BAIHP Ventilation Approaches

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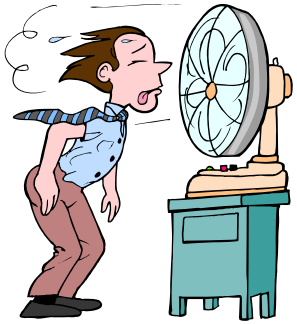
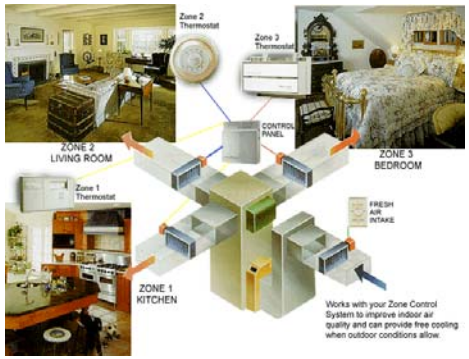
January 10, 2008

Comfort and IAQ Consideration



Ventilation

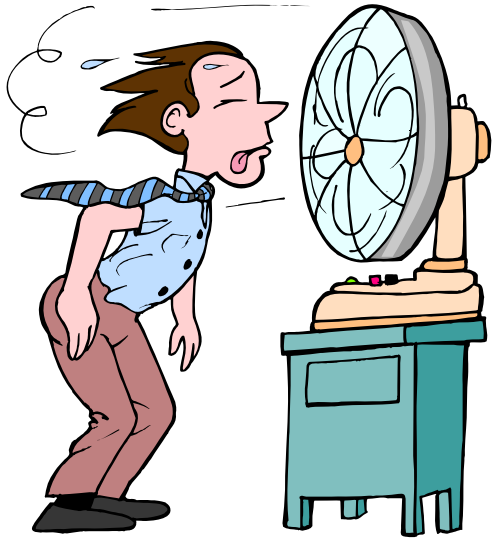
Dehumidification



Zoning

And of Coarse
Temperature Control

VENTILATION



Integrating ventilation air into the air conditioning system is controversial subject in the comfort, energy, and indoor air quality profession; especially in hot-humid climates.

Back in the pre-energy crunch days, homes were considered leaky and assumed to have sufficient infiltration for satisfactory indoor air quality. Heating and cooling equipment was sized large enough (400 SQ FT/TON) to handle the leaky envelope and all was well.

Since then we have tightened up the building envelope so much that along with condensation issues , IAQ issues have became very noticeable. Codes seem to be leaning towards Standard 62.2.

How much ventilation air?????

And what about the energy consequences of conditioning that air?????

Oil tipped over $100.00 a barrel yesterday.

BAIHP and its builder partners have been working on a method and field data testing procedures, to try to meet the special needs of homes built in hot humid climates.

Between January 2006 and April 2007 Ken Fonorow (FL H.E.R.O.) worked with two Building America Builder Partners and completed 111 homes using a uniform method of introducing outdoor air into the cooling and heating system. The results below (Table 1) show the amount of air being introduced into the AC system (WHMV rate [CFM]) and the pressure of the building relative to the outdoor world when the AC system is in operation (House Pressure WRT). Ken has reported satisfactory results-- good IAQ (no complaints) and affordable energy bills.

	Average (mean)	Median	Maximum	Minimum
House Size [sq ft]	2396	2362	4768	938
Hers Index	68	67	80	59
ACH50	4.5	4.3	8.8	2.7
Duct Leakage: Total CFM25 (% of Floor Area)	7.59%	7.24%	13.54%	3.90%
Duct Leakage: Out CFM25 (% of Floor Area)	4.3%	4.1%	7.8%	2.0%
ASHRAE 62.2	56.9	53.4	92.7	31.9
WHMV rate [cfm]	29	28	65	0
WHMV rate as a % of ASHRAE 62.2	54.9%	50.8%	119.0%	14.2%
House Pressure WRT Outdoors [Pa]	0.5	0.6	2.9	-1.1
% Window Area to Floor Area	16.3%	16.9%	23.7%	8.2%

Table 1 measured data from 111 BAIHP homes

A Comment we received:
The absence of evidence is not evidence of absence.
Philip Fairey

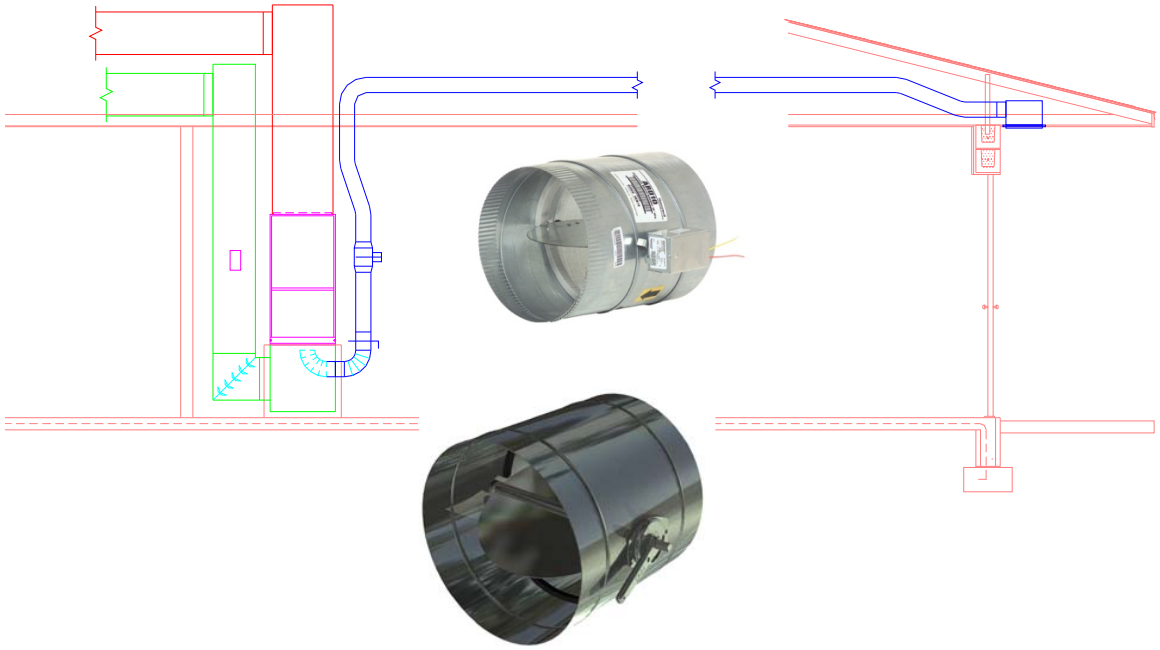
Procedures for calculating the amount of outdoor air have been derived from the results of Table 1 which shows that the measured out door air introduced was about 50% of ASHRAE 62.2. Based on this we have to use two different standards for calculating ventilation or infiltration for today's construction techniques. All homes calculated as Base Case (non BA Best Practice Homes) will use an infiltration rate; homes built to BAIHP standards will use a ventilation rate. The infiltration rate and ventilation calculation that will be entered into Manual J and energy modeling software shall be:

Manual-J Base Case
Infiltration = 0.2 ACH
Ventilation = 0 CFM

Manual J BAIHP Hot Humid Climates
Infiltration = 0
Ventilation = 50% ASHRAE 62-2 ventilation = 0.5((0.01*floor area)+(number bedrooms+1)*7.5))*

Follow up data collection will be performed on the test homes to determine the affects of the ventilation procedure used.

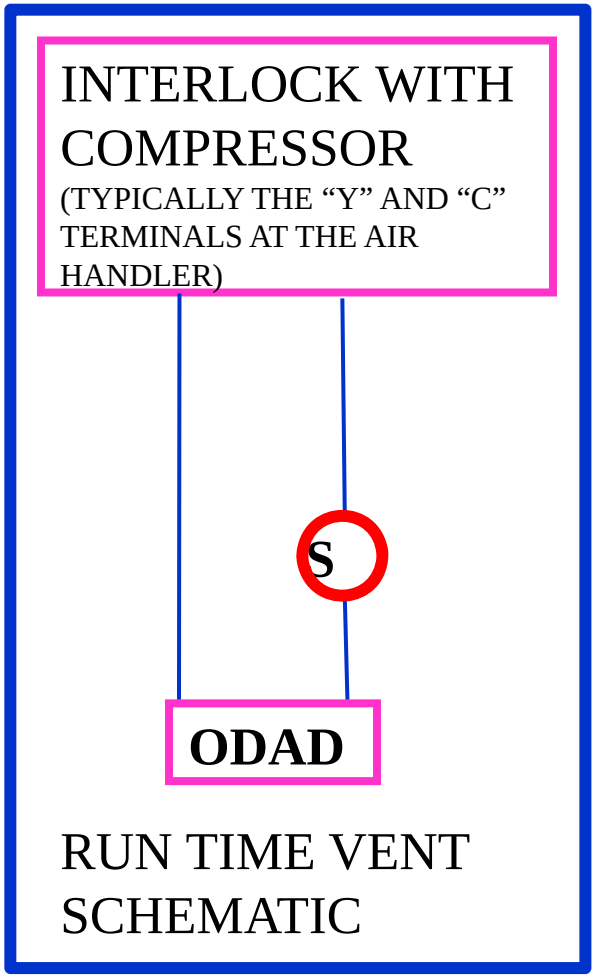
Run Time Vent



BD Similar to Crown Products #175

ODAD Similar to Honeywell EARD6

S Common Switch

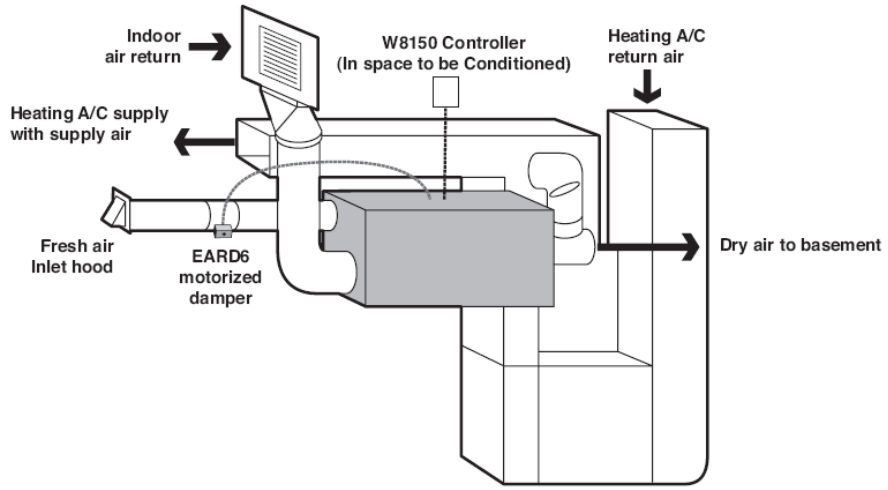


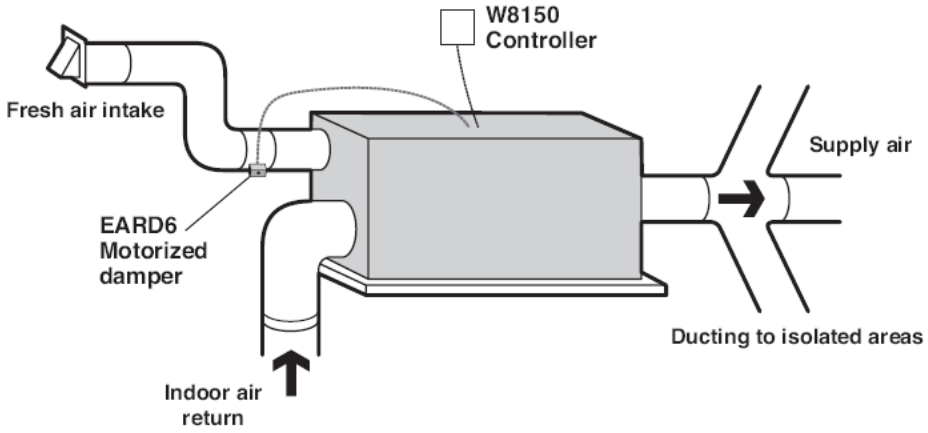
DEHUMIDIFICATION

Dedicated dehumidifiers are now being installed in today's high performance homes.

A dedicated dehumidifier is a dehumidifier that uses an air duct system to take air from the conditioned space, dry it, and move it back to the conditioned space.

There are two ways to duct a dehumidifier; 1) put it on its own duct system, or 2) integrate it with the air conditioning duct system.





