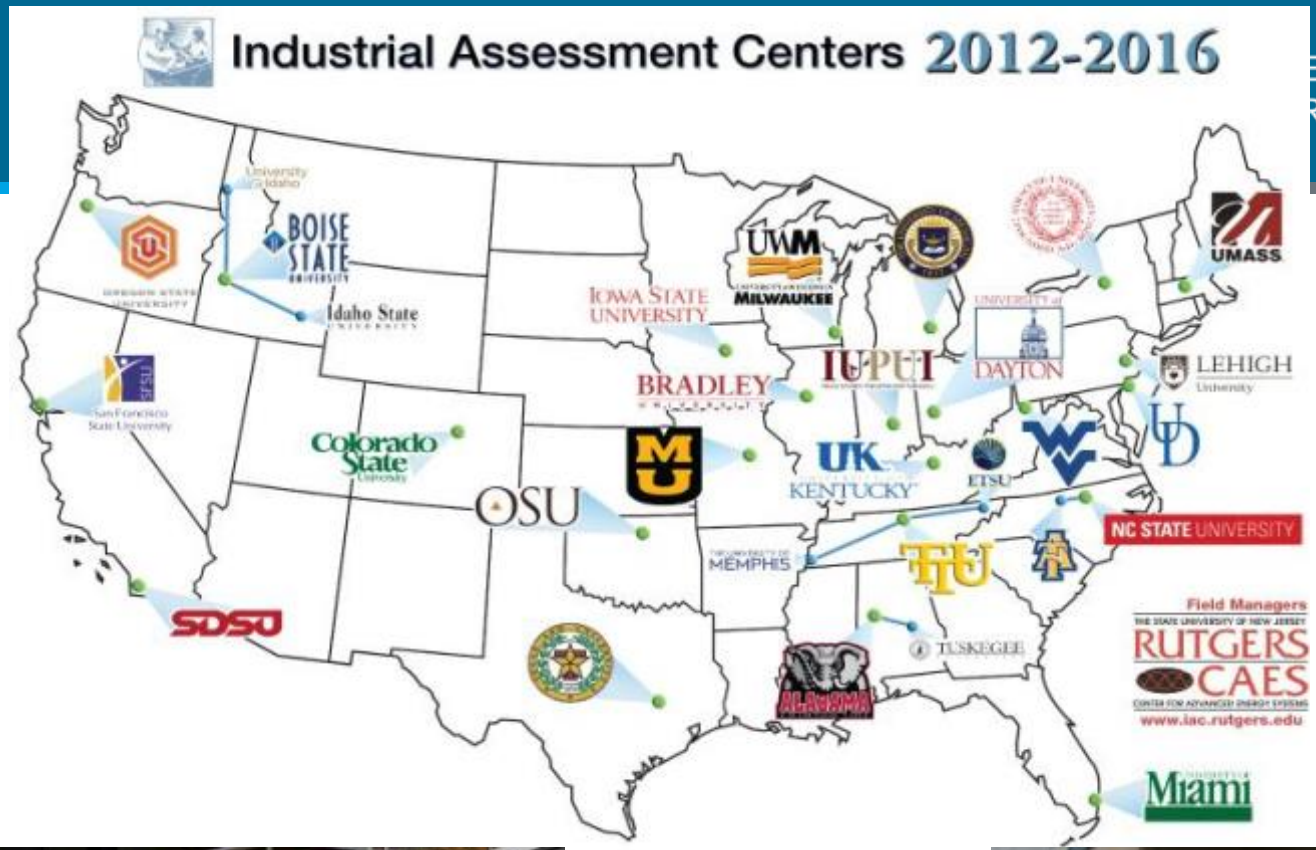
IAC Student Collaboration Webinar

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Thomas Wenning, PE
Oak Ridge National Laboratory

IAC Student Webinar Series
June 2015


Industrial Assessment Centers 2012-2016
University of Idaho
BOISE STATE UNIVERSITY
Idaho State University
Oregon State University
San Francisco State University
Colorado State University
OSU
SDSU
IOWA STATE UNIVERSITY
UWM
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Field Managers
THE STATE UNIVERSITY OF NEW JERSEY
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CENTER FOR ADVANCED ENERGY SYSTEMS
www.iac.rutgers.edu
Miami

IAC Student-Led Webinars Intro

- Alternative to student meeting
- Monthly student-led webinars
- Proposed Structure:
  - 30 min student presentation
  - 30 minutes of Q&A/open dialogue
- Allow students to connect

Webinar Series Purpose

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Mechanism for IAC-to-IAC student collaboration
- Possible topics:
  - Relevant items for day-to-day IAC operations (client recruitment, report writing, etc.)
  - New technologies and innovations
- Rotate speakers and topics each month
- Each center will lead or contribute a presentation to a future webinar

Feedback

We want your feedback (date, time, topics, etc)!

….and Volunteers!

Feedback

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Webinar Survey

1. Did you find this webinar helpful (1 being least helpful and 5 being most helpful) ?

   1 ○ 2 ○ 3 ○ 4 ○ 5 ○

2. What topic or topics would you like to see addressed in future IAC student-led webinars?

3. Would you be interested in leading a future webinar?

   ○ Yes

   ○ No

4. If interested in leading a future webinar, please list your name and contact email.

Student Research Awards

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Presented to ~4 IAC Student Research Awards
  - For undergraduate and graduate students to pursue assessment-inspired research
  - Up to $25,000
- Listing of the past award winners and research topics can be found at - http://www.iacforum.org:8080/iac/awards.jsp
- **Deadline for the 2015 submissions is May 29, 2015**
- Email me for an application (wenningtj@ornl.gov)

Old Announcement

Industrial Assessment Center Awards for Excellence in Applied Energy Engineering Research

The Advanced Manufacturing Office (AMO) is sponsoring the fourth annual research awards competition for students participating in the Industrial Assessment Center (IAC) program. Beginning in the fall of 2015, AMO will be presenting as many as four annual awards of up to $25,000 each.

Background

The goal of the IAC research award effort is to create funding for undergraduate and graduate students to pursue assessment-inspired research projects in the areas of manufacturing and industrial energy efficiency, waste and water reduction, and productivity improvement. As part of their specialized energy engineering experience, IAC students complete research projects, either as part of their undergraduate "capstone" efforts, or as part of their Master's thesis or Doctoral dissertations. The awards are intended to enhance these research efforts and to formally recognize innovative and exceptional research. The period of the awards will be one year, although AMO reserves the right to select projects of varying durations.

The initial concept of the awards program was developed by Dr. Michael R. Muller, a distinguished faculty member within the Mechanical Engineering Department and Director of the Center for Advanced Energy Systems at Rutgers University. Dr. Muller has been actively involved with the IAC program for more than 25 years. Serving first as a Center Director and later as the U.S. Department of Energy's Field Manager for the entire IAC program, Dr. Muller has demonstrated an unwavering commitment over the years to the work of developing the next generation of energy engineers. Under Dr. Muller's leadership, thousands of students have gained valuable knowledge and practical skills through a blend of rigorous coursework, direct interaction with small and medium-sized manufacturers, and exceptional research.

Eligibility

Any active IAC student(s) may apply through their Industrial Assessment Center for the research awards program. Successful projects will be based on assessment-inspired research. Center Directors and other IAC administrative staff will play a major role in the development of these projects, and in the preparation and submission of research proposals; however, particular emphasis will be placed by the selection panel on rewarding those proposals that demonstrate a significant degree of student initiative and involvement.

IAC student research awards will be made directly to the IAC in the name(s) of the winning student(s) and can be used to cover all normal costs associated with a research effort (e.g., wages, purchase of materials and /or equipment, appropriate travel expenses, and other direct costs). The award will be provided through the existing Center cooperative agreement, and will be included as a "Special Project" under Task 7 of the current award SOPO.

1

2015 Student Research Winners…

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

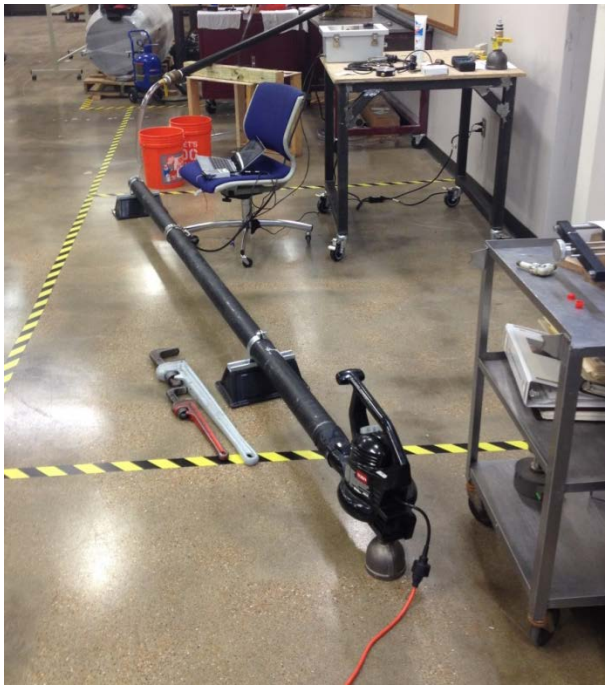
To be announced later today…

On to the Speaker…

- **Topic**: Novel Method for Non-Intrusive Measurement of Compressed Air Leakage Flow Rates
- **Who**: Trevor Terrill, Texas A&M IAC

trevorterrill@gmail.com

A Novel Method for Non-Intrusive Measurement of Compressed Air Leakage Flow Rates



Trevor Terrill

IAC Webinar

June 24, 2015

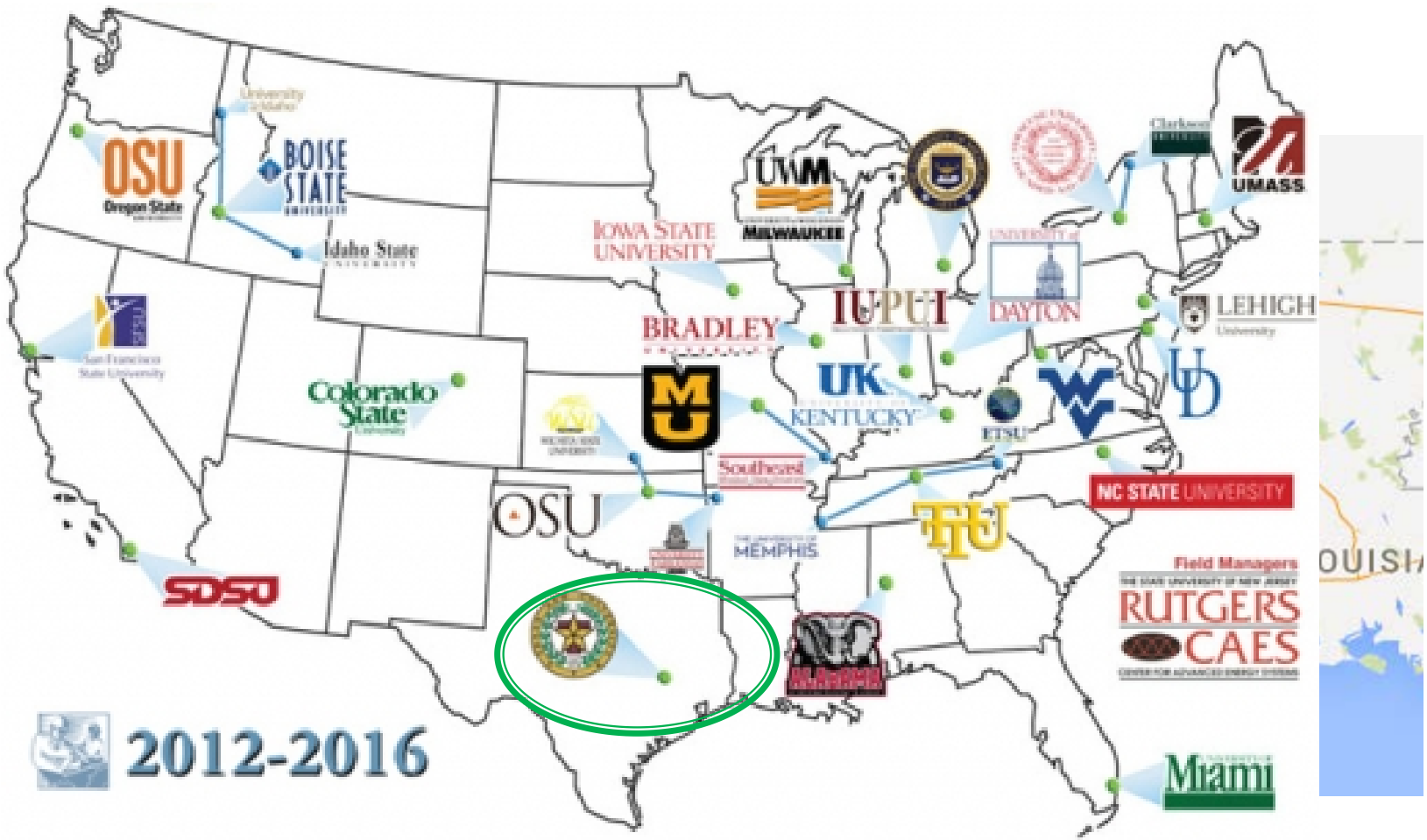
Texas A&M Industrial Assessment Center

IAC Student Research Award

Overview and outline

- Motivation for the webinar and project
- Details of the project and expected outcomes
- Simulation results
- Preliminary experimental validation
- Future experimental work

