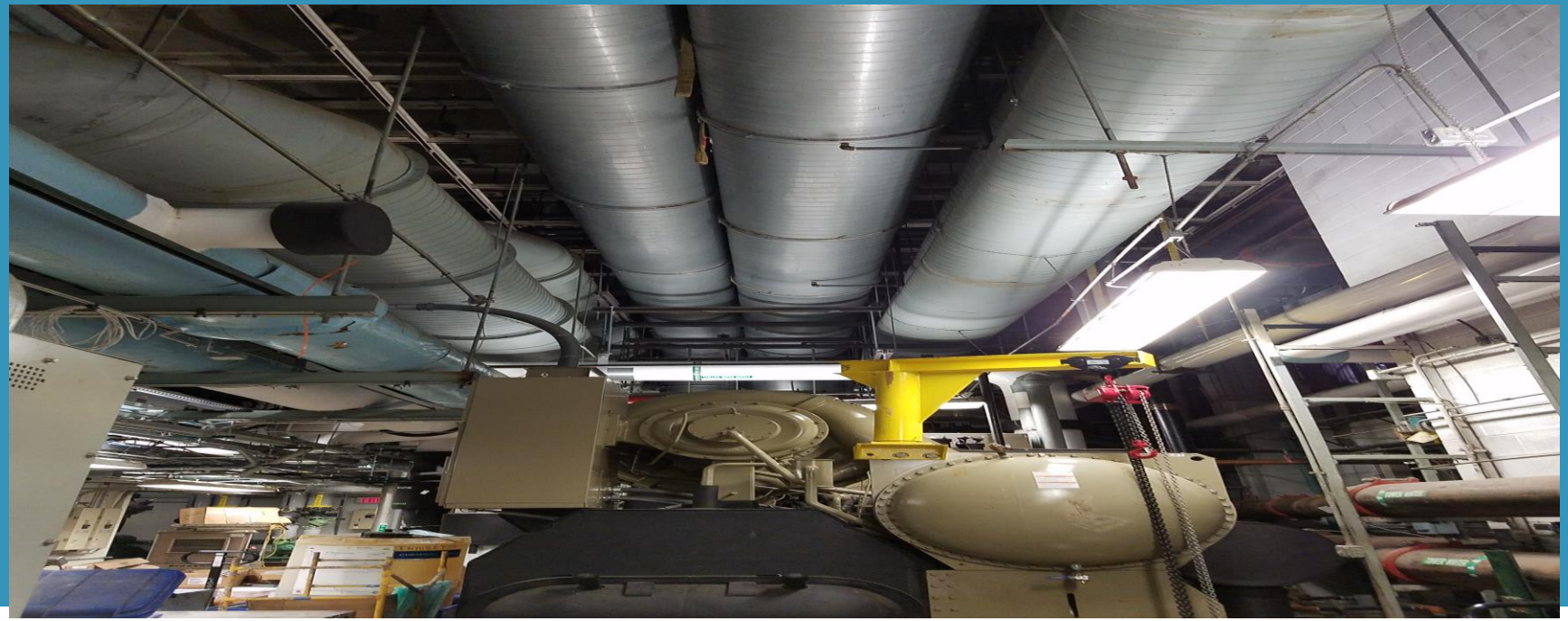
Identifying and Repairing Common Duct System Issues



Presenters

Michael J. McDavid

Zachary Ortwine

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.

What We'll Learn

- Black Particulate Discharging Systems
- Microbial Growth Within Systems

Discharging Debris

Purpose & Overview

Visual inspection of HVAC system components is the first step in the NADCA-recommended procedure for the assessment, cleaning, and restoration of HVAC systems, as outlined in ACR, the NADCA Standard.

Discharging Debris

Discharging Debris

- The presence of biofilms on the cooling coils of commercial systems can significantly reduce the heat transfer efficiency of the coils and may lead to the aerosolization of microbes into occupied spaces of the building

Discharging Debris

Discharging Debris

Discharging Debris

Discharging Debris

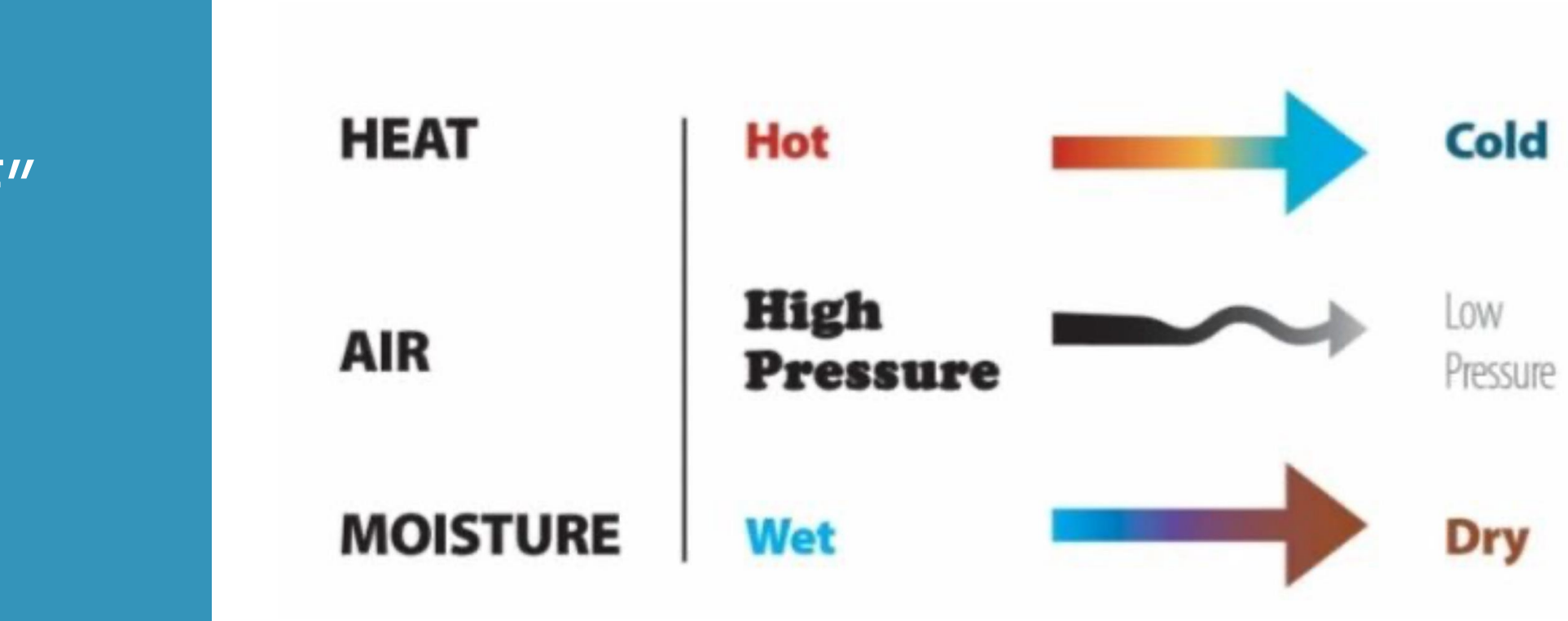
Discharging Debris

Discharging Debris

Discharging Debris

“WTF”

“WTF” - “Which **T**hree **F**actors” Influence Air Movements?