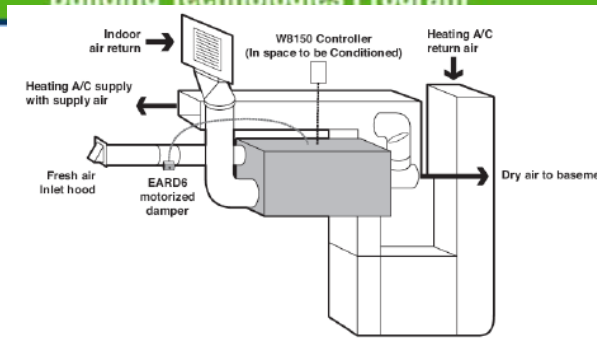


FIGURE 1

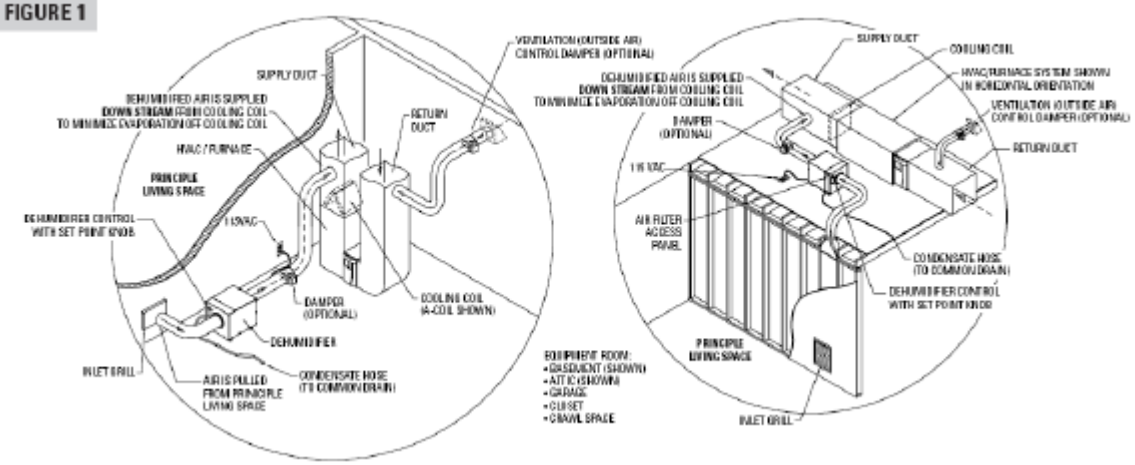
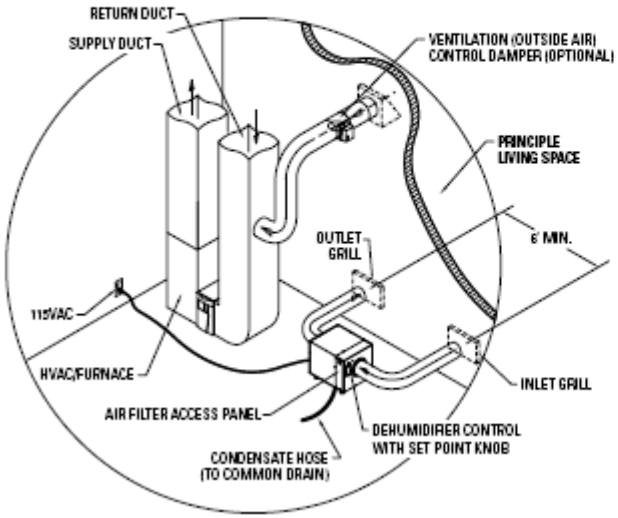
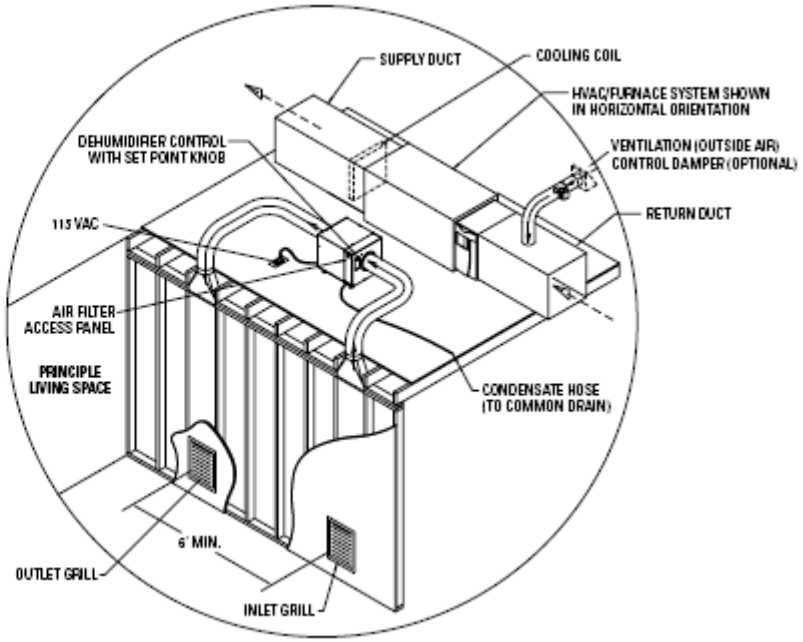
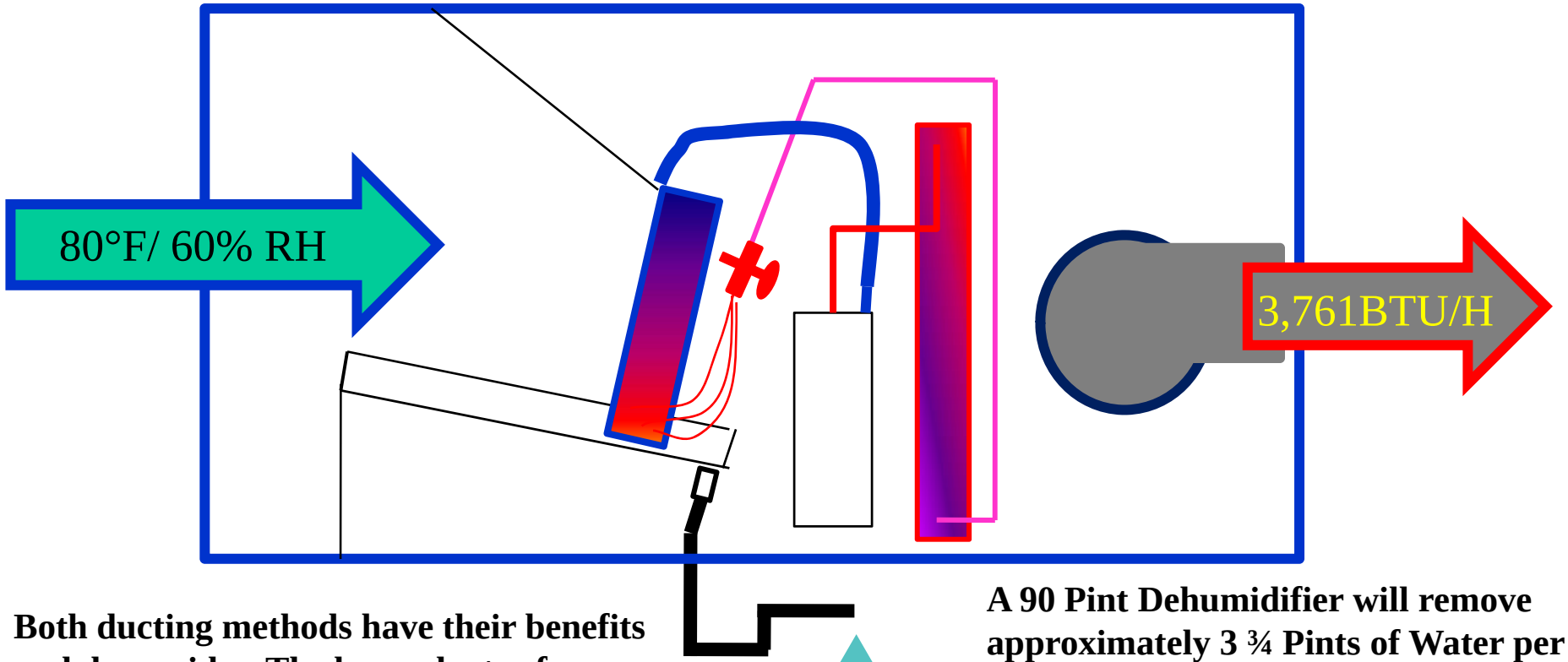