The Texas A&M IAC is located in southeast Texas near the Gulf of Mexico



We worked with undergraduate students in the design and setup of the experimental system

Patricio Ramirez

Brian Hinkel

Matthew Krebs

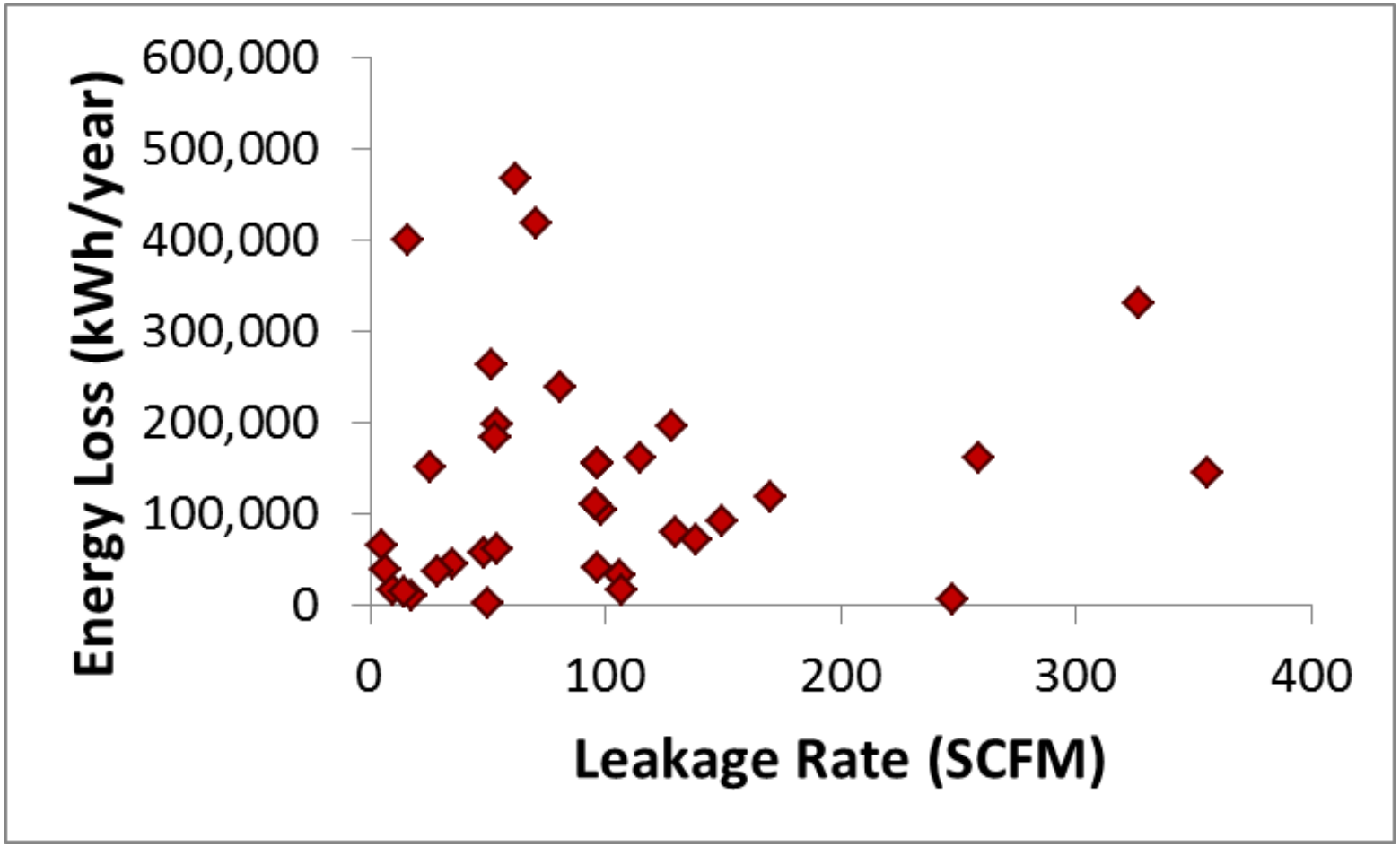
David Saltzman

Star CCM+ Simulation

Experimental Design

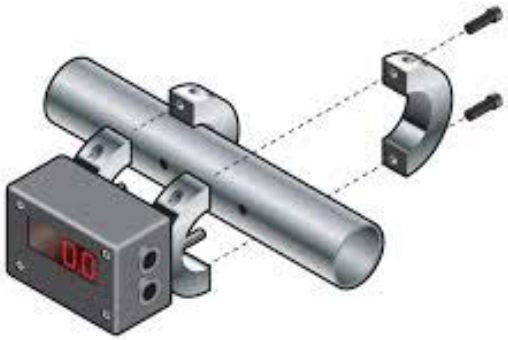
Preliminary Experiments

Repairing compressed air leaks is a common recommendation that often yields significant savings



There are challenges with current methods in measuring leakage rates in compressed air systems

Inline methods



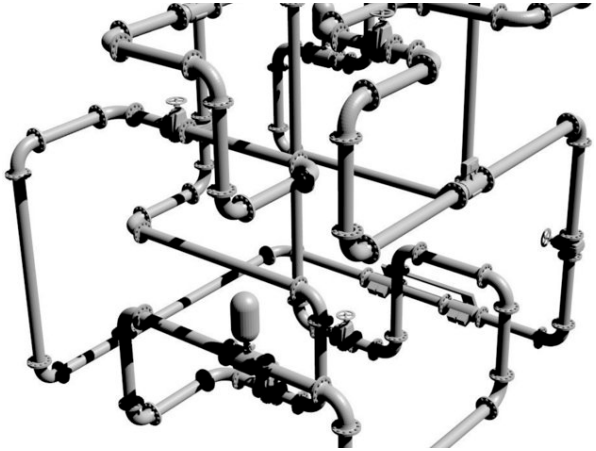
Leak Dropdown Test

Ultrasonic Leak Detection

Ultrasonic Flowmeter

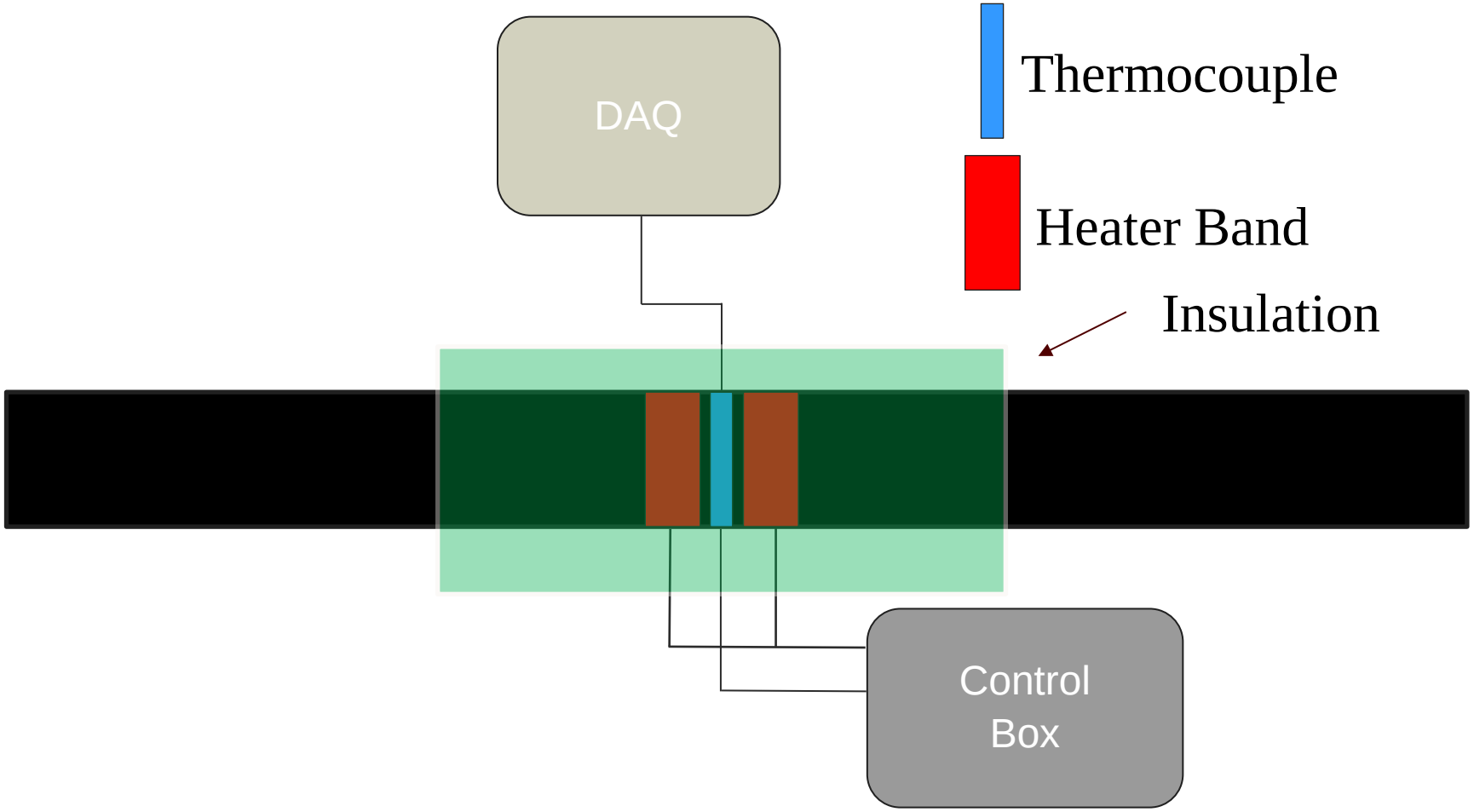
The goal of the project is to improve the estimation of compressed air leakage rate

