

# Training

## **Short Courses**

Heat exchanger technology for beginning and experienced engineers

## **Workshops**

Hands-on training for designers and process engineers using HTRI software and licensed products

## **Webinars**

Hour-long web-based seminars for HTRI members on software procedures, technical tips, and design guidance

**Heat Transfer Research, Inc.**

the premier provider of heat transfer technology



# Training from HTRI

Heat Transfer Research, Inc. (HTRI), is the global leader in process heat transfer and heat exchanger technology. Founded in 1962, our industrial research and development consortium serves the engineering needs of over 1000 corporate member sites.

## ***Why attend our training?***

*The short answer:* To achieve maximum benefit from HTRI software and to better understand how our research findings impact your heat exchanger designs.

HTRI continues to conduct research and to apply our findings in the latest software versions. Short courses and workshops give you the opportunity to update your knowledge of heat exchanger technology and the latest software features and to solve industrial design cases under guidance of HTRI staff.

Our instructors include the same engineers who conduct our research and develop our software—they know our products, and better yet, the heat transfer industry.

All courses include comprehensive manuals that you can review after the training session ends.

## ***Want customized or onsite training?***

Because we can customize our courses to fit your needs, your staff can immediately start using their new skills in their work and you will save staff time and travel costs. Contact us about a quote for onsite training today!

Call or e-mail us today to find out how our training can benefit your business.

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## Summary of Fees

through December 31, 2010

<b>Short Courses</b> (pages 4 - 5)	<b>Length (days)</b>	<b>Fee (per person)</b>
Designing Exchangers for Fouling Service	1	US\$600
Fundamentals of Heat Exchanger Technology	1	US\$600
Heat Exchanger Technology	2	US\$1000
Kettle Reboilers	1	US\$600
<b>Workshops</b> (pages 6 - 12)	<b>Length (days)</b>	<b>Fee (per person)</b>
Advanced <i>Xist</i>	1	US\$375
Condensers	1	US\$375
Enhanced Heat Transfer in <i>Xist</i>	1	US\$375
Heat Exchanger Troubleshooting	1	US\$375
HTRI Technology	2	US\$650
HTRI <i>Xchanger Suite</i> Essentials	1	US\$375
Reboilers	1	US\$375
Using HTRI <i>Xchanger Suite</i> with Process Simulators	1/2	US\$200
Vibration Analysis	1	US\$375
<i>Xace</i>	1	US\$375
<i>Xfh</i>	2	US\$650
<i>Xist</i>	1	US\$375
<i>Xphe</i>	1	US\$375
<i>Xvib</i>	1	US\$375

## Designing Exchangers for Fouling Service

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Don't get your exchangers all fouled up. Review traditional methods to apply margins in heat exchanger design for fouling service.

Industry experience indicates that these traditional methods may result in excessive heat transfer area in some applications and may promote fouling in other applications. Use of fouling models may provide an improved approach in selected applications where fouling data is available. In most cases, experience and judgment are used to set realistic design margins.

### Key Topics

TEMA fouling factors • “Clean” applications • Types of fouling • Fouling measurements • Fouling models (crude oil and water) • Thermal and pressure drop margins • Fouling characteristics of exchanger geometry • Case studies

### Suggested Participants

Engineers who specify, rate, and/or analyze heat exchangers in fouling service

## Fundamentals of Heat Exchanger Technology

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Focusing on the principles of heat exchanger technology provides a framework for practicing engineers to gain information and understand the latest methods of heat exchanger operations. By combining state-of-the-art heat exchanger design technology with practical plant applications, this course gives novice and occasional designers guidelines to evaluate heat exchanger operation and performance. *Hand calculator required.*

### Key Topics

Basic heat transfer principles • Heat exchanger geometries • Design methods • Overview of maintenance, repair, and troubleshooting • Two-phase pressure drop calculations • Rules of thumb • Standards and specifications

### Suggested Participants

Novice heat exchanger designers and engineers who are occasionally responsible for reviewing heat exchanger design and performance

# Heat Exchanger Technology

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A strong foundation of heat exchanger technology is needed to design and troubleshoot units efficiently. This course presents and then builds upon fundamental principles, as well as reviews the limitations of their application to industrial heat transfer equipment.