FIGURE 3 – LOCALIZED DEHUMIDIFIER CONFIGURATION







Both ducting methods have their benefits and down sides. The byproducts of a dehumidifier are liquid water and sensible heat. The water is carried away through a condensate drain system. The sensible heat is moved into the conditioned space. If the dehumidifier is on its own duct system the sensible heat can make an area of the conditioned space uncomfortable.

A 90 Pint Dehumidifier will remove approximately 3 ¾ Pints of Water per Hour
I Pint = 1.043 LBs
3 ¾ Pints = 3.8775 LBs water
970 BTU/H x 3.8775 Lbs of Water =

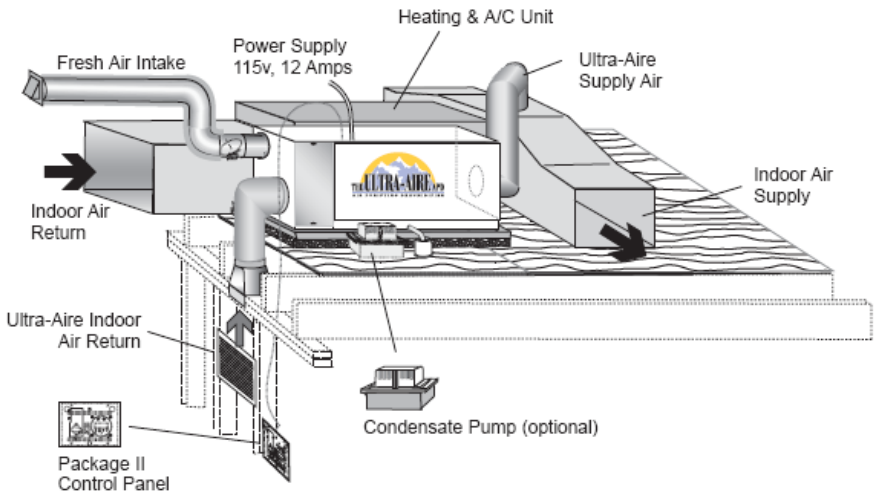
3,761 BTU/H

This discomfort can be avoided by integrating the dehumidifier with the HVAC duct system. The challenge is determining how to integrate the dehumidifier with the rest of the HVAC system.

Installation Recommendations and Options

Ultra-Aire UA-150H Attic Installation:

1. Indoor air return should come from an open area of the first (preferred) or second floor.
2. The Ultra-Aire supply should be ducted into the forced air system past the air conditioning coil.The duct connection should be perpendicular to the air flow.
3. The Ultra-Aire Vibration Isolation Kit should be installed and the unit placed in a drip pan.
4. The six inch fresh air intake should be located at least 6 feet away from any exhaust ports.
5. If placed in a high humidity location, an optional insulation kit is available to prevent condensation occurring on the Ultra-Aire cabinet.



Most manufacturers' specifications call for the supply side of the dehumidifier to be ducted into the supply side of the AC system. This method only works when the AC system is not in operation. AC systems can have a total static pressure of 0.5 IN WC or higher at the supply plenum especially when the air handler incorporates an ECM motor. Most dedicated dehumidifiers seem to be rated at less than 0.5 IN WC. If and when the AC system is in operation at the same time as the dehumidifier, the more powerful fan will win out; the dehumidifier will have greatly reduced airflow preventing it from functioning properly.

The reduction in airflow can be avoided by controlling the dehumidifier in such a way that it will not operate while the AC system is in operation.

To accomplish this operation timing scheme, the dehumidifier must know when the AC system is in operation.

An easy task if every AC manufacturer used the same control scheme in their equipment.

In this highly competitive market AC manufacturers have designed unique control circuits to do specific functions which they perceive will bring the most comfort to their customers.

