Viper Expander Applied in R410A Residential Heat Pump
Lennart Stania, B.Sc.; Riley B. Barta, PhD Student
Professor Eckhard A. Groll
lstania@purdue.edu

Project Description
- Turbomachine expander called the Viper Expander to harvest expansion work.
- Combine expansion work recovery and open economization in one device.
- Increase COP by reducing net work input and increasing cooling capacity.

Approach
- The Viper Expander is tested in a split-system heat pump installed in twin psychrometric chambers.
- Nozzles, housings, and turbines are interchanged iteratively in an effort to reach maximum performance.
- Analytical analysis of key components like the flash tank or nozzle are conducted consistently.

Discussion
- Process stability is reached by control of housing outlets.
- Improvement of the power output is reached by optimizing nozzle position and size.
- Effects of separating liquid and vapor to reduce friction on turbine are quantified.

Results
- \( W_{\text{Viper}} = 70 \text{ W} \)
- \( \eta_{\text{is,Viper}} = 20\% \)
- Phase separation approaching quality within 10\% of ideal
- Friction reduction on turbine can increase power output by 10-20\%