Improve simplicity of data collection

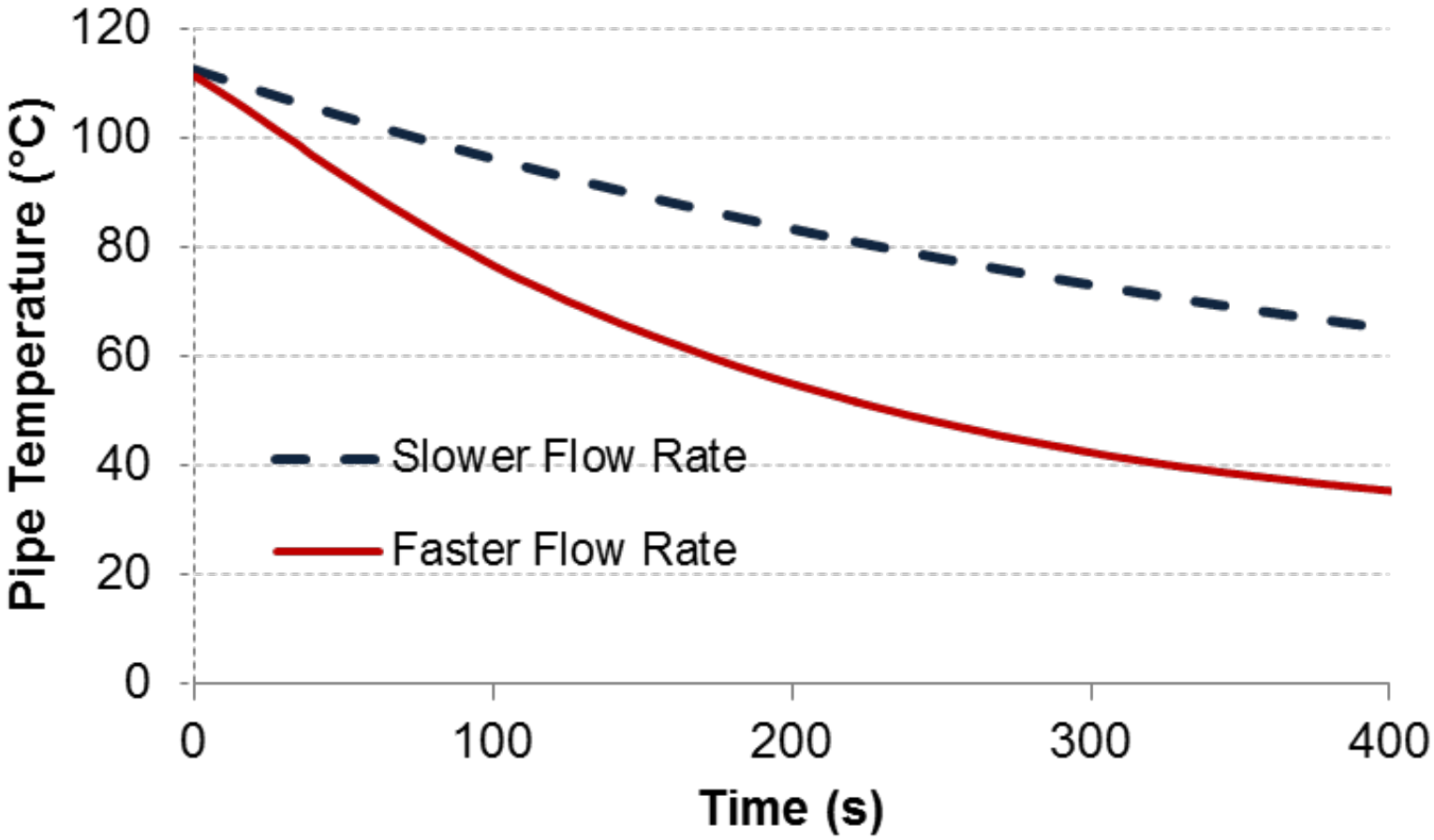


Maintain or improve accuracy of estimation

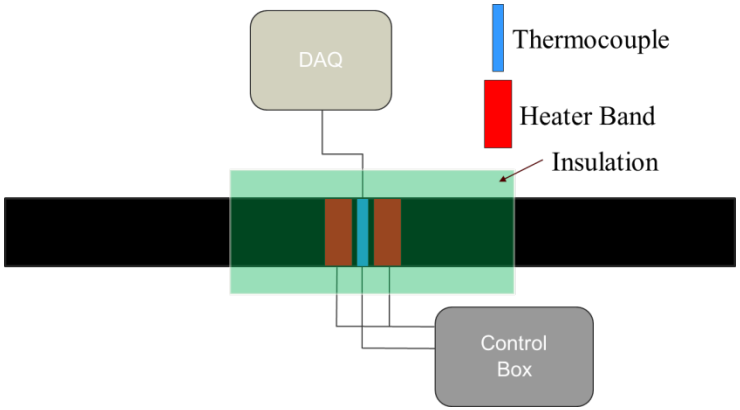
The proposed system relies on heat transfer to determine the leakage rate from compressed air



The system works by heating up the pipe and recording the temperature profile as it cools