Discussions of engineering standards and specifications, as well as software that is available to evaluate heat exchanger operation, provide a basis for case studies.

Participants analyze operational problems involving fouling, vibration, and temperature pinch. *Hand calculator required.*

## Key Topics

Basic heat transfer principles • Heat exchanger geometries • Design methods • Single-phase and two-phase pressure drop • Standards and specifications • Maintenance and repair • Case studies of operational problems, including fouling, vibration, leakage, and maldistribution

## Suggested Participants

Heat exchanger designers and engineers who are responsible for heat exchanger design and troubleshooting

# Kettle Reboilers

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Thermal design methods for kettle reboilers have evolved over the years and old rules -of-thumb no longer apply. New research results, software advances and feedback from industry all contribute to improved design practices. The course presents the most up-to-date research in kettle reboilers, provides our current recommendation to use *Xist* to model kettles accurately, and discusses future research and software development to improve predictions. Many example problems illustrate recommended good practices for using *Xist*, interpreting warning messages, improving designs, and troubleshooting cases.

## Key Topics

Shellside boiling methods • Recirculation • Liquid level and bundle dryout • Differences between bundle composition and feed composition • Kettle sizing • Entrainment • Vibration • Fouling

## Suggested Participants

Thermal design engineers and heat exchanger experts

## Advanced *Xist*

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Have you been using *Xist* successfully but need to know more about analyzing complex cases? This workshop is for experienced users with a good working knowledge of heat exchanger design and operation.

This class addresses the latest HTRI guidelines applied to difficult cases. New research developments and software options are discussed and applied to a set of troubleshooting exercises.

### Key Topics

Shells in series • Shellside condensation • Design mode • Flooded evaporators • Falling film evaporators • Modeling glycol injection • Continuous fins

### Suggested Participants

Experienced *Xist* users who troubleshoot cases and evaluate shell-and-tube exchanger performance

## Condensers

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Learn the fundamentals of condensation mechanisms and how they apply to condenser designs! Apply guidelines to develop *Xchanger Suite* cases for accurate performance assessment. This course provides a foundation for understanding the basis for thermal design of typical industrial heat exchangers.

### Key Topics

Film condensation on vertical surfaces • Condensation on horizontal tube bundles • Interfacial vapor shear effects on condensation heat transfer • Condensation inside horizontal tubes • Desuperheating and subcooling • Condensation with mixtures • Condensation with enhanced heat transfer surfaces • Two-phase pressure drop • Venting inerts • Drainage

### Suggested Participants

Engineers who design and evaluate condenser equipment

## Enhanced Heat Transfer in *Xist*

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If you have cases that are heat transfer or pressure drop limited, this is the workshop for you. Learn how to use *Xist* to enhance the performance of shell-and-tube exchangers. Case studies of suitable applications for enhanced geometry and features in *Xist* 5.0 will be discussed.

### Key Topics

Finned tubes • Tube inserts • Specifying vendor tubes • Helical baffles • EMbaffles • RODbaffles • Square-One baffles

### Suggested Participants

Engineers responsible for specifying or improving shell-and-tube exchanger performance

## Heat Exchanger Troubleshooting

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Design decisions can have a costly impact on heat exchanger operation. Learn by reviewing several real cases in which unit designs had critical commercial consequences for operators/owners. In some cases, the units did not work in service; in others, the designs were revamped before the units began operation.

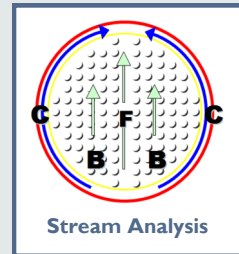
Each case study is introduced as a problem; participants work individually or in groups to determine the cause and develop solutions. Prior to each case, the instructor reviews related HTRI methods.

