ComfortReady HOME

Heat Pump Best Practices

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Comfort Ready Home Overview

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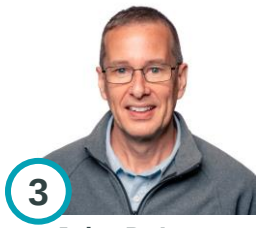

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Heat Pumps 101

What We'll Cover today

- Heat Pumps 101
- AHRI Ratings
- Compressor types
- Cold Climate heat pumps

What is a heat pump?

A device that transfers heat from one place to another, typically from a lower temperature to a higher temperature.

How does a heat pump heat or cool a home?

Heating mode: From the outside air, heated by the sun. Even when it is cold outside, heat energy can be extracted from the air and pumped inside.

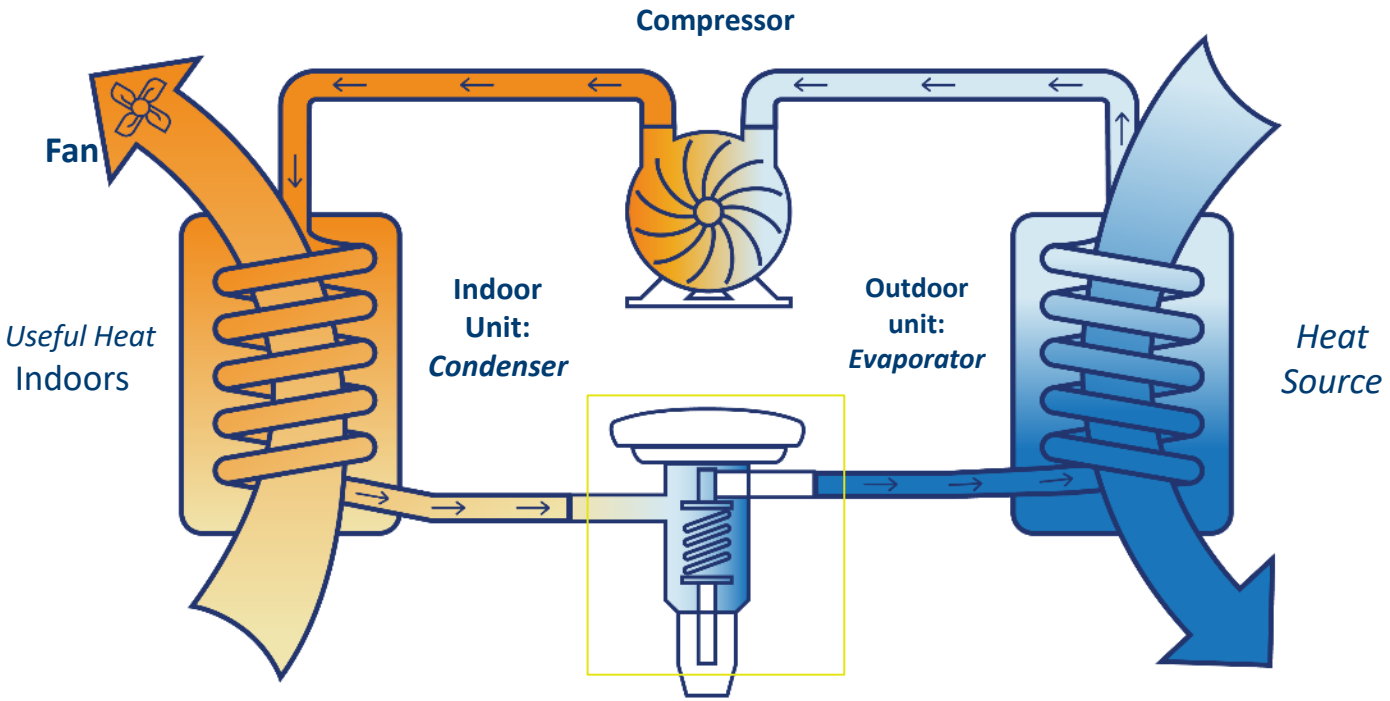
Cooling mode:
From the inside air.
It is not bringing in cold, it is pumping heat out of the building.