The proposed system is simple to set up and has inherently simple dynamics



Simple Dynamics

$$\dot{Q} = (\mathrm{h})(A_{surface})(T_{pipe} - T_{air})$$

Simple to set up

Heater bands

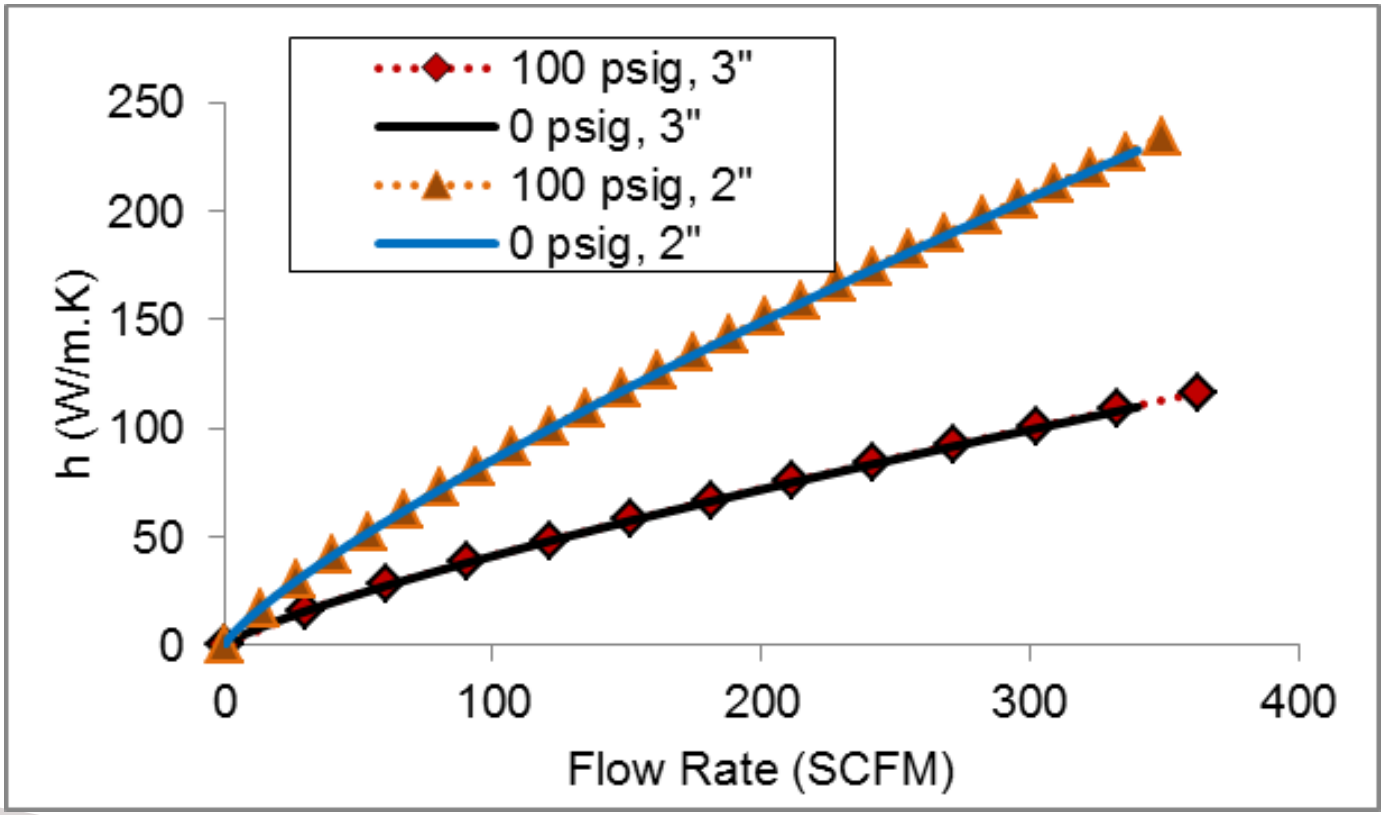
Pipe thermocouple

The device is independent from ambient temperature and compressed air pressure

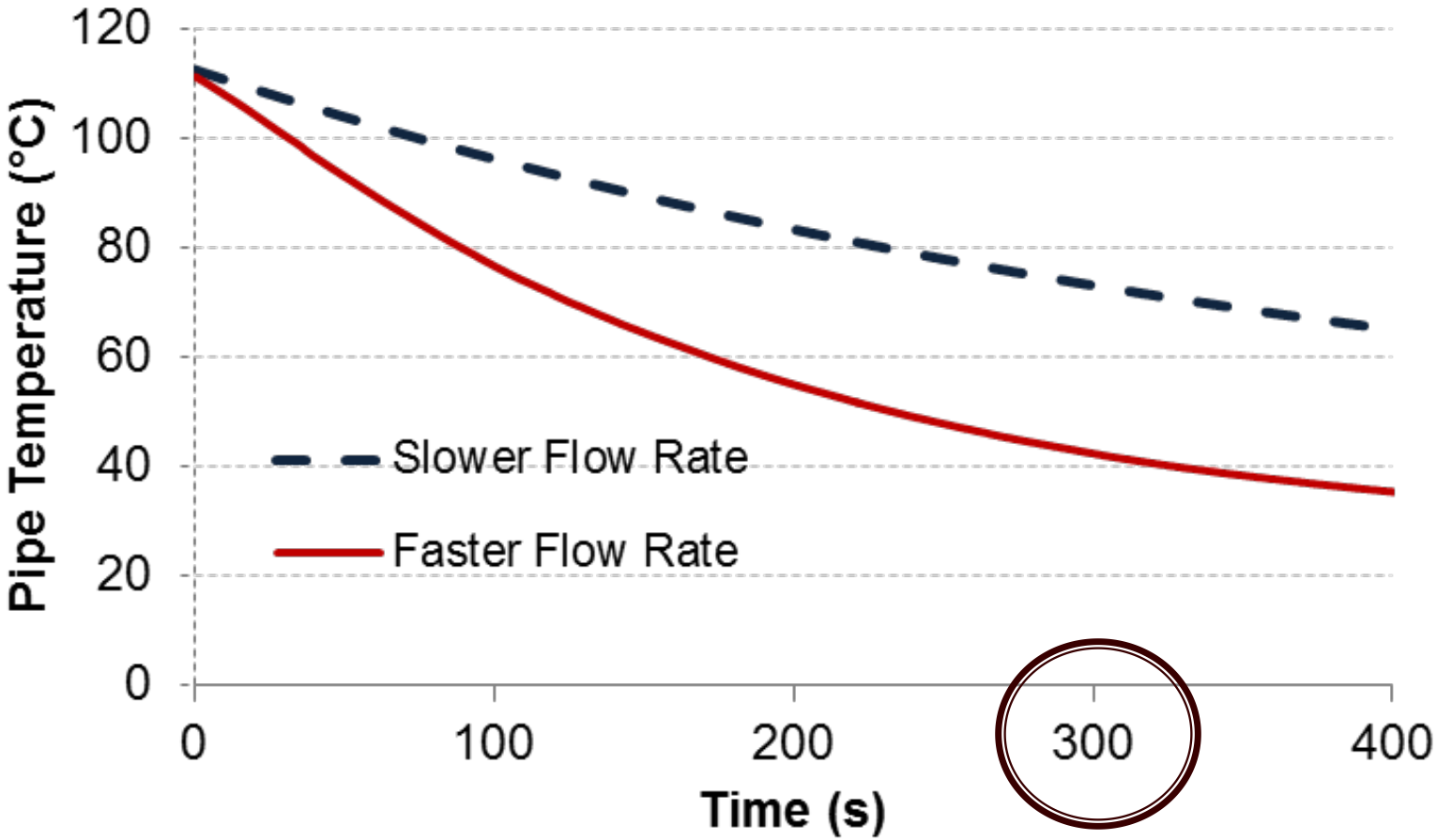
Independent of ambient temperature

$$\Delta T = T - T_\infty$$

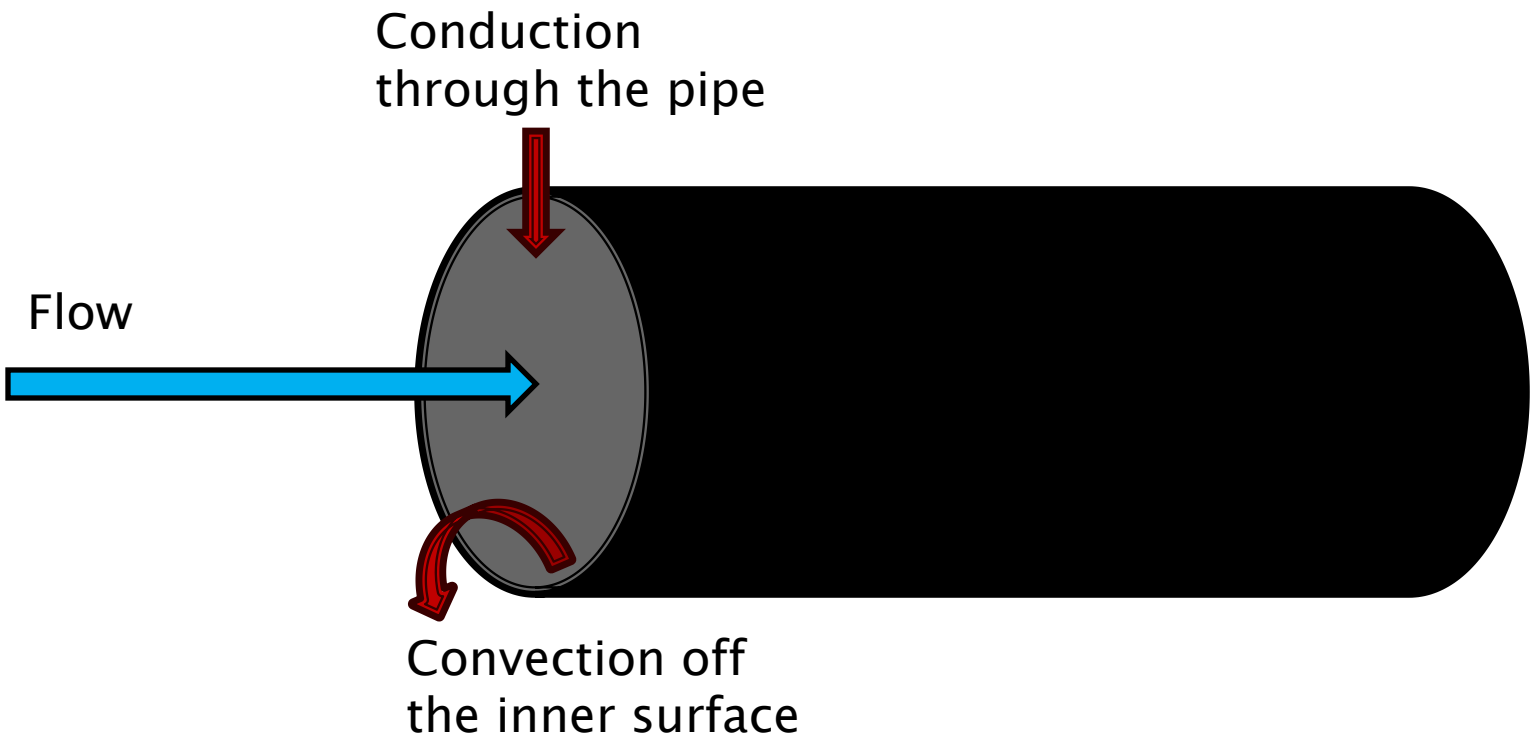
Independent of pressure



The system has an inherent averaging effect to reduce potential noise

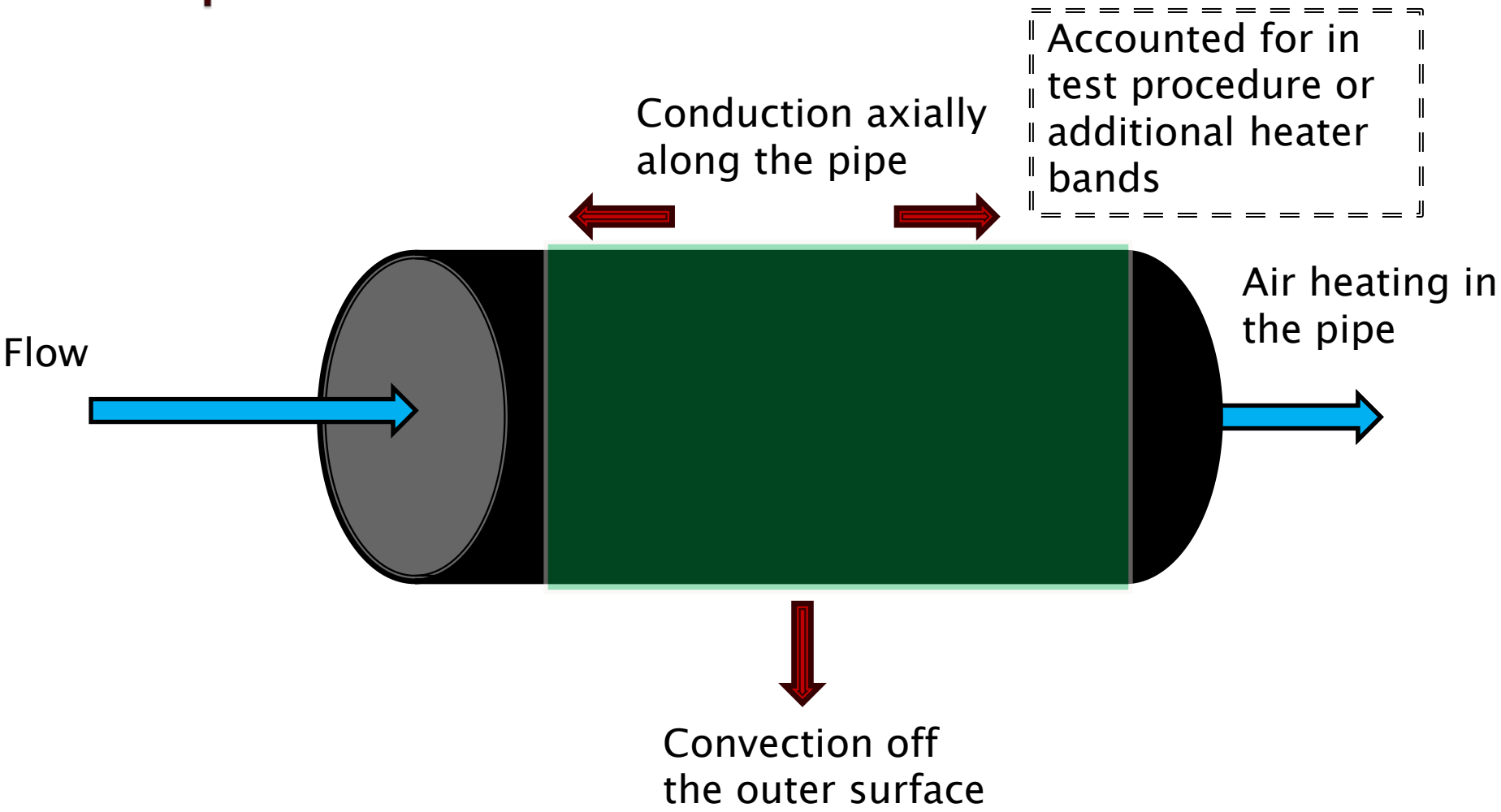


Convection can be accurately measured on the inside of the pipe because the rate of conduction through the pipe is high



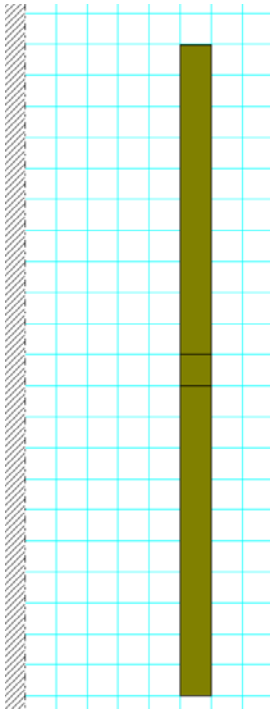
The cooling curves between the outer and inner surfaces are nearly identical

Heat transfer in undesirable areas is accounted for to prevent errors

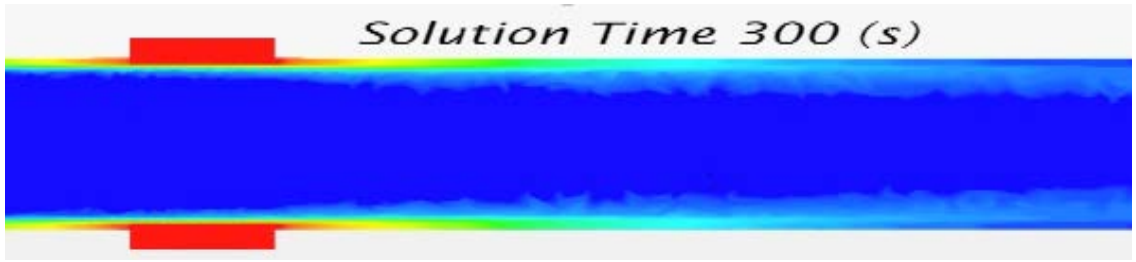


Several simulation programs were used to evaluate the feasibility of the method

Finite Element Heat Transfer

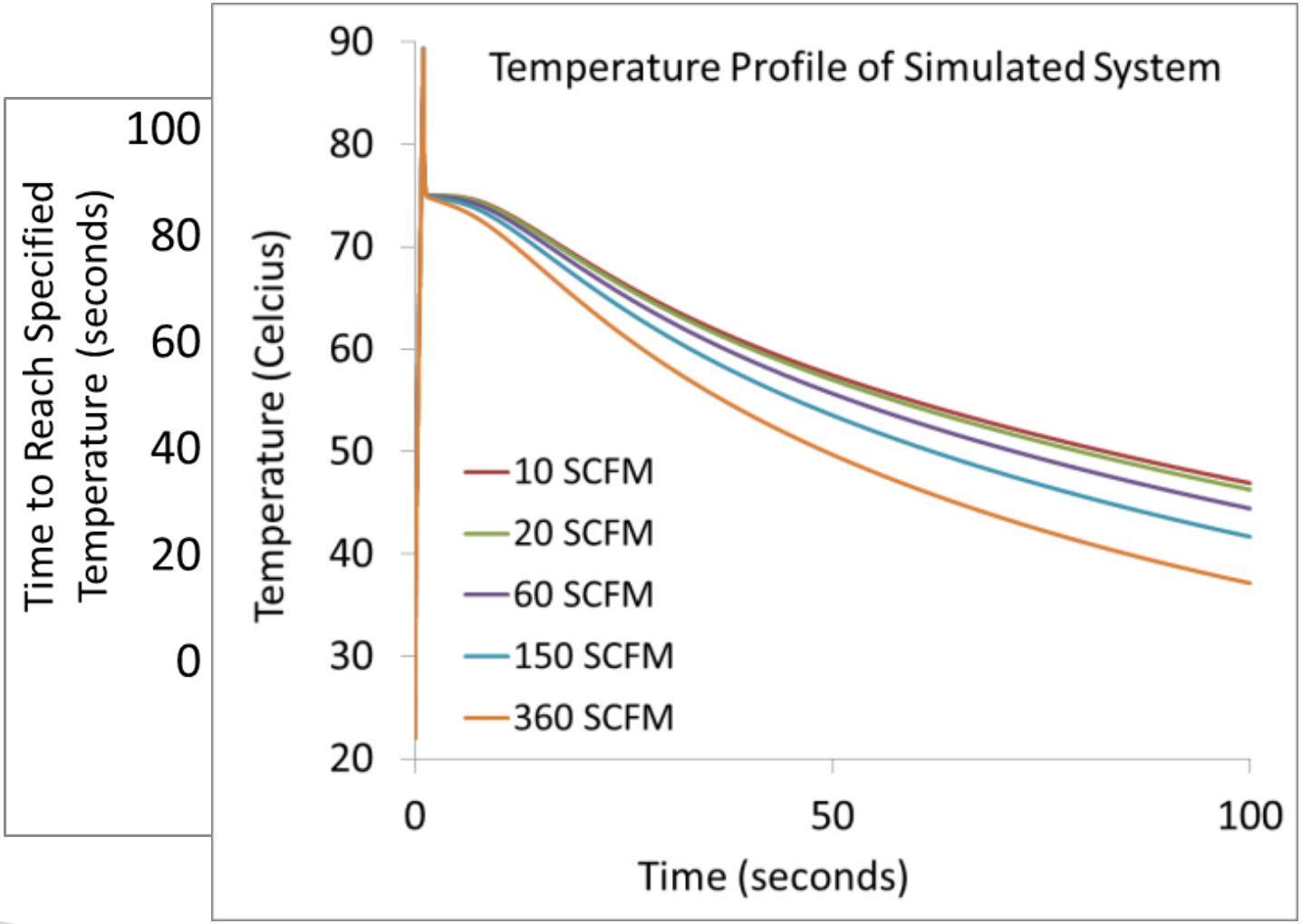


Star CCM+



Matlab

Finite Element Heat Transfer (FEHT) is a simple finite element program used to verify the initial idea



