Ductless and ducted mini splits- with case studies

Heat Pump and Air Conditioning

For

Energy Design Conference

By

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- In accordance with the Department of Labor and Industry's statute 326.0981, Subd. 11,

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Agenda

- What is a Mini Split?
- Proven applications
- Equipment in market
- Sizing and installation
- Ducted vs ductless mini split
- Performance and service
- Case studies- Passive House and Residential Remodel

What is a Mini-Split unit?

- The typical Mini Split unit is a High Wall mounted unit, less than 48,000 Btu/h capacity, but other types of Indoor unit have evolved since the products inception

- Mini Splits GENERALLY do not have, or are capable of using ductwork to distribute the unit airflow, and they use a remote control just like your TV to control the unit

What is a Mini-Split unit?

- Airflow is considerably less than the traditional 400 CFM per 12,000 Btu/h

- We move the air very slowly through our evaporator coil, allowing humidity and heat to be absorbed and colder drier air to be delivered into the room

What is a Mini-Split unit?

- Coil temperature is designed to be approximately 35 Deg F, lower than conventional US air conditioning units

- Temperature split for the units is between 30 and 35 Deg F, meaning that the air entering the coil at 75 Deg F is supplied to the room at approximately 40 to 45 Deg F

Why use a Mini- Split Unit

- No ducting needed…… or maybe a little duct work
- Very quiet operation, both inside and out
- Excellent at removing moisture, lower RH%
- Improves IAQ and comfort
- Energy credits
- Proven Technology
- Accepted by HVAC contractors

Design and Expectation

- Primary for cooling
- Primary for heating
- Seasonal home
- Utility program
- What is heating, cooling load
- Where is duct work to be installed
- Operation by end user, what do they want, expectations

Proven Residential Application

- Houses with boiler or radiant heat
- Master bedroom
- Additions
- Basement
- Houses that the forces air system simply can’t do the job
- Bonus room
- Green/passive house LEED
- Vacation home
- Media room / home theater
- 3 and 4 season porches
- Trailer

Remodel /Additions

Master bedroom

Children's bedroom second story, tri head 27,000 btu

Dining room 1930 construction

Boiler heating

Hot tub room

Churches

Vacation/ Cabin

Home theater 1ton mini ducted

Computer / Data room

Test trailers/ Fish houses /Buses /Rv

Equipment in market

- Wall Mounted

  They are mounted high on a wall, do not require ductwork, increasing energy efficiency. Could be a one or multi heads, this is the most common type

- Slim Duct

  Mounted horizontally or vertically , installed in attic or below ceiling. They use minimal ductwork , concealed and quiet. This area has is growing

- Floor Mounted

  Floor mounted systems are ideal for residential radiator replacements or any room with limited upper wall space, like a kitchen or sunroom. Newer to the market

- Compact Cassette

  Cassettes are extremely discreet, with only the grille showing in the ceiling.

  Have been used in this market both residential and commercial application

Inverter Technology

- New in the last 3 to 7 years
- Very even temp and operation, Wants to run
- ECM drive, DC drive like on furnace fan
- 50 % more efficient then non – inverter unit
- Design and sizing is more flexible
- Can be used in more application
- Less service issues

Inverter Technology

- Low temp operation

On cooling around 14 degrees F

On heating around minus 5 degrees F some model minus 15

- Longer line sets
- 26 to 14 SEER on different models
- Several modes of operation

Controller wireless… ductles

Wired controller…. ducted

Sizing

Inverter technology

Application

Expectation and use

Heating and cooling

Ducted vs ductless

Sizing

- Rules of thumb
- Proper methods

Sizing for Residential Use

UNIT	ROOM SIZE - Square Feet
7,000	300
9,000	400
12,000	600
18,000	800
24,000	1000
30,000	1200
36,000	1,400
44,000	1,600

- **Guide was based on commercial use**

Remember

- Mini splits work better when slightly undersized
- Comfort is both temperature and humidity related

