Efficiency Works™

Estes Park | Fort Collins | Longmont | Loveland

Mobile and manufactured homes building science training

Oct. 8, 2025

Agenda

- Lunch
- Efficiency Works reminders
- Mobile/manufactured home technical training
- Closing remarks

Before we start

Safety and reminders

- In case of an emergency
  - Building evacuation
  - Shelter in place
- Restroom locations
- Beverages and snacks

Meeting logistics

- Conversational throughout
- Big room with lots of people, so please speak up
- We are all coming from different starting points of Efficiency Works program and building science knowledge
  - If you have a question but think it might not be worth asking, it is likely someone else in the room has the same question, so…. ***ASK IT!***

Platte River and Efficiency Works

Efficiency Works operates as the customer-facing energy optimization program for Platte River Power Authority and its owner communities. This strategic alliance combines Platte River's energy expertise with Efficiency Works' innovative customer programming, outreach, education and program models. Together, we're helping to accelerate progress toward a noncarbon energy future.

Platte River Power Authority

Estes Park • Fort Collins • Longmont • Loveland

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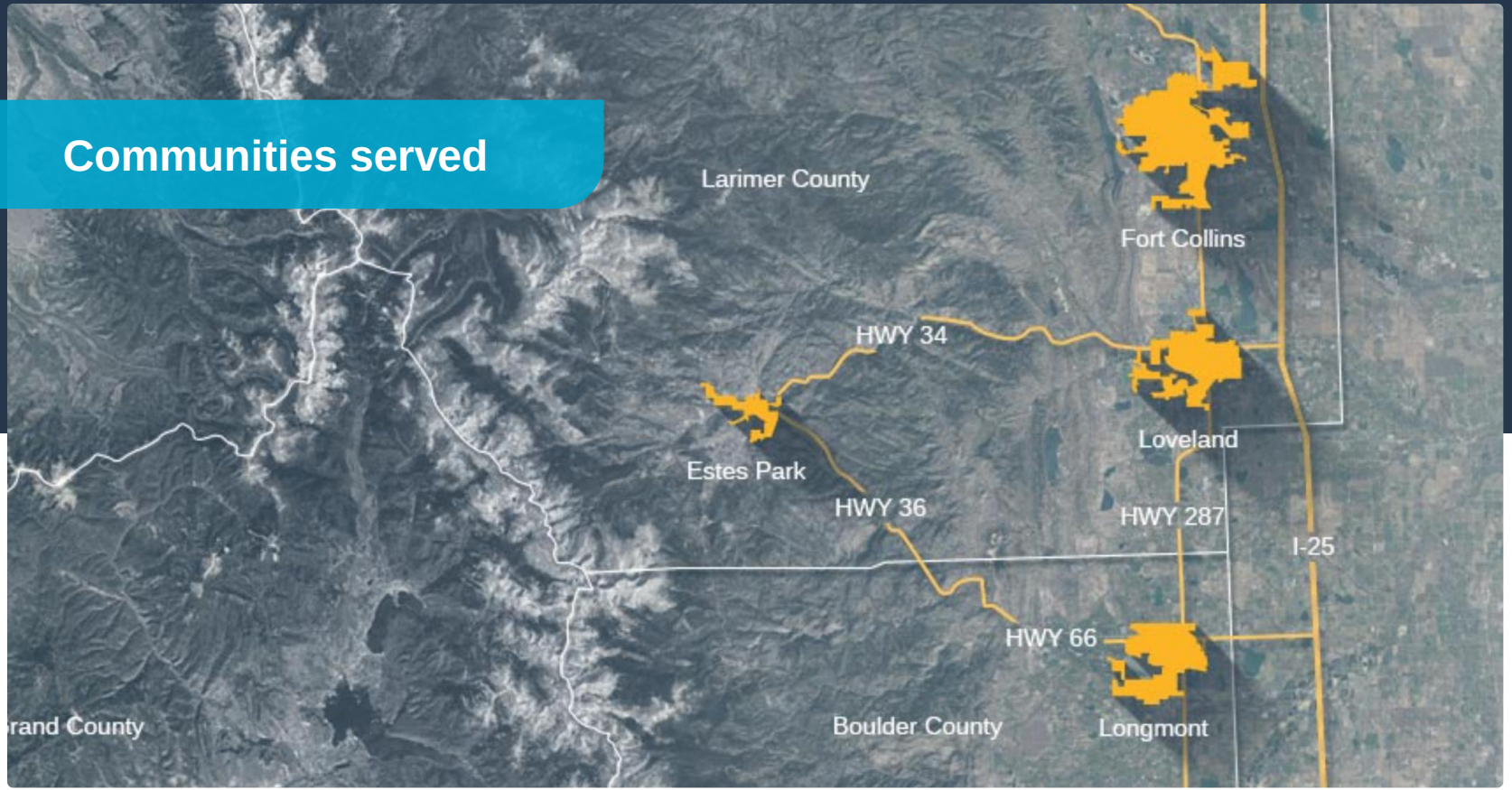
Communities served

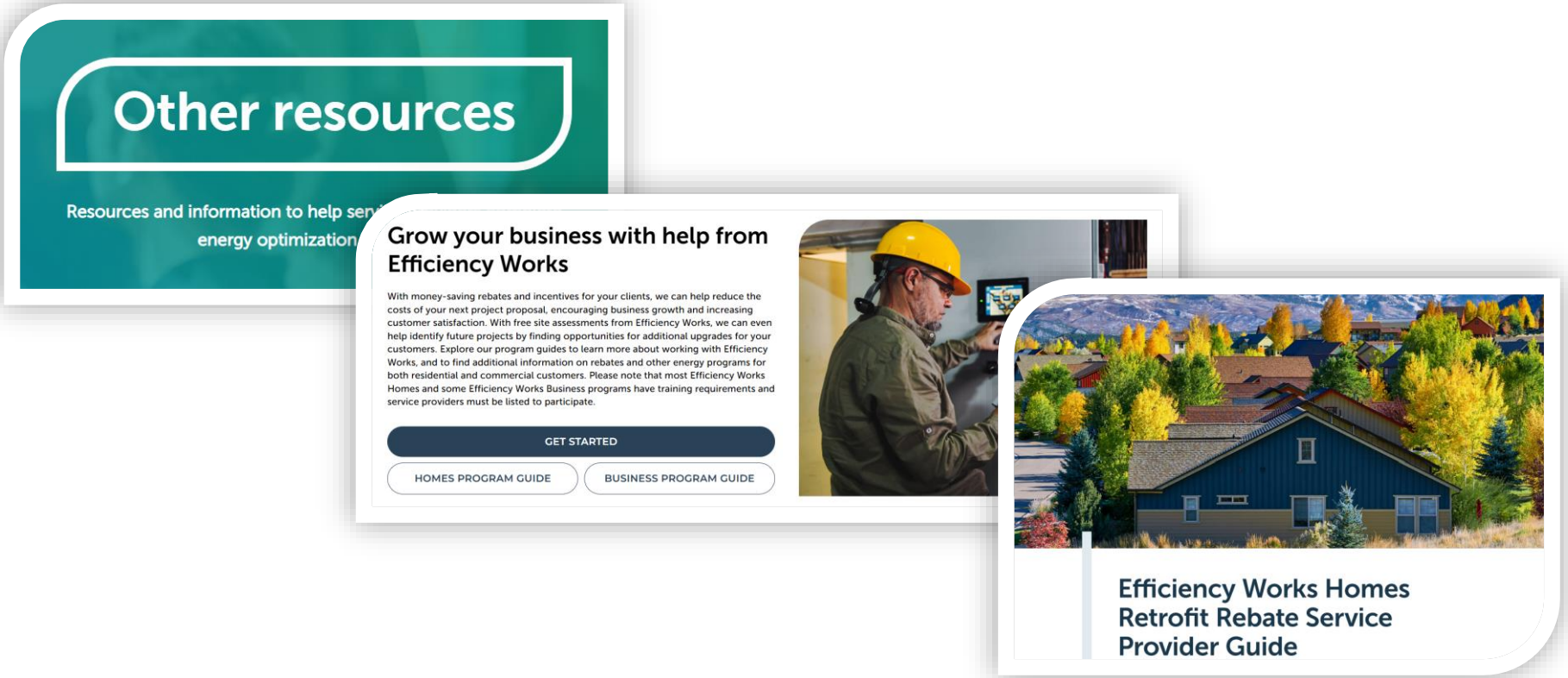


Efficiency Works Retrofit Rebate program

Reminders

- Preapproval requirements
  - Projects > $2,500
  - Rental bonus
  - Funds held for 45 days past the listed completion date
- 45-day submission deadline
  - From date of install or signed terms and conditions
- Required documents:
  - Refer to Homes Program Guide

Service Provider Guide



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Mentor improvement verification (MIV)

Details

- What is it?
  - Personal walkthrough of application submittals and additional program inquiries
- Who’s it for?
  - New/existing office staff who may be applying for Efficiency Works rebates can request an MIV
  - New/existing technicians who will be conducting the technical aspects for the Efficiency Works application can request an MIV

Post installation verification (PIV)

Details

- What is it?
  - Post-installation verification to ensure project measures meet Efficiency Works program criteria
- Who is it for?
  - Customers who recently had an upgrade completed through the Efficiency Works program with a listed service provider
- What occurs?
  - Review of rebated measures against the installation standards documented in the Homes Program Guide
- What are the outcomes?
  - Separate customer and contractor reports
  - Correction notice if installation does not meet minimum requirements

Efficiency Works listed service provider

Requirements

- ✓ Complete a minimum of one project in the Efficiency Works Homes program
- ✓ Attend one Efficiency Works Homes training
- ✓ Consistently pass inspections. Field conditions match the application and supporting documents.
- ✓ Uphold the ethics requirements in the service provider application and agreement
- ✓ Renew service provider application and agreement every two years
- ✓ Maintain general liability insurance policy

Benefits

- ✓ Be listed on the service provider search list
- ✓ Potential referrals and project leads
- ✓ Be the first to know about new program offerings
- ✓ Access to online application status via service provider portal
- ✓ Access to the service provider development grant and other training resources
- ✓ Access to co-branded materials

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Additional resources

Service provider development grant

We want you with us on our journey

Support to continue your team’s growth and skill development within efficiency.

- Up to $2,000 available per service provider per calendar year
- Preapproval is required
- Find an efficiency training and Efficiency Works Homes will help pay for it

Listed service provider	
Annual training maximum:	$2,000
Amount reimbursed for custom training:	50%
Minimum reimbursement:	$75

Trainings and events

Found on Efficiency Works website

Service provider training portal

Free on demand, short videos on selling energy

Year-long license to Selling in six commercial and industrial on-demand sales training

- Industry leading training boiled down into six-minute videos
- Over 100 videos on selling commercial energy upgrades

Additional offerings

- 10 live webinars with recordings available throughout the year
- Monthly mastermind coaching calls
- One-on-one proposal reviews with Mark Jewell

BUILDING PERFORMANCE CENTER

a division of Opportunity Council

8/6/2020

Mobile Home Assessment

Building Performance Center

Your Presenter for Today

- Bruce Manclark
- Earth Advantage

Learning Objectives

By attending this session, participants will:

- Mobile home characteristics and components.
- Discuss problems and opportunities
- Discuss retrofit options.
- Learn about the assessment processS

Mobile Home Characteristics

- Wooden frame bolted to a steel chassis.

Mobile Home Characteristics

- Constructed in long, narrow segments in a factory, delivered and completed on site.

Mobile Home Characteristics

- Shallow roof cavities

Mobile Home Characteristics

- Enclosed Floor cavities.

Mobile Home Characteristics

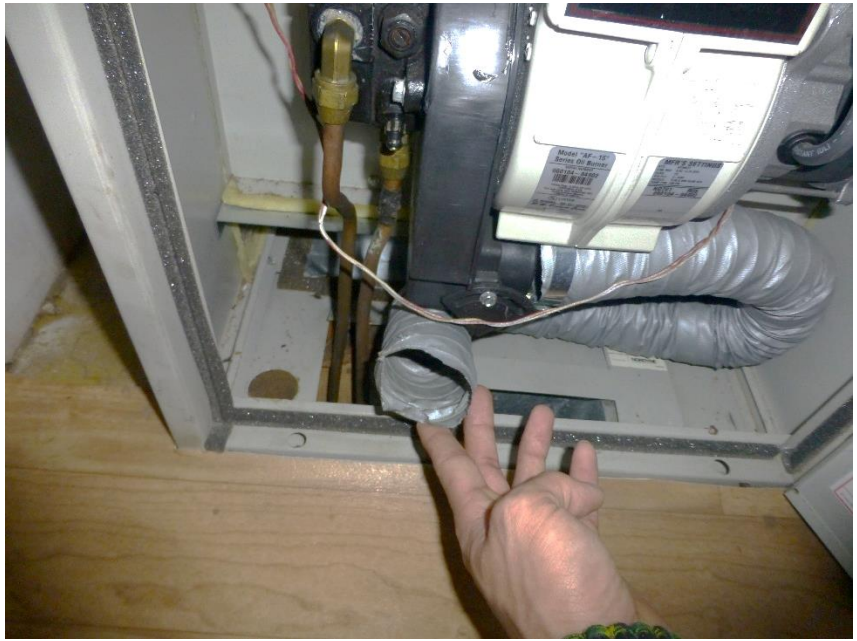
- Interior panels provide structural rigidity.

Mobile Home Characteristics

- No exterior sheathing, no headers.

Mobile Home Characteristics

- Sealed combustion heating systems.
  - closed combustion
  - direct vent



Mobile Home Construction

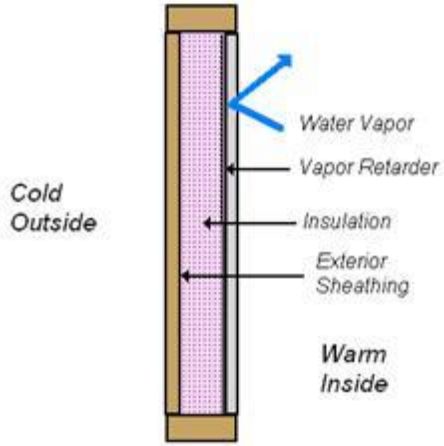
Pre-HUD Code (**before** 1976)

Post-HUD Code (**after** 1976)

Mobile Home Construction

Pre-HUD Code (before 1976)

- Little or no insulation (less than **R-6**).



Vapor Retarder in Exterior Wall

Mobile Home Construction

Pre-HUD Code (before 1976)

- **2x2** or **2x3** stud walls.

Mobile Home Construction

Pre-HUD Code (before 1976)

- Jalousie (slatted windows)

Mobile Home Construction

Pre-HUD Code (before 1976)

- Little or no attic venting.

Mobile Home Construction

Pre-HUD Code (before 1976)

- Often no mechanical ventilation.

Mobile Home Construction

HUD Code and Upgrades (**post** 1976)

- Set insulation standards per climate zones.

Mobile Home Construction

HUD Code and Upgrades (**post** 1976)

- Bathroom and kitchen exhaust fans.

Mobile Home Construction

HUD Code and Upgrades (**post** 1976)

- Vapor barriers in ceiling.