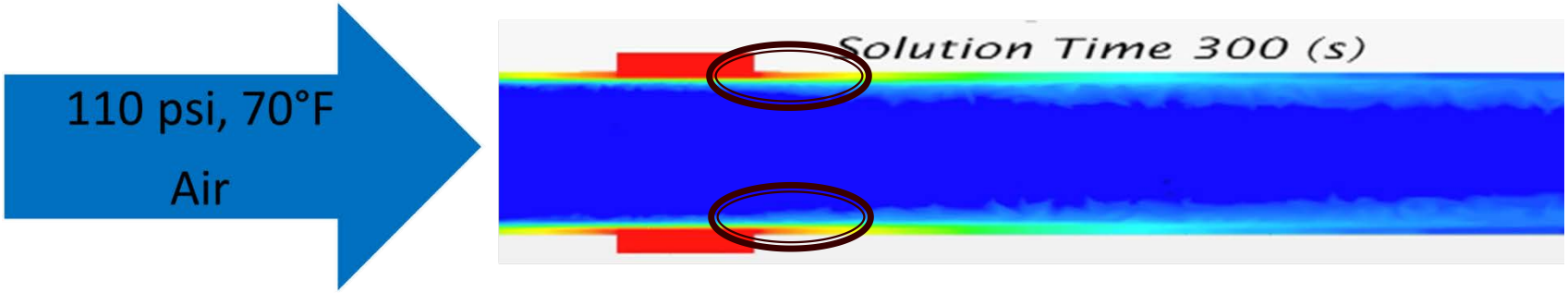
A more comprehensive simulation program was used to verify initial simulations and perform additional analysis

Star CCM+

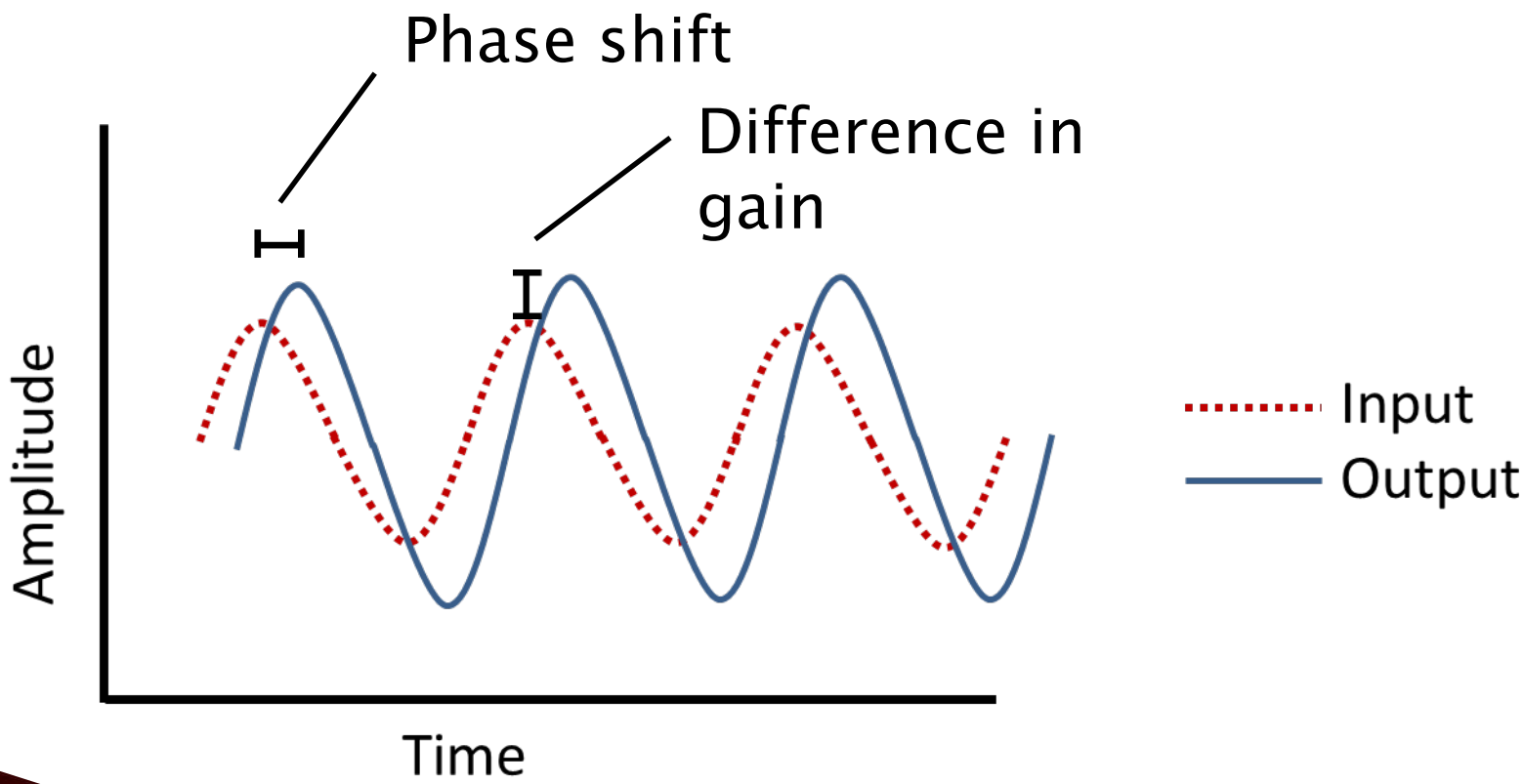
Upstream

Heat Effected Area (HEA)

Downstream



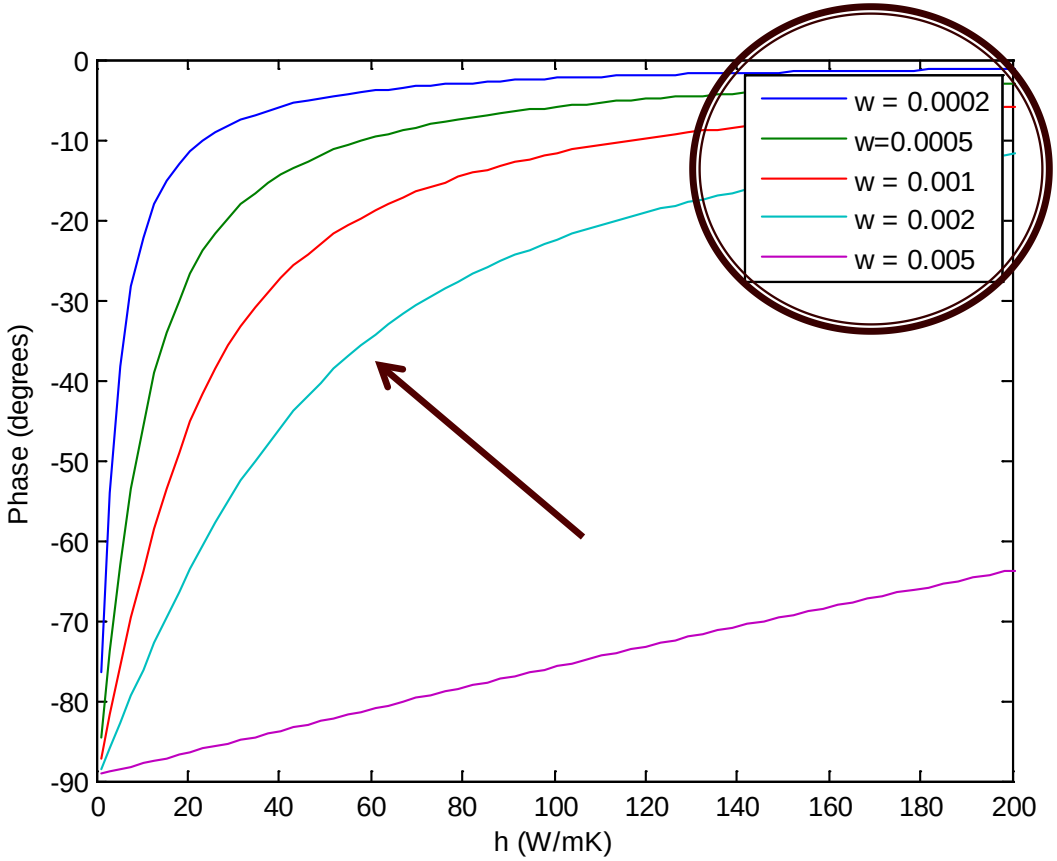
Matlab was used to evaluate the potential increase in measurement sensitivity through frequency analysis



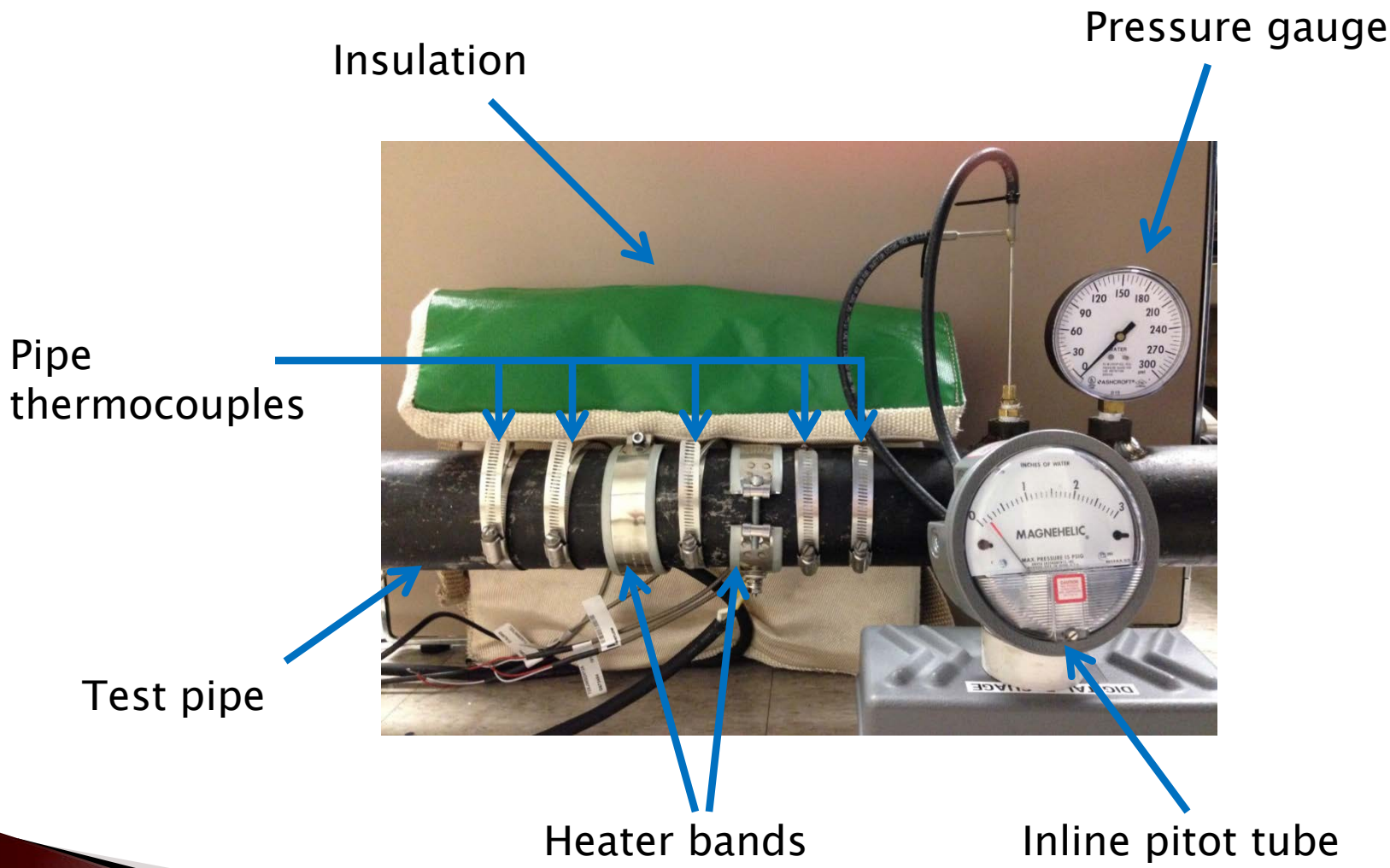
The required time is too long to analyze flow rates by frequency analysis