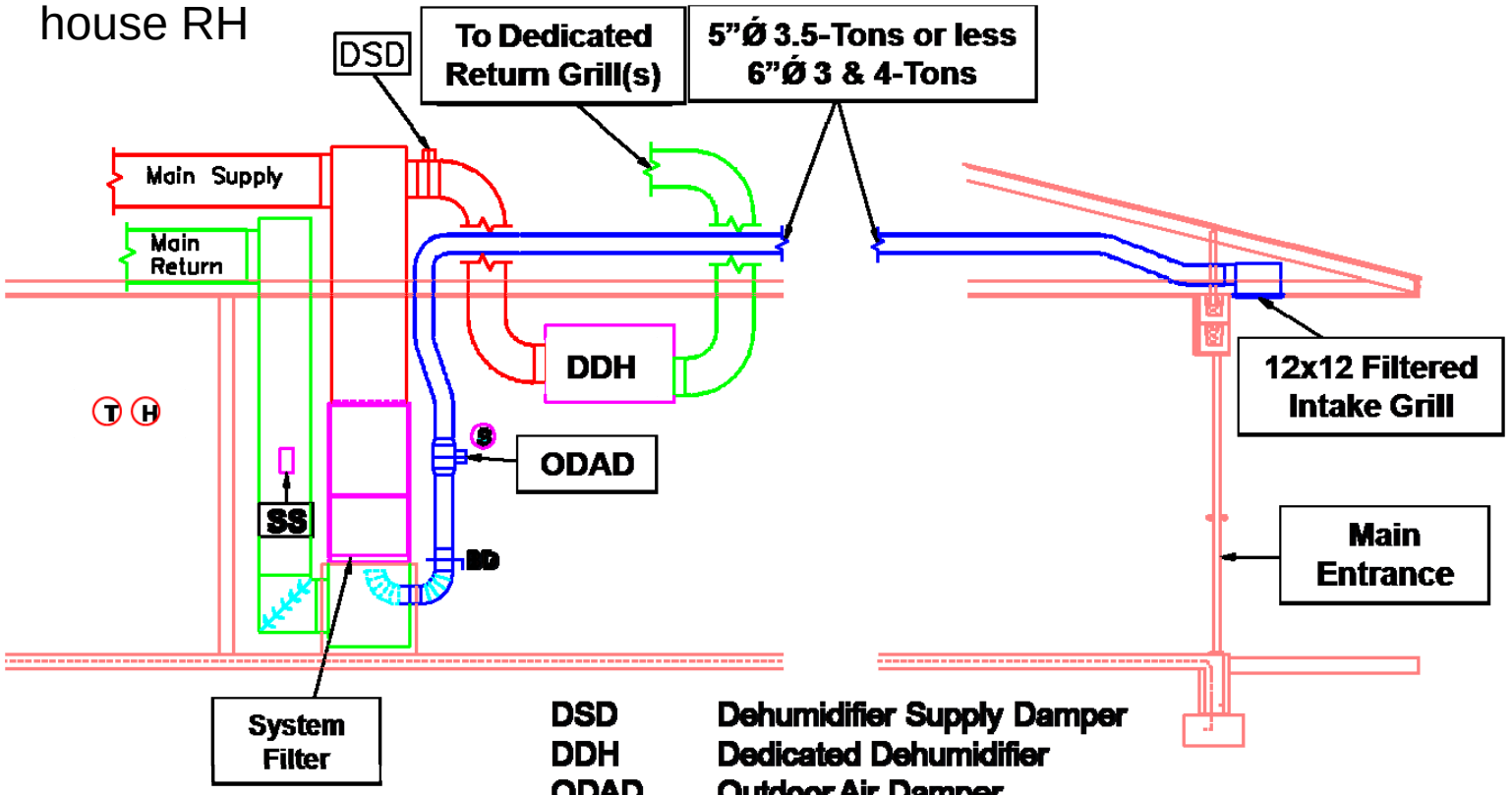
We have found that although the dehumidifier must know when the AC system is in operation it is best that the control circuit of the dehumidifier not be integrated with the control circuit of the AC system.