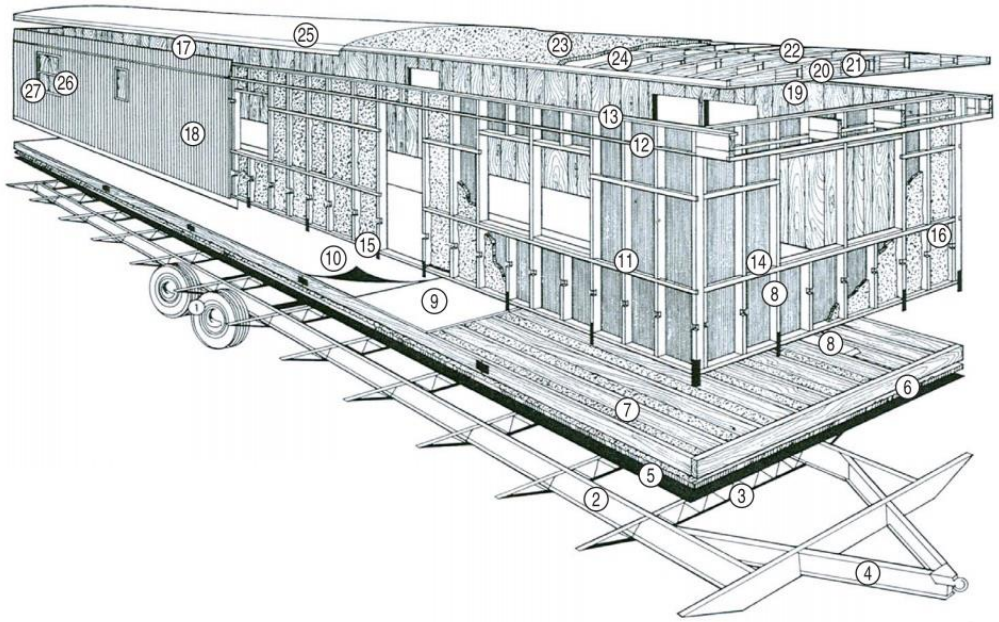
Mobile Home Construction

HUD Code and Upgrades (**post** 1976)

- Some attic venting.

Mobile Home Construction

- Wooden Floor frame on steel chassis



Mobile Home Construction

- Road Barrier protects
  - Heating
  - Electrical
  - Plumbing
  - Insulation

Mobile Home Construction

- Road Barrier protects
  - Heating

Heating Duct

Mobile Home Construction

- Road Barrier protects
  - Electrical

Mobile Home Construction

- Road Barrier protects
  - Plumbing

Mobile Home Construction

- Road Barrier protects
  - Insulation

Mobile Home Construction

- Windows
  - Metal framed
  - Single pane
  - Jalousie
  - Mounted on top of siding

Mobile Home Construction Summary

Pre-HUD Code (before 1976)

- Little or no insulation (less than R-6).
- 2x2 or 2x3 stud walls.
- Jalousie windows.
- Often no attic venting.
- Often no mechanical ventilation.

HUD Code and Upgrades (**post** 1976)

- Set insulation standards per climate zones.
- 2x4 exterior walls and single-hung slider windows.
- Bathroom and kitchen exhaust fans.
- Vapor barriers in ceiling.
- Some attic venting.
- R-8 or better insulation

Problems and Opportunities

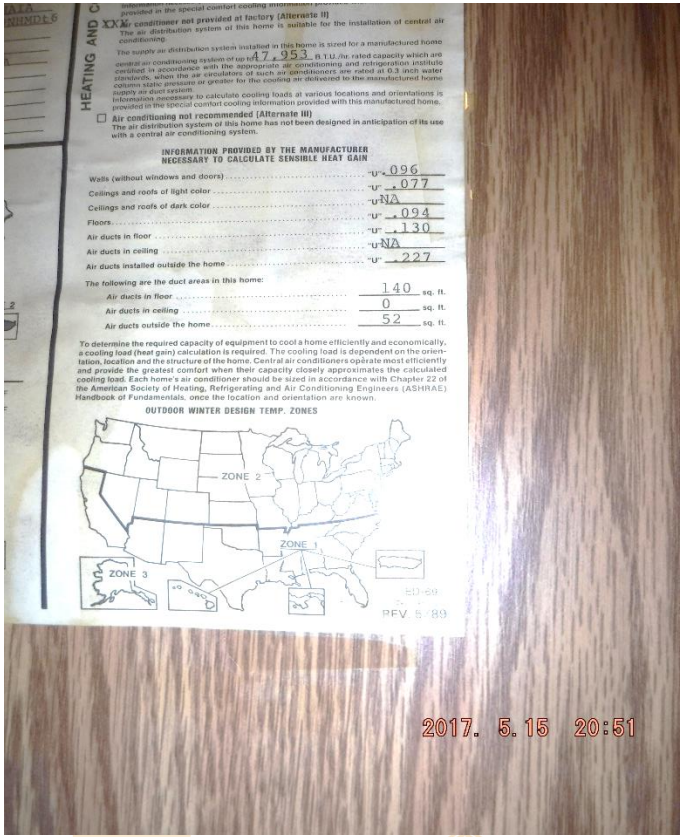
Mobile homes built before 1976

consume 1.5 to 2 times more energy than a site-built home.

Why?

Problems and Opportunities

- Low thermal mass (thin and poorly insulated floors, walls, and ceilings).



Problems and Opportunities

- Poor duct design, components, and installation.

Problems and Opportunities

- Poor quality plumbing materials

Retrofit Options

- What saves energy for the client?

Retrofit Options

- Duct systems
  - Sealing and repair
  - Conversion of cavity returns
  - Removing obstructions
  - Replace damaged registers
  - Duct cleaning

Retrofit Options

- Floor insulation
  - Air sealing
  - Road barrier repair
  - Dryer vent repair
  - Duct and pipe insulation

Retrofit Options

- Attic insulation
  - Air sealing
  - Fan installation
  - Re-roofing with insulation
  - Minor leak repair

Retrofit Options

- Sidewall
  - Air sealing
  - Re insulate walls
  - Window and door replacement

Mobile Home Assessment

- Health and safety

Mobile Home Assessment

- Health and safety
  - Electrical

Mobile Home Assessment

- Health and safety
  - Excessive moisture

Mobile Home Assessment

- Health and safety
  - CO and smoke detectors

Health and Safety Summary

- Fire
- Electrical
- Moisture
- IAQ
- Slips trips and falls
- CO and smoke detectors
- Pests

Exterior Summary

- Construction era (look for a certification label).
- Type and condition of the siding, windows, doors.
- Drainage around home
- Access and Accessibility for work
- Skirting or foundation type

Mobile Home Assessment

- Floor cavity
  - Standing water sewage

Floor Cavity Summary

- Condition and type of road barrier
- Insulation level and condition
- Joist direction
- Electrical
- Plumbing type condition location
- Condition of structure
- Clearance, accessibility
- Standing water sewage
- Dryer vent

Mobile Home Assessment

- Interior
  - Type of return air

Mobile Home Assessment

- Interior
  - Mechanical ventilation

Mobile Home Assessment

- Interior
  - Furnace condition, location

Mobile Home Assessment

- Interior
  - Water heater condition, location

Interior Summary

- Type of return air
- Condition of boots and registers
- Air sealing opportunities
- Electrical panel, issues
- Mechanical ventilation
- Furnace condition, location
- Water heater condition, location

Mobile Home Assessment

– Blower door, air leakage

Mobile Home Assessment

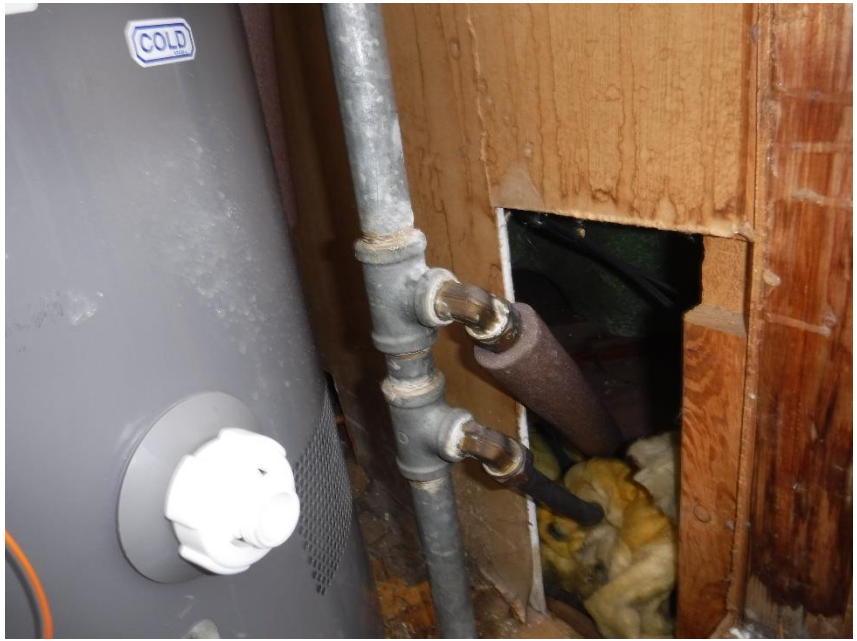
– Pressure pans

Mobile Home Assessment

– Duct tester, duct leakage

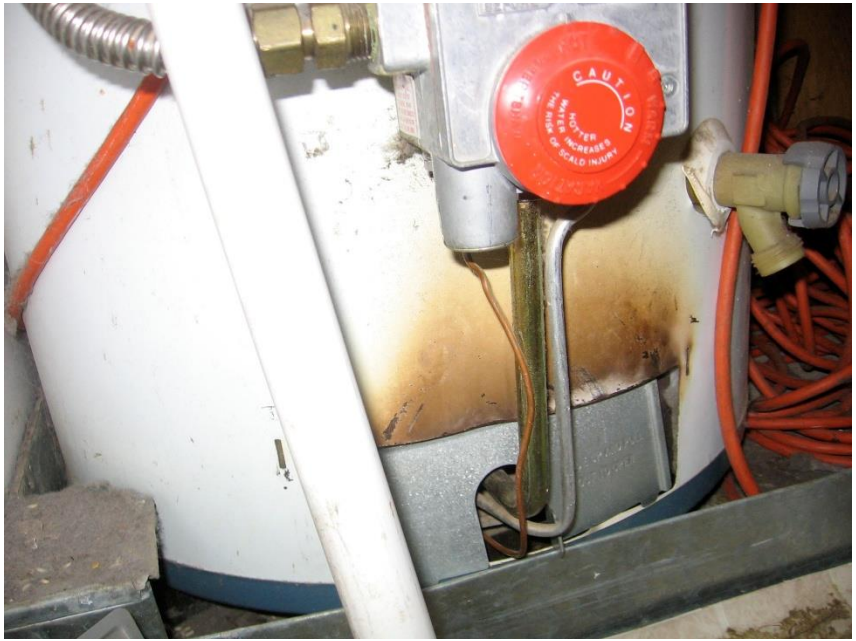
Air / Duct Leakage Summary

- Visual
- Blower door, air leakage
- Pressure pans
- Duct tester, duct leakage
- HVAC diagnostics



Mobile Home Assessment

- Combustion Safety



END

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8/3/2020

Mobile Attic Cavity Retrofit

Building Performance Center

Learning Objectives

By attending this session, participants will be able to:

- Differentiate between the two primary types of Mobile Home attics.
- Recognize the four truss types in mobile homes.
- Demonstrate the ability to assess building features and condition for a safe durable installation.
- Estimate the materials needed for the project.
- Learn about specialized tools and materials.
- Locate relevant work quality standards.
- Explore other methods for accessing the attic cavity.

Mobile Home Attic Retrofit

Re-insulating roof cavities on pre and post 1976 mobile homes is cost-effective.

The benefits include:

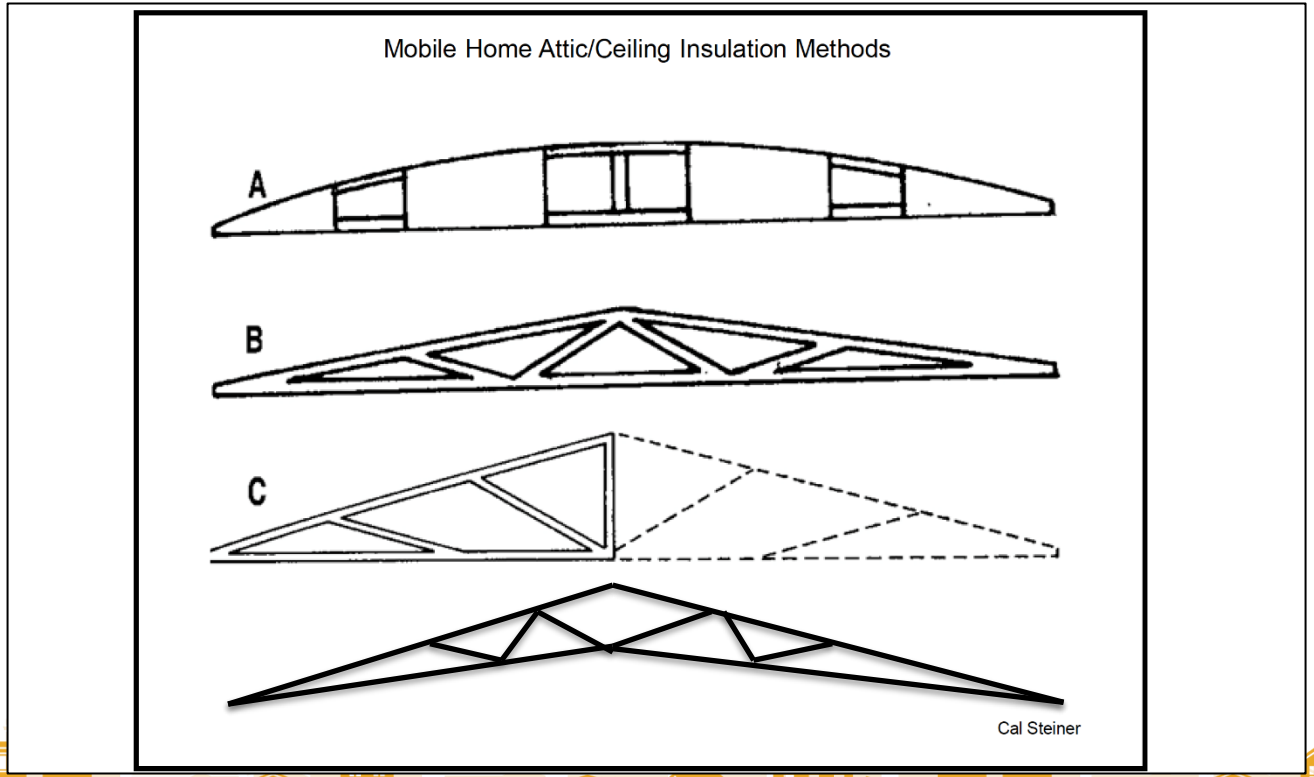
- Increases thermal performance
- Provides heating and cooling savings
- Can reduce “roof rumble”
- Fairly easy to do compared to other measures