Terminology

ComfortReady HOME

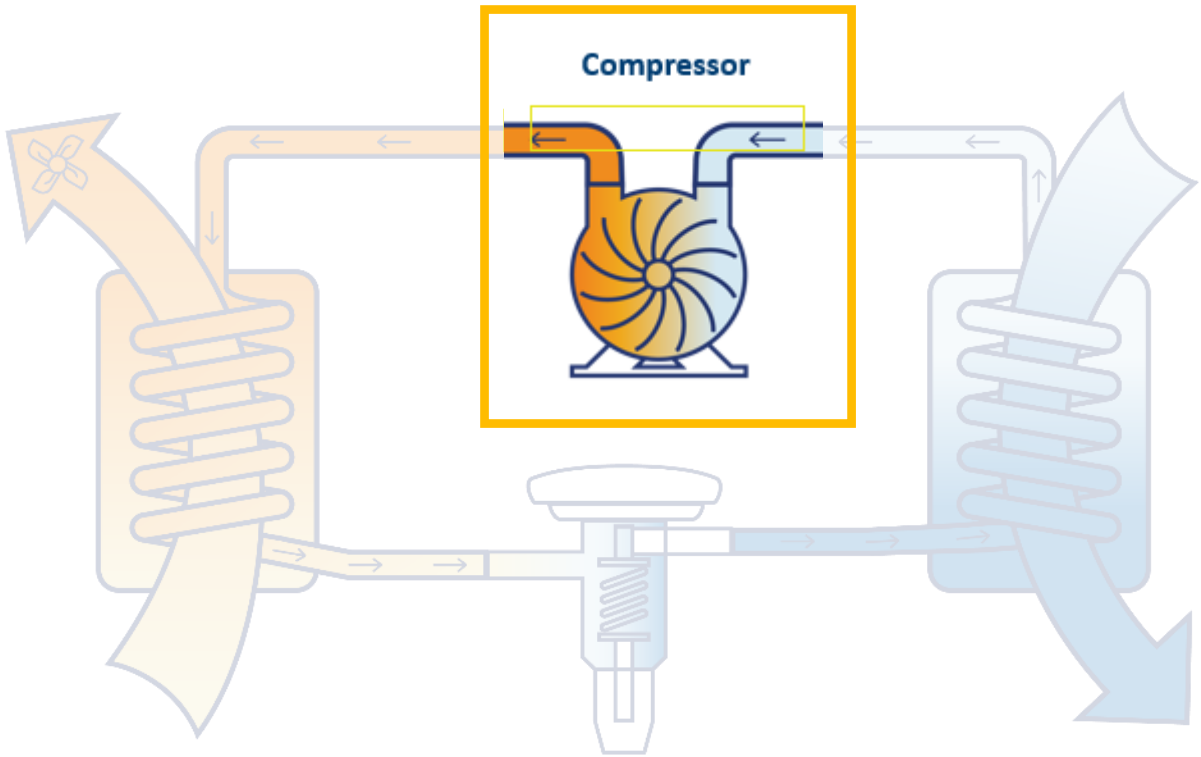
1. C.O.P. = Co-efficient of Performance
2. AHRI= Air Conditioning Heating and Refrigeration institute
3. A2L= refrigerant type that is less than flammable
4. R454b and R32 A2L refrigerants being used in residential heat pumps and air conditioners
5. Air handler= the indoor portion of a heat pump that is responsible for moving air.
6. Up-flow/Downflow/horizontal= this is referring to the orientation of the airflow from the air handler
7. 99% winter design temperature= the area is this temperature or above 99% of the year
8. BTUh-British Thermal Units per hour