"WTF"
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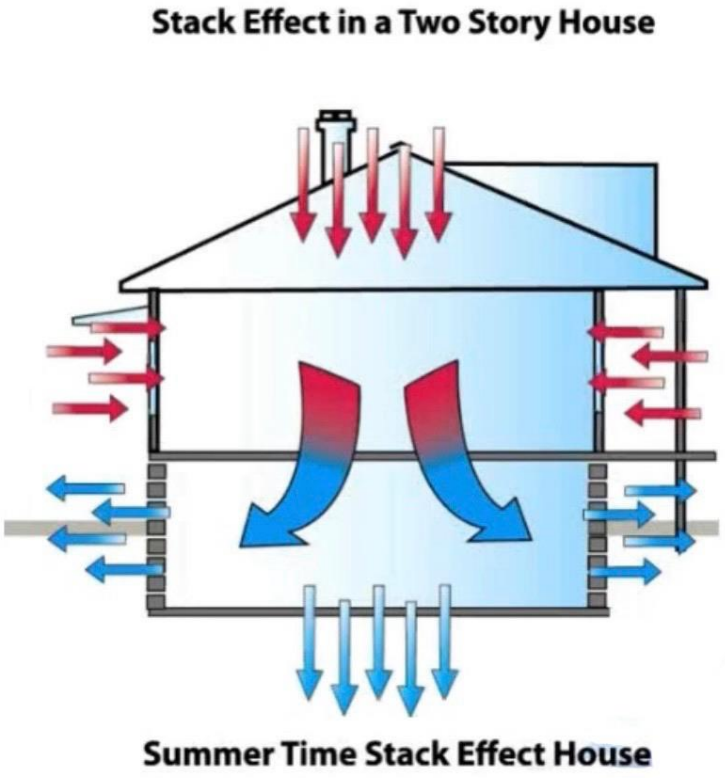
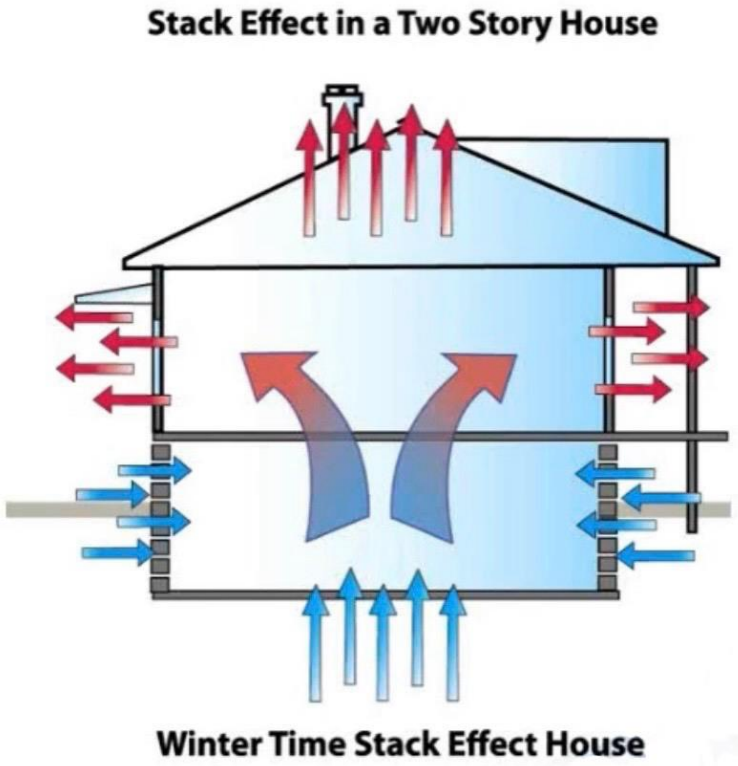
TEMPERATURE DIFFERENTIALS

Summertime Stack Effect = Dehumidification Challenges!

Winter Time Stack Effect = Humidification Challenges!





"WTF"

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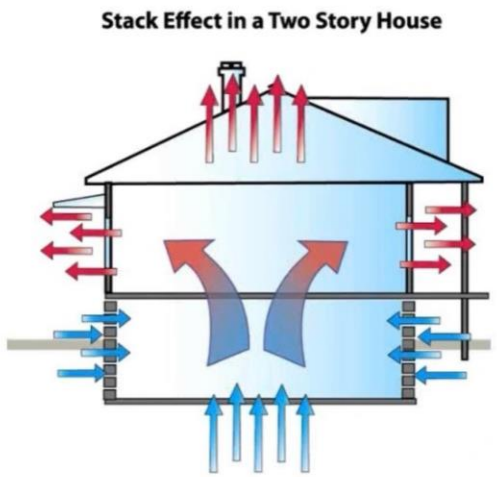
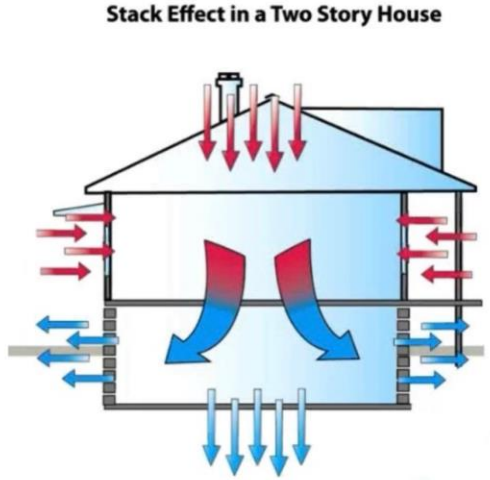
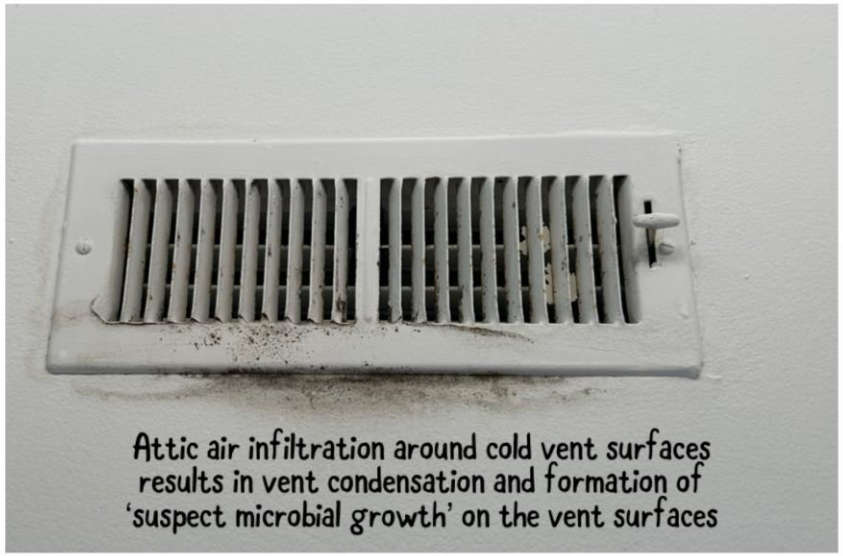
TEMPERATURE DIFFERENTIALS