Mobile Home Attic Retrofit

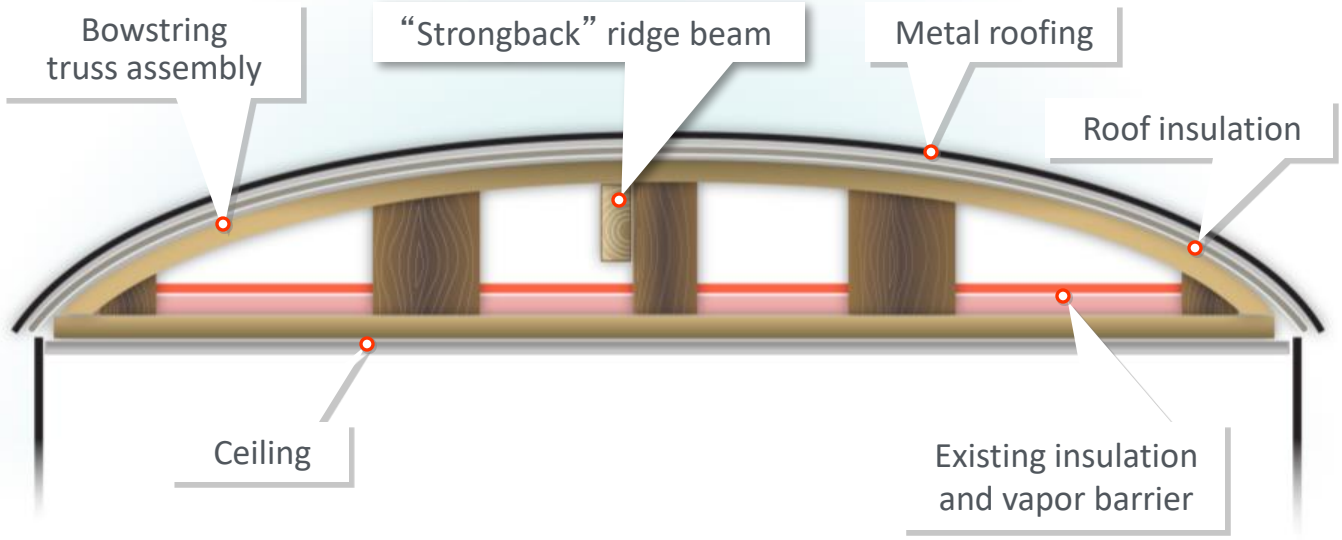
Open Attic Cavity

Closed Attic Cavity

Mobile Home Attic Retrofit

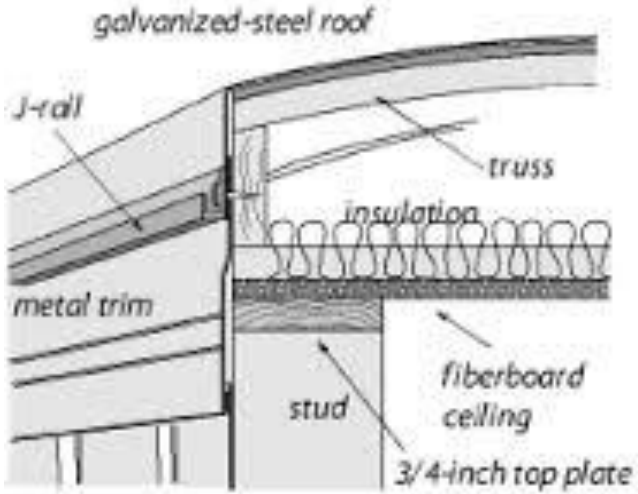


Mobile Home Attic Retrofit



Bowstring truss

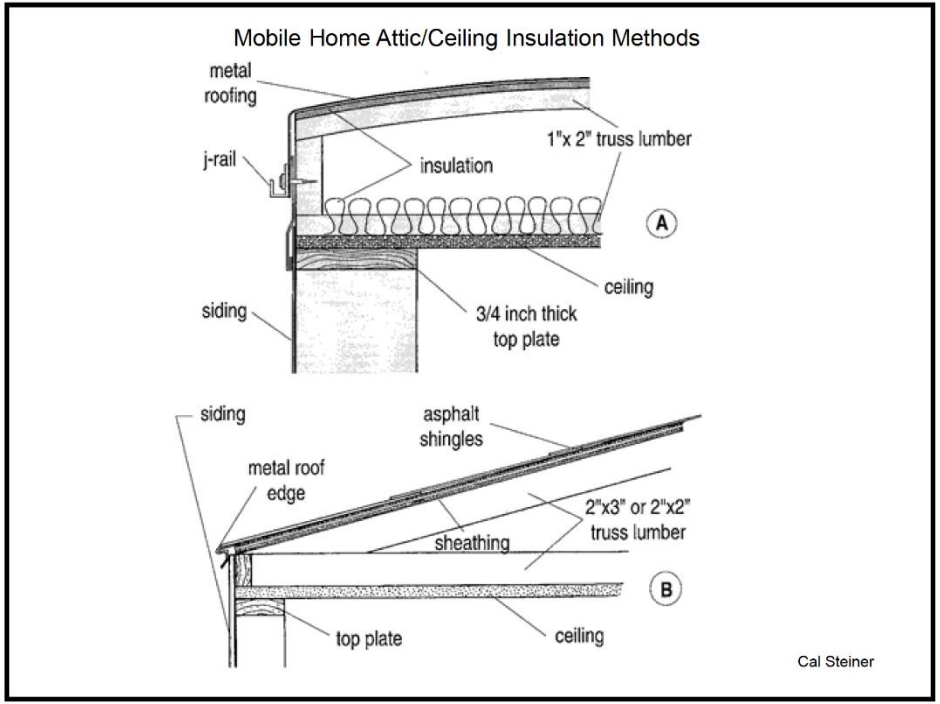
Mobile Home Attic Retrofit



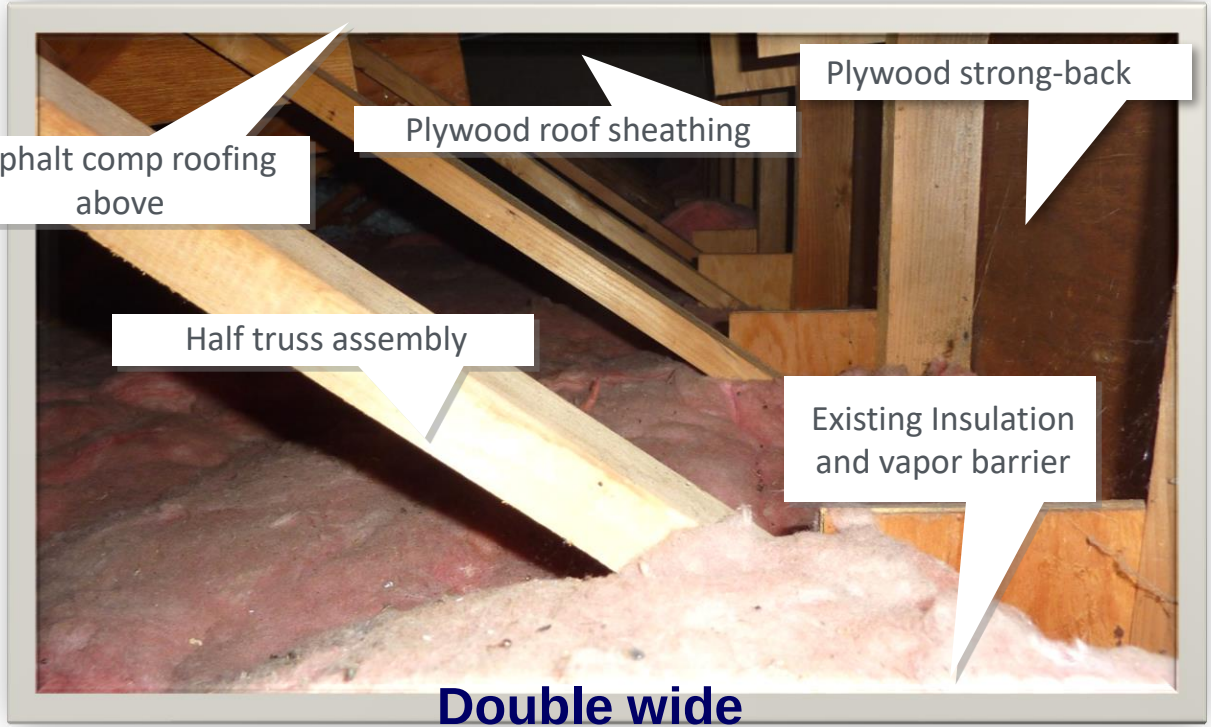
Bowstring roof details:
Hundreds of thousands of older mobile homes were constructed with these general construction details.

Bow string truss

Slope Truss


Mobile Home Attic/Ceiling Insulation Methods
metal roofing
j-rail
insulation
1"x 2" truss lumber
A
ceiling
siding
3/4 inch thick top plate
siding
asphalt shingles
metal roof edge
2"x3" or 2"x2" truss lumber
sheathing
B
top plate
ceiling
Cal Steiner

Sloped truss



Double wide

Sloped truss

Factory before insulation and roof

Sloped Truss

Sloped Truss

Mobile Home Attic Retrofit

Assess Conditions before work

- Fire
- Electrical
- Hazardous Materials
- Moisture
- Structural
- Roof

Mobile Home Attic Retrofit

Assess Conditions

- Fire Hazards.

- Woodstove Chimneys
- Recessed lights

Mobile Home Attic Retrofit

Assess Conditions

- Electrical Hazards.

- Aluminum wiring
- Open boxes
- Open splices

Mobile Home Attic Retrofit

Assess Conditions

- Moisture Issues.

- Leak or
- Condensation ?

Mobile Home Attic Retrofit

Assess Conditions

- Moisture Issues.

- Leak or
- Condensation ?

Mobile Home Attic Retrofit

Assess Conditions

- Moisture Issues.

- Leak or
- Condensation ?

Mobile Home Attic Retrofit

Assess Conditions

- Moisture Issues.

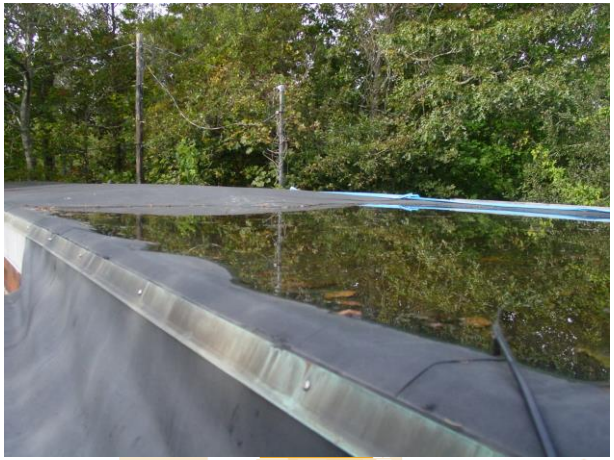
- Leak or
- Condensation ?

Mobile Home Attic Retrofit

Assess Conditions

- Structural Issues.

- Truss failure



Mobile Home Attic Retrofit

Assess Conditions

- Roof condition.

Mobile Home Attic Retrofit

Assess Conditions

- Check out the attic cavity.
- From outside

Mobile Home Attic Retrofit

Assess Conditions

- Check out the attic cavity.
- From outside

Mobile Home Attic Retrofit

Assess Features and Conditions

- Check out attic cavity from outside

Mobile Home Attic Retrofit

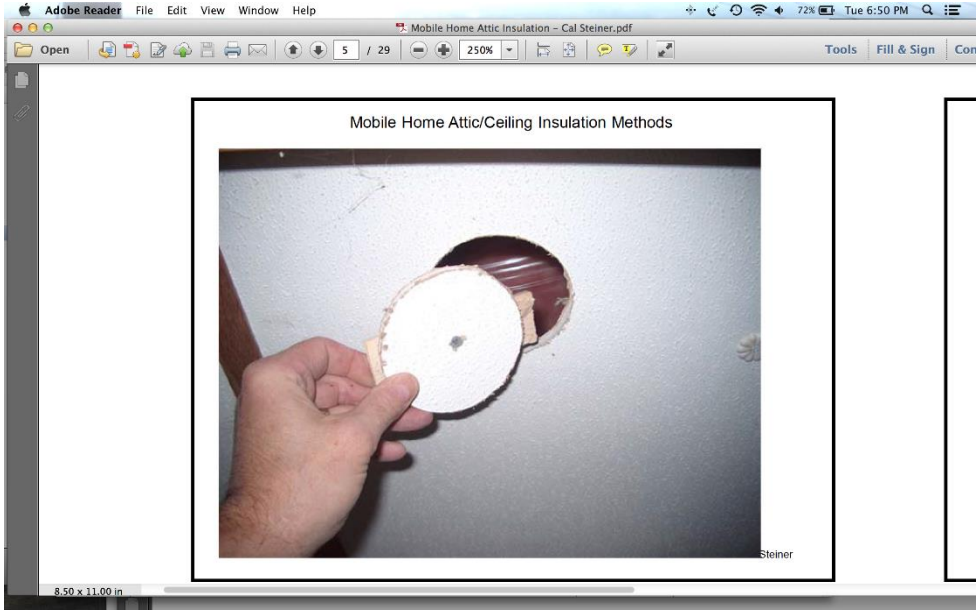
Assess Features and Conditions

- Inspect from outside

Mobile Home Attic Retrofit

Assess Conditions

- Check out the attic cavity
- Inside method.



Mobile Home Attic Retrofit

Now is a good time to replace a defective bathroom fan.

Mobile Home Attic Retrofit

- Air sealing

Mobile Home Attic Retrofit

- Air sealing

Mobile Home Attic Retrofit

- Air sealing

Mobile Home Attic Retrofit

- Calculate Volume
- Calculate Target Bag Count
- @Density 1.25-1.75lb/cuft

Mobile Home Attic Retrofit

Mobile Home Attic Retrofit

Photos courtesy of WV GOEO

Fit the flexible insulation hose into the bell end of the fill tube…..

…..and duct tape the joint

Mobile Home Attic Retrofit

Cut a taper on the end of the tube to get past obstructions

The Edge Lift Method

The Edge Lift Method


Loosen the gable edge to lift the roof
Photo courtesy of WV GOEO

Open the roof cavity about 4” and jack up the roof edge with scrap 2 x 4 lumber

Work the fill tube past the strongback…

…until it makes contact with the opposite wall

Pull back 4-6” and begin filling

Ensure the roof will close to original position

A small work crew can fill and close up at the same time


Keep hands back
from the edge and wear
safety equipment.
Photo courtesy of WV GOEO

Apply putty tape to the back of the gutter before fastening

Photo courtesy of WV GOEO

Top Fill Method

Photo courtesy of PA WTC

Top Fill Method – Specialized Tools & Materials


Photo courtesy of PA WTC

- Flexible 8-foot, 2” diameter fill tube
- High-temperature silicone caulk
- Galvanized steel roofing pieces
- Self-tapping galvanized screws
- Fiberglass mesh
- Elastomeric roof coating

Top Fill Method

Top Fill Close Up

Top Fill Close Up

Top Fill Close Up

Top Fill Close Up

Top Fill Close Up

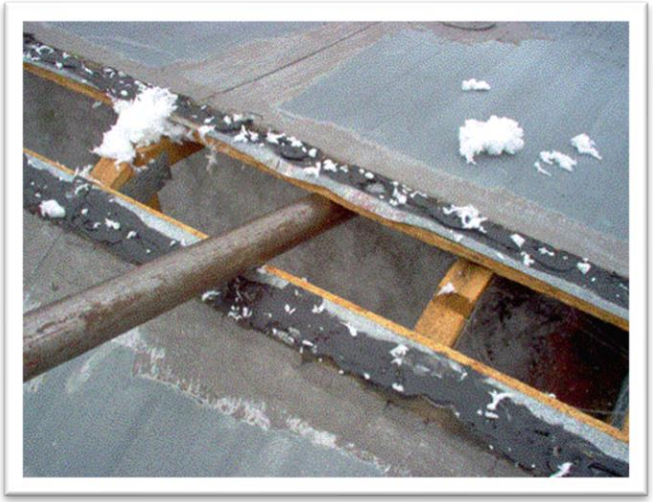
Top Fill Close Up

Top Fill Close Up

Top Fill Close Up

Top Fill Method

Ridge Method



Accessing the ceiling truss cavity through the roof ridge allows the installer to insulate the entire cavity