### Key Topics

Vertical thermosiphon which does not provide sufficient duty • Horizontal tubeside refrigerant evaporator which does not adequately chill water • Vertical shellside condenser with potential tube vibration problems after plant upgrade and duty increase • F-shell boiler feedwater heater that does not meet performance expectations • Brine chiller with 20% deficiency in duty • Gas cooler with inadequate temperature approach

### Suggested Participants

Engineers—from novice to expert—who want to ensure that design problems are identified before operation



## HTRI Technology

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This workshop provides instruction in effectively applying HTRI *Xchanger Suite* to rate, design, simulate and troubleshoot process heat exchangers. The workshop provides a survey of heat exchanger geometry supported by *Xchanger Suite*, discusses performance fundamentals based on HTRI research, provides input guidelines for specifying accurate thermal models, interpreting results, and troubleshooting cases. Students will apply the methods by working example problems.

### Key Topics

Heat exchanger types modeled in *Xchanger Suite* (shell-and-tube, air coolers, plate frame, and spiral plate) • Process specifications for thermal ratings • Guidelines for fluid property and heat release input • TEMA shell and tube technology • Air cooler technology • Vibration analysis including screening analysis in *Xist* plus an introduction to detailed analysis with *Xvib* • Condensers • Reboilers

### Suggested Participants

Engineers who design, maintain, or troubleshoot heat exchangers

## HTRI *Xchanger Suite* Essentials

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Do you need a review of modeling techniques and HTRI methods in *Xchanger Suite*? After a brief introduction to the component software, you receive debugging tips and a checklist for data needed to set up a case.

Using hands-on examples, learn about HTRI's latest guidelines to specify fluid properties, boiling and condensing method options, and general recommendations to review results.

### Key Topics

Overview of *Xchanger Suite* components and data entry • Geometry input for shell-and-tube, air-cooled, and plate-and-frame exchangers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

### Suggested Participants

Both novice users of *Xchanger Suite* and engineers who need an update on the latest HTRI recommendations

## Reboilers

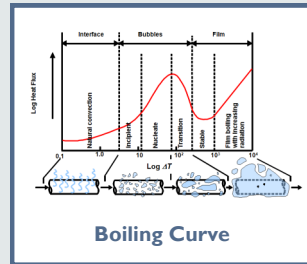
Learn the fundamentals of boiling mechanisms and how they apply to reboiler designs! Work with *Xist* to model boilers and thermosiphon reboilers accurately. This course provides a foundation for understanding the basis for thermal design of typical industrial heat exchangers.

### Key Topics

- Pool boiling mechanisms including nucleate boiling, departure from nucleate boiling, and film boiling
- Intube flow boiling mechanisms for horizontal and vertical configurations
- Desuperheating and subcooling
- Boiling with mixtures
- Boiling with enhanced heat transfer surfaces
- Two-phase pressure drop

### Suggested Participants

Engineers who design and evaluate reboilers



## Using HTRI *Xchanger Suite* with Process Simulators

This half-day workshop discusses the techniques and benefits of using *Xchanger Suite* with process simulators. Through a series of demonstrations, hands-on exercises, and case studies, attendees learn how to specify physical properties using different methods, import a stream from a process simulator, and import an exchanger unit operation from a process simulator. The workshop also describes and demonstrates the inclusion of HTRI unit operations within different process simulators.

### Key Topics

- Xchanger Suite* process simulator interfaces
- Heat exchanger models
- Xchanger Suite* – process simulator interfaces
- Process simulator environment

### Suggested Participants

Heat exchanger designers who want to use a process simulator to generate physical properties for exchanger designs or who want to embed rigorous heat exchanger ratings into a process simulator flowsheet

## Vibration Analysis

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A must for anyone who evaluates the vibration potential of shell-and-tube heat exchangers! In this course, you learn about vibration mechanisms in shell-and-tube heat exchangers and **Xist** methods to analyze vibration severity. Most importantly, you discover corrective measures to mitigate damage.

