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## La Crosse Technical Training Catalog Second Half, 2003



The Trane Company has a policy of continuous product improvement; it reserves the right to change course design and / or content without notice.  
The Trane Company reserves the right to reject any training course application.

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### *A CATALOG OF COMMERCIAL SYSTEMS SERVICE, MAINTENANCE AND OPERATION TRAINING — COVERING AIR CONDITIONING SYSTEMS AND PRODUCTS*

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The training described in this catalog is intended for our customers: Trane service company technicians, service contractor and dealer technicians, equipment owner HVAC operation and maintenance supervisors and facility engineering personnel.

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### Notice:

The Trane Engineering Technology Center in La Crosse is a smoke-free facility. Designated smoking areas are provided outside of the building.

## Safety First!

By registering to attend any course offered in this catalog, the student agrees to abide by any and all safety procedures required by the instructor and to utilize appropriate safety equipment and apparel as required.

## What To Wear

### In Class

The dress policy at Trane office facilities is “business casual” clothing. This means waist-length collared shirt and long trousers (“Docker™” type pants). For safety reasons, neither shorts nor cut-offs are appropriate apparel for course attendance.

### On Factory Tours

Leather shoes and long pants (not shorts) are required for plant tours. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.

## Enroll Early!

Class sizes are limited due to space restrictions and resource availability. You have a better chance of getting into a class that is offered early in the schedule than a later one.

### On the Cover . . .

The student entrance to the Trane Engineering Technology Center located in La Crosse, Wisconsin; home of the Trane Technical Training Center.



## No Pictures Please!

The taking of photographs inside the Trane Technology Center is restricted to specifically authorized photographers only.

Please check all photo equipment with our technical center security department when entering the building. It will be returned to you when you leave the premises.

## Make Room

Students attending our classes usually receive a lot of reference materials to take home with them.

Be sure to bring an extra piece of luggage or one that is big enough to accommodate a couple of large binders of printed materials.

## Verify Your Enrollment!

If you don't get an enrollment confirmation letter within two weeks of your class, you probably are not enrolled in the class!

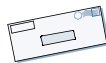
Call and check with us if this happens!

## Save \$ On Your Room

To receive our corporate discount on the cost of your hotel room and free shuttle service to and from class, you must make room reservations through our course registrar.

## Check Us Out Online

Learn more about new Trane products and services from our web page. Our internet address is: <http://www.trane.com>



## General Information

### Expert Training

This catalog presents complete descriptions and schedules for our current offering of HVAC and controls courses. These courses are designed to increase technician competence and build confidence when servicing newer systems and controls.

Course instructors have strong HVAC and controls service backgrounds and extensive teaching experience. They also have ready access to Trane's highly knowledgeable product, service and systems engineers and to Trane's extensive technical reference library. A controlled laboratory environment, complete with fully operational Trane HVAC systems, provides the ideal setting for the hands-on approach used in Trane service courses.

The cost of professional training always pays you back - sometimes within weeks! Well-trained technicians, with a good understanding of controls, refrigeration and airside systems, using correct diagnostic methods, are more likely to minimize service costs by efficiently identifying and correcting problems, and not wasting time and materials with trial and error methods.

### Enrollment Policy

To get the most effective training, carefully match your students with the appropriate courses by reviewing the course content and objectives with them. All courses are offered on a first registered - first attend basis. If the class you prefer is filled, we can hold standby space for the date you prefer (in case there's a cancellation) and register you for the same course offered at a later date.

If you register in advance, we will send you a confirmation letter about a month before the scheduled course starting date to verify your enrollment. Check it carefully and contact us immediately if you find an error in it. If you haven't received confirmation within two weeks of the course start date, you may not be properly registered for the course. In this case, contact us immediately! If you register late (within 2 weeks of the course date), we will **FAX** your confirmation letter to you at that time.

### Course Locations

Courses are held in our La Crosse, Wisconsin, Technical Training Center, unless noted otherwise on the course schedule on Page 4.

### Hotel Information

Students should pay hotel fees at check-out, unless credit arrangements were made directly with the hotel. Room reservations are normally made for Sunday arrival. Notify us if you will arrive on Saturday. **A major credit card is required to guarantee room availability.**

Room rates vary by hotel and season. Hotel charges are at Trane's corporate discount rate and include 12.5% tax. ***To receive this discount on the cost of your hotel room, you must make room reservations through our course registrar.***

Our hotels provide La Crosse airport shuttle service. Trane provides transportation between our training facility and the hotel. Students who make separate hotel arrangements are responsible for their own transportation between class and their hotel.

### How To Register

To attend a course listed in this catalog:

1. Review the course descriptions with the trainee to select the right course(s) and training level. **Read the target audience and prerequisites sections carefully.**

**Attention Contractors!** There are specific insurance requirements for attending our CenTraVac® Mechanical Service course. Read pages 22 and 23 carefully.

2. Make a first and second choice from the available course dates. You may confirm course availability by phone or FAX; see the "Registration Form", Page 24.

3. For tuition amounts and class lengths, see Pg. 4. Tuition covers transportation to and from our training facility, noon lunch, and all training and reference materials.

4. Copy and fill out the registration and technician agreement (if needed) forms. Mail them to the address on the form or

FAX it to the number shown. Be sure to include **"Technical Service Training"** in the address. Tuition payment must be sent with the enrollment form.

5. Make sure you know how hotel reservations and local transportation (in La Crosse) are handled. See "Hotel Information".

6. All class sizes are limited. If a class is full, we will contact the person designated on the form for instructions on standby space or an alternate class date. Maximum class sizes are given in the course descriptions on pages 5 through 22.

### How To Pay

Indicate your means of payment on the enrollment form. Payment can be made by the following methods:

1. By credit card (MasterCard, Visa & American Express only!).
2. By check or money order made out to The Trane Company.
3. By purchase order if a Trane Commercial Account has been established. (P.O. number must accompany enrollment form.

A purchase order without your account number will not be accepted.

***Note: If payment is not provided with the enrollment form, we will not enroll you in any class. Your form will be returned to you for payment.***

### Cancellation Policy

Trane has a late cancellation policy for confirmed enrollments. You can cancel out of a course up to six (6) working days before the course start date without penalty. Any cancellation made within six (6) working days of the course start date is subject to full tuition cost! Student substitutions are allowed.

Trane reserves the right to cancel any class. We will notify you of a cancelled class on or before the sixth working day prior to the class start date. We are not responsible for airline "super saver" or discounted ticket cancellation fees which may result from a class cancellation.

## Technical Training Courses

Available courses, intended audience, tuition, class length and dates offered are shown below. See pages 5 thru 22 for detailed course descriptions: They are important for determining coverage and prerequisites. The customer must ensure that the student's prerequisite skills, experience and training needs match course coverage. Course objectives are clearly stated in the descriptions.

**The student should read the course description before attending any course. Enrollment instructions are given on page three. All courses are held in Trane's La Crosse, Wisconsin, Technical Training Center, unless noted otherwise on the course date schedule below.** If you can't find the training you need in this catalog, contact the La Crosse Technical Service Training Department (See page 24).

Course Title	Intended Audience	Tuition	Length	Dates Offered
<b>Air Conditioning Service Courses</b>				
Air Conditioning Service	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Sep. 8, Oct. 13, Dec. 1
Commerical Service 1	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Sep. 22, Dec. 15
Commercial Service 2	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Sep. 29, Oct. 27
Commercial Service 3	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Oct. 6, Dec. 1
IntelliPak® Rooftop Service	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Sep. 8, Oct. 13, Nov. 10
Precedent® / Voyager® Rooftop Service	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Oct. 6, Nov. 17
<b>Electrical &amp; Electronic Controls Courses</b>				
HVAC Electrical Troubleshooting	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Sep. 15, Oct. 20
Commercial Unitary Controls	HVAC Service & Maintenance Techs	\$1,300	4.5 Days	Sep. 22, Nov. 3, Dec. 8
<b>Heavy Refrigeration Equipment Courses</b>				
RTAC Rotary Chiller Service	HVAC Service Technicians	\$1,300	4.5 Days	Sep. 29, Oct. 27(P), Nov. 17
RTAA / WA / UA Rotary Chiller Service	HVAC Service Technicians	\$1,300	4.5 Days	Sep. 8, Oct. 20, Dec. 15
RTHA / RTHB / RTHC Rotary Chiller Service	HVAC Service Technicians	\$1,300	4.5 Days	Sep. 15, Dec. 15
Absorption Essentials	Owner Operation & Maintenance Personnel, Supervisors & HVAC Technicians	\$1,300	4.5 Days	Sep. 29, Oct. 27
Trane Absorption Chillers	HVAC Service Technicians	\$1,300	4.5 Days	Nov. 3, Dec. 8
CenTraVac® Systems Fundamentals	Owner Operator Personnel, HVAC Service & Maintenance Technicians	\$1,300	4.5 Days	Sep. 15, Nov. 3
CenTraVac® Electronic Control	Owner Operator Personnel, HVAC Service & Maintenance Technicians	\$1,300	4.5 Days	Oct. 13, Dec. 8
Chiller Motor Control	HVAC Service Technicians	\$1,300	4.5 Days	Oct. 20, Nov. 17
CenTraVac® Mechanical Service**	HVAC Service Technicians	\$2,600	4.5 Days	Oct. 20, Nov. 10, Dec. 1

[P] = Class held in Pueblo, Colorado

\*\* Technician Agreement Form Required

# Air Conditioning Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

## Course Benefits

This is a comprehensive, entry-level air conditioning service course. It concentrates on essential refrigeration knowledge that all HVAC technicians must eventually possess in order to perform competent HVAC service work. After attending, technicians should have acquired knowledge in tool usage, basic system theory, metering devices, system problem identification, superheat, subcooling, piping, and evacuation and recharging techniques. This course is 45-50 percent lab intensive. Packaged rooftop units, 2 to 7-1/2 tons, are used in the lab sessions. A separate course is available to help develop electrical troubleshooting skills.

## Specific Course Objectives

- Understand basic system theory.
- Identify the four basic parts of the refrigeration system and how they work.
- Learn to use refrigeration instruments.
- Perform system logging.
- Perform system evacuation and charging.
- Diagnose and correct start up and service problems related to refrigeration systems.
- Measure and adjust superheat and subcooling using classroom methods.
- Demonstrate refrigerant recovery procedures.