Ceiling Method

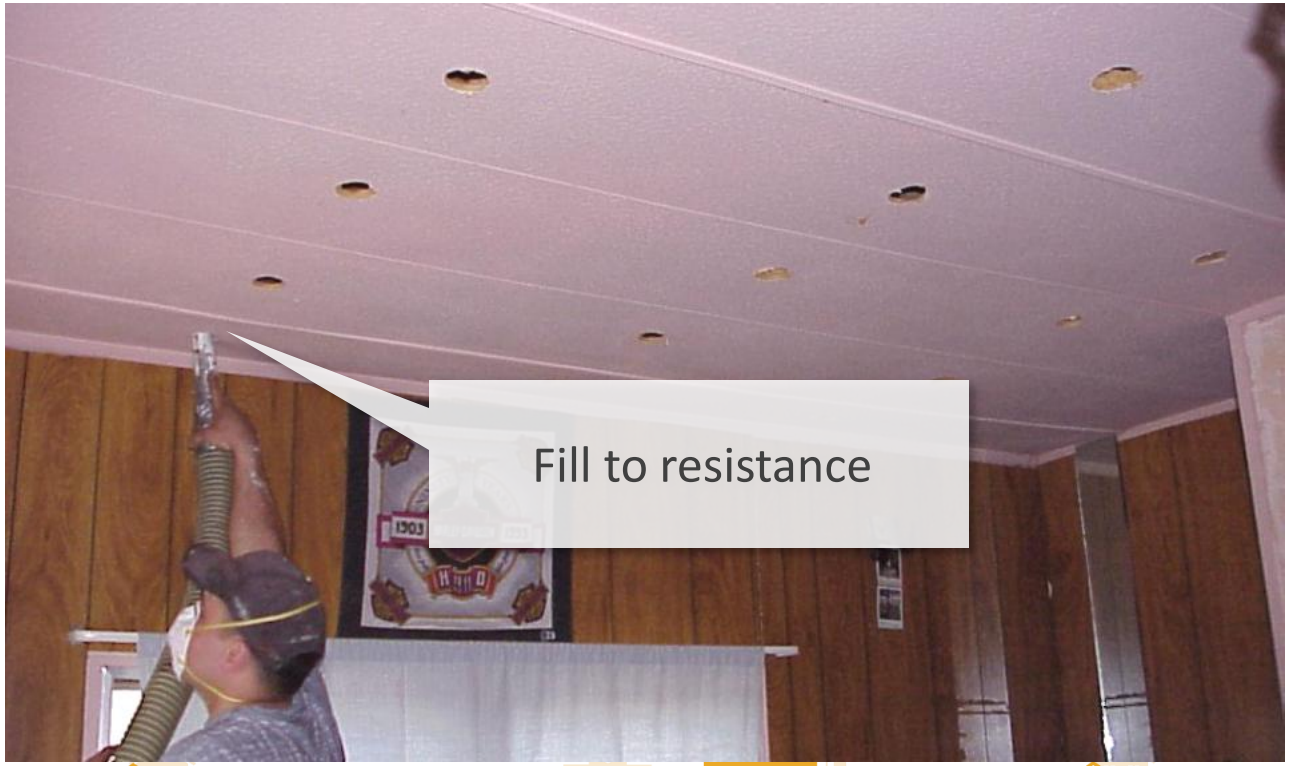
"Blowing from the inside!"

Ceiling Method

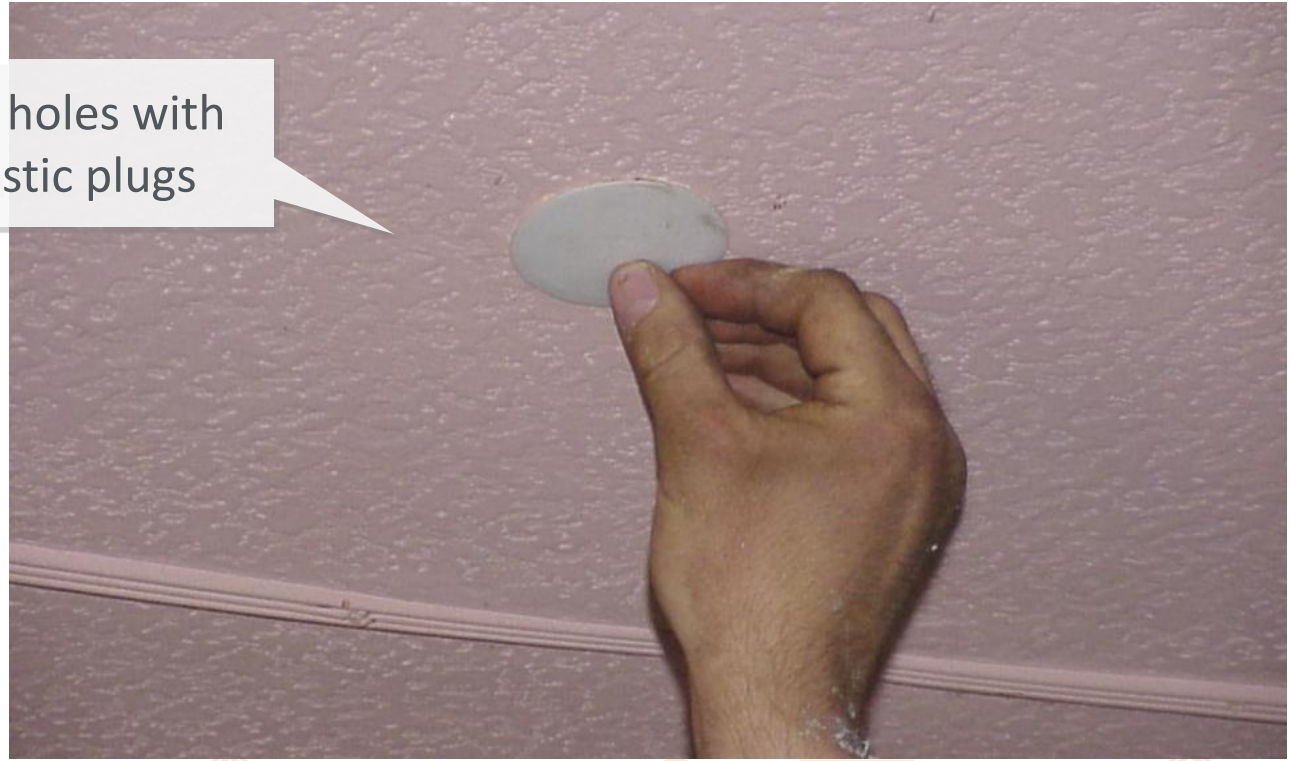
- Drill 2-inch holes at 16 inches on center with a hole saw bit
- Space holes 3-feet apart
- Keep holes 2-feet from the edge
- Space holes evenly

Photo courtesy of WV GOEO

Ceiling Method



Ceiling Method



Ceiling Method

- Cover the client's belongings
- Check the integrity of the ceiling and seal all interior leaks
- Drill a series of holes evenly across the ceiling
- Fill the cavity
- Seal holes with plastic plugs

Gable End Method

- Set up a scaffold at the end of the home
- Remove siding from the gable end
- Assemble sections of non-conductive 2” gray PVC pipe to equal the length of the home
- Push the pipe assembly into the cavity toward the other end of the home
- Fill the cavity with insulation along the entire length and width of the home
- Reinstall gable end siding

Gable End Method

Gable End Method

Gable End Method

Close Up Gable End

Don’t do this

Summary

- Insulating roof cavities where practical and possible is cost-effective.
- Insulating roof cavities can result in significant heating and cooling savings.
- Prepare for roof insulation by inspecting interior ceilings to avoid blow outs.
- Access roof cavities through gable ends, the top, or from inside the home.
- Seal all penetrations to prevent future leaks.
- Have the right tools and materials on hand.

The End

Photos courtesy of PA WTC

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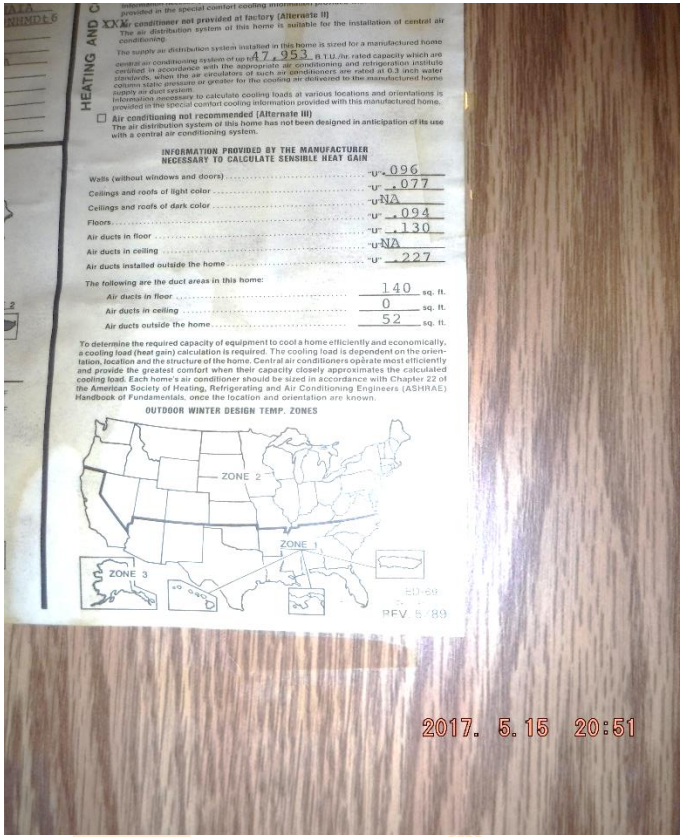
8/4/2020

Mobile Home Floor Cavity Insulation

Building Performance Center

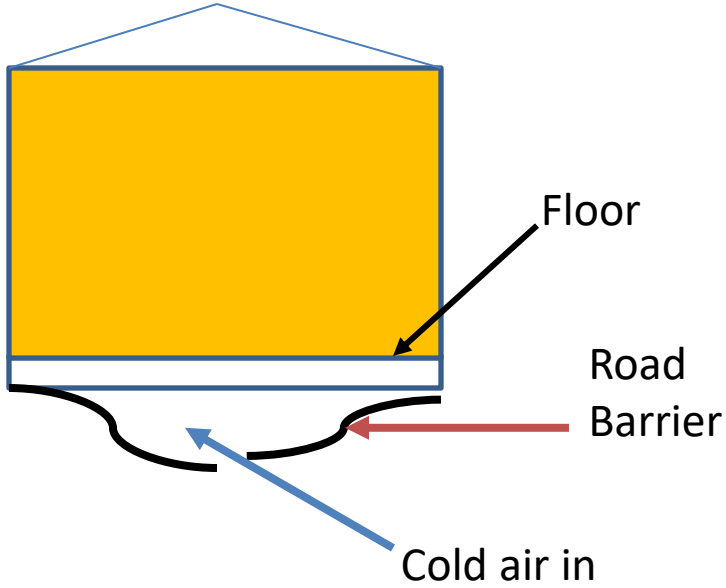
Floor Cavity Problems

- Poorly insulated floors



Floor Cavity Problems

- Pressure boundary is the floor
- Insulation 6-12” below
- Cold air bypasses insulation layer



Floor Cavity Problems

- Poor quality plumbing materials
  - Leads to damage of the road barrier

Floor Cavity

- Remember the road Barrier protects
  - Heating
  - Electrical
  - Plumbing
  - Insulation

Floor Cavity Assessment

- Condition of structure
  - Piers
  - Look stable
  - Somewhat level

Floor Cavity Assessment

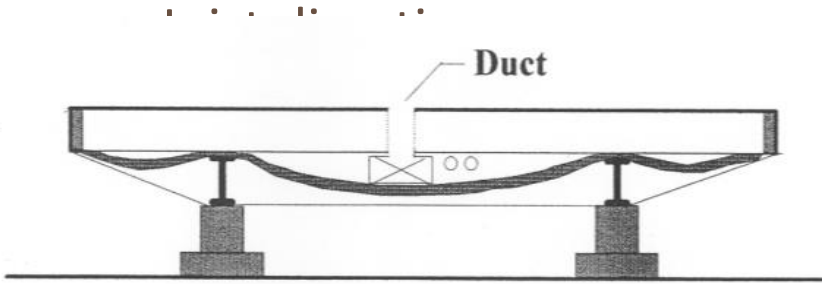
- Condition of structure
  - Framing
  - Repairs done or needed
  - Dry rot
  - Wet

Floor Cavity Assessment

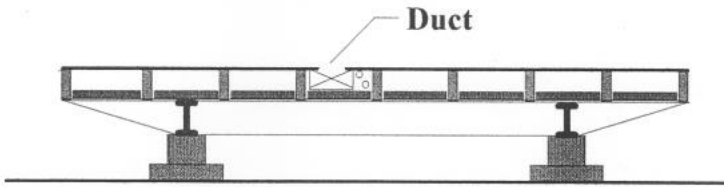
- Condition of structure
  - Large holes in subfloor
  - Safety

Floor Cavity Assessment

Cross-wise / more volume



Length-wise / less volume



Floor Cavity Assessment

- Road Barrier
  - General condition
  - What's it made of?
  - Hard
  - Soft

Floor Cavity Assessment

- Road Barrier
  - Can we use it for our retrofit?
  - Can it hold the weight?
  - How much weight is there?

Floor Cavity Assessment

- Road Barrier
  - How much needs repair?

Floor Cavity Assessment

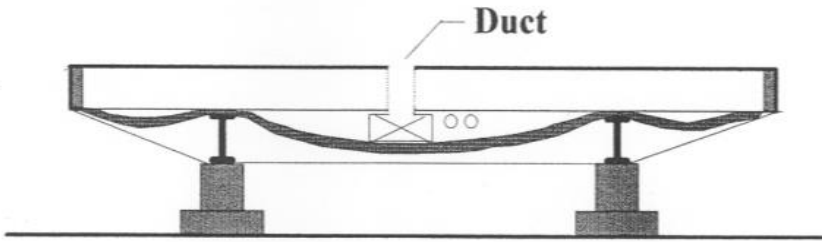
- Road Barrier
  - Should we start over?