Winter Time Stack Effect House

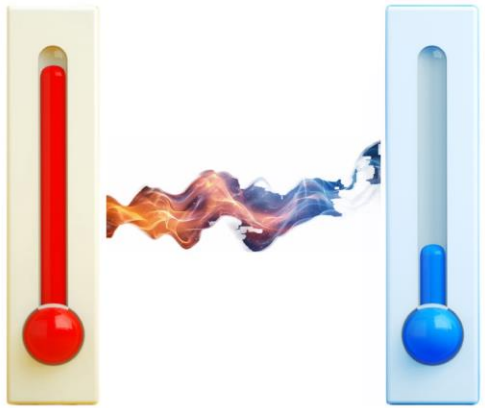


Summer Time Stack Effect House



"WTF" - TEMPERATURE & MOISTURE/RH

TEMPERATURE DIFFERENTIALS



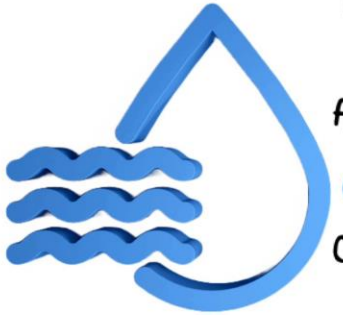
HOT (🔥) —> COLD (❄️)

THERMAL AIR MOVEMENTS CAUSE VENT CONDENSATION DURING SUMMER HUMID CLIMATES AND VENT DIRT RINGS DURING WINTER DRY CLIMATES AS A RESULT OF STACK EFFECT DURING EACH SEASON.

TEMPERATURE (🌡️) DIFFERENTIALS MAY RESULT IN:

1. CONDENSATION OF COLD SURFACES DURING COOLING SEASON IN HUMID CLIMATES
2. COMFORT-RELATED ISSUES INVOLVING 'HOT' AND 'COLD' ROOMS
3. MOISTURE-CONTROL ISSUES INVOLVING HUMID AIR INFILTRATION AROUND VENTS
4. INCREASED HEATING OR COOLING LOADS ON HVAC AIR CONDITIONING EQUIPMENT
5. INCREASED INCOMING RETURN AIR TEMPERATURES AND HUMIDITY LEVELS
6. REDUCED COOLING EQUIPMENT DELIVERED PERFORMANCE
7. INCREASED ENERGY CONSUMPTION REQUIRED TO HEAT OR COOL CONDITIONED AIR
8. INCREASED COOLING EQUIPMENT RUNTIMES REQUIRED TO HEAT OR COOL A SUFFICIENT VOLUME OF CONDITIONED AIR
9. INCREASED RISK OF INSULATION PERFORMANCE FAILURE AND RESULTING DUCT CONDENSATION

MOISTURE CONTENT & RELATIVE HUMIDITY (RH%)



AIR FLOWS IN THE DIRECTION OF:

💧 WET —> 🌵 DRY

CLIMATES WITHIN A BUILDING.

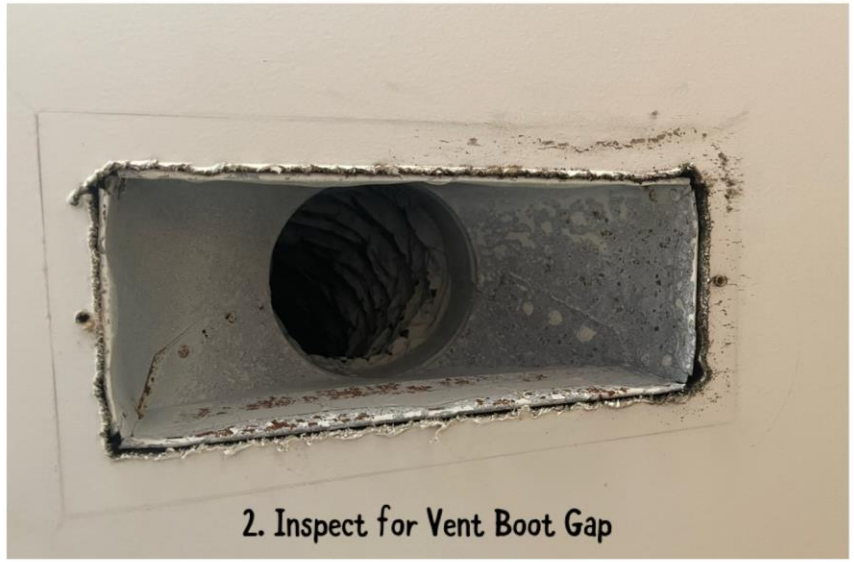
MOISTURE (💧) AND (-) NEGATIVELY DEPRESSURIZED SPACES CAN RESULT IN INFILTRATION OF HUMID, UNCONDITIONED AIR INTO A BUILDING ENVELOPE PENETRATIONS AND CREATE A SIGNIFICANT CAUSE FOR CONCERN TO BUILDING OWNERS...

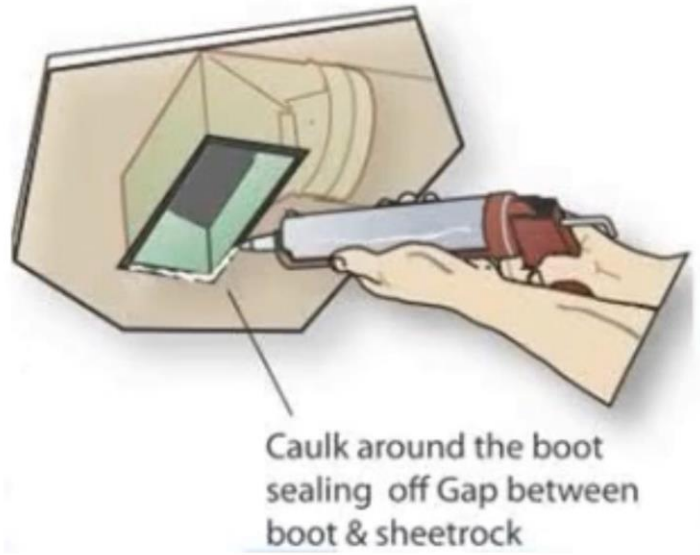
1. HIDDEN DAMAGES TO BUILDING MATERIALS MAY OCCUR DUE TO CONDENSATION BEHIND WALL CAVITIES, BETWEEN FLOOR JOISTS, AND ANYWHERE ELSE THAT HOLES, CRACKS, GAPS, AND OTHER TYPES OF "PENETRATIONS" EXIST BETWEEN THE CONDITIONED SPACE AND THE OUTSIDE UNCONDITIONED AIR.