SAMSUNG

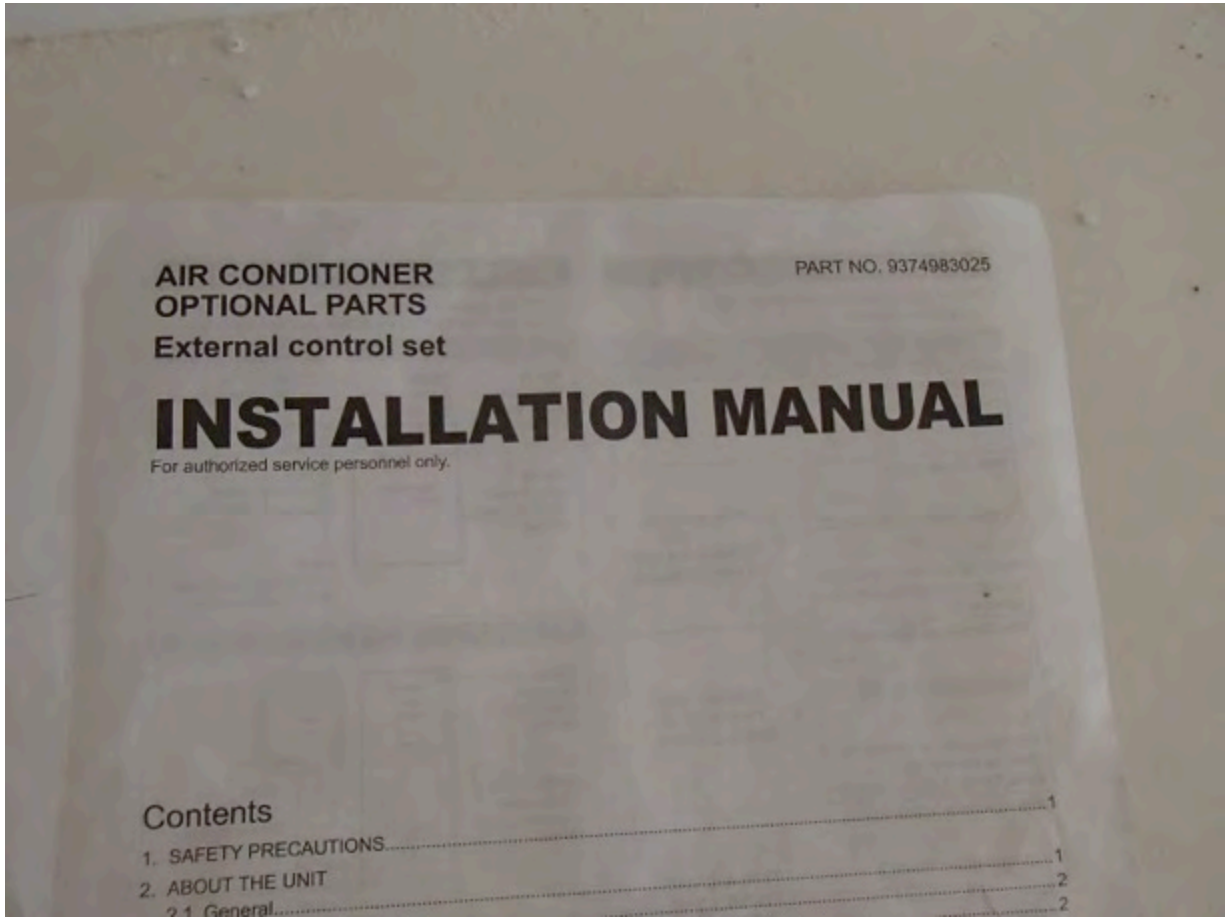
Window orientation

Low winter sun angle and thermal mass

Installation

- Location selection for Outdoor and Indoor unit
- Clearance requirements for setting the Outdoor and mounting the Indoor unit
- Refrigerant piping
- Wiring

READ THE INSTALL MAUNAL ?!#



AIR CONDITIONER
OPTIONAL PARTS

PART NO. 9374983025

External control set

INSTALLATION MANUAL

For authorized service personnel only.

Contents

Rough in for high wall install

Small server room, hanging bracket

Location, snow load, over hangs, roof tops, condensation, icing and wind

Hanging bracket, exterior mount

Snow stand

Computer room, all season cooling


Office and computer
room application
SAMSUNG
APOLLO HTS. 770-0603

Condenser in a large garage

Proper cleanliness, correct flares, dryness, deep vacuum go a long way for a good installation

Line set cover

Ducted mini split

Duct work and air flow

- Where is the duct to be installed
- Duct design
- Type of diffuser
- How much insulation
- Static pressure
- Duct blaster test