Basic refrigerant cycle

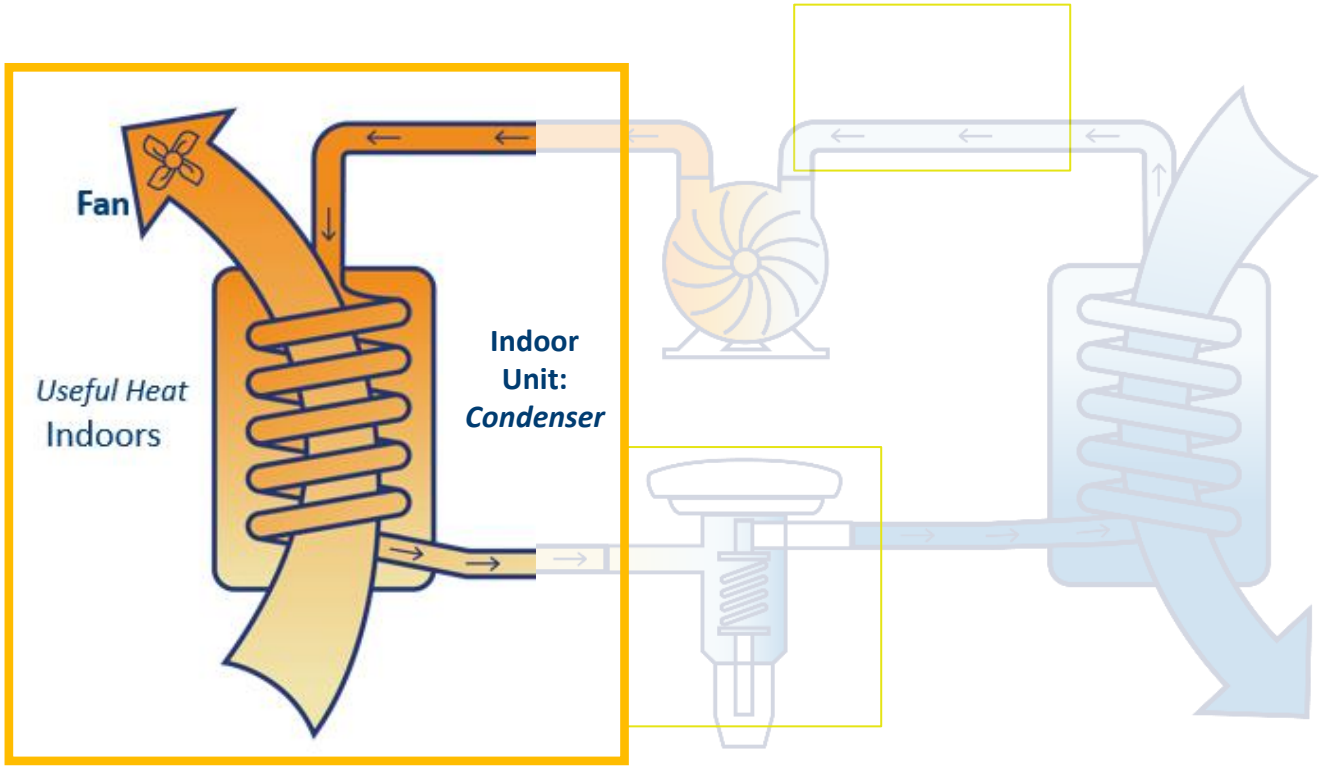


Heating Mode

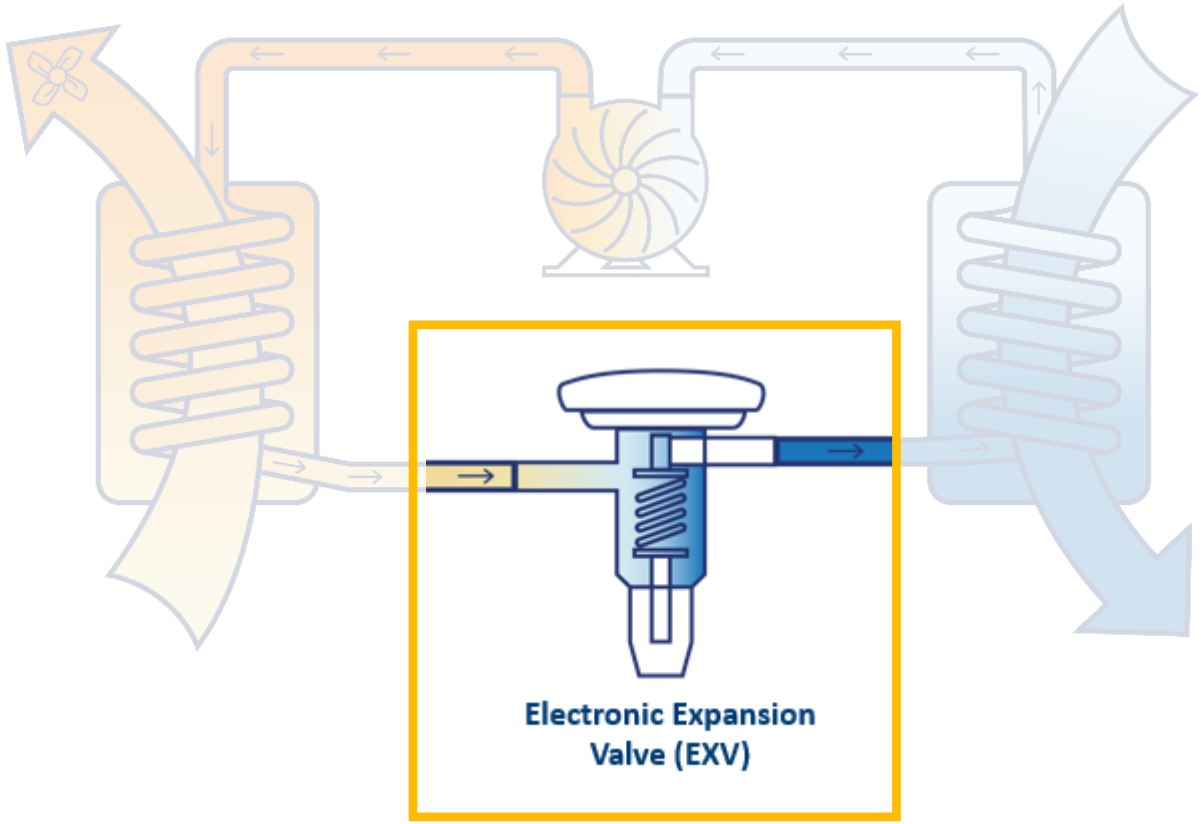
Basic refrigerant cycle - Compressor



