# ME 4054W Design Projects - Project Proposal Form

Semester for which project is proposed: Fall 2025

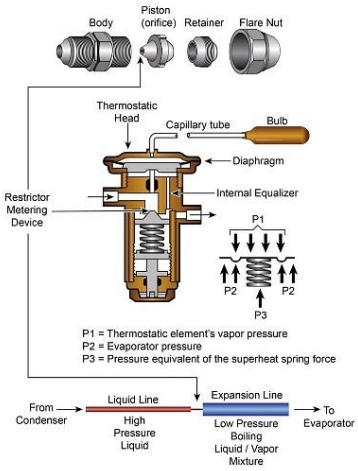
| | |
|---|---|
| **Project title** | **08 - Air Conditioning Valve Test System** |
| **Client** | Daikin Applied |
| **Client Rep. 1**<br>Address<br>Phone<br>email | Shaoping Shi<br>13600 Industrial Park Blvd, Plymouth MN 55441<br>(763) 264-1929<br>Shaoping.shi@daikinapplied.com |
| **Client Rep. 2**<br>Address<br>Phone<br>email | Brandon Petersen<br>13600 Industrial Park Blvd, Plymouth MN 55441<br><br>Brandon.Petersen@daikinapplied.com |

**Project Background**:

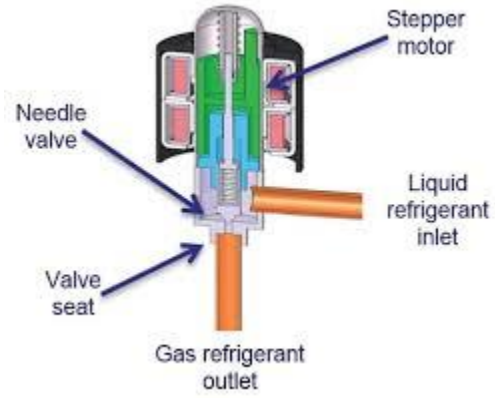
Understanding valve characteristics is critical for HVAC system design. However, detailed data—such as flow rate versus valve opening—is often unavailable or insufficient. To address this, we need to develop testing capabilities to characterize valves across a wide range of operating conditions.

**Project Objectives**:

To **characterize a TXV (Thermostatic Expansion Valve)** or **EXV (Electronic Expansion Valve)** for an HVAC system, we need to understand and measure how the valve regulates refrigerant flow in response to system demands. This is critical for optimizing **evaporator performance**, maintaining **superheat**, and ensuring **system stability**.




**Typical TXV**




**Typical EXV**

| Type | Control Mechanism | Response |
|---|---|---|
| TXV | Mechanical – uses bulb and spring | Opens/closes based on evaporator **superheat** |
| EXV | Electronic – stepper or pulse-width valve | Controlled by **microcontroller**, often PID loop |

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The objective of this project to design and build a test system to measure the response characteristics of the TXV and EXV to feedback signals, including flow characterization curves of refrigerant mass flow rate vs superheat or valve opening (%), helping determine:

- Linear vs nonlinear behavior
- Valve capacity range
- System stability margins

Project clients may require that students sign a UMN-approved intellectual property (IP) and/or confidentiality agreement. See the course website (z.umn.edu/me4054, then click on *Client Info* and *Sponsoring a Project*) for details.

Will you require students to sign the pre-invention IP assignment agreement? Yes ___ No _X_ Not sure ___

