INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Ametek - CSI*	**Date Submitted**	*3/26/2022*
Project Title	*Analysis and Testing of liquid-air flow in a Heat Transfer Apparatus* **(AMETEK_FLOW)**	**Planned Starting Semester**	*Fall 2022*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	6	Electrical	
Computer		Systems	

Company and Project Overview:

AMETEK, Inc. is a leading global manufacturer of electronic instruments and electromechanical devices with annual sales of approximately $4.0 billion. AMETEK has more than 15,000 colleagues at nearly 150 manufacturing locations around the world. Supporting those operations are nearly 100 sales and service locations across the United States and in 30 other countries.

Ametek - CSI is a division of Ametek Corporation and is located in Pineville, NC. CSI provides thermal maintenance systems and specialized process equipment for heating, cooling and control of liquid/vapor processes in the petrochemical, chemical, and refining industries. CSI does this through a combination of proprietary products and engineering methods developed over 40+ years of practice. The flagship products are ControTrace® engineered tracing, ControHeat® jacketing and SxSeal® Sulfur Traps. As a technology-neutral supplier, CSI evaluates all aspects for each project to deliver the most optimized heating or process equipment solution available – maximizing savings for both capital and ongoing operational costs. Some product examples:

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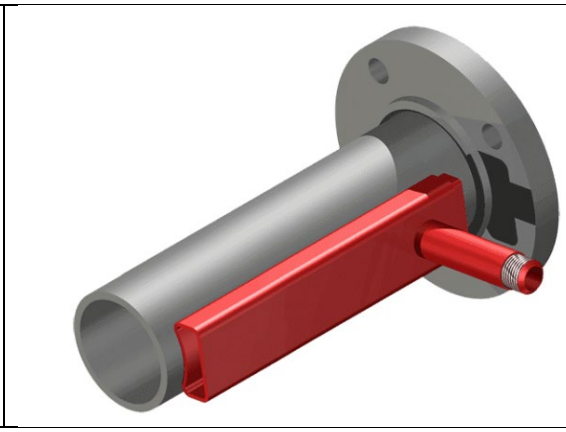

ControTrace® bolt-on heating elements have been the preferred tracing solutions for heating pipe, tanks, and vessels since 1980. These thermal solutions are a cost-effective alternative to fully jacketed piping and, in comparison to steam tracing, offer greater heating capacities and reliability. Today, over five hundred miles of ControTrace® heat tracing elements are in service in plants and refineries around the globe. The heating media for ControTrace can be a saturated vapor (typically steam) or a liquid like water, water/glycol, or hot oil (example hot oils).

ControTrace heating elements are made to fit the specific pipe routing of each application. Elements are daisy-chained together using intermediate jump-overs. A single string of consecutive elements is referred to as a thermal circuit and can extend for several hundred feet. The circuit must follow the pipe geometry which will navigate around equipment, over roadways, through pipe racks, etc. If the pipe geometry includes an upward elevation change followed by a downward elevation change, air can become trapped at the high point. Trapped air increases pressure drop and decreases heat transfer.