## Target Audience

This course is well suited for entry level air conditioning and/or HVAC maintenance mechanics or perhaps an electrician with new responsibilities in air conditioning maintenance and service. Some previous experience working with HVAC equipment is preferred, but not required.

## Prerequisites

This course is open to entry level service technicians and industrial or facility maintenance technicians. The student should have some basic mechanical and electrical background in addition to an aptitude and interest for work with HVAC equipment.

## Course Outline – Air Conditioning Service

### A. Introduction

1. Welcome
2. Course Content and Objectives
3. Training Facility Orientation
4. Daily Review of Study Guide

### B. Safety

HVAC and Lab Safety Considerations

### C. Product Familiarization

1. Nomenclature Identification
2. Identify Lab Units

### D. Refrigeration System Components

1. Air Conditioning Cycle Components
2. Compressor
3. Condenser
4. Metering Devices
5. Evaporator
6. AC Terms and Definitions

### E. Refrigeration Cycle Trainer

1. System Operation
2. Components in the System
3. Use of Pressure-Temperature Charts
4. Diagnosis of Refrigeration Cycle Problems

### F. Tool Identification and Use

1. Refrigeration Hand Tools
2. Refrigeration Diagnostic Tools

### G. Superheat and Subcooling

1. Calculation Method
2. Parameters
3. Guidelines for System Analysis
4. Lab Practice for Measuring

### H. Refrigeration Cycle Familiarization Lab

1. Manifold Gauge Connections
2. Temperature Analyzer Connections
3. System Logging
  - a. Model, Serial Numbers
  - b. Superheat and Subcooling
  - c. Evaporator, Condenser Delta-T's
  - d. Interpretation of Pressures
  - e. Pressure/Temperature Conversions

### I. Refrigeration Diagnosis Worksheets and Problems

1. Discussion of Symptoms to Causes
2. Troubleshooting Chart Analysis

### J. Refrigeration Troubleshooting Lab

1. Diagnosing Refrigeration Circuit Problems
  - a. Component Failures: TXV, Distributor, etc.
  - b. Low Refrigerant Charge
  - c. Excess Refrigerant Charge
2. Evaluate Operating Units

### K. Compressors

1. The Function of the Compressor
2. Compressor Failure Modes
  - a. Refrigerant or Oil Slugging
  - b. Refrigerant Flow Restrictions
  - c. Oil Loss and Starvation
  - d. Motor Overheating & Electrical Failures
3. Changing Compressor after Mechanical Failure
4. Changing Compressor after a Burn-out
  - a. Mild and Severe Burnout Cleanup Procedures
  - b. Filter-Drier Selection & Installation

### L. Refrigeration Piping

1. Three Main Concerns
2. Proper Trapping and Installation Precautions
3. Split Scroll Discussion
4. Brazing Basics

### M. Refrigerant Recovery

1. Recovery Equipment
2. Recovery of Lab Units

### N. Evacuation Methods

1. Deep Vacuum Pump Requirements
2. Triple Evacuation Requirements
3. Tools & Instruments Required
4. Evacuation of Lab Units

### O. Refrigerant Charging Methods

1. Weighing Refrigerant Charge
2. Partial Charging Suggestions and Techniques
3. Charging of Lab Units



## Commercial Service 1

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course fills the void between smaller equipment A/C service experience and large or applied commercial unitary service.

Hands-on training, using Trane light commercial 5 to 25 ton lab equipment, enhances the existing knowledge of technicians who already have appropriate fundamental A/C service skills. The course emphasizes a systematic approach to HVAC service troubleshooting.

#### IMPORTANT!

Be certain that your prospective student meets the educational and/or experience requirements to attend this course. Read the “Prerequisites” section carefully.

### Specific Course Objectives

- Review temperature / pressure recording procedures and interpretation of readings on an operating system.
- Discuss start-up and service problems within refrigeration system.
- Identify system problems caused by improper piping or application.
- Differentiate between various airside economizers; adjust minimum outdoor air requirements; diagnose and correct economizer circuit problems.
- Measure airflow using appropriate airflow instruments and determine basic airside problems.
- Determine heating efficiency. Check gas systems using proper test procedures..
- Use ANSI / Trane wiring diagrams to properly test single-, and three-phase electrical systems and components.
- Learn proper checkout of W-973 MEC control found in constant volume (CV), units, and micro control used in light-commercial units.

### Target Audience

This course is ideal for dealer, contractor, or owner maintenance technicians progressing from residential to light commercial service who have experience in HVAC. We recommend completion of HVAC Electrical Troubleshooting and Air Conditioning Service before attending this course.

### Prerequisites

Students attending **must** have completed a vocational or technical program in air conditioning / refrigeration, our Trane Air Conditioning Service course, or have equivalent practical experience. Students **must also** have a **working** knowledge of the basic theory needed to diagnose the refrigeration cycle and an understanding of the following tools and subjects:

- Refrigeration Manifold Gauge Set
- Volt / Ohmmeter
- Electronic Temperature Meter
- Clamp-on Ammeter
- Temperature / Pressure Relationships
- Metering Devices

## Course Outline – Commercial Service 1

### A. Introduction

1. Welcome
2. Course Content and Objectives
3. Training Facility Orientation
4. Daily Review of Study Guide

### B. Refrigeration Diagnosis Review

1. Refrigeration System Review
2. Metering Device Operation
3. Discussion of Symptoms Vs. Causes
4. Arrow Chart Discussion

### C. Refrigeration Troubleshooting Lab

1. Record System Conditions

### D. Technovate

1. Analyze Data
2. Diagnose Refrigeration Problems

### E. Piping

1. Main Concerns
2. Problem Applications
3. Scroll Piping Philosophy

### F. Heating

1. Negative / Positive-Pressure Heating Systems
  - a. Components
  - b. Operation
2. Combustion Analysis

### G. Airside Economizer

1. Types / Purposes / Components
2. Determining Minimum Outdoor Air Requirements
3. Proper Sequence of Operation
4. Setup and Checkout Lab

### H. Introduction to Air Systems

1. Terms and Definitions
2. Measurement / Instruments

### I. Air Conditioning Fans

1. Fan Types
2. Mechanical Failures
3. Fan Performance

### J. Air Lab

1. Duct Traversing
2. Measurement of Duct Pressures
3. CFM Calculations

4. Fan RPM Measurements

5. Measuring Devices Familiarization

### K. Electronic Controls

1. W973 with Economizer and Electronic T-Stat (Constant Volume)
2. Factory Mounted Controls
3. ReliaTel/Micro (UCP) Control Overview

### L. Wiring Diagrams

1. Read and Interpret ANSI / Trane Diagrams
2. Logical Electrical Troubleshooting

### M. Electrical Lab

1. Diagnose/Correct Electrical Problems
2. Use Electrical Test Instruments
3. Use ANSI / Trane Diagrams

## Commercial Service 2

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This is an advanced course for experienced HVAC service technicians needing updated knowledge and hands-on training on 20+ ton commercial air conditioning equipment. After completing this course, the technician will be capable of diagnosing system problems including hot gas bypass, unloaders, improper piping, master energy controls (MEC) and airflow problems as they relate to Trane large commercial self-contained, rooftop and split systems. This course concentrates on commercial unitary systems more than on specific products to familiarize technicians with a broader variety of commercial air conditioning equipment. This course does not cover air-cooled or water-cooled chiller products.

### Specific Course Objectives

- Recognize differences in Trane compressor designs and loading methods.
- Identify failed compressor parts for determining causes of compressor failure.
- Diagnose and set up a commercial system with compressor unloading and hot gas bypass.
- Diagnose refrigeration system problems caused by incorrectly designed piping.
- Check out master energy control circuit using vendor and Trane controls such as W973, W7100 and Trane VAV transmitter.
- Interpret NEC, and ANSI-style Trane control wiring diagrams and ladder logic. Electrically troubleshoot constant and variable air volume systems.
- Understand operation of unit economizer, static pressure regulator, inlet guide vanes, and exhaust air for proper ventilation and pressurization requirements.

### Target Audience

This course is designed for experienced refrigeration maintenance and service technicians who need updating on commercial air conditioning equipment in the 20 to 120 ton range. The course is also well-suited for maintenance and service technicians with advanced skill levels in other air conditioning product areas.

### Prerequisites

Maintenance and service technicians must have had (or soon will have) direct service experience with large commercial equipment in the 20 ton and larger size. We strongly recommend completion of the Trane Commercial Service 1 course (or completion of an equivalent course) before this course.

## Course Outline – Commercial Service 2

### A. Introduction

1. Welcome
2. Course Content
3. Training Facility Orientation

### B. Compressor Overview

1. Models
2. Reciprocating Compressors
3. Scroll Compressors
5. Capacity Control Methods

### C. Compressor Motor Protection

### 1. Furnas Overload

- a. Operation
  - b. Setup
- ### 2. Robertshaw Guardpak™
- a. Models
  - b. Operation
  - c. Setup/Troubleshooting

### D. Compressor Service Diagnosis

1. Refrigeration
2. Electrical
3. Lubrication
4. Contamination

### E. Hot Gas Bypass

1. Purposes
2. Applications
3. Setup and Servicing

### F. Hot Gas Bypass Lab

1. Operational Checkout
2. Adjustments

### G. Frostat™ System

1. Purpose
2. Operation

### H. Piping Example

1. Double Risers
2. Concerns
3. Rules
4. Unloading Systems
5. Split Scroll Discussion

### I. Master Energy Controls (MEC)

1. W973 With Economizer and Trane VAV Transmitter
2. W7100 Discharge Air VAV Control
3. Economizer Control
4. TIM Interface Overview

### J. Electrical Diagrams (Lab Units) Wiring Sequence

1. Read and Interpret ANSI / Trane Diagrams
2. Logical Electrical Troubleshooting

### K. Electrical Lab

Diagnose and Correct Electrical Circuit Problems

### L. Airflow

1. Introduction to VariTrane™ VAV
2. Static Pressure Regulation
3. Statitrac™ Building Pressure Control
4. Checkout Procedures

# New Course !

## Commercial Service 3

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course is intended to provide attendees with a well-rounded knowledge of water piping systems as applied to various types of water chillers. It will show technicians and supervisors how Trane utilizes water flows to obtain the most efficient chiller operation possible. The course will also discuss water system conditions that can be detrimental to efficient operation and possibly damaging to system components. Students will take water flow measurements in a laboratory setting, using recommended tools and techniques and learn how to obtain peak cooling tower performance. Chilled water optimization with multiple chillers will also be discussed, along with chiller control strategies for variable water temperature / flows using Trane Adaptive Control™ technology.