Floor Cavity Assessment

- Floor cavity insulation
  - Blanket
  - Blown
  - Encapsulated

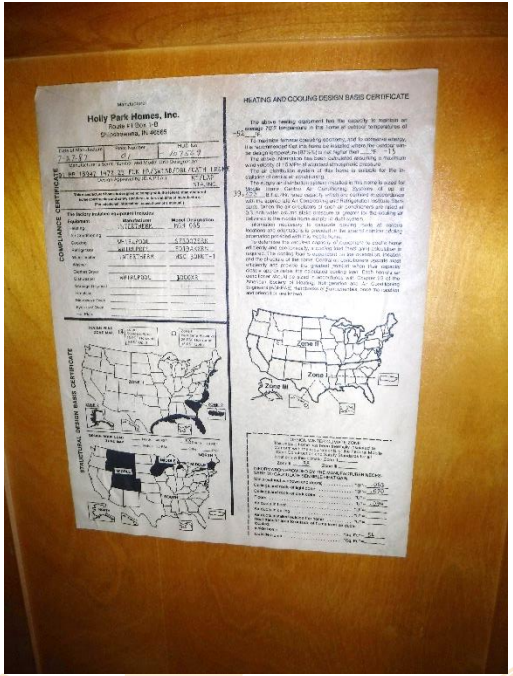
Floor Cavity Assessment

- Floor cavity insulation
  - Blanket



Floor Cavity Assessment

- Floor cavity insulation
  - Existing insulation R-value



Floor Cavity Assessment

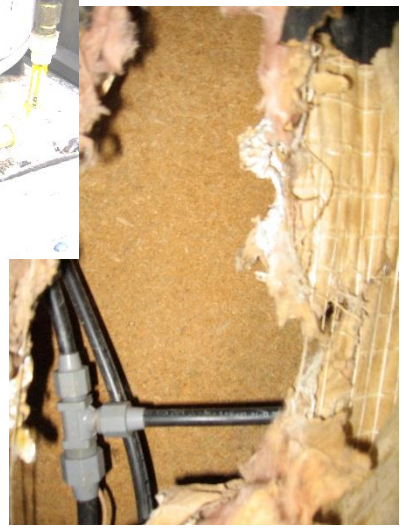
- Floor cavity insulation
  - Existing Insulation condition
  - De rate insulation that's trashed
  - De rate if large holes in road barrier

Floor Cavity Assessment

- Floor cavity
  - Electrical
  - Location

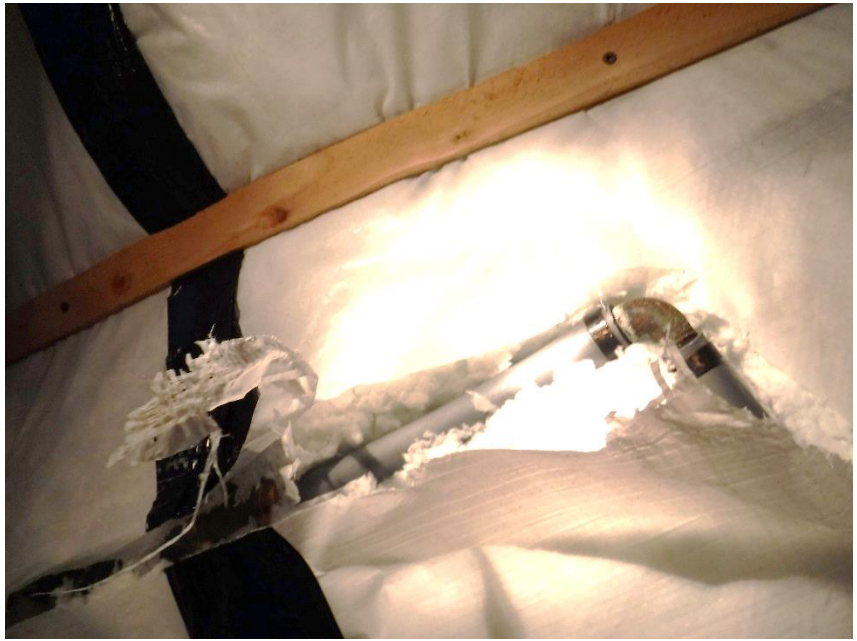
Floor Cavity Assessment

- Plumbing
  - Polybutylene
  - Copper
  - PVC
  - CPVC
  - Galvanized



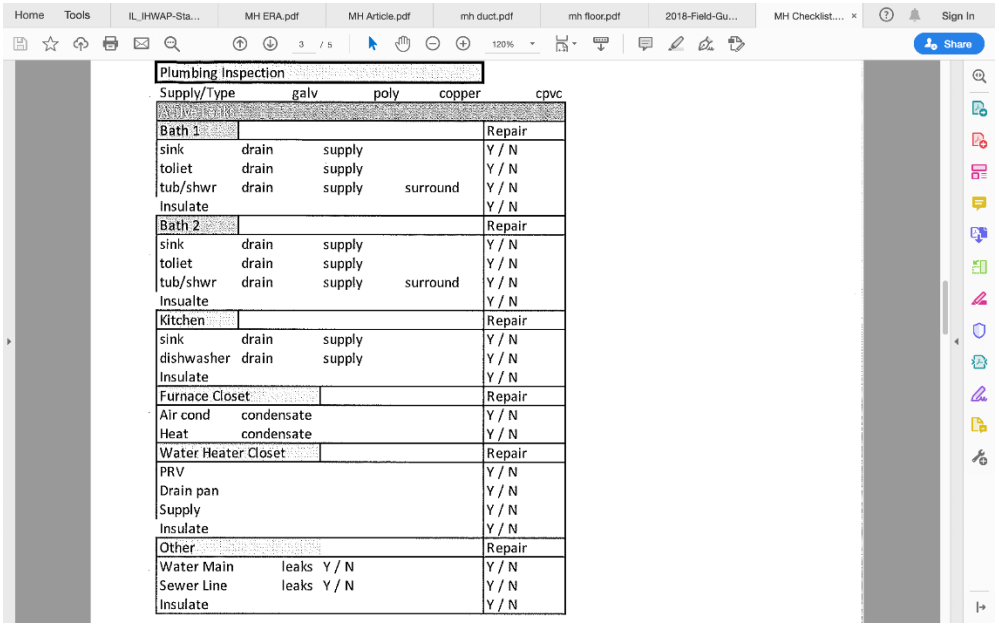
Floor Cavity Assessment

- Plumbing
  - Location
  - 3” of insulation below pipes



Floor Cavity Assessment

- Floor cavity
  - Plumbing
  - Condition
  - THIS IS BIG DEAL!!!!



Home Tools IL_IHWAP-Sta... MH ERA.pdf MH Article.pdf mh duct.pdf mh floor.pdf 2018-Field-Gu... MH Checklist.... Sign In

Share

Plumbing Inspection				
Supply/Type	galv	poly	copper	cpvc
Bath 1				Repair
sink	drain	supply		Y / N
toliet	drain	supply		Y / N
tub/shwr	drain	supply	surround	Y / N
Insulate				Y / N
Bath 2				Repair
sink	drain	supply		Y / N
toliet	drain	supply		Y / N
tub/shwr	drain	supply	surround	Y / N
Insualte				Y / N
Kitchen				Repair
sink	drain	supply		Y / N
dishwasher	drain	supply		Y / N
Insulate				Y / N
Furnace Closet				Repair
Air cond	condensate			Y / N
Heat	condensate			Y / N
Water Heater Closet				Repair
PRV				Y / N
Drain pan				Y / N
Supply				Y / N
Insulate				Y / N
Other				Repair
Water Main	leaks Y / N			Y / N
Sewer Line	leaks Y / N			Y / N
Insulate				Y / N

Floor Cavity Assessment

- Floor cavity
  - Clearance

Floor Cavity Assessment

- Floor cavity
  - Accessibility

Floor Cavity Assessment

- Floor cavity
  - Obstructions

Floor Cavity Assessment

- Floor cavity
  - Standing water
  - Black water

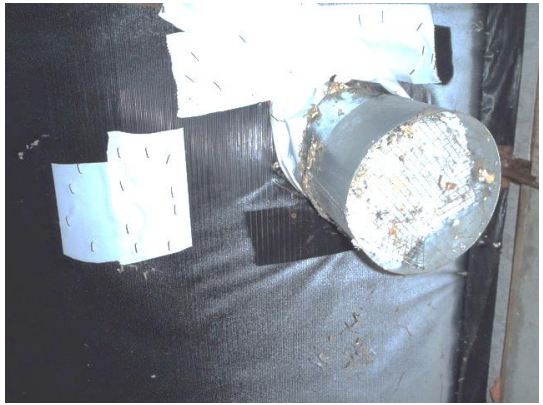
Do not flush

Floor Cavity Assessment

- Floor cavity
  - Dryer vent

Floor Cavity Assessment

- Floor cavity
  - Combustion air inlets



Floor Cavity Assessment

- Floor cavity
  - Ground cover condition

Floor Cavity Assessment

- Floor cavity
  - Volume Estimate
  - Target bag count

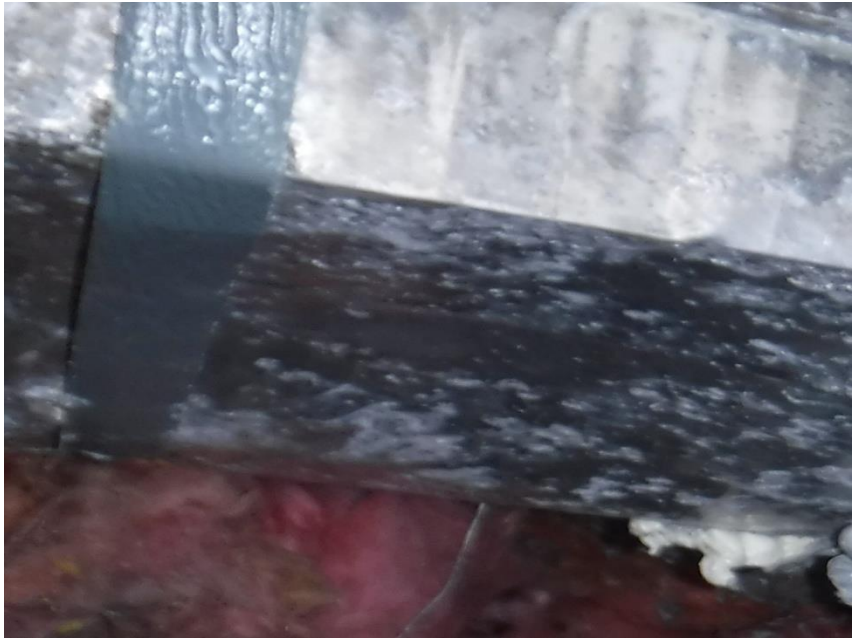
Floor Cavity Assessment

- Volume
  - Estimate for bags based on density
  - Some states require bag count

Floor Cavity Assessment

- Estimate
  - 1.25-1.75 lbs per cu.ft. density
  - Target bag count

Floor Cavity Preparation



Floor Cavity Preparation

- Air sealing

Floor Cavity Preparation

- Air sealing

Floor Cavity Preparation

- Duct sealing

Floor Cavity Preparation

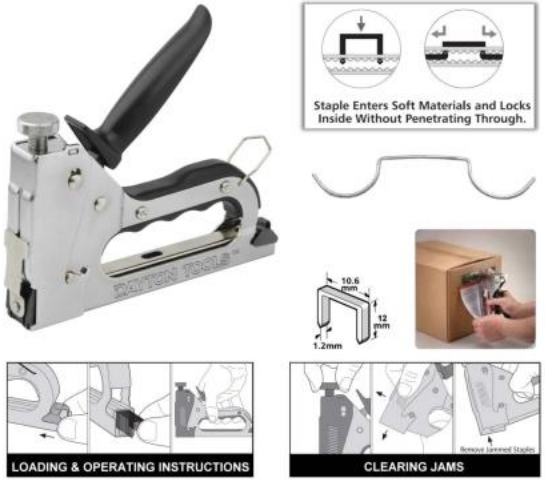
- Dyer venting

Floor Cavity Preparation

- Staplers for wood
  - Air powered
  - T-50
  - Slam stapler

Floor Cavity Preparation

- Staplers for fabric
  - Stitch stapler
  - Outward Clinch



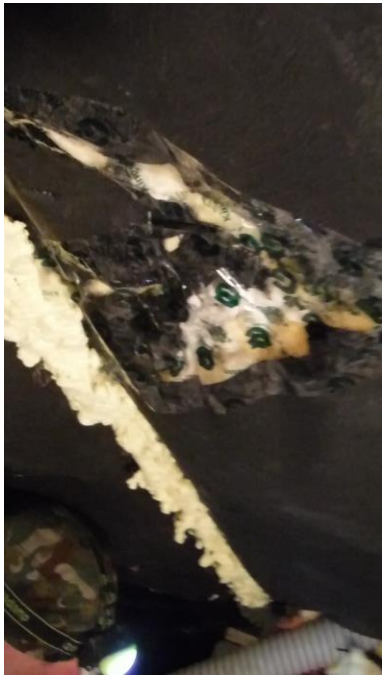
ITEM NO. QA-1321

OUTWARD CLINCH STAPLE GUN TACKER

- Suitable for Staples... Leg long 12 mm, Crown 10.6 mm, Thickness 1.2 mm.
- Fastens fiberglass duct board, Insulation around ductwork and pipes.
- Decorative works, caravans, covering of upholstered furniture
- Temporarily fastening merchandise to corrugated or corrugated to corrugated.
- Shipping labels and tags on corrugated containers.

Floor Cavity Preparation

- Staplers for fabric
  - Stitch stapler
  - Outward Clinch



Floor Cavity Preparation

- Tyvek or similar
- Tape
- Spray adhesive

Floor Cavity Preparation

- Lath
- 1x2, ½ x 2
- 2x4

Floor Cavity Preparation

- Big patches

Floor Cavity Preparation

- Outrigger patching

Floor Cavity Preparation

- Field patching
- Used to close up

Floor Cavity Preparation

- More patching

Floor Cavity Preparation

- More patching

Floor Cavity Preparation

- Taking out volume

Gaining Access to the Floor Cavity

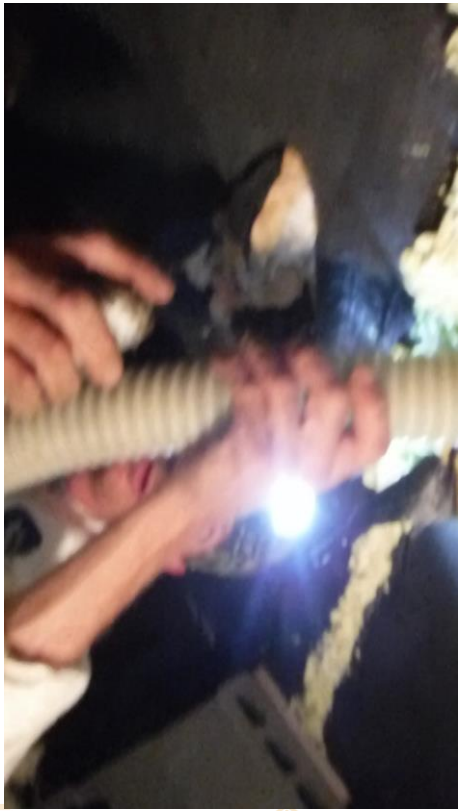
- Below the rim

Gaining Access to the Floor Cavity

- Through the rim

Gaining Access to the Floor Cavity

- From underneath



Installing Insulation

- Mark for obstructions when thru the rim or under

Installing Insulation

- Hard pipe
- Soft hose

Installing Insulation

- Hard pipe

Installing Insulation

Installing Insulation

- Mark the pipe

Installing Insulation

- Closing up

Insulation Comparison

Fiberglass

- Lighter in weight by volume than cellulose.
- Certain types install better than others in closed cavities.
- Low moisture retention at 5%.
- Price is fairly competitive with cellulose.
- Personal respiratory protection is required.

Cellulose

- Heavier in weight by volume than fiberglass.
- Installs extremely well in closed cavities.
- High moisture retention.
- Personal respiratory protection is required.

Installing Insulation

- Initially adjust your blowing machine settings at “high-air” and “low-material feed.”
- Gradually increase material feed to maximize production while minimizing clogs.
- Hose transitions should be gradual.
- Use at least 200 feet of hose for good maneuverability while working.
- Have someone on the crew continually check inside and underneath the home for spills.