2. HIDDEN MOLD AND MICROBIAL CONTAMINATION MAY OCCUR DUE TO THE INCREASED LIKELIHOOD OF SURFACE CONDENSATION CAUSED BY UNCONDITIONED AIR INFILTRATION IN HIDDEN SPACES OF A BUILDING THAT MAY GO UNNOTICED UNTIL ITS TOO LATE TO TAKE PREVENTATIVE MEASURES.

“WTF”
-
VENT BOOT SEALING FLOOR VENTS

"WTF"
-
VENT BOOT SEALING CEILING VENTS





"WTF"

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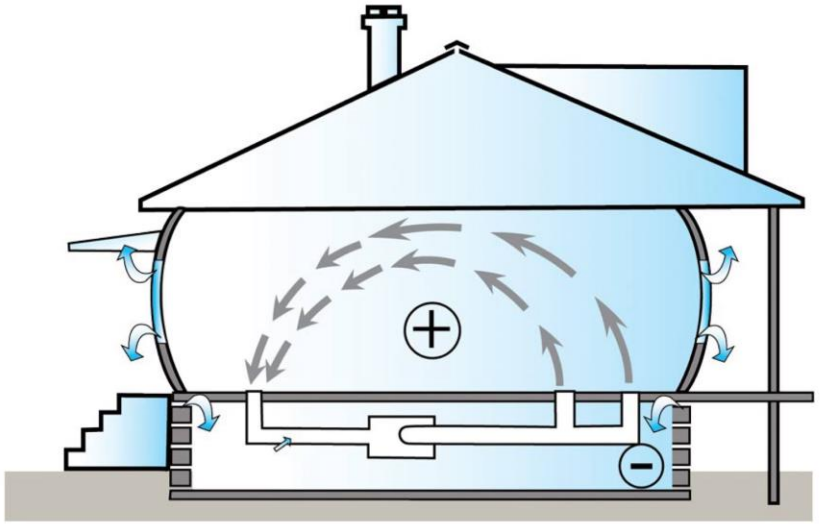
(+) PRESSURE SPACES



(+) PRESSURIZATION INDICATORS:

1. CLOSED ROOM DOORS, WITH NO RETURN AIR PATHWAY, AND CENTRAL RETURN INTAKE(S)

2. DIRT "LINE" OBSERVED UNDERNEATH DOOR IN CLOSED POSITION (AIR TRIES TO EXFILTRATE)

3. CONTAMINANT MIGRATION FROM (+) PRESSURIZED CONTAMINANT SOURCE ROOMS TO (-) PRESSURIZED SURROUNDING SPACES

4. ODOR MIGRATION FROM (+) PRESSURIZED ODOR SOURCE ROOMS TO (-) PRESSURIZED SURROUNDING SPACES

(+) PRESSURIZATION

(+) PRESSURIZATION EFFECTS:

1. DECREASED SUPPLY CFM TO (+) AREAS
2. DECREASED AIR INFILTRATION
3. INCREASED AIR EXFILTRATION

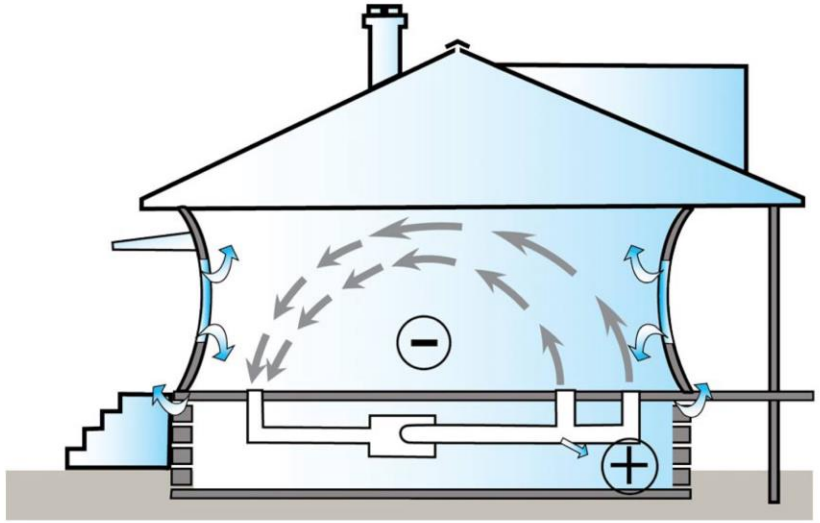
(+) PRESSURIZATION VARIABLES:

1. TOTAL SUPPLY CFM DELIVERED INTO SPACE
2. TIGHTNESS OF SUPPLY DUCT RUN(S)
3. TIGHTNESS OF ROOM(S) BUILDING ENVELOPE

(+) PRESSURIZATION CAUSED BY DUCT LEAKAGE:
DEPENDS ON WHERE DUCT SYSTEM IS LOCATED...

1. (DUCT LEAKAGE TO INSIDE OF CONDITIONED SPACE):
SUPPLY LEAKAGE = (+) SPACE PRESSURIZATION
2. (DUCT LEAKAGE TO OUTSIDE OF CONDITIONED SPACE):
RETURN LEAKAGE = (+) SPACE PRESSURIZATION

"WTF"
-
(-) PRESSURE SPACES



(-) DEPRESSURIZATION INDICATORS:

1. VENT "M*LD"/"SUSPECT MICROBIAL GROWTH" AT VENT
2. DIRT BORDER "RING" OBSERVED AROUND VENT BOOT
3. DIRT "LINE" OBSERVED AROUND FLOOR-TO-WALL AREAS
4. COMPLAINTS OF FREQUENT NEED TO CLEAN/DUST
5. BACKDRAFT OF EXHAUST FLUES, VENTS, & CHIMNEYS

(-) DEPRESSURIZATION

(-) DEPRESSURIZATION EFFECTS:

1. INCREASED SUPPLY CFM TO (-) PRESSURIZED AREAS
2. INCREASED AIR INFILTRATION
3. REDUCED AIR EXFILTRATION

(-) DEPRESSURIZATION VARIABLES:

1. TOTAL DIFFERENCES BETWEEN THE AMOUNT OF: TOTAL RETURN CFM - TOTAL SUPPLY CFM
2. TIGHTNESS OF RETURN DUCT SYSTEM
3. TIGHTNESS OF SURROUNDING WALLS, INTERIOR PARTITIONS, WINDOWS & DOORS

(-) DEPRESSURIZATION CAUSED BY DUCT LEAKAGE: DEPENDS ON WHERE DUCT SYSTEM IS LOCATED...

1. (DUCT LEAKAGE TO INSIDE OF CONDITIONED SPACE): RETURN LEAKAGE = (-) SPACE DEPRESSURIZATION
2. (DUCT LEAKAGE TO OUTSIDE OF CONDITIONED SPACE): SUPPLY LEAKAGE = (-) SPACE DEPRESSURIZATION

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"WTF"

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UNRESTRICTED RETURN AIR PATHWAYS

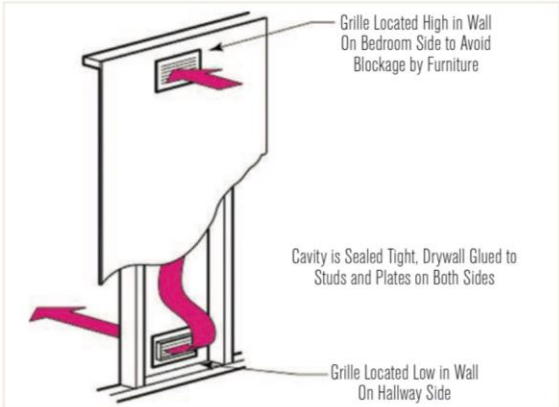


FIGURE 2B Transfer Grilles. This also addresses the problem in Figure 1b. Less expensive than a "jump duct," but not as quiet.