Ducted mini split

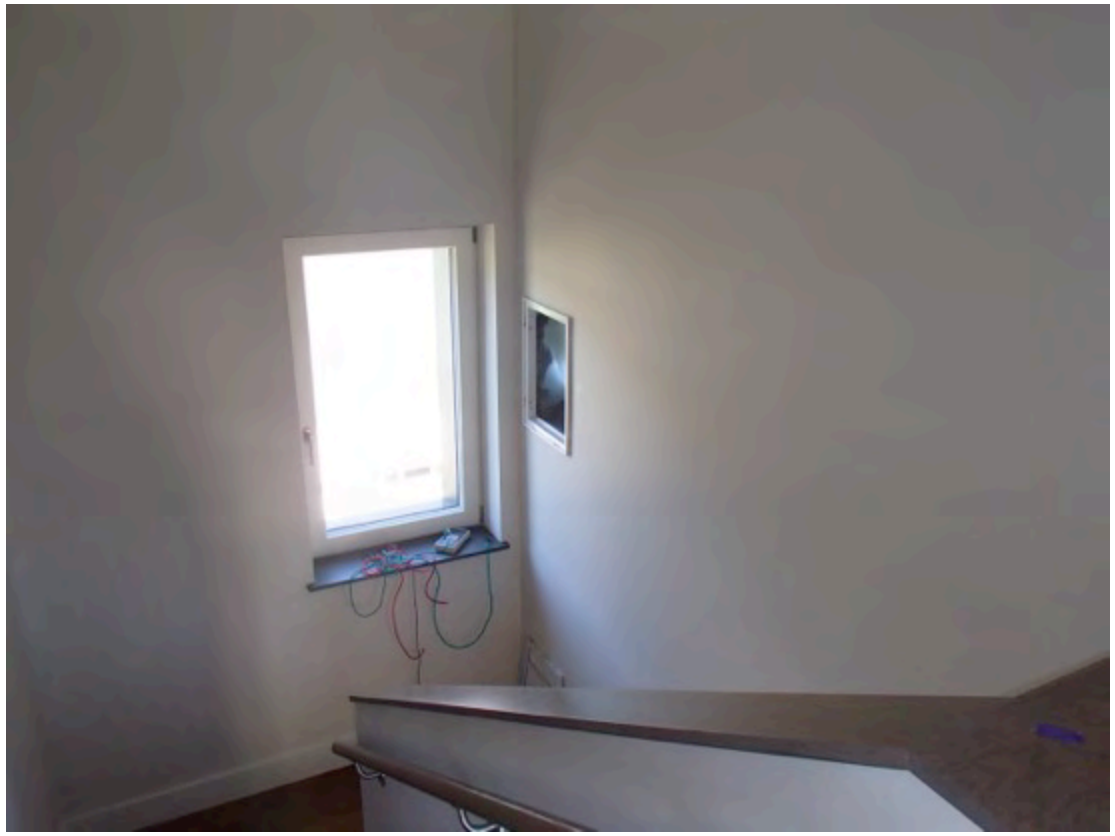
Ducted unit, dropped ceiling, bath room

Ducted unit , attic install, air sealing and insulation

Wire mounting hangers, keep unit off framing

Filter return grill

Central returns with filter rack built in



Diffusers

Diffusers

Snow stand mounted to pad

Verify performance and service

- Temp rise/fall
- Operating pressure
- Static pressure
- Measure CFM of Ducted units
- Duct tightness test