Photos courtesy of WV GOEO

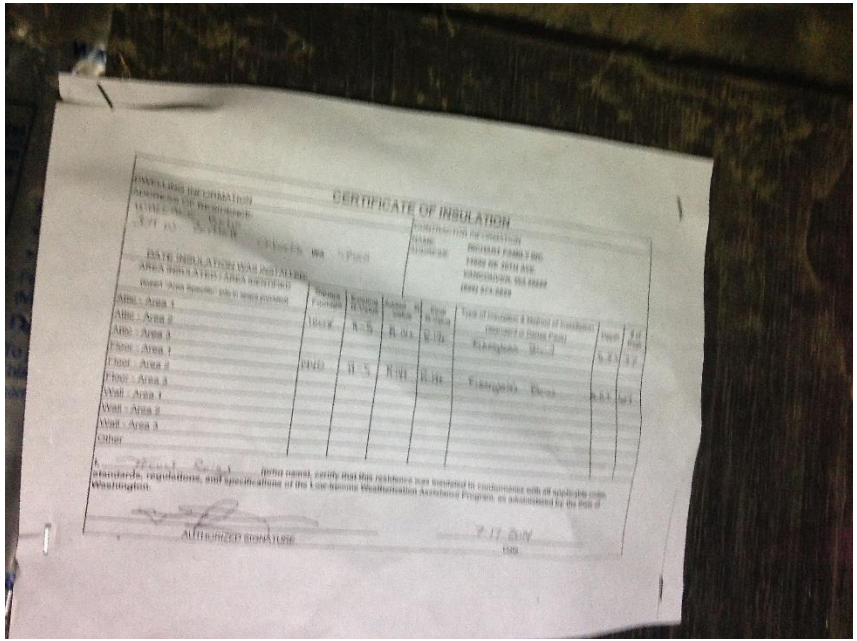
Installing Insulation

Open the product gate for optimal material feed

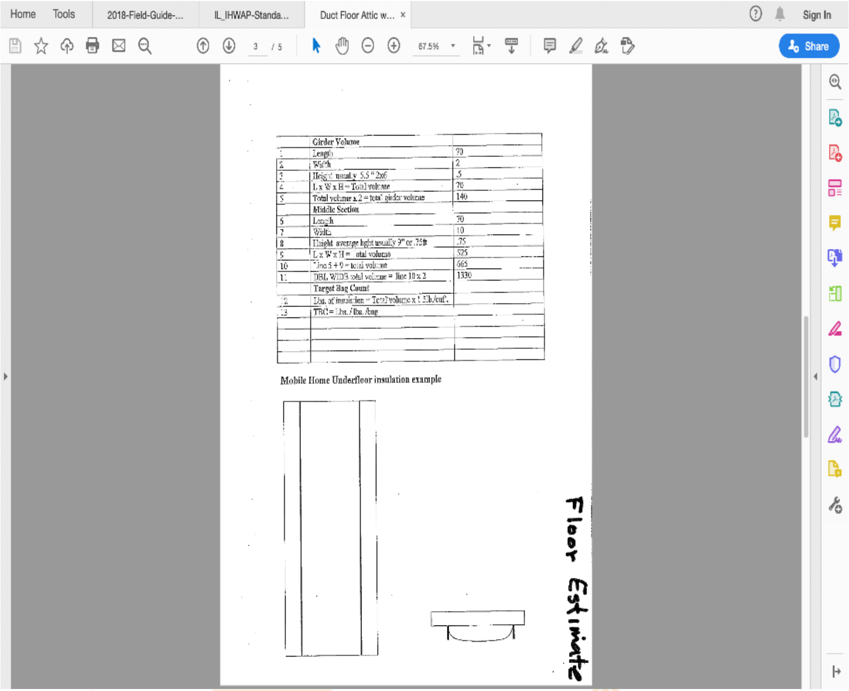
Adjust the air pressure to optimal flow

Installing Insulation / Quality Control

- Check patching
- Check insulation far away, and several places
- Do the math
- Check in ducts, water heater and furnace closet



Home Work



	Girder Volume	
1	Length	70
2	Width	2
3	Height usually 5.5 " 2x6	.5
4	L x W x H = Total volume	70
5	Total volume x 2 = total girder volume	140
	Middle Section	
6	Length	70
7	Width	10
8	Height average hght usually 9" or .75ft	.75
9	L x W x H = Total volume	525
10	Line 5 + 9 = total volume	665
11	DBL WIDE total volume = line 10 x 2	1330
	Target Bag Count	
12	Lbs. of insulation = Total volume x 1.5lb./cuf.	
13	TBC = Lbs. / lbs. /bag	

Mobile Home Underfloor insulation example

Floor Cavity Assessment Summary

- Condition of structure
- Joist direction
- Condition and type of road barrier
- Insulation level and condition
- Electrical
- Plumbing type condition location
- Clearance, accessibility
- Standing water sewage
- Dryer vent
- Combustion air inlets
- Volume

BUILDING PERFORMANCE CENTER

a division of Opportunity Council

Mobile Home Training

Duct Diagnostics and Repair

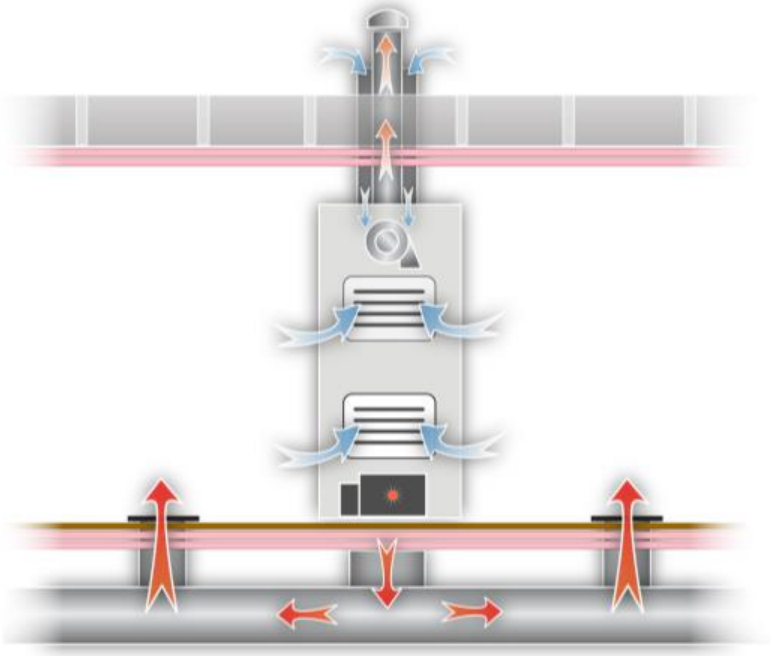
Learning Objectives

- Explain how a mobile home's forced air distribution system works
- Label mobile home duct components and how they are assembled
- Identify specific mobile home duct leakage locations
- List materials and techniques to fix leaky ducts
- Describe how to modify a floor or attic cavity return system
- Name other duct system improvements
- Compare duct diagnosis methods

Mobile Home Forced Air System

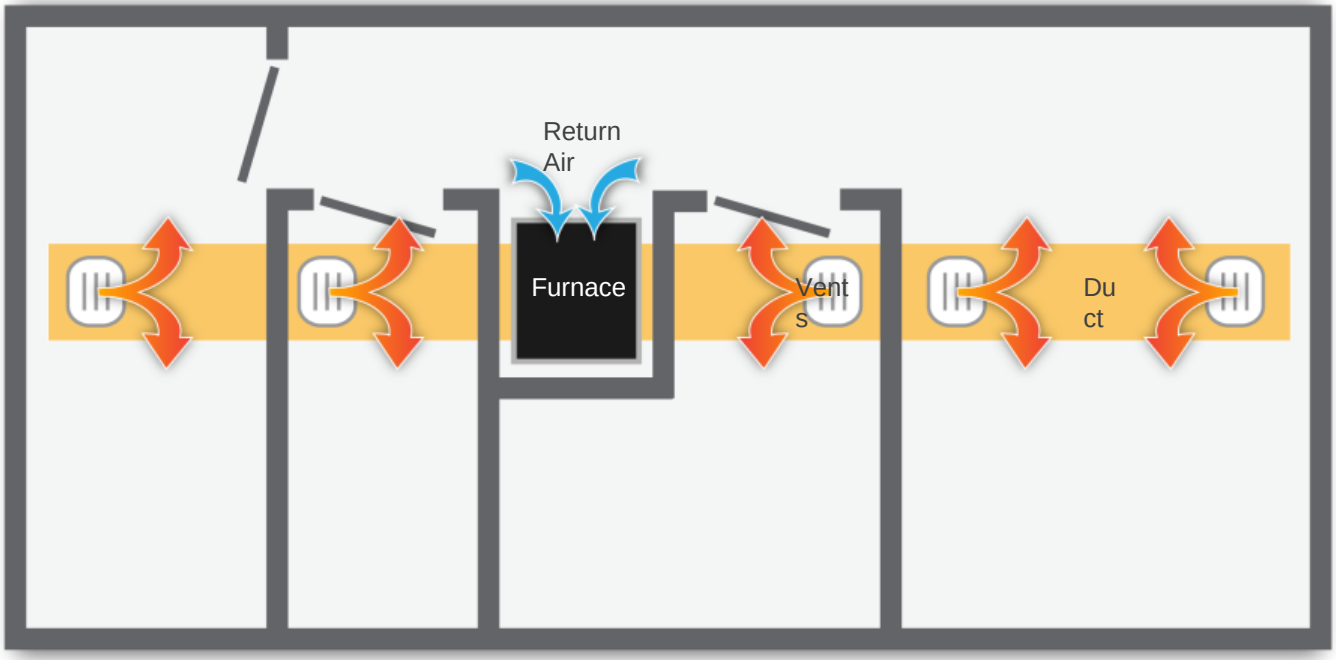
- Downflow furnaces
- No return duct
- The duct system is located outside the pressure envelope

Mobile Home Forced Air System

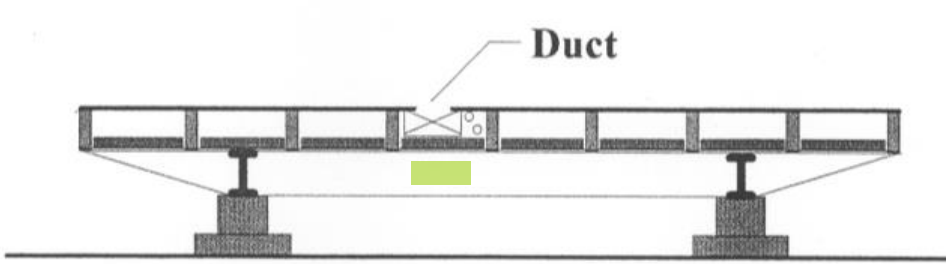


A typical mobile home Forced air is a <u>downflow</u> distribution system

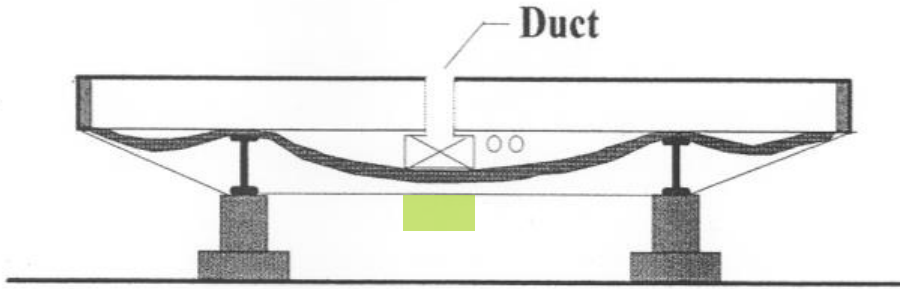
Mobile Home Forced Air System



Mobile Home Forced Air System



Lengthwise Floor Joist System



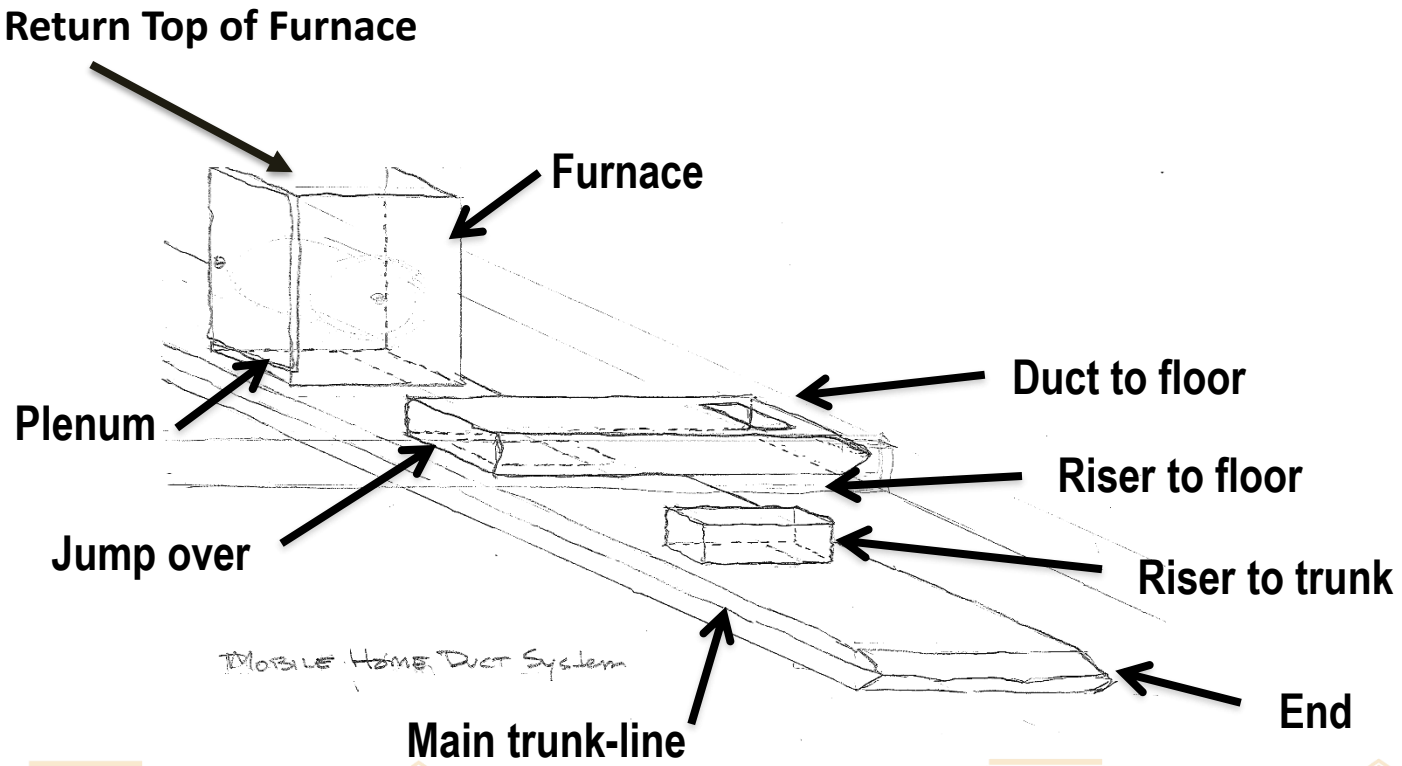
Crosswise Floor Joist System

Duct Components

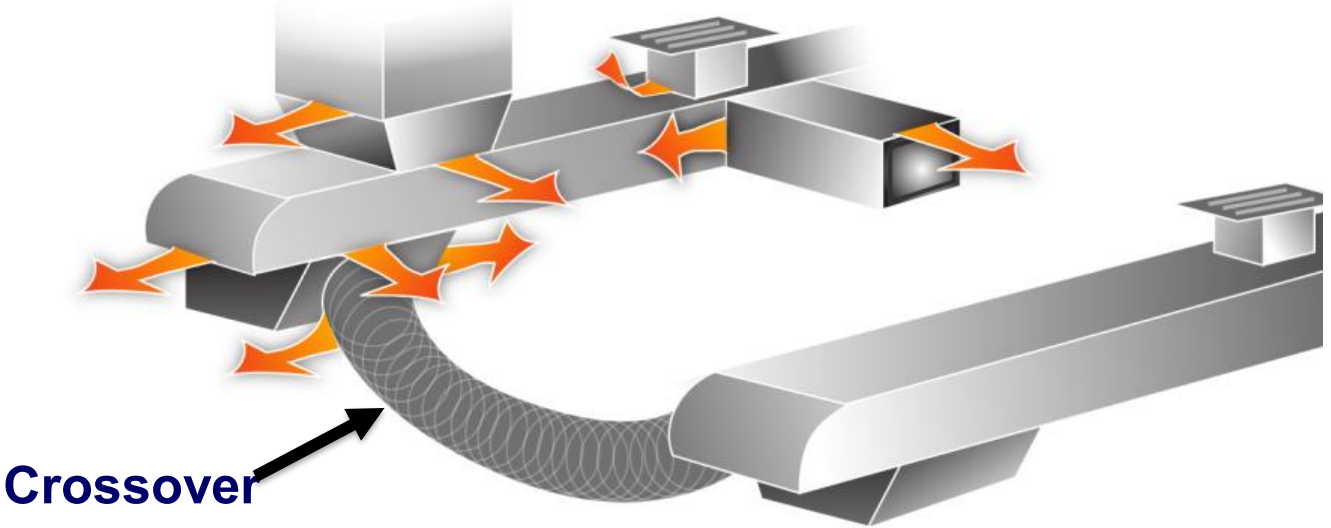
- Plenum
- Main trunk line
- Jump over trunk line
- Risers
- Ends
- Crossover duct
- Registers