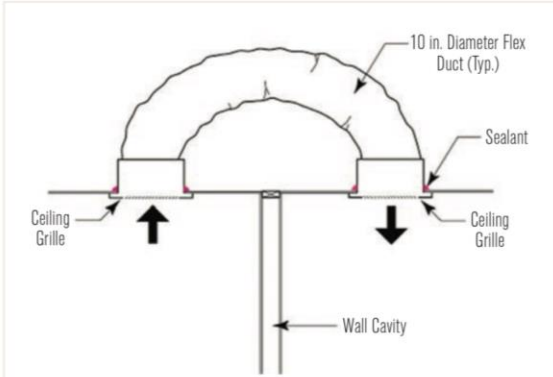
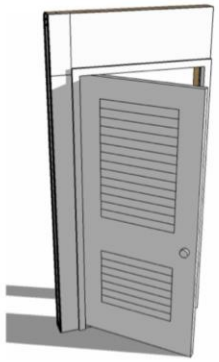


FIGURE 2A Jump Ducts. This addresses the problem in Figure 1b. What is nice about this approach is that it is quiet—no sound transfer. Also known as a "slinky."

Louvered passage doors are also a good solution if sound or moisture is not a problem.

Figure 8-15
Louvered Passage Doors



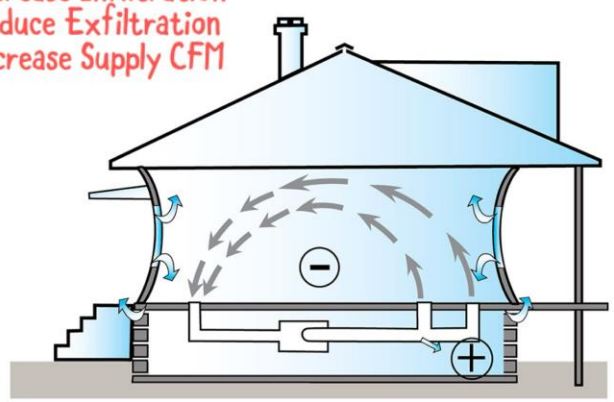
The following table indicates how many inches a typical door should be undercut to provide adequate return.

Required open area in lieu of a return duct and grill.

Supply Duct Size	Supply CFM	Inches to Cut Off Door
5 Inch	50 CFM	1 Inch
6 Inch	75 CFM	1 1/2 Inch
7 Inch	110 CFM	2 Inches
8 Inch	160 CFM	2 1/2 Inches
9 Inch	225 CFM	3 Inches
10 Inch	300 CFM	5 Inches
12 Inch	480 CFM	8 Inches
14 Inch	700 CFM	12 Inches

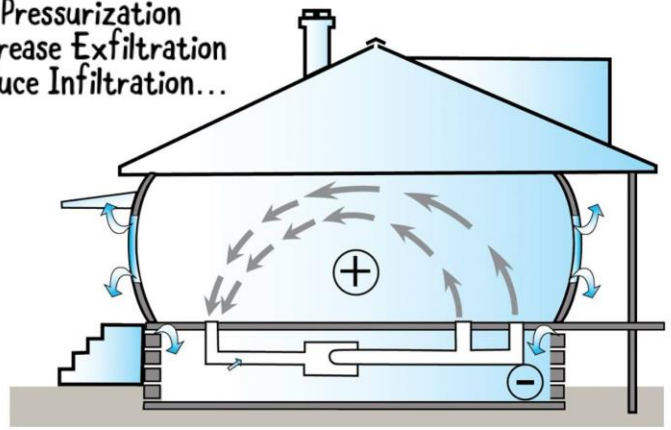
"WTF"

Negative (-) Depressurization
Increase Infiltration
Reduce Exfiltration
Increase Supply CFM



Supply leakage to outside = Building Depressurization (-)
Return leakage to conditioned space = Room Depressurization (-)

Positive (+)
Pressurization
Increase Exfiltration
Reduce Infiltration...



Return leakage to outside = Building Pressurization (+)
Supply leakage in conditioned space = Room Pressurization (+)

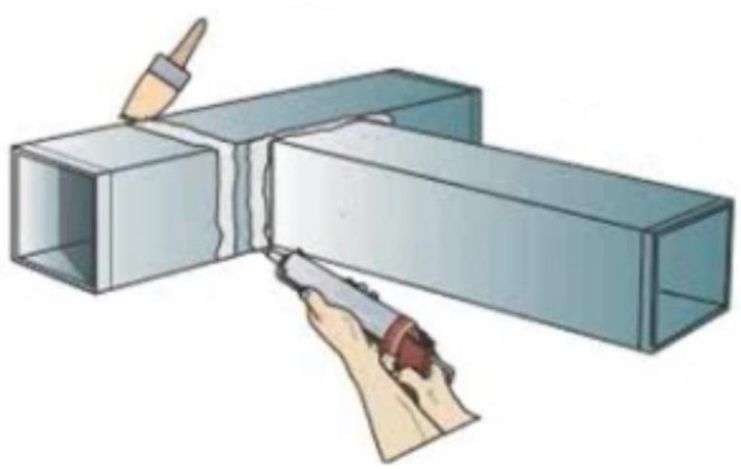
(-) DEPRESSURIZATION INDICATORS:
- Dirty Borders Around Vent Frames Overlap of Vent Boots
- Dirty Perimeter Floor-to-Wall Borders Caused by Infiltration
- "Vent M*ld" / "Suspect Microbial Growth" On Vent Covers
- Surface Condensation Issues and Humidity Control Issues
- Complaints of Frequent Cleaning/Housekeeping Requirements Due to Air Infiltration from Unfiltered Air Sources/Locations
- Backdrafting of Exhaust Fumes, Exhaust Vents, & Chimneys

(-) DEPRESSURIZATION VARIABLES AT PLAY:
- Pressure Differences between Return CFM - Supply CFM
- Tightness of Return Ductwork
- Unrestricted Return Air Pathways
- Tightness of Surrounding Indoor Walls, Partitions, Doors & Windows

(+) PRESSURIZATION INDICATORS:
- Carpet Dirt Lines Underneath Where Room Doors are Closed
- Closed Room Doors In Buildings With A Central Area Return
- Contaminants &/or Odors Migration From (+) to (-) Pressure Rooms
- Increased Energy Waste/Costs Due to Increased Exfiltration
- Reduced Supply CFM Available to Deliver to (+) Pressurized Rooms

(+) PRESSURIZATION VARIABLES AT PLAY:
- Supply CFM (Reduced) as Room (+) Pressurization (Increases)
- Tightness of Duct Run to Conditioned Space It Services
- Tightness of Building Envelope of Conditioned Space.