Full lab on Mini Splits, at Minneapolis Community/ Technical College

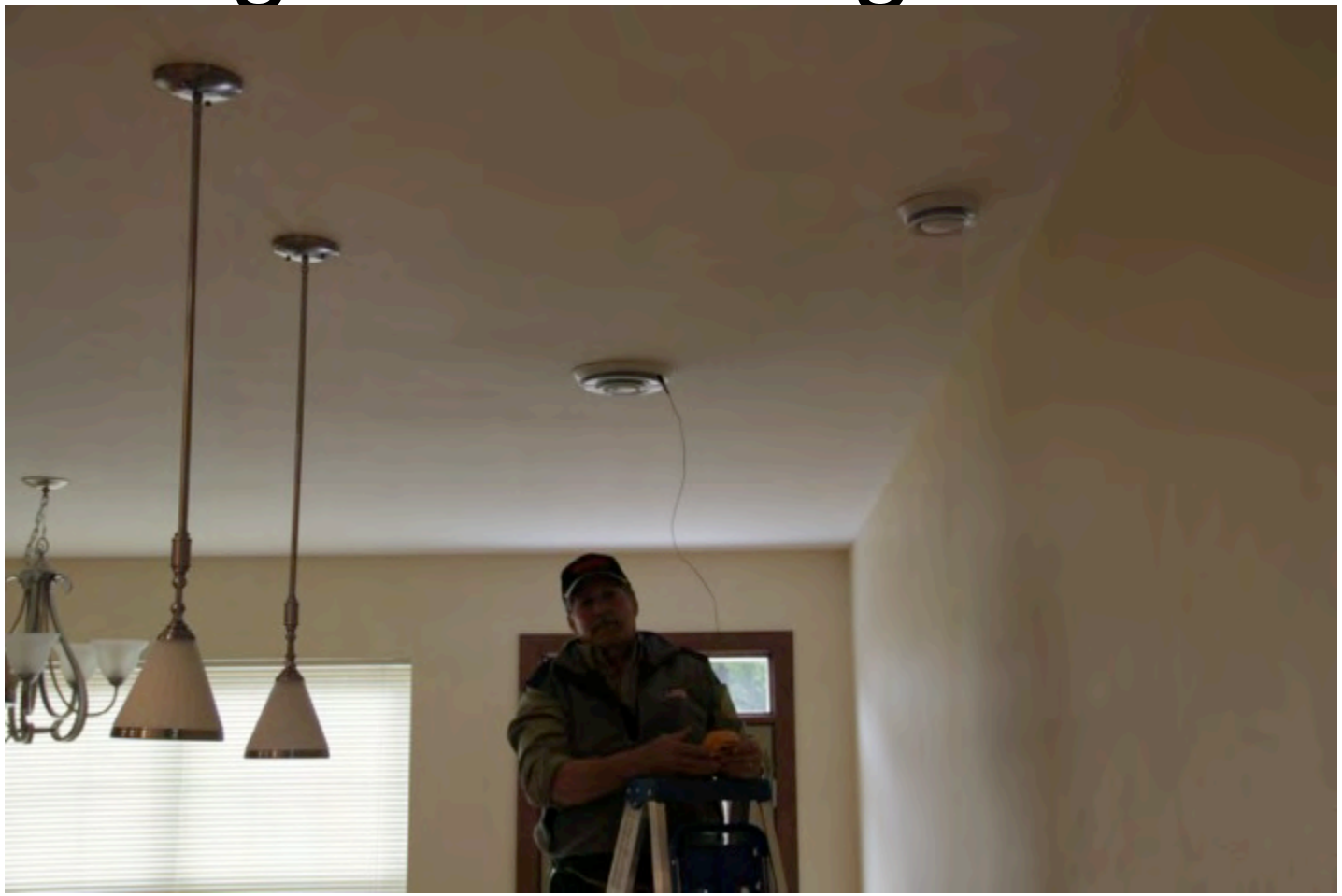
Measure RH%

Colder supply air temp, about 10 degrees F

What is your Delta T….22 to 30 degrees F

vs 18 to 22 conventional

Supply air temp, ducted mini split 125 f heating /43 f cooling



Duct tightness test

Service

- Fault codes
- Test the thermistors
- Check the wire and the connections
- Weigh in
- Superheat- Sub cool ?

410 A adapter

Critical charge, weigh it in

Gauge set

Is line set fully insulated ?

A number of details

Heavy snow and frosty days…tell home owner

Maintenance for the Minisplit Units

- Monthly : Check filters and clean or replace
- 6 monthly : Check indoor fan blade for dust and debris build up, check condensate pan for any debris
- Yearly : Check coils for cleanliness both indoor and outdoor, connections for tightness and insulation on the pipes

