

# Heat Pump Design for R454B

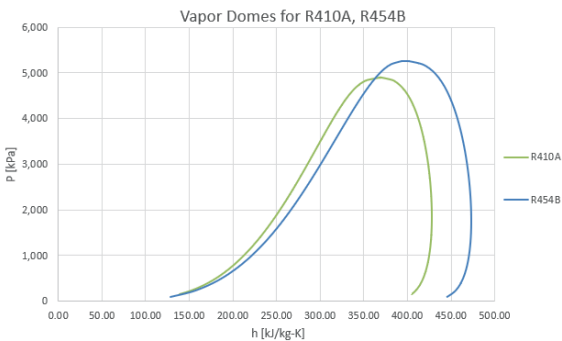


## Project Goal

- Evaluated a residential heat pump system using R410A vs. R454B
- Aimed to develop improved R454B designs for better low-ambient performance

## R454B Refrigerant Property Insights

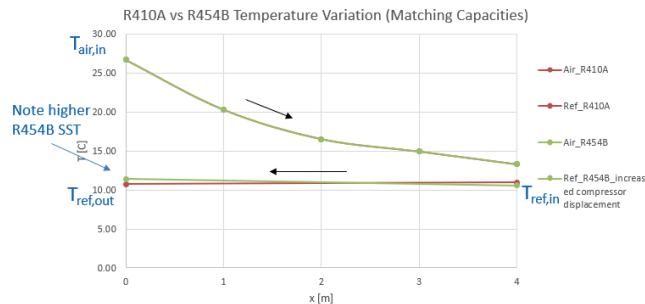
- A wider vapor dome with ~18% higher latent heat



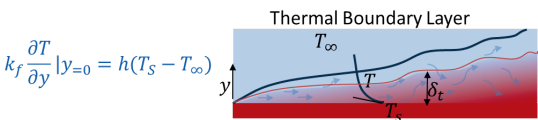
- 20% lower suction density for reduced mass flow rate

Parameters	Units	R410A	R454B	%Difference
$\Delta h_{\text{evap}}$	kJ/kg	334	394	18%
Suction Density	kg/m <sup>3</sup>	41	33	-20%
$\dot{m}$	kg/s	0.065	0.051	-22%
$k_f$	Wm-K	0.085	0.101	18.4%

- A slight temperature glide (~0.86 K) affecting evaporator performance



- 20% higher conductivity to improve heat transfer

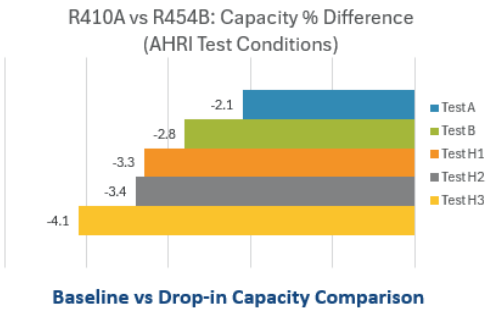


## Key Results

- R454B design improvements enable matching/exceeding R410A performance
- Redesigned heat pumps can maintain system capacity and enhance COP without extra compressor changes

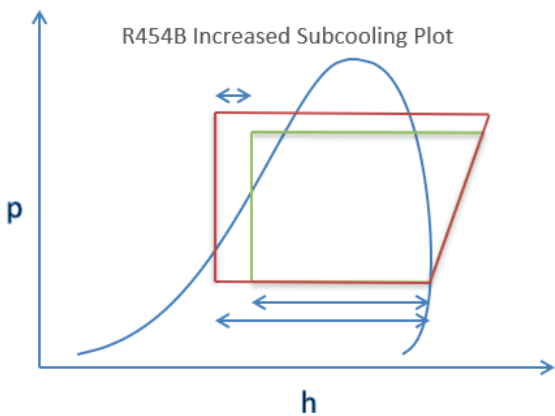
## Objectives

- Boost energy efficiency and system performance
- Reduce GWP by transitioning from R410A to R454B



## Solution

- Utilized CoilDesigner® and VapCyc® for baseline analysis
- Increased compressor displacement by 4.6% to counter R454B's low-ambient limitations
- Increased subcooling from 4°C to 12°C
- 2% capacity boost



- Improved coil design with 5 mm copper tubes, counterflow circuitry, and advanced fin designs

