 101

Residential HVAC 101

Presenter Contact Information

- Matt Mountain
- matt@mountainductcleaning.com
- 763-248-9411

Thank you for Attending!