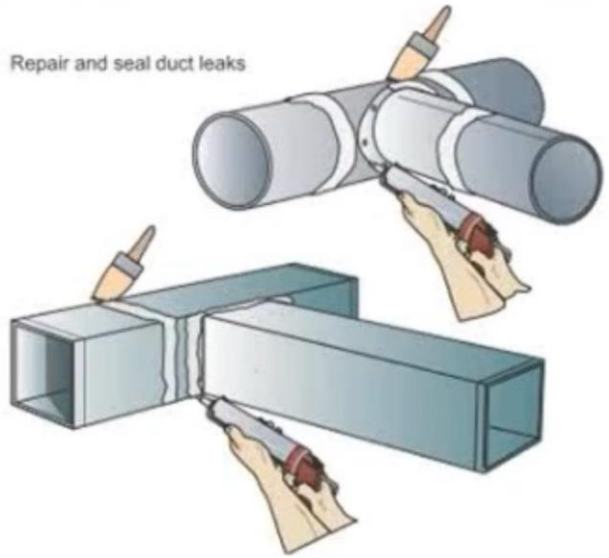
“WTF”

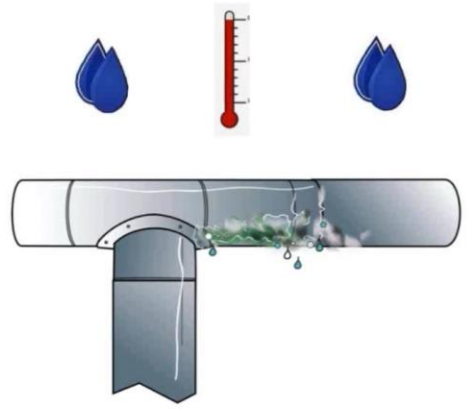


Re-Connect & Seal Leaky Duct Connections

“WTF”

“WTF”





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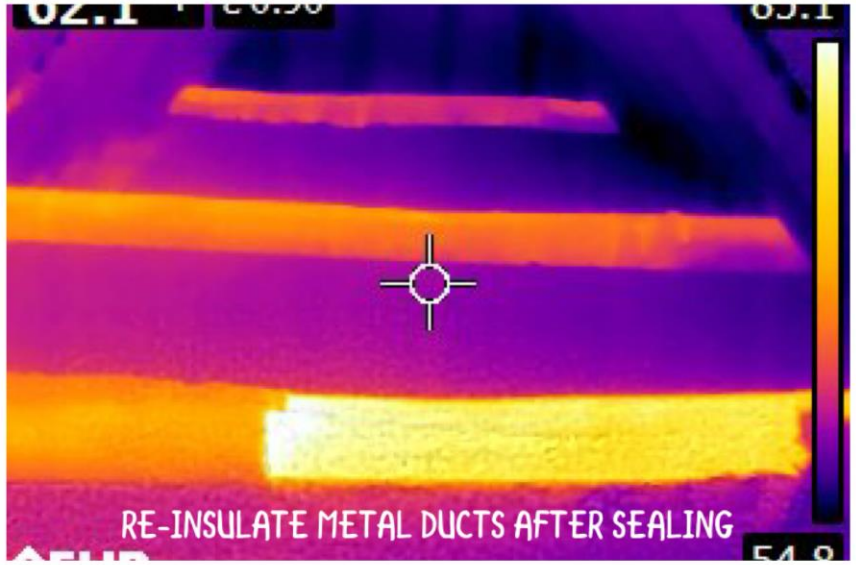
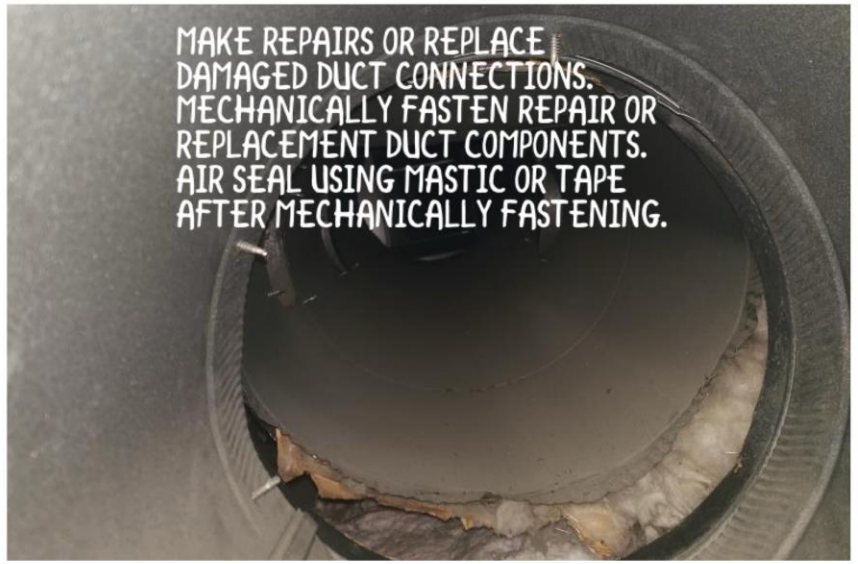
PATCH HOLES, LEAKS, OPENINGS