$\omega = 0.002$ rad/sec

T = 52 minutes

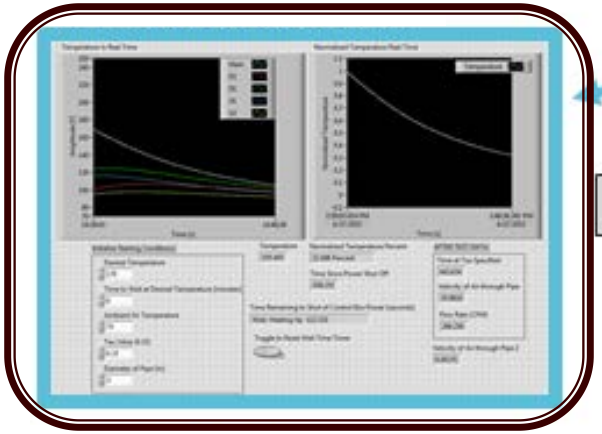


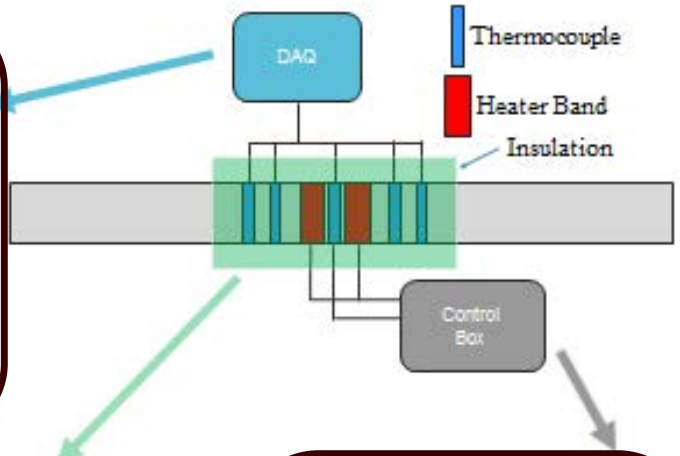
An experimental system was designed to verify simulation results and create a calibration curve

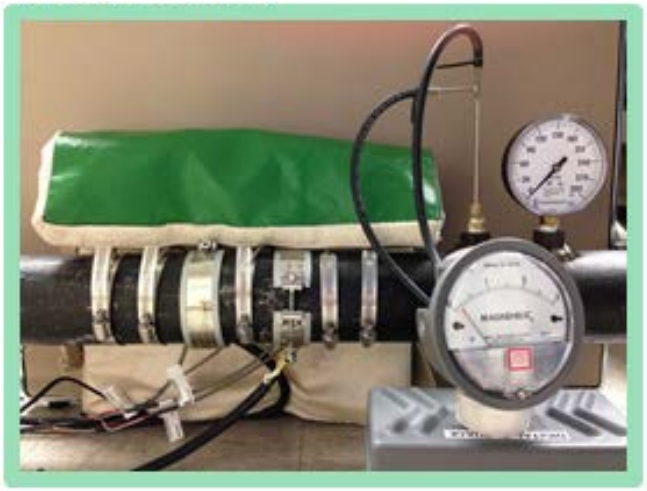


LabVIEW Software was used for data collection and a programmable PID controller was used to control the heater bands

Data Acquisition



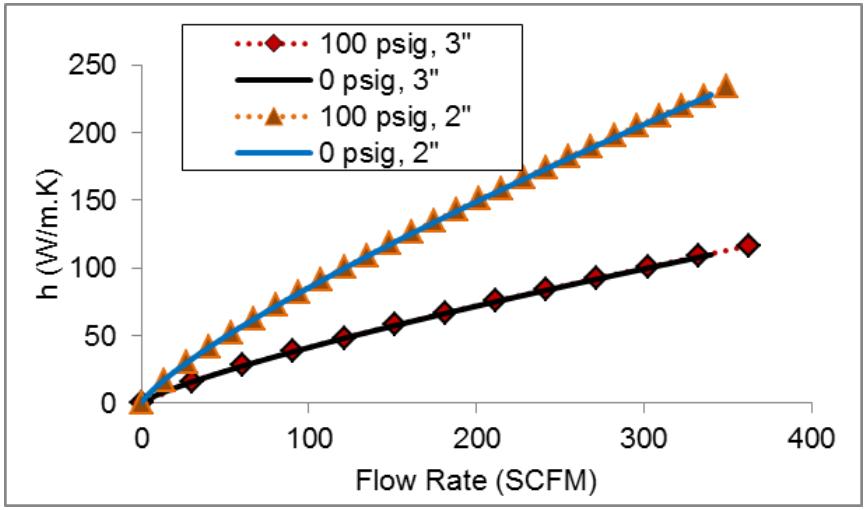




Control Box

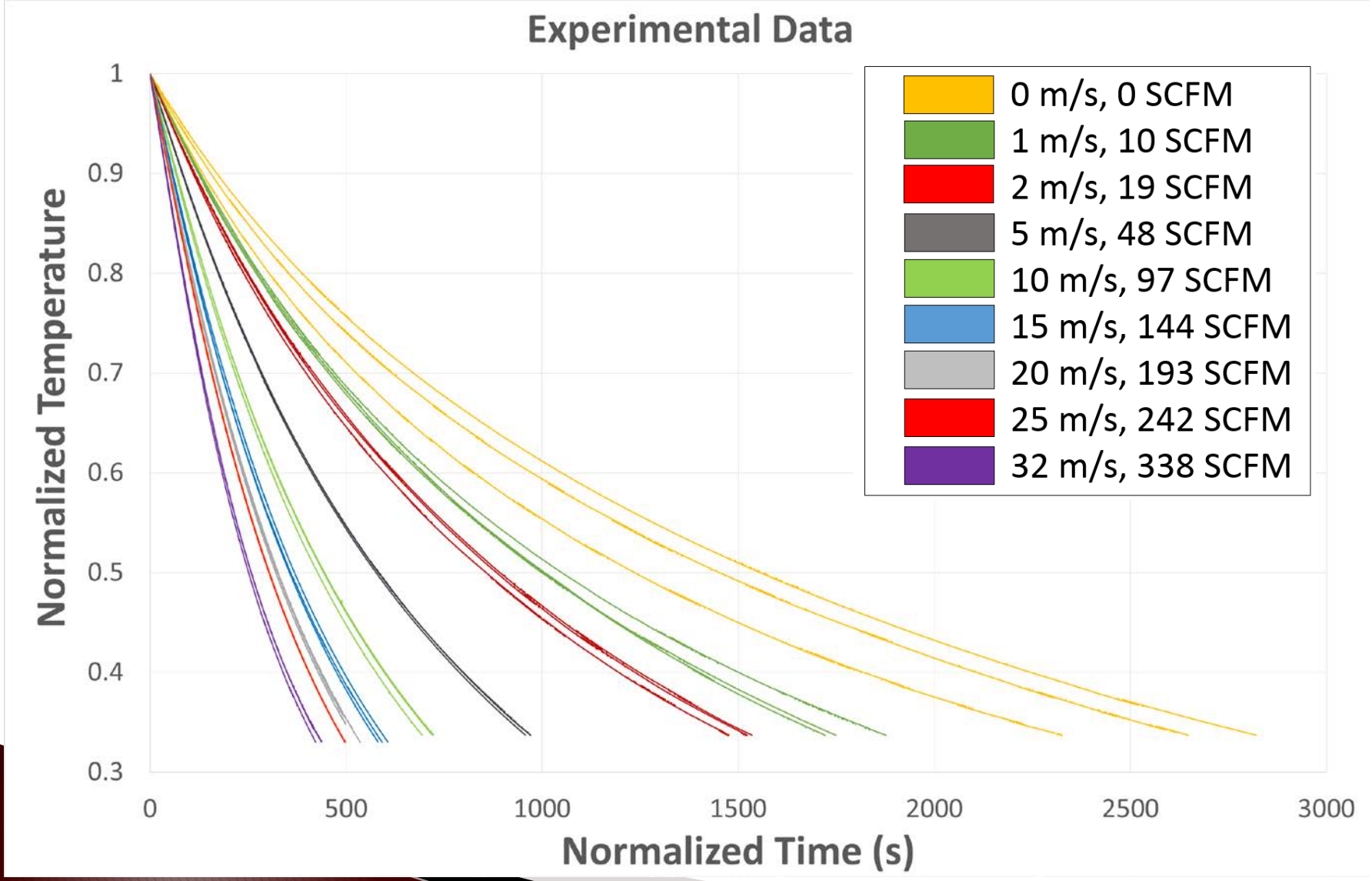
The device was tested at low pressure to build a calibration curve and verify simulation

Independent of pressure

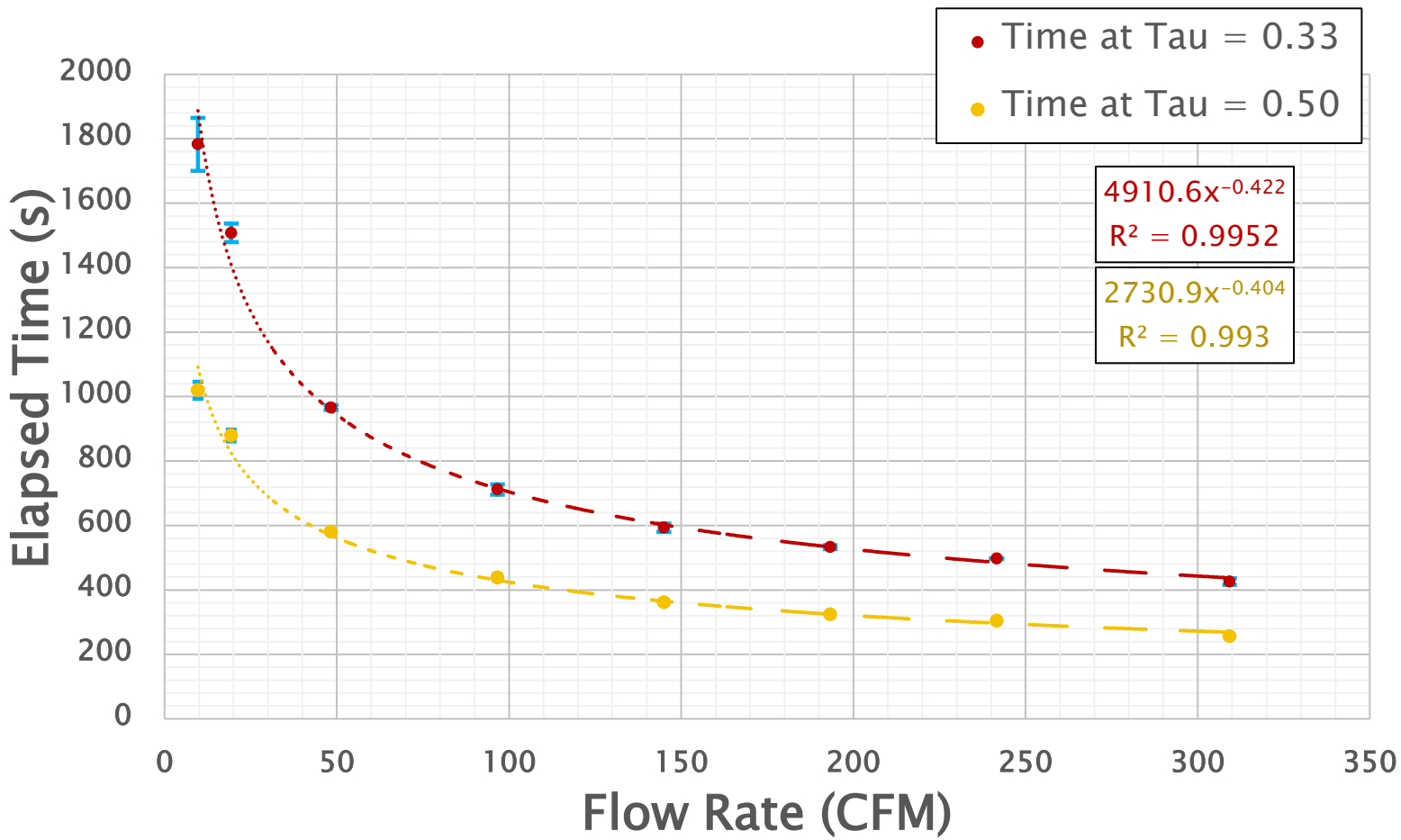


Leaf blower with variable transformer

Low pressure testing revealed the difference in cooling based on airflow through the pipe



A calibration curve correlate to the differing flow rates



$$T = \left(T_{peak} - T_o\right)e^{-\tau \cdot t} + T_o$$

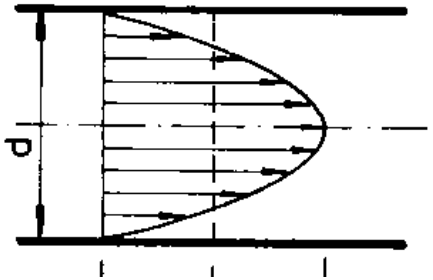
One of the main potential disadvantages is the errors at low flow rates