### Specific Course Objectives

- Understand the behavior of fluids contained in building chiller water systems.
- Identify and understand the application of chilled water system components and auxiliary system components.
- Understand the basic logic of chilled water plant design.
- Recognize and understand various chilled water system piping configurations.
- Identify cooling tower types and optimize their operation.
- Gain fundamental understanding of chilled water optimization.
- Learn how chilled water systems are designed and applied based on chiller type and single vs. multiple-chiller installations.
- Recognize waterside problems that reduce efficiency and damage equipment.

- Become aware of the importance of a proper water system treatment program.
- Learn how airside design and loads can affect chilled water systems.

### Target Audience

This course will benefit personnel who operate chilled water systems or who plan and/or conduct maintenance or service procedures for these systems. This course is intended for plant engineers, maintenance supervisors, operating engineers and HVAC service and maintenance technicians who need an improved understanding of chilled water system control and maintenance requirements and techniques.

### Prerequisites

This course addresses the needs of persons from widely varied backgrounds and does not require in-depth HVAC knowledge. Students should be ready, however, to assimilate HVAC 'system' thinking.

## Course Outline – Commercial Service 3

### A. Introduction

1. Welcome
2. Course Content
3. Course Objectives

### B. Safety

1. Potential Hazards
2. Lockout / Tagging
3. Chemical Safety
4. Lab Safety

### C. Fluid Dynamics

1. Fluid Properties
2. Velocity
3. Friction / Restrictions
4. Pressure
5. Laminar / Excessive Flow
6. Water Chemistry
7. Net Positive Suction Head

### D. Auxiliary System Components

1. Valves
  - a. Types
  - b. Two-Way
  - c. Three-Way
2. Pumps
  - a. Definitions
  - b. Types
  - c. Construction
  - d. Performance
  - e. Pump Curves
3. Terminal Units

### 4. Accessories

- a. Strainers
- b. Gauges
- c. Meters
- d. Thermometers
- e. Relief Valves
- f. Drains

### E. Chilled Water Plant Basics

1. Chiller Types
  - a. Air-Cooled
  - b. Water-Cooled
2. Heat Exchangers
  - a. Types
  - b. Construction
  - c. Flow Calculations / Measurement
  - d. Temperature Limits / Guidelines
  - e. Pass Divider Leaks
3. Formulas
4. Make-Up Water
5. Expansion Tank / Air Removal
6. Glycol Feeders
7. Heat Recovery
8. Chilled Water Reset
9. ARI Conditions

### F. Unit Control Strategies

1. Unit Control
2. Loading
  - a. Staged / Stepped
  - b. Variable
3. Safeties
4. Adaptive Control

### G. Piping Configuration Comparison

1. One-Pipe
2. Two-Pipe
3. Three-Pipe
4. Four-Pipe
5. System Variation
  - a. Primary / Secondary
  - b. Variable Flow
  - c. Low Flow

### H. Cooling Towers

1. Types
2. Construction
3. Service / Maintenance
4. Make-Up / Level Control
5. Placement
6. Indoor Sumps
7. Psychrometrics
8. Water Treatment
9. Control
  - a. VFDs
  - b. Pony Motors
  - c. Tower Bypass / Condenser Bypass
10. Tower Fans

### I. Chilled Water System Optimization

1. Single Chiller
2. Multiple Chiller
  - a. Series Chiller Configuration
  - b. Parallel Chiller Configuration
3. Sequence of Operation
4. Ice Building / Storage



## IntelliPak® Rooftop Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course is designed to provide comprehensive coverage of the Trane IntelliPak® rooftop. The course focuses specifically on this Trane product. Upon course completion, students will have been exposed in detail to the mechanical, electrical and control systems of these units and will have become knowledgeable in the start-up and maintenance requirements of these products.

**Note:** Two courses are held – at the training center in La Crosse, WI and at the factory. The sessions at the factory **DO NOT** include live unit hands-on but **DO** include a factory tour. Refer to the schedule page for individual class locations.

### Specific Course Objectives

- Understand refrigeration cycle.
- Demonstrate understanding of VAV airflow properties, dynamics and adjustment procedures.
- Gain an understanding of variable-frequency drive operation, programming and troubleshooting techniques.
- Employ proper mechanical cooling and heating system startup procedures.
- Understand combustion cycle.
- Gain understanding of heating components operation and troubleshooting.
- Learn operation, setup and checkout for Traq™ sensors.
- Describe Model R and scroll compressor operation, troubleshooting and change-out procedures.
- Apply maintenance / service schedules.
- Learn to properly configure and set up IntelliPak control system.
- Learn to service, diagnose and troubleshoot unit via human interface menus.

### Target Audience

This course is intended for rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftops units and systems, and who need extended knowledge of the Trane IntelliPak rooftop.

### Prerequisites

Students **must** have a good understanding of both the refrigeration and combustion cycles and understand airflow dynamics. Students should be able to follow electrical ladder diagram logic and be familiar with commercial unitary equipment sequence of operation.

### Plant Tour Requirement

Leather shoes which give good protection are required for plant tours. This applies to all class locations.

### Course Outline –

## IntelliPak® Rooftop Service

#### A. Introduction

1. Welcome
2. Course Content
3. Training Facility Orientation

#### B. Startup

1. Installation Procedures
2. Pre-Startup Preparation

#### C. Mechanical Systems / Cooling

1. Model R and Scroll Compressors
  - a. Construction
  - b. Operation / Checkout
  - c. Failure Modes

#### 2. Condenser

- a. Performance Mapping
- b. Low Ambient Components

#### 3. TXV

#### 4. Evaporator

#### 5. Refrigeration Cycle

- a. Logging
- b. Diagnosis
- c. Troubleshooting

#### D. Mechanical Systems / Heating

##### 1. Gas Heat (1 & 2-Stage / Modulating)

- a. Components
- b. Combustion Cycle
- c. Setup
- d. Operation
- e. Troubleshooting

##### 2. Electric Heat

- a. Components
- b. Setup
- c. Operation
- d. Troubleshooting

##### 3. Wet Heat

- a. Components
- b. Protection
- c. Setup / Freeze Avoidance
- d. Operation
- e. Troubleshooting

#### E. Mechanical Systems / Airside

1. Human Comfort
  - a. Temperature / Humidity
  - b. Particulates / Air Movement

#### 2. Airflow Terminology and Measurement Techniques

#### 3. Verifying Proper Airflow Using Instruments, Charts & Formulae

#### 4. Inlet Guide Vane Setup

#### 5. Variable Frequency Drive Programming and Operation

#### 6. Economizers

- a. Setup and Adjustment
- b. Service and Maintenance

#### 7. Exhaust and Return Fans

- a. Controlling Building Pressure

#### F. IntelliPak Control Package

##### 1. Control Programming

- a. Configuration Menu
- b. Setup Menu
- c. Setpoints Menu
- d. Service Mode Menu
- e. Diagnostics Menu
- f. Status Menu
- g. Custom Menu

##### 2. Input Devices

- a. BAS Interface
- b. Analog / Binary – Inputs / Outputs

##### 3. Components / Controls Functions Explained

- a. Software Vs. Hardware Points

##### 4. Wiring Diagram

- a. Sequence Of Operation
- b. Troubleshooting Logic

#### G. Options / Misc.

1. Traq Sensors

## Precedent™ / Voyager® Rooftop Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course is designed to provide comprehensive coverage of the Trane Precedent and Voyager® rooftops. The course focuses specifically on these Trane products. Upon course completion, students will have been exposed in detail to the mechanical, electrical and control systems of these units and will have become knowledgeable in the start-up and maintenance requirements of these products.

**Note:** Two courses are held – at the training center in La Crosse, WI and at the factory. The sessions at the factory DO NOT include live unit hands-on but DO include a factory tour. Refer to the schedule page for individual class locations.

### Specific Course Objectives

- Understand the refrigeration cycle.
- Understand product airflow properties, dynamics and adjustment procedures.
- Gain an understanding of variable-frequency drive operation, programming and troubleshooting techniques.
- Employ proper mechanical cooling and heating system startup procedures.
- Demonstrate understanding of combustion cycle.
- Gain understanding of heating components operation and troubleshooting.
- Describe scroll compressor operation, troubleshooting and changeout procedures.
- Properly apply maintenance / service schedules.
- Demonstrate ability to test and determine component condition.
- Apply techniques to service, diagnose and troubleshoot all Precedent and Voyager rooftops.
- Properly troubleshoot control modules.

### Target Audience

This course is intended for commercial rooftop service technicians who have a good understanding of both constant volume and variable air volume rooftops and systems, and who need extended knowledge of the Trane Precedent and Voyager rooftops. ASD and Trane IWD personnel must be aware that this course also covers larger tonnage sizes (27.5-50 tons).

### Prerequisites

Students **must** have a good understanding of both the refrigeration and combustion cycles and understand airflow dynamics. Students should be able to follow electrical ladder diagram logic and be familiar with commercial unitary equipment sequence of operation.