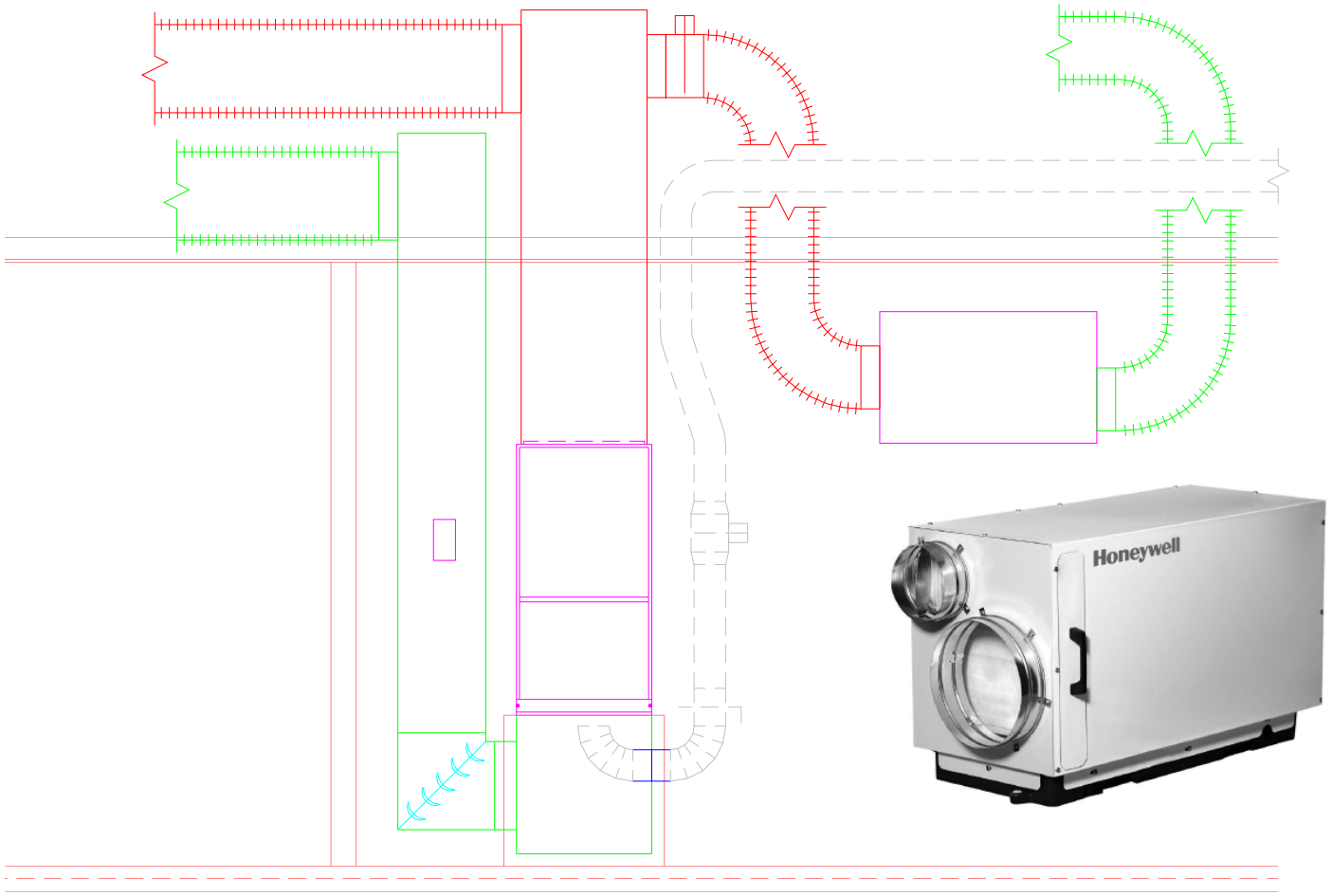
The Test Home

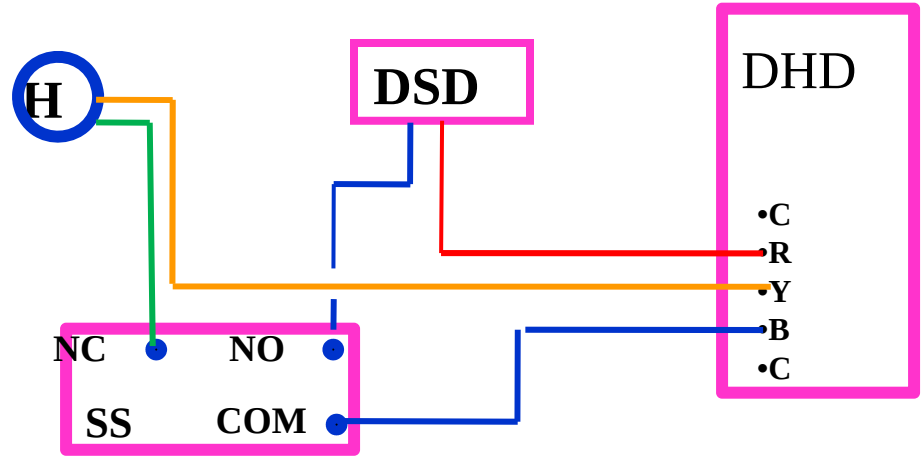
PHH Gen-X Solaro IBS 2007 Home

Site Relocation to Siesta Key, FL

This is the schematic that was used to connect the HVAC to the dehumidifier so that it does not run when ahu is running and dehumidifier is controlled by the house RH

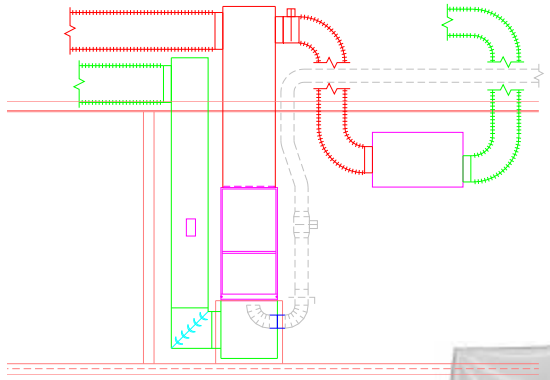



Honeywell



DEDICATED DEHUMIDIFIER SCHEMATIC

The Sail Switch deactivates the dehumidifier in response to airflow from the system fan.



DSD	Similar to Honeywell ARD10
DDH	Similar to Honeywell DH90
ODAD	Similar to Honeywell EARD6
(T)	Equal to Equipment Manufacturer's Recommendations
(H)	Equal to Equipment Manufacturer's Recommendations
SS	Similar to Honeywell S688A
BD	Similar to Crown Products #175
(S)	Common Switch

