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 1 ton 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

- **Guide was based on commercial use**

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

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<th>UNIT</th>
<th>ROOM SIZE - Square Feet</th>
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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 MANUAL ?!#
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
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 outdoor 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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