## Course Outline –

## Precedent™ / Voyager® Rooftop Service

### A. Introduction

1. Welcome
2. Course Content

### B. Precedent / Voyager Products

1. Standard Features
2. Options

### C. Cooling

1. Scroll Compressors
  - a. Basic Construction
  - b. Operation / Checkout
  - c. Failure Modes
  - d. Changeout Procedures
  - e. Oil Concerns

### 2. Condenser

- a. Performance
- b. Low Ambient Components

### 3. Metering Devices

- a. Fixed Orifice
- b. TXV

### 4. Evaporator Performance

### 5. Refrigeration Cycle

- a. Logging
- b. Diagnosis
- c. Troubleshooting

### D. Heating

1. Gas Heat
  - a. Components
  - b. Combustion Cycle
  - c. Setup
  - d. Operation
  - e. Troubleshooting
2. Electric Heat
  - a. Components
  - b. Setup
  - c. Operation
  - d. Troubleshooting

### E. Airside

1. Airflow Terminology and Measurement Techniques
2. Constant Volume Vs. VAV

### 3. Inlet Guide Vane Setup

### 4. Variable Frequency Drive Programming and Operation

### 5. Fan Maintenance

- a. Belts / Drives / Setup

### 6. Economizers

- a. Setup and Adjustment
- b. Service and Maintenance

### 7. Exhaust Fans

- a. Controlling Building Pressure
- b. Control Devices

### F. Microelectronic Controls

#### 1. Printed Circuit Boards

- a. Analog / Binary – Inputs / Outputs
- b. Troubleshooting
- c. Field-Installed Sensors
  - 1). Types
  - 2). Operation / Setup / Programming

#### 2. Wiring Diagrams

- a. Sequence of Operation
- b. Troubleshooting Logic

# HVAC Electrical Troubleshooting

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

## Course Benefits

This course is intended to improve a technician's ability and confidence when electrically troubleshooting commercial HVAC equipment. The course will broaden the technician's capabilities to troubleshoot controls and other electrical circuits by teaching an understanding of practical electrical theory as applied to the products and components found in HVAC. The information and skills learned should greatly decrease service diagnosis time and take the guesswork out of isolating problems found in single-, and three-phase air conditioning and heating products. This course makes extensive use of lab hands-on methods.

## Specific Course Objectives

- Define and use fundamental electrical terms, laws and formulas for understanding what electricity is and what it does.
- Understand the basic logic of series, parallel and series-parallel circuits.
- Proper usage of meters required to troubleshoot electricity.
- Increase confidence and ability in reading complex wiring diagrams.
- Improve understanding of control logic and sequence of unit operation.
- Understanding of safeties and component operation in Trane equipment.
- Become familiar with the characteristics of single-, and three-phase motors and their associated control components.
- Understand the principal maintenance requirements for longer operating life of electrical components.
- Learn a systematic, efficient method for electrical troubleshooting which can be applied to all major HVAC products.

## Target Audience

This course is ideal for HVAC installers, maintenance mechanics, industrial electrical technicians and apprentice-level service technicians who have HVAC servicing responsibility and need a thorough understanding of electrical troubleshooting skills. If your servicing confidence and ability decrease as voltage, electrical problems and wiring diagram pages increase, this course is for you!

## Prerequisites

This course is open to anyone that is motivated to become proficient with the electrical side of HVAC equipment. An understanding of the refrigeration cycle and its components will be helpful.

## Course Outline –

## HVAC Electrical Troubleshooting

### A. Introduction

1. Course Content
2. Training Facility Orientation
3. Study Guide

### B. Troubleshooting Fundamentals

1. Electrical Flow, Conductors and Insulators
2. Magnetism
3. Voltage, Current, and Resistance; Ohm's Law
4. Power, Safety, Volt-Ohm Meters

### C. Direct Current and Basic Control

1. Series Flow Logic
2. Parallel Flow Logic
3. Combination Series-Parallel Logic

### D. DC Circuits Exercise

1. Wiring Series, Parallel & Series-Parallel Circuits
2. Applying Ohm's Law
3. Troubleshooting of DC Circuits

### E. Alternating Current

1. Production
  - a. Single phase
  - b. Three-phase Wye and Delta Styles
2. Transformation
3. Rating Transformers
4. Distributing It from the Power Plant

### 5. Effects On Circuits

- a. Capacitance & Inductance
6. Resistive, Inductive and Capacitive Circuits
    - a. Power
    - b. Power Factor
    - c. Horsepower

### F. Hands-On Lab

1. Wiring up Series, Parallel & Series-Parallel A.C. Circuits
2. Applying Electrical Laws
3. Troubleshooting A.C. Circuits

### G. Motors

1. Single-Phase Motors
2. Starting Methods
3. Three-Phase Motors and Starters
4. Identifying Failure Modes: Insulation Failures, Ground Faults, Shorts, Opens, Internal Overload, Single-Phasing, Voltage, Current Unbalance

### H. Hands-On Motors Lab - Using Meters to Identify

1. Proper Phasing (3 phase)
2. Failure Modes
3. Calculating Voltage and Current Unbalance
4. Identifying Single-Phase Compressor Motor Terminals

### I. Wiring Diagrams

1. Understanding Trane Standardized Diagrams
2. Flow logic
3. Constructing Your Own Field Diagrams
4. Troubleshooting from Diagrams

### J. Controls & Safeties - Operation, Checkout & Troubleshooting of HVAC Electrical Components

1. How they Operate
2. How to Adjust
3. How to Troubleshoot

### K. Controls Lab

1. Wiring Control Circuits With Field-Drawn Diagrams
2. Troubleshooting Controls and Safeties as Applied in Trane Light Commercial or Commercial Rooftops

### L. More Hands-On

1. Troubleshooting in Class with Diagrams
2. Troubleshooting Trane Light Commercial and Commercial Rooftops

### M. Startup

1. Installation Procedures
2. Pre-Startup Preparation

# Updated Course !

## Commercial Unitary Controls

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course will benefit technicians who service the unitary control systems of Trane commercial products. It assumes the student is trained and has experience servicing the mechanical and refrigeration portions of the products and systems covered. Coverage concentrates on electronic and micro-electronic controls used by Trane for commercial unitary products and systems. This course does not cover centrifugal chiller controls. Major emphasis is placed on master energy controls (MEC) such as the W7100, IntelliPak™, Voyager® and Precedent-Reliabel unitary control processors. This course will provide general coverage of control system theory to help students “visualize” overall control strategies. Each MEC is covered in the classroom through lecture and discussion. Then each student is afforded the opportunity to operate, check out and troubleshoot the MECs on operating equipment in the training laboratory. Students will also be exposed to some Integrated Comfort™ Systems (ICS) controls such as Tracer Integration Modules (TIM) and TCM. These ICS controls

are covered from the HVAC equipment standpoint in order to teach interfacing and troubleshooting concepts.

### Specific Course Objectives

- Become proficient at troubleshooting the W7100, Voyager, IntelliPak and Precedent-Reliabel UCPs.
- Understand control system logic and system functional limitations.
- Learn operation, checkout and troubleshooting techniques.
- Build on a strong foundation of control concepts and fundamentals for more precise and logical troubleshooting techniques.
- Develop diagnostic skills to become more adept at determining control system problems.
- Troubleshoot commercial air conditioning controls used on older Trane or competitive equipment.
- Develop skills to isolate ICS control problems from equipment control problems.

### Target Audience

This course provides the most benefit to service technicians who need broader control familiarity and BAS technicians who lack HVAC experience. It is well-suited for “systems oriented” technicians who want to use a diagnostic approach rather than parts changing methods. It is intended for A/C technicians who want to discover how controls and control systems really work. Industrial facility technicians should attend only if the specific controls covered are used in their facility.

### Prerequisites

Students should be versed in electric and electronic control terminology. They should have a firm foundation of electrical wiring schematics and troubleshooting skills as well as general HVAC systems understanding of how and why individual controls interface with HVAC equipment. HVAC Electrical Troubleshooting is an excellent foundation course for this one.

### Course Outline –

## Commercial Unitary Controls

#### A. A/C Clinic - Control Fundamentals

1. Control Loops
2. Control Reset
3. Types of Control Action
4. Control Logic

#### B. ANSI Wiring Structure

1. Symbols
2. Nomenclature
3. Format
4. System Operation
5. Troubleshooting

#### C. Voyager Control - Constant Volume

1. Micro Module
2. Communications Module
3. Cooling System Operation
4. Heating System Operation
5. Defrost Module
6. Conventional Thermostat Module
7. Economizer Module
8. Troubleshooting Methods

#### D. Reliabel Control - Precedent Design

1. RTRM Module
2. Options Module
3. Communications Module
4. Heat Module
5. Economizer Module
6. Communications Module
7. Defrost Operation
8. Troubleshooting Methods

#### E. Basic VAV Operation

1. Air System Hardware Components
2. Air System Operation

#### F. Voyager VAV Temperature Control

1. Components
2. Cooling Operation
3. Heating Operation
4. Troubleshooting

#### G. Reliabel VAV Temperature Control

1. N/A

#### H. W7100 VAV Control

1. Setpoint Control
2. Reset Control
3. Control Band Control
4. System Control Operation
5. Troubleshooting

#### I. IntelliPak Control - CV / VAV

1. Component Hardware
2. Menu Structure
3. Control Points
4. Operation

#### J. BAS / ICS - TIM, TIM-E, TCM

1. Purpose
2. Commercial IntelliPak, Others
3. Control Points
4. Operation

#### J. Troubleshooting Lab

1. Midrange - Voyager, Reliabel
2. Commercial IntelliPak, Others
3. System Problems
4. Unit Problems



## RTAA / WA / UA Rotary Chiller Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course provides training for service and facility maintenance technicians who need an in-depth understanding of the controls, maintenance and troubleshooting of Trane's RTAA and RTWA helical-rotary chillers. The course provides insights into compressor design, unit operation, unit installation, start-up requirements, unit performance and service diagnosis. Specific service steps are covered for refrigerant handling and component service.

***Note:** This course may be held at the Training Center in La Crosse, WI or at an alternate factory location. The sessions at the factory include a factory tour but no hands-on instruction. The La Crosse sessions provide a hands-on lab utilizing control simulators. Refer to the schedule page for individual class locations.*

***Note:** Students attending the course in Pueblo, Colorado should bring a basic-function electronic calculator.*

### Specific Course Objectives

- Understand the theory of helical rotary chiller operation.
- Understand each chiller's construction and the interrelation of various components.
- Learn the capabilities of particular machine designs.
- Understand unit wiring and interconnecting diagrams.
- Understand control start sequence and operating logic.
- Understand system control methods available for building automation.
- Use control information for routine operational troubleshooting.
- Learn machine control menu-driven diagnosis.
- Know routine maintenance requirements for helical-rotary chillers.
- Become aware of limits to field servicing methods inherent with helical compressor designs.
- Understand service techniques used with refrigerant handling and component repairs.

### Target Audience

This course is intended for contractor and in-plant HVAC service technicians who will work regularly with Trane RTAA, air-cooled and RTWA water-cooled chillers. This course is primarily classroom oriented.

### Prerequisites

Technicians must have solid electrical skills equal to HVAC Electrical Troubleshooting. Service experience with other types of liquid chillers and/or Trane's UCP1 and UCP2™ chiller control system would be helpful, but are not required.

### Plant Tour Requirement

Leather shoes which give good protection are required for plant tours.