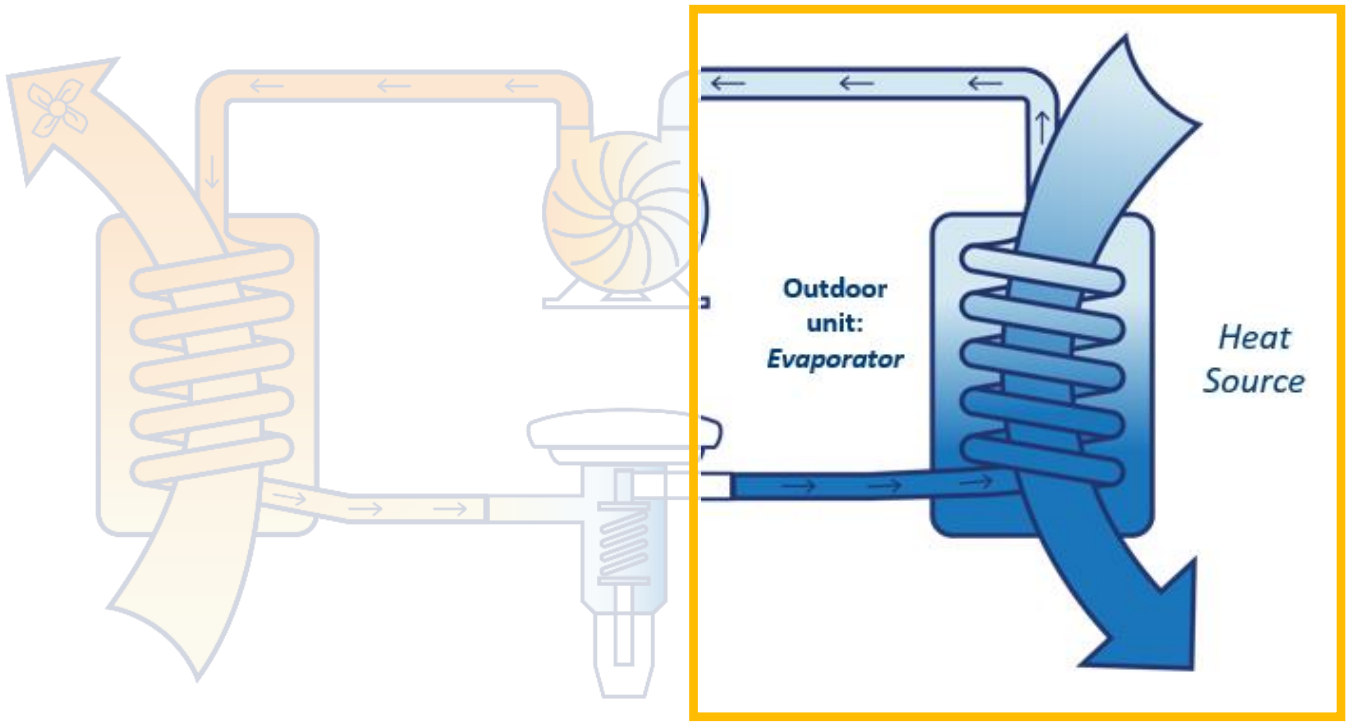
Basic refrigerant cycle - Condenser



Basic refrigerant cycle – Expansion Valve



Basic refrigerant cycle – Evaporator



Can heat pumps save energy?