Air Handler

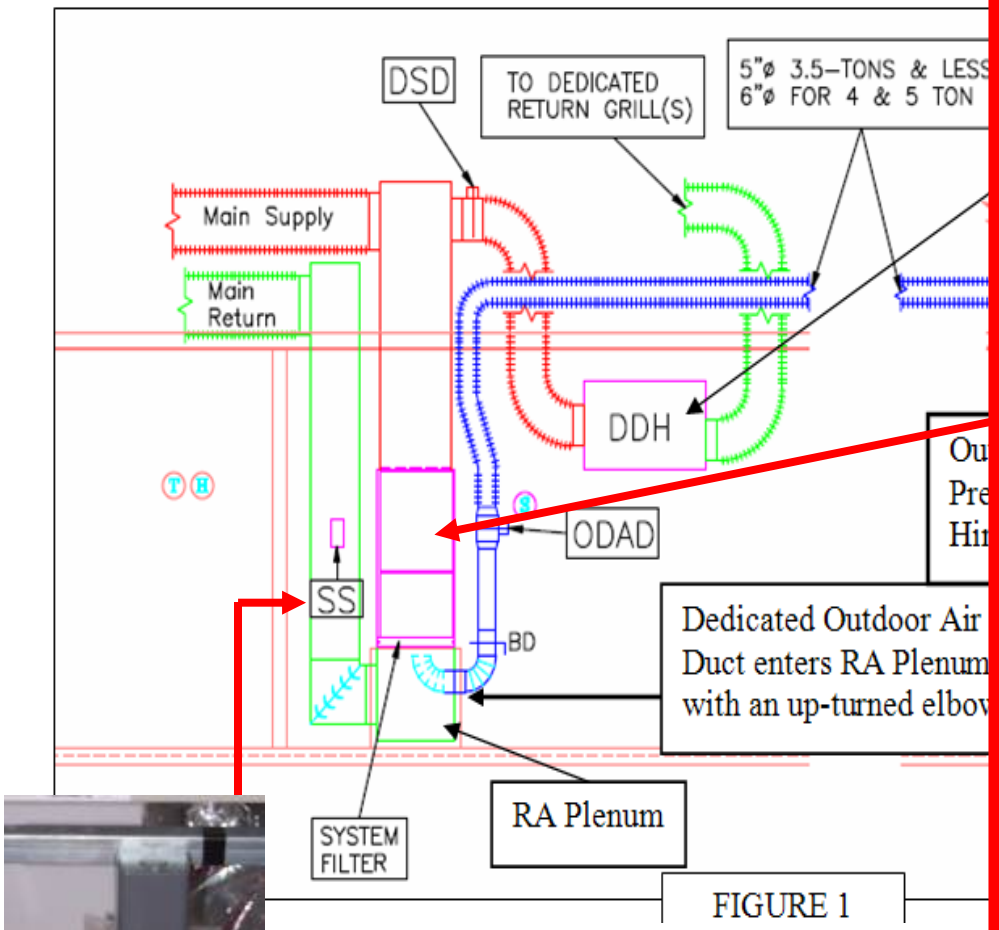
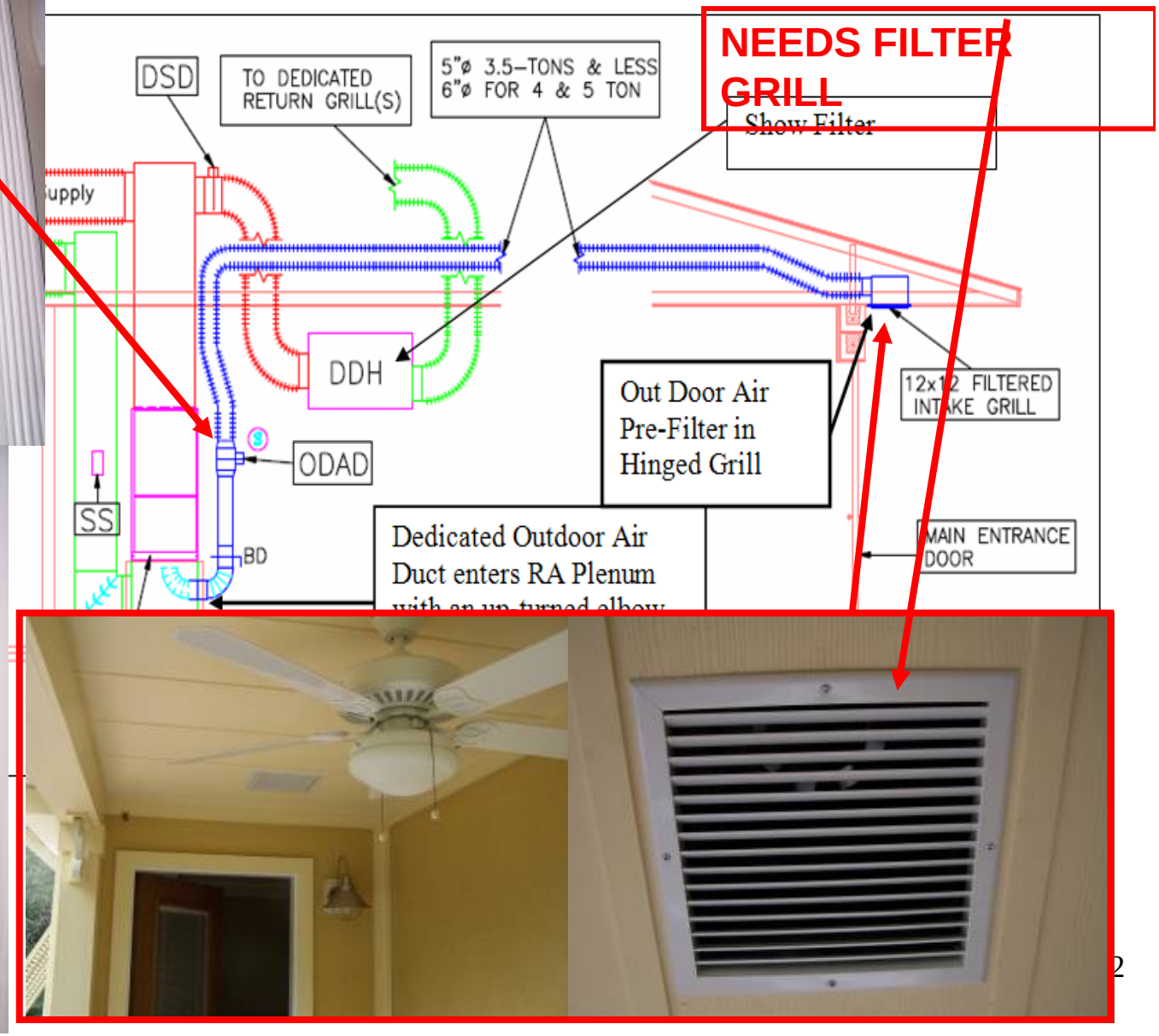
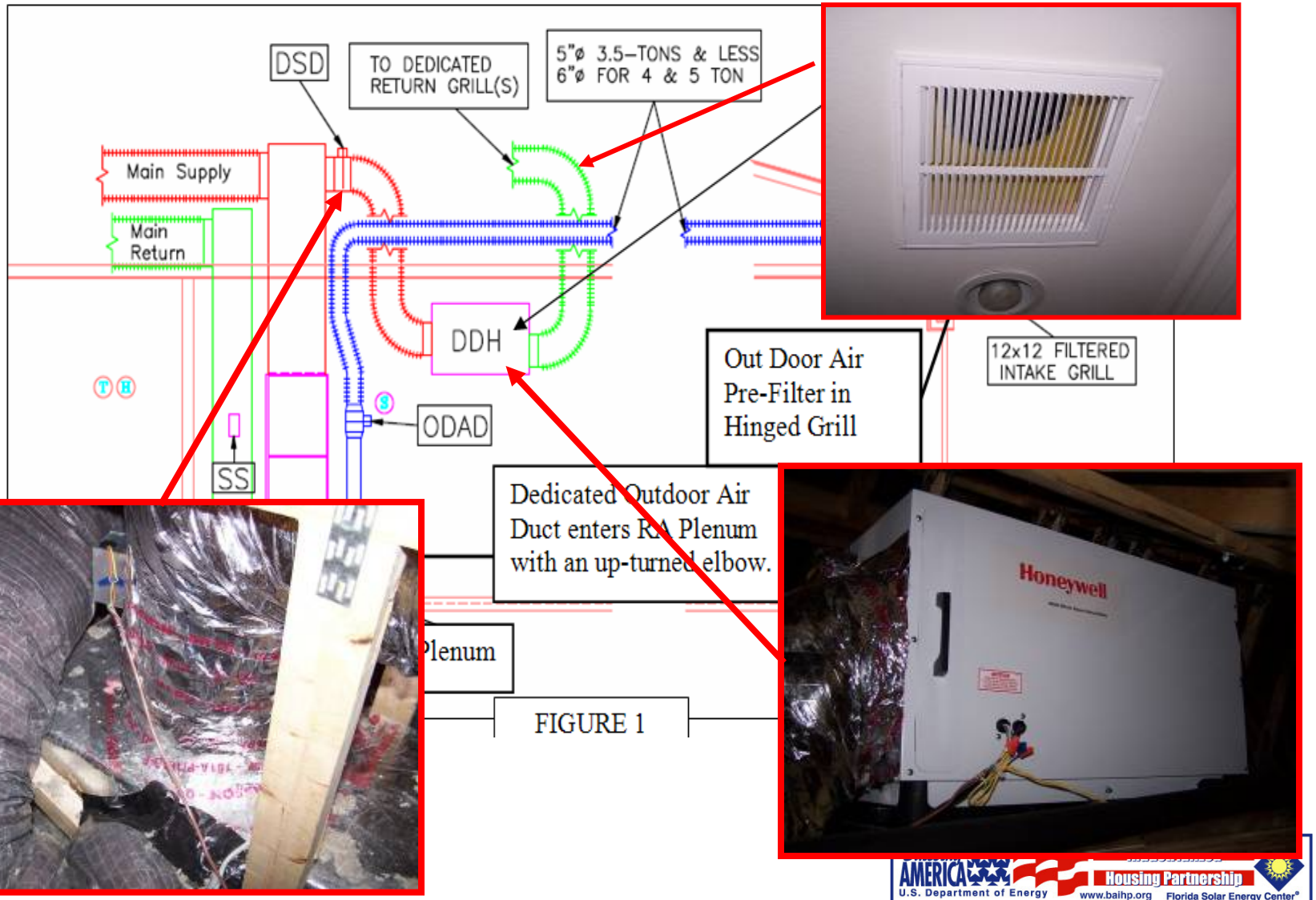