### Course Outline –

## RTAA / WA / UA Rotary Chiller Service

#### A. Introduction

Course Overview and Objectives

#### B. Helical-Rotary Chiller Specifics

1. Refrigeration Cycle, Main Components
2. Helirotor Concept
  - a. Operation
  - b. Advantages
3. Design and Construction/Operation
  - a. Compressors
    - Intermediate
    - General Purpose (GP)
  - b. Bearings
  - c. Motor / Rotor
    - Starter Options
  - d. Slide Valve & Step Unloaders
  - e. Check Valve
  - f. Oil Distribution System
  - g. Condensers
    - Air-Cooled (RTAA)
    - Water-Cooled (RTWA)
    - Remote (RTUA)
  - h. Evaporators
    - Standard
    - Remote (Optional)
    - Remote Evaporator Piping Techniques

i. Metering Devices

j. Options

#### C. Adaptive Control™ Systems

1. UCP1 Modules (70-400 Ton)
  - a. Sequence of Operation
  - b. Adaptive Control Logic / Functions
  - c. Operator Interface
  - d. Menus
  - e. Capabilities
  - f. Diagnostic Codes
  - g. Programming
  - h. Inputs / Outputs
  - i. Module Troubleshooting
2. Clear Language Display
  - a. Menus
  - b. Diagnostics Overview
  - c. Programming
  - d. Remote Panel
    - Functions / Capabilities

#### D. Plant Tour (Pueblo Sessions Only)

Question / Answer Session During Tour

#### E. Troubleshooting

1. Mechanical Components
  - a. Slide Valve / Piston
  - b. Load / Unload Solenoids
  - c. Expansion Valve Test

#### 2. Refrigeration Cycle

##### 3. Controls

- a. Current Transformers
- b. Temperature Sensors

##### 4. Safeties

##### 5. Control Modules

##### 6. Interpreting Diagnostic Codes / Menus

#### F. Maintenance / Repair

1. Logging
2. Performance Monitoring
3. Refrigerant Recovery / Recharging
4. Routine Maintenance

#### G. ICS Interface

1. Tracer
2. Generic
3. Troubleshooting

#### H. Sequence of Operation

Mapping Functions & Flow Logic Using Wiring Diagrams

#### I. Simulator Lab (La Crosse Sessions)

1. Programming the UCM
2. Perform EXV Test
3. Check Module Inputs / Outputs
4. Verify Control Parameters / Algorithms



# RTAC Rotary Chiller Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

## Course Benefits

This course provides training for service and facility maintenance technicians who need an in-depth understanding of the controls, maintenance and troubleshooting of Trane's RTAC helical-rotary chiller. The course provides insights into compressor design, unit operation and installation, start-up requirements, performance and service diagnosis. Specific service steps are covered for refrigerant handling and component service.

***Note:** This course may be held at the Training Center in La Crosse, WI or at an alternate factory location. The sessions at the factory include a factory tour. Refer to the schedule page for individual class locations.*

***Note:** Students attending the course in Pueblo, Colorado should bring a basic-function electronic calculator.*

## Specific Course Objectives

- Understand rotary chiller operational theory.
- Understand chiller construction and the interrelation of various components.
- Learn capabilities of various machine designs.
- Understand unit wiring and interconnecting diagrams.
- Understand operating logic for Tracer® CH530 control platform.
- Understand system control methods available for building automation.
- Use control information for troubleshooting.
- Learn to use menu-driven diagnostics.
- Know routine maintenance requirements for helical-rotary chillers.
- Learn limitations for field servicing of helical compressor designs.
- Understand service techniques for refrigerant handling and component repairs.

## Target Audience

This course is intended for contractor and in-plant HVAC service technicians who will work regularly with Trane RTAC, air-cooled chillers. This course is primarily classroom oriented.

## Prerequisites

Technicians must have solid electrical skills equal to HVAC Electrical Troubleshooting. Service experience with other types of liquid chillers and/or Trane's UCP1 and UCP2™ chiller control system would be helpful, but are not required.

## Plant Tour Requirement

Leather shoes which give good protection are required for plant tours.

## Course Outline – RTAC Rotary Chiller Service

### A. Introduction

1. Welcome
2. Course Overview
3. Course Objectives

### B. Helical-Rotary Chiller Specifics

1. Refrigeration Cycle Review
2. Mechanical Overview
  - a. R-134a / Polyolester Oil Concerns
  - b. GP2 Helical-Rotary Compressor
  - c. Oil Separator
  - d. Falling Film Evaporator / Liquid Vapor Separator
  - e. EXV
  - f. "W" Design Condenser
3. GP2 Design and Construction
  - a. Compressor Motor / Rotor - Starter Options
  - b. Male / Female Rotor Configuration
  - c. Bearings
  - d. Check Valve
  - f. Male Slide Valve Operation
  - g. Female Step Unload Operation
4. Oil Separator
  - a. Baffle Plate
  - b. Vortex Breaker
  - c. Heater
5. Condenser
  - a. "W" Design
  - b. E-Coil Configuration
  - c. Condenser Fan Staging
6. Electronic Expansion Valve Operation
  - a. Liquid Level Control
  - b. Position / Moisture Indicator
7. Liquid Vapor Separator
8. Falling Film Evaporator
  - a. Refrigerant Distribution
  - b. Evaporator Oil Return

### C. Tracer® CH530 Adaptive Control™

1. Control Platform

### 2. Adaptive Control Logic / Functions

3. Operator Interfaces
  - a. "Easy-View"
  - b. "Dyna-View"
    - Operation / Capabilities
    - Resistive Touch Screen
    - Menus / Sub-menus
  - c. "Tech-View"
    - Operational Capabilities
    - Laptop / Connection Requirements
    - Machine Views
    - Configuration
    - Binding View
    - Software Download / Updates
4. Diagnostics
5. Programming (Nameplate Configuration)
6. LLID (Low-Level Intelligent Device) Operation / Concept
  - a. Frame-Mounted LLIDS
  - b. Panel-Mounted LLIDS
  - c. LLID Binding
  - d. LLID Replacement

### D. Installation Concerns

1. Rigging Methods
2. Obstructions to Condenser Airflow
3. Unit Isolation and Leveling
4. Evaporator Water Piping
  - a. Water Box Nozzle Connections
  - b. Flow Switch
  - c. Accessories
5. Condenser Water Piping
6. Freeze Protection
  - a. Heaters
  - b. Glycol
7. Customer-Supplied Wiring
  - a. Power Connections
  - b. Chilled Water Pump Control
  - c. Chiller Water Flow Interlocks
  - d. Optional Convenience Outlet

### e. Alarm and Status Relays

- f. Optional Low Voltage Wiring

### E. Starting Methods

1. X-Line
2. Wye-Delta
3. Others

### F. Plant Tour (Pueblo Sessions Only)

### G. Troubleshooting

1. Mechanical Components
  - a. Compressor Male Rotor Slide Valve / Female Step Load
  - b. Refrigeration Cycle
  - c. Oil Related
2. Controls
  - a. IPC3 Communication Bus
    - Communication Failures
    - LLID Connection
  - b. Frame-Mounted LLID
  - c. Panel-Mounted LLID
3. Safeties
4. Interpreting Diagnostic Codes

### H. Maintenance / Repair

1. Pre-Start / Start-Up Procedures
2. Logging
  - a. Refrigerant-Side
  - b. Waterside
3. Refrigerant Recovery / Recharging Procedures
4. Routine Chiller Maintenance

### I. Sequence Of Operation

1. Mapping Functions
2. Understanding Control Logic
3. Using Wiring Diagrams

### I. ICS Interface

1. Tracer Summit
2. Generic BAS
3. Troubleshooting

## RTHA / RTHB / RTHC Rotary Chiller Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course provides training for the service technician who needs an in-depth understanding of the controls, maintenance and troubleshooting of Trane's RTHA, RTHB and RTHC helical-rotary chillers. The course provides insights into compressor design, unit operation, unit installation, start-up requirements, unit performance and service diagnosis. Specific service steps are covered for refrigerant handling and component service.

*Note: This course may be held at the Training Center in La Crosse, WI or at an alternate factory location. The sessions at the factory include a factory tour. Refer to the schedule page for individual class locations.*

### Plant Tour Requirement

Leather shoes which give good protection are required for plant tours.

### Specific Course Objectives

- Know the requirements for proper unit installation.
- Understand the theory of helical rotor chiller operation.
- Understand chiller construction and the interrelation of various components.
- Realize the capabilities of a particular machine design.
- Understand unit wiring and interconnecting diagrams.
- Understand control start sequence and operating logic.
- Understand system control methods available for building automation.
- Use control information for routine operational troubleshooting.
- Learn machine control menu-driven diagnosis.
- Know the requirements for proper routine maintenance of helical-rotor chillers.
- Become aware of limits to field servicing methods inherent with helical compressor designs.

- Understand service techniques used with refrigerant handling and component repairs.

### Target Audience

This course is intended for contractor and in-plant HVAC service technicians who will work regularly with Trane Series R® chillers. This course is primarily classroom oriented, but provides important in-depth technical details useful for technicians transitioning to service work on these products.

### Prerequisites

The technician must have solid electrical skills equal to HVAC Electrical Troubleshooting. Technician service experience with centrifugal and reciprocating chillers is recommended. An understanding of Trane's CVHE-UCP1 and UCP2™ (unit control panels) is helpful, but not required.