<u>Start of transition region</u>

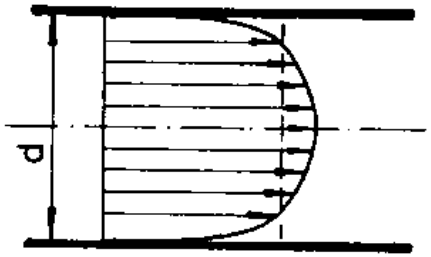
3” Pipe: 30 SCFM

2” Pipe: 20 SCFM

Laminar



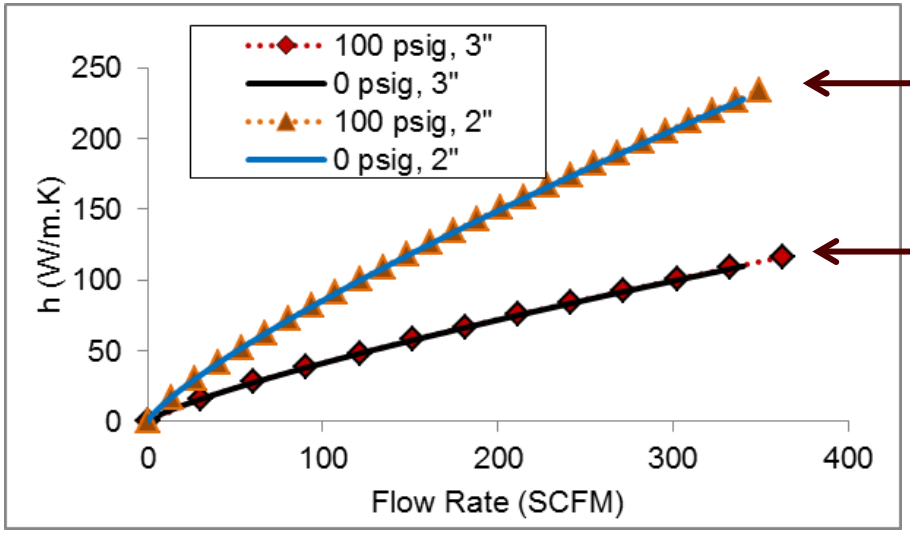
Turbulent



Current testing includes building a calibration curve for 2" compressed air lines

Matthias Zerza

Dependence of heat transfer on pipe size

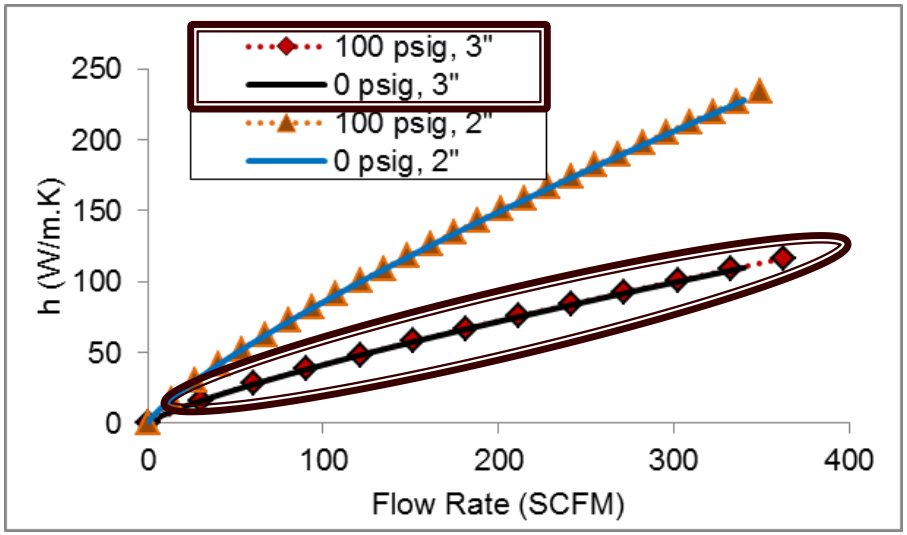


2" pipe

3" pipe

Higher heat transfer per flow rate for smaller pipes

Testing at high pressure is necessary to verify the calibration curve



200 hp compressor

2 Challenges

Limited Time

Water in Pipe

The compressed air leakage rate will be computed in a real plant using different methods to evaluate the accuracy of the device

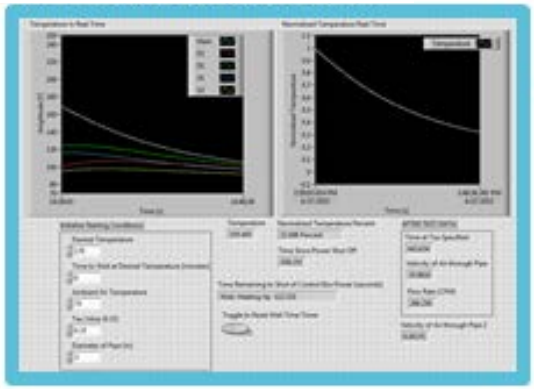
Dropdown Test

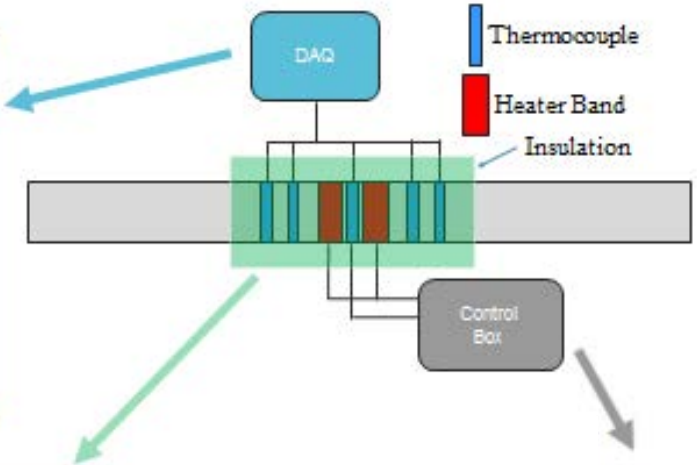
Ultrasonic Leak Detector

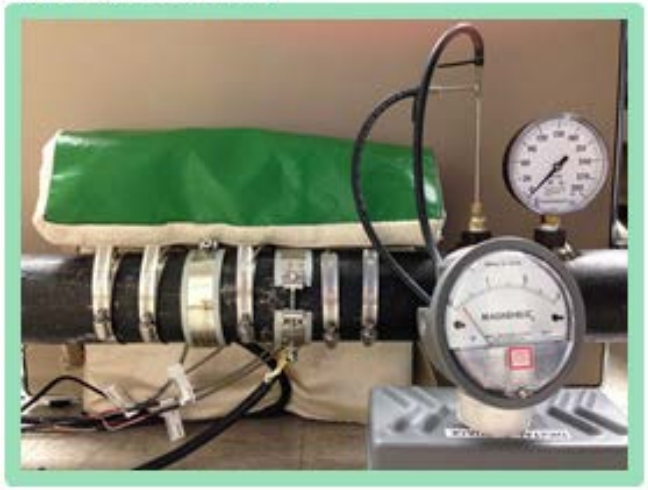
Conclusions

- A method based on heat transfer has been developed to quantify compressed air leakage rates
- Simulations demonstrate the viability of the device
- Experimental tests on low pressure air verify the results seen in computer simulations
- Future testing will be performed on high pressure compressed air and an actual plant

Questions?

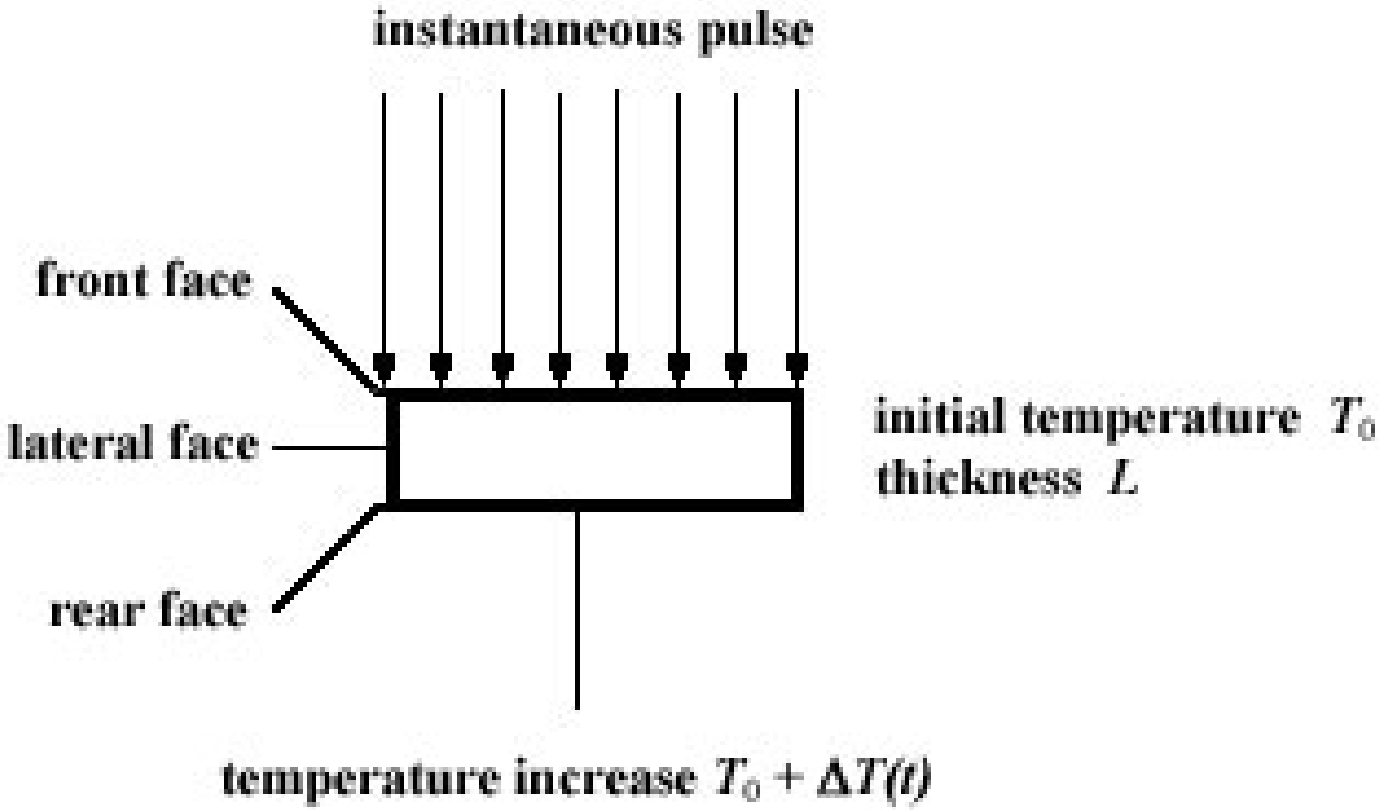






Appendix

- Motivation for the solution



Q & A…

2015 Student Research Winners

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Excellence in Applied Energy Engineering Research Awardees

University of Alabama

- Topic: Energy Performance Estimation of Industrial Cooling Towers
  - Dr. Keith Woodbury - Director
  - Joseph Carpenter, Andy Cloyd, Saba Lalani

University of Delaware

- Topic: Controllable Reflectance Roofing System to Tailor Building Solar Loads for Increased HVAC Efficiency
  - Dr. Keith Goossen
  - Dan Wolfe, Christine Longhitano

www.IACForum.org

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Student Registry and Exit Interviews

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- **Lead Student Responsibilities**
  - Ensure all students complete registry entry
  - Ensure all students complete exit interview
  - Ensure that lead/active/inactive status is current
- Exit Interviews
  - Identify new lead students
  - Update contact information for alumni
  - Capture alumni career data

http://www.iacforum.org/

Student Certificates

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- On-line requests are processed through the certificates link on www.iacforum.org
- **Students and alumni must be in the IAC registry to receive certificates**
- Deadlines occur 3 times per year:
  - October 1, March 1, and July 1
- Certificate process
  - Student initiates request online,
  - Director/AD receives email notification with link
  - He/she completes the request online
  - Certificates arrive
- Certificates <u>are mailed to the Directors</u> within 30 days of deadline

Certificate of Participation
presented to
Name
For the completion of requirements mandated by the
U.S. Department of Energy's
Industrial Assessment Center Program at
Texas A & M University

WEEC Invitation

- **September 30 – October 2** in Orlando, FL
- AEE's WEEC is open to students
  - Free admission for **3 students per center**
  - Applications were emailed to directors
  - Send to me (wenningtj@ornl.gov) and/or Susie Allen (allensc@ornl.gov)
  - **On your own** with respect to transportation, hotel, and meals
  - Informal IAC meet-up??