- Up to 4 times more efficient!
- Space heating is 44% of residential energy use.
- Ductless heat pumps are a great option for homes with no existing ductwork.

Photo Courtesy of NW Ductless Heat Pump Project

Configuration Types

Common System configurations:

- Central ducted Air Source Heat pumps
- Ductless
- Ductless/combination
- Dual fuel systems

Less Common

- Air to Water heat pumps, which can be central ducted, used for radiant or a combination of both
- Ground Source heat pumps (AKA geothermal)

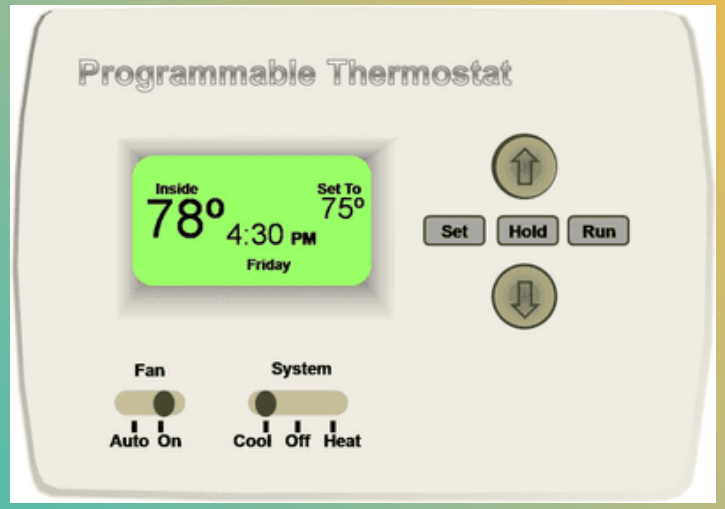
Compressor Types

- Single Stage
- Two Stage
- Multistage/Variable Capacity

Cold Climate Heat Pump IDS Ultra image courtesy of Bosch

Types of thermostats

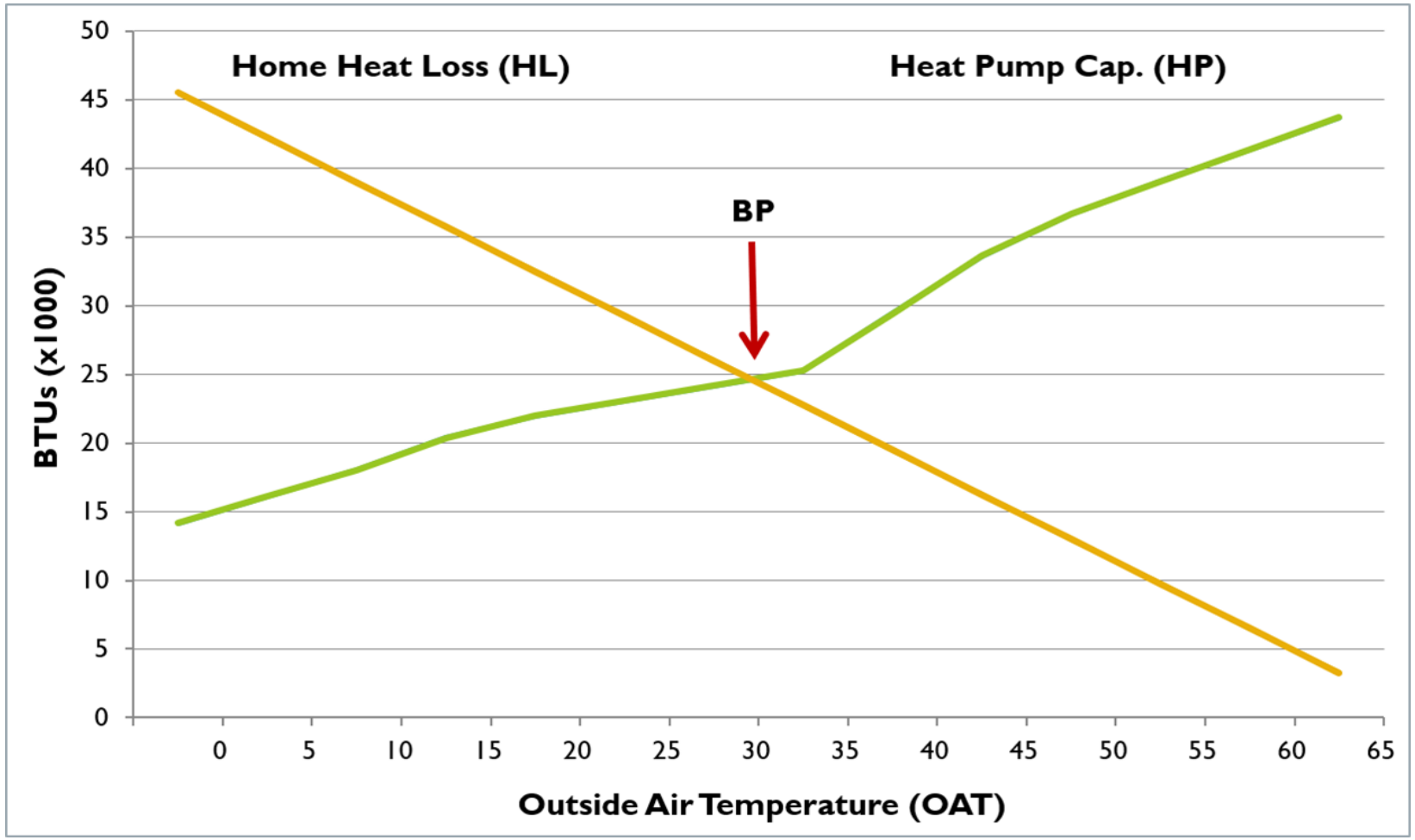
- Programmable
- Wi-Fi enabled
- Communicating proprietary
- Advanced smart thermostats



Balance points

- Thermal-Outdoor temperature when the home's heat loss and the heat pump's heat output are matched.
- Economic-Used for dual fuel applications to determine which fuel type is most cost effective based on ambient conditions.