### Course Outline –

## RTHA / RTHB / RTHC Rotary Chiller Service

#### A. Introduction

1. Course overview and objectives
2. La Crosse Training Center Logistics

#### B. Helical Rotor Compressor Development

1. Advantages
2. Compression cycle
3. Capacity Control
4. Oil Management
5. Efficiency

#### C. The Trane Series R® Compressor

1. Rotors
2. Bearings
3. Motor
4. Slide Valve
  - a. Load Solenoid
  - b. Unload Solenoid
5. Lubrication Circuits
  - a. Oil Separator(s)
  - b. Oil Tank
  - c. Oil Cooler
  - d. Oil Distribution System
- e. Oil Return Systems
  - 1) Active Oil Return
  - 2) Extended Unload
  - 3) Gas Pump
6. Motor Starters
  - a. Starter Terminology
  - b. Types of Starters
  - c. Starter Components

#### D. RTHA / RTHB Water Chiller

1. Heat Exchangers
  - a. Evaporator Construction
  - b. Condenser Construction
2. Refrigerant Circuit
  - a. Evaporator Performance
  - b. Motor Cooling
  - c. Economizer Action
3. Metering Devices
  - a. Fixed Orifices
  - b. Electronic Expansion Valve

#### E. RTHC Water Chiller

1. Heat Exchangers
  - a. Evaporator Construction
  - b. Condenser Construction
2. Refrigerant Circuit
  - a. Liquid Level Float
  - b. Electronic Expansion Valve
  - c. Liquid Vapor Separator
  - d. Evap. Refrigerant Distribution
  - e. Vapor Return To Compressor
  - f. Motor Cooling
3. Slide Valve
  - a. Load Solenoid
  - b. Unload Solenoid
  - c. Vapor-Powered Piston
4. Lubrication Circuit
  - a. Oil Filters
  - b. Differential Pressure Switch
  - c. Optical Sensor
  - d. Oil Cooler

#### e. Oil Return From Evaporator

#### F. RTHA Control System

1. 1U1 Relay Output Module
2. 1U2 Power Supply Module
3. 1U3 Micro Module
4. Operational Logic
  - a. Operators's Menu
  - b. Serviceman's Menu
  - c. Service Interface
  - d. Safety Controls
  - e. Diagnostics
5. Wiring Diagram
6. Sequence of Operation

#### G. RTHB / RTHC Control System

1. Modular Concept
  - a. Chiller Module
  - b. Circuit Module
  - c. Stepper Module
  - d. Starter Module
  - e. Clear Language Display
  - f. Options Module
2. Operational Logic
  - a. Settings Group Introduction
  - b. Operator's Settings
  - c. Service Settings
  - d. Service Tests
  - e. Diagnostics
3. Wiring Diagrams
4. Sequence of Operation

#### H. Plant Tour (Pueblo Sessions Only)

## Absorption Essentials

Length - 4.5 Days

Daily Schedule: Mon. – Thur. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course is the most thorough and comprehensive presentation ever offered by Trane on the foundational understanding of absorption chillers and their refrigeration cycle. Coverage includes a detailed view of absorption chiller components, detailed instruction in the “theory of absorption chiller operation” and in the lithium bromide chemical cycle (includes hands-on), the chemistry of inhibitors, overview of capacity control system operation, crystallization causes and effects, purge system operation, performance and operator logging recommendations, and a heat balance discussion.

#### IMPORTANT!

Be certain that your prospective student meets the educational and/or experience requirements to attend this course. Read the “Prerequisites” section carefully.

The primary emphasis is placed upon the single-stage absorption system, including a discussion of the operating concepts for the two-stage absorption cycle.

During this program, the Trane chemistry laboratory will demonstrate characteristics of lithium bromide by performing a series of experiments for the class.

Students will be involved in hands-on activities, utilizing an operating chiller, intended to build the confidence needed to service absorption products.

### Specific Course Objectives

- Become familiar with absorption chiller construction.
- Learn to recognize major absorber components and understand their functions.
- Become familiar with lithium bromide (charging, inhibitors, characteristics, etc.)
- Learn how to use a Equilibrium Chart and understand its importance for determining system conditions.

- Learn the sequence of control operation (pneumatics and electric).
- Learn how Trane’s UCP2™ Adaptive Control™ technology has been applied to absorption chillers.

### Target Audience

This course is well-suited for persons who desire a comprehensive understanding of the theory of absorption refrigeration systems.

### Prerequisites

The student should have a **working** knowledge of pneumatic, electrical, heat transfer, steam and mechanical systems.

### Plant Tour Requirement

Leather shoes which give good protection are required for plant tours.

**IMPORTANT:** This course utilizes a **fully operational** absorption chiller with UCP2™ micro control. This provides our students a practical, hands-on opportunity to attain the confidence they need to work with these chillers.

## Course Outline – Absorption Essentials

### A. Absorption Chillers - General

1. Introduction
2. Absorption Terminology
3. Absorption Vs. Mechanical Refrigeration Cycles
  - a. Steam Table
  - b. Pressure Table
4. Chiller Components
  - a. Generator
  - b. Condenser
  - c. Evaporator
  - d. Absorber
  - e. Heat Exchanger
  - f. Solution Pump
  - g. Economizer
  - h. Positive Concentration Limiter

### B. Operational Cycle

1. Generator Temperatures
2. Cooling Tower Function
3. Condenser Pressure and Temperatures
4. Chilled Water Circuit
5. Evaporator Pressure and Temperatures
6. Absorber Circuit
7. Heat Exchanger Cycle
8. Pumps and Seals
9. Lubrication Circuit
10. Purge System

### C. Operational Analysis

1. Calculating Tonnage
2. Using An Equilibrium Chart
  - a. Performance and Operation
  - b. Interrelation Between Components
3. Crystallization
  - a. Causes
  - b. Anti-Crystallization Devices
4. Chemistry
  - a. Lithium Bromide Characteristics
  - b. Chemistry Lab Experiments
  - c. Brine Analysis

### D. Charging

1. Lithium Bromide
2. Refrigerant
3. Evacuation Procedures
4. Inhibitors
5. Additives

### E. Internal Components

1. Eliminators
2. Metering Orifices
3. Absorber Spray Trees
4. Condenser and Evaporator Collection Pans

### F. Machine Maintenance (Hands-On)

1. Pulling Solution Samples
2. Determining Specific Gravity
3. Purge Techniques
4. Determining Hydrogen Production
5. Machine Logging
6. Pump Maintenance

### G. UCP2 Overview

### H. Plant Tour

# Trane® Absorption Chillers

Length - 4.5 Days

Daily Schedule: Mon. – Thur. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

## IMPORTANT!

This is an Advanced course. Be certain that your prospective student meets the educational and/or experience requirements to attend this course. Read the “Prerequisites” section carefully.

## Course Benefits

This **advanced** course begins, essentially where our Absorption Essentials course ends. Following a brief review of the absorption refrigeration cycle, the course delves directly into product specifics, including construction, operation and control, required maintenance, service and troubleshooting for each of Tranes’ absorption chiller products, including “Classic” Trane single – and two-stage chillers, Horizon™ single – and two stage machines and Trane ThermaChill™ direct-fired absorption chillers.

This course includes coverage of the lithium bromide chemical cycle, the chemistry of inhibitors, specific discussion of capacity control systems for each chiller, crystallization causes and effects,

purge system operation, performance and operator logging recommendations, and a heat balance discussion.

During this course, students will participate in hands-on activities in our training lab, utilizing a fully operational absorption chiller equipped with UCP2™ micro-control. This provides our students a practical, hands-on opportunity to build the confidence needed to service absorption products.

## Specific Course Objectives

- Become familiar with Trane absorption chiller construction methods .
- Learn to recognize all components of Trane absorption chillers and understand their functions.
- Review lithium bromide usage (charging, inhibitors, characteristics, etc.)
- Review use of Equilibrium Charts for determining system conditions.
- Review sequence of control operation for Trane absorbers.
- Learn how UCP2™ Adaptive Control™ technology has been applied to Tranes’ absorption chiller product line.

## Target Audience

This course is designed for absorption refrigeration technicians who need to learn in-depth operating and service techniques and procedures for Trane absorption chillers.

## Prerequisites

This course is intended for experienced owner technicians who operate and/or service a Trane absorption chiller(s) and service technicians who are responsible for troubleshooting and servicing various Trane absorption chillers. It is recommended that the student have previously attended our *Absorption Essentials* course or have equivalent knowledge and/or experience servicing absorption chiller products.

## Plant Tour Requirement

Leather shoes which give good protection are required for plant tours.

## Course Outline – Trane® Absorption Chillers

### A. Absorption Chillers - General

1. Introduction
2. Absorption Terminology
3. Absorption Vs. Mechanical Refrigeration Cycles

### B. Single-Stage (Classic & Horizon)

1. Chiller Heat Exchangers
  - a. Generator
  - b. Condenser
  - c. Evaporator
  - d. Absorber
  - e. Heat Exchanger
2. Operational Cycle
  - a. Solution Sampling (Hands-On)
  - b. Lithium Bromide/ Water Ratios

### C. Horizon Two-Stage

1. Chiller Heat Exchangers
  - a. Generators (High Temp / Low Temp)
  - b. Condenser
  - c. Evaporator
  - d. Absorber
  - e. Braze Plate (High Temp / Low Temp / Condensate
2. Operational Cycle

### 3. Flow Control

- a. VFD
- b. Steam

### 4. SDR

### 5. Purifier™ Purge

- a. Noncondensable Movement
- b. Noncondensable Removal
- c. Purge Parameters

### 6. UCP2

- a. Sequence of Operation
- b. Margin Control
- c. VFD Control

### 7. Burner Setup; Control & Analysis

### D. Thermachill™ Units

1. Operational Cycle
2. Heat Exchangers
3. Control
4. Purge
5. Burner Setup; Control & Analysis

### E. Operational Analysis (All Chillers)

1. Calculating Tonnage
2. Equilibrium Chart

### F. Crystallization

1. Causes

2. Anti-Crystallization Methods
3. De-crystallization

### G. Chemistry

### H. Charging

1. Lithium Bromide
2. Refrigerant
3. Evacuation Procedures
4. Inhibitors
5. Additives

### I. Internal Components

1. Eliminators
2. Metering Orifices
3. Absorber Spray Trees
4. Condenser and Evaporator Collection Pans

### J. Machine Maintenance

1. Pulling Solution Samples
2. Determining Specific Gravity
3. Purge Techniques
4. Determining Hydrogen Production
5. Machine Logging
6. Pump Maintenance

### K. Plant Tour



# CenTraVac® Systems Fundamentals

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

## Course Benefits

This course will familiarize owner maintenance supervisors and technicians with Trane centrifugal chiller operation and maintenance requirements and help them understand chilled water systems and load-based chiller control dynamics. The course will help technicians troubleshoot chilled water systems and will help chiller owners decide if work can be done in-house or not. While not intended as a hands-on repair class, maintenance technicians can particularly benefit from coverage on diagnosing and maintaining machine design performance, understanding control sequences, and discussions of newly available refrigerants and chiller conversion options. Students will have the opportunity to observe the manufacturing and the assembly of key components in a factory tour. This course relies primarily on classroom lecture and discussion.