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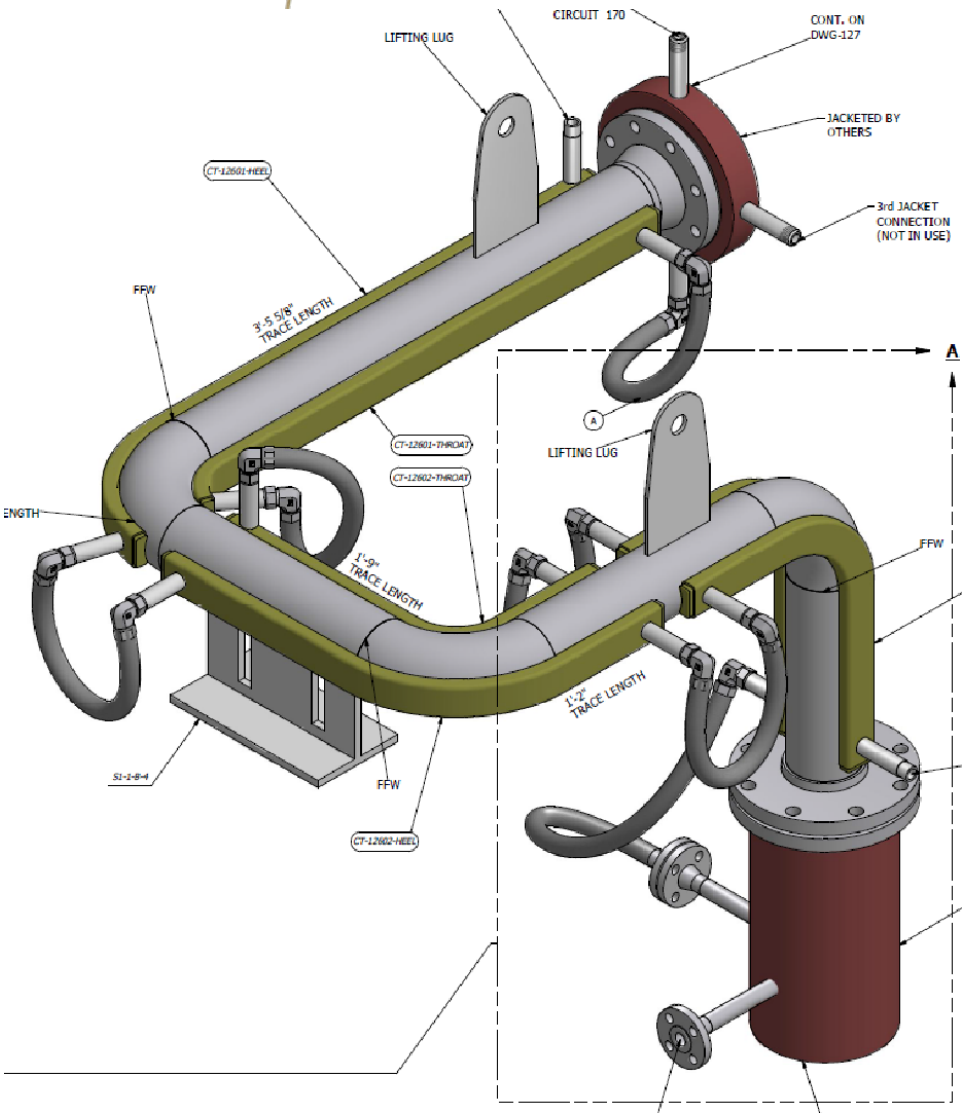

Project Requirements:

The goal of this project is to evaluate the air trapping mechanism. Specifically, to determine:

1. The conditions under which air becomes trapped
2. The extent of air entrapment in various conditions
3. The impact of time on air entrapment in various conditions (will it eventually clear out?)
4. The impact of the air on the hydraulic pressure drop

It is expected that several different conditions will be evaluated, including combinations of:

- Fluid flow rate
- Elevation change
- ControTrace slope
- ControTrace configuration / orientation
- Use of a jumper hose at the elevation change

- Fluid properties (i.e. water vs. water glycol vs. hot oil)

It is expected that the first semester will consist of predictive calculations, experiment design, and purchasing of long lead items. The second semester will consist of test apparatus assembly, conducting test runs, and interpreting results. CSI's facility in Pineville, NC will be available for the setting up of the test apparatus if desired.

Expected Deliverables/Results:

The deliverables shall include at a minimum:

- A detailed description of the tests performed including test apparatus, methodology, and raw test data.
- The test apparatus.
- Conclusions that quantifiably address:
    - For all combinations, the minimum flow rate required to ensure air is fully purged.
    - For select combinations, the minimum operating time required to establish steady-state flow (i.e. all the air that's going to purge out has purged).
    - For select combinations, the hydraulic impact of various levels of air purging (i.e. how much additional pressure drop is created by the presence of air compared to a fully purged system?).

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested:

All team members must have completed an undergraduate course in fluids.