Sample thermal balance point chart



Sizing supplementary heating

- Less is more
- Size it
- Stage it

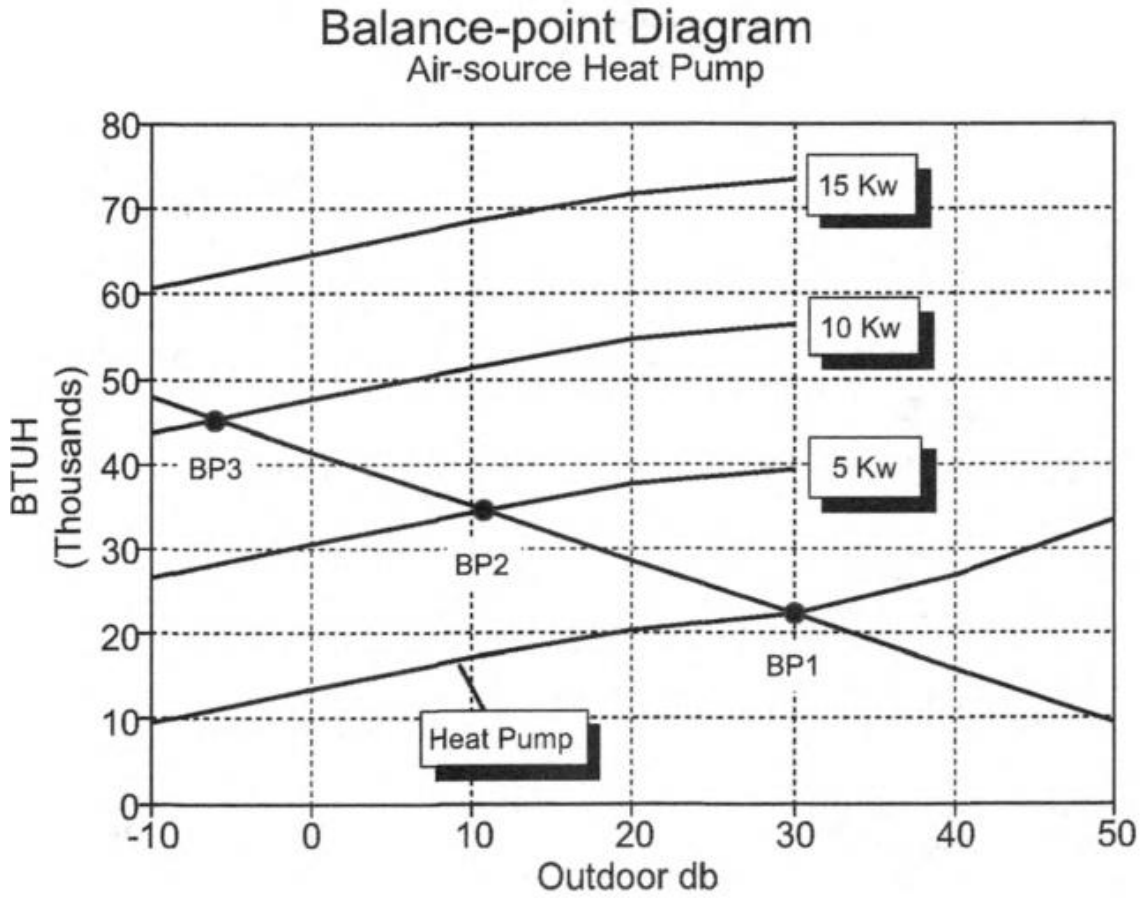


Photo Courtesy of ACCA

Heat Pump Ratings

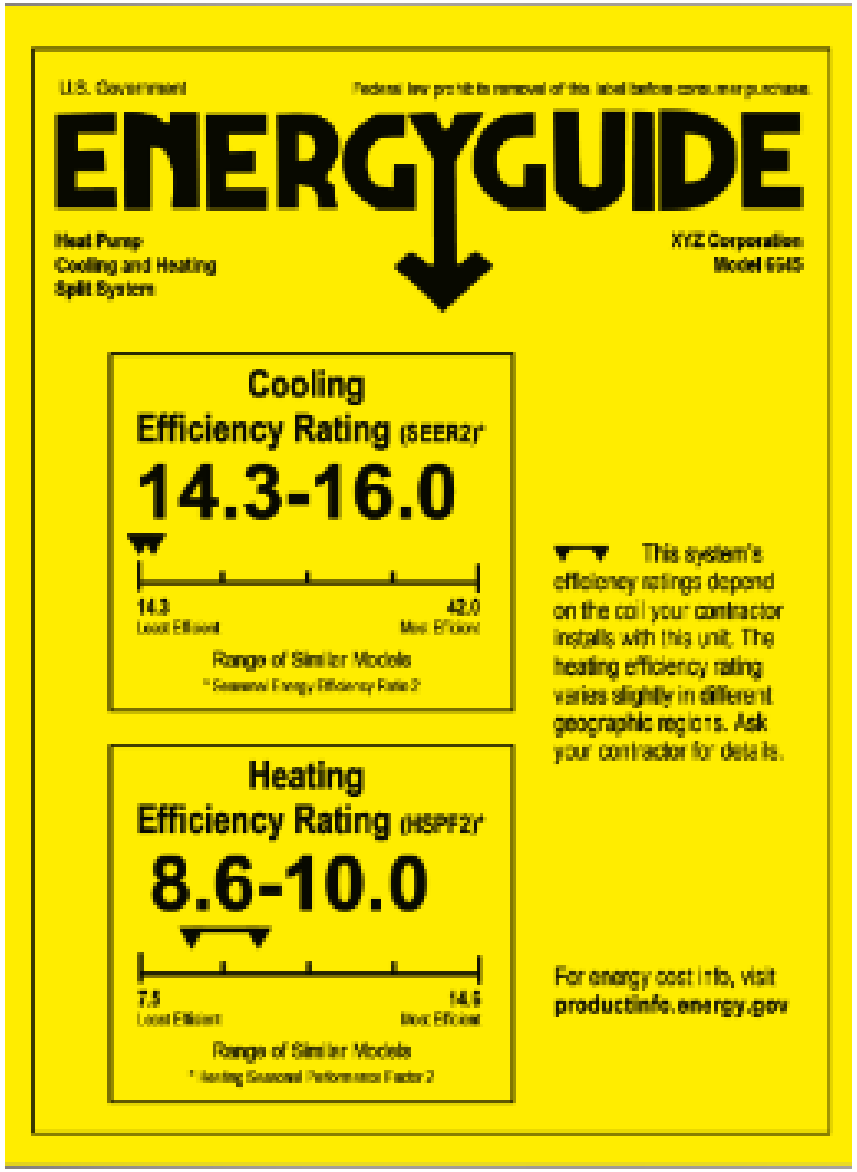
Air Conditioning, Heating and Refrigeration Institute (AHRI)

SEER 2 = Seasonal Energy Efficiency Ratio

This represents the total heat removed from the conditioned space during the annual cooling season expressed in BTUs divided by the electricity consumed expressed in watt-hours.

HSPF 2 = Heating Seasonal Performance Factor

This represents the total space heating required in region IV (north) during the space heating season expressed in BTUs and divided by the total electricity consumed expressed in watt-hours.



AHRI Certification

- What does AHRI do?
- Why is a certification important?
- Why wouldn't a combination be certified?

Potential Eligibility for IRA Tax Credit*

AHRI CERTIFIED®
www.ahridirectory.org

Certificate of Product Ratings

AHRI Certified Reference Number : 211806977 Date : 04-08-2025 Model Status : Production Stopped

AHRI Type : HRCU-A-CB (Split System: Heat Pump with Remote Outdoor Unit-Air-Source)

Series : ML17XP1 SERIES

Outdoor Unit Brand Name : LENNOX

Outdoor Unit Model Number (Condenser or Single Package) : ML17XP1-024-230A**

Indoor Unit Model Number (Evaporator and/or Air Handler) : CBA25UHV-030-230-**

The manufacturer of this LENNOX product is responsible for the rating of this system combination.

Rated as follows in accordance with the latest edition of AHRI 210/240 – 2024, Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment and subject to rating accuracy by AHRI-sponsored, independent, third party testing:

Cooling Capacity (A_{Full}) – Single or High Stage (95F), btuh : 23400

SEER2 : 16.00

EER2 (A_{Full}) – Single or High Stage (95F) : 13.00

Heating Capacity ($H1_{Full}$) – Single or High Stage (47F), btuh : 21600

HSPF2 (Region IV) : 8.10

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†"Active" Model Status are those that an AHRI Certification Program Participant is currently producing AND selling or offering for sale; OR new models that are being marketed but are not yet being produced."Production Stopped" Model Status are those that an AHRI Certification Program Participant is no longer producing BUT is still selling or offering for sale.
Ratings that are accompanied by WAS indicate an involuntary re-rate. The new published rating is shown along with the previous (i.e. WAS) rating.
The Department of Energy has published updated energy efficiency metrics for central air conditioners and heat pumps. This publication reflects both the 1987 metric (SEER) and the 2023 metric (SEER2). Efficiency requirements are published at 10 C.F.R. 430.32(c). Please refer to www.AHRInet.org for more information about updated energy efficiency metrics.
*As of the date, this AHRI Certificate of Product Performance is printed, the product may be eligible for the U.S. federal tax credit based on the displayed AHRI Certified ratings meeting the Consortium for Energy Efficiency (CEE) highest efficiency tier, not including any advanced tier, of the CEE Residential Heating and Cooling Systems Initiative - Electric Equipment Specification with effective date January 1, 2025.
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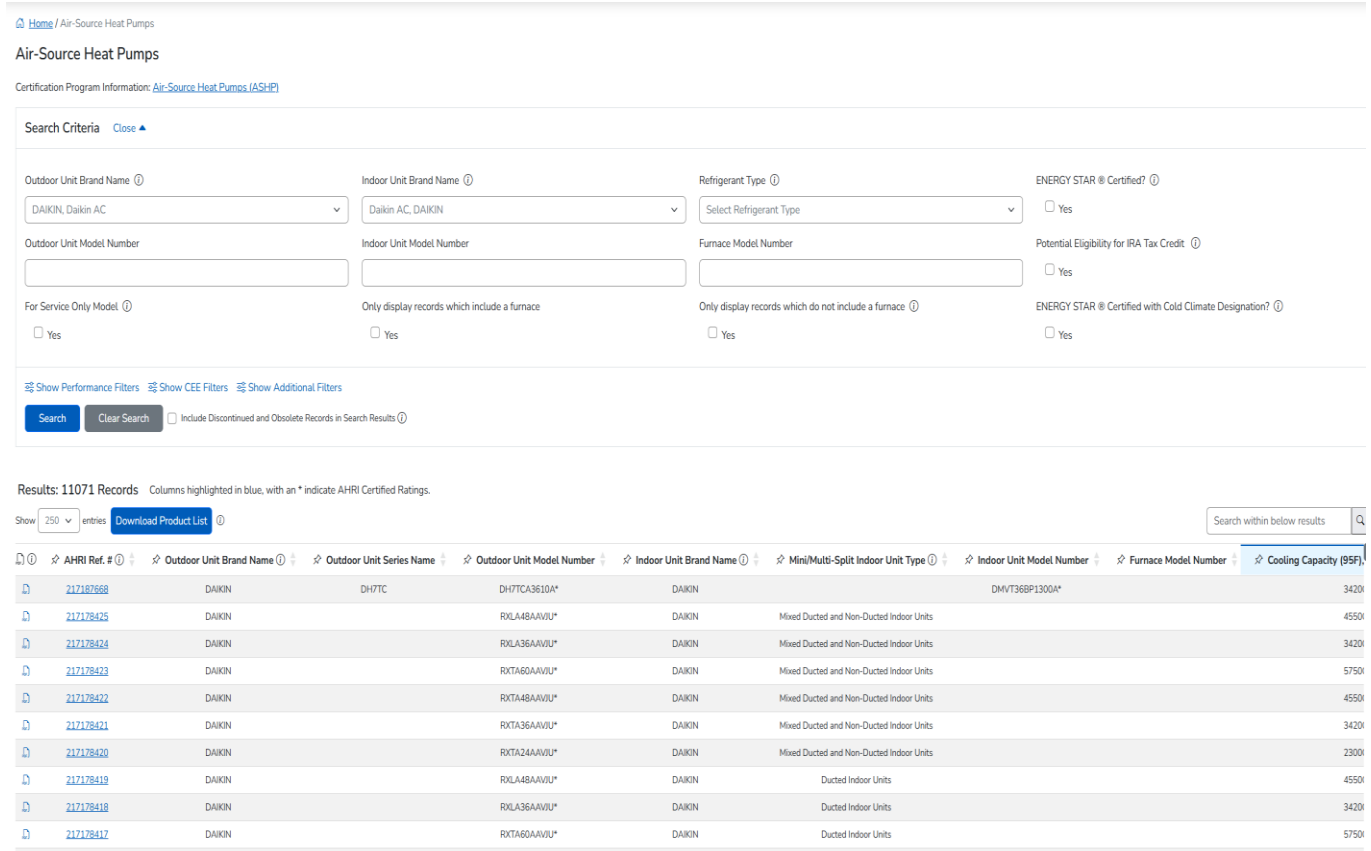
CERTIFICATE NO.: 133886207916012841

AHRI Certification

- You will find Ducted, Ductless and Ducted/Ductless combo systems under Air Source Heat Pumps.
- Unit type column (column 6 in the image) will tell you what type.
- Mixed Ducted and non-ducted indoor units requires some attention.



Heat pumps in cold climates

- Many heat pumps operate well in temperatures as low as 17°F.
- Heat pumps with Cold Climate designations operate at full capacity as low as 5°F.

MODEL DETAILS	
AHRI Reference # :	211806977
Outdoor Unit Brand Name ⓘ :	LENNOX
Outdoor Unit Series Name :	ML17XP1 SERIES
Outdoor Unit Model Number :	ML17XP1-024-230A**
Indoor Unit Brand Name ⓘ :	LENNOX
Mini/Multi-Split Indoor Unit Type ⓘ :	
Indoor Unit Model Number :	CBA25UHV-030-230-**
Furnace Model Number :	

OTHER RATINGS	
Heating Capacity (17F), btuh (Appendix M1) :	13600
Heating Capacity (5F), btuh (Appendix M1) :	10400
Heating COP (5F), btuh (Appendix M1) :	2.06
Full-Load Cooling Air Volume Rate, scfm (Appendix M1) :	810
Heating Capacity (17F), btuh (Appendix M) :	13600
Heating Capacity (5F), btuh (Appendix M) :	
Full-Load Cooling Air Volume Rate, scfm (Appendix M) :	810
Intermediate Cooling Air Volume Rate, scfm (Appendix M) :	
Minimum Cooling Air Volume Rate, scfm (Appendix M) :	

Cold Climate Heat Pumps and the many specifications

Effective January 1, 2025

CEE AIR SOURCE HEAT PUMPS

2025 CEE Split ASHP Specification					
CEE Level	SEER2	EER2	HSPF2	COP at 5°F*	Capacity Ratio˜
CEE Tier 1					
Path A	≥ 16.0	≥ 9.8	≥ 8.5	≥ 1.75	≥ 60% at 5°F/47°F
Path B	≥ 16.0	≥ 11.0	≥ 8.0	≥ 1.75	≥ 45% at 5°F/47°F
CEE Advanced Tier					
Refer to the DOE Cold Climate Heat Pump Challenge Specification					

2025 CEE Packaged ASHP Specification					
CEE Level	SEER2	EER2	HSPF2	COP at 5°F*	Capacity Ratio˜
CEE Tier 1	≥ 15.2	≥ 10.0	≥ 7.2	≥ 1.75	≥ 45% at 5°F/47°F

Effective January 1, 2026

2026 CEE Split ASHP Specification						
CEE Level	SEER2	EER2	HSPF2	COP at 5°F*	Capacity Ratio˜	Load Management†
CEE Tier 1						
Path A	≥ 16.0	≥ 9.8	≥ 8.5	≥ 1.75	≥ 65% at 5°F/47°F	AHRI 1380
Path B	≥ 16.0	≥ 11.0	≥ 8.0	≥ 1.75	≥ 50% at 5°F/47°F	AHRI 1380
CEE Advanced Tier						
Refer to the DOE Cold Climate Heat Pump Challenge Specification						