## Specific Course Objectives

- Understand Trane centrifugal chiller operation and chilled water system theory.
- Observe chiller construction process.
- Use operating logs to recognize normal operation and how abnormal influences affect chiller operation and performance.
- Learn the capabilities of particular chiller designs and some criteria used to make refrigerant conversion decisions.
- Recognize problems that reduce efficiency and damage equipment.
- Understand control systems on centrifugal chillers with microelectronic control panels.
- Perform normal operating procedures and basic machine troubleshooting.
- Learn basics of system components (pumps, cooling towers, etc.)
- Understand chilled water piping design criteria for various building types.
- Understand how airside design and loads affect the chiller water system.

## Target Audience

Persons responsible for the operation and preventive maintenance of Trane CenTraVac® chillers. This course will most benefit supervisors or engineers who make planning decisions to support centrifugal chiller maintenance. This class does not include hands-on maintenance training.

## Prerequisites

Students will benefit from this course in direct relation to their background knowledge of refrigeration, electrical, mechanical and basic heat transfer systems. This course addresses the needs of persons from widely varied backgrounds and does not require in-depth HVAC knowledge.

## Plant Tour Requirement

Leather shoes which give good protection are required. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.

## Course Outline –

## CenTraVac® Systems Fundamentals

### A. History

1. Identifying Owner's CenTraVac
2. Trane Centrifugal Development

### B. Basic HVAC

1. 5 Loops
2. Airside Distribution

### C. Basic Refrigeration Cycle

1. Refrigeration Terms
2. Charting the Cycle

### D. CTV Equipment

1. Components
2. Compressors
3. UCP2 Control Overview
4. CH530 Control Overview

### E. Performance

1. Design Factors in Performance
2. Performance and Operating Conditions
3. Effect and Costs of Inefficient Operation

### F. Logging and Troubleshooting

1. Components of a Good Log
2. Using Logs to Find Problems
3. Electrical Formulas
4. Principle of Heat Balance
5. Log Accuracy

### G. CenTraVac Plant Tour

1. Condenser Assembly
2. Evaporator Assembly
3. Unit Assembly
4. Run Test Stands

### H. Purge Operation

1. Basic Purge Cycle (Conventional)
2. Trane Purifier Plus™ Purge System
3. Design Sequences

### I. Chiller Systems Piping

### J. Free-Cooling and Heat Recovery

### K. Preventative Maintenance

1. Oil Analysis
2. Tube Analysis
3. Cooling Tower
4. Scheduled
5. Auxiliary

### L. Refrigerant Issues

1. The Ozone Issue
2. New Chiller Refrigerants
3. Existing Chiller Considerations



## CenTraVac® Electronic Control

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course is intended to update experienced service technicians on Trane CenTraVac® chiller control technology. Detailed coverage includes electronic capacity modulation controls found on all Trane centrifugal chillers manufactured between 1993 and the present. Earlier-model control systems are not discussed in depth. This course covers both the older UCP2™ and the new CH530 control system in use at this time.

### Plant Tour Requirement

Leather shoes which give good protection are required for plant tours. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.

### Specific Course Objectives

- Operate all the controls covered by this course, including systems interface.
- Understand operating logic for Tracer® CH530 control platform.
- Use control information for routine operational troubleshooting.
- Learn to use menu-driven diagnostics.
- Imitate UCP2 operation using a Clear Language Display (CLD) simulator.
- Practice chiller diagnosis from higher-level communications systems.
- Functionally diagnose various components of an operating control panel.
- Perform detailed trouble analysis on controls and determine necessary field repairs or replacement action.
- Determine potential electrical or electronic control faults through recommended isolation checkout procedures.

### Target Audience

This course is an intensive troubleshooting and service course for technicians who regularly work with Trane CVHE/F/G, post 1982 CVHB chillers. The course is not recommended for maintenance technicians unless they service chiller control systems. Coverage does not include mechanical maintenance or service.

### Prerequisites

Technicians must be comfortable with electrical controls, electrical meters such as digital volt-ohmmeters and understand refrigeration and centrifugal chiller control requirements. It is helpful if technicians have experience with other HVAC electronic control systems or have attended HVAC Electrical Troubleshooting.

## Course Outline –

## CenTraVac® Electronic Control

### A. Introduction

1. Course Overview and Objectives
2. Training Logistics

### B. Tracer® CH530 Adaptive Control™

1. Control Platform
2. Adaptive Control Logic / Functions
3. Operator Interfaces
  - a. “Dyna-View”
    - Operation / Capabilities
    - Resistive Touch Screen
    - Menus / Sub-menus
  - b. “Tech-View”
    - Operational Capabilities
    - Laptop / Connection Requirements
    - Machine Views
    - Configuration
    - Binding View
    - Software Download / Updates
4. Diagnostics
5. Programming (Nameplate Configuration)
6. LLID (Low-Level Intelligent Device) Operation / Concept
  - a. Frame-Mounted LLIDS
  - b. Panel-Mounted LLIDS
  - c. LLID Binding
  - d. LLID Replacement

### C. UCP2 Control Overview

1. UCP2 System Architecture
2. UCP2 Advantages
3. Unit Control Panel Layout
3. Control Module Breakdown

### D. UCP2 Specifics

1. Remote Clear Language Display (CLD)
2. CLD Keypad Operation
3. CLD Menu Structure
4. Reports
  - a. Custom Report
  - b. Chiller Report
  - c. Refrigerant Report
  - d. Compressor Report
5. Operator Settings
6. Component Operation
  1. Oil & Refrigerant Pump Operation
  2. Inlet Guide Vane Stepper Operation
7. Service Settings
  1. Basic Setup Group
  2. Field Start-Up Group
  3. Machine Configuration Group
8. Service Tests
  1. Condenser Water Pump
  2. Condenser Water Pump Flow Switch
  3. Starter Dry Run
  4. Oil Pump
  5. Inlet Guide Vane Control

### E. UCP Wiring

1. UCP2 Connections
2. Module Connections

### F. Troubleshooting

1. Operator - Service Data
2. Log Data
3. Performance Monitoring

### G. Motor Controllers

1. Starters & Starting Methods
2. X-Line
3. Wye / Delta
4. Solid-State
5. AFD

### H. Diagnostics

1. Diagnostic Types
2. Diagnostic Logs
3. Diagnostic Strategies

### I. System Logging

1. Using “Custom Report” Feature
2. Determining Log Point

### J. Chiller Operating Sequence

1. Basic Sequence
2. Timing Sequence
3. Sequence Breakdown

# Chiller Motor Control

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

## Course Benefits

This course will benefit technicians who regularly work with commercial or industrial type HVAC units which utilize different starting methods. It is assumed and required the student has a good working knowledge of electricity and is responsible with maintaining good safety procedures. Trane has announced the addition of a unit mounted “medium voltage (2200/4160)” starter. With starter technology growing at a rapid pace, and with the addition of the 2200/4160 unit mounted starter, we feel the time has come to offer this training. Safety will be paramount and safety procedures will be discussed pertaining to every starter discussed. The material presented will mainly cover the starting methods used by Trane, however this coverage can be easily applied to manufacturers who use other starters.

Coverage will include motor basics, SAFETY with all starters, and a **strong emphasis** will be placed on **safety concerning medium voltage starters**. This course will also cover wye-delta starters; frequency drives; solid state starters; across the line starts as well as discussions of why starting methods are required.

## Specific Course Objectives:

- Learn the operating principles of motors.
- Understand the importance of safety.
- Gain confidence in working with electrical components.
- Learn the operating principles of wye-delta starters.
- Understand how solid state starters operate.
- Understand the differences between starter types.
- Learn the correct procedures involved when working with medium voltage starters (2200/4160).
- Learn valuable safety procedures/concerns associated with medium voltage starters.
- Understand the operating principles of frequency drives.
- Learn how frequency drives are used on Trane chillers.
- Learn current cooling methods used with frequency drives.
- Learn the “operating modes” associated with the frequency drive.
- Understand the interface of microprocessors with various starters.
- Understand across the line starters.

## Target Audience

This course is designed for service technicians who are responsible for the

troubleshooting, operation / maintenance of starter types used with chiller systems. Usually advanced technicians are tasked with starter work, however this class is a “ground level” course, well-suited to anyone with a strong electrical background. We will also be discussing medium voltage starters which are now unit-mounted on some Trane chillers at the factory. This poses a scenario not directly associated with the lower voltage starters. Heavy safety emphasis will be apparent during the entire course, however special attention will be given to medium voltage starters.

These starters are used in many applications other than HVAC. Anyone wanting a good understanding of starters (provided they have a strong electrical background) are welcome to attend.

## Prerequisites

A strong understanding of electrical principles is mandatory. Training in control theory and the ability to understand wiring schematics is also important. HVAC Electrical Troubleshooting is an excellent foundation course to attend if the above requirements are not met.

## Course Outline – Chiller Motor Control

### A. Introduction

1. Welcome
2. Course Content
3. Course Objectives

### B. Safety

1. Potential Hazards Working With Electricity
2. Lockout/tagging
3. Safety Requirements Working With Low (208-600) and Medium Voltage (2200/4160) Starters
4. What To Do In An Emergency

### C. Motor/Starter Terminology, Symbolology and Definitions

### D. Understanding Motor Basics

1. Magnetism/Induction
2. Motor Terminal Identification
3. Form Wound Windings
4. Random Wound Windings

### E. Why Motor Starters Are Required

1. LRA (Locked Rotor Amps)
2. RLA vs. FLA
3. Effects Of Poor Starting Methods On Equipment And Peripheral Devices

### F. Motor Protection Methods

1. CT's (Current Transformers)
2. PT's (Phase/Potential Transformers)
3. Motor Cooling
4. Micro Processor
5. Winding Thermistors
6. Heating / Line Break Elements

### G. Motor Starting Characteristics

1. Auto Transformer
2. Reactor/Resistor
3. Solid State
4. Wye-Delta
5. AFD (Adjustable/Adaptive Frequency Drives)

### H. Motor Control Techniques

1. Power Circuit
2. Control Circuit

### I. Wye Delta Starters (closed transition)

1. Operating Sequence
  - a. Start contactor
  - b. Run contactor
  - c. Shorting contactor
  - d. Transition contactor
2. Microprocessor Function
3. Wiring

### J. Solid-State Starters

1. Allen Bradley

2. Cutler-Hammer/Eaton IT

3. Basic Theory
4. Functionality
5. Components
  - a. Power Poles
  - b. SCR's (Silicon Controlled Rectifiers)

### K. AFD (Adjustable/Adaptive Frequency Drive)

1. Rockwell/Reliance Liqui-Flo 1
  - a. drive basics
  - b. Component Identification
  - c. UCP 2 Interface
  - d. UCP 2 Menu Settings for Drive
  - e. Control Logic
  - f. Water Cooling Circuit Operation and Maintenance
  - g. Drive Menus / Parameters
2. Rockwell/Reliance Liqui-Flo 2
  - a. Component Identification
  - b. Tracer Ch 530 Interface
  - c. Ch530 Settings
  - d. Control Logic
  - e. Refrigerant Cooling Circuit
  - f. Drive Menus / Parameters

### L. Across-The-Line Starters

### M. Useful Terminology, Symbolology, and Definitions

## CenTraVac® Mechanical Service

Length - 4.5 Days

Daily Schedule: Mon. – Thurs. 8:00 a.m.- 4:30 p.m.; Fri. 8:00 a.m. – 11:30 a.m.