RE-INSULATE METAL DUCTS AFTER SEALING

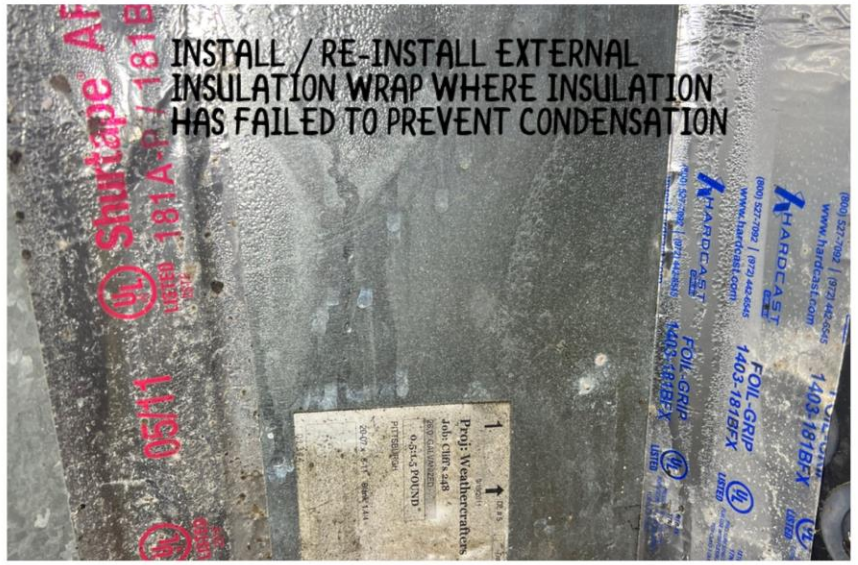

REPAIR / RECONNECT METAL DUCT DISCONNECTIONS

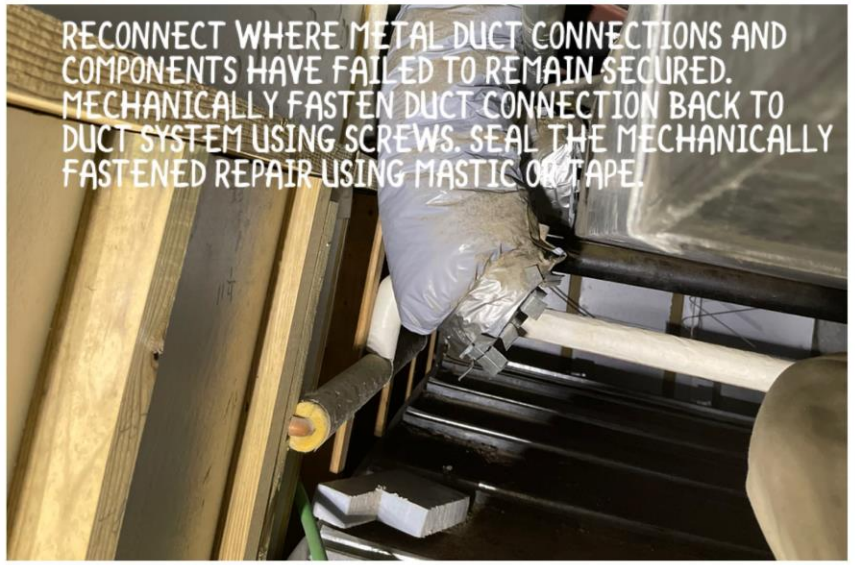

REPLACE METAL DUCT CONNECTIONS OR COMPONENTS
THAT HAVE FAILED AND ARE UNREPAIRABLE

“WTF”


MAKE REPAIRS OR REPLACE
DAMAGED DUCT CONNECTIONS.
MECHANICALLY FASTEN REPAIR OR
REPLACEMENT DUCT COMPONENTS.
AIR SEAL USING MASTIC OR TAPE
AFTER MECHANICALLY FASTENING.


SEAL LEAKY DUCT CONNECTIONS
USING MASTIC/FOIL TAPE


INSTALL / RE-INSTALL EXTERNAL
INSULATION WRAP WHERE INSULATION
HAS FAILED TO PREVENT CONDENSATION
Shurtape
181A-P / 181B
HARDCAST
FOIL-GRIP
1403-181BFX


RECONNECT WHERE METAL DUCT CONNECTIONS AND
COMPONENTS HAVE FAILED TO REMAIN SECURED.
MECHANICALLY FASTEN DUCT CONNECTION BACK TO
DUCT SYSTEM USING SCREWS. SEAL THE MECHANICALLY
FASTENED REPAIR USING MASTIC OR TAPE.

“WTF”
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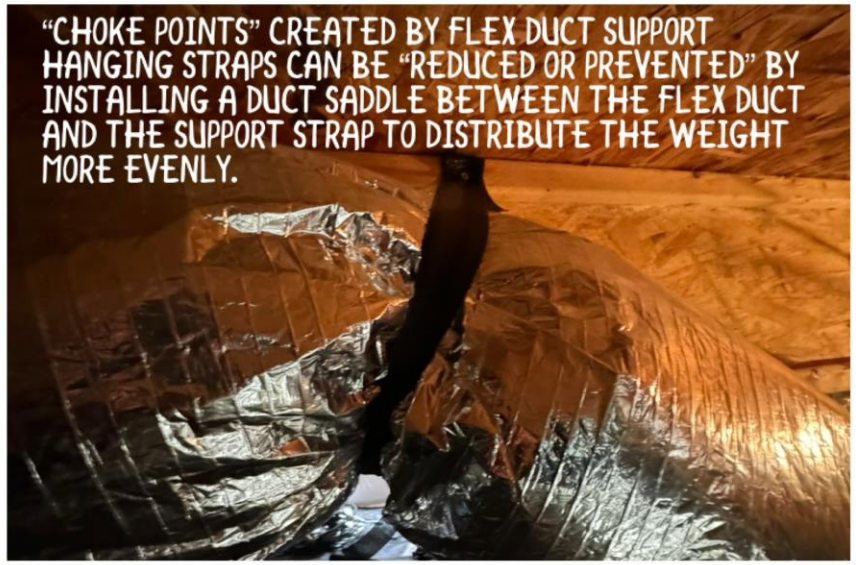
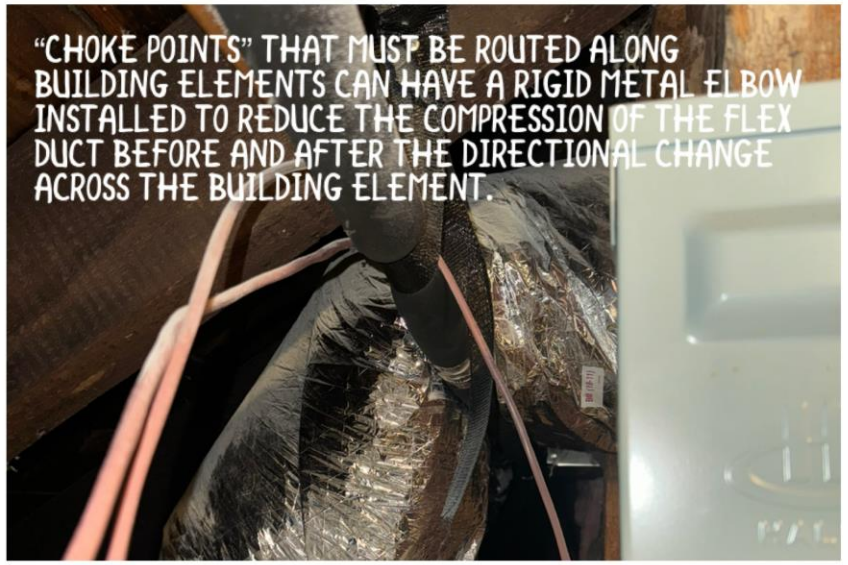
FLEX DUCT CHOKE POINTS





“WTF”