Passive House, La Crosse WI

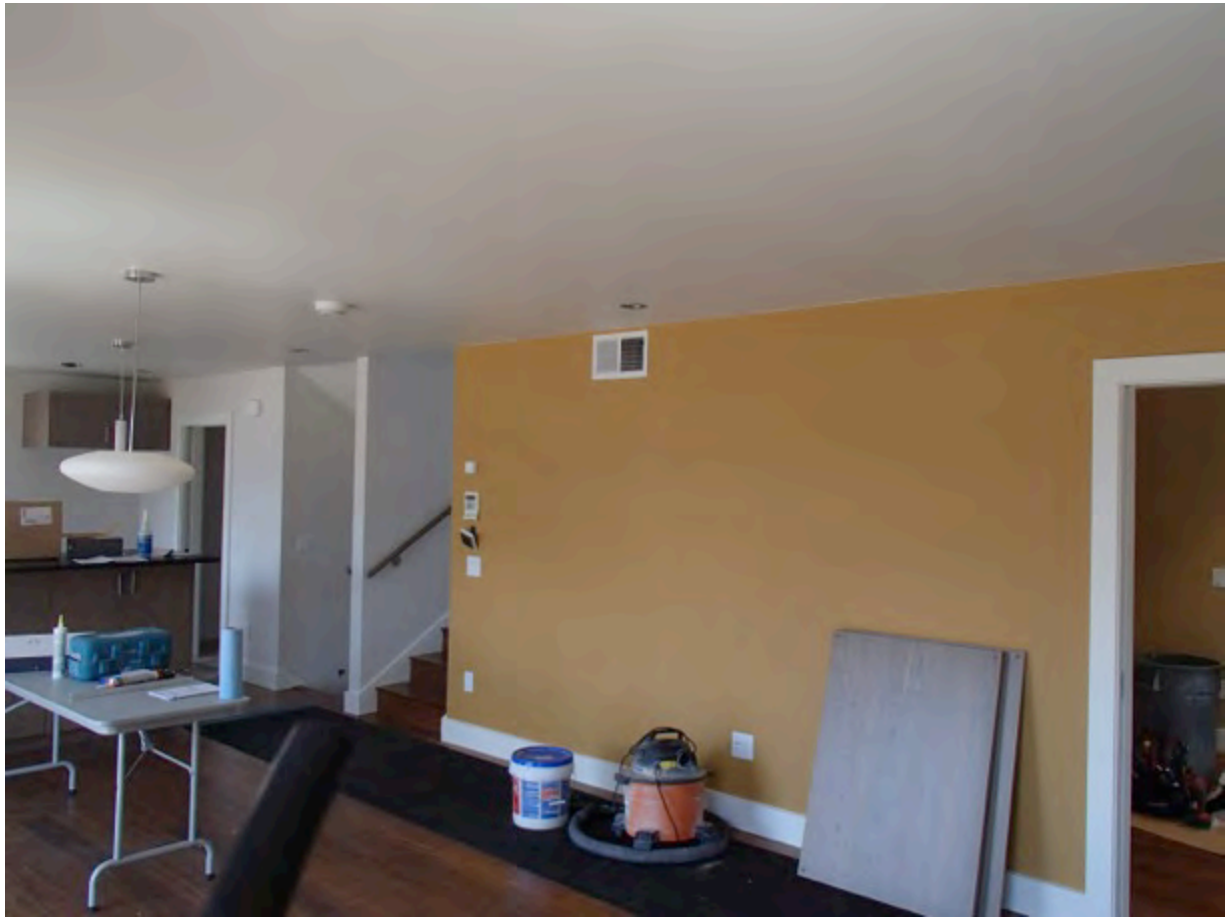
Equipment selection, and duct layout

- Two slim duct air handler units one for each floor
- One out door unit
- Pdf of floor plan

