

# Minisplit Heat Pump Lessons



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# Topics

- Sizing
- Installation
- Performance

# Key Sizing Issues

- Will the heat pump heat the building at design temperature?
  - Cold Climate Heat Pump Specification answers this
- Will adequate distribution of heat be achieved?
  - # of indoor units depends on the heat load of the building and how it is operated

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# Key Sizing Issues

- Will the heating and cooling capacities of the heat pump be sufficiently balanced to provide good performance in both seasons?
  - Over-sizing variable speed heat pumps rather than using a cold climate heat pump risks poor cooling performance

# Example: Non-ducted Single Zone System

- Design temperature 8°F
- Design heating load 13,000 BTU/hr
- Wall cassette, single zone

Find a unit that has at least 13,000 BTU/hr at 5°F

# Example: Non-ducted Single Zone System

## 6-2. HEATING CAPACITY

### MODEL: ASU9RLS2

AFR	500
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		Indoor temperature								
		°FDB		60		65		70		75
Outdoor temperature	°FDB	°FWB	TC	IP	TC	IP	TC	IP	TC	IP
	-5	-7	14.7	1.97	14.3	2.01	14.0	2.05	13.3	2.13
	5	3	16.1	1.98	15.7	2.02	15.4	2.06	14.6	2.15
	14	12	16.8	1.91	16.4	1.95	16.0	1.99	15.2	2.07
	23	19	18.3	1.84	17.9	1.88	17.5	1.92	16.6	2.00
	32	28	18.8	1.78	18.4	1.82	17.9	1.85	17.0	1.93
	41	37	21.3	1.85	20.8	1.89	20.3	1.93	19.3	2.00
	47	43	23.1	1.91	22.6	1.95	22.0	1.99	20.9	2.07
	50	47	25.5	1.94	24.9	1.98	24.3	2.02	23.1	2.10
	59	50	26.5	1.95	25.8	1.99	25.2	2.03	23.9	2.11

## 6-1. COOLING CAPACITY

### MODEL: ASU9RLS2

AFR	500
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		Indoor temperature																				
		°FDB			64			70			75			80			85			90		
		°FDB	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP	TC	SHC	IP		
Outdoor temperature	°FWB	54			60			63			67			71			73					
	67	8.4	6.0	0.38	9.4	6.0	0.39	10.3	6.6	0.40	10.7	7.1	0.40	11.3	7.1	0.40	11.9	7.5	0.41			
	77	8.0	5.7	0.44	8.9	5.7	0.44	9.8	6.2	0.45	10.2	6.7	0.45	10.8	6.7	0.46	11.4	7.2	0.46			
	87	7.6	5.4	0.49	8.4	5.4	0.49	9.3	5.9	0.50	9.6	6.4	0.50	10.2	6.4	0.51	10.8	6.8	0.51			
	95	7.1	5.1	0.54	7.9	5.1	0.55	8.7	5.6	0.56	9.0	6.0	0.56	9.5	6.0	0.57	10.1	6.4	0.57			
	104	6.0	4.5	0.50	6.7	4.5	0.51	7.4	4.9	0.52	7.6	5.3	0.52	8.1	5.3	0.53	8.5	5.7	0.53			
115	5.5	4.2	0.50	6.2	4.2	0.51	6.8	4.6	0.52	7.0	5.0	0.52	7.4	4.9	0.53	7.8	5.3	0.53				

# Example: Non-ducted Single Zone System

Temp: Fahrenheit

TC: kBtu/h

PI: kW

**FTXS24LVJU + RXS24LVJU**

INDOOR	OUTDOOR TEMPERATURE (°FWB)											
EDB	5		14		23		32		43		50	
°F	TC	PI	TC	PI	TC	PI	TC	PI	TC	PI	TC	PI
59.0	12.09	1.42	14.53	1.50	16.96	1.57	22.82	2.05	26.26	2.16	28.55	2.23
70.0	11.34	1.46	13.78	1.54	16.22	1.61	21.95	2.10	25.40	2.21	27.68	2.28
71.6	11.05	1.48	13.48	1.55	15.92	1.62	21.60	2.12	25.03	2.23	27.33	2.30