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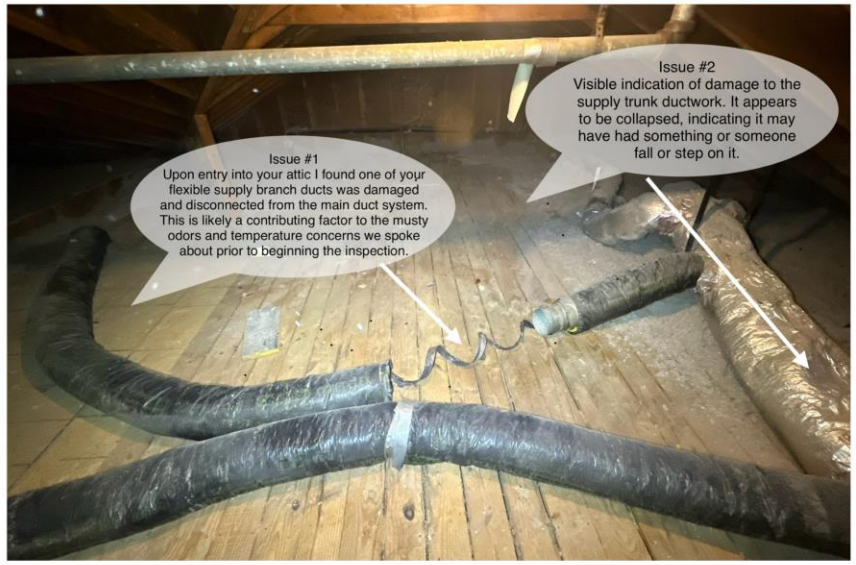
FLEX DUCT DAMAGE BEYOND REPAIR



"WTF"
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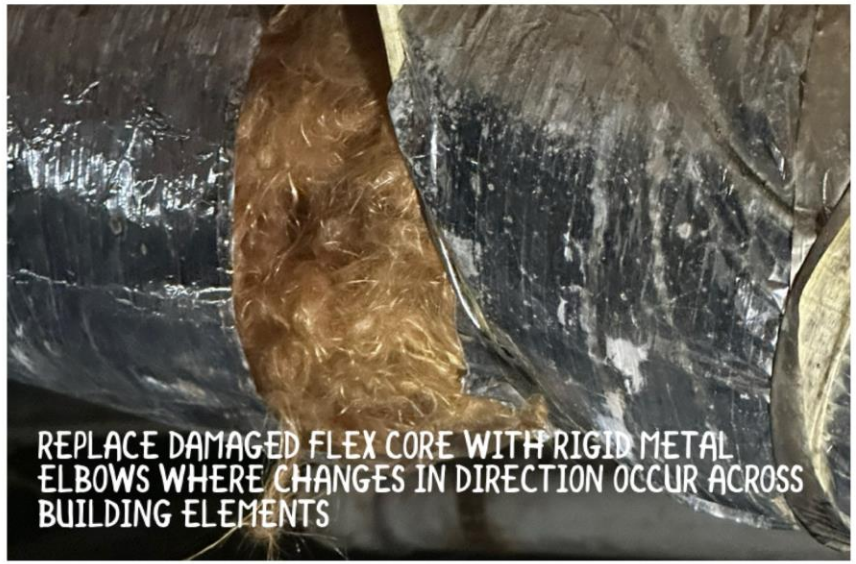
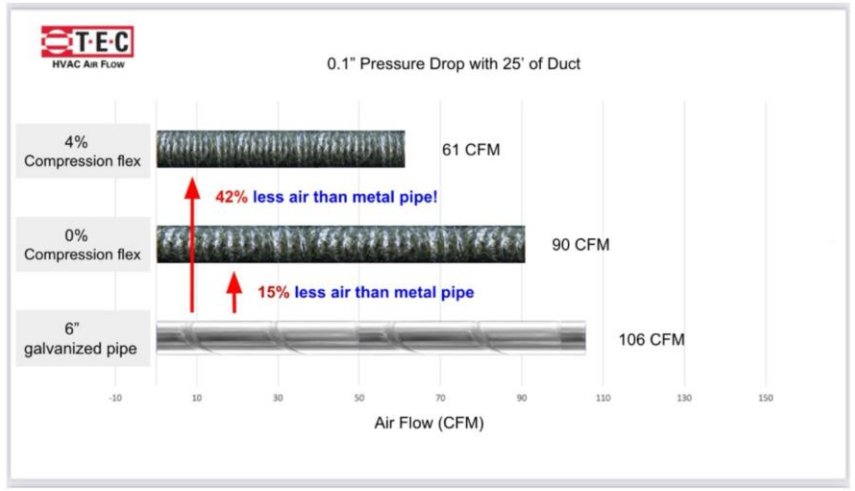
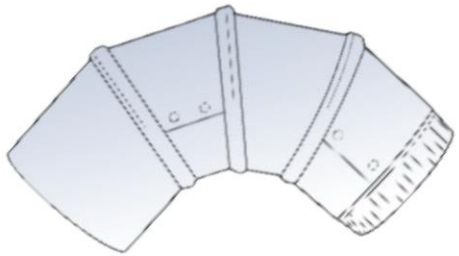
FLEX DUCT SADDLES LENGTH BUILDING ELEMENTS

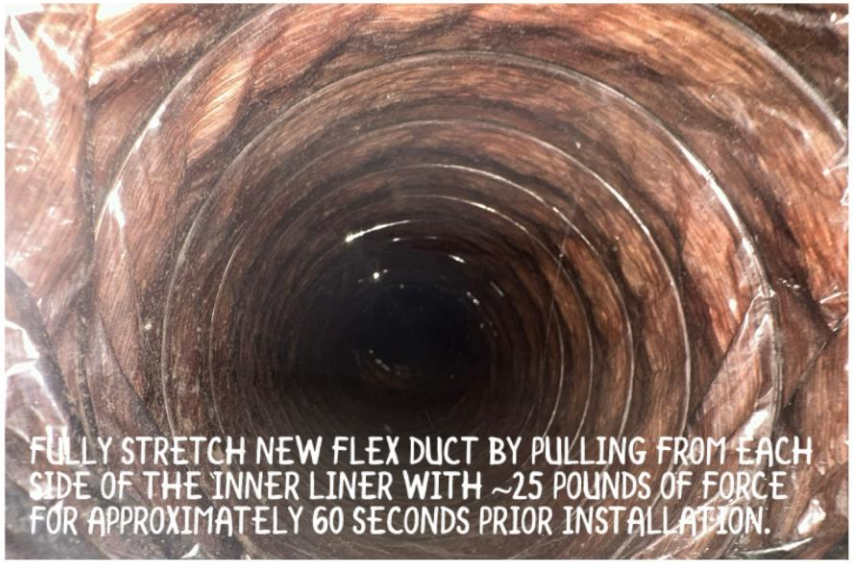




“WTF”
-
FLEX DUCT ELBOWS STRETCH STRAIGHTEN SHORTEN



INSTALL HARD METAL ELBOWS AT SHARP BENDS OR CHANGES IN DIRECTION WHEN POSSIBLE.
INSTALL HARD METAL ELBOWS TO VERTICAL FLOOR VENT BOOT CONNECTIONS WHEN POSSIBLE.
ALWAYS INSTALL FLEX DUCT SUPPORT STRAPS IMMEDIATELY BEFORE AND IMMEDIATELY AFTER A HARD ELBOW CONNECTION.



Microbial Growth

Microbial Growth in Commercial Systems

Microbial Growth

50 microns of biofilm have the potential to create approximately 30% more energy usage due to thermal transfer loss.

Human hair is 50 microns thick!

Microbial Growth

Microbial Growth

Microbial growth

Microbial growth

Title of Presentation

Identifying and Repairing Common Duct System Issues

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- Zach Ortwine
- zach@southeastcas.com

Thank you for Participating!