Dropped ceiling for ducting in hallway

Fully ducted , supplies high and from central trunk duct

One Supply for a big room

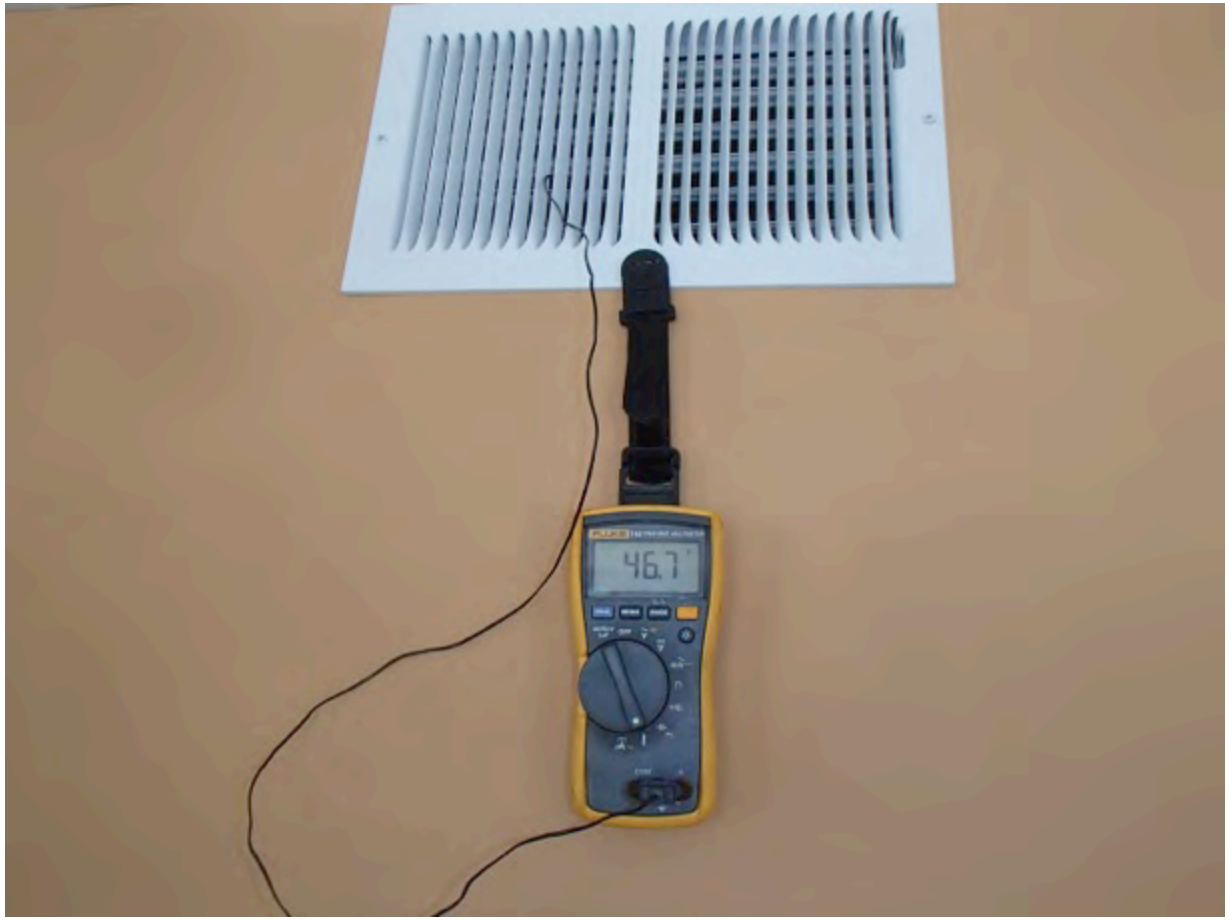


Checking air flow pattern

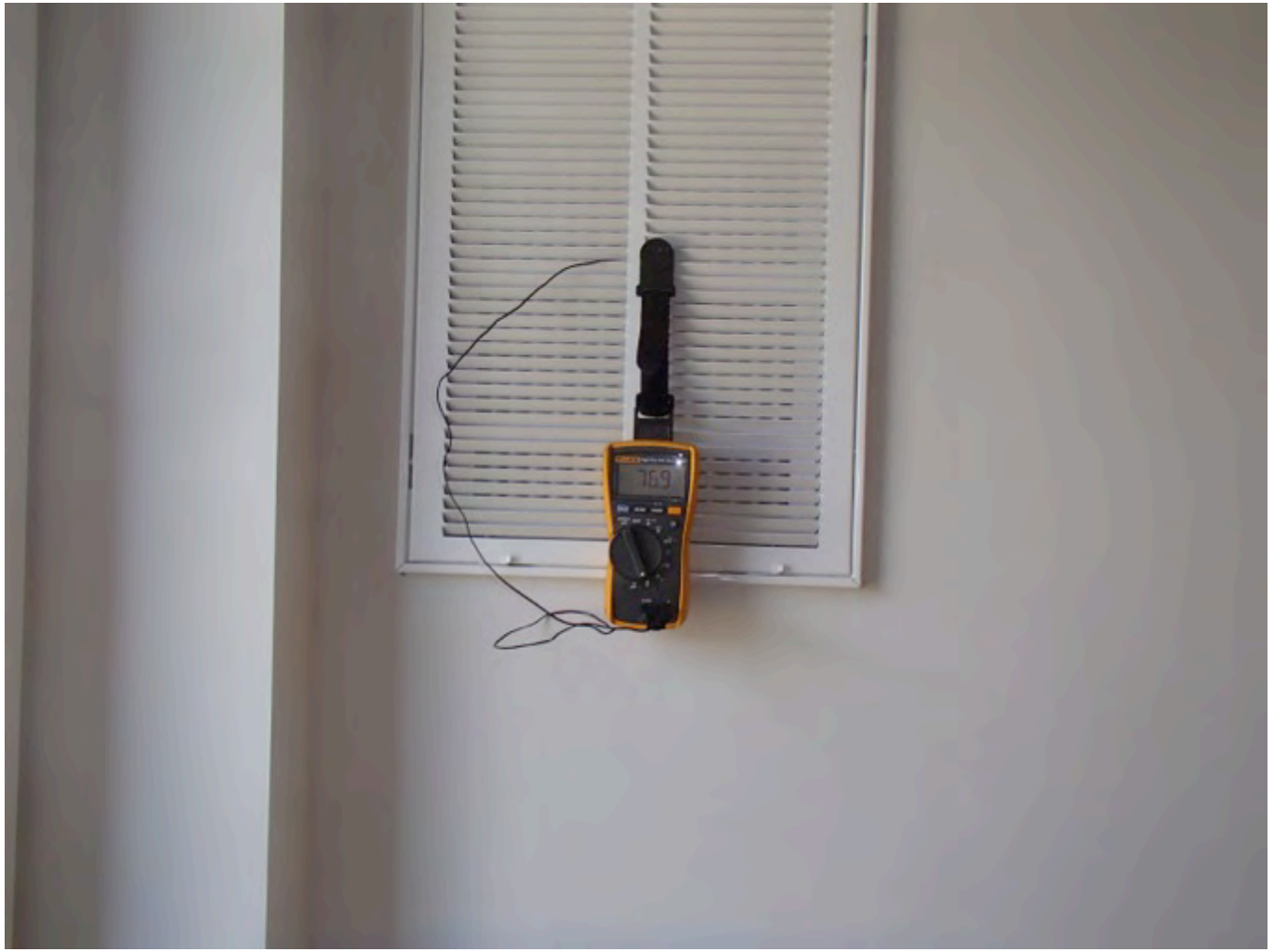
Mounted in ceiling

Heating mode

Cooling mode



Filter grill measuring return temp



Remodel in Minneapolis metro

Performance verification was done on a Ducted Mini split Heat Pump/AC unit

Brand and Unit

FUJITSU

Model # ARU12RLF (Indoor) AOU12RLFC (Outdoor)