- Connections
  - Furnace to plenum
  - Jump over trunk to main trunk line
  - Riser to trunk line
  - Riser to floor
  - Ends

Duct Components



Duct Components-crossover



Duct Components-registers

Duct Components-assembly

Duct Components-returns

Return Front of Furnace

Return Top of Furnace

Duct Components-return air pathways

Return air path/ grille wall

Return air path/ grille in door

Duct Components-return in floor

Return in floor cavity

HINT

- Offset grilles in floor of all rooms with doors
- Solid door on furnace closet
- Hole in furnace closet floor

Duct Components-return in attic

Return in attic cavity

HINT

- Grilles in ceiling of all rooms with doors
- Solid door on furnace closet
- Hole in furnace closet ceiling

Hole to attic cavity

Duct Components-conversion

Converting attic and floor cavity returns or not

Duct Components-plenums

Plenum Top View

Plenum View from Below

Duct Components-crossovers

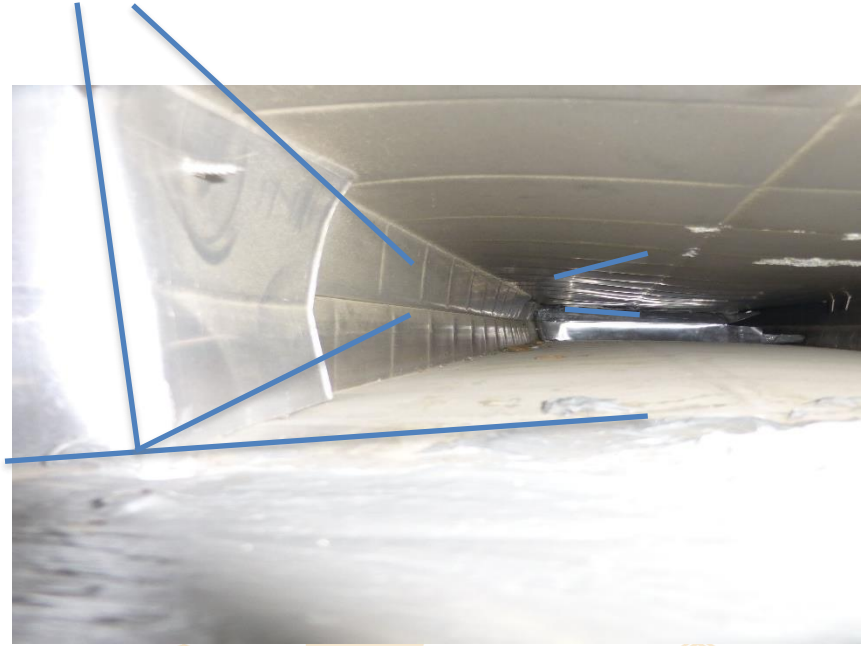
Crossover Duct

Crossover Ducts old/new

Duct Components-jump over, branch

Jump-over duct in- between joists

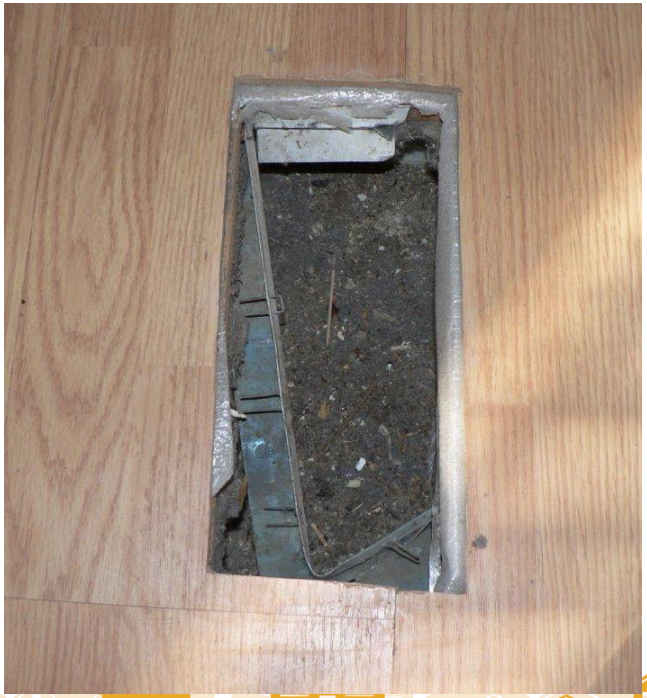
Branch duct / trunk line connection



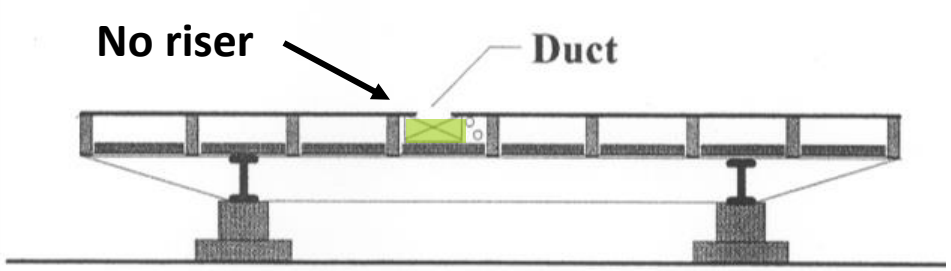
Duct Components-riser to floor

Riser to Floor/ joists run across house/ 6” down to trunk-line

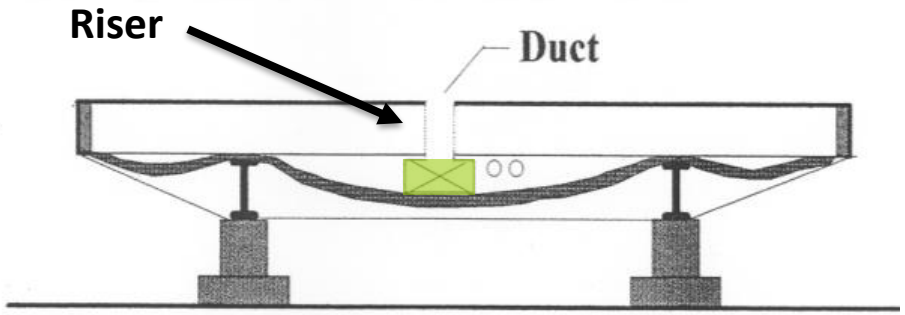
Trunk to floor/ joists run long/ ¾” down to trunk-line



Duct Components-riser to floor



Lengthwise Floor Joist System

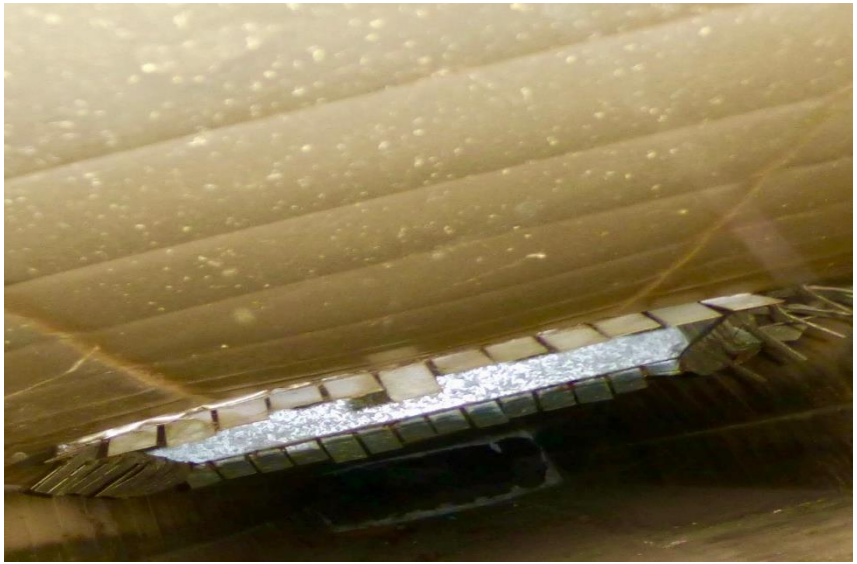


Crosswise Floor Joist System

Duct Components-riser

Riser **crosswise joists**

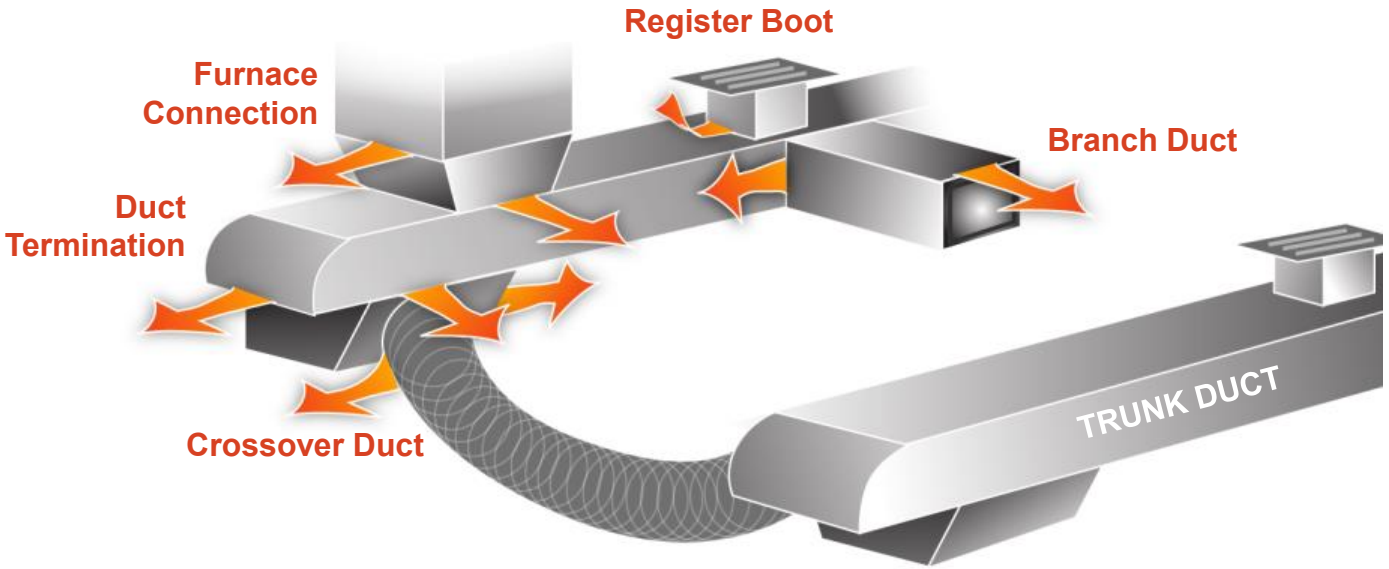
No riser **long joists**



Duct Components-ends

Duct Leakage

Typical Air Leakage Locations



Duct Leakage-plenum

Plenum

Plenum

Duct Leakage-jump over, branch

Jump over

Branch

Duct Leakage-end

End

End

Duct Leakage-riser to trunk line

Riser to Trunk

Riser to floor

Duct Leakage-Trunk to floor

Trunk to floor

Trunk to floor

Duct Leakage-seams

Seams

Splices

Duct Leakage

Duct Sealing

- Where to seal from
- Tools
- Materials
- UL 181 materials
- Boot repair and replacement
- Return air conversions

Duct Sealing

From the house

From underneath

Duct Sealing

Tools

- Drill
- Snips
- Flashlight
- Mirror
- Vacuum

Materials

- Mastic and Mesh tape
- UL 181 Butyl tape
- Metal
- Screws
- Straps

Duct Sealing-sequence

Sequence

- Inspect ducts and boots
- Repair or replace ducts
- Clean ducts at register
- Seal Boot to Floor
- Seal Boot to Trunk
- Seal Ends
- Seal Jump Overs
- Seal Furnace Plenum

DUCT INSPECTION AND MODIFICATION TOOLS

Duct Sealing-inspect

Inspect for blockage and loose seams

Check the flanges and inspect for damage

Duct Sealing-inspect

Damage

- Wear and tear
- Register
- Seams
- Flooring around

Registers

Duct Sealing-inspect

Obstructions

- Couches
- Debris
- TVs
- Chest of drawers

Registers

Duct Sealing-inspect

Obstructions

- Debris
- Garbage
- Bathroom material
- Rodent material
- Insulation

Trunk line

Duct Sealing-inspect

Damage

- Damaged during installation
- Damaged by animals
- Damaged by water
- Damaged from age

Crossover

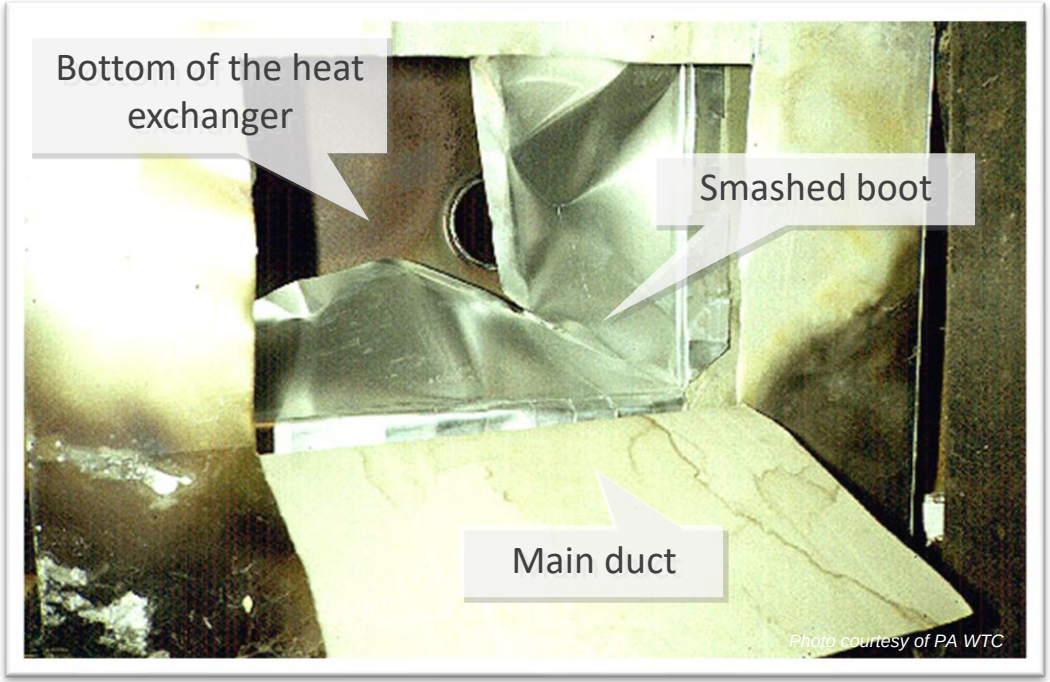
Duct Sealing-inspect

Duct Sealing-inspect

…when the crawl space is the warmest room of the house!