### Key Topics

Introduction to vibration phenomena • Flow-induced vibration in heat exchangers (fluidelastic instability, vortex shedding, turbulent buffeting, acoustic vibration) • Design options to mitigate vibration • Field fixes • **Xist** Vibration Report • Example application and case studies

### Suggested Participants

Design and plant engineers responsible for the mechanical condition of shell-and-tube heat exchangers

## Xace

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Do you design only air-cooled heat exchangers? Evaluate their performance? Then this workshop is for you. Unlike the **Xchanger Suite** workshops, this course focuses only on air-cooler geometry.

Learn how to use **Xace** effectively to rate and design air-cooled heat exchangers, economizers, and air preheaters. All example problems and practice exercises relate to geometries handled only by **Xace**.

### Key Topics

Overview of **Xace** capabilities and applications • Geometry inputs for air coolers and economizers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

### Suggested Participants

Designers of air-cooled heat exchangers and process engineers who evaluate their performance

## Xfh

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Learn how to simulate the performance of fired heaters. By using **Xfh**, designers can predict the entire performance for a fired heater in a single run, including process tubside methods for pressure drop and heat transfer.

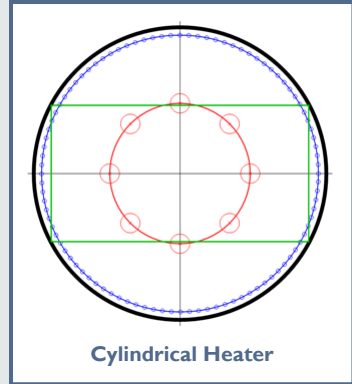
**Xfh** can help you troubleshoot plant problems and assess the effects of energy-efficient additions, as well as evaluate competing designs or proposed changes to plant conditions and/or existing designs.

### Key Topics

Data entry and program navigation •  
Combustion • API 530 • Convection •  
Cylindrical heaters • Box heaters

### Suggested Participants

Designers of fired heaters and process engineers who evaluate their performance



## Xist

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Even if your work is limited to shell-and-tube heat exchangers, there's much to be learned! Unlike the **Xchanger Suite** workshops, this session is devoted to the geometries handled only by **Xist**.

The day focuses on the extensive options available in **Xist** and how you can use these methods effectively to solve several example problems. You'll leave the class knowing how to take full advantage of the features this robust tool offers.

### Key Topics

Overview of **Xist** capabilities and applications • Geometry input for shell-and-tube heat exchangers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

### Suggested Participants

Designers of shell-and-tube heat exchangers and process engineers who evaluate their performance

## **Xphe**

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Discover how to use HTRI's graphical tool for designing, rating, and simulating plate-and-frame heat exchangers. If you work only with plate-and-frame geometries, **Xphe** is the software for you.

In this workshop you learn how it handles single-phase and two-phase heat transfer and pressure drop for many common plates and configurations. You'll also come away with a better understanding of the analytical methods used in **Xphe**.

### **Key Topics**

Overview of **Xphe** capabilities and applications (single-plate types, multiple-plate types, frames in series, maldistribution) • Geometry input for plate-and-frame heat exchangers • Process specifications for rating, simulation, and design • Guidelines for specifying fluid properties • Introduction to HTRI analysis methods

### **Suggested Participants**

Designers of plate-and-frame heat exchangers and process engineers who evaluate their performance

## **Xvib**

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Because vibration can cause critical operating problems in heat exchangers, it is important to analyze the potential for flow-induced vibration.

This workshop teaches you how to develop an input file, interpret results, and obtain accurate prediction of the vibration potential for installed units. Using **Xvib** you'll practice determining if a heat exchanger is susceptible to vibration damage.

### **Key Topics**

Analysis methods for fluidelastic instability and vortex shedding • Velocity profile development • Vibration susceptibility

### **Suggested Participants**

Engineers responsible for the mechanical condition of shell-and-tube heat exchangers

## **Webinars**

HTRI frequently offers free, one-hour webinars to our members. These sessions, each covering a specific topic on exchanger design or on HTRI software and services, are suitable for various experience levels.

Find the latest schedule in Upcoming Events on our website, [www.HTRI.net](http://www.HTRI.net).