FIGURE 1

Outdoor Air


DSD
TO DEDICATED RETURN GRILL(S)
5"ø 3.5–TONS & LESS
6"ø FOR 4 & 5 TON
NEEDS FILTER GRILL
Show Filter
Supply
DDH
ODAD
SS
BD
Out Door Air Pre-Filter in Hinged Grill
12x12 FILTERED INTAKE GRILL
Dedicated Outdoor Air Duct enters RA Plenum
MAIN ENTRANCE DOOR

Dedicated Dehumidifier



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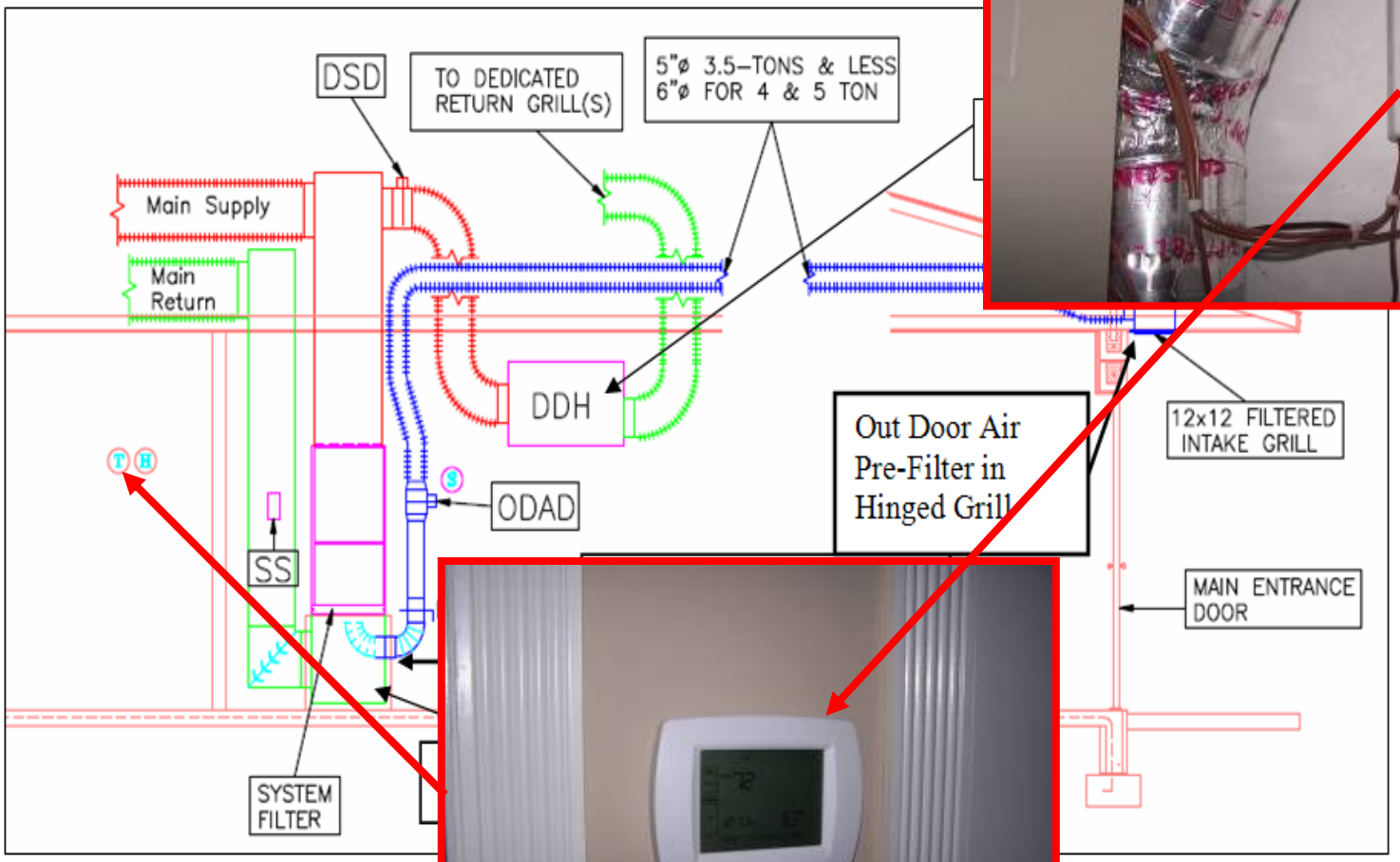
DSD
TO DEDICATED RETURN GRILL(S)
5"ø 3.5–TONS & LESS
6"ø FOR 4 & 5 TON
Main Supply
Main Return
DDH
Out Door Air Pre-Filter in Hinged Grill
12x12 FILTERED INTAKE GRILL
T
H
S
ODAD
SS
MAIN ENTRANCE DOOR
SYSTEM FILTER

Next Steps for Siesta Key Home

- Complete all work and commission the system
- Instrument and monitor starting ~March 2008

StalwartBuilt HOMES
beyond green

Location	Callaway, FL
Number of Homes	270/ 10 to date
HERS Index (PV / no PV)	27 / 60
Benchmark (PV / no PV)	69% / 46%
Green Program	LEED

Factory built modular houses, geothermal HVAC with heat recovery water heater, ducts in conditioned space, runtime vent w/ dehumidifier, unvented attic, vented crawlspace, 1 with 3.6 kW PV