The following test were done on 10-31-14

Outside condition were calm, 48 degrees F, 52% RH

All test equipment is calibrated and functional

The test that were conducted were

- Static pressure
- Air flow at supply and return grills
- Temp Delta T, heating and cooling
- Controller operation
- Duct work, insulation, drain pan
- Post heat operation

- STATIC PRESSURE

The External Static Pressure was .17 on the return was .15 and on the supply was .02 this is well within the operating pressure for this system

The test was done in cooling mode

- AIR FLOW

SUPPLIES five total, 333 CFM TOTAL

Corner bedroom, End diffuser 72 CFM, other 84 CFM

Bath room, 50 CFM

Small bedroom, 87 CFM

Over stair well, 40 cfm

SINGLE RETURN, 313 CFM

- TEMPERATURE measurements and Delta T

  COOLING operation

  The return air was at 67.4
  Supply temperature was at 47.4

  20 degree delta T, this is with operating specs for this unit

  HEATING operation

  The return air was at 65.7
  Supply air the was at 124.3

- CONTROLER OPERATION

The controller was tested in heating, cooling and fan mode and was functional

- DUCT WORK, INSULATION, DRAIN PAN

An air tightness test was done by others and the tightness of the duct system was acceptable,

The insulation over duct work was good, an insulated box was to be placed over air handler

By the builder

Drain pan was installed and provisions to shut system down if a bulk water event occurs were