### Course Benefits

This course will broaden any technician's level of service and overhaul expertise. It will help them gain confidence and experience in system start-up, maintenance, repair and major overhaul of water-cooled CenTraVac® chillers. The course provides learning situations not otherwise available or that may take months or even years of on-the-job exposure to encounter.

This course lays a substantial foundation for the technician's continued professional growth and provides familiarity with other centrifugal chiller products. This is a mechanical service course only. Controls course attendance is required for complete CenTraVac chiller service coverage.

**Notice:** The Trane Company reserves the right to reject any training course application.

### Specific Course Objectives

- Identify various Trane centrifugal chillers and variations in mechanical components.
- Gain familiarity with documented factory service information available to support Trane centrifugal chillers.
- Learn to properly maintain, troubleshoot and repair chiller with varying lubrication and cooling system designs.
- Properly overhaul a Model CVHE CenTraVac chiller compressor and motor, using factory-recommended procedures.
- Learn to properly inspect compressor and motor components for compliance to factory specifications.
- Learn how to evaluate centrifugal chiller performance in relation to chiller design.
- Understand how to properly diagnose problems for centrifugal chiller refrigeration systems.

### Target Audience

This course is designed for technicians or mechanics who have experience in other HVAC chiller products and are now beginning to work with centrifugal products. The class is also very useful for experienced centrifugal service technicians who have no formal centrifugal training or experience with Trane CenTraVac chillers.

### Attendance Requirements

- The student must be regularly employed by a Trane Service Company or eligible independent service contractor.
- The student must have previous heavy refrigeration service experience.
  - The student must attend Trane's "CenTraVac Systems Fundamentals" course or have two or more years service exposure to centrifugal equipment.
  - The student must have skills with close-tolerance measuring instruments.
  - The student must have experience with shop rigging of heavy components (over 150 lbs.), and have completed a "Technician Agreement" form (Next Page) attesting to the above conditions.

**Notice:** Students are required to provide and wear steel-tipped shoes for completing mechanical lab service procedures.

### Plant Tour Requirement

Leather shoes which give good protection are required. Neither sandals nor cloth-top shoes are permitted in manufacturing areas.

## Course Outline – CenTraVac® Mechanical Service

### A. Introduction

1. Familiarize Students With Trane Operations

### B. Lubrication System

1. CenTraVac Lube System Operation
2. Oil Retention System
3. Lube System Maintenance Procedures
4. Oil Cooler Operation and Maintenance
5. Oil Analysis As A Maintenance Tool

### C. Purge Systems

1. Old Style Purge System Maintenance
2. New Style Purge System Maintenance
3. Purge System Operation
4. New Purge Mechanical Troubleshooting

### D. Machine Components

1. Heat Exchanger Construction and Troubleshooting
2. Compressor Construction and Troubleshooting
3. Review Service and Repair of CVHE/F Compressors
4. Review Diagnosis of Machine Malfunctions

### E. Motor

1. Review Motor Construction
2. Review Bearing Configurations and Service Procedures
3. Motor Cooling Systems Including Refrigerant Pump
4. Motor Assembly and Service Procedures

### F. Performance

1. Chiller Performance Review
2. Heat Exchanger Effect On Performance
3. Chiller and / or System Optimization

### G. Troubleshooting

1. Identifying Waterside Problems
2. Identifying Refrigerant-Side Problems
3. Focusing On Specific Problem Causes

### H. Lab Exercise

Students Properly Disassemble, Inspect and Reassemble Model CVHE Compressor

### I. Plant Tour

See "Plant Tour Requirements" above.

# Registration Requirements For CenTraVac® Mechanical Service

## How To Register

To attend the *CenTraVac® Mechanical Service* course, do the following:

1. Note the available course dates (Pg. 4). Make a first and second date choice. You may confirm availability of your choices by phone or FAX; the phone numbers are on the registration form (See Page 24).

2. **The total tuition amount is \$2,600.00.** A company check, major credit card information (Visa, MasterCard, or American Express only) or acceptable Trane customer equipment account number must accompany all registrations. Tuition covers local transportation to and from our training facility, noon lunch, and all training and reference materials.

3. Copy the registration form on the next page and fill it out completely. Mail it to the address on the form or FAX it to the number shown.


Be sure to include all contact information for enrollment follow-up and confirmation. Follow the payment instructions on the form.

4. To attend this course, contractor **technicians must complete and submit the Technician Agreement Form** (below) before the course start date. Copy the form and fill it out completely. Mail or FAX it to the locations shown on the registration form.

5. Trane requires a **current insurance certificate from the employer, indicating workman's compensation coverage**, unless a current form is already on file.

6. Class size is limited. If a class is full, we will contact the person designated on the form for instructions on standby space or an alternate class date.

**Notice:** The Trane Company reserves the right to reject any training course application.

 <b>Technician Agreement Form</b>		CenTraVac Mechanical Service Training
Name of Applicant:		
Employer Name:		
City, State:		
As A Training Applicant for the CenTraVac® Mechanical Service Class, I certify and agree to the following:		
1. I am currently a regular employee of the above named employer.	6. I agree not to represent myself as "factory trained" except on those products and systems actually covered by the training course.	
2. I have previously attended Trane's "CenTaVac Systems Fundamentals" course or I have two or more years experience with centrifugal refrigeration service and repair.	7. I agree not to represent myself as "certified", "authorized", "endorsed", or use any other terms, implying Trane endorsement of my competence to perform service work on centrifugal refrigeration equipment.	
3. I have working skills with close machine tolerances, close tolerance measuring devices, field rigging of heavy components (over 150 lbs.), motors and motor controllers, and control wiring diagrams and troubleshooting.	8. I am covered by my employer for appropriate worker comprehensive disability insurance and will have my employer send a current "certificate of insurance" as proof of coverage. (Not required for Trane Service Companies or others who already have current insurance documentation on file with Trane.)	
4. I am familiar with and understand all safety precautions appropriate to servicing heavy refrigeration and associated electrical controls.		
5. I agree to release Trane from any personal injury claim resulting from my own negligence or disregard for the safety items (#4 above) during the course of my training.		
Signed: _____		Date: _____

## Notes

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## Technical Training Course Registration Trane Commercial Systems

(Note: Use A Separate Form For Each Student. Please Print Or Type)

### Registration Information

We cannot be responsible for courses selected which are not appropriate for the technical level of the student. Refer to the course descriptions (Pgs. 5-22) for details of individual course coverage. Consult with an instructor if you are unsure. Our confirmation letter is your assurance that registration is complete. Please contact us at the number below if the student has not received confirmation within two weeks of the course starting date.

Students are responsible for paying hotel fees at check out, unless advance credit

arrangements have been made directly with the hotel. **A major credit card is required to guarantee room availability.**

### Cancellation Policy

You may cancel course enrollment for full tuition credit up to 3 p.m. (CST) on the sixth working day prior to the course starting date (usually a Friday). Cancellations after this time are subject to tuition forfeiture. Trane may cancel any scheduled course up to six working days before the course starting date. We are not responsible for non-refundable travel costs

due to cancellations. Please check with us before assuming the risk of a non-refundable airline ticket.

### Registration (Tuition) Fee

See Page 4 for tuition fees. A company check, major credit card (Visa, MasterCard, or American Express only), or purchase order billable directly to a Trane customer equipment account, must accompany all registrations. Trane cannot complete registration or guarantee space without appropriate billing information and/or payment with your enrollment.

----- FAX Or Mail The Form Below -----

<b>Technical Training Registration Form</b> <b>Trane Commercial Systems</b> <i>(Use a separate form for each student. Please type or print clearly.)</i>			
Student Name:		<input type="checkbox"/> I have read and understand Trane's Course Cancellation and Refund Policy	
Supervisor's Name:		Phone:	
Company Name:		FAX:	
Company Address:		P.O. Box:	
City:		State:	ZIP:
Email Address:			
Local Trane Office		Trane Office Contact Name	
Preferred Class Title and Tuition Amount:		\$	Preferred Date:      2nd Date:
Alternate Class Title and Tuition Amount:		\$	Preferred Date:      2nd Date:
Credit Card For Tuition: <input type="checkbox"/> Visa <input type="checkbox"/> MasterCard <input type="checkbox"/> Amer. Express		Fee payable in U.S. dollars only to: <b>The Trane Company</b> Submit Enrollment Form To: Ellen Vossler, 12-1 Technical Service Training The Trane Company 3600 Pammel Creek Road La Crosse, WI 54601-7599	
Card # _____ Expir. Date: _____			
Purchase Order #:	Trane Equip. Acct. #:		
<b>I need hotel reservations:</b> <i>(We assume Sunday arrival unless otherwise indicated.)</i> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Single Room <input type="checkbox"/> Double Room <input type="checkbox"/> Smoking <input type="checkbox"/> Non-Smoking <input type="checkbox"/> Saturday Arrival <input type="checkbox"/> Sunday Arrival    ↓			
You <b>must</b> provide credit card information below to guarantee room availability. <input type="checkbox"/> Visa <input type="checkbox"/> MC <input type="checkbox"/> Am. Express    Card # _____ Signature: _____ Expir. Date: _____		Ph: 608-787-3232 Fax: 608-787-4388	

**Notice:** The Trane Company reserves the right to reject any training course application.