Desperate times call for desperate measures…

Duct Sealing-inspect



No heat? *No wonder!*

Duct Sealing-inspect

The old flashlight and mirror trick

Is that a squeegee down there?!

Duct Sealing-inspect

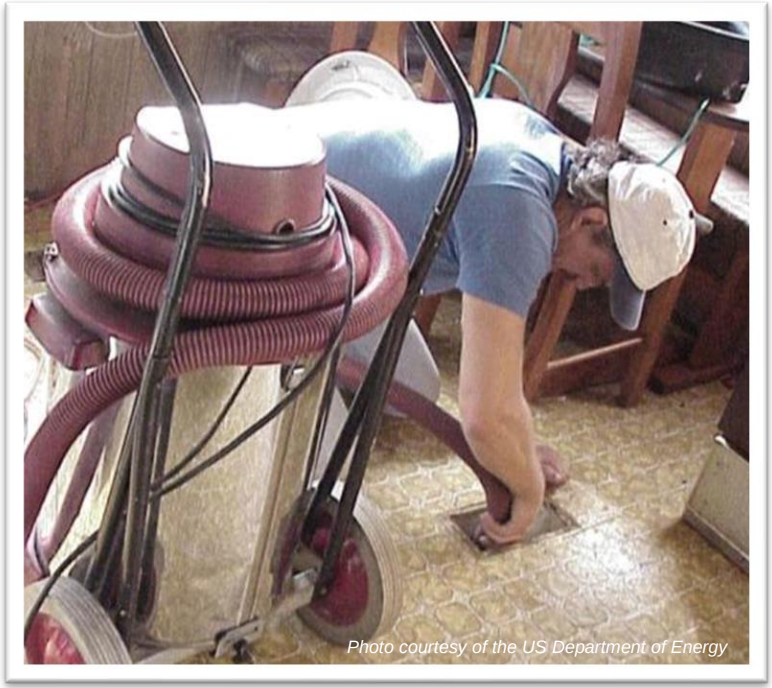
Duct Sealing


Photo courtesy of the US Department of Energy


Photo courtesy of PA WTC

Aluminum coil stock and boot fabrication

Duct Sealing



Make sure to clean ducts before sealing

Duct Sealing

Butyl-backed tape

Image Source: http://www.hardcast.com/PRODUCTS/pr_detail.asp?pid=3

Duct Sealing

Mastic sealant

Photo courtesy of the US Department of Energy

Image Source: http://www.rcdmastics.com/pd6.asp

Duct Sealing

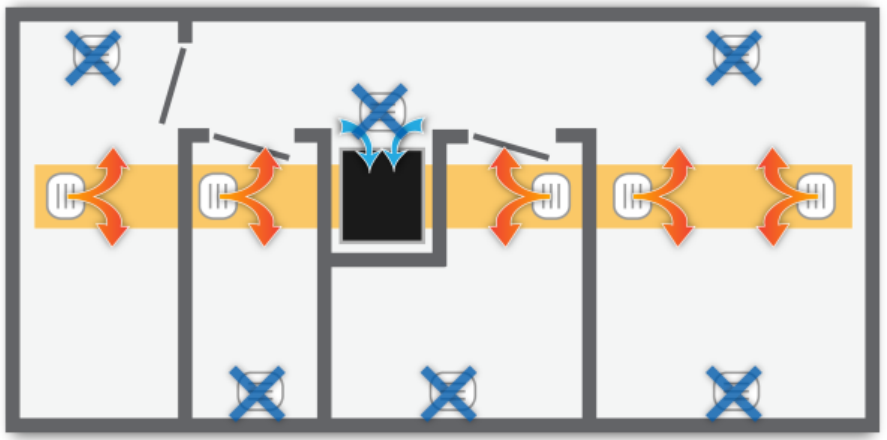
Use fiberglass mesh tape to span gaps larger than ¼ inch

Latex gloves are often your mastic brush

Photos courtesy of the US Department of Energy

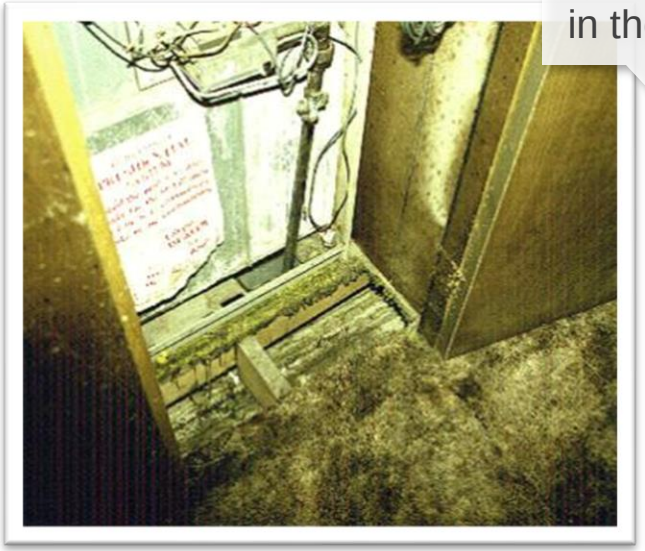
Duct Sealing -belly and attic returns

- Permanently seal all return registers (including the register in the floor of the furnace closet)
- Create a hallway return system
- Add a louver to the furnace closet door

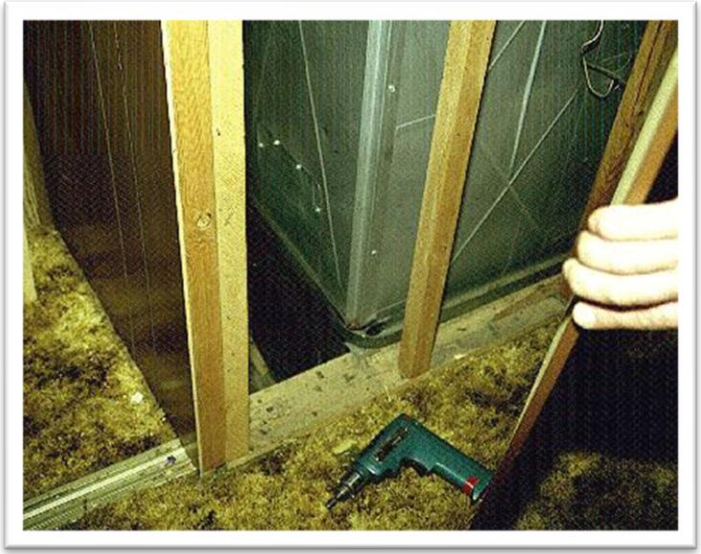


- Undercut doors to adjacent rooms or provide louvers
- Verify good air flow with a pressure balancing test

Duct Sealing- belly and attic returns



Duct Sealing- belly and attic returns



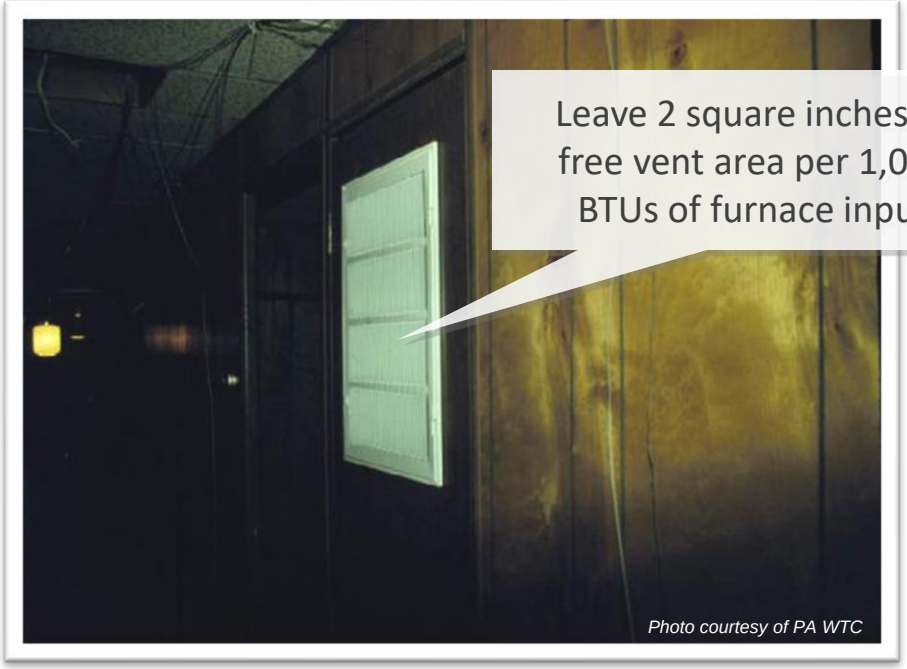
Return may extend behind the furnace cabinet and must be sealed

Aluminum coil stock was fastened to the floor with hex-head screws

Duct Sealing- belly and attic returns

Permanently seal all return registers

Duct Sealing- belly and attic returns



Install a return louver in the furnace closet door

Duct Diagnostics

- Diagnostics always backs up visual assessments
- Pressure pan tests
  - Doesn't show leakage, show's pressure indicating leakage
- Duct tester tests
  - Quantifies leakage
- Dominant duct leak test

Duct Diagnosis-3 ways

- Visual Assessment
  - Flash-lite and mirror from above
  - Also from below
- Pressure Pans
  - Qualifying test
- Duct Tester
  - Quantifying test
  - Total leakage
  - Leakage to outside

Duct Diagnostics-pressure pan

Test the duct system with a pressure pan and blower door to identify:

- Leakage to outdoors when ducts are located outside the thermal boundary.
- Leakage pathways from duct-containing building cavities to outdoors (e.g., floor-joist cavities adjacent to porch roofs, cantilevers).

Duct Diagnostics- pressure pan procedure

- Depressurize house to 25 or 50 Pa with blower door.
- Test each register and document readings.
- Registers too large or oddly shaped may be covered with plastic and taped on edges.
- Seal duct leaks and retest.
- **Goal = Readings lower than 1 Pa.**

Duct Diagnostics-Duct Tester

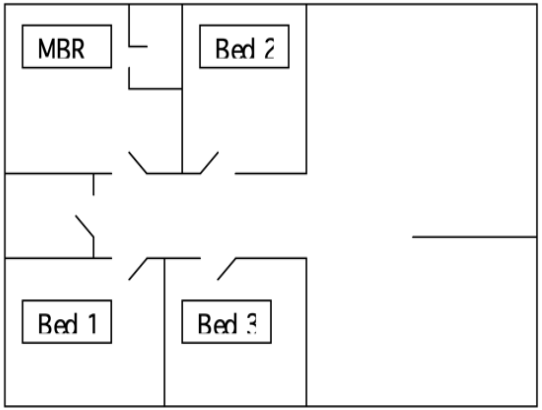
- Total Leakage
  - Duct tester only
- Leakage to outside
  - Blower door and duct tester

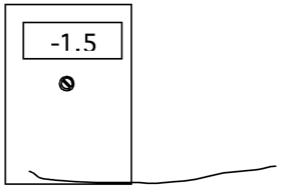
Duct Diagnostics-Duct Tester – Total Duct Leakage

- Procedure
  - Hook duct tester to system
  - Tape off registers
  - Open window to remove house from calculations
  - Take test – Pressurize/Depressurize

Duct Diagnostics- dominant duct leak

Dominant Duct Leak Test

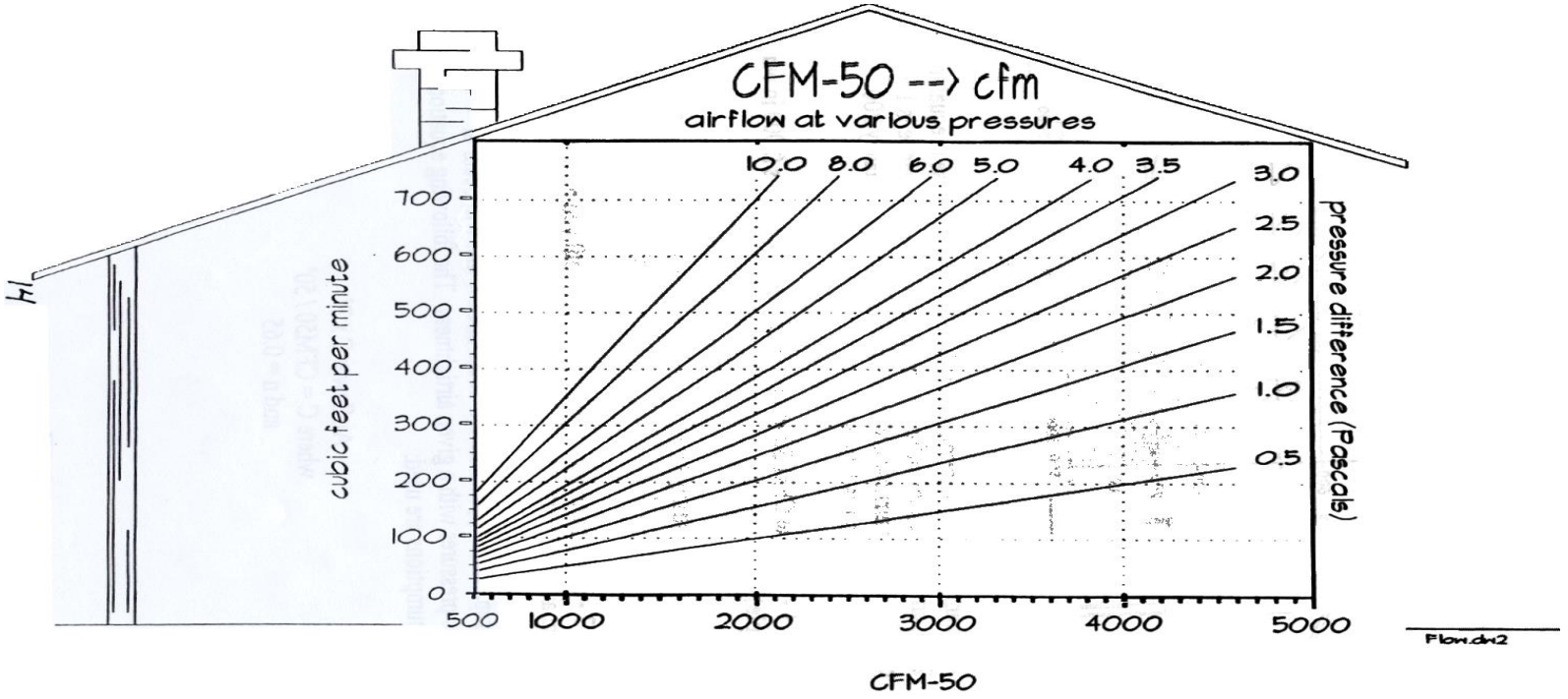




- Exterior of house closed
- Interior or house open
- Furnace air handler on
- Take a pressure Main body with reference to Outside

Duct Diagnostics-House DP chart

House Depressurization Chart Exercise



Summary

- Mobile home ducts are very prone to leakage.
- Diagnosing and repairing duct leakage is the single most cost-effective measure you can apply to mobile homes.
- Effective duct sealing is possible through the use of innovative duct sealing materials.
- Other duct improvement measures, such as cleaning, removing obstructions, and system balancing can improve comfort and lower fuel bills.

Thank you

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Efficiency Works™

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