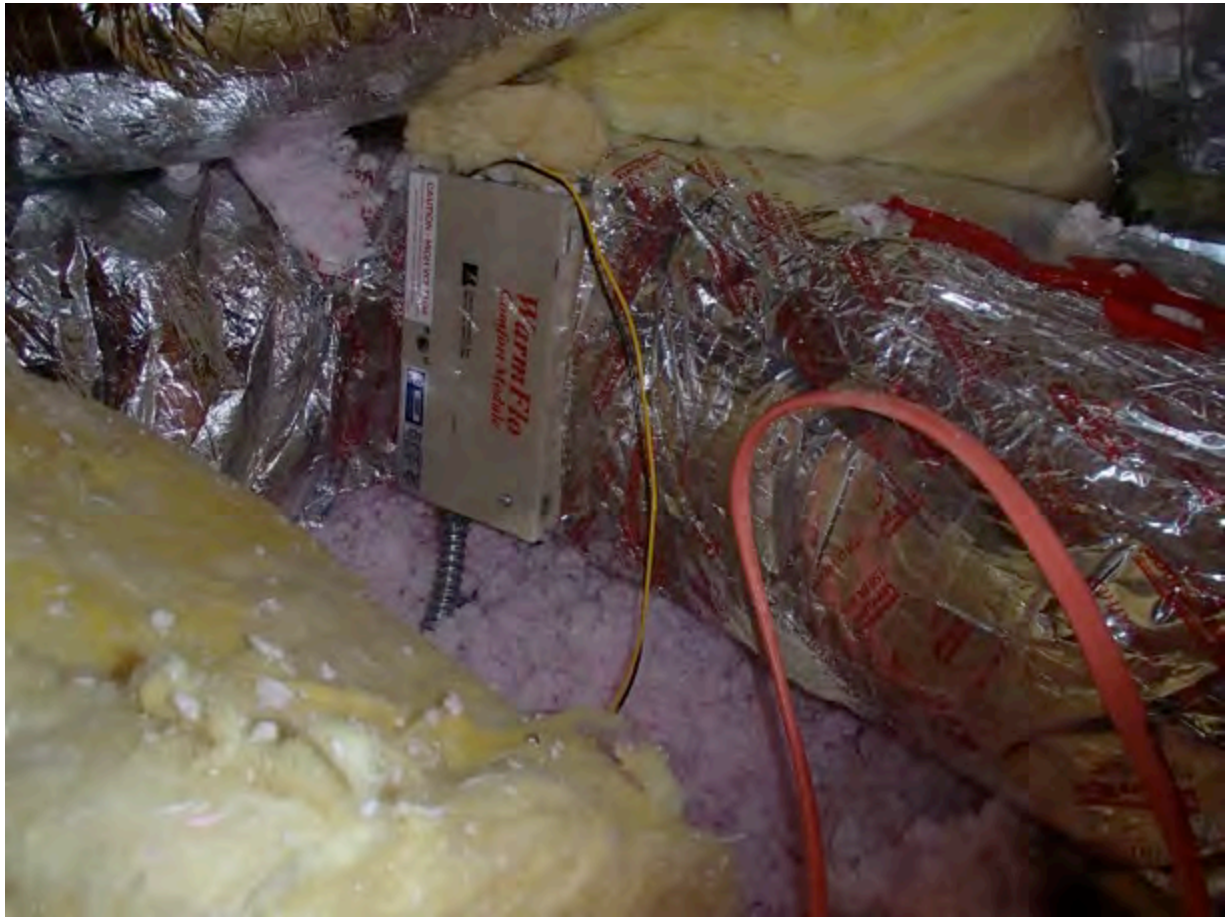
Installed

- POST HEAT OPERATION

Controls, interface wiring and duct heater were checked, there were functional

Outdoor unit

Post heat duct heater

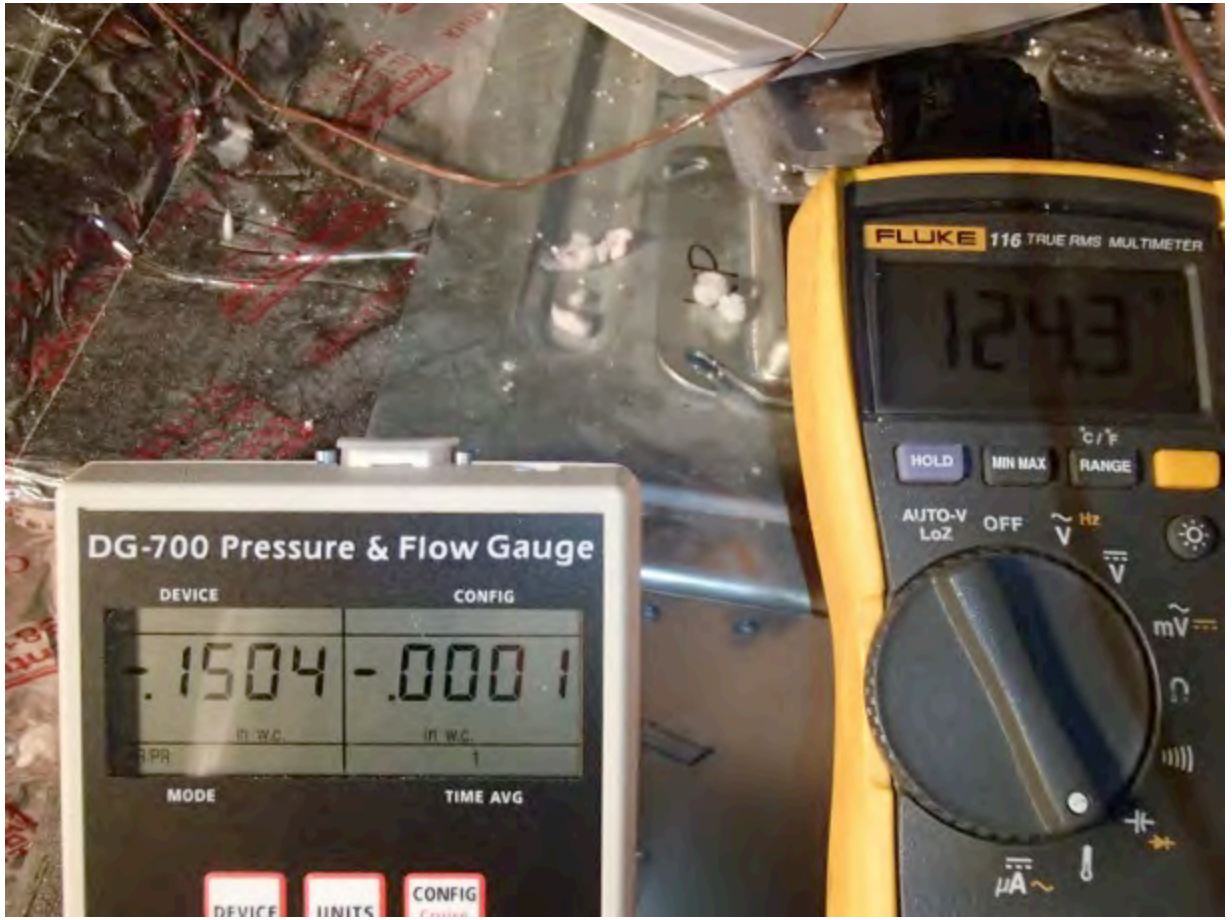


Transfer grill

Insulated thermax box over slim duct air handler

Nice insulation job

Static pressure and delivered air temperature



Supply air temperature on a 0 degrees F day

Thank you for your time

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