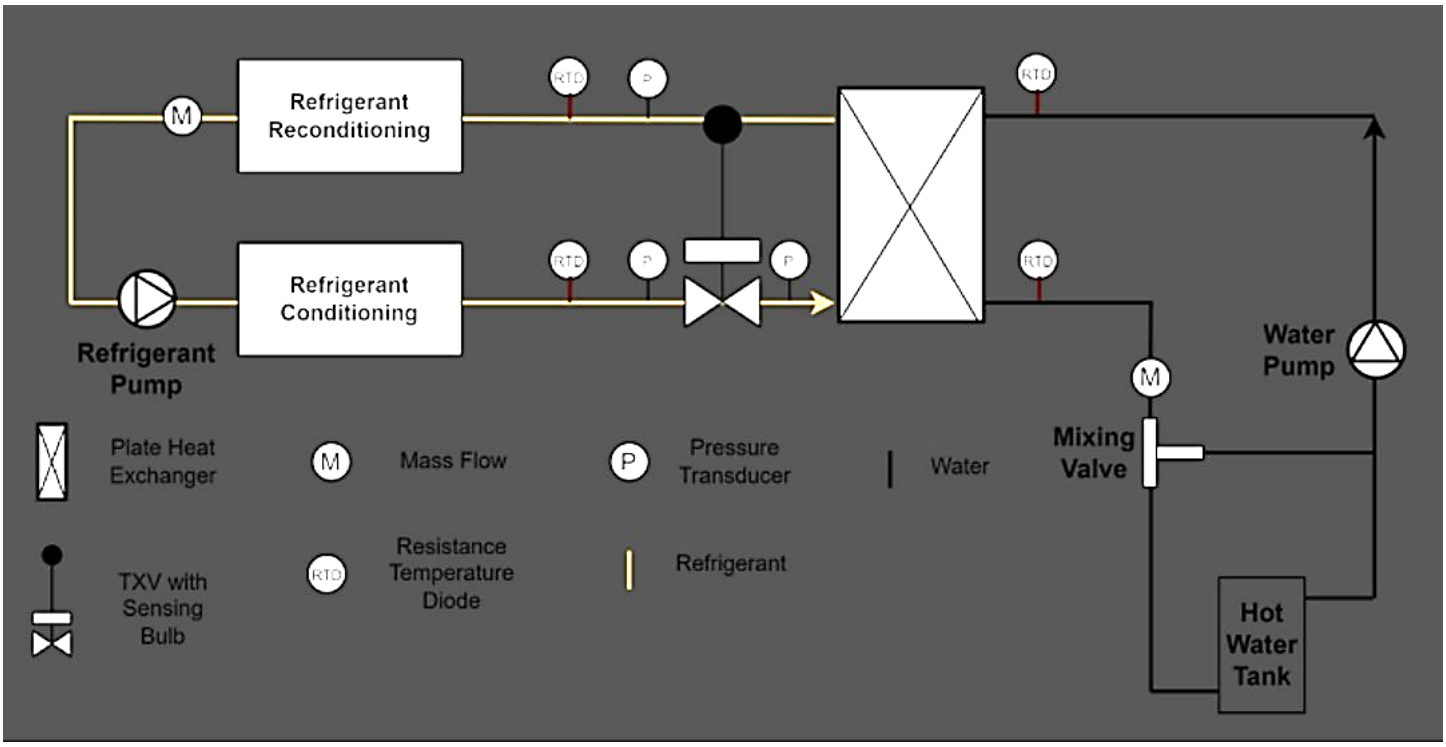
Will you require students to sign the non-disclosure agreement? Yes _X_ No ___ Not sure ___

Mechanical engineering (ME) is a multidisciplinary field of study. However, some projects can benefit from broadening the team's knowledge pool. There is a potential to add a student from the Electrical and Computer Engineering (ECE) department to teams needing more expertise in topics than is typical for ME students. There are two caveats. First, the work assigned to the ECE student must be sufficient to provide a meaningful semester-long assignment. Second, we will attempt, but cannot guarantee, to add an ECE student to your team if their expertise is needed.

Do you think your project needs ECE student(s) to be successful? Yes ___ No _X_ Not sure ___

What potential gap do you see and what work would be assigned to the ECE students(s)? Please be specific.

The following is a schematic of one possible test system configuration.

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**Clients' Background:**

Shaoping Shi is a Principal Engineer for Daikin Applied's New Technology Introduction (NTI) team. Prior to Daikin, Shaoping worked with Ansys for 7 years, served as an Engineering Integration Leader with GE, was a Chief Scientist at the China Huaneng Group Clean Energy Technology Research Institute, and an Engineering Manager at Whirlpool. He completed his bachelor's and master's in Energy and Power Engineering at Xi'an Jiao Tong University and completed his PhD in Mechanical Engineering at West Virginia University.

Brandon Petersen is the Director of Model-Based Engineering at Daikin Applied Americas. He brings extensive experience in controls and systems engineering, having previously overseen model-based controls algorithms and system validation at Thermo King. His prior roles at Eaton and Pratt & Whitney reflect a strong foundation in engineering innovation and systems management. Complementing his industry leadership, he teaches as an adjunct instructor in Automation Controls Engineering at Dunwoody College of Technology. Brandon completed his BSME, MSME, and MBA at University of Hartford, and is pursuing his PhD in Interdisciplinary Engineering at Purdue University.

**Company Description:**

Founded in 1924 and headquartered in Plymouth, MN, Daikin Applied is a global leader in HVAC solutions. A subsidiary of Daikin Industries - headquartered in Osaka, Japan – Daikin Applied specializes in providing innovative and energy-efficient heating, ventilation, and air conditioning systems for commercial and industrial applications. With a commitment to sustainability and advanced engineering, Daikin Applied continues to play a significant role in shaping smart, efficient, and environmentally friendly climate control solutions worldwide.