Specifying agencies

- Energy Star-Cold Climate Designation
- NEEP Cold Climate specification with QPL
- CEE-Tiers

DOE Residential Cold Climate Heat Pump Challenge

Performance Requirements

Seasonal Heating

- 8.5 HSPF2 (Region V)
- Heating at 5°F [-15°C]
- Minimum COP of 2.1-2.4 at 5°F
- Capacity ratio of 100% for 5°F capacity to 47°F capacity
- Minimum turndown ratio at 47°F
- Compressor cut-in and cut-out temperatures

Heating at -15°F [-26°C] (optional)

- HP operation at -15°F as measured by compressor cut-in and cut-out temperatures

Auxiliary heat

- Staged auxiliary heating

Low GWP Requirement

- Employ refrigerant with a global warming potential (GWP) value of no more than 750 (AR4,100 year)

Connected Product Criteria

- Offer the connected product capabilities within the latest ENERGY STAR specification (v6.1).

Further details on the challenge specifications can be found here.

Importance of Heat Pump Verification

Department of Energy research Top Takeaways:

- 90% of systems tested had duct leaks.
- Half of the systems tested had restricted airflow.
- Sizing and commissioning procedures are not being followed.

The top 5 most common install faults are:

- Leaky ductwork
- Low airflow.
- Overcharged/undercharged refrigerant system
- Presence of non-condensables in refrigerant lines
- Incorrectly sized systems

Is airflow really that important?

Poor Airflow ↓

Poor Heat Transfer ↓

Poor System Efficiency ↓

Poor Comfort

What typically causes low airflow?

Most common causes of low airflow:

1. Poor duct design:
   - Too many turns
   - Too small
   - Not enough return
2. Restrictive registers:
   - Open registers or replace
3. Restrictive air filters
   - Replace with less restrictive filter
   - Upsize (if space allows)

Photo taken from PTCS presentation

Importance of the vacuum procedure

Removes non-condensables

- Removes Water Vapor, Air, and any remaining Nitrogen

Image courtesy of Navac inc.

Thermostat set-up

1. Thermostat setbacks for heat pumps should be less than three degrees to limit engagement of auxiliary heat.
2. Pay attention to thermostat location if occupation sensor is being utilized.
3. Keep thermostats out of direct sunlight.

Compressor lock out?

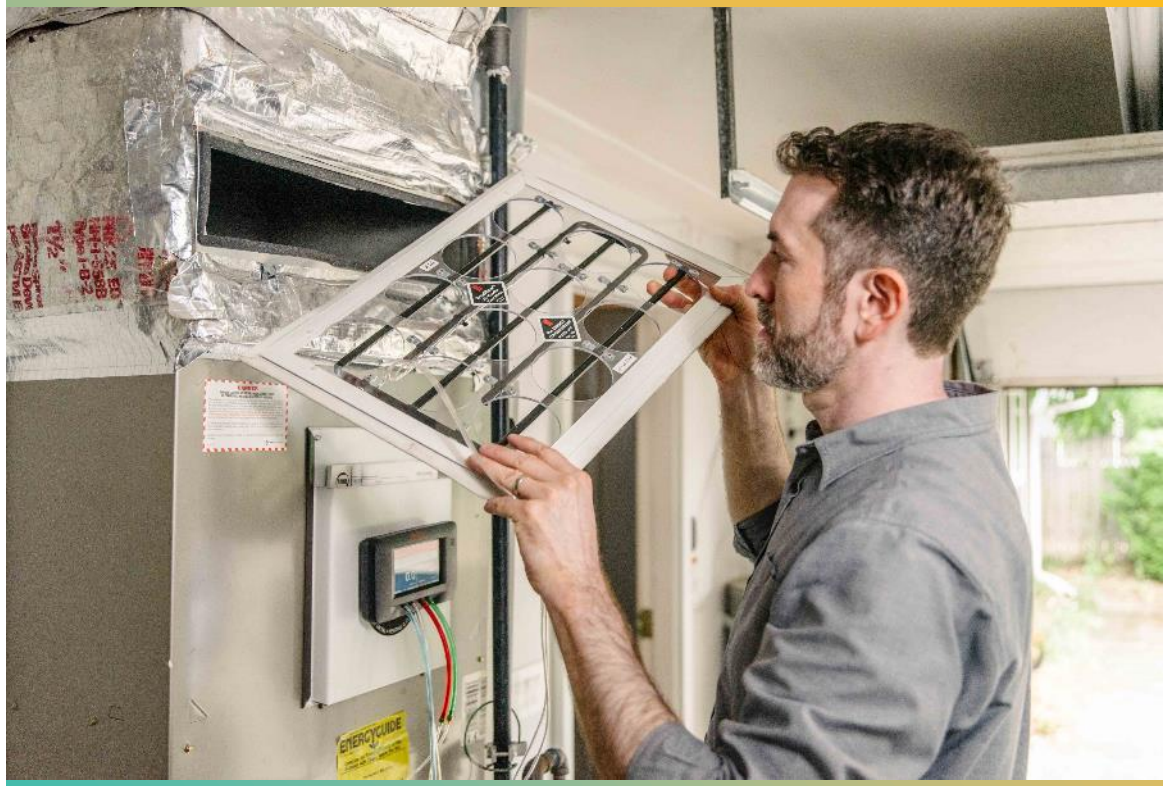
- No compressor lockout west of the cascades!
- Typically 5º east of the Cascades.

Options for verifying Heat Pump installs

1. Resnet 310
2. ACCA QI standard 5

Both methods can be made quite easy utilizing

- HVAC Smart tools (Bluetooth connected measurement tools)
- Measure Quick or proprietary app



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Thank You!