2015 FAEE-WEEC
Student Scholarship

2015 WEEC World Energy Engineering Congress

Please return this form at your earliest convenience to Priscila Rivera: fax (770-446-3969);
E-mail priverea@aeefoundation.org; or mail to Scholarships-WEEC, 3168 Mercer University Drive, Atlanta, GA 30341

REGISTRATION FORM

Please check the events you will attend:
(This information will help us make more accurate catering guarantees.)

Name: _____ (Last) (First)

Status in your local energy organization, if applicable (president or other officer, member, etc.): _____

College or University: _____

Address: _____

City/State/Zip: _____

Phone: _____ E-Mail Address: _____

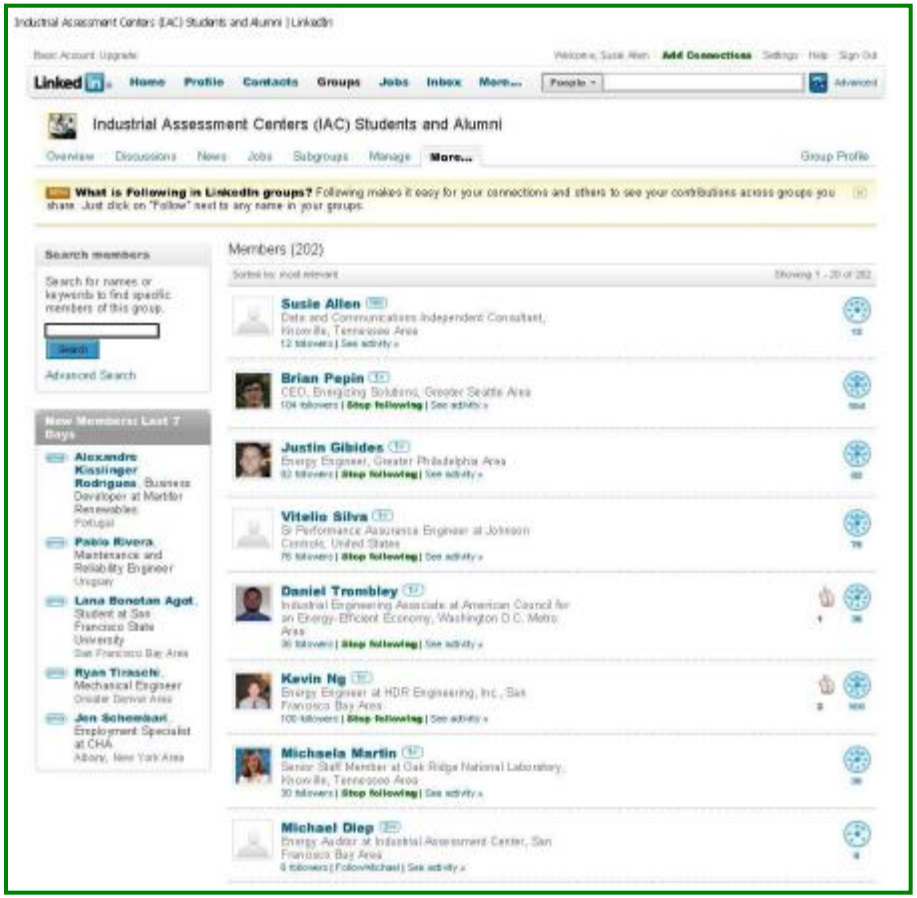
I hereby confirm that I am a full-time college or university student: _____ Yes

Wed Sep 30 - Fri Oct 2 – 2015 WEEC CONFERENCE	
☐ Complimentary Registration to Conference ($895 Value) - Yes, I will attend	
Tue Sep 29 - LEGENDS IN ENERGY / Disney Epcot Theme Park (6:00 – 10 pm)	
☐ $150 - Yes, I will attend	☐ $150 - Yes, my guest will attend - Name: _____
Wed Sep 30 - AEE AWARDS BANQUET	
☐ $50 - Yes, I will attend	☐ $50 - Yes, my guest will attend - Name: _____
Wed Sep 30 – MEET THE AUTHORS NETWORKING EVENT (4:00-6:00 PM)	
☐ Free - Yes, I will attend	☐ Free - Yes, my guest will attend - Name: _____
Wed Sep 30 – LAS Symposium & Expo (Energy Management in Latin America and Spain)	
☐ Free - Yes, I will attend	☐ Free - Yes, my guest will attend - Name: _____
Thurs Oct 1 - CWEEL BREAKFAST (7:30 – 9:00 AM)	
☐ Free - Yes, I will attend	☐ Free - Yes, my guest will attend - Name: _____
Thurs Oct 1 – Energy Star Portfolio Manager Benchmarking Workshop (12:30 - 2:30 pm)	
☐ Free - Yes, I will attend	☐ Free - Yes, my guest will attend - Name: _____

LinkedIn IAC Group

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Established in year 2008
- Professional networking site for IAC students and alumni
- 520+ members
- News items, professional profiles, discussions
- **Want to utilize more heavily for ongoing collaboration**



Request: Pictures, Video Clips, Articles & Stories

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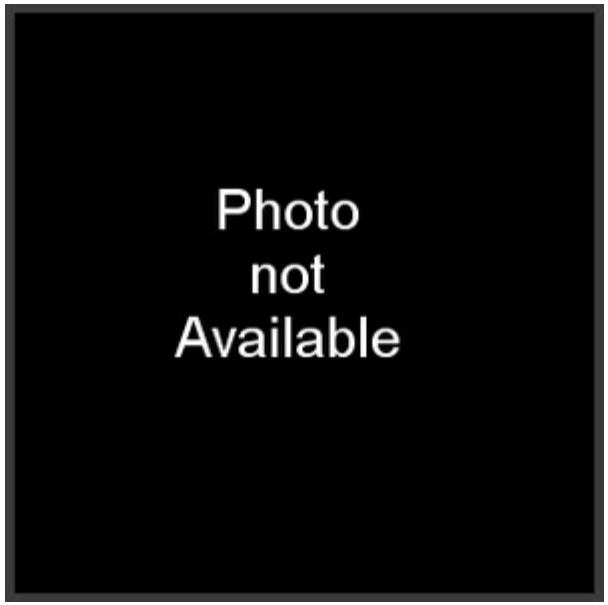


Please send to:
wenningtj@ornl.gov

Looking ahead…July

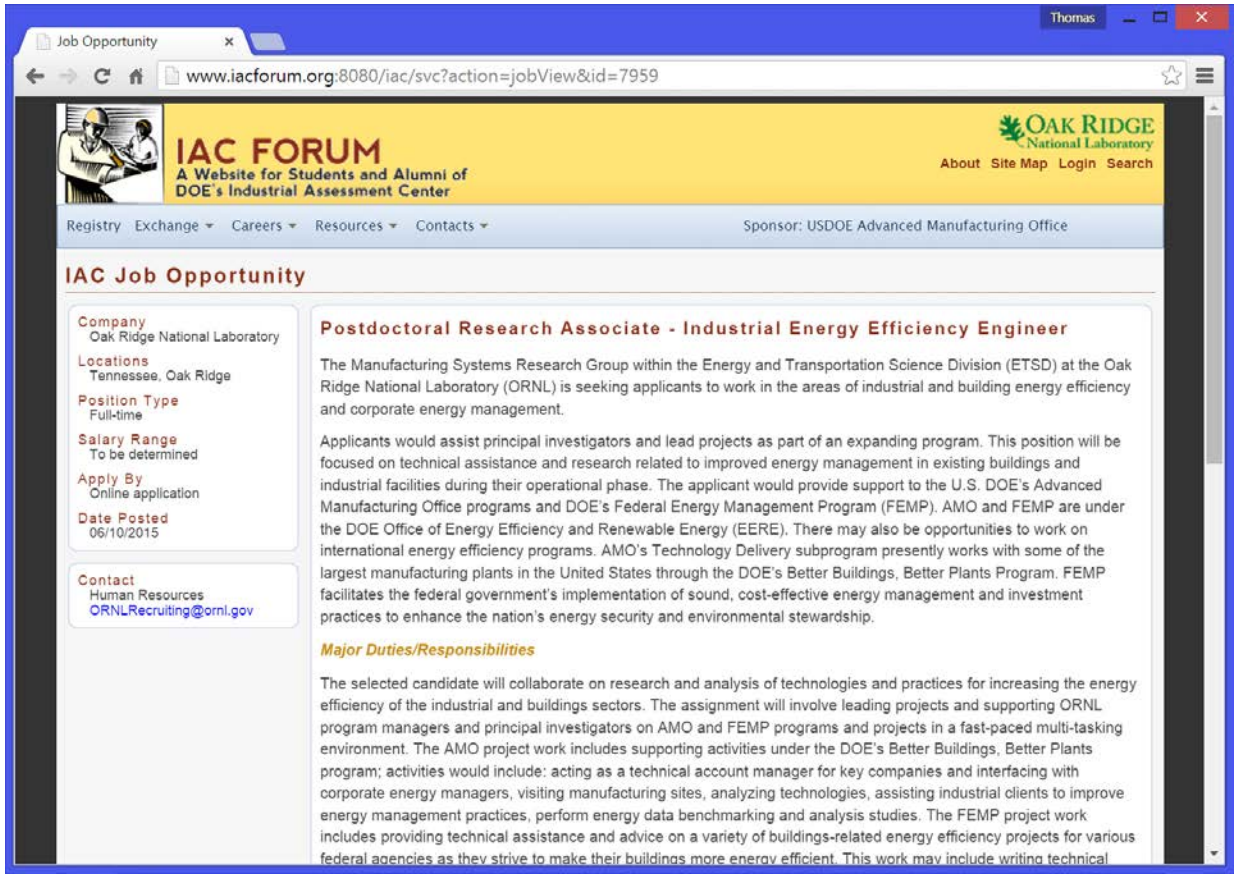
- **Topic**: Use of cloud storage for more effective communication, file sharing, and report write-ups between TTU IAC collaborators
- **Who**: Ian Swagerty & Anthony Taylor, Tennessee Tech University IAC
- **When:** Tuesday, July 21, 2015 @ 2pm ET

Job Announcements

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

ORNL has an open position (Post-Masters & Post-Doc)

See - http://www.iacforum.org:8080/iac/svc?action=jobList



Job Opportunity

www.iacforum.org:8080/iac/svc?action=jobView&id=7959

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Oak Ridge National Laboratory

Locations
Tennessee, Oak Ridge

Position Type
Full-time

Salary Range
To be determined

Apply By
Online application

Date Posted
06/10/2015

Contact
Human Resources
ORNLRecruiting@ornl.gov

Postdoctoral Research Associate - Industrial Energy Efficiency Engineer

The Manufacturing Systems Research Group within the Energy and Transportation Science Division (ETSD) at the Oak Ridge National Laboratory (ORNL) is seeking applicants to work in the areas of industrial and building energy efficiency and corporate energy management.

Applicants would assist principal investigators and lead projects as part of an expanding program. This position will be focused on technical assistance and research related to improved energy management in existing buildings and industrial facilities during their operational phase. The applicant would provide support to the U.S. DOE's Advanced Manufacturing Office programs and DOE's Federal Energy Management Program (FEMP). AMO and FEMP are under the DOE Office of Energy Efficiency and Renewable Energy (EERE). There may also be opportunities to work on international energy efficiency programs. AMO's Technology Delivery subprogram presently works with some of the largest manufacturing plants in the United States through the DOE's Better Buildings, Better Plants Program. FEMP facilitates the federal government's implementation of sound, cost-effective energy management and investment practices to enhance the nation's energy security and environmental stewardship.

Major Duties/Responsibilities

The selected candidate will collaborate on research and analysis of technologies and practices for increasing the energy efficiency of the industrial and buildings sectors. The assignment will involve leading projects and supporting ORNL program managers and principal investigators on AMO and FEMP programs and projects in a fast-paced multi-tasking environment. The AMO project work includes supporting activities under the DOE's Better Buildings, Better Plants program; activities would include: acting as a technical account manager for key companies and interfacing with corporate energy managers, visiting manufacturing sites, analyzing technologies, assisting industrial clients to improve energy management practices, perform energy data benchmarking and analysis studies. The FEMP project work includes providing technical assistance and advice on a variety of buildings-related energy efficiency projects for various federal agencies as they strive to make their buildings more energy efficient. This work may include writing technical

Thank You!

Thomas Wenning, PE

IAC Student Activities Coordinator

Oak Ridge National Laboratory

865-946-1504, wenningtj@ornl.gov