INDOOR		OUTDOOR TEMPERATURE (°FDB)														
EWB	EDB	68			77			86			90			95		
°F	°F	TC	SHC	PI	TC	SHC	PI	TC	SHC	PI	TC	SHC	PI	TC	SHC	PI
57.2	68.0	22.02	16.61	1.32	21.02	16.11	1.45	20.02	15.62	1.57	19.62	15.43	1.62	19.02	15.14	1.70
60.8	71.6	23.01	16.32	1.33	22.01	15.86	1.45	21.01	15.40	1.58	20.61	15.21	1.63	20.01	14.94	1.71
64.4	77.0	24.00	17.14	1.33	23.00	16.70	1.46	22.00	16.28	1.59	21.60	16.11	1.64	21.00	15.85	1.72
67.0	80.0	24.50	18.11	1.34	23.50	17.69	1.47	22.50	17.28	1.59	22.10	17.12	1.64	21.50	16.88	1.72
71.6	86.0	25.98	17.48	1.35	24.98	17.11	1.48	23.98	16.75	1.60	23.58	16.60	1.66	22.98	16.39	1.73
75.2	89.6	26.97	17.03	1.36	25.97	16.70	1.48	24.97	16.36	1.61	24.57	16.23	1.66	23.97	16.04	1.74



# Installation - Clearance



# Installation – Penetration



# Installation - Clearance



# Performance

- Six houses on Martha's Vineyard
- 1,250 – 1,334 ft<sup>2</sup>, over full basements
- 5,600 – 6,100 HDD65°F
- Single zone heat pumps – non-ducted and ducted
- Bedroom electric radiant in non-ducted
- Four new, two Deep Energy Retrofits

# Performance



# Performance

	Floor area	Modeled heat, kWh/yr	Heat, kWh/year	COP
MV Cottage DER	1,258	4,878	2,032	2.4
MV DER	1,334	4,188	1,297	3.2
(4) IHT 2 BR	1,250	3,628	1,487	2.4

architecture

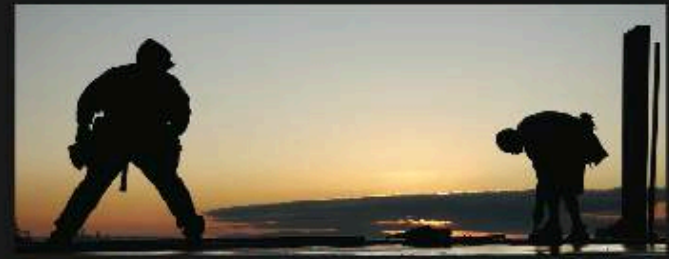
building

renovations

interiors

fine woodwork

green energy



Thank You

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## DHP Program Experience

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Bruce Harley

Technical Director Applied Building Science

NEEP DHP Conference, 6 October 2015



# CLEAResult DHP Programs:

- Northwest (BPA, other): 30,000+ / 7 years
  - Resistance heat customers
- Maine: 12,000 / 3 years
  - Oil/LP and resistance customers
- Mass: 14,000+ / <3 years
  - Some other programs have DHP as measure
- Vast majority are:
  - Single-zone
  - Offsetting (not replacing) existing heat source

# Overall Experience

- Savings vary widely
  - Highly dependent on occupant behavior
  - Somewhat lower offset of heat than assumed
  - A few installations result in poor efficiency
- Still cost-effective
- Customer satisfaction is very high

# Customers / Controls

- Controls are sometimes confusing....
- Do “set and forget” (avoid setbacks)
  - *Don't* set on Auto changeover; auto fan is good
- Handheld unit doesn't sense temperature
- Set temperature above “other” system
- Integrated controls?
  - Maybe... I'm not convinced
  - People may set back “entire system”
  - Wifi controls invite setbacks

# Other ways to improve savings...

- Whole-house systems...
  - Maybe
- Multi-zone systems = replace, not offset
  - More expensive
  - More savings
- Central systems
  - When existing ducts aren't messed up
- CO<sub>2</sub> systems .....

# Installation Issues / Solutions

- Installs are not foolproof
  - Flare connections are critical
  - Purge/vacuum, charge adjustments for long lines
  - The right tools matter (flare tools; charging set w/isolation valves, short hoses)
- NW – training, training, training
  - Listed contractors: factory training, regular webinars, pass QA inspections
  - “Master Installer”: frequent installs, testimonials
- Cold climate issues
  - ME – drip caps, wall mount (few drain pan heaters)
  - NW – some wind baffles, drain pan heaters

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Thank you